

**Trade, Exchange, and, Sociopolitical Development in Iron Age
(500 BC – AD 500) Mainland Southeast Asia:
An Examination of Stone and Glass Beads from Cambodia and Thailand**

by

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Abstract

This dissertation is an examination of trade and socio-political development in Iron Age (500 BC –AD 500) mainland Southeast Asia through the analysis and comparison of stone and glass beads from sites in Cambodia and Thailand. The primary research objective is to identify trade and interaction networks in mainland Southeast Asia during the Iron Age and understand how these trade networks were associated with emerging socio-political complexity in the Mekong Delta during this period. This topic was addressed through morphological, contextual, and compositional analysis of agate/carnelian, garnet, and glass beads. Using these objects I identified distinct patterns in the distribution of stone and glass beads on two different scales: within individual sites in Cambodia and Thailand and over time and across the region of mainland Southeast Asia. I then linked these bead distribution patterns to changing patterns of socio-political and economic organization in the Mekong Delta.

The results of this research indicate that the types of agate/carnelian and glass beads and the mechanics of trade and exchange changed over time. During the early Iron Age in the late centuries BC “Period 1 Type” agate and carnelian beads and potash glass beads appear to have been exchanged through a pre-existing coastal exchange networks between specific settlements. However, some communities, specifically people living at Angkor Borei and sites in the Mekong

Delta do not appear to have been participating in this network. Instead, the analysis of glass and stone bead data reveal that the Mekong Delta and other communities were not entering into long-distance bead exchange networks until the early centuries AD, as trade with South Asia was intensifying. New types of beads, including “Period 2 Type” agate and carnelian beads and high-alumina soda glass beads eventually came to be traded in these networks. I argue that the distribution patterns of these new stone and glass bead types can be seen as proxies for expanding socio-political and economic influence between elites in the Mekong Delta and communities further inland.

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Dedications

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If you would like to contact me about this dissertation please email: alisonkyra@gmail.com

“A proper understanding of South-east Asian beads will certainly throw much light both on the chronology of many archaeological sites in the region and on the patterns of ancient trade. The quest for such understanding needs no justification.”

--Alastair Lamb, 1965a: 90

Chapter 1: Introduction and Research Questions

This dissertation is an examination of trade and socio-political development in Iron Age (500 BC –AD 500) mainland Southeast Asia through morphological, contextual, and geochemical analyses and comparisons of stone and glass beads from sites in Cambodia and Thailand. The primary research objective is focused on identifying trade and interaction networks in mainland Southeast Asia during the Iron Age and understanding how these trade networks were associated with emerging socio-political complexity in the Mekong Delta during this period. Three specific questions are explored:

- Are there distinctive patterns in the distribution of agate/carnelian, garnet, and glass beads over 1) time and 2) across mainland Southeast Asia, specifically Cambodia and Thailand?
- 3) Can these patterns of distribution be linked to changing patterns of socio-political and economic organization in the Mekong Delta?

By exploring these three questions it has been possible to develop a better understanding of the role of trade during the Iron Age period, to define the regions of mainland Southeast Asia that were interacting with one another through the exchange of these ornaments, and better determine the role of the Mekong Delta in trade and interaction networks within the larger region of Southeast Asia. In this dissertation I argue that stone and glass bead data provide evidence for two distinct bead trade networks that varied somewhat over time and space. An earlier bead exchange network was established in coastal communities, but based on data presented in this dissertation I suggest that smaller regional exchange networks, especially in southeast Cambodia

and Northeast Thailand, were present. However, communities living at sites in the Mekong Delta were not participating in these early exchange networks. Instead, I argue that stone and glass bead data show an expansion of exchange networks during the early centuries AD, in which elites in the Mekong Delta appear to have been interacting more heavily with sites further inland. Also of note is the irregular distribution of beads within burial contexts, indicating that beads were not available to all members of a community and that some people had more access to beads than others.

The Iron Age period of mainland Southeast Asia was a time of a great social change that brought about the emergence of some of the first complex state-level societies in Southeast Asia. Interaction with South Asia and the introduction of new goods and ideas from this region is believed to have been a key factor in the emergence of sustained social and political hierarchy (e.g. Bronson 1977; Christie 1990, 1995; Coedès 1968; Glover 1989; Hall 1985; Higham 2002; Kulke 1990; Mabbett 1977ab, 1997; Wheatley 1979, 1982, 1983; Van Leur 1955, see Chapter 3 for more discussion). Several scholars have more specifically argued that the presence of new prestige objects, such as beads from South Asia, provided an opportunity for Southeast Asian elites to expand their power by controlling the trade and exchange of these goods (e.g. Bellina 2003; Bellina and Glover 2004; Bronson 1977; Christie 1995, 1996; Francis 1996). More recent studies have focused on identifying regional changes in the nature of trade with South Asia over time (Bellina 2003; Bellina and Glover 2004; Lankton and Dussubieux 2006, 2013), while compositional analysis of materials has helped to better define long-distance networks trade in insular and mainland Southeast Asia in the periods leading up to and during Iron Age (Hung et al. 2007; Dussubieux 2001). In addition, a regional study by Dr. Robert Theunissen (2003) based on sites in Northeast Thailand, proposed specific bead trade networks between that region and

elsewhere in Southeast Asia. These previous studies have resulted in models of trade and socio-economic and political complexity that are partly supported by my new evidence, however these data also allow me to suggest new ways of explaining the regional patterns that will be discussed in more detail in subsequent chapters.

Unfortunately due to political conflicts and a lack of archaeological research from approximately the late 1960s-1990s, data from Cambodia have largely been omitted from these previous examinations of trade during the Iron Age period. This oversight is problematic since the Mekong Delta region of Cambodia and Vietnam is home to what some have argued may be the earliest or one of the earliest complex polities in mainland Southeast Asia (Hall 1982, 1985; Higham 2002; Stark 2004). Therefore, previous models regarding trade, exchange, and socio-political development have been unable to incorporate data from a region that was likely heavily involved in trade during the Iron Age period. My study has been able to correct this situation by incorporating data not just from the site of Angkor Borei, but also from other regions in Cambodia and Thailand. This has allowed me to undertake a more comprehensive examination of trade networks over time and space and to specifically address questions regarding the growth of the Mekong Delta as a center during the Iron Age and the involvement of elites in the trade of stone and glass beads.

This introduction chapter provides a background to my theoretical orientation and definitions of key terms used in this text. A brief overview of the major sites and regions, i.e., Angkor Borei, the Mekong Delta, and “Funan,” is also presented to contextualize their importance during the Iron Age period. A detailed discussion of the theoretical framework, research questions, and the methods used to answer these questions is presented below, followed by an outline for the remaining chapters in this thesis.

Definitions and theoretical orientation

Mainland Southeast Asia

Southeast Asia is made up of countries on both the mainland and surrounding islands (see discussion in Chapter 2). This dissertation focuses primarily on mainland Southeast Asia, which is made up of the countries of Cambodia, Laos, Peninsular Malaysia, Myanmar (Burma), Thailand, and Vietnam (Figure 1.1).

South Asia

In this dissertation I rely on the United Nations classification scheme for South Asia (United Nations Statistics Division 2011), which includes Afghanistan, Bangladesh, Bhutan, India, Iran, Maldives, Nepal, Pakistan, and Sri Lanka (Figure 1.2). However, the areas that were primarily interacting with Southeast Asia during the Iron Age period were those countries with access to the Indian Ocean: India, Bangladesh, and Sri Lanka (Ray 2003). Similarities in material culture found at Southeast Asian sites and sites in Pakistan, such as Taxila, also suggest that this region was interacting with Southeast Asia either directly or indirectly (e.g. Glover 1989; Pryce et al. 2008).

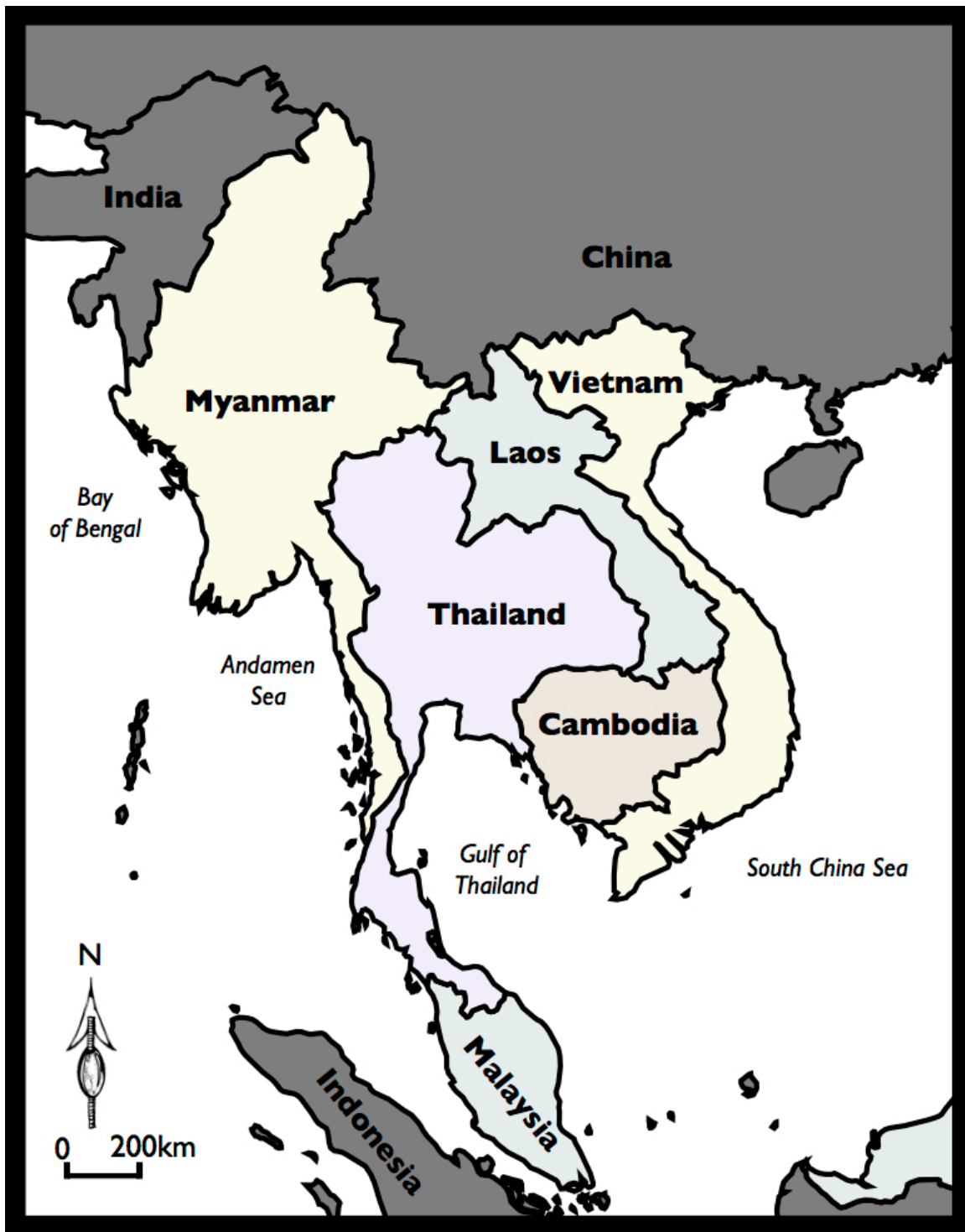


Figure 1.1: Map listing countries in mainland Southeast Asia.

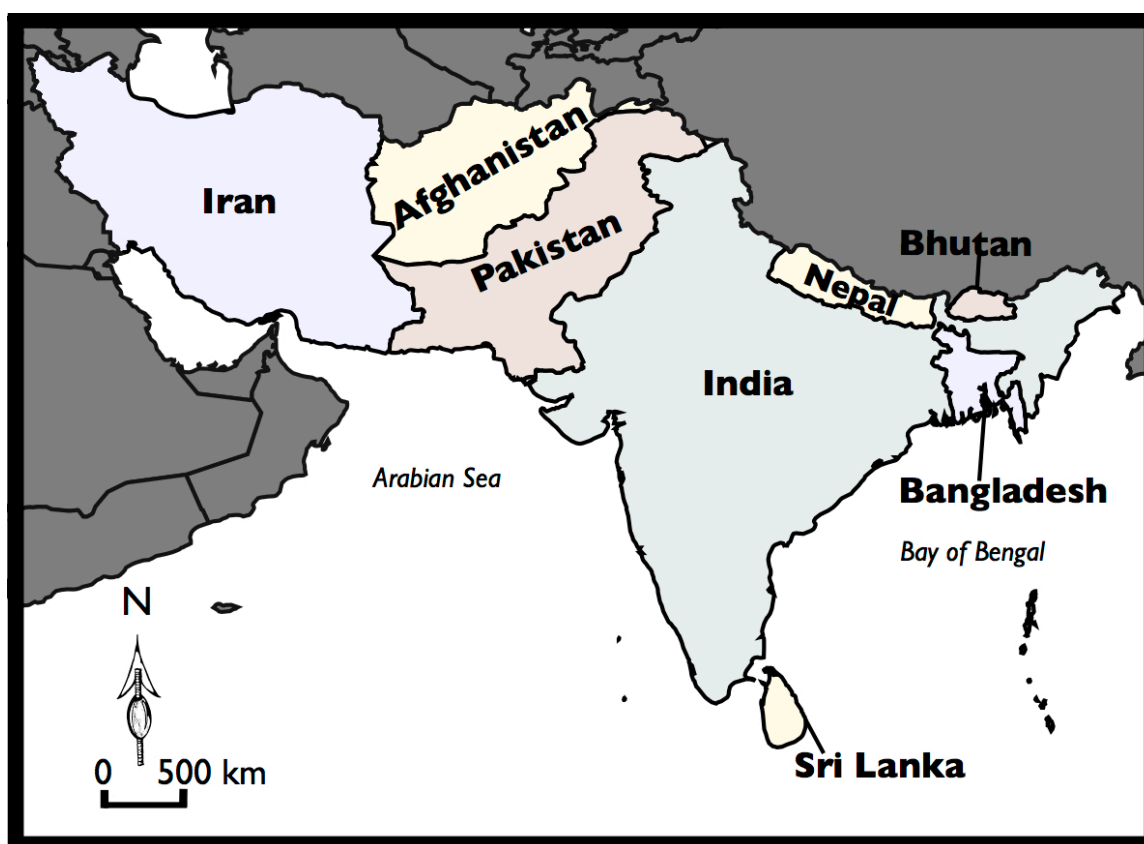


Figure 1.2: Map listing countries in South Asia.

Prestige goods

In archaeological research there generally has been a dichotomy between utilitarian or subsistence objects and wealth or prestige objects (e.g. Brumfiel and Earle 1987; D’Altroy and Earle 1985). Utilitarian goods are those objects related to subsistence production or other practical household needs. Prestige goods, in contrast, are more strongly related to ideology. In this dissertation, I define prestige or wealth objects as artifacts or symbols of wealth or status “used in display, ritual, and exchange” (Brumfiel and Earle 1987: 4). These objects can be used to attract followers (Hayden 1998), whether they are displayed for the broader population or for a smaller group of elites (Kenoyer 2000). Prestige goods are generally made from raw materials that are rare or exotic and often employ specialized technological processes and skilled labor

(Kenoyer 2000). As important symbols of wealth and status, elites often control the distribution of the finished products, as well as access to the raw materials and labor used to create these products (Kenoyer 1989; Vidale and Miller 2000). Some scholars have noted that the definition between utilitarian goods and prestige objects can be fluid, depending on “culturally specific values,” (Flad and Hruby 2007: 10). Certain types of artifacts can carry different meanings in different contexts. For example, glass beads may not be considered high-value or prestige objects at their place of manufacture, but by traveling a long-distance to they become exotic and increase in value and prestige (Helms 1993: 48). In this dissertation I argue that stone (agate, carnelian, and garnet) as well as glass beads were important prestige objects for Southeast Asian people in that they were made from exotic raw materials, were strung and worn for display, and were produced or modified utilizing complex technological skills. Additionally, my analysis of the data show that beads were not evenly distributed in burials within sites.

In many ancient societies, exotic prestige goods from distant locations are perceived to be valuable due to their association with far-off locales that are regarded as “places where ancestors or culture heroes may have originally come to earth” (Helms 1993: 47). The scholar Mary Helms (1993:49) argues that finished and unfinished products from these geographically distant locations are associated with skilled crafters who are “the once and future ancestors themselves.” As will be discussed later in this chapter, one origin myth popular in Cambodia and Vietnam described Cambodians as having been descended from a foreigner, perhaps a Brahman. Inscriptions and texts from at least the 6th century AD describe this story, indicating that ancient people in parts of mainland Southeast Asia have long considered themselves to hold mythical and exotic ancestry. Not only did objects like stone and glass beads have value objects themselves, but also I believe they could have been considered important because of their

connections with a powerful and geographically distant civilization. Connection with this distant power allowed local elites to emphasize their authority and status within their own communities. Stone and glass beads, as objects made from new materials, complex technologies, and associated with significant geographically and culturally distinct communities were widely acknowledged as being important prestige goods in Southeast Asia (Bellina 2003; Francis 1996; Theunissen et al. 2000).

Trade and Exchange

Trade and exchange have often been used to describe the same activity (e.g. Dillian and White 2010; Renfrew 1975). Renfrew (1969: 152) provides a broad definition of trade and exchange as “the reciprocal traffic, exchange, or movement of materials or goods through peaceful human agency.” Renfrew (1975) has also identified and defined several different types of trade and their spatial distribution, ranging from reciprocity, to down-the-line exchange, to central place market exchange. Other scholars have emphasized the social aspects of trade, and “the relationships before, during, and after exchange,” (Oka and Kusimba 2008: 340). However, some scholars have related trade and exchange more specifically with market trade, calling redistribution and reciprocity “forms of integration” (Polanyi 1957: 250).

In this dissertation, I follow Renfrew’s definition and use trade and exchange broadly and interchangeably. I choose this broad definition because archaeological data in mainland Southeast Asia is still too thin to make more specific assessments about the types of trade and exchange happening during the Iron Age period. Scholars have argued that there was reciprocal or down-the-line exchange during the Neolithic (2500-1500/1000 BC) and Bronze Age (1500/1000- 500 BC) periods, with some kind of prestige goods network emerging during the last few centuries BC (e.g. Bellina and Glover 2004; Chang 2001; Higham 2002; Wheatley

1975). It is this emerging prestige goods network that I explore in more depth by tracking the distribution of stone and glass beads, and using them as symbols of socio-political and economic networks that connected elites in different communities to one another.

There are two different scales of exchange addressed in this dissertation. On one level I explored long-distance exchange of stone and glass beads between South Asia, primarily India and Sri Lanka, and people at sites in Cambodia and Thailand. However, I have also looked at smaller regional scales of exchange between sites in Cambodia and Thailand, and how people at these sites may have also been connected to other regional networks in mainland Southeast Asia. Lastly, I have examined the distribution of stone and glass beads within sites, in order to address questions regarding access to these objects within sites.

Sites and Communities

In this study I examined stone and glass beads from 12 archaeological sites in Cambodia and Thailand. Of these 12 sites, ten were cemetery sites and two were occupation sites. While I primarily call these sites or archaeological sites, I also refer to them as communities.

Archaeologists have often described archaeological sites or settlements as communities (for example see studies mentioned in Kolb and Snead 1997:612 or Parsons 1972: 137), however it is recognized that larger and more complex sites may actually have been made up of multiple distinct groups of people that could be described as discrete communities (Kolb and Snead 1997). Although a single settlement may have used more than one cemetery location (Chapman and Randsborg 1981: 15), these ten cemetery sites were repeatedly used by a group of people to bury their dead. For this reason, I feel that it is appropriate to refer to these cemetery sites as representative of communities. One of the two occupation sites, Krek 52/62, was a circular earthwork site believed to have been the location of a single settlement. As this site appears to

represent a single group of people that regularly interacted with one another, I also feel comfortable referring to this site as a community (Kolb and Snead 1997). The second occupation site, Khao Sam Kaeo, is larger (54 hectares) and appears to have been a cosmopolitan urban settlement with people from both South and Southeast Asia living at the site (Bellina and Silapanth 2008). Although this site was likely made up of multiple groups of people, the site was heavily looted and the beads analyzed were from looted contexts. Without more specific information on the contexts of these beads I refer to them as coming from this single settlement, which will be broadly referred to as a community. However, it is acknowledged that with further study the beads could be argued to have belonged to different communities within this settlement.

Complexity and Trade

This dissertation is concerned with questions regarding emerging socio-political complexity in mainland Southeast Asia. In this context, I use the concept of emerging sociopolitical complexity specifically to refer to the appearance of ranked societies or societies with social inequality or hierarchy, such as chiefdoms or states, in mainland Southeast Asia. Unfortunately, due to limited archaeological research, Stark (2006:408) has noted that distinguishing between the chiefdoms, city-states, and kingdoms of the early first-millennium AD polities of Southeast Asia “remains unclear.” Recent research in Northeast Thailand has highlighted the complex process of emerging social inequality, as there is evidence for a brief period of social stratification in burials during the Bronze Age before a second sustained emergence of social hierarchy during the Iron Age (Higham 2011a, 2011b). However, we do know that during the Iron Age and Early Historic periods (500 BC-AD 500) communities in Southeast Asia began to develop a centralized authority, some of which could control massive labor projects, the emergence of large settlements, and hierarchical social stratification as

evidenced in burials (Higham 2002: 224-227). Recent archaeological research at the site of Co Loa in Vietnam, combined with earlier archaeological and historical data, has caused some scholars to argue that there was “a local and indigenous state-like polity had emerged in the Bac Bo region during the Dongson period” (Kim et al. 2010:1025; Kim 2010). Kim argues that Co Loa was the center of an urbanized state from approximately 300-150 BC due to the presence of political centralization required to plan and organize large-scale monumental fortifications, a military force, high-population density, social inequality, the agricultural potential of the Red River Delta to support a large population, and “reciprocal complexity” caused by interaction with peer-polities in southern China, central Vietnam, and elsewhere in mainland Southeast Asia (Kim et al. 2010: 1025-6; Kim 2010: 306-7).

As Kim is focusing on a civilization roughly contemporary with the polities in the Mekong Delta being examined as part of this study, it is worth considering the criteria he uses for identifying the presence of a state-level society. Kim (2010:51-60) argues that a state-level society should have most of the following markers: a high population, agricultural intensification to support a large population, monumental architecture, the presence of a hierarchy or social ranking, the presence of an urban center, settlement size hierarchy at the regional scale, attached craft specialization, centralized control over important resources, and a monopoly on physical power.

These benchmarks are not so different from four pre-conditions for state-level society noted by Kenoyer (1998) in the Indus Valley. His first precondition is a diverse subsistence base to produce enough surplus to feed a large population in city or urban center as well as access to raw materials to construct settlements and make both utilitarian and prestige goods. Secondly, Kenoyer argues that the rise of states and urban centers require the establishment of trade and

communication networks that “link settlements to each other and their agricultural hinterlands” (1998:40). New specialized technologies are also needed to support a complex urban settlement as well as to produce goods to “differentiate the many different classes of people who live in cities” (Kenoyer 1998:41). Lastly, emerging states require status and power to control “access to essential resources, which include both food items and material goods that define status and power” (Kenoyer 1998: 43).

Based on archaeological and historic data from the first millennium AD, detailed later in this chapter, it appears that sites in the Mekong Delta were fulfilling many of these requirements. Monumental construction was taking place to build walls around the cities of Angkor Borei and Oc Eo and dig moats and canals. These canals may have been used as both transportation and communication networks, as well as for agriculture. The agricultural land around Angkor Borei could have supported up to 120,000 people (Fox and Ledgerwood 1999: 47). Site survey in the region around Angkor Borei has identified numerous mounds and site localities, indicating a populated landscape around Angkor Borei (Stark 2006a). Angkor Borei and Oc Eo are clearly the largest sites in their region, also indicating a regional settlement size hierarchy was in place. Chinese historical documents from the third century AD describe kings living in palaces and written texts (Coedès 1968). Excavations at Oc Eo in the 1940s point toward long-distance trade contacts and evidence for manufacture of jewelry and prestige goods (Malleret 1959-1962). However, we know that people were living in the Mekong Delta from at least the 4th or 5th century BC (Stark 2004) and by the mid-first millennium Khmer and Sanskrit inscriptions describe a process of local rulers increasingly adapting Indian titles (Vickery 1998). Based on these data and using Kim’s criteria, I would argue that communities in the Mekong Delta were also state-level societies. However, what is not clear is exactly *when* all of these changes were

taking place i.e., at what point in their development were communities in the Mekong Delta becoming state-level societies. Additionally, although trade appears to have been an important part of the economic base of the Mekong Delta communities, the exact nature of this trade and how people at sites in the Mekong Delta were interacting with other sites in mainland Southeast Asia is not well understood. In this dissertation I will use stone and glass bead data to understand both when people at sites in the Mekong Delta began participating in long-distance trade with South Asia, as well as how emerging elites in the Mekong Delta were involved with trade networks within mainland Southeast Asia.

The role of trade and exchange, specifically of prestige goods, in the emergence of complex societies has been discussed extensively in the archaeological literature (e.g. Brumfiel and Earle 1987; Dillian and White 2010; Renfrew and Shennan 1982; Sabloff and Lamberg-Karlovsky 1975; Schortman and Urban 1992). The emergence of prestige goods and control over their manufacture and distribution is a key component of emerging complexity and maintenance of power in chiefdoms and states (Blanton et al. 1996; Brumfiel and Earle 1987; D'Altroy and Earle 1985; Helms 1992, 1993; Kipp and Schortman 1989). Elites could use prestige goods to create bonds or loyalties with members of the community and maximize their networks of alliances, allowing for expanding power and centralization of control (Blanton et al. 1996; Frankenstein and Rowlands 1978). Increasing control over trade can also lead to the development of increased coercive power (Kipp and Schortman 1989). The exchange of prestige goods played important socio-political roles in displaying status and creating and reinforcing hierarchical networks (Kenoyer 2000).

For this reason, I argue that examining the distribution of prestige goods like stone and glass beads can assist us in understanding emerging socio-political and economic power by elites

at communities in the Mekong Delta. As Angkor Borei and the Mekong Delta were growing in political and economic power, they were also likely increasing their control over the distribution of prestige good objects such as stone and glass beads. The presence of walls at both Oc Eo and Angkor Borei is one indicator of control over trade (e.g. Kenoyer 1998). I argue that by examining the distribution of stone and glass beads at sites in Cambodia and Thailand, I should be able to see evidence for increasing participation in trade by people at sites in the Mekong Delta and that this increased participation in the trade of stone and glass beads can be seen as a proxy for increasing socio-political and economic networks based in the Mekong Delta.

One additional measurement of increasing control over prestige goods is the shift from the trade of finished products, to the manufacture of prestige goods under elite control. The scholars Vidale and Miller (2000: 223) have argued that in chiefdom-level societies, elites will “employ status markers based on the procurement of rare, exotic, raw materials,” but that in state-level societies and empires elites will “favor the use of status markers produces by more elaborate technologies... but exploiting local, cheap, base materials.” This shift from importing exotic materials or finished products to producing prestige objects using local materials would be one way to determine if elites in the Mekong Delta had achieved a higher level of socio-political complexity. Both Bellina (2007) and Theunissen (2003; Theunissen et al. 2000) have argued that elites in Southeast Asia may have begun to make their own stone beads by copying the higher-quality Indian imports. If this shift was really taking place, it should be testable through compositional analysis of raw materials in order to determine if local stone sources were being used to produce beads. This analysis is discussed in Chapter 6, however I argue that it is not clear that local stone sources are being used, although additional analyses of Southeast Asian geologic sources for beads is needed.

Based on the stone and glass distribution patterns observed and discussed in this dissertation, I conclude during the last few centuries BC, stone and glass beads were entering into preexisting bead exchange networks and that people at sites in the Mekong Delta were not participating in these networks. However, during the first few centuries AD trade with South Asia begins to intensify and it appears that elites in the Mekong Delta were heavily participating in newly established and expand trade networks with inland communities. Stone and glass beads can be seen as symbols of these expanding socio-political and economic networks.

Angkor Borei, the Mekong Delta, and “Funan”

In the third century AD, two Chinese emissaries from the Wu kingdom traveled to Southeast Asia to visit a kingdom they called Funan, located in the Mekong Delta region of Cambodia and Vietnam. They described a king named Fanzhan, who had sailing vessels that facilitated his control of a large region from the Thai-Malay peninsula, perhaps up to the coast of Burma (Figure 1.3). These documents also describe a kingdom involved in trade with India, going so far as to develop a relationship with the Murunda dynasty in India, and sending their own emissaries, including a group of musicians, to China (Coedès 1968; Ishizawa 1995). The Chinese emissaries provided the following description of life in Funan:

“There are walled villages, palaces, and dwellings. The men are all ugly and black, their hair frizzy; they go about naked and barefoot. Their nature is simple and they are not at all inclined toward thievery. They devote themselves to agriculture. They sow one year and harvest for three. More over, they like to engrave ornaments and to chisel. Many of their eating utensils are silver. Taxes are paid in gold, silver, pearls, and perfumes. There are books and depositories of archives and other things. Their characters for writing resemble those of the Hu [a people of Central Asia using a script of Indian origin],” (Coedès 1968: 42).

Excavations at the 450 hectare walled and moated site of Oc Eo by the French archaeologist Louis Malleret in the 1940s uncovered a wide range of artifacts including stone and glass beads,

silver and gold jewelry, intaglios, coins, and ceramics, largely from India, but also from Rome and the Sassanian empire (Malleret 1959-63). This varied collection of objects highlighted that the people of Oc Eo were involvement in international trade, and Malleret argued that it was the trading port for the Funan kingdom.

Angkor Borei in Cambodia, approximately 70 kilometers from Oc Eo, also was believed to have been an important center of Funan. As with Oc Eo, Angkor Borei was surrounded by a brick wall and double moats, enclosing an area of approximately 300 hectares (Figure 1.4). Numerous artifacts testify to this region's importance during the mid-first millennium AD. The oldest dated Khmer language inscription was found within Angkor Borei, dated to AD 611, and numerous other inscriptions have been found in the Mekong Delta region describing the activities of local rulers and elites (Jacob 1979; Vickery 1998). The French geographer Pierre Paris identified a series of canal networks linking Angkor Borei with other sites in the region, including Oc Eo (Paris 1931, 1941a, 1941b)(Figure 1.5). At the site of Phnom Da, a small hill located just a few kilometers south of Angkor Borei, are some of the earliest examples of Khmer sculpture (Dowling 1999; Jacques and Lafond 2007). Recent archaeological research at Angkor Borei has also identified numerous collapsed brick structures within the city walls as well a cemetery dating from 200 BC- AD 200 (Stark et al. 1999; Stark and Sovath 2001; Stark 2001, 2006). Excavations have also determined that people were living at Angkor Borei perhaps as early as the 5th or 4th century BC (Stark 2004).

Additional archaeological work in Vietnam since reunification has uncovered over 90 contemporary "Oc Eo Culture" sites, including burial, ritual, and residential sites (Vo Si Khai 2003). However, only two sites, Oc Eo and Go Thap, have been thoroughly excavated and thus far it appears that the Oc Eo culture sites, with the exception of Go Thap, post-date Angkor Borei

(Manguin 2009). In fact, scholars have noted that there is not yet archaeological evidence for a clear transition from the prehistoric period and that “the Oc Eo culture per se started developing in the lower reaches of the Mekong in a somewhat sudden manner, around the first century A.D.” (Manguin 2009:108).

The landscape surrounding Angkor Borei also was filled with mounds and water control features as well as site clusters, some of which were connected to Angkor Borei through canal systems (Sanderson et al. 2007; Stark 2006a). Although these sites have not been excavated, similarities in surface ceramics suggest they were contemporary with Angkor Borei. Luminescence dating of collapsed brick structures at some of these sites date to the 7th-10th centuries AD, and suggested continued occupation at Angkor Borei after the decline of Funan (Stark et al. 2006).

While Angkor Borei was connected to the coast via Oc Eo and the canal linking the two sites, its inland position and connection to inland sites also suggest the importance agriculture must have had on the emergence of this site as an important center (Fox and Ledgerwood 1999; Manguin 2009). During the rainy season, the Mekong Delta environment is wet, with much of the landscape covered in water. This has led some scholars to argue that the Mekong Delta is “an uncomfortable environment for human survival” (Fox and Ledgerwood 1999: 37). Nevertheless, this region is also favorable to dry-season flood-recession rice, a productive rice farming technique in which floodwaters were contained in banded areas and then used to irrigate fields during the dry season. Dry-season flood-recession rice also requires the use of specialized agricultural technology to move water from the low-lying areas into the fields. Although there is not yet direct archaeological evidence for this kind of technology in use during the Angkor Borei period, Fox and Ledgerwood (1999: 48) have speculated that the development of this agricultural

technology in Angkor Borei may have “become the basis of future civilizations in the lower Mekong basin, including Angkor.” Using LANDSAT data, Fox and Ledgerwood (1999:47) have estimated that the agricultural land within a 10km radius of Angkor Borei could have provided enough food for up to 120,000 people, but would have needed the labor of approximately 80,000 people to work then land. This would have provided enough food for a fairly large non-farming population, perhaps made of full-time craft specialists, bureaucrats, or warriors, although more archaeological work is needed to determine the farming methods used and the extent of the agricultural land exploited around Angkor Borei. Conversely, Oc Eo’s proximity to the coast and the richness and diversity of the goods found there emphasize its importance as a coastal trading center (Manguin 2004, 2009).

Table 1.1 presents a summary of some of the major developments in the Mekong Delta from the mid-first millennium BC to the mid-first millennium AD. Although we still know little about how these sites emerged, historical and archaeological data support the interpretation that by the early centuries AD this region was a powerful polity. As Manguin states (2009: 110), it was during this period that Funan “achieved a socio-economic maturity that allowed it to build, all over the lower Mekong Delta, a multiplicity of urbanized centers in varied environments, and to generate enough revenue through agricultural and trade economic surplus to be able to build this extensive canal system, with enough control of its population to require from it the construction of such an imposing public works assignment.” This archaeological evidence supports the Chinese historical documents describing an important and powerful polity in the Mekong Delta region.

Dates	Development
500 – 300 BC	Evidence for habitation in the Mekong Delta at Angkor Borei, Cambodia (Stark 2004) and Go Thap, Vietnam (Manguin 2009).
200 BC – AD 200	Vat Komnou cemetery in use at Angkor Borei (Stark 2001)
0 BC/AD	Construction of some of the major canals around Angkor Borei. A brick in the canal linking Angkor Borei with Oc Eo was found to date from AD 160-200 (Stark et al. 2006: 117).
0 – 600 AD	Construction of the brick wall around Angkor Borei (Stark 2006)
200 – 300 AD	Construction of moats around Oc Eo (Manguin 2009)
500 – 700 AD	Funan begins to decline (Stark 2004)

Table 1.1: Some of the major developments in the Mekong Delta as identified through archaeological investigations. All dates are approximate.

By the 6th or 7th century AD, Funan appears to have declined in power as trade networks shifted further south to insular Southeast Asia (Manguin 2004; Stark 2006c). However, Chinese historical texts indicate that Funan fell to the Chenla (sometimes spelled Zhenla) kingdom, believed to be located further inland. Stark has noted that this may not have been a disintegration of Funan, but “a geographic shift by Funan rulers to the north in response to declining trade returns” (2006c: 153). However, Khmer inscriptions also indicate some competition between rulers during this period (Stark 2006c, Vickery 1998). Regardless, it appears that people continued to live in this area well into the Angkorian period. Angkor Borei might have been continuously inhabited from the 5th century BC until present day (Stark 2004).

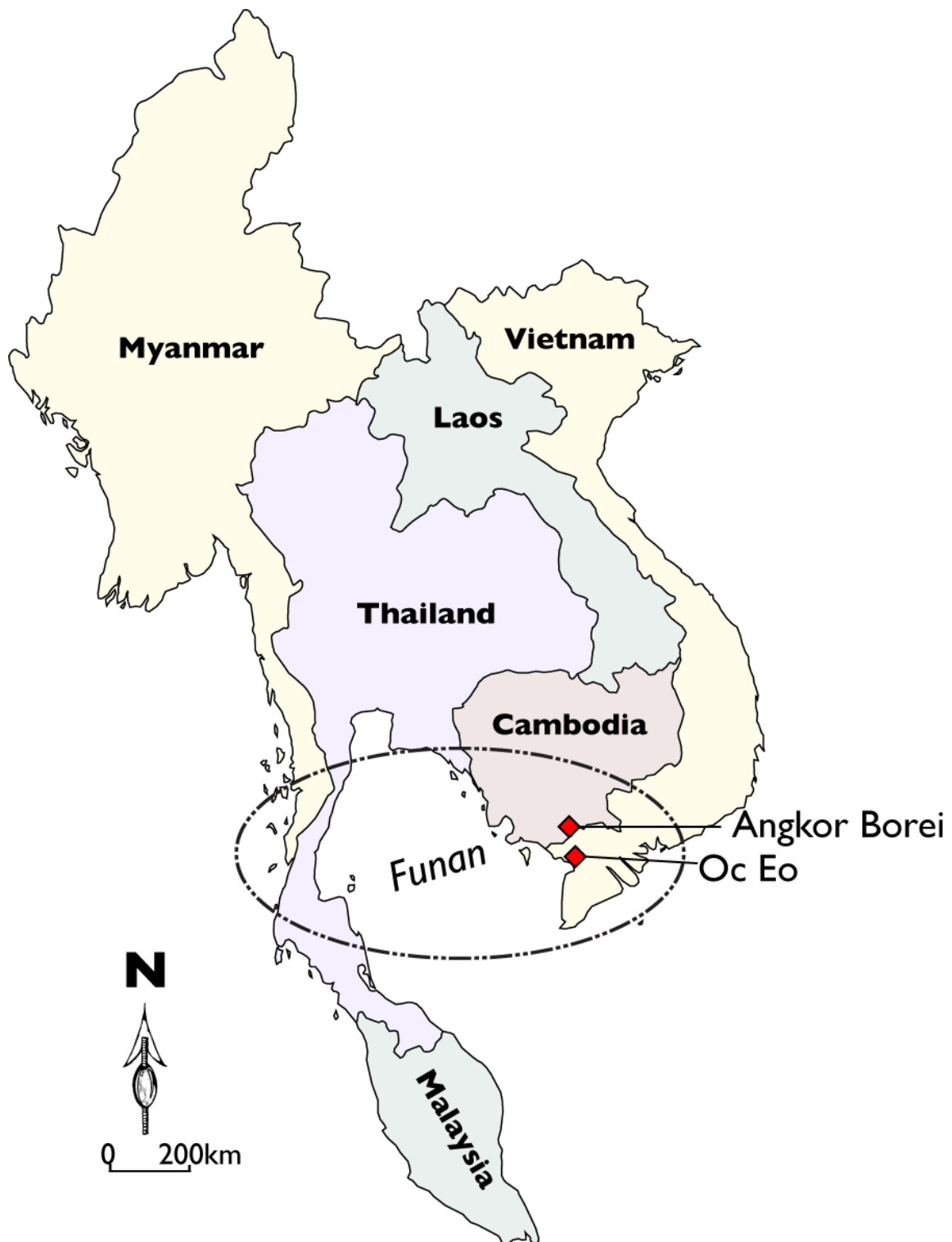


Figure 1.3: A map of the supposed territory of Funan based on historical documents and the locations of Angkor Borei and Oc Eo. There is little archaeological evidence that Funan controlled such a vast territory.

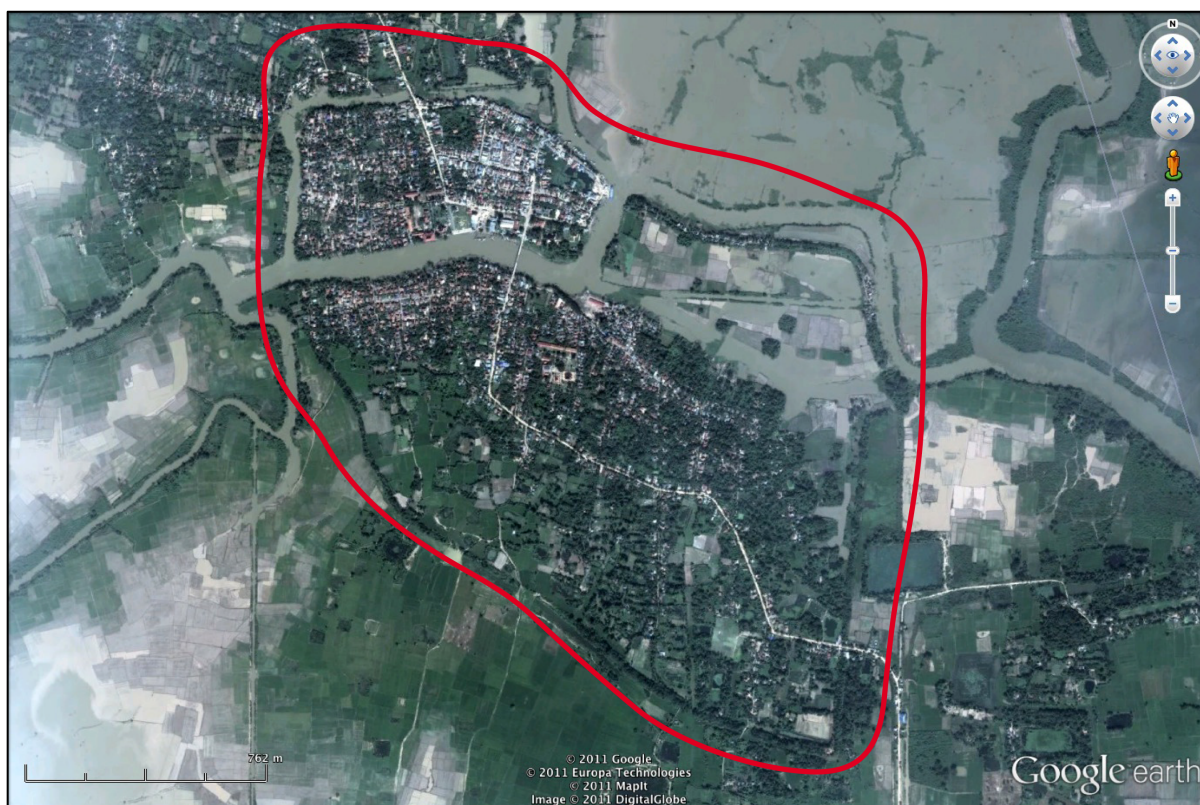


Figure 1.4: Google earth image of Angkor Borei. The red line highlights the wall and moats around the city.

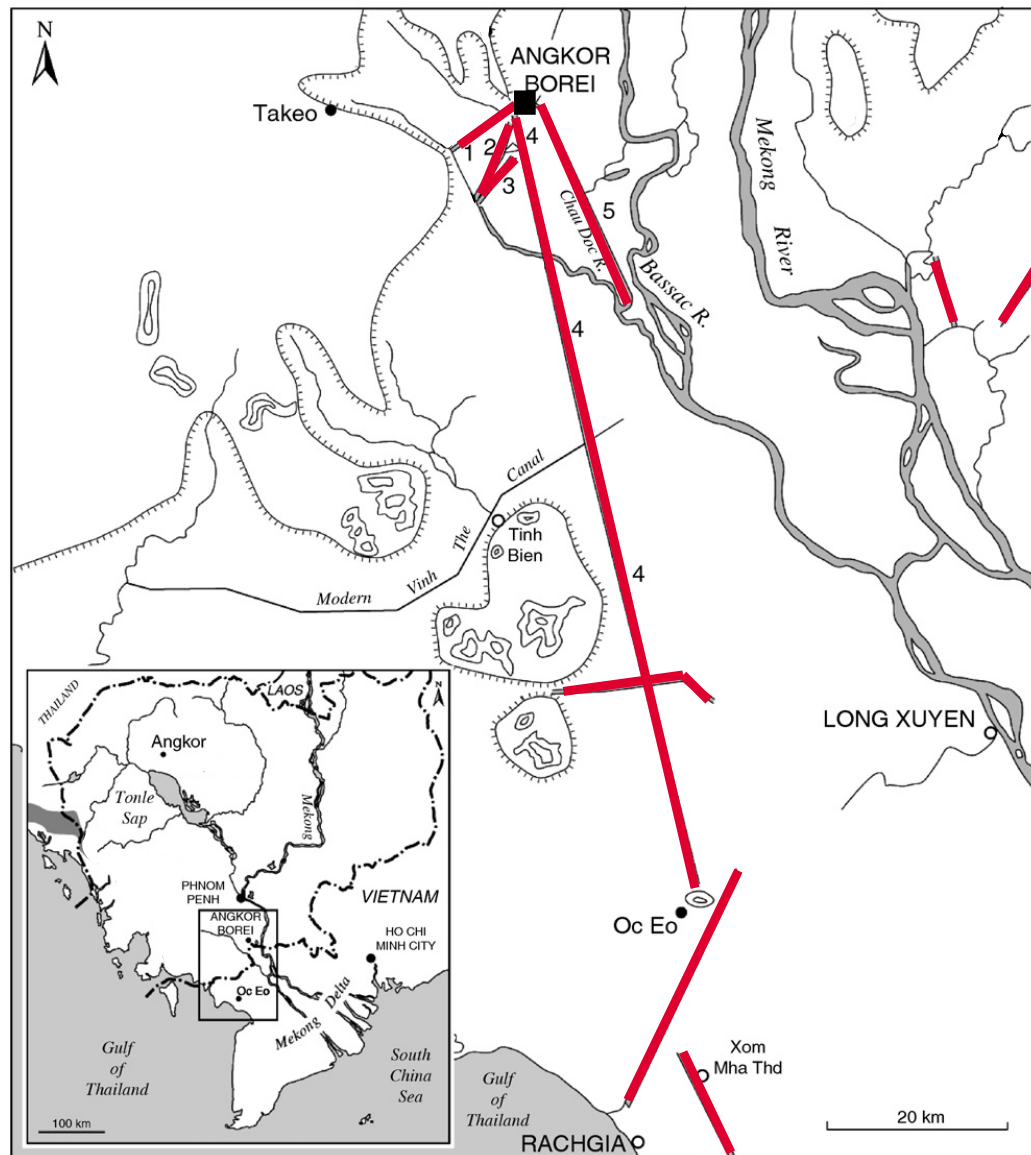


Figure 1.5: Map of canals around Angkor Borei in red. Adapted from Sanderson et al. 2007, Figure 1.

Cambodian perspectives

In addition to archaeological data and historic texts, there is also a rich indigenous history about the Mekong Delta region (see Sovath 2003: 37-42 for a brief review). Sixth century Chinese historical texts recorded a legend regarding the foundation of the Funan kingdom by a prince named Kaundinya (in Chinese Hun-tian) and a princess Soma (Liu-ye). The story was

also referenced in a Cham inscription and Kaundinya and Soma are mentioned as founders of the first ruling dynasty in later pre-Angkorian and Angkorian inscriptions (Gaudes 1993). Scholars of the 19th and early 20th century recorded additional variations of this story and an agglomerated version was widely taught in Cambodian textbooks as a legend for the foundation of Cambodia (Gaudes 1993). The basic version of the legend involves a foreigner from a far-off land, sometimes described as a Brahman, who arrives in Cambodia by ship. He is met by the local princess, sometimes described as a *naga* or magical water serpent, and in some versions of the story he shoots an arrow into her boat, scaring her into submission. She is also sometimes described as being naked and Kaundinya offers her cloth to wear. They are married and as a wedding present the *naga* princess' father drinks up the water, offering the newly drained land to the newlywed couple on which to found their kingdom, called Kambuja (Gaudes 1993). The exact location to which the legend refers is not clear, however many consider it to be related to the kingdom of Funan (Gaudes 1993).

I discovered an additional folktale or origin story for what may be the Funan kingdom in a children's book telling the story of Phnom Borei and Phnom Da, two small hills located near Angkor Borei (Keo Rathana 2010). In this story, a princess is exiled from her kingdom for taking up with a handsome but dim-witted commoner. Together they travel on a raft downstream from her palace in Champasak, and eventually settled at Phnom Borei. One night, the princess has a dream in which a holy man appears to her and tells her she will live a happy and prosperous life. Shortly thereafter, her husband finds valuable materials including gold and wood while out in the forest. Although he does not recognize their value, his wife does and she asks him to continue collecting them. Once a stockpile had been accumulated, the princess raised a flag so that passing ships could see they were "open for business." Ships began arriving and bartering for

the goods, however before trading away her gold she asked for them to bring 100 goldsmiths and additional men and women to settle at Phnom Borei. Once the new laborers had arrived, they assisted with the mining and production of gold objects, and this in turn attracted more traders and more residents. Over time, the princess and her husband became king and queen and built a wall around their town. Following their great success, they constructed a small temple on the Phnom Da mountain in honor of the holy man who came to the princess in her dream. In the illustration, they appear to be referring to Ashram Maha Rosei, a small basalt temple on Phnom Da that dates to the 7th century AD (Jacques and Lafond 2007).

This story was initially published by in 1967 (Commission des Moeurs et Coutumes du Cambodge 1967); however there does not appear to have been any additional scholarly work investigating the tale. I believe that this folktale provides a fruitful comparison for the archaeological data, as well as another perspective on the establishment of a state-level society in the Mekong Delta. The story relates the growth of Angkor Borei to the formation of long-distance maritime trade networks. As discussed earlier, existing archaeological evidence suggest that Angkor Borei and especially Oc Eo were important trading centers. (However, it should be noted that Phnom Borei and Phnom Da are located too far inland to have been seen by passing ships). The ethnic identity of the foreign traders in the story is unclear, however it is notable that the city was settled by craftspeople brought to the site by these traders. This could be tested through isotopic analysis of skeletal remains found at burial sites in Angkor Borei and throughout the Mekong Delta. Furthermore, the story tells of increasing sociopolitical complexity as the princess and her husband transition from savvy business people to becoming the king and queen. This increased socio-political complexity is largely achieved over their control of raw materials (gold) and the production of prestige objects (gold ornaments). Malleret

(1959-1962) believed that jewelry production was taking place at Oc Eo, however further excavations are needed to find similar workshops at Angkor Borei. Lastly, the story notes that the construction of the massive wall around the city was commissioned by the king and queen, indicating their considerable power over the labor of large numbers of people.

The archaeological, historical, and mythological evidence all point toward communities in the Mekong Delta, and specifically at the site of Angkor Borei, as being part of a complex polity during the first millennium AD. Unfortunately, as discussed above, the earliest stages for the emergence of Funan are poorly understood. However, one would expect that if trade was an important factor in the emergence of the Mekong Delta/Funan as a complex polity, we would be able to see evidence for expanding socio-political and economic networks between sites in the Mekong Delta and sites further inland in the distribution of important prestige objects like stone and glass beads. By better understanding the trade and interaction networks at play during the Iron Age period, we can begin to better understand the emergence of Funan.

Research questions addressed in this dissertation

This research project was designed to better understand Iron Age trade and exchange networks in Southeast Asia through an examination of stone and glass beads. By identifying the different types of beads found at sites across Cambodia and Thailand and tracking their distribution I have been able to determine that there were two phases of trade, an earlier phase that focused on coastal exchange networks and a later phase, in which elites in the Mekong Delta appear to have been expanding their influence through the exchange of certain types of stone and glass beads to sites further inland. I have been able to come to this conclusion by developing specific research questions that were tested through systematic data collection and combined with scientific analysis.

As there had not yet been a comprehensive examination of Iron Age trade networks using data from multiple Cambodian archaeological sites, the first task involved addressing the question: *are there distinct patterns in the distribution of agate/carnelian, garnet, and glass beads over time and across mainland Southeast Asia?* These data were supplemented with stone and glass bead data from four sites in Thailand. Data from these sites allowed for a broader view of possible interaction networks between sites in Cambodia and sites in Northeast, central, and peninsular Thailand.

In order to address this question, agate/carnelian, glass, and garnet beads were recorded, with a focus on morphological characteristics, bead shape, and markings on the beads that were related to their production methods. This was supplemented with compositional analysis on a selection of the beads using laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS). Compositional analysis was used on glass beads in order to determine what glass recipe was used produce the beads, as glass beads may look similar to one another but have been produced using different recipes from different workshops. These data were compared with known glass types in circulation during the Iron Age (Lankton and Dussubieux 2006) as a means of determining the quantity of different glass types at each site.

Agate, carnelian, and garnet beads also underwent geochemical analysis using (LA-ICP-MS) and were compared with geologic source samples from South and Southeast Asia in order to determine the geologic source used to produce these stone beads. One goal of this analysis was to determine if stone beads from specific stone sources could be traced over time and space, and in some cases was it possible to define some general source areas, although further studies are needed (see Chapters 5, 6, and 8). The various bead shapes and bead perforations were also

carefully noted in order to determine similarities and differences in stone bead types between sites.

Results from my examination of agate, carnelian, garnet, and glass beads have produced several surprising conclusions. My work confirms that there are differences in both the stone and glass beads found during the early Iron Age period and the later Iron Age period, a pattern that has been identified but not quantified by earlier scholars (Bellina 2003; Bellina and Glover 2004; Lankton and Dussubieux 2006, 2013). During the early Iron Age period, trade in stone and glass beads from external sources appears to have been focused along coastal exchange networks. People at coastal sites were exchanging potash glass beads and higher quality stone beads. Patterns in the spatial distribution of specific types of glass and stone beads highlight the importance of regional networks during the early Iron Age. While glass and stone beads may have originated outside of the localized exchange networks, they served to connect sites in these regions with one another. These patterns are especially clear at sites in southeast Cambodia and Northeast Thailand.

The burial contexts in which stone and glass beads were found also were carefully recorded in order to identify and determine if there were patterns of restricted distribution within each of the ten cemetery sites. Although beads may have been incorporated into burials in different ways in different communities, my research shows that not all members of a community had equal access to beads. Within a community there were several people who appear to have had larger numbers of beads than others in their community.

Recent hypotheses arguing that Southeast Asian craftsmen may have produced agate and carnelian beads themselves, perhaps using a local stone source, (Bellina 2003, 2007; Theunissen 2003; Theunissen et al. 2000) raise the issue of changing socio-political expansion. If agate and

carnelian beads were being made in Southeast Asia using Southeast Asian stone sources then, as discussed earlier, one could argue that Southeast Asian elites might have reached an even greater level of socio-political complexity than previously expected. LA-ICP-MS analysis of agate and carnelian beads was used to test the hypothesis regarding local Southeast Asian bead production and the results indicate that the majority of the agate and carnelian beads found in Southeast Asia were produced using raw materials derived from the Deccan Traps geologic formation in western India. It is still possible that there was some local production, but clearly the raw material was being imported from elsewhere.

The patterns observed in the glass and stone beads were then used to address my second question: *can these patterns of distribution be linked to changing patterns of socio-political and economic organization in the Mekong Delta?* As noted above, results from the analysis of stone and glass beads show evidence for two distinct trade networks in which higher quality agate and carnelian beads and potash glass beads were traded in an earlier coastal exchange network. However, glass and stone bead data from Angkor Borei and previous studies from Oc Eo indicate that these sites were not active participants in the bead trade until the later Iron Age. During this later period, trade with South Asia appears to intensify, with greater numbers of goods being imported to Southeast Asia (Bellina and Glover 2004) including high-alumina soda glass beads and lower quality agate and carnelian beads. It is also in this period that we see increased numbers of stone and glass beads at inland sites. I argue that with these shifting trade networks and increased availability of stone and glass beads, elites would have been able to expand their power by trading these objects with inland communities that did not have access to beads through the earlier coastal exchange network. In this way, we can view beads as a symbol of the expanding power and influence of elites in the Mekong Delta. As objects that were meant

to be worn and displayed, beads can be seen as public exhibitions of this economic and socio-political power.

Archaeological evidence has shown that sites in the Mekong Delta, specifically Oc Eo, were important trading centers. Both Angkor Borei and Oc Eo were walled sites that could control the movement of goods into and out of these settlements. Furthermore, Angkor Borei's was located in an area with rich agricultural land that could support a growing population. This population growth is perhaps something that earlier coastal settlements could not have sustained. I argue that the Mekong Delta acted as a conduit for the trade of exotic objects, including stone and glass beads, to interior sites. The distribution of stone and glass beads can be seen as a representation of these expanding exchange and interaction networks.

Conclusion and dissertation outline

In this introductory chapter I have provided an introduction to my research questions, a discussion of my theoretical orientation and a definition of important terms, a background on the Funan and the Mekong Delta polities, and a review of my research questions and results. In Chapter 2, I introduce mainland Southeast Asia more broadly through a discussion of the geography, ecology, and natural resources in this region, focusing especially on Cambodia and Thailand. I follow this discussion with a background on the chronological framework used in Southeast Asia, as well as an introduction to the major archaeological cultures that have been identified in Southeast Asia. I conclude with a description and background on the Thai and Cambodian sites that will be the focus of this dissertation. In Chapter 3, I discuss the emergence of complexity in Southeast Asia and the role of trade and exchange in this process. Both historical and archaeological perspectives on the emergence of socio-political complexity are reviewed. In Chapter 4, I present the methods used to record and analyze stone and glass beads.

Chapters 5-8, focus on the results from the analyses of glass and stone beads. In Chapter 5 I discuss the results of both contextual and morphological analysis of agate and carnelian beads, with the results of the compositional analysis being discussed in Chapter 6. In Chapter 7, I discuss the distribution of glass beads and results of LA-ICP-MS analysis, identifying the different glass types in circulation in Cambodia and Thailand during the Iron Age. In Chapter 8, I discuss the results of morphological and compositional analysis of a small group of garnet beads. Lastly, in Chapter 9, I return to my primary research questions and evaluate them in light of the evidence discussed in earlier chapters. I have also included appendices that list the beads recorded in this study, the compositional and geochemical data, as well as additional details on the geologic sources and the statistical techniques and methods used to differentiate the geologic sources and artifacts.

Chapter 2: Archaeological Background of Southeast Asia

This chapter serves as an introduction and background to Southeast Asia and the sites in this study in order to situate and contextualize the data presented in later chapters. I begin with a brief background on the geography of Southeast Asia, focusing on Cambodia and Thailand. I will then discuss the chronological framework used to describe the different periods in Southeast Asian history and prehistory. Following this, I will provide a brief overview of the major Iron Age cultures in Southeast Asia and the cultural milieu in which Iron Age sites in Cambodia and Thailand were operating. Finally, I conclude with a summary of the archaeological sites that are the focus of this study.

The sites in this study are located in Cambodia and Thailand in mainland Southeast Asia, but the boundaries and definition of mainland Southeast Asia (SEA) are not always clear. The current non-island members of ASEAN (Association of Southeast Asian Nations) include Cambodia, Laos, Peninsular Malaysia, Myanmar, Thailand, and Vietnam. However, others may consider parts of southern China, specifically Yunnan, Guaxi, and Guangdong provinces, to be a part of the cultural sphere of mainland Southeast Asia (Higham 2002). There also are strong cultural and genetic links tying communities in northeast India with Southeast Asia (Reddy et al. 2007). For the purposes of this dissertation, I follow the divisions set out by Bellwood and Glover (2004: 7) with mainland Southeast Asia being made up of the countries of Cambodia, Laos, peninsular Malaysia, Myanmar, Thailand and Vietnam, and insular Southeast Asia being made up of the countries of Taiwan, the Philippines, East Malaysia, Indonesia, and Brunei. However, it is recognized that the people in these locations interacted regularly with one another and with people areas of southern China, northeast India, and the Pacific Islands.

Geography and ecology of mainland Southeast Asia

The current landmass of mainland Southeast Asia has seen significant changes in its coastline since the Pleistocene epoch. During the Ice Age period as sea levels fell, a massive swath of land, known as Sundaland, was exposed that connected mainland Southeast Asia to Sumatra, Java, Borneo, and Bali (Bellwood and Glover 2004). Even as recently as 10,000 BP sea levels were 40-60 meters lower than present, which exposed low-lying coastal areas that have since been inundated. The coastline did not begin to stabilize into its current form until approximately 4000 years ago. The current geography of Southeast Asia can be divided into two categories: first, the major river systems, their flood plains and river valleys and deltas, and second, the upland areas (Higham 2002). Overwhelmingly, the focus of this dissertation will be on Iron Age sites located in the river valleys, deltas, and flood plains of mainland Southeast Asia.

Life in Southeast Asia is heavily affected by the availability and management of water, be it from the seasonality of the river systems to the monsoonal weather patterns. Mainland Southeast Asia falls into a subtropical monsoon climate, although the climate and especially rainfall are locally variable (Higham 2002). During October through April a northeast wind dominates the landscape, bringing on the dry season. During May through October, the winds shift and move in from the southwest bringing a rainy season. However, there are several areas that fall into a rain shadow during this period such as the Chao Phraya and Tonle Sap plains and the Khorat Plateau. The results of these rain shadows affect the production of rice in these regions and farmers must rely on the flooding of rivers and silt deposits (Higham 2002).

Cambodia

Cambodia is primarily dominated by low, flat plains, although the western coastline is marked by the Damrei (Elephant) and Cardamom Mountains, and portions of the northeast and

southeast fall within the Annamite Chain (Figure 2.1). Perhaps the most important ecological zones within the country are the Tonle Sap Lake and the Mekong River and Mekong Delta regions. The Tonle Sap Lake in central Cambodia is one of the world's largest and most important inland fisheries. During the rainy season the Mekong River floods, brought on primarily by the spring snowmelt in the Himalayas. The flooding of the Mekong is so great that when the Mekong and Tonle Sap Rivers meet in Phnom Penh, the Tonle Sap River reverses direction and floods into the Tonle Sap Lake in central Cambodia. During this period the Tonle Sap Lake can increase its size to approximately 25,000 square kilometers (Nesbitt 1997). An assortment of rice farming techniques and varieties of rice are utilized in Cambodia. Deepwater rice can be grown in the regions adjacent to the rivers and Tonle Sap Lake, although this practice is declining (Nesbitt and Phaloeun 1997). Rain fed lowland rice is grown in every province of Cambodia today (Javier 1997). However, some scholars have suggested that dry-season flood recession rice was important for the growth of Angkor Borei and the Mekong Delta polities (Fox and Ledgerwood 1999).

Thailand

The geography and ecology of Thailand is quite diverse, but the sites discussed in this dissertation lie in three distinct regions: central Thailand, a region dominated by the Chao Phraya River and its tributaries, the Khorat Plateau in Northeast Thailand, and the Thai-Malay peninsula (Figure 2.2). The Chao Phraya River basin and the Central Plain of Thailand is approximately 500 km long running north-south through the center of Thailand. The Chao Phraya derives from four rivers, which drain from the mountainous region of northern Thailand. The Chao Phraya has a seasonal flow, with low levels during the dry season (April-May) and higher levels during the rainy season (May-September) (Gupta 2005b).

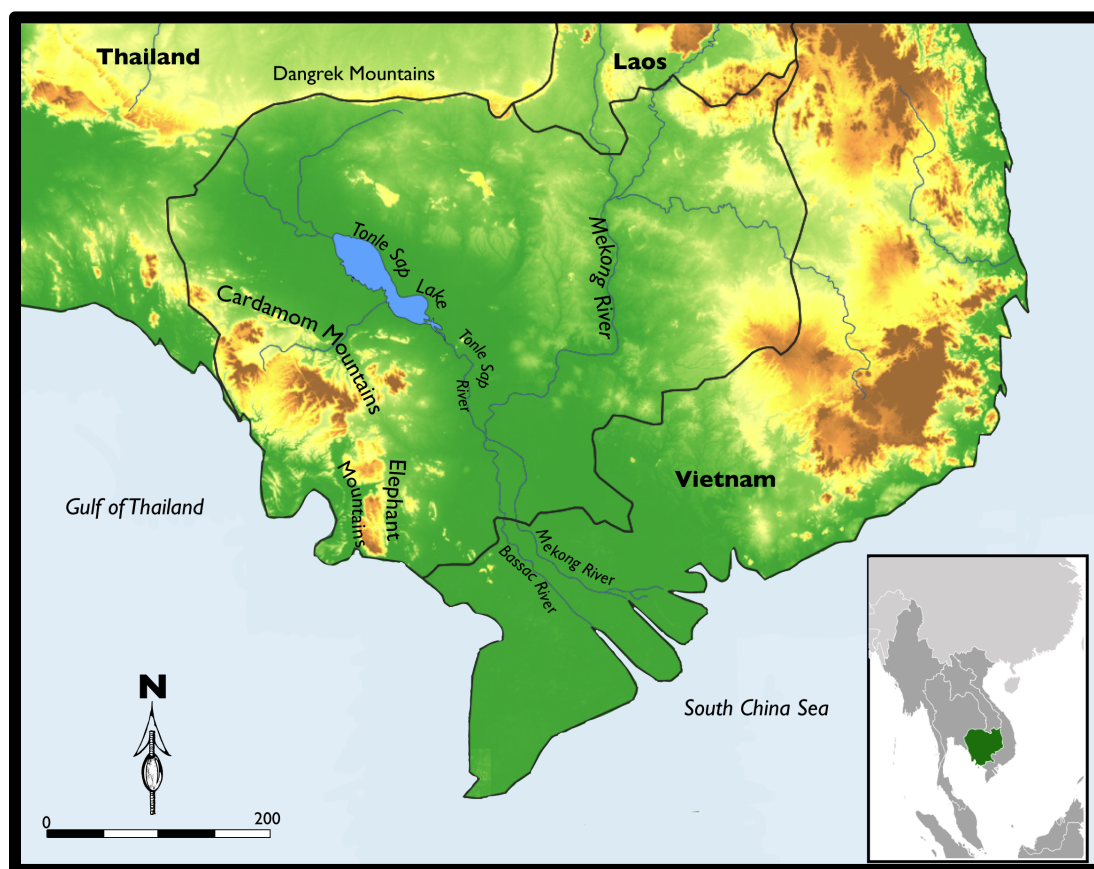


Figure 2.1: Map of Cambodia noting important physical features. Digital Elevation Model data taken from ASTER GDEM [<http://www.gdem.aster.ersdac.or.jp/index.jsp>]. ASTER GDEM is a product of METI and NASA. Map inset adapted from Wikipedia Commons [https://en.wikipedia.org/wiki/File:Location_Cambodia_ASEAN.svg]

Alluvial sediments are deposited in the lowland regions, and communities in this area currently practice rain-fed rice agriculture (Lertcharnrit 2010). However, recent research in the Khao Wong Prachan valley in central Thailand suggest that millet may have been an important crop and was grown prior to the emergence of rice agriculture in the first millennium BC (Weber et al. 2010).

The Chao Phraya Valley is also well known for its ideal location in relation to trade networks. The western portion of this valley is linked to the Three Pagodas Pass (Figure 2.2), a fault in the Tenasserim Hills, which linked communities in Thailand to the area of modern-day Myanmar and India further west. Along the eastern portion of the Chao Phraya Valley are links

to northern Cambodia and the Tonle Sap region, while the Gulf of Siam connected this region to coastal communities in South and Southeast Asia (Higham 2002).

Northeast Thailand, regionally referred to as Isan, is a unique region, with strong influences from both Laos and Cambodia (see McCargo and Hongladarom 2004). As Northeast Thailand refers to a specific socio-cultural location, I follow other scholars in capitalizing Northeast. This territory is dominated by the landmass known as the Khorat plateau, an upland area approximately 150,000 square kilometers. Portions of the plateau reach 1000m in elevation, however most of the area is approximately 50-200m above sea level, with a downward slope towards the southeast. The Plateau is separated from the Chao Phraya valley by the Petchabun Mountains, and the Mekong River Valley in the south by the Dangrek (sometimes spelled Dong Rek or Dang Raek) Mountain range (Gupta 2005a). Two important rivers, the Mun and Chi, flow through the Khorat Plateau and numerous ancient settlements have been found along the flood plains of these rivers (Higham 2002). As with the Chao Phraya, these rivers have seasonal flows, with the Chi River dropping 10-12 below the flood plain during the dry season. As noted above, this region falls within a rain shadow and some of the soils have a high salinity. Salt-production has been an important part of the economy in this region since prehistoric times (see Nitta 1991, 1997, 1999).

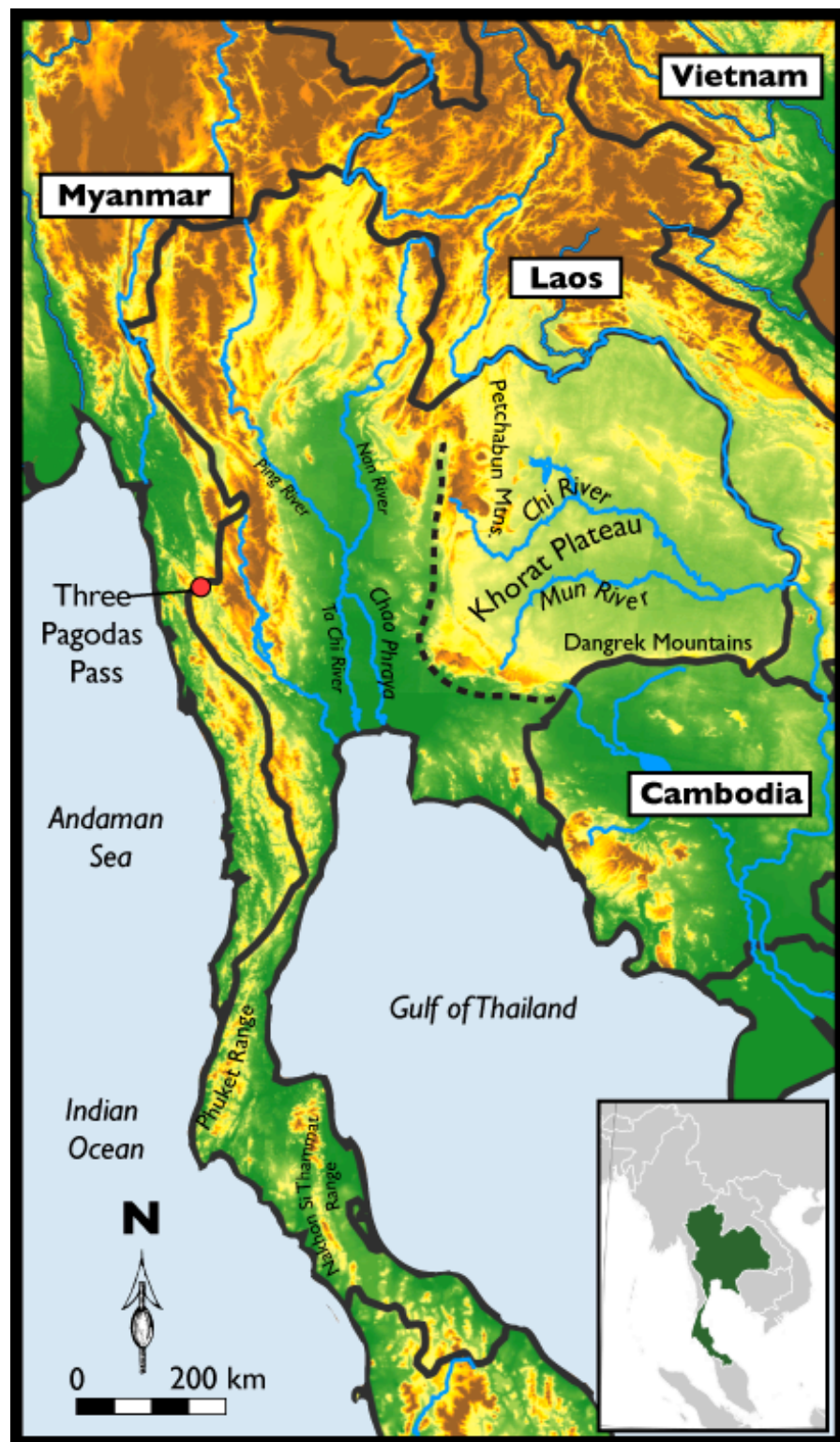


Figure 2.2: Map of Thailand noting important physical features. Map created using publically released GLOBE data [<http://www.ngdc.noaa.gov/mgg/topo/globe.html>]. Map inset taken from Wikipedia Commons [https://en.wikipedia.org/wiki/File:Thailand_%28orthographic_projection%29.svg]

The geography and climate of the Thai-Malay Peninsula is slightly different from the rest of mainland Southeast Asia. The peninsula is a long and narrow landmass, with the widest portion being not more than 300 kilometers across and the interior sections being not more than 150 kilometers from the sea. A series of nine mountain ranges stretch along the peninsula (Jacq-Hergoualc'h 2002), with coastal plains on the east and west sides of the peninsula. Although these areas are currently used for wet rice cultivation, research suggests that they did not exist until well into the historic period (14th century AD) and were brought on by erosion from the inland hills. This suggests that Iron Age communities in the Thai-Malay peninsula focused on inland, hill slopes and rain-fed agriculture, such as dryland rice or millet (Allen 1991). Several of the rivers on the peninsula flow from east to west and connect the coasts to one another. As with the rest of mainland Southeast Asia, the monsoon winds also heavily influence the climate and rainfall in the peninsula. Perhaps most importantly, is that the monsoon winds affected the process of commercial exchange in the peninsula and mainland Southeast Asia by extension. During the southwest Monsoon, maritime traders were able to use the favorable winds to easily cross from India to Southeast Asia across the Bay of Bengal, while in the other half of the year the southeast winds carry traders made travel from the east to the peninsula more favorable (Ray 2003; Tripathi 2006).

These seasonal Monsoon winds likely affected trade across mainland Southeast Asia, as goods were potentially only available part of the year when traders were able to arrive in Southeast Asia with their cargo (Ray 2003: 20). Furthermore, monsoon winds and flooding would have made overland travel on road networks difficult during the rainy season, and rivers too dangerous to use due to swelling water levels (Hendrickson 2007). Trade was a seasonal

activity centered on the monsoon winds and affected by the rainy season impact on the environment.

Natural resources important for trade

Southeast Asia is also a source for numerous natural resources that were exploited by Iron Age communities and were important commodities in long-distance trade. Foreign traders came to Southeast Asia to gather a variety of resources, including forest products, spices, and precious metals (Bronson 1992; Glover 1989; Glover and Bellina 2011; Fuller et al. 2011; see also Smith 1999). Gemstones also may have been important trade objects. A recent study indicates rubies from Burma were traded as far as Mesopotamia during the 2nd century BC- 2nd century AD (Calligaro 2005). However, gemstones were not mined in large quantities until more recently (e.g. Aranyakanon 1983; Van Long 2004). During the “Age of Commerce” in the 15th-17th centuries AD, Southeast Asia was known for cotton and cloth production as well as, spices, rice, metals, and ceramics (Reid 1988). Similar items may have been traded during earlier periods, however the organic objects are not well preserved in the archaeological record. For this reason, the metal trade is perhaps the best known and studied of the natural resources traded by early Southeast Asians.

Metals were an important resource exploited by Iron Age communities and were likely important resources traded with foreign traders. In the first century AD the Roman emperor Vespasian forbid the export of gold coins, leaving Indian merchants in search of another source of gold (Higham 2002). (Although it should be noted that gold continued to leave the Roman Empire due to the presence of Roman gold coins in India from later periods). Indian myths discussed the fabled land of gold, or *Suvarnabhumi*, which is believed to be located in modern-day Southeast Asia, perhaps Myanmar (Moore and Win 2007), but gold is sporadically

encountered in deposits across Southeast Asia and other regions may have been lumped under this general term. There are currently numerous gold mines at various locations in Cambodia, as well as gold deposits in Laos, central Vietnam, northwest Thailand, and in alluvial sediments in the Mekong Delta (Reinecke et al. 2009). There is also evidence for gold working at the site of Oc Eo and the nearby site of Go Thap in southern Vietnam (Figure 2.3, Sites 14 and 15)(Li Thi Lien 2005), but it is unlikely that the alluvial deposits in the Mekong Delta were able to produce enough gold to supply this region (Reinecke et al. 2009). Tin also appears to have been an important part of the earliest periods of exchange between South and Southeast Asia. The Thai-Malay peninsula contains nearly 95% of the world's tin reserves and has been described as "Southeast Asia's premier metal in terms of economic importance," (Bronson 1992: 83). Recent research from the peninsular site of Khao Sam Kaeo suggests that tin may have been exploited to produce high-tin bronze as early as the late first millennium BC (Glover and Bellina 2011; Murillo-Barroso et al. 2010; Pryce et al. 2008).

Other precious metals are present in Southeast Asia, although in smaller quantities. Large silver deposits have been found in Myanmar and were exploited during the historic period, although it is unclear if they were exploited earlier (Bronson 1992). There is extensive evidence for copper production and smelting in the Khao Wong Prachan Valley in central Thailand (Pigott et al. 1997; Pryce et al. 2011) and exploitation of the northeast Thai copper mine of Phu Lon (Figure 2.3, Site 7) as early as the mid 2nd millennium BC (Pigott and Weisgerber 1998). Copper is currently mined in large quantities in Laos and may have also been exploited in the past (Cawte 2009). There are also extensive iron deposits across Southeast Asia, although they are distributed unevenly. Areas of southern Vietnam have no iron deposits whereas the Thai-Malay peninsula, northern Thailand, Laos, and northern Vietnam all have plentiful iron ores (Bronson

1992). Iron smelting has been identified at Iron Age sites in Thailand such as Ban Dong Phlong in Northeast Thailand (Figure 2.3, Site 1)(Nitta 1997). During the Angkorian period a large iron production workshop was located at the site of Preah Khan of Kampong Svay in eastern Cambodia (Figure 2.3, Site 21)(Jacques and Lafond 2007).

While Southeast Asia was home to numerous natural resources, they were not evenly distributed across the landscape. In some regions, the patchy distribution of various resources encouraged intraregional exchange (e.g. Christie 1995; Welch 1989). These resources were appealing not only to foreign traders but to communities within Southeast Asia as well. Scholars have also argued that important centers emerged when they could facilitate the trade of long-distance goods arriving through maritime trade with important resources found further inland (e.g. Bronson 1977; Christie 1995, 1996). Beads may have been used by coastal communities in exchange for some of these items and traveled over the same networks discussed above. Historic documents from the mid-17th century describe upland minority communities exchanging forest products, gold, slaves, elephants and other objects with lowland communities for metal objects, Chinese ceramics and glass beads (Richter 2000: 116-117). We can assume that glass and stone beads were traded and used by Iron Age communities in a similar way as these other materials, since beads were part of the larger trade of this region.

Chronological Frameworks

In this dissertation, I draw primarily on the chronological framework most recently described by Charles Higham (2002). This framework largely grew out of archaeological research in Thailand, but has been applied to Southeast Asia as a whole. However, a chronological framework used in South Asia (Kenoyer 2000) may eventually prove to be better fit in describing the cultural developments happening in Southeast Asia. The currently used

modified Three-Age system is broad and perhaps overly technologically focused. In this section I review the major chronological developments using Higham's framework and will use this framework in my dissertation to allow easy comparison with the current literature. However, I will also present the alternative chronological framework that may be beneficial to future studies. Following this discussion, I present a brief summary of the major Iron Age archaeological cultures that have been identified in mainland Southeast Asia and their relationship with sites in Cambodia and Thailand.

As recently as the 1980s and 1990s, Southeast Asia lacked a widely used cultural chronology or framework. During the 1980s several scholars proposed chronologies for Northeast Thailand (e.g. Bayard 1984, 1987; Higham 1986; Bayard 1987; Welch 1985). In one widely used framework, Southeast Asian history and prehistory were divided into a series of general periods, associated with the emergence of rice-farming, bronze, iron, and state-level societies (Bayard 1984; Higham 1989: xv-xvi). More recently, scholars producing major regional syntheses on the prehistory of Southeast Asia have relied on a modified version of the Three Age system (Bellwood and Glover 2004; Higham 1996, 2002; O'Reilly 2007). In this dissertation, I follow this framework (Table 2.1).

Current Framework	Cultural Traditions Framework	Dates
Angkorian Empire	Integration Era?	Approx. 800-1400 AD
Iron Age	Regionalization Era	500 BC- AD 500
Bronze Age		1500/1000 – 500 BC
Neolithic	Early Food Producing Era	2500 – 1500/1000 BC
Hunter-Gatherers		Approximately 40,000 BP to 2500 BC

Table 2.1: Chronological periods discussed in this dissertation.

Hunter-Gatherers

The first modern human occupants of Southeast Asia were hunter-gatherers, with some of the earliest sites dating to approximately 40,000 BP (Bellwood and Glover 2004; Higham 2002) or possibly 63,000 BP (Demeter et al. 2012). Hunter-gatherer sites have been broadly divided into two different classes: those located in the uplands, primarily in rock shelters, and sites located in coastal settlements. However, it is generally accepted that these archaeological sites represent just a portion of the diverse lifeways of prehistoric hunter-gatherer groups. Generally, upland sites have been better studied and preserved as coastal sites have largely been destroyed or are submerged due to changes in sea-level over time (Higham 2002; Higham et. al 2011). One of the best-known hunter-gatherer archaeological cultures is the Hoabinhian, whose earliest sites may date to 20,000 BP (Yi et. al 2008) and have been identified in rock shelters and caves in Vietnam, Cambodia, and Thailand. The French researcher Madeleine Colani was the first to identify and name the Hoabinhian culture and specifically the unifacially worked stone tools made from river cobbles known as sumatraliths (Matthews 1966). In the 1970s, research at the Hoabinhian site of Spirit Cave (Figure 2.3, Site 9) uncovered plant remains that were believed to be early domesticates (Solheim 1972). However, it is now realized that Hoabinhian hunter-gatherers had a broad-spectrum subsistence strategy, but were not involved in the local domestication of plants. Later Hoabinhian sites are believed to extend into the middle Holocene, a period Vietnamese archaeologists refer to as the Middle Neolithic, which is noted for the first appearance of pottery and the evidence for possible vegetable cultivation (Nguyen Khac Su 2004).

Neolithic period and introduction of rice agriculture

By approximately 2500-2000 BC, Neolithic rice-farming communities and technology began to move into mainland Southeast Asia from China. Rice is believed to have been domesticated in the middle Yangzi River Valley, however the process and timing of this event is still under debate. For example, recent research has argued that rice was domesticated in a single process somewhere in Asia (Molina et. al 2011) while other scholars have argued that there is evidence for rice cultivation as early as 9000 BP (Liu et. al 2007). Nevertheless, it appears to have taken perhaps up to 7000 years for this technology to reach southern China and Southeast Asia (Bellwood 2005; Chi and Hung 2008; Higham 2004). These dates are similar across broad stretches of southern China and mainland Southeast Asia suggesting that there were “related expansionary movements southwards, following the courses of the major rivers,” (Higham 2004: 51). Many of these early Neolithic communities shared pottery styles and mortuary rituals (Higham 2004; Rispoli 1997). However it is important to note, the shift to rice farming was not uniform across mainland Southeast Asia. Recent DNA evidence suggests that many hunter-gatherer groups persisted despite the influx of agriculturalists, although in isolated locations (Higham et. al 2011). The site of Khok Phanom Di (Figure 2.3, Site 5) in coastal central Thailand is one example of a community interacting with or transitioning to rice agriculturalists (Higham and Thosarat 1994). Early layers at the site suggest a dependence on fishing and wild resources. However upper layers contained human feces with the remains of domesticated rice, although the environment immediately surrounding Khok Phanom Di was not conducive to rice farming (Higham 2002). Strontium isotope data on skeletons at the inland site of Ban Chiang, Thailand (Figure 2.3, Site 8) show evidence for the appearance of non-local men during the late Neolithic-early Bronze Age period. It is believed that early agriculturalists practiced

matrilocal, which may be linked to the spread of agriculture in mainland Southeast Asia (Bentley et. al 2005). Continued genetic and isotopic research along with archaeological data should lead to a better appreciation of the complexity of the spread of agriculture in the future (Higham et. al 2011).

The Bronze Age

Around 1500-1000 BC we see the first evidence for the appearance of bronze and bronze technology in mainland Southeast Asia, although the timing of this process has been the object of some debate. In the 1960s and 70s excavations at the sites of Ban Chiang of Non Nok Tha in Thailand (Figure 2.3, Sites 6 and 8) both produced very early dates for bronze (Gorman and Charoenwongsa 1976; Solheim 1968). However, these dates were found to be in error and the generally accepted dates for the beginning of the Bronze Age were shifted to 1500-1000 BC (Higham 2002). Recent research at the site of Ban Non Wat in Northeast Thailand (Figure 2.3) has pushed the Neolithic-Bronze Age transition in that region to 1000 BC (Higham and Higham 2009). Conversely, Joyce White, using recent rice chaff dates from pottery found at Ban Chiang notes that the appearance of bronze dates from 2100-1700 BC, the earliest evidence for bronze in Southeast Asia (White 2008; White and Hamilton 2009). Many scholars have argued that Southeast Asian bronze technology originated in China (for a review see White and Hamilton 2009). However, as White and Hamilton (2009: 375) note “proponents of Sinocentric models must either dispute or ignore evidence for early second millennium BC bronze in Southeast Asia.” In this vein, Higham (Higham and Higham 2010; Higham et. al 2010) has recently questioned the accuracy of the rice chaff dates from Ban Chiang. Evaluating these arguments is beyond the scope of the current work. For this reason, I will maintain the predominant currently accepted view that the Bronze Age begins in Southeast Asia around 1500-1000 BC.

Once bronze technology entered mainland Southeast Asia, it was used to produce a variety of objects from personal ornaments to weapons. Copper resources were also exploited and copper was smelted and worked by indigenous craftspeople (Higham 2002: 117-8). However, unlike other parts of the ancient world the introduction and use of bronze technology did not result in the emergence of complex polities in Southeast Asia (Muhly 1988). Several scholars have argued that Bronze Age communities in Southeast Asia were arranged heterarchically, which prevented the emergence of hierarchically based chiefdoms or states (Eyre 2011; O'Reilly 2000, 2003; White 1995; White and Piggott 1996). However, research at Ban Non Wat has again complicated this view. Portions of the Bronze Age cemetery show evidence for “outstandingly wealthy men, women, infants and children,” (Higham 2011a: 380). This appearance of wealth and social stratification was short-lived however, and after 150-200 years there was a decline in the mortuary wealth at the site. Higham argues that the wealthy burials reflect the appearance of aggrandizers, whose power eventually declined. He notes:

“Social organization from the eleventh to the fifth centuries BC in the upper Mun Valley was, it is held, transegalitarian. The eruption of social display and ostentation that took place with the initial Bronze Age reflects social inequalities that gave differential access to the ownership of resources and access to prestige goods. In the nature of transegalitarian societies, social success achieved by aggrandizers was impermanent, and there was no embedded political control from one centre over its contemporaries,” (Higham 2011a: 388).

While these data are immediately applicable to the Mun River Valley region, Higham also argues that similar patterns may be found at other Bronze Age sites in Southeast Asia (2011a: 386). It should be noted that the majority of Bronze Age sites in Southeast Asia have been excavated in Thailand. There is limited information in English about Vietnamese Bronze Age sites and very incomplete research on Bronze Age sites in Cambodia, and Laos. As excavation

in these countries continues we will develop a more balanced and detailed understanding about the Southeast Asian Bronze Age.

The Iron Age

The first appearance of iron in mainland Southeast Asia occurs approximately 300-500 BC (Higham 2002). In addition to the appearance of iron, the Iron Age is notable for the first evidence for contact with South Asia, and increasing socio-political complexity (Higham 2002). As with bronze, the origin of iron technology in Southeast Asia is still debated, as it could have been developed indigenously or introduced from China or India (Higham 2002: 169-70). At the site of Noen U-Loke in Northeast Thailand, the earliest iron artifacts are personal ornaments such as bangles and it is not until later phases that iron is used for utilitarian goods (Chang 2001; Connelly 2007).

The Iron Age was a period of great change spanning approximately 1000 years, however we do not yet have a clear understanding of the different phases within this period. In Cambodia, some scholars also refer to the late Iron Age as the “Early Historic period,” as it is during this phase that Chinese historians began visiting and writing about polities in the Mekong Delta region (Stark 2004). In one Chinese document, they describe the presence of libraries and written documents at sites in the Mekong Delta around the 3rd century AD (Stark 1998). Excavations at specific sites have provided information on the transformations happening at the site or regional level (e.g. Higham and Higham 2009; Higham 2011b). The emergence of socio-political complexity and influence from South Asia did not happen uniformly across mainland Southeast Asia, therefore site or regional-level analyses may be the best way to understand these changes.

By the mid-first millennium AD several complex polities, often identified as states, emerged in parts of mainland Southeast Asia (Higham 2002). As discussed in Chapter 1, I and

other scholars have argued that polities in the Red Rive Delta in northern Vietnam and in the Mekong Delta of Cambodia and Vietnam may have been states. Sites in the Mekong Delta are notable for their use of writing, influence from India, especially in the practice of Hinduism and/or Buddhism, and the emergence of sculpture and brick and stone architecture. In Cambodia, the 6th-8th centuries are known as the Pre-Angkor period and historical documents describe the emergence of several competing kingdoms (Stark 2004). By the 7th century the Dvaravati kingdom developed in the Chao Phraya river valley (Indrawooth 2004). In coastal Vietnam around AD 600 there are a series of kingdoms known as Champa (Higham 2002; Southworth 2004). These states had their origin in the Iron Age communities found across Southeast Asia.

Cultural Traditions Framework

As an alternative to the technology-based chronological framework currently used by scholars in Southeast Asia, a framework used by scholars of ancient South Asia (Kenoyer 1991; Shaffer 1992) would allow for a more detailed description of cultural developments in this region. Unfortunately, the limited archaeological evidence in Southeast Asia makes defining this framework complicated. For this reason, I rely on the current chronological framework in this dissertation. However, it is valuable to begin outlining this alternative framework in the hopes that it can be refined with additional research. I will also return to this alternative framework in the final chapter.

In this framework, a cultural *tradition* is identified, which is divided into four *eras*, and from this further sub-divided into *phases*. A tradition is defined as a “persistent configuration of technologies and cultural systems within a context of temporal and geographic continuity” (Shaffer 1992: 442). In the context of the current study, it may be difficult to define a single tradition, as multiple communities and culture groups interacted with one another with power

shifting between regions and cultural groups over time. With future studies, we may wish to identify an Angkorian Tradition, Champa Tradition, or Dvaravati Tradition and use the eras and phases below to outline the long cultural trajectory of these Traditions. However, for the moment I will refrain from assigning the eras and phases below to a specific cultural tradition.

In contrast to traditions, eras and phases are descriptive, “non-evolutionary and do not have set temporal or geographic boundaries,” making them more applicable to the Southeast Asian archaeological record (Law 2008: 97). The first era is the Early Food Producing Era (EFPE). Following Kenoyer, this era is defined by a subsistence economy based on domestic plants and animals by semi-sedentary or sedentary communities. This era would correspond with the Neolithic period in the current chronological framework (Table 2.1).

Following the EFPE is the Regionalization Era, which has been described elsewhere as “a period of cultural development on a regional scale with the emergence of distinctive artifact styles, burial practices, and settlement organization,” (Kenoyer 2000: 90). In Southeast Asia, I argue that the Regionalization Era applies to the Metal Age periods, combining both the Bronze and Iron Ages. Traditionally these two periods have been divided by both differing metal technologies, as well as evidence for contact with South Asia and increasing socio-political complexity during the Iron Age (Higham 2002). However, it is not unprecedented to consider these two periods together. For example, recent research at Ban Non Wat in Northeast Thailand has demonstrated the continuity between both periods and provided evidence for a brief period of social stratification during the Bronze Age (Higham 2011a, 2011b). Researchers in other parts of Southeast Asia have also identified continuities between Bronze and Iron Age communities (e.g. Gutman and Hudson 2004; Moore 2007; Nguyen et al. 2004; Reinecke 2009). By combining the Bronze and Iron Age periods together in a single Regionalization Era, we are able

to better appreciate the connections between these periods as well as acknowledge the different cultural trajectories present in mainland Southeast Asia during this time.

Within eras are phases, which “are defined on the basis of a set of distinctive material culture traits (frequently this is a diagnostic assemblage of ceramics) present in a specific place and time,” (Law 2008: 97-8). Recent work by White and Eyre (2011) has identified 13 ceramic sub-regions in Thailand that could be classified as phases within this chronological framework. It is also acknowledged that chronologies within a site may overlap with phases, eras, and traditions. With further archaeological research and the identification of a variety of regional subcultures and phases, the Regionalization Era should become clearer.

Following the Regionalization Era is the Integration Era, a period defined by increased homogeneity in material culture, as well as economic, socio-political, and ideological integration of previously disparate regions (Kenoyer 1991, 2000). This is followed by the Localization Era, a period in which there is a “breakdown in integration and the reemergence of regional cultures that reflect localized trade networks and stylistic features of material culture,” (Kenoyer 2000: 90). The transition from the Regionalization to Integration Era in mainland Southeast Asia is thus far difficult to determine. As noted in the introduction chapter, some scholars have suggested that the polity of Funan integrated a large region of southern Cambodia and Vietnam as well as possibly portions of the Thai-Malay peninsula. However, archaeological evidence has not yet borne out this hypothesis. On the other hand historical documents dating from the mid-first millennium AD discuss a series of increasingly powerful leaders vying for control of large territories (Stark 2006c). It may be possible that over the period of several centuries, portions of Cambodia may have been integrated for brief periods, followed by periods of localization. It is not until the 9th century AD that a large region of Cambodia, and later portions of Vietnam,

Thailand, and Laos were more clearly integrated under the Angkor Empire. Much archaeological work needs to be done in order to better understand the transition from the Regionalization to Integration Era in Southeast Asia.

While much work still needs to be done to flesh out this alternative chronology. I believe that it provides another framework for understanding cultural and chronological development in mainland Southeast Asia in more depth. With additional research it is expected that we may be able to build on and expand this framework to better incorporate and describe the cultural developments in mainland Southeast Asia. In the following section, I discuss some of the cultural groups present in Southeast Asia during the Iron Age, a period that with additional work might also be described as the Regionalization Era.

The Iron Age Cultures of Mainland Southeast Asia

Numerous Iron Age archaeological cultures have been identified across mainland Southeast Asia (Figure 2.3). As this dissertation focuses on 12 sites from Cambodia and Thailand, an overview of the different cultures is important for both contextualizing the broader cultural groups in which these communities were found as well as identifying the different groups with whom these communities interacted. In this section I will provide a brief background of several different Iron Age cultures and discuss how they may have been interacting with sites discussed in this study, focusing on the glass and stone beads that may have been traded.

The Dongson Culture

The Dongson culture was based in the Red River delta of northern Vietnam. This archaeological culture was first identified at the Dongson site (Figure 2.3, Site 24), excavated by Pajot and Janse in the 1950s, although the Dongson people are also mentioned in Chinese

historical documents, as they were contemporary with Chinese expansion into northern Vietnam (Higham 2002). The earliest Dongson sites date to approximately 600 BC, slightly earlier than Iron Age in other parts of mainland Southeast Asia.

The Dongson is perhaps most famous for its bronze work, especially the large Dongson drums that were widely traded across mainland and island Southeast Asia. Dongson people were also familiar with iron technology, although iron casting techniques may have been introduced to the region by the Chinese (Higham 2002: 169-70).

Since the excavation at the initial Dongson site, there have been at least 70 additional sites found including stone ornament workshop sites, a limited number of settlement sites such as Co Loa (Figure 2.3, Site 25) (Kim et al. 2010), and cemeteries, which are the most numerous (Pham Minh Huyen 2004). Most material culture, including personal ornaments, has come from burial contexts. Unlike some other Iron Age archaeological cultures in mainland Southeast Asia which eventually evolved into states, the Dongson culture is considered to have ended in AD 43, when northern Vietnam came under Han control (Pham Minh Huyen 2004).

Dongson bronze drums have been found at several of the sites in this study: Village 10.8 and Prohear in Cambodia (Figure 2.3, Site 17) and Khao Sam Kaeo in Peninsular Thailand. Although they may not have been directly trading with this region, it suggests that sites in Cambodia and peninsular Thailand were part of a broader Dongson drum interaction sphere (Nitta 2007). The Dongson region is also one of the areas where potash glass beads may have been produced, perhaps low CaO potash glass, although direct evidence is still lacking (Lankton and Dussubieux 2006, 2013). Little work has been done exploring the agate and carnelian beads at Dongson sites.

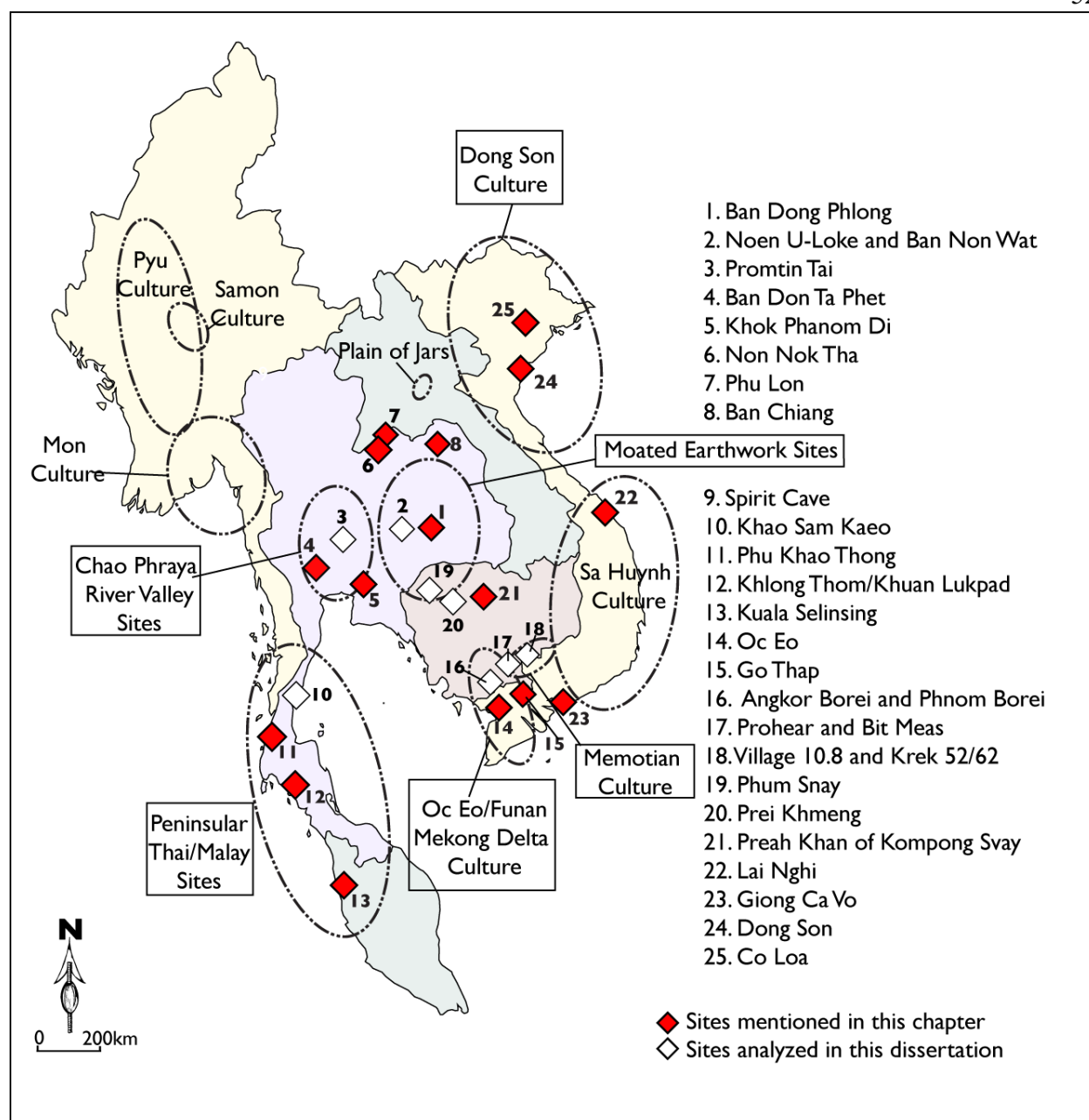


Figure 2.3: Map of Iron Age archaeological cultures and sites mentioned in this chapter.

The Sa Huynh Culture

Sa Huynh culture sites have been found in central coastal Vietnam, dating from approximately 500 BC- AD 100 (Southworth 2004). The Sa Huynh culture is believed to be a precursor to the later Cham kingdoms, although direct links between these two cultures has not yet been identified (Reinecke 2010; Southworth 2004). This culture was first identified by their jar burials, a relatively unique practice in Southeast Asia (Higham 2002). Since the first excavations in the early 20th century, over 60 jar burial sites have been excavated in Vietnam. Among the objects found in these jar burials are distinctive personal ornaments made of glass and stone including a double-headed animal earring and an earring with three protrusions known as a ling ling-o (see Chapter 3). Although rare, these objects were traded across island and mainland Southeast Asia and seem to reflect the long-distance connections Sa Huynh people had with other Southeast Asian communities (Reinecke 2009). During the later phases of these sites, large numbers of glass and stone beads have been found with the burial goods, indicating contact with South Asia. At the site of Lai Nghi (Figure 2.3, Site 22) over 10,000 carnelian, agate, nephrite, and glass beads have been found as burial goods, including one burial with more than three thousand beads made of glass, agate, carnelian, and nephrite, as well as bronze and iron objects. There is also evidence for contact with Chinese communities; one late burial contained Han style bronzes (Reinecke 2009).

Evidence discussed later in this dissertation suggests that sites in Southeast Cambodia may have been interacting with Sa Huynh people in southern Vietnam. Similarities between garnet beads found at Village 10.8, Bit Meas, Prohear, and sites in southern Vietnam suggest a regional trade network in this area. As will be discussed in Chapter 7, there is evidence for possible primary glass production at the Sa Huynh site of Giong Ca Vo (Figure 2.3, Site 23) and

potash glass was widely traded at both Sa Huynh sites and sites in southeast Cambodia. There is also evidence for connections between the site of Khao Sam Kaeo (Figure 2.3, Site 10), an important craft production site in peninsular Thailand considered as part of this dissertation, and Sa Huynh culture sites. Glass ornaments that may have been produced at Khao Sam Kaeo have been identified at Giong Ca Vo (Lankton et al. 2008). Some of the agate and carnelian bead at Khao Sam Kaeo also share similarities with those found at Giong Ca Vo and other Sa Huynh sites (Bellina and Silapanth 2006). In all, the Sa Huynh culture was an important trading partner for several of the communities examined as part of this study.

The Memotian Culture

The Memot culture is the name given to the community that produced a series of circular earthwork sites in the Red Soil region of southern Cambodia and Vietnam. The earthworks were initially identified by the French scholars Louis Malleret (1959b) and B.P. Groliser (1966a, 1966b). Unlike the moated sites found in northeast Thailand (below), the moats and embankments around the Memot earthworks do not appear to be related to water management, although their function is not clear. However, the sites are believed to be settlement and habitation areas of an agricultural community (Dega 2002). Based on the limited material culture found at these sites, these early scholars believed the earthworks dated to the Neolithic period. However, during more recent excavations glass was found in the upper layers, suggesting these sites might extend into the Iron Age period (Haidle and Neumann 2004). Radiocarbon dates and ceramic seriation have produced a dates of occupation from 2300 BC to 300/200 BC. Although the earthworks fall within the Neolithic through Iron Age periods, they do not appear to have used any metals. Unfortunately, the acidic soil is not favorable to bone preservation and so burial data from these sites is lacking.

One carnelian bead from the Memotian culture site of Krek 52/62 (Figure 2.3), Site 18) was included in this study. However, previously studied glass artifacts from Krek suggest connections with sites in Vietnam (Haidle and Neumann 2004) and Khao Sam Kaeo, Thailand (Lankton et al. 2008). Although there is little comparative data with other circular earthwork sites in this region, this preliminary evidence does suggest that these sites were connected to broader regional trade networks.

The Moated sites of Northeast Thailand and northwest Cambodia.

A series of sites enclosed by circular moats or earthworks have also been identified in parts of Northeast Thailand, especially around the Mun and Chi River Valleys, as well parts of northwest Cambodia. As noted above, these moated, circular earthwork sites are believed to be distinct from the Memotian circular earthworks in southern Cambodia. Two moated sites located in the Mun River Valley of Northeast Thailand were included in this study: Ban Non Wat and Noen U-Loke (Figure 2.3, Site 2). While some sites, such as Ban Non Wat, were occupied as early as the Neolithic period (Higham and Kijngam 2010), it appears that there was an expansion of new settlements in the Mun River valley and many sites were not occupied until the Bronze or Iron Ages (Higham 2002, 2004). However, excavations on the moats around several sites indicate they were not constructed until the late Iron Age, several hundred years after many of the sites were initially occupied (McGrath and Boyd 2001). The moats appear to have been constructed in reaction to environmental changes in the region, in order to provide access to a more reliable water supply (Boyd 2007:44). Some scholars have argued that the construction of moats and a demarcation of the landscape may have “affected how the inhabitants saw themselves and their relationships with both neighbouring communities and the wider landscape,”

(Boyd and Chang 2010: 291). The moats appear to reflect a shared response to environmental pressure by the communities in this region.

Previous research on sites in this region has emphasized similarities in their mortuary ritual and material culture, including ceramics and personal ornaments (Higham 2002, 2011b). Furthermore, Prestige goods, primarily found in burial contexts, also appear to tie elites in this region to one another as well as connecting them to broader trade networks. This has led some scholars to compare sites in these regions to the Hopewell Interaction Sphere in the United States (McNeill and Welch 1991; Welch 1989). Previous work on agate and carnelian beads from sites in this region has suggested that there may have been local production of these materials (see Chapter 5)(Theunissen et al. 2000; Theunissen 2003). As will be discussed in Chapter 7, there also appears to have been a unique mixed alkali wrapped glass that was exchanged amongst communities in this area.

The Chao Phraya River Valley/Central Thailand

A large number of moated sites, over 65, have been identified in the Chao Phraya River valley region in Central Thailand, including one site examined in this study: Promptin Tai (Figure 2.3, Site 3). Many sites have both late prehistoric and historic period occupations dating to the Dvaravati kingdoms (mid-first millennium AD) and the Lopburi period (11th century AD) (Vallibhotama 1992; Indrawooth 2004). During the historic period, many of these sites appear to have been important urban centers, and archaeological evidence suggests that during the late first millennium BC there was emerging centralization (Higham 2002:223).

Grave goods found at these sites also highlight the long-distance connections between this region, South Asia and the Sa Huynh and Dongson communities in Vietnam (Glover 1989; Higham 2002). At Ban Don Ta Phet (Figure 2.3, Site 4), an “elite burial enclave” with an

increased number of grave goods including exotic objects from South Asia, points toward emerging socio-political stratification (Higham 2002: 218). This area not only had rich agricultural and mineral resources but also was ideally located at a central point on exchange routes connecting to India on the west, northern Cambodia on the east, and the Gulf of Siam (Higham 2002). Unfortunately, the relationship between long-distance exchange and increasing socio-political complexity, eventually leading to the Dvaravati kingdoms is still poorly understood (Higham 2002). However, recent research suggests that “proto-Dvaravati” sites in Central Thailand, which show signs of Indian influence, linked the Iron Age polities in this region with the later Dvaravati sites (Barram and Glover 2008; Glover 2011).

The Mekong Delta/Oc Eo/Funan Culture

An introduction to Angkor Borei, Oc Eo, and Funan has already been presented in chapter 1 and so I will not repeat this discussion here. However, in this dissertation I include the bead collections from two sites in this region: Angkor Borei and Phnom Borei (Figure 2.3, Site 16). While extensive survey in the area around Angkor Borei has identified a large number of contemporary sites (Stark 2006a), only one other Cambodian Mekong Delta site contemporary with Angkor Borei has been excavated, Phnom Borei. The site of Phnom Borei is located just a few kilometers from Angkor Borei and contained a small number of burials with few grave goods, but similar to those found at Angkor Borei (Phon 2004).

The large amount of material culture uncovered at Oc Eo (Figure 2.3, Site 14), especially stone and glass beads, has provided important comparative material for not only Angkor Borei and the Mekong Delta but archaeologists working at other sites in Southeast Asia (Manguin 2004). Based on the similarities seen between artifacts archaeologists have identified connections between Oc Eo and the Mekong Delta and Khao Sam Kaeo and peninsular Thailand (Bellina and

Silapanth 2006; Lankton et al. 2008), Peninsular Malaysia (Manguin 2004), Northeast Thailand (Theunissen 2003), Central Thailand (Glover 2011), Pyu and Mon sites in Myanmar (Moore 2007), and a broader South China Sea exchange network (Dalsheimer and Manguin 1998; Stark 2006a).

Peninsular Thai-Malay Sites

A series of important Iron Age sites have also been discovered on the Thai-Malay peninsula. Several of the most well known sites, including Khuan Lukpad (also called Khlong Thom) (Figure 2.3, Site 12) and Khao Sam Kaeo in Thailand (Figure 2.3, Site 10) and Kuala Selinsing, Malaysia (Figure 2.3, Site 13), have unfortunately suffered from serious looting, which limits our understanding of these communities. However, remaining evidence points towards the growing importance of trade with South Asia and emerging socio-political complexity related to this interaction. Many of sites were located on both sides of the peninsula in areas ideal for accessing trade and exchange networks, as these communities became a meeting point between South Asia and sites farther east.

Several sites have evidence for long-distance contacts with both South and East Asia. Excavations at Khao Sam Kaeo suggest that South Asian craftsmen have been living at the site producing objects for Southeast Asian elites (Bellina 2001, 2007, Murillo-Barroso et. al 2010). At the nearby site of Phu Khao Thong (Figure 2.3, Site 11) unique glass vessels have been found that were also identified in Han tombs (Lankton et al. 2009). As noted earlier, sites in this region also appear to have been interacting with sites in the Mekong Delta, Sa Huynh sites in Vietnam, as well as sites in central Thailand (Bellina and Glover 2011). This region is believed to have been an important area for craft production of prestige objects. Some of the best evidence for this is found at the site of Khao Sam Kaeo (Bellina 2007, Lankton et. al 2008) but evidence for bead

production is also suspected at Khuan Lukpad (Bronson 1990; Veraprasert 1992), and Kuala Selinsing (Evans 1928, see Chapter 5). It is important to note that communities in the peninsular region were not just traders, consumers, and producers of goods, but also a source for important raw materials including forest products, gold, and tin (Murillo-Barroso et. al 2010; Noonsuk 2005).

Other cultures in Myanmar and Laos

There are several additional cultures in Myanmar and Laos that should be discussed, however there is currently little direct evidence that they were interacting with sites examined as a part of this study. Nevertheless, it is expected that future research may find connections between communities in these areas and communities in Cambodia and Thailand.

In the Samon Valley, south of Mandalay, Myanmar, a series of burial and cemetery sites were identified in the 1980s. These sites are now known as belonging to the Samon culture, which has been dated from 700 BC- AD 400. Unfortunately, many sites have been looted in the search for semi-precious beads, and the relationship between habitation and cemetery sites for this region is not well known. A similarity in bronze artifacts links the Samon culture sites with Dian culture sites in Yunnan, however there are also many unique artifacts as well (Moore 2007: 105-110).

Samon culture sites are especially known for their semi-precious stone beads, and most likely produced large numbers of carnelian and green chalcedony beads (Moore 2007:114). Line-decorated beads known as pumtek are distinctive of the Samon culture, but many of these bead types are also shared with the Pyu culture. The Samon culture's relationship to the Pyu culture is still being debated, with some scholars arguing that it was the "homeland" for the later

Pyu (Hudson 2005) with others noting that sites appear to overlap and be contemporaneous (Moore 2007).

Pyu and Mon culture sites are generally identified as walled, urban sites located in Upper Myanmar (Pyu) and Lower Myanmar (Mon). However it is important to note that these names are not related to specific ethnic or cultural groups. Instead, the archaeologist Elizabeth Moore argues that differences between the two groups were more strongly influenced by the different environmental zones in each part of the country (2007). Both Pyu and Mon sites have been dated to the first Millennium AD (approximately 200-900 AD). Generally the Pyu sites of Upper Myanmar have been better studied, due to a lack of excavation and access to sites in Lower Myanmar. However, both sites in Upper and Lower Myanmar share a use of brick to construct walls, religious, and ritual architecture and Hindu-Buddhist influence.

There are also important distinctions between the two cultures. Burial urns, sometimes containing beads, have been found both inside and outside city walls and other structures at Pyu sites in Upper Myanmar (Moore 2007: 136-139). Mon sites were located in a laterite-rich environmental zone and often used laterite in their construction. Some scholars have argued that there is “little or no evidence of the Mon in Lower Burma much before the eleven century,” (Gutman and Hudson 2004: 165). However, Moore argues that several earlier sites, contemporary with the Pyu, belong to the Mon culture and may have even been a part of the legendary *Suvarnabhumi* or “land of gold” described in Indian texts (Moore 2007; Moore and Win 2007).

The Plain of Jars is located in upland Laos and consists of over 40 of sites with large stone burial jars; with some sites having just a few and the largest up to 250 (Sayavongkhamdy and Bellwood 2000). The jars contained cremated remains along with grave goods, including

bronze jewelry, iron tools and weapons, carnelian and glass beads, and cowry shells. Excavations at a jar site, Phon Savan, have also turned up additional burials in the ground around the stone jars. The excavators currently hypothesize that these may be family members buried in secondary burials around their family member's stone burial jar (Sayavongkhamdy and Bellwood 2000). Little is known about the people who produced these burial urns, however material culture appears to link them with the Khorat Plateau and their mortuary patterns may be related to the Sa Huynh culture (Higham 2002: 183-4).

The 11 cultures and regions described in this section highlight the diversity of cultures present in mainland Southeast Asia during the Iron Age period. As the 12 sites that are part of this study are discussed in depth below and in later chapters, it is important to remember that they were a part of a broader cultural group that was interacting with communities both within and outside of their own cultural groups. I will return to discuss many of these cultural groups and regional areas in later chapters, and especially in the final chapter when I argue for the importance of regional exchange networks during the early Iron Age period.

The archaeological sites considered in this study

Glass and stone bead collections from eight archaeological sites in Cambodia (Figure 2.4) and four archaeological sites in Thailand (Figure 2.5) were examined as a part of this dissertation. Almost 10,000 glass and stone beads were examined (Table 2.2) of which 346 were analyzed using LA-ICP-MS (Table 2.3).

Site Name	Country	Dates	Glass	Agate/ Carnelian	Garnet	Total
Angkor Borei	Cambodia	200 BC – AD 200	1368	12	5	1578
Bit Meas	Cambodia	Contemp. with Proher?	6	2	5	13
Krek 52/62	Cambodia	Approx. 500 BC	0	1	0	1
Phnom Borei	Cambodia	Approx. 200 BC – AD 200	48	2	0	50
Phum Snay	Cambodia	350 BC – AD 200	285	50	0	335
Prei Khmeng	Cambodia	1 st -6 th centuries AD	2056	1	0	2057
Prohear	Cambodia	200 BC – AD 100	550	6	2	558
Village 10.8	Cambodia	400 BC – AD 50	209	53	11	273
Ban NonWat	Thailand	400 BC – AD 500	746	12	0	758
Khao Sam Kaeo	Thailand	4 th – 2 nd Century BC	0	18	0	18
Noen U-Loke	Thailand	400 BC – AD 500	3531	0	0	3531
Promptin Tai	Thailand	500 BC – AD 500	960	43	0	1003
Total			9759	200	23	9982

Table 2.2: List of stone and glass beads recorded at each site. The bead collections at Ban Non Wat and Noen U-Loke were briefly examined but not recorded in as much detail as other sites in this study. The glass bead numbers refer to those that were examined briefly, and the agate/carnelian number refers only to those beads from Ban Non Wat that were analyzed using LA-ICP-MS.

Site Name	Country	Glass	Agate/Carnelian	Garnet	Total
Angkor Borei	Cambodia	15	12	5	32
Bit Meas	Cambodia	5	2	2	9
Krek 52/62	Cambodia	0	1	0	1
Phnom Borei	Cambodia	6	2	0	8
Phum Snay	Cambodia	30	9	0	39
Prei Khmeng	Cambodia	42	1	0	43
Prohear	Cambodia	59	3	2	64
Village 10.8	Cambodia	14	7	4	25
Ban NonWat	Thailand	29	12	0	41
Khao Sam Kaeo	Thailand	0	18	0	18
Noen U-Loke	Thailand	29	0	0	29
Promptin Tai	Thailand	24	13	0	37
Total		253	80	13	346

Table 2.3: Number of stone and glass beads from each site that were analyzed using LA-ICP-MS.



Figure 2.4: Iron Age sites in Cambodia. Those included in this study are marked in red.



Figure 2.5: Sites in Thailand examined as a part of this study.

The eight Cambodian sites in this study make up the most comprehensive examination of Cambodian Iron Age sites thus far undertaken; all eight sites were excavated in the last 20 years. While archaeological research began in Cambodia under French colonial rule during the period of the French Protectorate (1863-1953), only a handful of prehistoric sites were examined, as the

primary focus of research was on Angkorian period temples (Stark 2004: 91). While some Iron Age sites were noted in systematic surveys, the focus of archaeological excavation during this early period was primarily on Neolithic and Bronze Age sites. Archaeological research in Cambodia ceased during the Khmer Rouge period, with only three Cambodian archaeologists in Cambodia surviving the bloodshed (Griffin et al. 1999). The Iron Age sites examined in this dissertation were all excavated in the last twenty years as part of largely international collaborative projects (see Carter et al. 2013). To the best of my knowledge, only three Cambodian Iron Age sites were not included in this study. I was unable to contact the primary investigator of Krosaing Thmei (Figure 2.4), a small site just a few kilometers from the site of Phum Snay (discussed below). However, I was able to obtain an excavation report on the site, which included photographs of the artifacts including stone and glass beads for comparison (Sok Keo 2005). Recently two new projects at the site of Phum Sophy (Figure 2.4), also located near Phum Snay, and Lovea, Siem Reap province (Figure 2.4), have been undertaken. I have been able to examine the bead collections from these sites, however there was not enough time to include these data in my dissertation.

As with Cambodia and other regions of Southeast Asia, early archaeological research in Thailand was largely concerned with documenting architecture and recording art history. Early scholars were aware of prehistoric sites across Thailand; the moated sites of central and Northeast Thailand were first recognized in aerial photographs in the mid 20th century (Williams-Hunt 1950). However, it was not until the 1960s that foreign archaeologists, influenced by the “New Archaeology” movement, began systematically excavating prehistoric sites (Glover 1993; Higham 1989). As Ian Glover notes, “until about 1980 most sustained work in Thai prehistory was carried out by overseas researchers and was published in English, usually in international

journals or monographs published overseas,” (1993: 47). Despite this, many Thai archaeologists were trained as a part of these projects and they continued to study and teach archaeology, primarily at Silpakorn University in Bangkok, lead their own excavations, and collaborate with Western researchers. Currently there are hundreds of known Iron Age sites in Thailand and dozens that have been excavated and studied (see Higham 2002; Higham and Thosarat 2012). Unlike Cambodia, archaeological research has been practiced in Thailand continuously and was not dramatically affected by the political conflicts in Southeast Asia during the 1960s and 1970s. The sites included in the current project were all excavated in the last fifteen years (Figure 2.5).

Angkor Borei, Cambodia

Angkor Borei is a walled and moated site measuring over 300 hectares and believed to be the capital of an ancient civilization known to the Chinese as Funan (see discussion in Chapter 1) (Stark 1998). Located in the Mekong Delta, in the province of Takeo, Angkor Borei was well known to early French researchers, however serious archaeological research at Angkor Borei was not undertaken until 1995 by the Lower Mekong Archaeological Project (Griffin et al. 1996; Stark 1998, 2001, 2006a; 2006b; Stark et al. 1999; Stark et al. 2006). Over the course of multiple field seasons several features were excavated or cleared, a 16m trench was dug to examine a portion of the brick wall around the site, three 1x2m units were dug in order to better understand the stratigraphy and a large 2x3m unit was opened to examine a portion of a cemetery (Stark et al. 1999; Stark 2001). A coring program was also undertaken in order to better understand the construction and dating of the canals and paleoenvironment (Bishop et al. 2003, 2004; Sanderson et al. 2003, 2007).

The glass and stone beads from Angkor Borei came entirely from the cemetery excavations, called the Vat Komnou cemetery as they were excavated on the grounds of the local

Buddhist temple called Vat Komnou. Over 1500, beads were recovered primarily from the cemetery matrix with a small proportion of these beads found in burial contexts. Compositional analysis was previously performed on 97 glass beads as part of Laure Dussubieux's doctoral dissertation (Dussubieux 2001). Additionally, a small number of carnelian beads were studied by Robert Theunissen, but not published (Robert Theunissen, personal communication 2010). As part of this dissertation I performed compositional analysis on an additional 15 glass beads that appeared to be unusual or distinct from the types analyzed previously by Dussubieux. Additionally I analyzed the entire collection of stone beads from the site: five garnet beads and 12 agate and carnelian beads.

Phnom Borei, Cambodia

Phnom Borei is a small site located about five kilometers south of Angkor Borei and may have been related to the larger Angkor Borei settlement (Miriam Stark, personal communication 2010). A Cambodian archaeologist, Kaseka Phon, led a survey and excavation of a small 2x4m trench plus a 140x120cm extension, which uncovered nine burials, numerous pottery fragments, iron slag, bronze fragments, animal bones and beads. Ceramics at the site are quite similar to those found at Angkor Borei and radiocarbon dates place Phnom Borei in the last few centuries BC (Phon 2004). A total of 48 glass beads and two stone beads were found during excavations and recorded as part of this study. Both stone beads and six glass beads that represented the range of glass beads found at the site were selected for analysis.

Prohear, Cambodia

The site of Prohear is located in Prey Veng province in southeastern Cambodia. The site is approximately 85 km northeast from Angkor Borei, but still in the Mekong Delta flood plain. In early 2007 villagers found ancient artifacts and began looting the site. Several Cambodian

archaeologists discovered the looting and tried to stop it, but it was not until 2008 that salvage excavations could take place. A joint German-Cambodian team excavated 116.4 square meters in one of the few places that had not yet been destroyed by looting: the main road. From these small excavations 52 burials were uncovered, although only 32 contained human remains (Krais 2010). Additional excavations have increased the total number of burials to 76, however only materials from the initial 52 burials were considered from this site. Included in these burials was an impressive array of grave goods including pottery, approximately 2700 stone and glass beads, and gold, silver, bronze and iron artifacts (Reinecke et al 2009). The cemetery has been dated from 200 BC to AD 100 (Reinecke et al. 2009:100).

Glass beads were common artifacts; of the 52 burials at the site only six partially disturbed burials did not have glass beads (Reinecke et al 2009:118). As part of the current study 550 glass beads held at the Memot Centre for Archaeology were recorded, this represented only apportion of the total number of glass beads found. Of these, 59 glass beads and artifacts including rings, earrings, and bangle fragments were selected for further LA-ICP-MS analysis. There were smaller amounts of agate, carnelian, and garnet beads found at Prohear. Only six carnelian/agate beads and two garnet beads were recorded, although 200 additional garnet beads and many more agate/carnelian beads were reported from later excavations (Andreas Reinecke, personal communication, 2011) and numerous stone beads were found by looters prior to excavation (Reinecke et al. 2009). From this collection, three agate/carnelian beads and both garnet beads were brought to the US for analysis. Based on published descriptions of the additional materials found at the site, I believe the portion of the glass and stone bead collection I recorded and analyzed represented the broad range of beads found at Prohear.

Bit Meas, Cambodia

Bit Meas is a cemetery site located in a small village located eight kilometers southwest of Prohear in the Mekong Delta flood plain. Unfortunately it was almost completely looted by villagers in 2006. The Royal University of Fine Arts undertook a small salvage excavation and recovered few artifacts, but no additional burials were found (Reinecke et al 2009:19-21).

Cambodian archaeologists also collected several glass and stone beads from the site. Thirteen beads were recorded and five glass beads, two garnet beads, one agate bead, and one carnelian bead were brought to the United States for LA-ICP-MS analysis. Based on some of the reported finds, including Dongson drums and gold jewelry, as well as the artifact similarity with Prohear, archaeologists believe this site dates to the Iron Age (Reinecke et al. 2009).

Village 10.8, Cambodia

Village 10.8 is a cemetery site located in the red soil region of Cambodia, Kampong Cham province. This is an upland region of Cambodia, approximately 100m above sea level.

Village 10.8 is located in a valley in between two streams (Heng 2005). The site was first identified in 2000, and several excavation campaigns in 2001, 2002, and 2004-6 were undertaken by a joint German- Cambodian archaeological team, including the Memot Centre for Archaeology (Heng 2004, 2005). A total of 63 square meters in five locations have been excavated (Heng 2005). Decorations on a Dongson drum found at the site are similar to other designs from the 3rd-1st centuries BC and radiocarbon dates range from 400 BC to AD 50 (Heng 2005). More than 40 burials have been uncovered and 209 glass beads and 64 stone beads held in the collections at the Memot Centre for Archaeology in Phnom Penh were recorded for this study. Eleven of these beads were garnet, eight were agate, and 45 were carnelian. Fourteen glass beads, four garnet beads, and seven agate/carnelian artifacts were selected for compositional analysis.

The objects were selected for compositional analysis as they reflected the diversity of bead types found at the site.

Krek 52/62, Cambodia

Krek is a circular earthwork site located in Kampong Cham province, belonging to the Memotian culture. The site was excavated in 1996 as part of a joint German-Cambodian archaeological project, which excavated over 57 square meters (Albrecht et al. 2001). However, it was within the 9 square meters of Unit II, which sectioned the inner wall and ditch of the earthwork, that a few glass beads and bangle fragments were identified as part of these excavations. Compositional analysis was performed on the glass artifacts by Miriam Haidle and Udo Neumann (2004; Haidle 2001). A garnet bead was also reportedly found at this site (Albrecht et. al 2001; Haidle 2001). While at the Memot Centre in 2008, a single carnelian bead from Krek 52/62 was also located amongst the collections from Village 10.8 and this is the only bead from this site included in the study, however published data on the other materials will be referenced. Dating of earthwork sites has been difficult due to the acidic nature of the soil and the poor preservation of organic remains that could be used in dating. The presence of glass in the upper layers indicates that this portion of the site dates from at least 500 BC.

Prei Khmeng, Cambodia

The site of Prei Khmeng is located in the Angkor plain, just outside of the Tonle Sap Lake flood zone and near the Khmer capital from the 9th to 15th centuries AD. The site is home to a small pre-Angkorian brick tower and lintel, one of the oldest in the Angkor area. Three excavations by the MAFKATA mission (EFEO and Apsara Authority) led by Dr. Christophe Pottier uncovered several prehistoric burials and an occupation area that dates from the 1st-6th centuries AD (Christophe Pottier, personal communication, 2009; Zoppi et al. 2004). A total of

almost 115 square meters was excavated, however the beads came from Units 15/16 (a 5.8x1m trench with a 1.7x1m extension) and Unit 21 (3x3m). Interestingly, nearly all of the beads from this site are glass (n=2056) and it had the highest number of glass beads found at any site in the study, with one burial having over 1700 beads. Of the over 2000 beads recorded from burial contexts, 42 glass beads and artifacts from four different burials were analyzed using LA-ICP-MS in order to reflect the diversity of glass bead types found at this site. A single carnelian bead found in a burial was not examined as it was on display in a museum exhibit. However a small agate manuport was recorded and brought to the US for geochemical analysis.

Phum Snay, Cambodia

Phum Snay is a cemetery site located in a village on the edge of a natural mound and near a small tributary to the Tonle Sap Lake in Banteay Meanchey province in northwest Cambodia. The site was discovered during road construction in 2000 and subsequently looted. Salvage excavations were undertaken in 2001 (5x5m unit) and 2003 (100 square meters excavated), which uncovered numerous burials and grave goods radiocarbon dated to 350 BC- AD 200 (Domett and O'Reilly 2009; O'Reilly and Pheng 2001; O'Reilly et al. 2004; O'Reilly 2004). Phum Snay is perhaps the best-studied Iron Age site in Cambodia and several scholars have examined beads from this site (Gratuze 2005; Lapeteff 2006, 2007, 2009; Sophy 2008; Vanna 2007). Recently, additional excavations have been undertaken by a joint Japanese-Khmer archaeological team (Yasuda et al 2008; Yasuda 2009). Only beads from the 2001 and 2003 excavation collections were analyzed as a part of this study. 285 glass beads, 16 agate, and 34 carnelian beads were recorded. A small number of glass beads from these excavations were not available for study as another researcher was examining them. From this group 30 glass artifacts

and nine agate/carnelian beads were selected for further analysis using LA- ICP-MS in order to reflect the different glass and stone beads types found at the site.

Noen U-Loke, Thailand

Noen U-Loke is a circular moated earthwork site located in the Mun River Valley in the Khorat Plateau, Nakhon Ratchasima province, Northeast Thailand. Circular, moated earthwork sites are well known in this region and Noen U-Loke is notable for its multiple moats. The site was initially excavated by a Thai archaeologist who found numerous Iron Age burials with unique grave goods (Higham et al. 2007). Drs. Charles Higham and Rachanie Thosarat led a new excavation campaign over two field seasons (1996-1998), excavating an area of 220 square meters. They found a light Bronze Age deposit and thick Iron Age deposit with five mortuary phases. The numerous agate and carnelian beads from these mortuary contexts have already the focus of previous studies by Robert Theunissen (Theunissen et. al 2000; Theunissen 1997; 1998; 2003; 2007). In addition to the agate and carnelian beads, over 7000 glass beads and artifacts were uncovered from Noen U-Loke (Talbot 2007). Compositional analysis on approximately 50 glass beads and objects were undertaken by Saitowitz and Reid (2001). While their report was admirable, Saitowitz and Reid did not provide a context for the beads they analyzed.

Furthermore, compositional analysis of glass artifacts has greatly improved since their initial report, therefore I analyzed an additional 29 glass beads from both burial and non-burial contexts using LA-ICP-MS. In 2010 I also recorded the entire available collection of glass beads and objects from the 1996-1998 excavations, which are now stored at the Phimai National Museum (n=3531). This allowed me to observe some of the glass artifacts that were not described in detail in the Noen U-Loke excavation volume. Although not all of the objects were available for study, this provided a more balanced view of the entire glass collection from Noen U-Loke and

allowed me to make broader hypotheses about the character of the entire glass bead collection from Noen U-Loke.

Ban Non Wat, Thailand

Ban Non Wat is a circular moated earthwork site located just 2 kilometers northeast of Noen U-Loke. 878 square meters were excavated by the Origins of Angkor project directed by Drs. Charles Higham and Rachanie Thosarat from 2000-2008. Ban Non Wat contains both occupation and burial contexts dating from the Neolithic through late Iron Age/Early Historic periods. The extensive excavations have produced a large number of radiocarbon dates, making Ban Non Wat one of the best-dated sites in Southeast Asia (Higham and Higham 2009). Ban Non Wat is also notable for its large number of over 700 burials, which are the focus of several ongoing studies. In 2010 all available glass (n=746) and some of the stone beads from Ban Non Wat were briefly recorded in order to make comparisons within the collection. Twenty-nine glass beads and artifacts and 12 agate and carnelian beads were brought to the US to be analyzed as part of this study. The artifacts came from multiple burial and non-burial contexts from Iron Age layers across the site and were chosen as they characterized the diversity of different bead types found at the site.

Promptin Tai, Thailand

Promptin Tai is an Iron Age- Early Historic period site located in the undulating terrain of Lopburi province, central Thailand (Lertcharnrit 2006). This region lies in the eastern Chao Phraya River Valley and close to the prehistoric copper mining sites of the Khao Wan Prachan Valley. This region contains a variety of environmental zones, from terraces to plains to swamps, and soil types, which has resulted in a diversity of land use practices and cultivation (Eyre 2011). Promptin Tai was initially excavated in 1991 by the Thai Fine Arts Department who focused on

the on a later Ayutthaya period structure (14th- 17th century AD) (Lertcharnrit 2006). However, Iron Age burials and artifacts were also found during this project and so additional excavations were planned by Silpakorn University, led by Dr. Thanik Lertcharnrit in 2004. Since 2004 there have been several field seasons at this site. As part of the current study, approximately 1000 glass and stone artifacts from burials uncovered in the 2007 field season were photographed and recorded. Although there are not yet radiocarbon dates for this site, the beads provided for study were from the lower layers of the site believed to belong to the Iron Age period (Thanik Lertcharnrit, personal communication 2008). Twenty-four glass artifacts and 13 agate and carnelian beads largely from burial contexts were analyzed using LA-ICP-MS. Beads were chosen to reflect the diverse stone and glass bead types found at Promptin Tai.

Khao Sam Kaeo, Thailand

Khao Sam Kaeo is an Iron Age archaeological site located on the Kra Isthmus in the Thai-Malay peninsula. The Kra Isthmus is the narrowest point in the peninsula and was strategically located along an overland route between the Bay of Bengal and the Gulf of Siam (Bellina and Silapanth 2008). The site itself is on four hills along the banks of the Tha Thapao River. Khao Sam Kaeo has been heavily looted, however excavations totaling 324 square meters by a Thai-French archaeological team from 2002-2005 have turned up evidence for metallurgy as well as waste material from the manufacture of both stone beads and glass objects (Bellina and Silapanth 2008). The presence of stone waste material and unfinished agate and carnelian beads has led researchers to hypothesize that there were South Asian craftsmen living and working at the site (Bellina 2007, 2001; Glover and Bellina 2011). Additionally, analysis of the glass artifacts from the site may indicate some connections with northern India, although this is still under debate (see Lankton et. al 2008). Unfortunately, artifacts from the recent excavations

have been acquisitioned by the local museum, making them unavailable for study. However, a Thai bead collector, Dr. Bunchar Pongpanich, obtained many beads and artifacts from the local villagers, which currently belong to the Suthiratana Foundation. Dr. Berenice Bellina brought several of these artifacts to the site of Khao Sam Kaeo and had villagers identify the locations from where the beads came, providing some context for a few of these materials. The locations largely appear to be occupation or manufacturing areas. Eighteen of these agate and carnelian beads, some of which were unfinished brought to the US for LA-ICP-MS analysis. These beads were selected by Bellina from the Suthiratana Foundation collection as they represented some of the different finished and unfinished types from the site, but were not among the more valuable objects in the collection.

Conclusion

In this chapter I have provided a background to the Southeast Asia, including the environmental zones and important natural resources used in trade. This was followed by a discussion of the chronological framework and an introduction to the different cultural groups present in Iron Age Southeast in which sites in this study were members or with whom they interacted. These data are summarized in Table 2.4. Several sites, such as the sites in southeast Cambodia, Phum Snay and Prei Khmeng have not yet been assigned to a specific regional culture group, however in the final chapter I discuss possible cultural groups they may belong to or were interacting with in more detail.

This study is the most comprehensive analysis of Iron Age sites in Cambodia thus far undertaken. In contrast, the four Thai sites were included opportunistically and while they are not a representative sample of all Thai Iron Age sites these four sites contained important stone and glass bead collections that allowed me to test the extent of the Mekong Delta's influence in the

long-distance trade of stone and glass beads as well as providing evidence for the influence of other stone and glass bead trade networks outside of the Mekong Delta. Khao Sam Kaeo in peninsular Thailand was already known for being an important trading center and bead production center. By examining the stone beads from this site, I am specifically testing questions regarding stone sources used in the local production of beads and how and where these finished products may have been traded. Promptin Tai, in central Thailand, was included as later mid-first millennium AD archaeological evidence suggests interaction between communities in this area and those in the Mekong Delta (Indrawooth 2004). An examination of glass and stone beads from Promptin Tai allows for a study of the time depth of these interaction networks and an examination of the role other overland trade networks from the west may have played at this site. In Northeast Thailand, Ban Non Wat and Noen U-Loke also have evidence for interaction with the Mekong Delta that I wanted to explore further. Additionally, these sites have undergone intensive and careful excavations with carefully seriated burials that span the entire Iron Age. This unique dataset provides for a more careful consideration of the changing trade networks over time. Combined with previously published data on other Thai Iron Age sites, these dataset provides a comprehensive analysis of Iron Age stone and glass bead trade networks

Site Name	Dates	Location	Cultural Group	Notes
Angkor Borei, Cambodia	200 BC- AD 200 (Vat Komnou cemetery)	Mekong Delta Flood Plain	Mekong Delta/Funan	
Phnom Borei, Cambodia	Approx. 200 BC – 0 AD	Mekong Delta Flood Plain	Mekong Delta/Funan	
Prohear, Cambodia	200 BC – AD 200	Mekong Delta Flood Plain		Southeast Cambodia group
Bit Meas, Cambodia	Contemporary with Prohear?	Mekong Delta Flood Plain		Southeast Cambodia group
Village 10.8, Cambodia	400 BC – AD 50	Red soil region Upland region		Southeast Cambodia group
Krek 52/62	Approx. 500 BC	Red soil region		Southeast Cambodia group
Prei Khmeng, Cambodia	1 st -6 th centuries AD	Angkor plain, just outside of Tonle Sap flood zone		See Chapter 9 for more on cultural group
Phum Snay, Cambodia	350 BC – AD 200	Natural hill near tributary to Tonle Sap Lake		Possible connection with Mun/Chi moated sites
Noen U-Loke, Thailand	400 BC – AD 500	Khorat Plateau/Mun River Valley	Moated sites in Mun/Chi River Valleys	
Ban NonWat, Thailand	400 BC – AD 500	Khorat Plateau/Mun River Valley	Moated sites in Mun/Chi River Valleys	
Promptin Tai, Thailand	500 BC – 500 AD	Undulating terrain of the east Chau Phraya River Valley	Chao Phraya/Central Thailand	
Khao Sam Kaeo, Thailand	4 th – 2 nd century BC	Hills in inner portion of Thai/Malay peninsula (Kra Isthmus)	Thai/Malay Peninsula	

Table 2.4: Summary of the sites in this study, their dates, locations, and culture groups to which they belong.

At each site, I aimed to examine as many stone and glass beads as possible. At six of the 12 sites (Angkor Borei, Phnom Borei, Village 10.8, Prei Khmeng, Phum Snay, and Promtin Tai) I was able to record in detail the entire excavated collection of stone and glass beads. The entire collection of stone and glass beads from Prohear was not available for study, however I was able to examine a large number of materials from this site and have supplemented my analyses with published data and discussions with the excavators. I believe my conclusions about the stone and glass beads from Prohear do reflect the overall bead collection excavated from this site. Bit Meas was heavily looted and so the beads from this site are not believed to represent what might have been found had the site not been destroyed. Nevertheless, I believe the few beads analyzed give a preliminary understanding as to how the beads from Bit Meas fit into broader bead exchange patterns. Khao Sam Kaeo was also heavily looted and although I was able to see and photograph many beads from this site, the stone beads analyzed in this study likely only represent a small fraction of the bead types and diversity found at this site. Only one stone bead was analyzed from Krek 52/62 making it difficult to make conclusions about the stone beads at this site. However I also relied on published data on the glass artifacts in order to fit this site into broader patterns of stone and glass bead exchange. Stone and glass beads from Ban Non Wat were not recorded in as much depth as other sites in the study due to time limitations, however I was able to examine the entire collection from this site. Stone beads were not examined from Noen U-Loke as they had been previously studied by another researcher (Theunissen 2003) and Charles Higham initially chose the glass beads that underwent compositional analysis. However, I was able to examine most of the remaining glass bead collection held in the Phimai National Museum, and from that gained a better understanding of the overall glass bead collection at the site. At all sites, the stone and glass beads selected for LA-ICP-MS analyses were chosen to reflect the

diversity of bead types found at a particular site (discussed further in Chapters 6-8). As archaeologists were always dealing with an incomplete record, nevertheless I made every effort to undertake as comprehensive analyses on the stone and glass bead collections as possible and I believe the conclusions drawn in this study are representative of these collections.

This study is not a complete examination of Iron Age trade networks and there are several gaps that still need to be filled. Myanmar was likely an important crossroads for stone and glass beads from India as well as a likely source of agate and carnelian beads. While there have been some preliminary studies on these material for Myanmar (e.g. Cambell Cole 2003; Moore and Tan 2008) it is not yet clear how widespread these artifacts were traded. Additionally, archaeological research on Iron Age sites in Laos is in its infancy and little is known about beads found at sites in this adjacent region. Lastly, while there has been extensive archaeological research on Iron Age sites in Vietnam, there have been few studies published in English and Vietnamese publications often lack adequate photographs of the stone and glass beads found at these sites. While some compositional research has been done on glass beads in Vietnam (Brabander 2008), additional research is needed on many of the important coastal trading and possible bead production sites. However, I believe that my current dissertation research provides a strong foundation for future studies that will eventually include these data from other regions. In the next chapter, I shift my focus to discussing trade, exchange, and interaction networks in Southeast Asia and how these changing networks may have facilitated the emergence of complexity and early states.

Chapter 3: The Emergence of Complexity in Southeast Asia and the Role of Trade and Exchange

The role of trade has been central to theories regarding the emergence of socio-political complexity in Southeast Asia. This chapter provides a review of these theories, beginning with a discussion of the prestige goods exchange networks of the late Bronze and early Iron Age periods, dating to approximately 600 BC. During this period, objects such as nephrite ear ornaments were traded in a widespread network that appears to have connected elites across a broad area. These networks are important as they demonstrate emerging hierarchies and the presence of advanced craft production technology in certain regions of Southeast Asia. Evidence presented later in this dissertation demonstrates that during the early Iron Age glass and stone beads were entering into these preexisting exchange networks. This discussion is followed by a review of recent work by Bellina and Glover (2004) showing evidence for two phases of trade with South Asia during the Iron Age. Stone and glass bead data presented in later chapters provides additional evidence for these changing trade networks, and this process in turn has implications for the emergence of socio-political complexity in the Mekong Delta.

Following this review, I examine how previous scholars, both historical and archaeological, have described the processes of emerging complexity in Southeast Asia and the role that long-distance trade, specifically with South Asia, had in this process. Evidence for emerging complexity in regions of Southeast Asia that did not have direct contact with South Asia is also discussed. Lastly, I focus on the role that beads played within these interaction networks and how the current study builds and expands on earlier research.

Exchange in Southeast Asia prior to the Iron Age

Southeast Asian people were participating in widespread exchange networks long before contact with South Asia. The presence of specific archaeological artifacts at sites across island and mainland Southeast Asia suggests widespread interaction between these regions for several thousand years. During the Upper Paleolithic period (30,000-20,000 BP) stone artifacts, classified as Hoabinhian type or Hoabinhian culture, were widespread across Southeast Asia until approximately 5000 BP. Hoabinhian artifacts have been found as far as Australia from approximately 15,000 BP (Bowdler 2006). While scholars acknowledge Hoabinhian artifacts were locally made, some scholars have suggested that the widespread distribution of Hoabinhian artifacts across Southeast Asia and Australia could be evidence for an early “chain of connection, through which ideas and ideologies circulated along with other, probably perishable, material goods,” (Bowdler 2006: 357). By 1500-1000 BC Southeast Asian people were regularly traveling great distances across the open ocean and beginning to populate the remote Polynesian islands (Bellwood 2004).

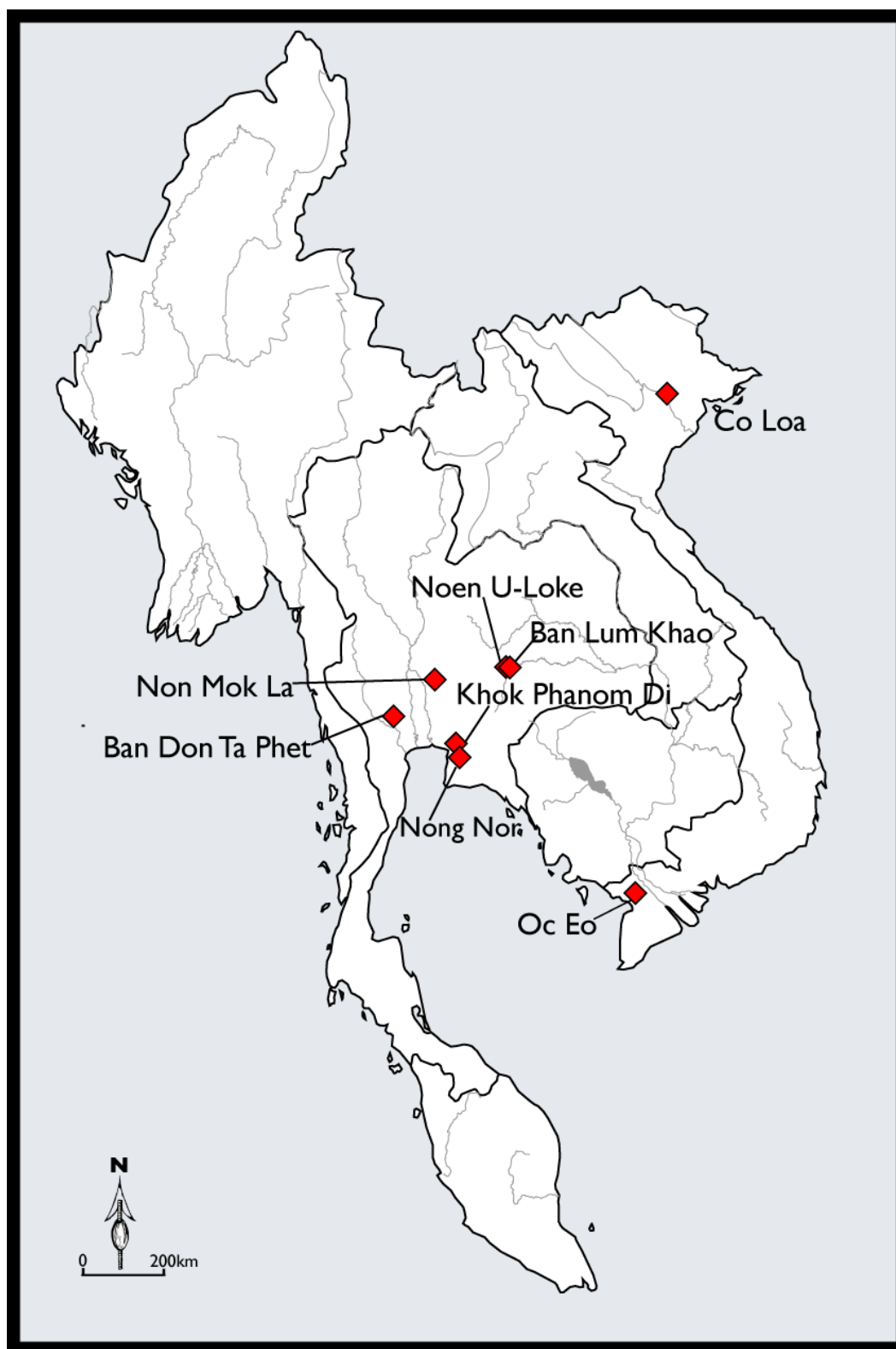


Figure 3.1: Map of sites discussed in this chapter

Regional interaction networks within mainland Southeast Asia continued during the Neolithic (2500-1500/1000 BC) and Bronze Age (1500/1000-500 BC) periods, especially in the trade and exchange of prestige goods and personal ornaments. Shell was an important early trade item. The site of Khok Phanom Di, Thailand, which dates to from 2000-1500 BC, marks the transition from hunter-gatherers to early Neolithic farming communities. Shell objects, especially beads, were found in large numbers in many burials, and one exceptional burial had over 120,000 shell disc beads interred with the dead (Higham and Thosarat 1994). However the *Conus* and *Tridacna* shell from which they were made most likely traded-in from the Thai peninsula (Chang 2001; Pilditch 1993). During the Bronze Age period, marine shell objects, especially bangles, were popular at inland sites in Northeast Thailand. Some items such as *Trochus* shell bangles may have been transported via down-the-line exchange from the Mekong Delta, up the Mekong River, and to Northeast Thailand via the Mun River (Chang 2001:121). However, not all sites had access to this trade network, as the coastal sites of Khok Phanom Di and the nearby coastal site of Nong Nor had no *Trochus* shell bangles. This difference may be evidence of “separate marine catchments being exploited by the Central and Northeast Thai communities,” (Chang 2001: 86). This evidence suggests that distinct regional interaction networks were already in play by the Bronze Age period.



Figure 3.2: Example of a T-section bangle excavated at Ban Non Wat in February 2007.

The distribution of certain bangle styles also indicates the widespread knowledge and popularity of a type of personal ornament. Numerous T-section bangles, made from a variety of materials, including glass, stone, and bronze, have been found at Bronze Age sites across mainland Southeast Asia, and may have originated in China (Figure 3.2)(Chang 2001). T-section bangles made from clay have been found at Non Mak La and Ban Lum Khao, Thailand (Chang and Voelker 2003). At Nong Nor, stone T-section bangles were made from serpentine, marble, and talc (Chang 2001). The serpentine bangles may have been imported from northern Vietnam, as a nephrite bangle workshop has been discovered there (Chang 2001: 89; Nguyen 1996). These bangles indicate the broad connections and communication networks between regions across East and Southeast Asia. During the next phase, exchange patterns continued to connect broad regions of Southeast Asia, however the introduction of more elaborate prestige goods appears to connect *elites* in different communities to one another.

Prestige good trade in Southeast Asia in the late Bronze and early Iron Age periods

During the late Bronze and early Iron Age periods we see the emergence of several types of prestige good objects that connect communities and groups of elites across mainland and insular Southeast Asia. These trade networks roughly coincided with early, but not yet intensive, contact with South Asia and especially connected coastal sites bordering the South China Sea. Objects in these trade networks traveled over great distances, likely through a series of “interconnected local networks,” as opposed to direct long-distance exchange between coastal polities (Manguin 2004: 283). I argue that during the early Iron Age, glass and stone beads entered into these same prestige goods exchange networks. In this section, I discuss one example of a type of prestige object traded during this period: nephrite ear ornaments. This discussion highlights the nature of early coastal exchange networks that connected coastal sites in mainland

and island Southeast Asia and provides a foundation for understanding the early exchange of stone and glass beads from South Asia.

Nephrite ear ornaments

As archaeological research in Southeast Asia expanded, scholars began to notice the widespread distribution of several types of nephrite ear ornaments: the lingling-o and the double-headed or bi-cephalous earring (Loofs-Wissowa 1982; Solheim 1984). While most lingling-o and bi-cephalous earrings were made from nephrite, there have also been examples found made from glass, carnelian, and clay (Loofs-Wissowa 1982; Reinecke 1996). The lingling-o earring is a round shape with three protrusions, two on the side and one on the bottom, and a slit on the top to place in the ear (Figure 3.3). The lingling-o in particular has been described as “the most widespread form of jade ornament in Southeast Asia,” (Hung et al. 2007). The bi-cephalous earrings are H-shaped, with the animal heads on each end of the earring and a long stem in the center used to place in the ear (Figure 3.4). Scholars have noted that despite being found across Southeast Asia, the earrings appear to be fairly standardized in their size, style, and manufacturing methods (Hung and Bellwood 2010).

Both ornament types have been found at sites across the South China Sea, especially in Vietnam and the Philippines. Some nephrite ornaments have been found as far inland as Samrong Sen, Cambodia (Loofs-Wissowa 1982). Scholars have suggested that these earrings were important prestige objects for Southeast Asian communities, especially due to their relative rarity (Bellina 2007). Reinecke notes that bi-cephalous ear ornaments have been found with rich burials at sites in Vietnam, indicating, “earrings were worn by men who held outstanding positions or performed special activities (1996: 8). The ear ornaments are most commonly found in jar burials in Sa Huynh cultural contexts (Reinecke 1996; Southworth 2004). As discussed in

the previous chapter, the Sa Huynh culture is primarily known from jar burial sites found on the coasts of central and southern Vietnam from approximately 500 BC- AD 100 (Southworth 2004). The similarities between the nephrite objects found in Vietnam and the Philippines reinforced connections first identified based on similar pottery assemblages that Solheim called the Sa-Huynh-Kalanay pottery tradition (1964). Similar pottery and nephrite ear ornaments have also been reported in Indonesia, and peninsular Thailand (Hung and Bellwood 2010). The Sa Huynh people appear to have been extremely active in maritime trade across the South China Sea network.



Figure 3.3: Example of lingling-o ear ornaments. Image courtesy of Andreas Reinecke.

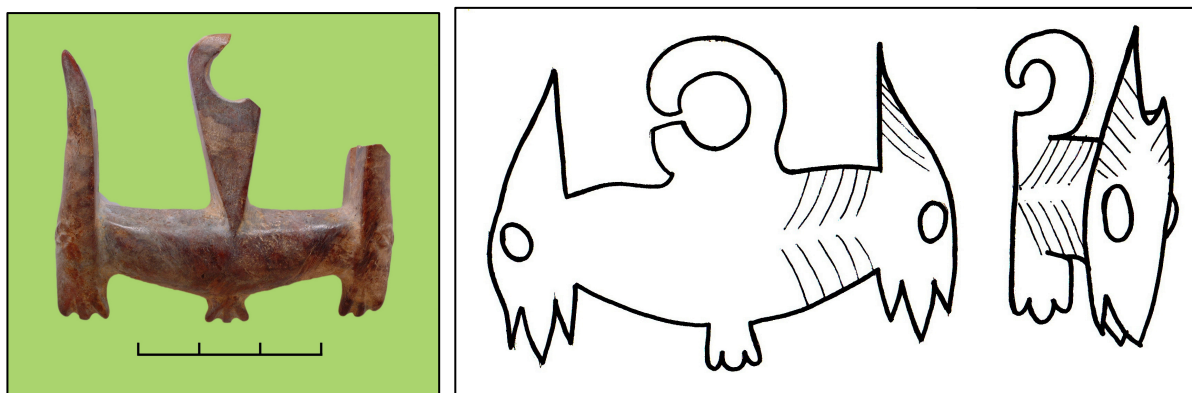


Figure 3.4: Example of a bi-cephalous double animal headed ear ornament, scale in cm. Image on the left courtesy of Andreas Reinecke. Drawing on the right of a similar pendant from Hung and Bellwood 2010:234. Drawing by P. Madavi.

Recent compositional studies have indicated that most of the raw materials for these objects were coming from Taiwan, specifically from the Fengtian nephrite source (Hung et al. 2007). In fact, a recent study by Hsia-Chun Hung and others (2007) suggested that nephrite artifacts were traded between Taiwan and the Philippines as far back as the Neolithic period (approximately 3000 BC). It is interesting to note that there is no evidence for the manufacture of these items in Taiwan, leading the researchers to suggest raw material blanks were exported to regions “where artisans manufactured artifacts to local taste,” (Hung et al. 2007: 19746). While other local nephrite sources in Vietnam and the Philippines may have been used to make similar objects, the overwhelming majority appears to derive from this Taiwanese source.

Craft production workshops for the nephrite ear ornaments have been found on islands off the coast of Taiwan, the Philippines, Vietnam, and possibly peninsular Thailand (Hung et al. 2007: 19749). It appears that blanks were being exported from the nephrite source in Taiwan to these manufacturing centers. Hung and others (2007: 19749) have proposed that these earrings were being produced by “itinerant jade craftsmen” who acquired jade from the source either directly or indirectly, and then “traveled to and/or resided along the shorelines of the South China Sea to produce extremely uniform jade ornaments to suit the demands of local elites.” The predominant use of jade from a single source as well as the standardization of the products indicates a high-level of specialization, however it should be remembered that this is not necessarily reflective of the presence of a complex society (Kenoyer et al. 1991). The itinerant nature of the craftsmen also indicates that they were not attached to an elite patron who controlled the production of these objects. However, the rarity of these objects and their association with high-status individuals points toward some amount of control over their distribution. It appears that there were more formalized trade networks connecting the coastal

manufacturing centers with the raw material source, while the distribution of finished products, especially to sites further inland may have been through down-the-line exchange networks.

The Vietnamese scholar Lam Thi My Dzung (2011: 11) has argued that the exotic long-distance exchange goods from India (and China in the case of many Vietnamese sites) were incorporated into the “pre-existing infrastructure of Southeast Asian networks.” Furthermore, that these networks were evidence for emerging social stratification and growth of trade networks prior to contact with South or East Asia (Dzung 2011). I agree with Dzung’s statements and argue that evidence presented in this dissertation indicates that particular types of stone and glass beads were a part of these early Iron Age exchange networks. However, by the later Iron Age period both trade networks and the type of beads available appear to change. Additionally, sites that had not been previously a part of these early coastal exchange networks begin to participate in these newly expanded bead trade networks. It is during this period that interaction with South Asia also appears to intensify.

Changing phases of trade with South Asia during the Iron Age

Some of the most important recent archaeological research on the nature of trade between South and Southeast Asia has identified two distinct phases of contact (Bellina and Glover 2004). Based on the examination of imported artifacts from numerous Southeast Asian archaeological sites, Bellina and Glover (2004) noted that during the earlier phase, Phase 1 (fourth century BC to second century AD), exchange with South Asia was less intense, with diverse artifacts but in small quantities, including pottery, bronze containers, stone and glass beads, and coins and intaglios. These objects frequently are found in what have been called “non-Indianized” contexts, such as burials (Bellina and Glover 2004:73). During Phase 2 (second-fourth centuries AD), exchange between the two regions as well as within Southeast Asia increased dramatically.

During this period there was greater quantities of Indian objects found at sites in Southeast Asia, but less diversity in the types of objects, and in the case of stone beads, decreased quality (Bellina 2003). Stark has also proposed a third phase of interaction with South Asia after the fourth century AD, consisting of “intensified ideological contact,” (2006: 411).

Bellina (2003,2007) specifically identified morphological and technological differences in the agate and carnelian beads between the two phases (discussed further in Chapter 5). Recent research on the chemical composition of glass artifact has also identified a shift in the type of glass beads being traded over time (Lankton and Dussubieux 2006, 2013)(discussed further in Chapter 7). The archaeological identification of these phases of interaction is significant as it highlights the evolving and changing nature of trade and interaction with South Asia over time. Stone and glass beads are especially important artifacts for identifying these changing trade networks. I argue that bead collections from Cambodia and Thailand examined as part of this study clearly demonstrate a sites participation in either Phase 1 or Phase 2 trade networks. Furthermore, I argue that it is the shift to Phase 2 trade that allows elites in the Mekong Delta to begin expanding their power. I will return to the discussion of these changing trade networks following a review of earlier theories regarding the emergence of socio-political development and exchange in the Iron Age and the impact and influence of South Asia on these processes.

Socio-political development and exchange in the Iron Age

Although recent research by Higham (2011) suggests that there was a brief florescence of social inequality during the Bronze Age period, there was no sustained socio-political hierarchy and the emergence of early states likely did not occur until the Iron Age period in the first millennium AD. For many years, these early polities were known only from Chinese historical documents and inscriptions found in both Sanskrit and local languages. For this reason, some of

the earliest hypotheses regarding the emergence of complex societies were proposed by historians and only later amended by archaeologists. The polity known as Funan was frequently discussed as a case study for the emergence of states, with some scholars arguing it was the first true state in Southeast Asia (Hall 1982, 1985). This was largely due to the availability of Chinese historical documents, inscriptions, and archaeological evidence from the site of Oc Eo. These excavations confirmed the presence of an important trading center in the Mekong Delta, which allowed historians to use written evidence to speculate on the appearance and organization of this early complex polity. In the section below, models proposed by historians for the emergence of socio-political complexity in early Southeast Asia are reviewed. It should be noted that most scholars have focused on the role of trade and long-distance contact in the emergence of socio-political complexity, especially in the Mekong Delta. However, it is acknowledged that other factors, such as peer-polity interaction or warfare, can also be considered causal factors in the emergence of complex societies. These alternative influences appear to have been at play in other regions of Southeast Asia and will be discussed later in this chapter.

The historical perspective: Indianization

Due to a relative lack of archaeological evidence from Iron Age and prehistoric sites and abundant literary evidence of states and empires that had been influenced by India, early scholars such as the French scholar George Coedès (1968) assumed that Southeast Asia had not reached socio-political complexity until coming into contact with South Asia. Many historians (Kulke 1990; Mabbett 1997; Van Leur 1955, Wheatley 1879, 1983) have generally tried to explain this process by arguing that the adaptation of Indian ideas of kingship and religion allowed for the expansion and consolidation of political power by elites in Southeast Asian communities. These states were described as having been “Indianized” (Coedès 1968). The so-called “Indianized”

states of Southeast Asia were first regionally synthesized and examined in 1944 by Coedès (1968), who hypothesized that the earliest visitors to Southeast Asia may have been merchants who came “without a preconceived plan” (Coedès 1968:23). These were soon followed by members of Indian society who had a greater knowledge and understanding of religion and Sanskrit. He argued (Coedès 1968:24) that the establishment of a kingdom or state happened in one of two ways. Either an Indian declared himself king and ruled over the native peoples, or an indigenous chief “adopted the civilization of the foreigners, strengthening his power by becoming Indianized.” Coedès claimed that merchants, ritual specialists or Brahmans, and other travelers from India had a civilizing influence on the peoples of Southeast Asia and were responsible for the emergence of states and cities in this area. However, he acknowledges that the native peoples retained much of their own indigenous culture giving each “Indianized” state a “certain measure of originality,” (Coedès 1968: 13, 35).

Scholars like J.C. Van Leur have rejected Coedès assertions that Southeast Asians had little agency and were merely vessels for Indian ideas about politics and culture. Van Leur (1955: 99) observed that most early contact with Southeast Asia was from South Asian traders, who would not have been familiar with or qualified to transmit ritual and religious ideology or ritually legitimate early rulers. Only Brahmans would have been qualified to do this and Southeast Asian rulers specifically invited Brahmans “for the magical, sacral legitimation of dynastic interests and the domestication of subjects, and probably for the organization of the ruler’s territory into a state,” (Van Leur 1955:104). In Van Leur’s model, Brahmanical Indian religion and conceptions of kingship were needed to transform a chiefdom into a state, but this process was entirely initiated and controlled by Southeast Asians who were active participants in the process.

The historian and geographer Paul Wheatley (1979, 1982, 1983) argued for a similar process in his studies on the origins of urbanism in Southeast Asia. For Wheatley (1979, 1983), the process of urbanization began when local Southeast Asian village chiefs adopted Indian concepts of kingship in order to expand their political power. These concepts of kingship were almost always associated with the Hindu god Siva. As Wheatley (1979: 295) succinctly stated, the Indian conception of kingship would have been “a political device especially attractive to village chieftains in situations in which the egalitarian solidarity of tribal society was proving incapable of extending authority to validate the power required for the institutionalization of supra-village rule.” The adoption of this new type of leadership would have instituted a suite of organizational changes, including the presence of craftsmen to make royal prestige goods, a military to guard the royal court, the building of defensive structures, and a farming class that provided a surplus to the royal court. These changes resulted in what Wheatley called a *nagara*, or ceremonial city, that was a focal point on a landscape (1979; 1983). Wheatley acknowledged that local chiefs could have begun a process of social differentiation through a control of involvement in trade or improvement of agricultural technology, but it was the Indian concept of kingship that had the biggest impact on sociopolitical development in Southeast Asia and the origins of urbanism. However, it should be noted that Wheatley (1983:11) was reluctant to call these early polities states and adopted Service’s view that chiefdoms are differentiated from states by their “lack of a formal legal apparatus of forceful repression.”

The historian O.W. Wolters (1999: 110) has also argued that indigenous peoples of Southeast Asia selectively adopted traits of Indian culture, a process he calls “self-Hinduization.” Wolters argues that the *bhakti* movement in India made Hinduism especially appealing to Southeast Asian peoples, specifically with regard to the god Siva. Drawing on ethnographic data,

Wolters suggests that the bilateral kinship network of Southeast Asian peoples meant that they did not emphasize ancestry and lineage. Instead, achieved status was considered to be more important. “All people were believed to be endowed with an innate spiritual property but in greatly varying degrees, and personal achievement and leadership clearly signified a superior and potent spiritual influence,” (Wolters 1999: 112). These people have been termed “men of prowess” by Wolters. According to Wolters the *bhakti* movement with its emphasis on the spiritual power of Siva, made it easy for local leaders to come to be seen as powerful and Siva-like. Chiefs maintained power through alliances and coercive power, as well as communicating their status as a person of prowess via the written and spoken word (Wolters 1999:118). Although Wolters does not specifically discuss how this process relates to the formation of the first cities, his model for the emergence of powerful local chiefs has been influential in discussions of state formation (Bayard 1992; Reynolds 1995). Wolters’ model provides an alternative view for how indigenous Southeast Asians may have been incorporating aspects of Indian culture into their lives, and how this was changing preexisting social organization.

The scholar Ian Mabbett (1977a, 1977b) synthesized the available historical and archaeological data in a pair of essays on the “Indianization” of Southeast Asia. He made a salient point that all of the historical sources describe polities after they had been “Indianized,” but do not describe the process of “Indianization” itself. For this reason, he argued, “the various theories that have been offered are speculation,” (Mabbett 1977b: 155). Instead Mabbett believes that the actual process may have been a mix of all the proposed theories. He also reminded scholars that India was not a monolith and itself was undergoing a process of “Sanskritization,” in which parts of southern India were being influenced by the Hindu and Buddhist ideologies of the North. It may be that the Indian people in Southeast Asia may have “consisted very largely

of the people from communities being Sanskritized rather than the agents of Sanskritization,” (Mabbett 1977b: 161). Mabbett (1977a: 13) also argued that when these early trading center polities were flourishing, “the greater part of the population of the region continued its ways of life with little change.” Interaction with South Asia was not uniform and the consequences of this contact were not uniform as well. This is an important point to remember as we review the archaeological evidence; so little archaeological work has been done in the region that research undertaken at only a handful of locations often becomes a proxy for what is happening across Mainland Southeast Asia.

More recently, Ian Mabbett has attempted to address why the adoption and adaptation of Indian culture would be so appealing to Southeast Asian people. Mabbett (1997: 350) notes, “a plausible speculation yet has to be advanced to describe the cultural mechanism that gave importance to Indian culture in Southeast Asian kingdoms.” In order to answer this question, Mabbett proposed a loose hypothesis that contended that as rulers gained power and expanded their control over territories; the new communities needed a way to become a part of the larger community. These small communities needed to redefine their identities and Mabbett (1997: 351) argued, “Indian culture... furnished a rich storehouse of legend and cosmology permanently capable of supplying new variations upon existing traditions and could supply the vocabulary for the process of self-redefinition.” This process had happened at multiple times and places across India, and then spread into Southeast Asia. In this way he proposed that the process of “Indianization” was responding to a need, not an imposition.

Mabbett’s hypothesis drew from an earlier work by Hermann Kulke (1990), who argued for “cultural convergence” between South and Southeast Asia. Kulke reflects on earlier models by both archaeologists and historians, but highlights two early inscriptions to illustrate his point.

These inscriptions describe early Southeast Asian leaders whose family lineages had risen to power and who had begun to expand their territory over neighboring communities. Kulke (1990: 20) argued that emergence of these chiefdoms was not related to Indian influence, however he noted, “at a certain stage of this development Brahmins ‘came hither’ in order to legitimize the new status and wealth of these chiefs.” Kulke argued that this same process was happening in eastern and southern India, as states from north India moved into these regions. However, it was not the north Indian polities who were moving in to Southeast Asia, but these emerging polities in eastern and southern India who were making the primary contact with their Southeast Asian neighbors. The Brahmins who came from these India communities were from “princely courts whose rulers were still facing quite similar problems of establishing their authority and ‘domesticating’ their people,” (Kulke 1990:28). In this way, Southeast Asians adapted Indian concepts of kingship and religion easily. Not because their societies were so different, but because of a “social nearness” and similarity in social change with the South Asian communities with which they were interacting (Kulke 1990: 28).

The historian Kenneth Hall (1985) also discussed a similarity between the process of “Sanskritization” in southern India and the Indianization of Southeast Asia. However, Hall is also one of the few historians to look more closely at the economic aspects of the emergence of complex polities, and has drawn on archaeological evidence from excavations at Oc Eo, Vietnam to supplement his argument. In his model for the growth of Funan, Hall argued that it was the influence of traders who brought about the process of Indianization. Funan’s leaders attracted traders to dock at their port by providing an agricultural base with which to feed traders and a safe port where they would not be threatened. Hall (1982: 88) argued that it was an ability to control both an agricultural base as well as a seaport that “allowed this ruler to use revenues

derived from these two income sources to establish supremacy over his fellow chiefs.” These leaders had control over human resources that could construct hydraulic systems for greater irrigation and could be mobilized as an army. As part of having a successful port, leaders were able to collect profits both in the material goods being traded as well as being exposed to new ideas and “new perceptions of the world” (Hall 1982:86). These material goods could be used as status markers over other competing elites. However, as leaders attempted to expand their power they found that “society’s norms restricted [their] ambition” leaving him to turn towards Indian models of kingship (Hall 1982:86).

These historical models draw heavily from Chinese historical documents, oral histories, and analogy with southern India. Many scholars have reviewed and critiqued these models recognizing they were incomplete, but without providing any new models of their own (e.g. Bayard 1992; Bentley 1986; Reynolds 1995; Winzeler 1976). Although some scholars took into account some of the limited archaeological evidence from the Iron Age period, historical hypotheses have focused largely on the intangible process of adopting Indian ideas about religion and kingship, which is not well represented in the archaeological record. As Stark has noted, it is important for archaeologists to consider these historical models, not in order to *prove* them, but as hypotheses to be tested using the archaeological record (1998). However, by the 1980s, the emerging archaeological evidence coming out of Southeast Asia could not be ignored (Bentley 1986). In the next section I discuss in more detail the archaeological perspectives on the emergence of complexity in Southeast Asia.

The archaeological perspective

Material evidence for contact between South and Southeast Asia has resulted in archaeological models that have focused on the role of trade and exchange in the emergence of

states. Several archaeologists have critiqued our ability to accurately understand what was happening in Southeast Asia based solely on archaeological evidence (Bayard 1992; Manguin 2000), however this has not prevented scholars from proposing models based on existing evidence. Nevertheless, archaeologists have generally been more cautious in describing the socio-political complexity of Iron Age communities they are studying, in contrast to historians who have discussed early polities such as Funan as a state (e.g. Hall 1982, 1985). Additionally based on research in Northeast Thailand, archaeologists have proposed that the process of emerging complexity was happening differently in the inland versus coastal areas.

Emergence of complexity and states in coastal areas

Bennet Bronson (1977:39) was amongst the first archaeologists to propose a model for state development, focusing on coastal Southeast Asia. At that time he considered his model to be “speculative” and noted that “hard data through which it can be tested do not yet exist.” The model was based on the observation that regions in insular and peninsula Southeast Asia were different from the mainland in that their coastlines were not well populated and the inland areas were not ideal agricultural zones. The states that developed in these regions were economically dependent on trade, primarily through water networks. A center would develop at the mouth of a major river system as it drains into the sea. Goods from secondary centers and other more remote communities would move down the river system and out to an overseas center, the primary consumer of these products. The primary center at the mouth of the river basin would control the movement of overseas goods upstream to the secondary centers as well as the goods that moved downstream and out to the overseas consumers. As new archaeological data has come to light, Bronson’s hypothesis has been expanded by several archaeologists working in peninsular and island Southeast Asia (see Christie 1990; Junker 1994; Manguin 2000).

Although Bronson's model was provisional, ongoing research during the 1980s were highlighting the early and consistent contact with South Asia, and these data needed to be taken into account. Ian Glover was one of the first archaeologists to synthesize a great deal of the archaeological evidence for contact with South Asia in Southeast Asia (1989; 1996). In his work he argued that the great quantity of materials from South Asia found at Southeast Asian sites indicated the presence of regular interaction and exchange during the late first millennium BC, centuries earlier than previous scholars had speculated (Glover 1989: 4). These long-distance trade networks connected Southeast Asia to Rome via India and in the other direction to China, which Glover (1989: 12) argued was the first World System. In this model the pre-existing, localized, down-the-line exchange networks in place in Southeast Asia since the late third millennium BC were replaced by new long-distance trade networks with India. Glover (1989: 3) describes these new networks as being "approximate to Renfrew's 'Middleman Trading', and 'Port of Trade' modes." Additionally, the identification of several artifacts specific to Indian Buddhism, including a carved carnelian lion bead and bronze knobbed ware bowls, pointed toward the presence of Buddhist missionaries in addition to traders (Glover 1989: 47). Unfortunately, Glover's model in this iteration was only loosely formulated. He did not provide a hypothesis on how Southeast Asians integrated this new system into their pre-existing localized exchange networks. Glover also did not discuss how participation in this network would have affected socio-political organization in Southeast Asia.

The archaeologist Jan Wisseman Christie (1990, 1995) has explored state formation in maritime Southeast Asia in more depth. Christie (1990: 42) argues that emerging complexity and processes leading to state formation in this region may have been beginning prior to Indianization. However, she also added that "long-distance sea trade itself played an key role in

stimulating political development which eventually led to the formation of states,” (1995:244).

As evidence for this, she points out that the Malacca Straits and the south Java Sea regions had the largest numbers of trade goods and trading activity in the maritime region during the late first millennium BC, and are also the location where the earliest maritime states emerged, although more recent work in the Mekong Delta suggests that state formation could have been happening contemporaneously in this region. In Christie’s model these regions both began participating in external trade that brought in new and exotic luxury goods. The presence of these new good spurred a swift change in political organization. Elites in coastal areas could control the trade of these new luxury objects in exchange for products from inland regions. During the second stage of Christie’s model (200 BC- AD 300), the maritime area’s trading partners were undergoing their own changes as northern Vietnam was conquered by the Han Chinese and Indians began to trade more extensively with Rome. It was at this point that Southeast Asia became part of the expanding maritime trading system that reached from the Mediterranean to China. During the third stage, AD 300-600, several fully formed states had emerged in the maritime regions that were influenced by the spread of Hinduism and Buddhism. However differences between regions in the maritime area also began to emerge, as parts of Java and Bali began to diversify their economy through rice agriculture and the spice trade (Christie 1995: 278-9).

Despite the influence of exotic luxury goods and long-distance trade, Christie also emphasized the importance of peer-polity interaction within the maritime region. She argues that much of the early trade in the Bay of Bengal region may have been transported on Malay or Indonesian ships. She notes that the rapid transmission of new ideas and information across this region suggests, “the carriers of most of this trade were members of maritime Southeast Asian communities rather than outsiders,” (Christie 1995:277). Christie (1995) argues that the early

centers of trade in the maritime region were likely the preexisting polities that were already controlling movement between the coasts and inland areas. However, data presented in this dissertation suggest that polities in the Mekong Delta were not part of these preexisting trading networks.

In a recent regional synthesis on the archaeology of mainland Southeast Asia, Charles Higham (1989, 2002) has proposed a model for the emergence of complexity in the Mekong Delta. Higham observes that around AD 1-400, trade relationships with long-distance trading partners began to emerge in the Mekong Delta (2002:292-4). New types of exotic goods were incorporated into a pre-existing system that emphasized the display of status through exotic objects, such as the nephrite ear ornaments discussed earlier. These new goods had effects on the development of cultural complexity in several ways. First, they were a limited resource and communities that were involved in trade of these commodities became more powerful, economically and socio-politically. Second, involvement in trade spurred the production of local products with which used to exchange for foreign goods, including those products that may have been available from farther inland. This new demand for goods from inland sites would have affected the developmental sequence as well. The agglomeration of craft specialists at specific sites would have had an impact on the intensification of agriculture and food production, leading to the construction of drainage canals. The construction of these canals may have also spurred a need for slave labor and allowed for water storage and irrigation, allowing for intensified production of rice (Higham 2002: 292-293).

Although the emergence of urbanism and statehood in the Mekong Delta was not due to a single variable, Higham argues that the introduction of exotic trade goods from India and China were important factors that induced changes in multiple areas of the local cultural system,

eventually leading to the emergence of states. Higham (2002: 294) emphasizes that the role of Indians during this early phase of emerging complexity was minimal; they were only in the region to supply exotic goods and practice trade. Therefore, the emergence of complexity took place within “a local cultural matrix.”

The archaeological models discussed here have emphasized the control over trade as a key factor in the emergence of early states and complex polities in the coastal regions of Southeast Asia. Bronson’s (1977) upstream-downstream model may best apply to the archaeological data presented in this dissertation, as I argue that elites in the Mekong Delta were expanding their socio-political and economic alliances with inland communities through the trade of stone and glass beads. There is not yet clear archaeological evidence for local production of crafts at sites in the Mekong Delta. However, archaeological evidence from looted contexts, as well as Chinese descriptions of craft production, and Cambodian folklore about the founding of Angkor Borei all point towards an agglomeration of craft specialists, as proposed by Higham (2002). I disagree with Christie’s model (1990, 1995) that early states in Southeast Asia emerged from locations involved in pre-existing coastal exchange. Stone and glass bead data presented later in this dissertation do not suggest elites in the Mekong Delta were participating in these early networks. However, I do agree with her assessment that exotic objects from South Asia were likely first entering into these early trade networks (Christie 1995).

Alternative models for the emergence of complexity in mainland Southeast Asia

The focus of the discussion on socio-political development thus far has been on the importance of trade and long-distance contact with South Asia in the emergence of complexity in mainland Southeast Asia. However, there are multiple factors that may lead to the emergence of complex societies or states, including ecological models and warfare (Carneiro 1970), the actions

of aggrandizers (Clark and Blake 1994), and peer-polity interaction (Renfrew 1996) among others. There is archaeological evidence for emerging complexity and hierarchy happening in two regions of mainland Southeast Asia that were not directly involved in long-distance trade with South Asia. These include Northeast Thailand and the Dongson culture of northern Vietnam.

Emergent complexity in Northeast Thailand

In the mid 1980s, Charles Higham and his colleague Amphan Kijngam (1984) proposed a preliminary model for the emergence of centralized chiefdoms based on research in the Chi River Valley in Northeast Thailand. The evidence for the existence of centralized chiefdoms was largely based on the presence of large moated sites, much larger than others in the region, which may have indicated a two-tier settlement hierarchy. Higham and Kijngam argued that these sites might have grown in power based on a variety of factors. Sites where major river systems entered the flood plains could have controlled exchange of exotic prestige goods coming in from the Chao Phraya Valley in central Thailand. These same trade routes may have also brought iron technology, which could facilitate the expansion of agriculture. Rising population could have also spurred warfare and competition between different settlements. At the time Higham and Kijngam proposed this model, little archaeological work had been done in this region and other scholars disagreed with their assessment that these sites represented chiefdoms (Bayard 1992). More recent research done in the Mun River Valley of Northeast Thailand has added additional data. Excavations at sites such as Ban NonWat and Noen U-Loke have uncovered burials related to the entire Iron Age period. Within these burials one can see evolving mortuary rituals that shifted from mortuary feasting to burials with increasing amounts of personal wealth in the form of beads, gold, silver, and bronze ornaments, and ceramics (Higham 2011b; Theunissen 2003). Higham notes that control over these new exotic prestige objects could have increased social

status within a community. However people could also earn wealth by producing and exchanging salt, pigs, ceramics and other goods. Increasing competition over goods and resource may have then lead to the emergence of leaders (Higham 2011b). This research done at the site level shows the impact that exotic prestige goods had within a group of small communities. However, these changes were happening across the Khorat plateau in Northeast Thailand and seemingly without any direct contact from South Asia. Although, these changes can be seen as the result of a “ripple effect” from changes happening at coastal sites (Higham 2002: 292).

The Dongson culture

The Dongson culture is located in the Red River Delta in northern Vietnam. It is notable for elaborate bronze casting technology, stratified high-status burials, and large settlements such as Co Loa, which highlight the socio-political complexity developed by this culture (Bellwood 2007; Kim 2010; Kim et al. 2010; Pham 2004). Some scholars (Bellwood 2007; Higham 2002) have argued that the Dongson were centralized chiefdoms and at least partly urbanized, while others have argued that Co Loa was a state-level society (Kim et al. 2010; Kim 2010). As discussed in Chapter 2, I follow Kim’s assessment that Co Loa was a state.

In his recent study, Kim (2010) identifies several factors for the emergence of Co Loa as an important urban center of a state-level society including both peer-polity interaction and coercive interaction. The Dongson people were excellent craftsmen making large Dongson bronze drums, that were exchanged across mainland and island Southeast Asia (see Calo 2009). The exchange of these prestige objects appears to have been important for emerging social hierarchy, connecting elites in different communities to one another (e.g. Loofs-Wissowa 1983). In addition to these contacts, the Dongson people appear to have been closely interacting with

the Dian culture in Yunnan province. Francis Allard has suggested that interaction between these two cultures “may have benefitted the almost simultaneous emergence of Bronze Age complex societies in eastern Yunnan and northern Vietnam,” (1999: 83). Cultural interaction between these two regions may have increased agricultural production, population growth, and the emergence of social inequality and socio-political complexity (Kim 2010: 180).

In addition to this more friendly interaction, the Dongson and Dian polities were also experiencing pressure and eventual colonization by the Han Chinese. Bronze technology was used to make metal weapons that are found frequently in burials and iconography on Dongson drums and other artifacts depicts battles scenes and warriors. Earthworks at Co Loa were also believed to have been used as fortifications (Kim 2010). As Kim (2010: 191) argued, “the evidence in the form of weapons, warrior burials, and iconography all point to the role of warrior prestige in bringing about changes in societies and social status for individuals.”

After the colonization of northern Vietnam by the Han, archaeological and historic evidence suggests that influence of Chinese culture on the local population appears to have been inconsistent, with “mutual influence” between the Han Chinese rulers and local population (Kim 2010: 297). Although communities in the Mekong Delta and elsewhere in mainland Southeast Asia were not colonized by South Asian polities, we can see a similarity between northern Vietnam and the Mekong Delta, in that local traditions persisted even with the introduction of new socio-political, economic, and ideological systems.

The current study builds on these previous models with new data gathered from the examination of stone and glass beads. These data support the conclusion, previously argued by Christie and Dzung, that stone and glass beads were initially incorporated into pre-existing long-distance exchange networks. However, it is does not appear that these elites were using the

availability of these new materials to expand their pre-existing trade networks. It is not until the later Iron Age (Phase 2) that trade networks appear to shift and the Mekong Delta becomes involved in the trade of stone and glass beads. I argue, as others have suggested, that elites in the Mekong Delta controlled the trade of these objects and used the exchange of these objects to expand their power and connections with inland communities (Bronson 1977; Higham 2002). However, there is not yet enough data to identify the specific aspects of growth suggested for Funan by Higham.

Data from Northeast Thailand and northern Vietnam highlight the importance of provincial peer-polity interaction networks in the emergence of social stratification and the presence of regionally specific response to expanding trade networks. I argue that data in this dissertation also shows similar evidence for the importance of regional peer-polity interaction networks, especially during the early Iron Age. The uneven distribution of agate/carnelian and glass beads within sites also points towards the emergence of social stratification at inland sites. Incorporate this above?

Trading with Southeast Asia: The view from India

Many scholars have noted that South Asia was not a monolith and that southern India was in a process of “Sanskritization,” or influence from the Brahman, Hindu, and Buddhist polities in the north, at approximately the same time as Southeast Asia (Hall 1985; Kulke 1990; Mabbett 1997, 1977a, 1977b). In order to better understand how trade with South Asia was organized, several scholars have begun more closely examining questions regarding which regions and people were participating in trade with Southeast Asia, their motivations for participating in trade, and the directionality of interaction.

Recognizing that the emergence of states was not uniform across Southeast Asia, the Indian scholar H.P. Ray (1989: 42) has called for “the demarcation of micro-regions both within India and Southeast Asia where the earliest contacts developed.” Ray notes that around the turn of the first millennium AD the east coast of India was becoming increasingly linked together via trading networks. With the growth of Indo-Roman commerce, southern India was becoming increasingly focused on trade. Ray argues that Southeast Asia could have been an important source of mineral resources including tin, as well as aromatics, and wood. Preexisting trade networks linking peninsular Southeast Asia, which was high in tin, and mainland Southeast Asia could have been easily integrated into the long-distance trade networks from India (Ray 1989: 50). The identification of micro-regions of trade would allow archaeologists to better understand the nature of trade and how the two regions interacted more broadly. Although outside the scope of the current project, this could be achieved through continued compositional analysis of stone and glass beads in both South and Southeast Asia.

Ray has also proposed that the growth of Buddhism and its favorable views towards wealth accumulation and trade as an occupation may have had a major impact on the expansion of trade into Southeast Asia. South Asian artifacts with ties to Buddhism at sites in Southeast Asia were already well known (e.g., Glover 1989). However, Ray notes that the expansion of Buddhism into southern India and the subsequent restructuring of the economic base, which placed economic power in the hands of Buddhist monasteries, might have also been taking place in parts of Southeast Asia. However, Manguin suggests that in addition to Buddhism, Vaisnavism also played an important role in the political, religious, and economic parts of life in Southeast Asia (2010). Unfortunately, it is not yet clear how Vaisnavite merchants in Southeast Asia may have influenced the organization of trade, although it is important to consider the

“consumption patterns of religious communities” when looking at the archaeological record of Southeast Asia (Manguin 2010: 177). However, it is not likely that these religious communities were having a major impact on the organization of trade during the period being discussed, as we do not see clear evidence for the practice of Hinduism and Buddhism until the mid-first millennium AD.

The scholar Sunil Gupta (2005) has suggested that the process of Indianization in Southeast Asia was the result of long-standing contact between eastern India and Southeast Asia in what he calls the Bay of Bengal Interaction Sphere (BBIS). Demand for spices such as cinnamon in Sri Lanka during the first millennium BC mark the earliest evidence for contact between these two regions, which continued to approximately 500 AD. Gupta argues that “Indianization” of Southeast Asia was not an event, but a cumulative process of reciprocal exchange between regions on either side of the Bay of Bengal; a process that may have even included Southeast Asian people traveling to India. It was this deep history of contact that allowed for quick appearance and spread of Hindu and Buddhist sculptures in Southeast Asia, as their adoption “implies prior knowledge of the symbolisms associated with their worship,” (Gupta 2003: 395). Gupta relates his hypothesis to the popularity and spread of beads, which is discussed in more detail below.

The archaeologist Monica Smith (1999) has examined trade between South and Southeast Asia “from the Indian point of view,” and is skeptical that Indians had the sea-faring vessels to initiate contact with Southeast Asia. She argues that Southeast Asians most likely initiated early trade and that Indians had little reason to actively trade with Southeast Asia as most goods were available on the sub-continent or via their preexisting trade routes with Africa, the Middle East, and the Mediterranean. For Smith, strong interaction between South and Southeast Asia did not

begin until the mid-first Millennium BC and coincides with the emergence of the Gupta dynasty. However, Smith also notes that China was also interacting with Southeast Asia during this period and wonders why they did not have more of a socio-political, economic, and religious influence. She concludes that the militaristic interactions between China and northern Vietnam were a warning to other communities in mainland Southeast Asia. “Presented with two models of state-operation, the Chinese and the “Indian,” indigenous leaders in Southeast Asia chose to incorporate a model of bureaucratic organization that encompassed little threat of political intervention,” (Smith 1999: 18). It was for this reason that Indian influence became so prevalent in Southeast Asia, but earlier interactions were initiated and directed by Southeast Asians.

Although Smith raises several important points regarding the agency of Southeast Asian elites in the process of Indianization, she overlooks much archaeological data indicating sporadic, though influential, contact between the two regions prior to the mid-first millennium AD. In the years since her article has been published this evidence has only increased, especially in Cambodia. Rispoli (2005) has argued that early Indian writings about Southeast Asia always discuss it as a place of opportunity and profit. While she agrees that interactions between the two regions were peaceful, her arguments counter Smith’s by arguing that diplomatic trade was possible because of the great number trade goods Southeast Asia could supply to India (Rispoli 2005: 258). However, Rispoli’s conclusion is in agreement with Smith, that Southeast Asians *chose* to interact with India.

Using compositional analysis of stone and glass beads I had hoped to be able to identify more specific trade networks between “micro-regions” of South Asia and Southeast Asia. Unfortunately, the analysis of these materials was not fine-grained enough to develop this type of evidence. Nevertheless, recent work by other scholars has shown that exploring these questions

is fruitful and these studies have now led to the identification of long-standing relationships between specific areas of South and Southeast Asia (e.g., Manguin et al. 2011). I believe that future compositional research, especially on garnet beads, may provide more specific linkages between raw material resources areas in South Asia and the trade of finished products in Southeast Asia.

The role of beads in early trade

Many early scholars have recognized the importance of beads in Southeast Asian archaeology, especially for their role in elucidating trade patterns and examining questions of socio-political development. The archaeologist Alaistar Lamb (1956b: 87) specifically observed “in the South-east Asian context, beads have potentially a most important archaeological role to play.” In this section I review some of the most influential studies that have used beads to elucidate trade and socio-political development in Southeast Asia, concluding with a discussion on how the current study builds and expands on these previous works.

One of the first scholars to tie research on beads with socio-political developments in Southeast Asia is Peter Francis Jr. In the course of his wide ranging studies of many different types of beads, Francis proposed several hypotheses regarding the production, trade, and use of beads in Southeast Asia and their relationship to state development that are still influential today (Francis 1996, 2002). Drawing on archaeological evidence for the production of stone and glass beads at some sites in Southeast Asia, Francis argued that the spread of beads, specifically a type of monochromatic, drawn glass bead called Indo-Pacific glass beads and the technology used to produce them was “a perfect metaphor for the spread of Indian influence in the region at this time,” (Francis 1996:141)(see Chapter 7 for an in-depth discussion of Indo-Pacific beads). Francis noted that many of the locations believed to have been manufacturing centers were also

among of the earliest urban sites in their regions and together they might have formed a league, which he calls the Arikamedu League. Beads were important trade objects in Southeast Asia, and the presence of a manufacturing location may have been “markers (not makers) of emerging core areas or states,” (Francis 1996: 149).

Francis pointed out that several sites in the Arikamedu League produced both stone and glass beads, however his focus was primarily on the production of Indo-Pacific glass beads in these locations. In his model, Indian beadmakers traveled, perhaps unwillingly, to Southeast Asia to produce glass beads. He argued that Indo-Pacific beadmaking was a complex skill, and suggested that the Indian beadmakers probably did not teach this intricate technique to local apprentices who would have taken away their livelihood. During later periods, Indian craftsmen were organized in guilds and Francis speculates that the Arikamedu League beadmakers may have also been united under some sort of guild system, which facilitated their interactions with local leadership (2002: 38-39). As in contemporary India, Francis argued that the beadmakers in Southeast Asia probably had little control over the trade of these objects (2002).

In reality, there has not yet been enough clear archaeological evidence for glass and stone bead production in Southeast Asia to assume that a high degree of craft organization was present. Evidence for stone and glass bead production at the Southeast Asian sites he mentions is problematic as much of the data he used to build his theories was from looted contexts. This makes it difficult to determine if bead manufacturing was even taking place at many of the locations Francis mentions and if so, it is nearly impossible to evaluate how workshops were organized. However, research at the site of Khao Sam Kaeo in peninsular Thailand does indicate that it was a stone and glass bead production center. Although the site was heavily looted, preliminary excavation data support at least partially Francis’ hypotheses. Excavators believe

that Khao Sam Kaeo was inhabited by Indian craftsmen, due to the finely made beads found there produced using Indian techniques (Bellina 2003, 2007; Glover and Bellina 2011), although there is no evidence they were organized in guilds or that they traveled to the site unwillingly. Bellina and colleagues (Bellina and Silapanth 2008) have also argued that Khao Sam Kaeo was an early urban center due to the earthwork construction, water management features, as well as seemingly restricted craft production areas in the site. Additionally, the assumed presence of Indian craftsmen would mark Khao Sam Kaeo as being fairly cosmopolitan. However there is no clear evidence that control over bead production and distribution at Khao Sam Kaeo corresponds to emergence of a state-level society. With additional work at potential workshop sites it is hoped that we will be able to clarify the roles of the beadmakers and the extent of involvement by local elites in the process of the production and distribution of glass and stone beads.

Although not concerned with the production of beads, the scholar Sunil Gupta shared Francis' belief that beads were markers of Indianization in Southeast Asia. In his model, beads, especially stone beads, were objects of ritual importance and related to aniconic aspects of Hinduism and Buddhism that existed in Southeast Asia prior to the adoption of iconic sculptural traditions (2003). Gupta points towards beads such as the leaping lion found at Ban Don Ta Phet, Thailand, that are believed to be related to Buddhist practices, as well as the numerous written and iconographic examples of beads used in ritual in India. Gupta does not deny that beads may have had more than one function, such as status markers. However he does argue that they also might have had a ritual importance, which has been overlooked. While Gupta's hypothesis is provocative it is difficult to test archaeologically. Most beads in Southeast Asia are found in local forms of burial contexts and without any associated Indian derived ritual artifacts, and any ritual associations associated with them are intangible.

Furthermore, Gupta has argued that bead production in Southeast Asia may have begun as a result of the preexisting Bay of Bengal Interaction Sphere (2003, 2005). He suggests that long-standing interaction between the two regions may have resulted in shared bead-production technology and not the introduction of new technology from India. However, as will be argued in Chapters 5-8, an examination of attributes on the stone beads, such as shape and drilling technology, as well as chemical signatures and techniques from glass bead production points toward Indian bead production techniques that have no predecessors in Southeast Asia (Bellina 2003; Lankton et al. 2008). While there may have been long-standing contact between cultures in the Bay of Bengal, evidence from stone and glass beads does not support this hypothesis.

However, innovative research on stone beads has allowed for a deeper understanding of the role that Southeast Asian people had in the bead trade. Research by Bellina (2003, 2007) and Bellina and Glover (2003, 2004) have identified several stone bead shapes, such as notched agate pendants, that have been found in Southeast Asia but *not* in India. Bellina (2003: 292) argues that these beads may have been commissioned by Southeast Asians and suggest that “a South-east Asian elite wanted what the best Indian manufacturers could produce but in a style corresponding to their own cultural values.” Southeast Asians were taking an active role in the trading process by requesting the production of specific bead types. As noted earlier, Bellina also claims that foreign craftsmen may have been living and working in Southeast Asia, perhaps under the patronage of an elite, an interpretation that has been further refined and supported by her research at Khao Sam Kaeo (Bellina 2003, 2007). Although evidence from Khao Sam Kaeo does not yet indicate elites were controlling the production of agate and carnelian beads, Bellina’s research suggests that Southeast Asian’s were more socio-politically complex than previously thought, with elites who directed and participated in a prestige goods exchange

network that linked them with both foreign cultures and other Southeast Asian elites. The system used by Indian craftsmen and Southeast Asian elites may not have been very different from that believed to have been used by itinerant nephrite craftsmen at sites in coastal Vietnam. In this dissertation I will use the distribution of glass and stone beads to explore identify these prestige goods exchange networks more specifically.

Robert Theunissen has also argued for a greater recognition of the role of elites in the production and trade of stone beads, based on his research on agate and carnelian beads in Northeast Thailand (2003, Theunissen et al. 2000). Using geochemical analysis of stone beads from Noen U-Loke, Theunissen has suggested that some stone beads may have been made in Southeast Asia, under the control of local elites, and using a local stone source in Lopburi province, Thailand. Theunissen's work has also shown that people at Noen U-Loke placed a high value on stone beads as prestige objects (Theunissen 1998, 2003). Theunissen's study was only preliminary, but has been influential in challenging assumptions about the diffusion of Indian stone beads throughout Southeast Asia (see Bellina 2003). Despite this, no stone bead production workshops have yet been identified in Northeast Thailand. Additional methodological and interpretive problems with Theunissen's geochemical analysis and his conclusions are discussed in more detail in Chapter 6.

Bellina and Theunissen's arguments that Southeast Asian people were active agents in the bead trade process are compelling. However, their contention that elites may have been producing or controlling the production of agate and carnelian beads, perhaps for trade with inland communities, has not been well tested. As discussed in Chapter 1, studies on craft production in the Indus Valley have shown that the increasing complexity of craft technology is correlated with increasing socio-political complexity in a community (Kenoyer 1992; Vidale and

Miller 2000). If Southeast Asian communities were producing stone beads using local raw material sources we would expect them to have a higher level of socio-political organization, as they would be controlling both the technology used to produce the artifacts as well as the raw material used to make them. In contrast to other communities that may have focused purely on the trade of finished objects, or who may have had South Asian craftsmen working in their communities using imported raw materials. Through geochemical analysis of agate and carnelian beads, I will specifically test this hypothesis (see Chapter 6). My results show that there is not yet clear evidence to support Theunissen's hypothesis that Southeast Asian raw material sources were being used to produce beads. Instead, there is strong evidence that a majority of beads in Southeast Asia were made using raw materials from western India, although some beads may have been produced in Southeast Asia using this imported raw material.

The examinations of beads discussed above were concerned primarily with the organization of production of stone and glass beads. However, I believe addressing the production of beads in Southeast Asia is difficult with the currently available archaeological dataset, which has often been disturbed and looted. Instead, my dissertation is focused on using glass and stone beads to explore the trade and exchange networks in Cambodia and Thailand and how these expanding networks were related to the emerging socio-political complexity of elites in the Mekong Delta. By examining beads the morphology, context, and composition of stone and glass beads I am able to identify patterns in the distribution related to changing trade networks and control over trade.

Conclusion

In this chapter I reviewed a number of theories regarding the emergence of complex polities and states in Southeast Asia. The earliest theories were written by historians who largely

focused on the adaptation of Indian conceptions of kingship and religion as a means for Southeast Asian elites to expand and consolidate their power. On the other hand, archaeological theories have drawn largely on material evidence and specifically objects believed to have been prestige goods. For this reason, archaeological theories largely focused on the control over these early prestige good networks as a means of increasing and expanding power and complexity in early polities. However, instead of addressing South Asia as a monolith, archaeologists have also begun to question the motivations for trade between South and Southeast Asia, as well as develop a better understanding about from who and where early trade contacts were coming.

Archaeological research has also shed light on the periods just preceding and coinciding with the earliest contact from South Asia as well as in regions that did not have direct contact with this area. These studies have shown that the process of emerging complexity in Southeast Asia was multifaceted and did not necessarily require a direct connection with South Asia, as some historical models have suggested. In some areas, such as in northern Vietnam, Southeast Asian communities may have reached chiefdom-levels of complexity prior to contact with South Asia. Other inland regions saw emerging complexity arising after the introduction of goods from South Asia, but seemingly without the additional ideological influence seen at coastal centers. Archaeologists and scholars have also studied stone and glass beads to better understand the early phases of trade and emerging complexity. These studies have underlined the role that Southeast Asian elites played in the early period of contact with South Asia, and the presence of unique bead types in Southeast Asia has suggested to scholars like Bellina (2003, 2007) that elites were requesting specific beads types and then controlling their distribution, and possibly production.

In this dissertation I use the patterns identified by the distribution of distinct types of archaeological stone and glass beads in order to test the prevailing archaeological and historic models regarding the importance of trade and expansion of power in the Mekong Delta. I argue that the stone and glass bead data presented in this dissertation suggests that during the early Iron Age, beads appear to have been entering into pre-existing coastal exchange networks that were already trading prestige objects like nephrite ear ornaments. However, not all communities appear to have been participating in these trade networks, including sites in the Mekong Delta. Instead, I argue that glass and stone bead evidence suggests that the sites in the Mekong Delta did not emerge as important centers until the first few centuries AD, as trade with South Asia was believed to have been intensifying. Based on the identification of specific bead types found at the Mekong Delta and sites further inland, I argue that elites in the Mekong Delta were expanding their exchange and interaction networks with communities further inland. In this model, beads can be seen as a proxy for expanding socio-political and economic networks based in the Mekong Delta. In the remaining chapters of this dissertation I discuss this evidence in more depth, beginning with the next chapter, which provides an exploration of the various methods used to examine stone and glass beads and test these research questions.

Chapter 4: Research Methodology

As outlined in Chapter 1, this dissertation is concerned with using stone and glass bead data to address two research questions. First, are there patterns in the distribution of distinct types of stone and glass beads that can be identified over time and space? And second, are these patterns related to emerging socio-political complexity in the Mekong Delta? In order to address these questions, glass and stone beads from 12 sites in Cambodia and Thailand were carefully examined.

It was first necessary to define specific bead types to avoid overlap or misclassification that has resulted from earlier categories used in the literature and site reports. Bead attributes were recorded in the field in order to identify preliminary types and develop specific types that could be identified and related to chronological time periods. The contexts in which beads were found were noted in order to identify patterns of distribution. Many beads were from burial contexts, and so additional information was recorded including the sex, age, and additional grave goods found with the burial. This information was in order to determine if beads were common or rare and identify patterns in the distribution of beads that could be related to age or gender. Compositional analysis using laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) was used to analyze the geochemical composition of the stone beads and the glass recipes used to make the glass beads. Compositional analysis of beads from Southeast Asia has never been undertaken systematically in the past and my research has established a relatively comprehensive database for future comparative studies. Stone beads were assigned to geographical sources areas using a variety of statistical techniques. Scanning Electron Microscope (SEM) analysis of impressions of stone bead perforations allowed for a better

understanding of the manufacturing methods used to make these objects. Lastly, these data were compared among sites and similarities and differences among sites were identified. It is with these data that I am able to address the research questions discussed above.

This chapter discusses in detail the methods used to examine and analyze stone and glass beads. The chapter begins with a brief introduction on the equipment and database software used as well as the data recorded for all beads. This is followed by a more in depth discussion of the attributes recorded for stone beads and following this, attributes recorded for glass beads. I then move to a discussion of compositional analysis of the stone and glass beads and the various statistical techniques used to interpret these data. Lastly, methods used to examine the drilling technique used to produce garnet beads are explained. By using these various lines of data, I am able to address my research questions and identify patterns in the distribution of specific types of beads over time and space.

Recording glass and stone beads

Prior to beginning fieldwork in Cambodia and Thailand in 2008 I created a database to facilitate the recording of glass and stone beads. I used the database software FileMaker Pro, beginning with FileMaker Pro 8 and later upgrading to FileMaker Pro 11. The database was modified multiple times over the course of the project to reflect improved and streamlined recording techniques. Each entry received a unique database ID to distinguish it from all of the other entries. Also recorded for each bead was data related to the context including the site name, catalogue number, material type (stone or glass), the condition of the bead (fresh, worn, slightly worn, heavily worn, chipped, or broken), and the bead shape. Photographs were also taken of every bead using a digital SLR and macro lens. Additionally, many beads were examined more

closely using a DinoLite AM313 digital microscope. Images from both the digital SLR and digital microscope were also included in the database for reference.

The context in which beads were found was also recorded, with special focus on those beads from burial contexts. This information was used to determine how beads were distributed within burials within a single community. Although the quantity of burials excavated differed between sites, patterns of uneven distribution were identified. Determining the relative wealth or status of the individuals with beads was not the primary focus of this dissertation. However, as beads are believed to have been exchanged between elites, one may assume that burials with large quantities of beads may have been important members of their community. Burials with agate and carnelian, glass, and garnet beads are discussed below within their individual chapters. The proportion of burials with these bead types out of the total number excavated were noted in order to identify generally how restricted the distribution of each artifact was within the community. It is recognized that the burials excavated may not be a representative sample of the whole site, but provide a preliminary understanding about the distribution of these artifacts based on the available evidence. In the final chapter, I address broader patterns regarding the distribution of beads in burials.

Identifying stone bead types

In order to identify patterns in the distribution of agate/carnelian and garnet beads, the different types of stone beads needed to be categorized. Previous work by Bellina (2001, 2003, 2007) identified a difference between earlier (Phase 1) Iron Age agate and carnelian beads and later (Phase 2) beads. These differences are visible in the bead shape and quality of production, raw material type and quality, the polishing technique used, and the perforation size. Additionally, previous work by Theunissen (2003) has identified preliminary patterns in the

distribution of specific bead types across mainland Southeast Asia. In the current study, attributes from agate/carnelian and garnet beads were recorded in order to identify if they could be classified as either Phase 1 or Phase 2 beads. The bead shapes were also carefully recorded and compared with Theunissen's preliminary findings.

Attributes recorded for the stone beads are listed in (Table 4.1, see also Appendix 5.1). These attributes recorded are specifically related to the bead's appearance as well as noting scars or marks on the bead that would aid in determining what techniques may have been used to make the beads. Examining markings related to manufacture can aid in identifying where bead may have been produced, as certain techniques for bead production, such as drilling or polishing, can be temporally, regionally or culturally specific (e.g. Bellina 2003, 2007; Francis 2002; Kenoyer 1992a, 1992b). The attributes used in recording the stone beads is discussed below.

Variables recorded for stone beads
-Raw material: agate, carnelian, garnet
-Stone color
-Drill hole type (drilled from one end, drilled from both ends etc)
-Exterior surface: polish and wear
-Number of facets
-Measurements: Width, maximum length, minimum width, thickness, interior perforation

Table 4.1: List of bead attributes recorded.

Bead Shape

The bead shape was the first step in the stone bead recording process. Pre-existing bead shape classification systems by Beck (1928) and J. Mark Kenoyer's Harappan bead code system were used to categorize beads from sites in Cambodia and Thailand. However, there were also additional bead shapes identified that did not fall into either of these classification systems. In these cases, I assigned a name to these bead shapes that would accurately describe the bead. If a bead was faceted, the number of facets was also recorded. Approximately 35 bead shapes were

identified (see Chapter 5 for further discussion). As discussed above, bead shapes were critical for identifying initial patterns in the distribution of beads across the landscape. Bead shapes were also used, with other attributes, to determine if beads belonged to the Phase 1 or Phase 2 groups.

Raw material and stone color

The raw material of each bead was recorded, distinguishing between carnelian, agate, and garnet beads (Figure 4.1). In addition to the raw material type, the stone color was recorded to reflect if the bead was made from a black and white banded agate, or a light yellow, orange or red carnelian, or a dark purple garnet. Beadmakers in South Asia often enhance the color of natural stones, deepening the reds and browns (Kenoyer 2003). Recording the color also allowed for noting any unique imperfections or other distinguishing marks on the bead.

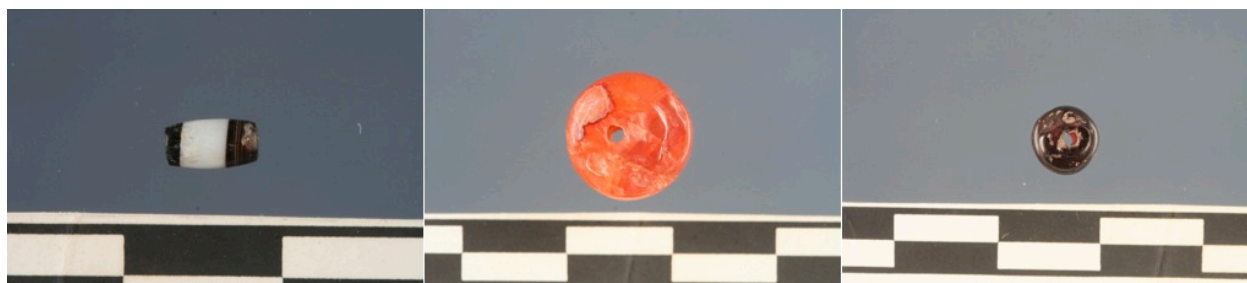


Figure 4.1: Examples of black and white banded agate (left), carnelian (middle), and garnet (right) beads. Scale in cm.

Exterior surface

The exterior surface of the bead was noted to determine if there were any nicks, chips, or imperfections, as well as information on the type of polish on the bead. This analysis was facilitated by the use of a digital microscope to inspect and record surface features in more detail. Bellina (2003) has identified a difference in polishing techniques between the earlier high-quality beads found in Southeast Asia that were polished using a rotary grinding technique, and later period beads that were mass-polished in a drum. Kenoyer has also done experimental work on bag polishing of beads and provided several examples for comparison (J. Mark Kenoyer,

personal communication 2008). As part of Bellina's (2003) study, she took molds and produced high-quality resin replicas that she examined under a microscope. Using a digital microscope in the field provided a more expedient technique for examining the surface, however the low-powered microscope did not provide the fine-grained detail of Bellina's technique. Additionally, determining the polish can be difficult and some surface-wear on the bead may be related to use-wear and not necessarily due to polish (Kenoyer, personal communication, 2012). For this reason, recording of the exterior surface was limited to determining the degree of polish (low-luster, medium polish, or high polish), the presence of any grinding striae, and wear patterns that may be related to a bag polish technique (Figure 4.2). However, in practice these latter two attributes were difficult to determine and not discussed in depth. Future studies may wish to investigate this aspect of the agate and carnelian beads in more detail.

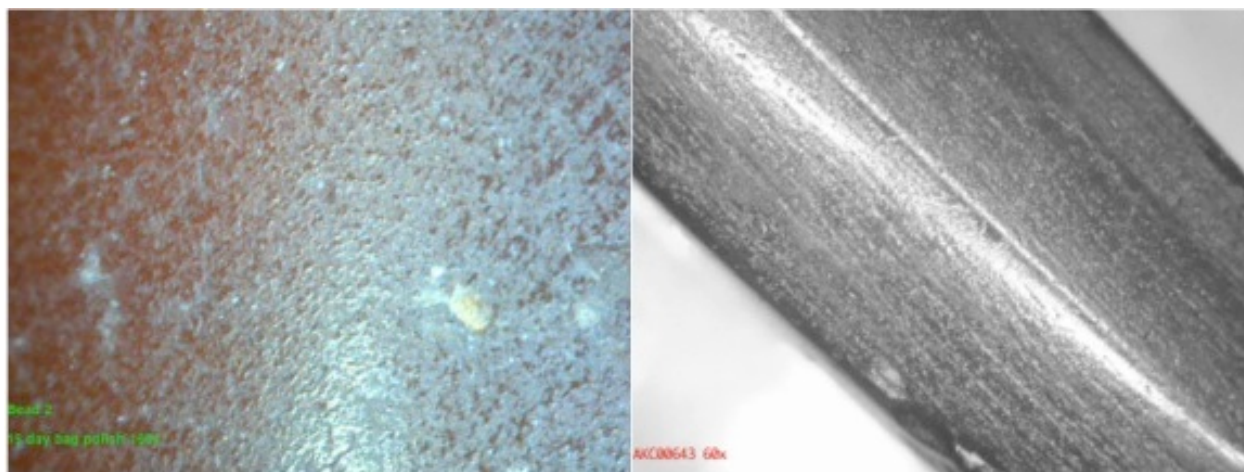


Figure 4.2: Digital microscope image of a bag-polished bead (left) and a bead with grinding striae (right).

Type of drill

The shape of the drill perforation was also noted as a means of identifying the drill type. As with the bead shapes noted above, I referred to previous drill types noted by Beck (1928) and the Harappan Bead Code System to assist with my classifications. I recorded the shape of the

drill, and when possible how the bead was drilled. Determining the specific drill used to perforate the beads involved taking impressions of the drill hole and examining the impression with the SEM, or digital microscope (discussed below). Due to limited time and finances, SEM was not used extensively on the agate and carnelian beads. However, the garnet beads employed a diverse set of drilling techniques and SEM was used to examine these in more depth (see Chapter 8). The different drill types encountered are listed in Figure 4.3. With the exception of the Type 4 double conical drill, all the drill types involved straight cylindrical drills typical of the diamond-drilling technique.

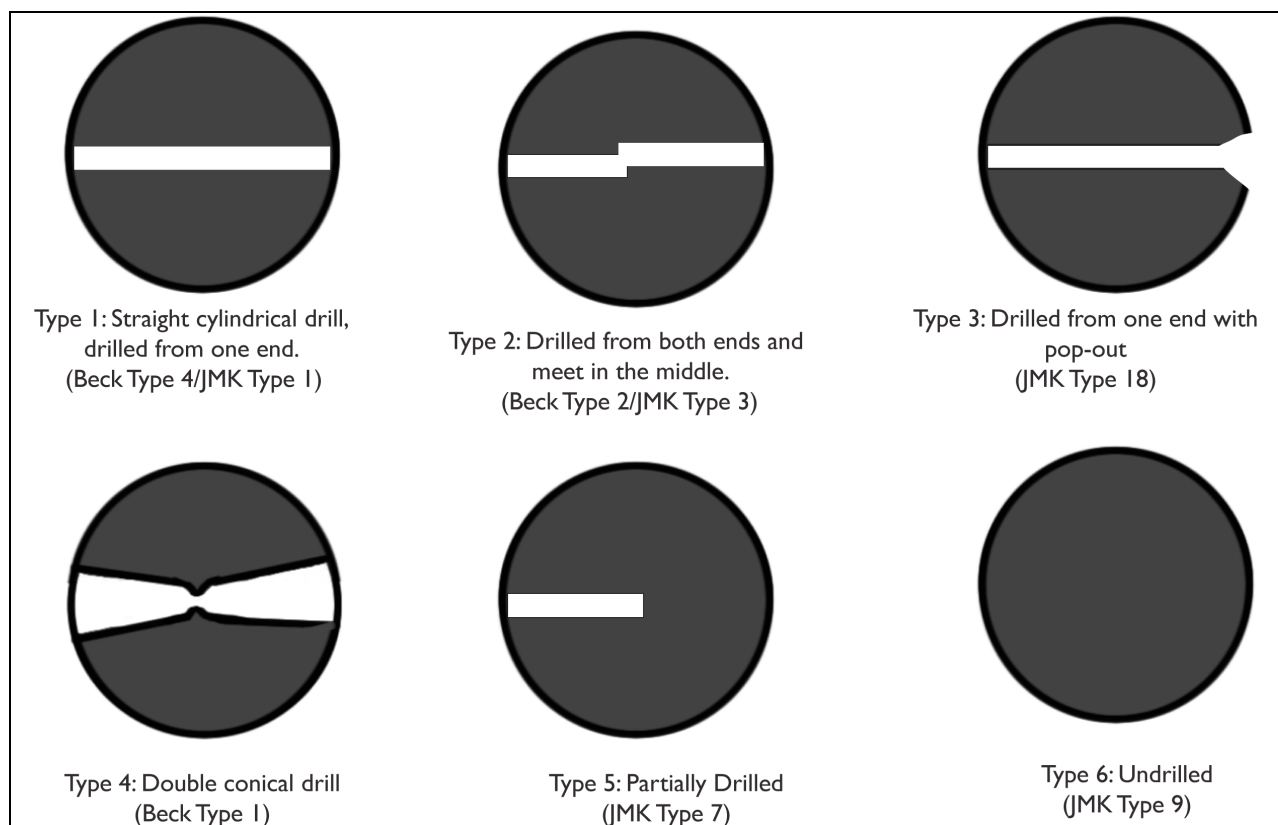


Figure 4.3: Different drill types identified in the study.

Overall quality and complexity of agate and carnelian beads

In Bellina's study of agate and carnelian beads from South and Southeast Asia, she used multiple lines of evidence to determine the overall quality and complexity of a bead including the raw material type, polishing method, and shape (2001, 2003, 2007). A modified version of this method was used in the current study. Bead shapes were classified as simple or complex based on Bellina's assessment that geometric and spherical shapes were more simple to produce, while other beads types like faceted beads were more technically difficult and therefore complex. In order to determine the overall quality of the beads, I took into account the bead shape, raw material. For example, a group of hexagonal faceted bicones from Phum Snay had uneven facets and some beads were made from a raw material with dark or light inclusions; these beads were rated as low quality. Comparatively, a group of faceted bicone beads from Village 10.8 were more finely made with even facets and a higher quality stone; these beads were classified as high quality. These classifications were not made in the field, but instead based on photographs and notes from the field. For this reason, the assessments of bead quality may be considered to be preliminary. Nevertheless, I believe these quality assessments are broadly comparable between sites and will be discussed in more depth in Chapter 5.

Measurements

Measurements were taken on all the stone beads and selections of the glass beads. All measurements were taken with digital calipers and were recorded in millimeters. Length refers to the measurement across a bead from one hole to the other, reflecting the orientation of the bead if it were strung. Width denotes the measurement of the bead at its widest part perpendicular to the bead hole. For tabular beads, a thickness measurement was taken to reflect this dimension. For beads with tapered ends, such as bicones, I also took minimum measurements on the area around

the perforations at the narrowest part of the bead as well as a maximum measurement along the middle. Lastly, measurements were taken of the bead perforations on each side of the beads. The length, width, and perforation size was also collected for most glass beads.

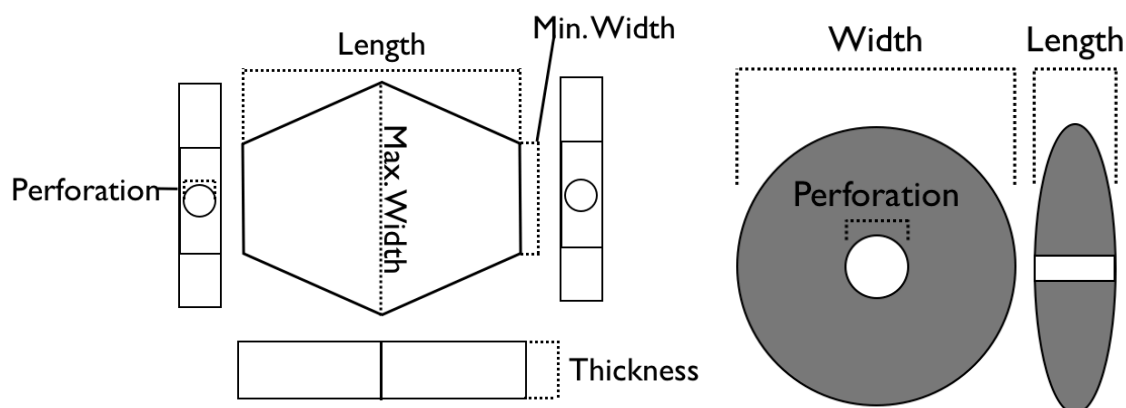


Figure 4.4: Major measurements taken on stone beads (left) and glass beads (right).

Methods of recording glass beads

Most glass beads in this study are of a type known as Indo-Pacific beads (see discussion in Chapter 7). Due to the overwhelming similarity of the beads encountered, patterns in the distribution of the glass beads were initially limited to bead color. It was not until compositional analysis was undertaken that clearer patterns in the glass types could be determined (discussed below). However, there were also additional attributes identified related to the manufacturing technique of the glass beads (Table 4.2, see also Appendix 7.1). Identifying patterns related to the manufacturing method did assist in the identification of a unique glass type found in Northeast Thailand that appears to have been wrapped (Chapter 7).

Variables recorded for glass beads
-Number of beads in entry (if recorded as a group). -Glass color -Opacity: opaque, translucent, transparent -Manufacturing method: drawn, wound/coiled/molded/other -Angle bead was cut from tube -Roundness factor

Table 4.2: Glass bead attributes recorded.

Bead Shape

As with stone beads, the shape of the glass beads was also recorded. The majority of the glass beads recorded were Indo-Pacific beads. These beads are generally spherical or oblate shaped and their shape was usually recorded as “Indo-Pacific bead.” However, some Indo-Pacific beads were tubular, or longer than they are wide. Still others were very small, less than 2mm and were identified as “Indo-Pacific Micro Beads.” Shapes of other non-Indo-Pacific beads were also recorded, including segmented beads, and collared beads (see Chapter 7 for a more detailed discussion).

Glass Color and opacity

Glass colors were recorded for each glass bead. As determining color can be subjective, broad color categories were used including: red, orange, yellow, green, black, grey, brown, violet, white, cream, and clear. There were several shades of blue and distinguishing between them could be difficult. A decision was made to simply distinguish between light blue and dark blue, which was often a cobalt blue color. It was also noted if beads were opaque, when no light passed through the bead, transparent, when light passed easily through the bead, or translucent, when diffused light could pass through a bead. However, these opacity determinations were not discussed in depth in the current study.

Manufacturing method

A preliminary assessment regarding the manufacturing method of the glass beads was also recorded. As noted above, most beads were Indo-Pacific beads that were cut from long, drawn tubes. These types of beads have unique identifiable longitudinal striations as a result of the drawing technique (discussed in Chapter 7). A small number of beads were made using other techniques such as winding, coiling, or wrapping (Figure 4.5).

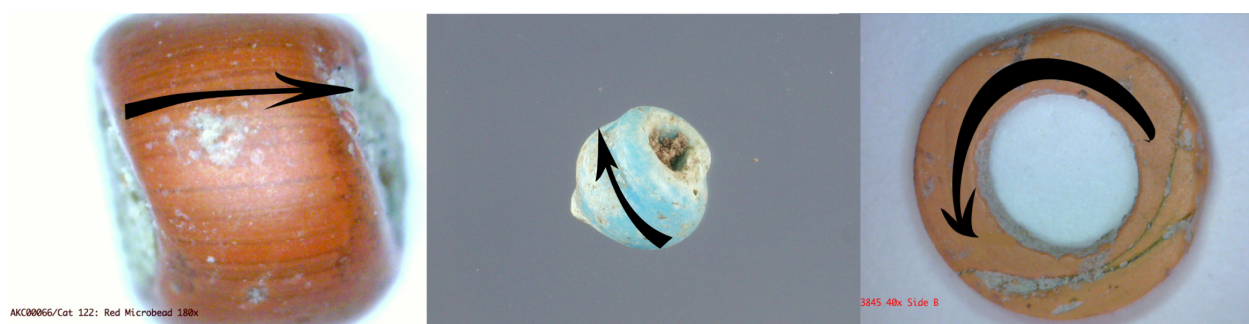


Figure 4.5: From left to right- Example of an Indo-Pacific drawn bead with longitudinal striations from the drawing technique, a coiled bead, and a wrapped bead.

Angle bead was cut from the tube and the roundness factor

In his work on Indo-Pacific beads, Francis has suggested recording two aspects of the beads in order to help assess their shape (2002: 25-26). The first is noting the angle the bead was cut from the tube, if it was cut with two straight parallel angles, if it was cut with two converging angles, or if it was cut with one angle. The roundness factor (Figure 4.6) is related to how long the cut beads were reheated. Francis notes “a low temperature and a short period of the fire will just barely round off its edges. On the other hand, a high temperature and/or a lengthy time over the fire will result in a small oblate,” (2002:26). In recording beads, I found that most Indo-Pacific beads had a roundness factor of R2 or R3. However this method was helpful for identifying several beads that had an R1 roundness factor that was unique. These beads were later found to have a less common glass bead composition. When analyzing a group of similar

Indo-Pacific beads as a single entry, these attributes were not recorded as a large group of beads may have multiple different attributes.

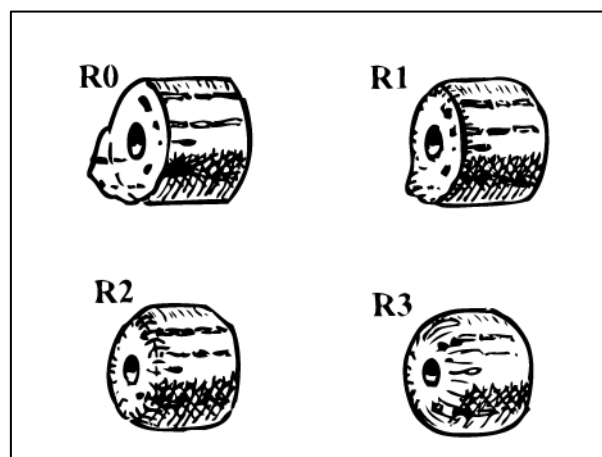


Figure 4.6: Roundness factor for glass beads.

Reprinted with permission from *Asia's Maritime Bead Trade* by Peter Francis, Jr. Published by the University of Hawai'i Press, Honolulu.

The attributes discussed above for the glass, agate/carnelian and garnet beads were used to describe the beads examined as part of this study and begin to determine where and when identifying preliminary characteristics related to their manufacture. By looking at the distribution of these characteristics within a site and between sites one is able to begin identifying patterns in the distributions of certain types of beads over time and space. However, many of these beads may look similar to one other but may have been made using very different stone geologic sources or glass recipes. Additionally, I wanted to determine if local stone sources were being used to produce beads, if the Period 1 and Period 2 type agate and carnelian beads were being produced from different geologic sources, or if different colors of glass beads were related to differences in their glass recipes. For this reason, compositional analysis is needed in order to come to a deeper understanding of the different types of beads in circulation.

Compositional Analysis

Following analysis of the stone and glass beads in the field, a selection of the beads were for further compositional analysis. As discussed in Chapter 1, I selected glass and stone bead samples from most of the 12 sites in this study. Beads were selected to represent the range of bead diversity found at the site, but were not a statistically significant sample. Whenever possible, beads were selected from secure burial contexts, however some unique or unusual beads from non-burial contexts were also selected. Dr. Charles Higham selected glass beads from Noen U-Loke for LA-ICP-MS analysis as they represented samples that had already been exported from Thailand. Dr. Bérénice Bellina selected stone beads from Khao Sam Kaeo for LA-ICP-MS analysis as they represented beads for which she had relatively secure contextual data, but were not amongst the more unique and valuable beads in the collection of the Suthiratana Foundation.

The purpose of the compositional analysis was to determine which geologic sources were being used to produce the stone beads and which glass recipes were being used to produce the glass beads. With this additional information I would be better able to identify patterns in the distributions of specific bead types. Furthermore, identifying the presence of stone beads made using local Southeast Asian sources could indicate increasing control over the production of these materials by Southeast Asian elites. In order to identify the geologic sources used to produce the stone beads, numerous agate/carnelian and garnet geologic source samples from South and Southeast Asia were also analyzed.

LA-ICP-MS analysis was chosen as an ideal technique for analyzing archaeological artifacts as no sample preparation is required and it is virtually non destructive. A laser 50-100 microns in diameter is used on the materials, which produces a small pit barely visible to the naked eye. The analyses were performed at the Elemental Analysis Facility (EAF) at the Field

Museum in Chicago, Illinois, which is managed by Dr. Laure Dussubieux. The technique to analyze the glass and stone materials is roughly similar.

The equipment used includes a Varian (now Bruker) quadrupole ICP-MS connected to a New Wave UP213 laser unit. LA-ICP-MS is composed of three major components. The first is the laser sampling system. Samples were placed in a-chamber with continuous helium gas flow-through and a laser beam focused on the sample. For glass beads and objects a laser 55 microns in diameter was used, while a laser 100 microns in diameter was used for garnet, agate, and carnelian samples. As the laser is ablating the sample, particles are transported via the helium gas to the second component, an argon plasma torch, which dissociates the particles into constituent ions. The final component is the quadrupole mass spectrometer. The quadrupole flight path through the spectrometer separates the ions by mass and charge before they are measured in the ion detector. Detection limits for most elements range from 10 parts per billion (ppb) to 1 part per million (ppm), with an accuracy of 5-10% depending on the elements and their concentrations. The ICP-MS was set to scan the mass range three times and average the resulting signal. This process was repeated three times, for a total of nine replicates. The nine replicates were then combined into a single average, and this process was repeated at different locations on the sample. For glass beads and objects this was repeated at four locations per sample, for garnet objects it was repeated at five locations per sample, and for agate and carnelian objects it was repeated at ten locations per sample. The locations for sampling were randomly selected from the portion of the sample that was clearly visible within the chamber. However, for samples that were visibly heterogeneous, such as banded agates, locations were selected to reflect the range of variation within the sample. The data from each of the four, five,

or ten point ablations were then averaged together to calculate elemental concentrations in each sample.

In order to obtain quantitative data, four glass standards with known compositions were also analyzed. National Institute of Standards and Technology Standard Reference Materials (NIST SRM) 610 and 612 are silica glasses made with sodium and calcium and doped with varying levels of trace elements, approximately 500 ppm for NIST SRM 610 and 50 ppm for NIST SRM 612. Corning glass standards B and D were also used for the analysis of major elements. Corning C, a lead glass, was used during analysis glass beads. During analysis, NIST SRM 610 and another glass standard were run every three to four samples in order to correct for possible instrumental drift. Silica (^{29}Si) was used as an internal standard. As part of the calibration procedure, the Si concentration was measured for each analysis location along with all other elements. These were averaged to produce a value for the sample as a whole. The analytical protocol and calculation methods used were adapted from Gratuze (1999).

Following analysis, the concentration of elements in each sample were calculated using an excel program designed by Dr. Dussubieux with the aid of Dr. Bernard Gratuze (a detailed account of the calculations involved in this process are described in Gratuze 1999:873-874). For each sample the blank was subtracted and average values were calculated. The data was then normalized using the silica signal of the standards and corrections were made for isotopic abundance ratios and interferences.

Assigning stone beads to regional geological source areas

Following analysis of the stone artifacts and geologic sources samples, exploratory data analysis using principal components analysis (PCA) and bivariate plotting of elements was used to distinguish between the geologic sources and identify differences between them. Canonical

discriminant analysis (CDA) was used to assign artifacts to the geologic sources. However, prior to beginning statistical analysis, I used my own method, described below, to determine which elements were more homogeneously distributed within a sample and were therefore more ideally suited to statistical analysis. Following this, the geologic sources needed to be differentiated from one another. In order to distinguish between the sources and identify differences between them exploratory data analysis was performed using bivariate plotting of elements and principal components analysis (PCA).

Determining the heterogeneity of the elements within a sample

As noted above, agate samples were ablated at ten points per sample while garnet beads were ablated at five points per sample. However, I discovered that many of the 55 elements were heterogeneously dispersed within the sample. This resulted in a high relative standard deviation (RSD) for the average of the ten ablations. Relative standard deviation is a measure of the precision within data analysis and is calculated by taking the standard deviation of a series of a series of values, in this case the measurements for a single element across a series of ten ablations, dividing this number by the average of the series of values and multiplying by 100.

Scholars have noted that heterogeneous objects may be difficult to characterize using LA-ICP-MS (e.g. Roll et al. 2005:60). Therefore, having a method in which to identify those elements that were more homogeneous within a sample would allow me to rely on these elements for my calculations. For this reason, I randomly selected four to five samples from each source, for a total of 62 samples, and looked more closely at the relative standard deviation produced during the ten point ablations. For each element I counted how many of the selected samples had an RSD between 0-10.99%, 11-20.99%, 21-30.99%, 31-40.99%, 41-50.99%, and over 50%. Elements were then assigned to either the less variable category (60% of samples

with an RSD under 30.5%), variable (Samples with RSD between 30.5% and 50.5%) or most variable (50% of samples with an RSD over 50.5%). Once the elements were classified in this manner, I began my statistical analyses. While I tried to rely on elements that were considered to be less variable, occasionally the use of variable or more variable elements was necessary in order to discriminate between specific sources.

Differentiating between the geologic sources

Three exploratory data methods were used to differentiate the geologic sources from one another. First, Bivariate plotting used the values from two elements to plot a simple X-Y scatterplot using Excel. This technique provided a quick visual method for identifying obvious differences between the geologic sources. This was followed by PCA in order to determine additional elements important for distinguishing between geologic sources. Lastly, **ternary diagrams** were used when evaluating the garnet compositional data. There are several species of garnet, which differ based on the major elements. These species have been sub-divided into two series in which there is fairly continuous variation (see Chapter 8). Using ternary diagrams to plot three major elements allows for a way to visualize the variation represented in the samples. This method is not used to assign the unknown artifacts to a source, but to recognize similarities and differences between the species of garnets represented.

Principal Components Analysis (PCA) was employed as an exploratory data technique on the agate, carnelian, and garnet geologic samples. For the current study, PCA was performed using the SPSS 20.0 statistical software program. The major element concentrations were converted from weight percent to parts per million, and all the data were logged (base 10). This method is ideal for examining the results of compositional analysis as it reduces a large number of correlated variables, such as the dozens of elements measured in LA-ICP-MS analysis, into a

smaller number of uncorrelated components. By reducing this large dataset into smaller components, it is easier to characterize the variation between the different geologic groups (VanPool and Leonard 2011). The first component produced accounts for the most variation within the entire dataset. The second component condenses the remaining variation in the dataset, and so on with successive components until all the variation has been accounted for. For the current study, I used the Aabel 3.0 software program to produce bivariate and trivariate scatter plots of the various components (e.g. component 1, component 2, and component 3) as a way to visualize the data. As there were often 8-10 components produced in this analysis, there were multiple scatterplots produced. In some plots, it was clear that specific geologic groups from a single source were clustering together and away from the other sources. I then consulted the factor loadings table produced by SPSS, which indicates the correlation between each variable (element) and the component. In this way I was able to narrow down the elements that were most significant and that would be used in the next phase of data analysis used to assign the artifacts to a geologic source.

Assigning stone bead artifacts to a geologic source

In the next stage of statistical analysis, the artifacts were assigned to a geologic source group using a statistical technique called **canonical discriminant analysis** (CDA). In previous geochemical compositional studies of stone artifacts, CDA was found to be the most effective method for differentiating geological sources and assigning provenience to artifacts (Law 2008; Law et al., in press). CDA begins by assuming that within a single dataset there are distinct groups, and that all possible groups are represented in these dataset (Baxter 1994: 185-6). CDA then produces discriminant functions, or linear combinations of variables that display and maximize the difference between the assigned groups. The number of discriminant functions

produced is always one less than the number of groups in the dataset. The results of CDA can then be visualized by plotting the first and second functions on a bivariate scatter plot, as these two functions are often the most useful for demonstrating the difference between groups (Baxter 1994:188). The individual members (cases) of a group are plotted by their discriminant score, “which are the values that result when discriminant functions (unstandardized canonical discriminant function coefficients) are applied to each case,” (Law 2008:80). In order to more accurately measure the discrimination success between the groups, I also performed cross-validation using the “leave-one-out” function in SPSS. In this method, each sample is left out of its assigned group and compared to the entire dataset as an ungrouped case. A cross-validation success percentage is produced, which is related to the number of cases that are correctly assigned to the group to which they belong. This method allows for a more accurate measurement of group separation (Baxter 1994; Kovarovic et al. 2011; Law 2008). When the first and second discriminant functions are plotted in a scatter plot, ideally one should have clusters of distinct, discrete groups that correspond to the known groups with no misclassifications or overlap.

The second aspect of CDA involves classifying a group of unknown samples (the stone artifacts) to the defined groups that they most closely resemble (geologic sources). As with the “leave-one-out” classification described above, these samples are treated as ungrouped cases. The mean of the defined groups’ discriminant scores is called the group centroid. The discriminant score of the ungrouped cases is compared to the group centroids and their similarity or dissimilarity is determined, producing a Mahalanobis distance value. The Mahalanobis distance between each unknown case and each defined group is determined, and the ungrouped cases are assigned to the group with whom they have the smallest Mahalanobis distance value.

However, it is important to note that this group assignment does *not* mean that the cases conclusively belong to their assigned groups. CDA assumes that all possible groups are present and will always assign an ungrouped case to a group. In reality, the group assignments could change as additional geologic sources are added to the dataset. As the current study was only able to analyze a limited number of geologic sources, we should consider the group assignments to merely reflect predicted group membership. Additionally, unknown cases can easily be misclassified due to similarities between the different defined groups (geologic sources) or because the case itself is an outlier of a group. The CDA in SPSS produces two possible group assignments and the second group was considered on a case-by-case basis (Law 2008).

It is important to note that while I have tried to gather samples from as many geologic sources as possible, the present study includes only a small segment of all the possible sources that could have been used to produce agate, carnelian, and garnet beads during the Iron Age period. For this reason, the predicted group membership for the stone beads discussed in Chapters 5, 6 and 8 should be taken as provisional.

A Fisher's Exact test was used in Chapter 6 to determine if there was a difference in the agate and carnelian sources used to produce Period 1 beads versus Period 2 beads. A Fisher's Exact test is an ideal method to use with smaller sample sizes that have been classified with categorical data. A 2x2 contingency table was used to calculate a p-value (see VanPool and Leonard 2011: 250-2 for a more detailed discussion of the mathematics used to produce this value). A p-value greater than .05 means that we cannot reject the null hypothesis that two groups are equal.

Using compositional data gathered from geochemical analysis using LA-ICP-MS, I was able to determine the probably general geologic source area for the majority of the

agate/carnelian beads in this study. The geologic source area for a small portion of the agate/carnelian beads as well as the garnet beads is still unknown. These data, combined with the attributes discussed above, allows me to identify patterns in the distribution of specific types of beads across time and space. In this way I have been able to test if Phase 1 and Phase 2 beads were produced using the same raw material source, if there is evidence for the use of Southeast Asian raw material sources to produce beads, and if certain bead shapes were made from the same or different geological sources areas. The resulting patterns were then used to interpret the role of the Mekong Delta sites in the distribution of specific bead types.

Determining glass types

Compositional analysis of glass beads was more straightforward than for the stone beads. There have been extensive compositional studies of the different types of glass in circulation in Southeast Asia during the Iron Age period (e.g., Dussubieux 2001; Dussubieux and Gratuze 2003; Lankton and Dussubieux 2006, 2013). A recent study by Lankton and Dussubieux (2006) has provided a detailed table of glass compositional groups and their reduced compositions that have been further refined in more recent publications (e.g. Dussubieux et al. 2010; Lankton and Dussubieux 2013; Lankton et al. 2008). LA-ICP-MS data from the glass artifacts in the current study were compared with these previously identified groups and then assigned to glass type based on the similarities in their compositions.

These glass types were made from three important components: silica, fluxing agents, and stabilizing agents. The primary component of glass is silica (SiO_2), the source of which was generally sand or quartz pebbles (Henderson 2000). Because silica has a high melting point, fluxing agents were added in order to facilitate the melting process. The two principal fluxing agents were potassium oxide (potash, K_2O) or sodium oxide (soda, Na_2O). These fluxing agents

were often derived from plant sources, however soda from mineral deposits was also used (Henderson 2000). The last important component of glass was the stabilizer, which prevented the glass from dissolving in water; the most common stabilizers were lime (calcium oxide, CaO) and Alumina (aluminum oxide, Al₂O₃) (Turner 1956). Other elements found in glass include intentionally added opacifiers or coloring agents, such as antimony, tin, cobalt, copper, lead and iron, along with naturally occurring impurities. Glass recipes can vary depending on the different types and amounts of silica, fluxing agents, and stabilizers used.

Some glass recipes are also identified with a specific time period, region, or workshop. However, this is not always clear as recipes can be used in multiple locations and over hundreds of years. Furthermore, a single glass production workshop may use several different recipes to make glass beads (Lankton and Dussubieux 2006). Nevertheless, LA-ICP-MS allows for the identification of the different glass recipes used to produce the glass artifacts examined in this study. Generally the assignment of the glass artifacts to different glass types was clear-cut. However, I occasionally used bi-variate scatterplots or PCA to distinguish between different glass types whose compositions were not immediately clear.

Compositional analysis of glass beads was especially effective for identifying patterns in the distribution of different glass types that were not immediately obvious by looking at the bead attributes alone. The identification of specific glass bead types at sites also allows for their placement into broader glass bead exchange networks linking areas within mainland Southeast Asia and between South Asia and Southeast Asia.

Determining the drilling methods of garnet beads

In addition to recording bead attributes and examining bead compositions, I also examined the drilling methods used on the garnet beads by taking impressions of the bead

perforations and examining these under a scanning electron microscope (SEM). Previous studies have found that drilling methods are culturally specific (Kenoyer 1992a), therefore identifying the drilling method used to produce a bead may give one clues as to when and where a bead may have been produced. Impressions also allow for a clearer view of the bead perforation size and shape (Figure 4.7c), which is useful for understanding the type of drill used to make the bead.

While I had initially intended to use this methodology on both agate/carnelian and garnet beads, I narrowed the focus to garnet beads alone due to time and financial restrictions. Furthermore, visual inspection and preliminary examination using a digital microscope of the bead perforation impressions from the agate and carnelian bead showed that nearly all appeared to have been drilled using a double-diamond drill (see discussion in Chapter 8). However, the bead perforations on the garnet beads were unique and warranted further inspection.

Impressions of the bead perforations or holes were taken in the field using silicone dental impression material following a method pioneered by Gorelick and Gwinnett (1978) and further revised by Kenoyer and Vidale (1992). The impression material is forced through the bead hole and allowed to set, when removed it producing a perfect cast of the interior of the bead hole (Figure 4.7a-c). Impressions were brought back to the United States and a selection was chosen for SEM analysis in the Biological & Biomaterials Preparation, Imaging, and Characterization Laboratory (BBPIC) at the University of Wisconsin-Madison. The impressions were first mounted on a metal slide and glued in place using colloidal silver and left to dry over night (Figure 4.7d). Once at the BBPIC, the samples were placed in a SeeVac Auto conductavac IV sputter coater, and evenly coated with 10-20 nanometers of a 60/40 gold/palladium alloy. Without this metal coating, the electrons in the SEM could damage the sample and cause imaging problems.

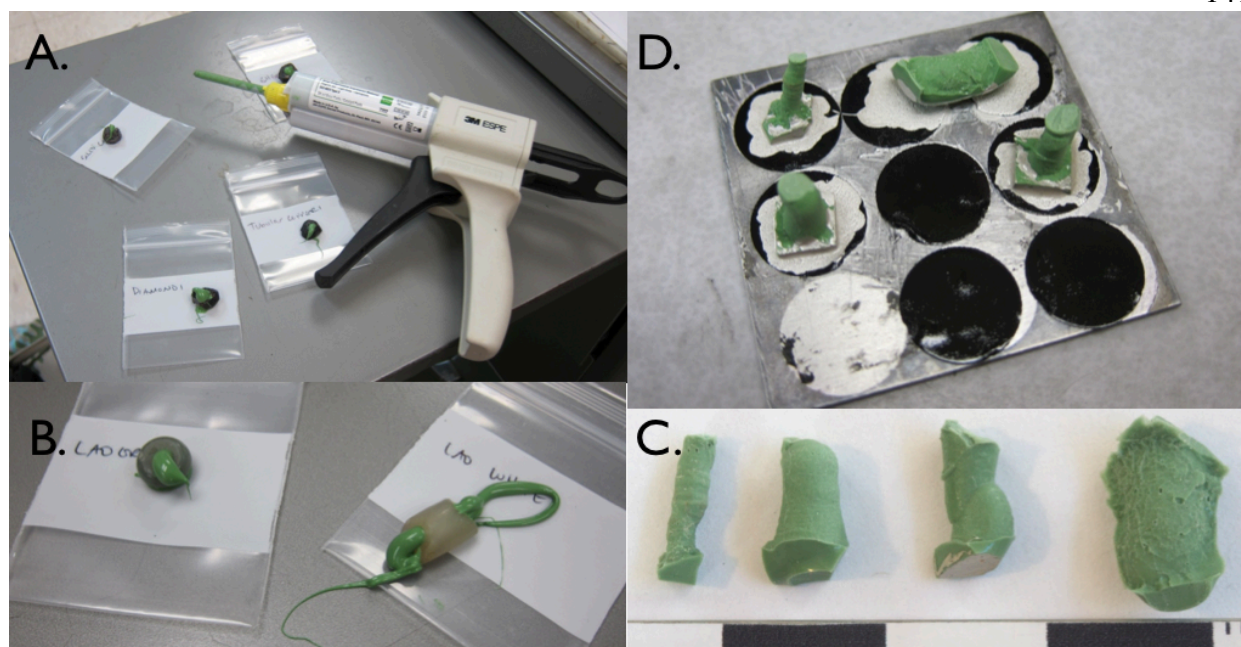


Figure 4.7: A. Taking impressions of stone bead perforations using dental impression gun. B. The beads with impression material while it is setting. C. The impressions after removal from the beads showing the different shapes of the interior perforations. D. The impressions mounted on a slide for SEM.

Once coated, the samples were then placed in the SEM chamber and images of the impressions were taken at multiple magnifications from 25-35x magnification, approximately 50x magnification and approximately 100x magnification. Previous research has highlighted the effectiveness of SEM in determining the drilling method (see Gorelick and Gwinnett 1988; Gwinnett and Gorelick 1986, 1998; Gorelick et al. 1996). However more recent research has emphasized the importance of using high-resolution SEM images to determine the different drill types (Kenoyer and Vidale 1992; Kenoyer 1997). SEM images were compared with SEM images from earlier experimental studies that tested different drilling techniques on a variety of stone materials. These comparisons provided a preliminary hypothesis regarding how the garnet beads were drilled. However, these must be further tested using experimental studies on garnet. These studies are ongoing, however they are outside the scope of this dissertation.

Examining the drilling methods used to produce garnet beads allows for the identification of a two distinct garnet bead types that were manufactured using two different drilling methods and with two distinct distributions. Examination of the drilling method also allows me to address questions regarding the control over distribution, as the identification of a drilling method that may be related to local manufacture has implications for control over the production of beads by Southeast Asian elites.

Conclusion

In this chapter I have discussed the various methods used to identify patterns in the distribution of stone and glass beads over time and space. By recording visible attributes on stone and glass beads I am able to identify preliminary patterns regarding the distribution of Phase 1 and Phase 2 beads, the distribution of various agate/carnelian and garnet bead shapes, and the distribution of different Indo-Pacific bead glass colors. These preliminary patterns were then explored further by using compositional analysis on a selection of stone and glass beads. This type of analysis allows for an identification of the geologic sources used to produce the stone beads and the different glass recipes used to produce the glass beads. Using a variety of statistical methods, the geologic sources were distinguished from one another and stone artifacts were assigned to these sources. These data, when combined with the attribute data, allow for the identification of more specific bead types that share both a raw material or glass recipe, as well as a variety of other characteristics including shape, color, or manufacturing method. Examination of garnet bead perforations using dental impression material and SEM analysis provide another layer of information regarding the manufacturing methods used to produce these beads. By identifying these specific bead types over time and space, I have been able to detect patterns in their circulation. These patterns can then be related to the changing exchange

networks and increasing participation in trade by elites at sites in the Mekong Delta. In the next three chapters I will discuss the results of these analyses in more detail, beginning with the agate and carnelian beads.

Chapter 5: Agate and Carnelian Beads- Contextual and Morphological

Analysis

Agate and carnelian beads make up only a small portion of the total bead collection examined as part of this study, however the information collected will fill the next two chapters. In this chapter I focus on contextual, morphological, and metric data from agate and carnelian beads to address the following questions:

- Based on morphological and metric analyses, is there a pattern in the types of beads being traded over time and space and can these patterns be linked to trade networks?
- Does evidence from trade patterns suggest increasing involvement in the trade of these objects by elites in the Mekong Delta?

I begin this chapter by discussing the identification and variations in rocks that are referred to as agate and carnelian. I also review the archaeological and ethnographic evidence on major production techniques used in the manufacture of agate and carnelian beads in Southeast Asia and South Asia. The complexity of the technology and knowledge required to produce these beads adds value to their status as prestige objects. I then review previous studies of agate and carnelian beads in Southeast Asia, explore how the study of agate and carnelian beads has changed over time, and discuss hypotheses raised by more recent studies about the production and trade of agate and carnelian beads. I also provide an overview of Southeast Asian sites believed to have been agate and carnelian bead manufacturing centers. Following this review, I begin my discussion of the agate and carnelian beads included in this study and their context. Nearly all of the beads were found in burial contexts and the beads appear to have had a restricted distribution within sites, with only a few people at a site having agate and carnelian

beads and an even smaller number having a large quantity of these beads. This evidence also indicates that certain sites had greater access to agate and carnelian beads, or even certain types of beads, than others.

Following the contextual discussion, I examine bead types, quality, and perforation in more detail, noting patterns in the distribution of certain types of beads across the region. Two scholars (Bellina 2007; Theunissen 2003) have already noted patterns in the types of beads being traded over time and space, which is believed to be related to different trade networks and possible local production of beads. By evaluating the bead shapes and perforation sizes of the agate and carnelian beads I aim to show that beads from different sites in Cambodia and Thailand appear to have been a part of different trading networks. These data is then used to inform the geochemical study of agate and carnelian beads, which I discuss in Chapter 6.

Agate and Carnelian: Definitions

Agate and carnelian are sedimentary rocks made largely of microcrystalline quartz, and fall into the same family as flint, chalcedony, jasper and chert (Luedtke 1992). The term agate has generally been used to describe banded translucent rocks that are usually shades of white, grey, and brown. These colors are sometimes enhanced by bead-makers using a dying process, resulting in darker browns and blacks that archaeologists have called onyx (Francis 2002; Kenoyer 2003). Carnelian refers to translucent rocks that range in color from yellow, orange, and deep red, which are naturally occurring or enhanced by heating the stone (Kenoyer 2003). The formation processes of agate, carnelian, and chert in general are not well understood. However it is believed that most agates form in small cavities of other rocks, growing from the outside in (Luedtke 1992). Microcrystalline quartz is made primarily of silica with very small amounts of other impurities; it is these trace elements that aid in geochemically identifying geological

sources and assigning provenience to agate and carnelian artifacts. Agate and carnelian can be found today in primary contexts as part of host rocks, including dolomite or limestone, although many of the more outstanding examples of agate and carnelian form in volcanic rocks, specifically basaltic lavas (Luedtke 1992:33). However, agate and carnelians can form in any rock or even organic substance where silica can accumulate. Many agate and carnelian samples are also found in large secondary gravel deposits after having eroded from their host rock. These widespread secondary deposits can sometimes contain materials from multiple source locations, which can make “fingerprinting” these sources difficult. Samples from the same source can also have a high degree of variability (Luedtke 1992: 51). For this reason, it is important to know the geological context of the source being analyzed.

In addition to agate and carnelian, a small number of clear quartz beads were also examined. Clear quartz is part of agate and carnelian family and can sometimes be found in the same deposits with carnelian and agate. Although, clear rock quartz from South India does not occur with agates and instead comes from other deposits, (J. Mark Kenoyer, personal communication, 2012), quartz beads appear to be worked at the same Indian beadmaking sites as agate and carnelian (Francis 2002). Based on these similarities, I included a single quartz crystal bead from Angkor Borei with the rest of the agate and carnelian materials.

Agate and Carnelian Bead Production

Several ethnographic studies of modern beadmaking in India allow for a detailed understanding of the process of beadmaking from raw material acquisition to the finished product (Kenoyer et al. 1991, 1994, Possehl 1981; Roux 2000; Vidale et al. 1992, 1993). Recording the manufacturing waste and debris from the different stages of production can assist with identifying bead workshops in the archaeological record (Figure 5.1). The first stage

involves the acquisition of raw materials, which can be either found on the surface or mined.

Currently in Gujarat, state contractors control the mining of high-quality carnelian nodules. The raw materials are then sold to middlemen or sent to bead workshops in Khambhat (Kenoyer et al. 1991). After mining, the agate and carnelian nodules must then be dried in the sun for several months to remove any remaining moisture. Following this process, the nodules are slowly heated to approximately 340° C to remove any remaining moisture and allow the nodules to be more easily flaked and shaped. Large nodules are often sawn into smaller pieces in order to maximize raw material. The nodule can then be flaked into bead roughouts. In India a specialized technique is used called inverse indirect percussion, in which the bead nodule is held against an iron stake in the ground and hit by a hammer made from water buffalo horn to remove flakes and shape the bead. A bead roughout can continue to be shaped by chipping off additional small flakes or being ground on a grinding stone (Kenoyer et al. 1991; Kenoyer 2003).

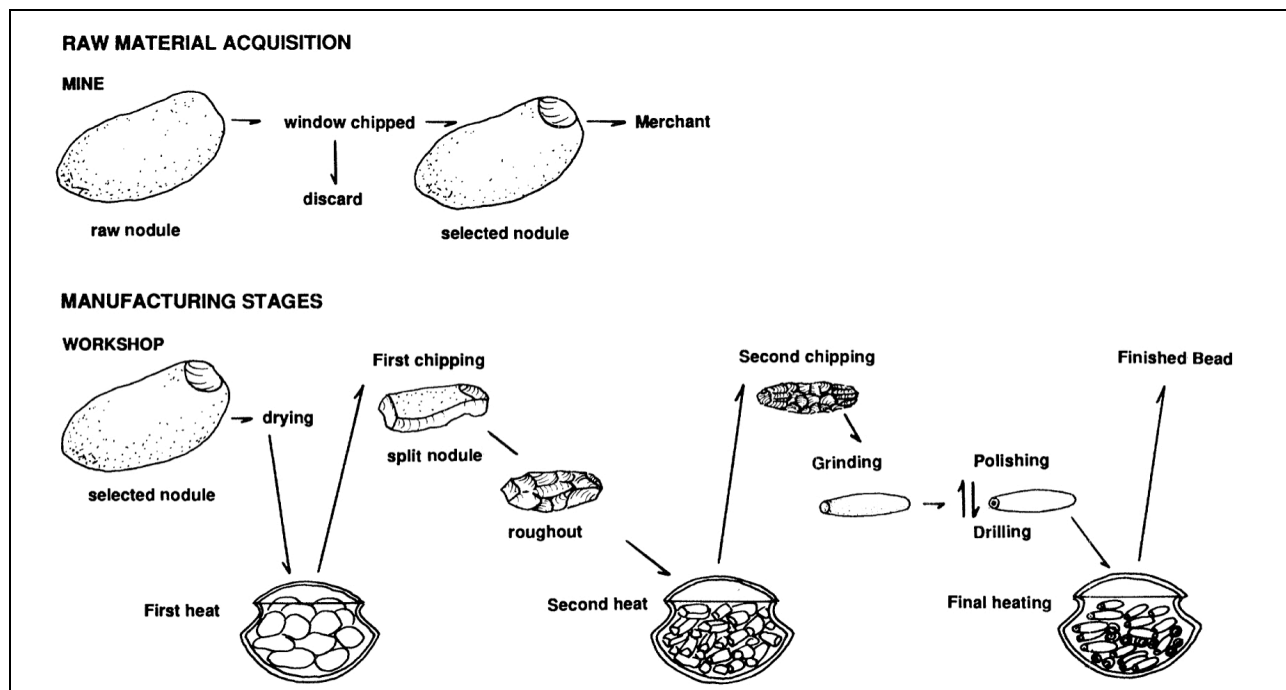


Figure 5.1 Agate and carnelian raw material acquisition and manufacturing stages. Image courtesy of J. Mark Kenoyer from Kenoyer, Vidale, and Bhan 1991: Figure 2.

The next steps in the process, perforation, heating, and polishing, can be performed in almost any order. Although, beadmakers often performed the polishing and heating stages after perforation, as many beads were broken during this process (Kenoyer 2003). In the perforation stage, the bead is drilled to create a hole. In India, a diamond tipped drill has been used to perforate beads since at least 600 BC (Kenoyer 2003). Modern Indian bead drillers use a special drill with two diamond chips mounted on the drill tip (Kenoyer and Vidale 1992). These two chips mounted on the side of the iron drill tip result in a straight cylindrical perforation, with distinctive spiraling striations from the drilling. The size of the drill hole depends on the size of the diamond chips and the overall mounting on the drill tip. This double-diamond technique appears to be limited to South Asian bead makers, specifically peninsular India and is still widely practiced in Khambhat, Gujarat (Kenoyer et al. 1991). Single diamond drills, in which a single diamond chip is inserted into the tip of a metal drill, were also used. However this drill type is more commonly found in the northern and western parts of Asia (Kenoyer 1992, 2003).

Most beads are currently polished using electrically powered abrasive wheels or tumbling barrels. However, in the past polishing was done by hand, for example by using abrasive wheels made from a mixture of insect resin (lac) and emery or corundum powder that were hand turned on a lathe (Kenoyer et al. 1991). Polishing could also be done using grinding stones or abrasive on a wooden or leather surface (Kenoyer 2003). These processes were time consuming, taking several hours or several days per bead. However, a mass polishing technique was introduced, perhaps as early as the third century BC (Kenoyer et al. 1991:54), in which a group of beads was put in a watertight leather bag with water, and abrasive powder or corundum. The bag was then rolled back and forth for 15 days, producing beads with a low-luster polish (Kenoyer 2003).

Agate and carnelian beads could also have their color enhanced by additional heating.

Brown and white agate beads can be soaked in a sugar solution, which saturates the stone (Kenoyer 2003). When heated, the sugar darkens the stone to a deep brown or black. Additional heating of carnelian beads can produce a deep red-orange color due to the iron present in the stone; heating a bead seven to ten times can produce a deep red color (Kenoyer et al. 1991).

As part of my research I recorded various aspects of the agate and carnelian beads that are related to different steps in their manufacturing process. Understanding the techniques used to make agate and carnelian beads is important for identifying similarities and differences in the production process that may be related to specific workshops or manufacturing locations. Furthermore, it is important to understand the technological complexity involved in manufacturing beads so that discussions of production in Southeast Asia can be critically evaluated.

Agate and Carnelian Beads in Southeast Asia

Agate and carnelian beads have been found across sites in Southeast Asia. Early scholars assumed that all these beads were made in South Asia and imported to Southeast Asia. However as early as the early 20th century, scholars suggested that beads might have also been locally produced in Southeast Asia. In this section, I will describe some of the previous research on agate and carnelian beads in Southeast Asian, concluding with a discussion on local production.

Previous research on agate and carnelian beads in Southeast Asia

Early scholars and researchers were aware of the importance of stone beads found at sites in Southeast Asia, with many immediately recognizing the connections with India or even Rome (e.g., Gardner 1937). This earliest phase of research focused on describing beads and classifying them based on size, shape, and raw material type. The primary purpose was to identify

similarities to beads found at other sites, in order to recognize trade contexts and loosely date sites to a specific time period (e.g., Beck 1930). Other scholars identified similarities between ancient beads they found and others being used and worn by modern populations (Evans 1928, 1932), indicating the potential for curation of ancient beads.

In the 1970s and 80s, looting and subsequent excavation at the sites of Ban Don Ta Phet (BDTP) and Khlong Thom (also called Khuan Luk Pad) turned up additional unusual and diagnostic types of beads. These beads highlighted the intensive trade between India and Southeast Asia (Glover 1989). A leaping lion bead found at BDTP showed a striking similarity to lion pendants found at Gandharan reliquaries in northern India. The presence of this type of bead at BDTP suggested the presence of both Indian goods and ideologies in Southeast Asia prior to the presence of sculpture and images (Gupta 2003).

Beads from BDTP were amongst the first to undergo comprehensive scientific study (Basa et al. 1991; Basa 1991; Gorelick et al. 1996; Williams 1984). Analysis of the drill holes on stone beads showed that they were made with a diamond tipped drill, analogous to those found in India. Furthermore the beads showed evidence for hand polishing (Gorelick et al. 1996). A unique bead type frequently called etched beads was also found at Ban Don Ta Phet, among other sites. Etched beads generally refer to a bead that has a design painted on the surface. Recent scholars have sometimes used the term “alkaline-etched” to refer more specifically to the beads that have been painted with a sodium carbonate mixture (Glover and Bellina 2001). These beads may have also been referred to as Bleached Carnelian as the surface decoration does not in fact etch the surface as explained by Kenoyer (2003). I use the term etched as it is commonly used in Southeast Asia, although technically not accurate. Etched beads from BDTP were examined using an Energy Dispersive X-Ray Analyzer (EDAX) in order to identify the recipe

used to etch the bead (Glover 1989: 25-6). Unfortunately, it was difficult to determine the presence of sodium carbonate using this technique.

Etched beads were initially produced during the Harappan period during the 3rd millennium BC, but were also made during a middle period (300 BC- AD 200) and late period (AD 600-1000) in India (Beck 1933). Several scholars have classified these beads based on their surface designs and the period in which they were found (Beck 1933; Dikshit 1949). The majority of etched beads in Southeast Asia are either carnelian with a white design or a dark brown or black agate with a white design (Glover and Bellina 2001, 2003). A recent study (Glover and Bellina 2003) has examined the distribution of these beads and found that while many are similar to those found in India (Beck middle period Type 1 and 2), there are also numerous types of beads that are common in India but rarely found in Southeast Asia and vice versa.

Research on the different types of beads found in Southeast Asia and their distribution has been greatly expanded by Bérénice Bellina (2001, 2003, 2007; Bellina and Glover 2004). In her work, Bellina examined over 1400 beads from South and Southeast Asia (2001, 2003, 2007). Approximately one third of the beads were from protohistorical Indian sites, including Hastinapur and Ahichhatra in northern India, Mahurjhari, Ujjain, and Mahurjhari, in central India, Sisupalgarh in eastern India, and Brahmagiri, Arikamedu, Karaikadu, and Kodumanal in southern India. The remainder of the beads (n=860) were from 28 Southeast Asian sites in Bali, Java, Malaysia, Myanmar, the Philippines, Thailand, and Vietnam. Bellina examined the raw material, size, shape, perforations, and finishing techniques of all of these beads in order to identify patterns in the types of beads found at South Asian sites versus Southeast Asian sites, as well as beads from sites dating to different time periods in South and Southeast Asia. As she

was unable to take beads out of the country, she also had high-quality resin replicas produced for further microscopic examination in order to determine the finishing processes used to produce the beads. Her results show that beads can be divided into two periods that relate to the two phases of interaction with South Asia discussed in Chapter 3 (Bellina and Glover 2004). Period 1 type beads are primarily found during Phase 1 exchange with South Asia (approximately 4th century BC – 2nd century AD) and are predominantly finely made beads with complex shapes, such as faceted beads, etched beads, and animal shapes. Bellina has observed that some of these Period 1 beads found in Southeast Asia had no analog in India and yet they were produced with high-quality Indian manufacturing techniques. Bellina argues that these beads are reflective of beads “made-to-order” by Southeast Asian elites who preferred beads in a local style. Some of these unique shapes include octagonal faceted bicones or flattened elliptical collar beads. Bellina (2003: 293) contends that these beads are reflective of an “active role” that Southeast Asians took in their exchange relationships with Indian traders and craftsmen; “by giving direction to Indian production and supply, Southeast Asian elites also took part in shaping the inter-regional exchange network.”

During the second phase of interaction with South Asia, Bellina observed a shift to Period 2 type beads that were generally of a lower quality beads but appearing in higher quantities. Although she notes that there continued to be smaller quantities of the high-quality Indian beads seen during the earlier period. Bellina (2003, 2007) notes that the mass-produced lower-quality beads coincide with the emergence of Southeast Asian manufacturing centers. For this reason, she argues that these lower-quality beads were local productions and that elites at important trading centers were keeping the higher-quality beads for themselves and trading the lower quality materials inland. While this hypothesis is one interpretation for the pattern of agate

and carnelian beads observed, the assumption that all lower quality beads were produced in Southeast Asian workshops is problematic as the evidence for local production of these materials is not clear. Lower quality beads could have been produced at workshops in South Asia and imported to Southeast Asia. The distribution of lower-quality and higher-quality beads could also reflect cultural choices regarding the types of beads being traded or deposited in burials. While I agree with Bellina's observations regarding the presence of Period 1 and Period 2 types beads, there is not yet enough archaeological evidence to support her interpretation regarding local production of lower-quality agate and carnelian beads.

In his dissertation research Robert Theunissen (2003) traced the movement of specific bead types, such as black and white banded agate beads, long faceted carnelian beads, and notched agate pendants among other shapes, over time and space identifying potential trade networks and changing trade over time. More details on these networks will be discussed at the end of this chapter. However it is important to note that like Bellina, Theunissen also observed a difference in the types of beads being traded and their distribution over time. During the early Iron Age, Theunissen argues that beads were likely exchanged between elites at a smaller scale, with little evidence that elites within a core area were controlling the trade. Evidence for this is largely due to a lack of evidence for direct Indian-controlled trade. As beads had to travel through diverse communities overland, by river, and along the coast Theunissen (2003: 141) argues that local elites "must have exercised some control." However, during the later Iron Age phase Theunissen notes that there are large quantities of beads at sites in the Thai-Malay peninsula that were on a direct route from India. Theunissen (2003: 143-6) contends that Indian traders might have controlled bead distribution at these sites. However inland areas of mainland Southeast Asia appear to have been exchanging beads through an "elaborated prestige goods

exchange” network, with three sites that could potentially control trade of both imported objects as well as local production of artifacts.

However, upon more critical examination, it is evident that the sites that he proposes were controlling trade, Oc Eo in Vietnam, sites in the southern Thai peninsula, and a site near the central Thai agate source of Ban Khao Mogul, have little archaeological evidence to support this conclusion. For example, proposed manufacturing sites at Oc Eo and on the Thai-Malay peninsula have been heavily looted. While some manufacturing debris, as well as unfinished and undrilled beads have been identified in these locations they do not come from clear workshop contexts. Furthermore, the proposed site near the Ban Khao Mogul agate sources has not been identified. Nevertheless, Theunissen and Bellina’s work has done much to expand our understanding of the agate and carnelian bead trade in Southeast Asia. Their evidence shows that Southeast Asian people were directly involved in the consumption, distribution, and possibly the production of important prestige objects, in contrast to early views that assumed Southeast Asians had taken a more passive role in trade relations.

Determining the value of agate and carnelian beads

Several scholars have also discussed the value or symbolism of agate and carnelian beads found in Southeast Asia (Bellina 2007; Gupta 2003; Theunissen 1997, 1998, 2003, 2007; Theunissen et al. 2000). The scholar Sunil Gupta has suggested that beads were more than trade and status objects, but could in fact be interpreted as objects of “proto-Indianization,” (Gupta 2003: 395). In his model, the etched and animal-shaped beads were specifically related to an aniconic religious tradition in circulation several centuries prior to the appearance of Indian religious sculptural traditions. Gupta (2003: 404) argued that this seemingly “sudden” appearance of Indian iconography “could only happen when the indigenous communities of

Southeast Asia had prior knowledge of the religious ideas underlying Buddhist/Brahmanical iconography.” However, Gupta also notes that many Southeast Asian people most likely projected their own beliefs and ideologies on to the agate and carnelian beads as well.

On a smaller scale, Theunissen (1997, 1998, 2003, 2007; Theunissen et al. 2000) has examined the impact of agate and carnelian beads at sites in Northeast Thailand. Theunissen analyzed agate and carnelian beads found in Iron Age burials at Noen U-Loke. In order to assess the impact of the introduction of agate and carnelian beads on the Noen U-Loke community, Theunissen first had to identify the value of the beads in relation to other grave goods; evaluating them based on their physical traits, rarity of material, exoticness, the labor used to produce the object, and the skill/technology needed to produce the artifact. In his evaluation, agate and carnelian beads were the highest valued objects placed in graves, even more valuable than gold beads (Theunissen 2003: 199-203). The notched agate pendants may have been especially valued, as several were repaired after having been broken and continued to be used as ornaments prior to inclusion in the burial (Theunissen 1998).

Theunissen (2003: 211) also found that burials with agate and carnelian beads also had other high-value grave goods, making them amongst the wealthiest at the site. However, these beads were not highly restricted to only the most elite members of the community, as nearly one third of the burials contained these beads. Instead, Theunissen argues the inclusion of these beads signaled a shift in mortuary ritual at Noen U-Loke. During the earlier phases of the site communal feasting appears to have been associated with “the pursuit of prestige and power;” however with the appearance of agate and carnelian beads “there is a shift to the storage of wealth as durable and wearable personal ornaments used for the acquisition and expression of prestige, social status, and power” (Theunissen 2003: 220).

Bellina (2007) also supports the idea that in the earliest period of exchange with India, agate and carnelian beads were important symbolic status markers for elites. However, she points out that we know very little about the nature of exchange and the relationships in which prestige goods were exchanged. Despite this, a preexisting network that circulated Dongson drums, and nephrite earrings indicate the presence of a shared prestige good value system in place prior to contact with South Asia (Bellina 2007). During the later period of interaction, an increasing number of lower-quality beads appear at sites in Southeast Asia, which Bellina assumes are local products. In this case, Bellina (2007: 72) argues that the higher-quality Indian beads may have been perceived as more valuable than local productions that “have been stripped of any Indian cultural aspect.” These lower quality beads were traded inland to communities that did not have direct access to the higher-quality imports. I will return to these ideas below, however it is important to note that Noen U-Loke, which was peripheral to the major prestige good networks, still received high-quality agate pendants (Theunissen 2003).

Although we may never know how Southeast Asian people perceived these artifacts, agate and carnelian beads were important prestige objects and appear to have been used to mark status within a community. The current study adds to this evidence by showing specific evidence for the unequal distribution of artifacts both within individual cemeteries and between sites. At sites like Prohear and Noen U-Loke, agate and carnelian beads appear to have been more highly valued than gold (Theunissen 2003; Reinecke et al. 2009). Furthermore, previous research has highlighted that morphological and metric analysis of beads can tell us about different trade networks, control over trade, and phases of trade. In the next section I will test these ideas against the agate and carnelian dataset that I collected in Cambodia and Thailand.

Local production of agate and carnelian beads in Southeast Asia

Several scholars have argued for local production of agate and carnelian beads in Southeast Asia, however most of the evidence for production has been found in disturbed contexts and excavations at workshop sites have not produced enough data to allow us understand how production was organized. Nevertheless, most scholars agree that some form of bead manufacture was taking place in Southeast Asia (Figure 5.2). Several of these sites also have evidence for glass beads production, which will be discussed in more detail in Chapter 7.

Several scholars have hypothesized about how bead manufacturing came to be practiced in Southeast Asia. Bellina (2007: 73) has suggested that the Indian craftsmen living and working at Khao Sam Kaeo may have been invited there by Southeast Asian elites, due to the fact that many beads found at the site were unusual types produced for a “local elite” but using high-quality Indian techniques. Later historic documents also discuss the presence of Indian trade guilds within Southeast Asia (Bellina 2007:53; Francis 2002). The technological complexity of bead production and the long apprenticeship required to make beads likely prohibited Southeast Asians from learning this craft. However, it has been noted that if some beadmakers had settled in Southeast Asia they may have been able to pass on these skills to local craftsmen (Glover and Bellina 2011:40-1).



Figure 5.2: Map of Southeast Asian sites with evidence for bead production.

Kuala Selinsing, Malaysia

Kuala Selinsing, located in peninsular Malaysia, was one of the first sites where evidence of local production was found. Ivor Evans (1932) reports that carnelian beads were the most

common type found at the site. In addition to finished pieces, there were also unfinished beads that were polished but had no perforation or had a perforation but were not yet polished. However, he did not find any raw material and so hypothesized that semi-finished beads were sent to the site and finished there (Evans 1932:91). Francis reports that agate and carnelian waste material have been found at the site more recently, in addition to possible grinding stones used to shape or polish beads (2002: 142).

Oc Eo, Vietnam

Louis Malleret reported over 10,000 beads from Oc Eo, unfortunately less than 1000 of them came from his excavations while the rest were from looted contexts. Malleret also found evidence for local production of stone beads, predominantly quartz and amethyst but also agate/carnelian and garnet (see Chapter 8 for a discussion of garnet bead production at Oc Eo). Evidence for this is found in unfinished and undrilled beads. Malleret (1962: 147) also notes the presence of flakes that may have been from the drilling process.

Khlong Thom/Khuan Lukpad, Thailand

The site of Khlong Thom or Khuan Lukpad is located in Krabi province on the Thai-Malay peninsula. The site is known for its large number of stone and glass beads, primarily from a looted context (Veraprasert 1992). During excavation at the site numerous undrilled stone beads were found, indicating some type of manufacture at this location. Veraprasert (1992: 156) also reports a large “rectangular core stone” (10cm x 3cm) found amongst looted materials stored at the local Wat, from which pieces may have been flaked off to make beads. The large and diverse sets of artifacts from this site have lead several scholars to describe it as an important trade center or entrepôt. There have been no radiocarbon dates, however based on similarities of

artifacts it is believed to have been inhabited from the late centuries BC to the early centuries AD (Veraprasert 1992: 159). More recent work on glass production at this site (see Chapter 7) points towards dates ranging from the 1st/2nd century-7th century AD (Lankton and Dussubieux 2013).

Giong Ca Vo, Vietnam

Giong Ca Vo is a Sa Huynh culture burial site located near the Mekong Delta and Ho Chi Minh City, dated to approximately 400 BC (Higham 2002). A very large quantity of jewelry, and especially carnelian and jade beads and objects, has been found at this site. Bellina (2007: 54-5) reports that a small number of knapping flakes found near the burials could indicate the presence of itinerant Indian craftsmen producing beads. Also notable is a carnelian earring with projections, known as a ling ling-o ear ornament, a local Sa Huynh artifact made in a non-local material, which may also suggest some kind of local production (Nguyen Kim Dung 2001). Nephrite blocks indicate that there may have been local production of nephrite ear ornaments and other objects at Giong Ca Vo as well (Hung et al. 2007).

Khao Sam Kaeo, Thailand

Khao Sam Kaeo is located on the Kra Isthmus in the Thai-Malay peninsula. As noted in earlier chapters, Khao Sam Kaeo is believed to have been an important urban trading center, dating to the 4th-2nd centuries BC. As with other sites discussed in this section, Khao Sam Kaeo was heavily looted. However numerous undrilled and unpolished, but shaped beads have been discovered from this site. Also present are chunks of agate and carnelian raw material, as well as very roughly shaped beads (Bellina 2007; Glover and Bellina 2011). Finished products show high-quality Indian manufacturing techniques, such as diamond drilling and hand-polishing and traditionally Indian bead styles. This has led Bellina to argue that Khao Sam Kaeo was a

manufacturing center likely inhabited by Indian craftsmen (Bellina 2003, 2007; Glover and Bellina 2011). It should be noted that Bellina has not ruled out the presence of local Southeast Asian beadmakers, but suggests they likely would have had to undergo a lengthy apprenticeship with Indian beadmakers (Glover and Bellina 2011).

Buni Region, Java

The Buni cultural complex is found in western Java, and consists of a series of looted graves with carnelian and gold beads, a few fragments of Indian Rouletted ware, and other objects (Bellwood 2007). Bellina (2003: 289, 2007) has also mentioned the presence of unfinished beads at this site, which she suggests could have been made from local agate and carnelian sources located further inland.

Myanmar

Myanmar is home to numerous semi-precious stone sources suitable for use in bead manufacture, including agate and carnelian (Campbell Cole 2003). Beadmakers in the Samon Valley region may have exploited local carnelian, chalcedony, and fossil wood sources to make beads found in burial sites in this area and bead roughouts and unfinished beads have been found at sites throughout this region (Campbell Cole 2003; Moore 2007). Additionally, Bead roughouts and raw material have been found near the Pyu sites of Thaton and at Sriksetra in Lower Myanmar (Campbell Cole 2003). Ancient beadmakers also etched or line-decorated agate, carnelian, and especially fossil wood beads, which is still practiced in Myanmar today, and believed to have been introduced to this region via influence from South Asia (Moore 2008).

Other sites with unfinished beads or raw materials

There are several other sites that have been briefly referenced as having evidence for unfinished beads and therefore could potentially be locations of bead manufacture. These include Muang Thong (Ko Kho Khao) in peninsular Thailand (A. Srisuchat 1996:268), Bukit Maris in Sarawak, Malaysia (Francis 2002:147), and Phu Khao Tong in peninsular Thailand (Chaisuwan 2011:87; Chaisuwan and Naiyawat 2009:99). Glover (1987: 89) reports seeing unfinished beads while visiting the village of Ban Plai Nam that may have come from the nearby site of Don Pacha in west-central Thailand. Survey in the Lopburi province region of central Thailand also identified fragments of agate and carnelian on the surface of the site of Dong Marum (Fiorella Rispoli, personal communication 2012) (Figure 5.3). The site of Ban Khao Mogul, also located in Lopburi province has also been discussed as a possible raw material source of agate and carnelian (discussed further in Chapter 6).



Figure 5.3: Image of agate and carnelian fragments from the surface of Dong Marum, Thailand. Collected by the Thai-Italian Lopburi Regional Archaeological Project during the 1993 survey in the Lopburi region. Photo courtesy of Fiorella Rispoli.

Although the sites above are suggestive of bead production, I feel we must evaluate the evidence more critically. Ethnographic studies of contemporary bead production workshops have highlighted the large quantity of waste material produced during bead manufacturing, which often results in multiple dumps of lithic debitage (Vidale et al. 1993). Ethnoarchaeological work has identified patterns in the dumps from agate and carnelian bead production that can be used to distinguish between different types of workshops (Kenoyer et al. 1991; Vidale et al. 1993). Some sites have been classified as possible bead production centers simply due to the presence of unfinished beads. We can imagine, for example, that some if beads were being exported and sold by weight, that some unfinished beads would be included as a means of increasing the price. There are still many questions about the type and extent of bead production taking place at these sites. Were partially finished beads brought to Southeast Asia to be finished or did all stages of manufacturing take place in Southeast Asia? Were workshops attached to elites or working independently? While many of these questions will remain unanswered without additional archaeological research, we can begin to understand the nature of bead production and exchange through compositional analysis of the beads themselves.

Agate and Carnelian Beads: Results from Contextual and Morphological Analyses

Over 200 agate and carnelian beads were examined as a part of my dissertation research. Appendix 5.1 lists all of the agate and carnelian beads in this study, their context, measurements, morphological information, and assessment of quality. Most of the beads in this study came from burial or cemetery contexts. In this section I argue that mortuary evidence points toward the differential distribution of agate and carnelian beads within burials. Burials with many beads could be markers of high status or an important member of a community. Furthermore, it appears that not all sites had equal access to agate and carnelian beads, indicating the presence of

multiple bead trade networks. I also argue that morphological and metric analysis points toward two groups of beads that may be related to different phases of trade with South Asia as defined by Bellina and Glover (Bellina 2003, 2007; Bellina and Glover 2004). The distribution of certain shapes or types of beads across space may also indicate specific trade networks or connections between different communities. Taken together, these data show that higher-quality beads appear to be more strongly associated with the earlier phase of trade, while lower-quality beads are more widespread and associated with intensified trade with South Asia during the later Iron Age.

Context and Chronology for the Agate and Carnelian Beads

In this section I will review the contextual data for agate and carnelian beads from mortuary contexts at seven sites: Angkor Borei, Phnom Borei, Prohear, Village 10.8, Phum Snay, Ban Non Wat, and Promtin Tai (Figure 5.4). I will then consider the beads from Khao Sam Kaeo, Bit Meas, and Krek 52/62, which came from non-burial contexts, as well as a carnelian nodule discovered at Prei Khmeng (Figure 5.4). Beads from two sites are not considered: stone beads from Noen U-Loke were not recorded and the only carnelian bead from Prei Khmeng was on display in a museum exhibit and unavailable for study. Table 5.1 lists the beads sites discussed in this chapter, their dates, and the quantity and context of beads from each site.

Site Name	Date	Beads from Burial contexts	Burials with agate and carnelian beads/Total number of burials	Beads from Non-burial Contexts
Angkor Borei, Cambodia	200 BC – AD 200	2	2/111	9
Ban Non Wat, Thailand	420 BC – AD 600	38	12/125	19
Bit Meas, Cambodia	Contemporary with Prohear?	0	N/A	2
Khao Sam Kaeo, Thailand	4 th -2 nd century BC	0	N/A	18
Krek 52/62, Cambodia	2 nd half of the 1 st millennium BC	0	N/A	1
Phnom Borei, Cambodia	200 BC- 0 BC/AD	1	1/9	1
Phum Snay, Cambodia	350 BC – AD 200	37	2/23	13
Prei Khmeng, Cambodia	1 st -6 th centuries AD	0	1/*	1 (carnelian nodule)
Prohear, Cambodia	200 BC – AD 200	6	5/52	0
Promptin Tai, Thailand	500 BC – AD 500?	33	6/35	14
Village 10.8, Cambodia	400 BC – AD 50	50	10/50	3

**Table 5.1: List of the quantity of agate and carnelian beads from each site discussed in this chapter.
The bead from the Prei Khmeng burial was not available for study.**

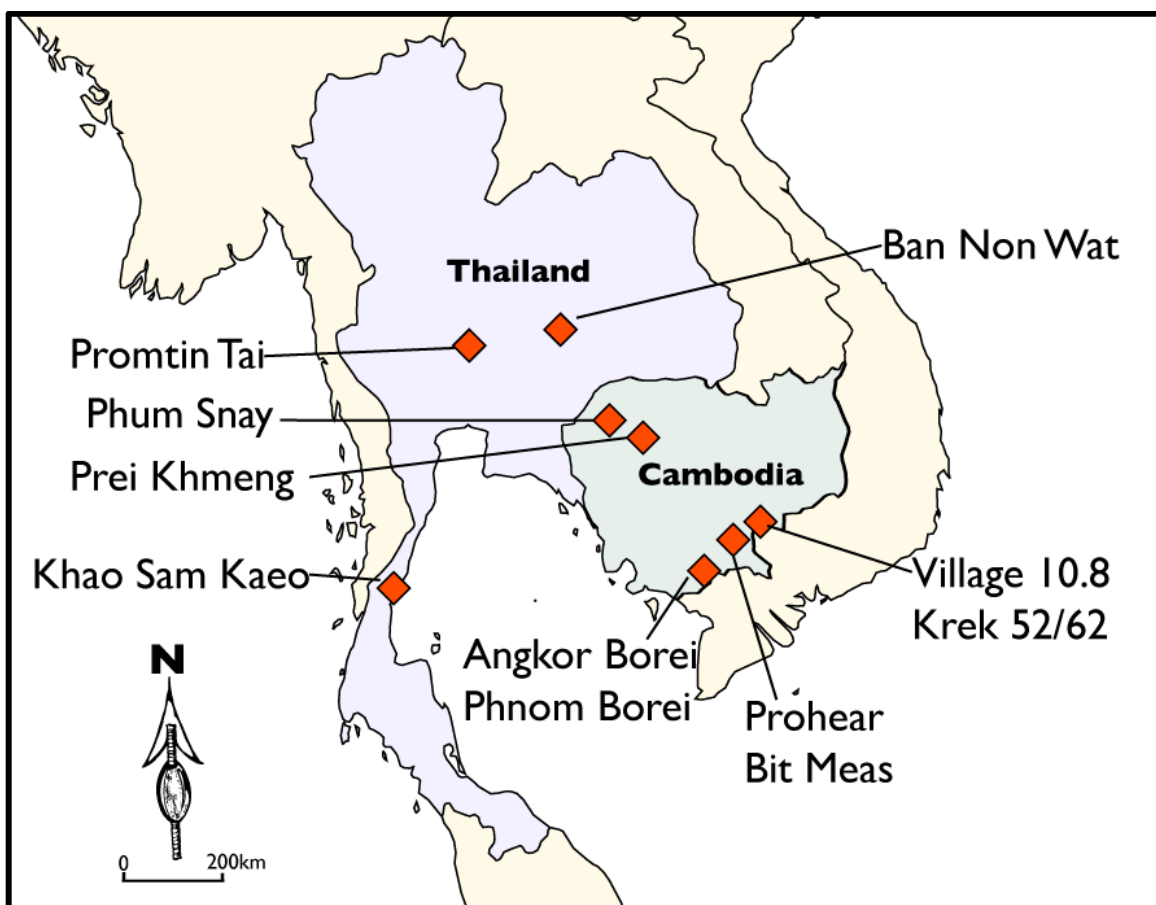


Figure 5.4: Map of sites with agate and carnelian beads analyzed as part of this study.

Angkor Borei

A portion of a densely packed cemetery was excavated at the site of Angkor Borei over the course of two field seasons. A 5x7 meter unit was opened in the central and most elevated part of the site, near the modern Wat Komnou pagoda (Figure 5.5). The stratigraphy in this area was quite deep, with some units extending almost 7 meters below the surface (Stark 2001). Radiocarbon dates for the cemetery range from 200 BC – AD 200 (Stark 2001). Unfortunately, the tightly packed cemetery, occasionally with burials cutting into one another, prevents a more detailed seriation within this 400-year time span (Miriam Stark, personal communication 2011). However, 111 primary inhumation and secondary burials were recovered from this excavation (Ikehara-Quebral 2010). Most burials included pig skulls and globular earthenware jars as grave

offerings (Stark 2001). Only two burials contained carnelian beads ($n=2$) that were directly associated with a skeleton. The remaining agate and carnelian beads ($n=9$) as well as one quartz bead, were found within the cemetery matrix, but not associated with a specific burial.

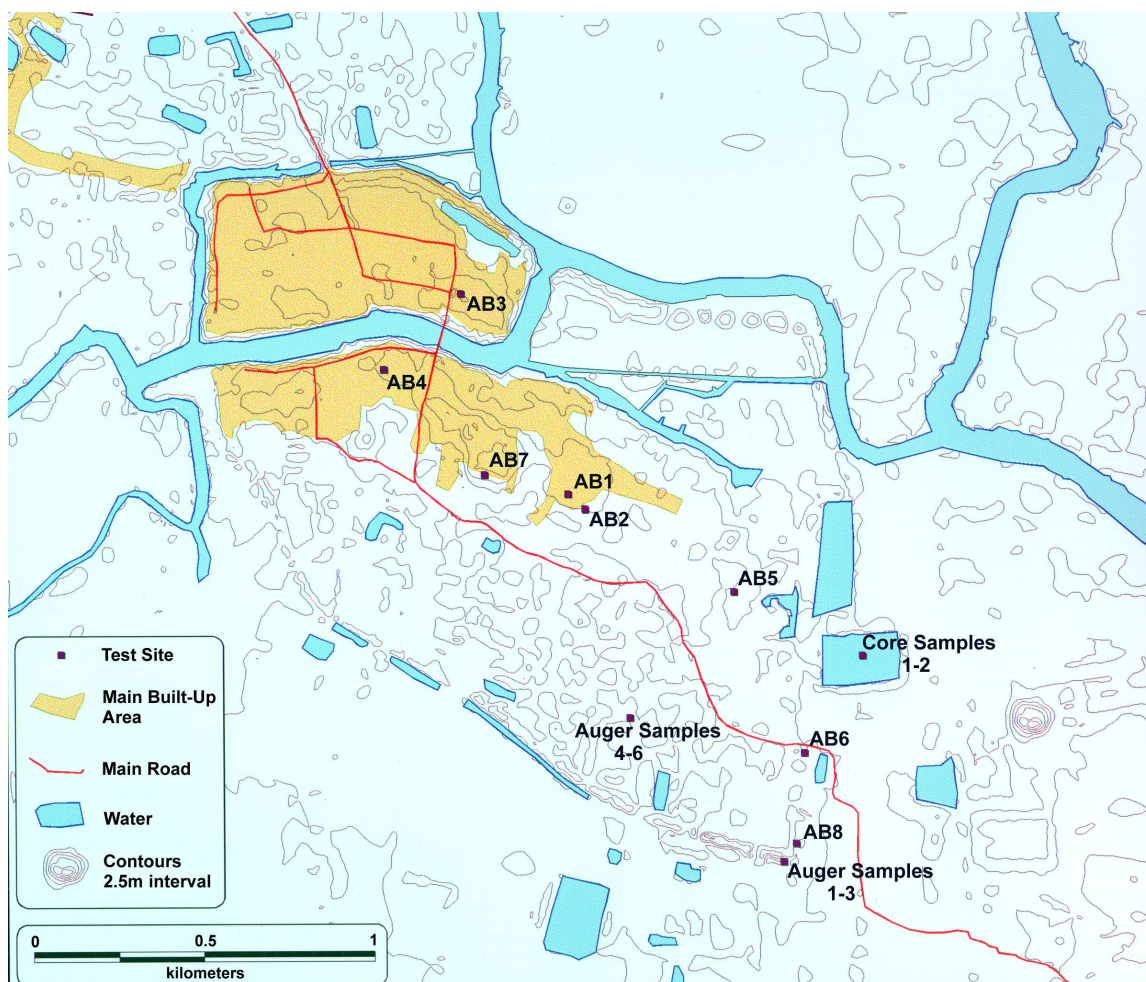


Figure 5.5: Angkor Borei contour map. Excavation units are listed as AB1-8. AB7 denotes the Vat Komnou cemetery excavation. Constructed by John Shearer, Anne Dunlop and Jane Drummond; first published in Bishop et al. 2003.

Burial 44 contained a female aged 35-44 and a portion of a young adult that was sorted in the lab (Ikehara-Quebral 2010). In addition to the rough spherical carnelian bead, animal bones, 13 gold beads, a garnet bead and glass beads in the pelvic and chest area ($n=6$) were found associated with this burial, making it one of the richer burials uncovered at Angkor Borei (Ikehara-Quebral 2010: 38). Furthermore, oxygen isotope analysis on the dental enamel from

Burial 44 indicates this person was non-local and may have immigrated from the north (Krigbaum et al. 2007 as discussed in Ikehara-Quebral 2010: 43-44). Burial 51 contained the burial of a small child, 1.5-2 years old. Four pottery vessels, animal bones, and a spherical carnelian bead were found associated with the body, as well as a possible bracelet on the right arm (Ikehara-Quebral 2010).

Angkor Borei is notable for the large number of skeletons recovered during excavation; nevertheless the quantity and quality of grave goods in these burials is low when compared with other contemporary sites. As only a small portion of the 300-hectare site has been excavated, it is possible that more richly equipped burials are located in a different portion of the site, however this can only be resolved with continued excavations.

Phnom Borei

Small excavations were undertaken at Phnom Borei, a small hill located seven km south of Angkor Borei (Figure 5.6). A 2x4 meter trench was opened, but extended to include a burial found during excavation. Additional burials were discovered in this extension, with nine total burials uncovered in Layer 5 (Phon 2004). As at Angkor Borei, the skeletons were buried close to one another and accompanied by few grave goods, primarily small pottery vessels, similar to those found at Angkor Borei (Figure 5.7). Two spherical carnelian beads were found during excavation, however only one bead was associated with a skeleton and found under the chin (Phon 2004). Radiocarbon dating from organic materials found in layers 3 and 4 are contemporary with Angkor Borei, dating from the last few centuries BC (Phon 2004). Unfortunately, detailed analyses of the skeletons have not yet been undertaken, however preliminary results indicate that males, females, and at least one child were buried in this small cemetery. As noted earlier, Miriam Stark has suggested that Phnom Borei may be part of the

larger Angkor Borei habitation sphere. If this is the case, the burials at Phnom Borei seem to have fewer beads than at the Wat Komnou cemetery at Angkor Borei. However, the samples size for the site is too small to make broad conclusions.

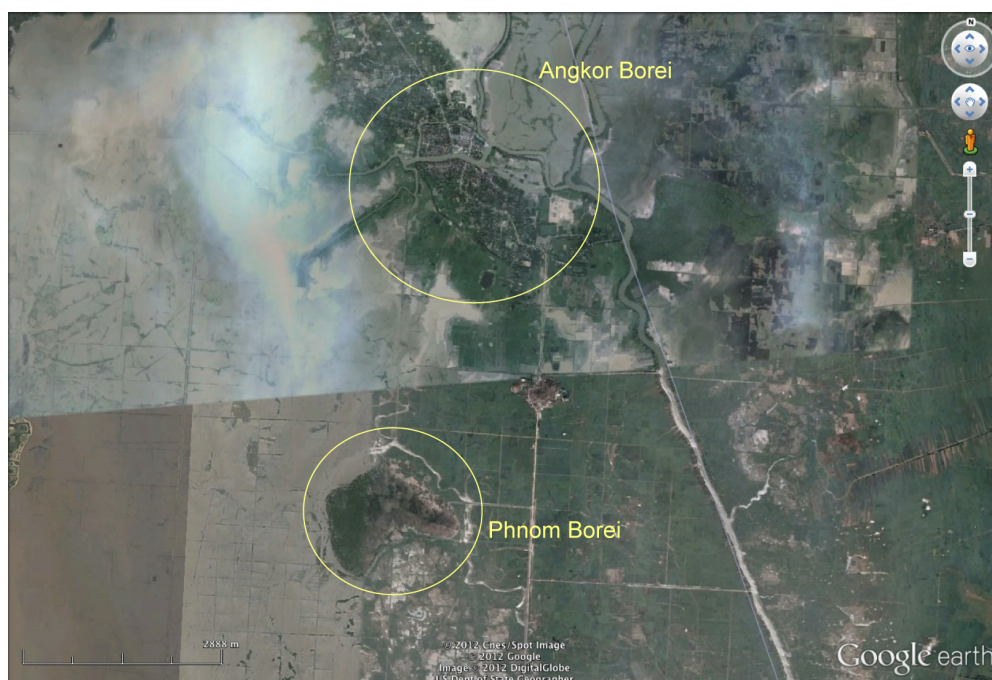


Figure 5.6: Angkor Borei and Phnom Borei as viewed from Google Earth.



Figure 5.7: A group burials found at Phnom Borei. Photo by Phon Kaseka.

Prohear

Although the Iron Age cemetery at Prohear was heavily looted, 52 burials were uncovered over two field seasons (2007-2008). Of these burials, five included agate and carnelian beads. Six beads from three burials were available for study. Two agate beads were found with Burial 2, the burial of a male dating from burial phase II (100/50 BC- AD 100). In addition to these agate beads and numerous other artifacts (Table 5.2), his burial also contained a unique phallic stone pestle that was placed between the legs (Reinecke et al. 2009). Burial 24 contained two carnelian beads, over 150 glass beads, iron bracelets on both arms, as well as gold and silver jewelry (Reinecke et al. 2009). As with Burial 2, this burial dates to burial phase II.

Prohear Burial Number	Sex	Time Period	Beads found in burial	Associated grave goods
Burial 2	Male	Phase II 100/50 BC – AD 100	Two agate beads	Glass beads, Dongson drum fragments, iron and bronze bangles and weapons/tools, gold jewelry ceramics, and a stone pestle.
Burial 4	Female	Phase II C14 dates: 44 BC – AD 51	Two agate beads	Dongson drum, bronze buffalo bracelet, ceramics, gold and silver jewelry, and glass beads. Additional carnelian beads.
Burial 24	N/A	Phase II 100/50 BC – AD 100	Two carnelian beads	Over 150 glass beads, iron bracelets, and gold and silver jewelry.

Table 5.2: Burials from Prohear with agate and carnelian beads recorded in this study.

Two agate beads were identified within Burial 4, perhaps the richest burial uncovered at Prohear. This burial of a female over 40 years old, perhaps the oldest person at the site, was found with her head resting inside a Dongson drum (Figure 5.8), a large bronze “buffalo bracelet” (Reinecke et al. 2009) (Figure 5.9). Carnelian beads were also reported from this burial, but they

were unavailable for study. Charcoal from inside the bronze drum has been radiocarbon dated to 44 BC – AD 51, placing this burial within the second burial phase.



Figure 5.8: Heng Sophady restores a bronze Dongson drum from Burial 4 with the skull of an older female still inside.



Figure 5.9: Bronze buffalo bracelet from Burial 4.

The burials at Prohear are amongst the richest discovered in Southeast Asia and many burials also contained gold beads and other artifacts (Reinecke et al. 2009). Agate and carnelian beads are found less frequently than gold objects and are strongly associated with extremely rich burials. Four of burials with agate and carnelian beads were described as among the “wealthiest” or amongst the highest status burials at the site (Reinecke et al. 2009: 59). Only three burials (Burials 3, 12, and 40) considered to be “wealthy” contained no beads at all. These results suggest that not everyone had equal access to agate and carnelian beads and that these objects were used as status symbols. Andreas Reinecke has also noted that in general, burials women contained more beads and jewelry than those of men (Reinecke et al. 2009: 52).

Village 10.8

The cemetery at Village 10.8 contained approximately 50 burials. However, determining the exact number of individuals is difficult due to the highly acidic lateritic soil, which led to poor bone preservation. Unfortunately, this also means that additional details regarding the age, sex, and health of the people from Village 10.8 are not available. Burials were identified by the layout of pottery and associated artifacts, as it appears that many people were buried in a wooden coffin or tree trunk. Thirteen jar burials are believed to contain the burials of children (Heng et al., In Press). Fragments of a Dongson drum were found on the surface of the site, but unlike at Prohear, none were found in burials. Radiocarbon dates from this cemetery range from 400 BC-AD 50; however there has not been a seriation of the burials within this time frame, so they are treated as a single unit. Of the 50 burials from Village 10.8, ten burials contained agate and carnelian beads (Table 5.3). Fifty-three beads total were examined, of which only three were not from a clear burial context.

Village 10.8 Burial Number	Beads found in burial	Associated grave goods
Burial 1	Six carnelian beads	Six garnet bead, two glass beads, broken ceramics, iron tools and an iron bangle
Burial 3	14 carnelian beads	Two garnet beads, glass beads, iron bangle, and broken ceramics.
Burial 4	One carnelian bead	One garnet bead, an iron tool, broken ceramics.
Burial 15	Two carnelian beads	Glass beads, broken pottery
Burial 25	Two carnelian beads	One glass beads, broken pottery
Burial 26	One carnelian bead	Broken ceramics
Burial 28	Eight agate beads	Glass rings, broken ceramics, iron tools, one garnet bead.
Burial 34	Two carnelian beads	One garnet bead, glass beads, an iron bangle, an iron spade, broken ceramics.
Burial 37	Four carnelian beads	Broken ceramics, an iron spade?
Burial 48	10 carnelian beads	Iron dagger, knife, iron bangles, iron spade, and broken ceramics.

Table 5.3: A list of burials with agate and carnelian beads from Village 10.8 and their associated grave goods. Age and sex are unknown.

Most of the burials with beads contained only one or two beads, however there were four burials with larger numbers of agate and carnelian beads. Burial 28 contained eight agate beads, the only agate beads thus far uncovered at Village 10.8. Burial 1 contained 6 carnelian beads, while Burial 48 contained 10 small, finely made carnelian beads. Burial 3 had 14 carnelian beads, the largest number found at the site. These burials also contained a larger number of grave goods than burials with smaller quantities of beads and may represent elite burials. Although a higher quantity of agate and carnelian beads were found at Village 10.8, these burials appear to be less richly equipped than those found at Prohear.

Phum Snay

As at Prohear, the cemetery at Phum Snay was also heavily looted. However, salvage excavations in 2001 and 2003 uncovered 23 burials and 50 agate (n=1) and carnelian (n=49)

beads. Thirteen beads were not directly associated with a burial and the remaining thirty-seven beads were found in two burials. Two carnelian beads were found as part of Burial 2, the burial of a middle-aged or older male. In addition to the beads this burial also contained a sun bear tooth, several iron weapons and unidentified iron objects, iron bangles, bronze bells, and several pottery vessels (O'Reilly et al. 2004). The remaining 35 beads all came from Burial 9, the burial of an adult woman that contained a large quantity of pottery vessels, glass beads, 35 carnelian beads around her chest, waist, and wrist, a gold bead, spindle whorls, bronze rings and bangles, iron tools, and a bronze bowl covering part of her face. A complete “Phimai Black” ceramic bowl, a unique pottery type found predominantly in Northeast Thailand, was also included amongst her offerings (O'Reilly et al. 2004; Domett and O'Reilly 2009).



Figure 5.10: Looted beads from Phum Snay currently stored at Wat Bo in Siem Reap, Cambodia. Scale in cm.

While it seems that the distribution of agate and carnelian beads was extremely restricted at Phum Snay, it is important to take into account the small sample size and heavy looting that

has taken place at this site. Thousands of additional glass and stone beads have been identified from looted contexts (Lapteff 2006). Many of these looted objects were collected by a concerned monk in Siem Reap and stored at the Buddhist temple of Wat Bo in Siem Reap, Cambodia (Figure 5.10). Subsequent excavations at Phum Snay by a Japanese-Khmer team have uncovered additional burials with beads, including the burial of a female with 27 carnelian beads (Yoko Nijima, personal communication, 2012).

Promptin Tai

Thirty-six individuals in 35 burials have been uncovered in excavations at the site of Promptin Tai. Forty-seven agate and carnelian artifacts were identified in these excavations of which 14 were not associated with a specific burial. The remaining 33 beads belonged to six burials (Table 5.4). Unfortunately, there are no radiocarbon dates for this site and the burials are described simply as belonging to the Iron Age (500 BC- AD 500). However, the burials were divided into an earlier or later period based on burial depth (Liu 2012). All of the burials with agate and carnelian belonged to the earlier period.

Promptin Tai Burial Number	Sex	Age	Beads found in burial	Associated grave goods
Burial 9	Unknown	Adult, 20+	One agate bead	One greenstone bead and glass beads
Burial 16	Female	20-22	One agate bead	A bronze ring, bronze bell, animal bones, and shell.
Burial 18 (two individuals)	Unknown	Adult, 20+ and child, 3.5-4.5	One agate bead	Greenstone beads, glass beads, bronze bracelets, an iron spear, and ceramics.
Burial 19	Unknown	9.5-11	14 agate beads	Glass and greenstone beads, a bronze bracelet, 2 bronze rings, ceramics, two spindle whorls, and animal bones.
Burial 20	Female	20-25	Five agate beads and seven carnelian beads	Greenstone and glass beads, ceramics, and shell.
Burial 32	Unknown	Subadult	Four carnelian beads	Greenstone beads, glass beads, ceramics, a bronze bangle and an iron tool.

Table 5.4: Burials with agate and carnelian beads from Promptin Tai.

Four burials contained fewer than five agate or carnelian beads. However two burials contained a large number of beads and are considered to be amongst the richest at the site (Thanik Lertcharnrit, personal communication, 2012). Burial 19 was the burial of a child, age 9.5-11, who had linear enamel hypoplasia (LEH) on their teeth indicating some kind of childhood physiological stress (Kathy Liu, personal communication, 2012). Burial 20 was of an adult female, age 20-25 who also experienced LEH as a child. Despite their apparent status differences, isotope analysis indicates that their oxygen and carbon isotope signatures were “normal” compared to the rest of the population at Promptin Tai (Kathy Liu, personal communication, 2012). However, we must also consider that the burials at Promptin Tai may not be contemporary with one another and that the discrepancy in grave goods could be related to a

trend towards increasing wealth in burials, similar to what is seen at sites in Northeast Thailand (Higham 2011b). Additional seriation of burials as well as radiocarbon dates would assist with understanding the burials at Promptin Tai.

Ban Non Wat

At the site of Ban Non Wat the majority of burials (n=125) date to the Iron Age 1 period (420-100 BC). There were only 23 partial and complete burials from the later Iron Age periods, although these are better represented at the nearby site of Noen U-Loke (Higham 2011b). From 12 burials, 38 agate and carnelian beads were recovered, while 19 beads were uncovered from non-burial contexts (Table 5.5). Most burials were dated to Iron Age Period 1 (420-150 BC) although one burial dates to Iron Age Period 2 (150 BC- AD 200), and 4 to Iron Age Period 4 (AD 400-600).

Ban Non Wat Burial Number	Sex	Age	Beads found in burial	Associated grave goods
Burial 36 <i>Iron Age Period 4</i>	Female (1) Male (1)	Old adult? (female) Mid-adult (male)	Five carnelian beads, two agate pendants (one broken into two pieces)	Glass beads, ceramics, gold bead, spindle whorl, bronze bangle fragment
Burial 115 <i>Iron Age Period 4</i>	Unknown	Adult	One agate pendant	Pottery vessel
Burial 203 <i>Iron Age Period 4</i>	Unknown	Young adult	16 agate beads, two agate pendants	Bronze bangles, earrings, and finger rings, and glass beads
Burial 259 <i>Iron Age Period 1</i>	Female	Young adult	Three carnelian beads	Ceramics, glass beads, water buffalo limb bone, red ochre
Burial 266 <i>Iron Age Period 4</i>	Unknown	Infant	One agate pendant	Bronze bangles, bronze ring, glass beads and ceramics

Burial 312 <i>Iron Age Period 1</i>	Female	Young adult	One agate bead	Ceramics, bronze bangles, bone earplug, spindle whorl, pig limb bones
Burial 317 <i>Iron Age Period 1</i>	Unknown	Young-mid adult	One agate bead	Ceramics, tin bead, socketed iron tools, bivalve shell
Burial 321 <i>Iron Age Period 1</i>	Unknown	Adolescent/Adult?	One agate bead	Ceramics, shell bangles, shell ring, red ochre, pig limb bones, and spindle whorls
Burial 322 <i>Iron Age Period 1</i>	Female	Young adult	One agate bead	Ceramics, iron blade, red ochre, shell earplug, spindle whorl, and pig bones
Burial 343 <i>Iron Age Period 1</i>	Unknown	Infant (9 months)	One agate bead	7 ivory bangles, glass beads, ceramics, shell pendant, bronze bangles, iron tool, iron artifact, red ochre, grey clay, pig limb bones
Burial 356 <i>Iron Age Period 1</i>	Female	Older adult	One agate bead and one carnelian bead	Glass beads, iron bangles, shell bangle, spindle whorls, ceramic vessels, stone adze, and red ochre
Burial 471 <i>Iron Age Period 2</i>	Female	Young-mid adult	One agate bead	Ceramics, iron knife, bronze bangle?, spindle whorl, and a golden earring

Table 5.5: Burials at Ban Non Wat with agate and carnelian beads.

Although most burials contained three or less beads, two burials are notable for their larger bead collections and both date to the Iron Age Period 4. Burial 36 was disturbed and contained both male and female adults, as well as two agate pendants and five faceted carnelian

burials. Burial 203 contained a partial burial of an adult with bronze bangles and finger rings, glass beads, two agate pendants, and a necklace of 16 agate barrel beads. Charles Higham has noted that during the very early Iron Age (Period 1) “[w]e have not found any evidence for hierarchic social distinctions,” (2011b: 133). Therefore, it may be difficult to interpret the presence of beads with these burials as an indicator of social status. Mortuary wealth increased overtime at Ban Non Wat, so while Burials 36 and 203 appear impressive when compared to other burials with beads, they were not amongst those with the most grave goods at Ban Non Wat during Iron Age Period 4 (Higham and Kijngam 2012). However, agate and carnelian beads do appear to have been an important and high value object; at the nearby contemporary site of Noen U-Loke agate and carnelian beads are believed to have been high-value goods with the agate pendants perhaps acting as “symbols of status, or perhaps rank,” (Theunissen 2007: 376). Therefore, I argue that while the people in Burial 36 and 203 may have not been amongst the wealthiest, they may have held important positions within their community.

Conclusions regarding the distribution of agate/carnelian beads in burials

Agate and carnelian beads are not evenly distributed within burials at sites in Cambodia and Thailand. At all of the sites, only a small portion of the total burials contained agate or carnelian beads. Table 5.6 summarizes the total number of burials uncovered from each site discussed above, and the number of burials with agate or carnelian beads found at each site. Agate and carnelian bead were uncommon artifacts and only a few members of each community had access to these materials.

	Total Burials	Burials with agate/carnelian beads
Angkor Borei	111	2 (2%)
Ban Non Wat	160	12 (7.5%)
Phnom Borei	9	1 (11%)
Phum Snay	23	2 (9%)
Prohear	52	5 (10%)
Promptin Tai	35	6 (17%)
Village 10.8	50	10 (20%)

Table 5.6: The quantity and percentage of burials with agate and carnelian beads amongst the sites studied.

However, it should be kept in mind that there are numerous factors that could have influenced these counts. As noted above, evidence from sites in Northeast Thailand suggest that burials during the early Iron Age did not have clear status differences, but that mortuary wealth increased over time. It is not clear that this pattern is found elsewhere in Southeast Asia, however we must keep in mind the impact of changing mortuary rituals over time. At sites like Angkor Borei, the densely packed cemetery and intercutting of burials may have made it difficult to associate beads with specific burials. Furthermore, at sites like Prohear and Phum Snay, heavy looting of burials has left only a portion of burial contexts intact. Lastly, only small portions of all of these sites have been recovered. It is possible that additional burials with larger numbers of agate and carnelian bead exist, but they were not uncovered during excavation. Despite these factors, less than one quarter of all burials at each site contained agate and carnelian beads. Furthermore, many of the burials with beads also had additional unique objects that highlighted them as high status individuals, such as Burial 4 from Prohear, the burial of an elderly female with her head inside a Dongson bronze drum.

Several burials had very high numbers of agate and carnelian beads in comparison to the other burials within their community (Table 5.7). Although the sex of all the burials is not known, it is striking that several of these burials are of women. Table 5.8 lists a table identifying

the number of male and female burials with and without agate/carnelian beads. While this table demonstrates the number greater quantity of female burials with beads, full interpretation of this pattern is hampered by a small samples size and 23 unsexed or subadult burials that also contained agate and carnelian beads. As noted above, during the more recent Japanese-Khmer excavations an additional female burial from Phum Snay was uncovered that contained over two-dozen beads. Additionally, in March 2012 I examined a collection of agate and carnelian beads from the site of Phum Sophy, located in Banteay Meanchey province near the site of Phum Snay, which contained the burial of a female with over 200 carnelian beads. Mortuary data from Prohear indicates that women's burials contained more beads and jewelry than men's burials. I am not yet sure how to interpret these data, however a similar pattern has been observed with the glass bead data, discussed further in Chapter 7. These burials will be considered together and discussed in more depth in Chapter 9.

Site Name	Burial Information	Total number of agate beads	Total number of carnelian beads	Sex
Ban NonWat	Burial 36	2 agate pendants	5 carnelian beads	Female and male
Phum Snay	Burial 9	N/A	35 carnelian beads	Female
Promptin Tai	Burial 19	14 agate beads		Female
Promptin Tai	Burial 20	5 agate beads	7 carnelian beads	Female
Village 10.8	Burial 3	N/A	14 carnelian beads	Unknown
Village 10.8	Burial 28	8 agate beads		Unknown
Village 10.8	Burial 48	N/A	10 carnelian beads	Unknown

Table 5.7: Table of burials with large quantities of beads.

	With beads	Without beads
Male burials	3	156
Female burials	11	104

Table 5.8: Table denoting the number of male and female burials with and without agate and carnelian beads.

Beads were not evenly distributed among the sites studied. Some sites had higher numbers and seemingly greater access to agate and carnelian beads than others. Although this could be related to the extent of fieldwork or burials uncovered at each site there are obvious differences in the access to agate and carnelian beads across the region. For example, at Prei Khmeng a large number of glass beads have been found, however only one carnelian bead, not available for study, was uncovered. This disparity may be due to the small amount of fieldwork done at this site, however this may also reflect changing trade networks and access to beads by people at this site. Prei Khmeng is one of the later sites considered as part of this study, dating from the 1st-6th centuries AD. However, the upper layers at Noen U-Loke are contemporary with Prei Khmeng and contained a large amount and variety of agate and carnelian beads (Theunissen 2007). Other sites have had more extensive excavations, and yet the quantity of beads found at these sites is fewer than at sites with smaller excavations. For example, fieldwork at Angkor Borei and Ban Non Wat have uncovered over 100 burials at each site, and yet smaller numbers of agate and carnelian beads have been recovered from these burials than at Phum Snay, which has had less than a quarter of the burials excavated. For this reason, I argue that the differential distribution of agate and carnelian beads across Cambodia and Thailand is meaningful.

The distribution of beads in burials suggests that they were restricted objects to which not all communities or individuals in the communities had equal access. Furthermore, in many cases, burials with large numbers of beads appear to have been high-status individuals based on the presence of other high status goods. These individuals appear to have had additional goods such

as glass beads and metal objects that also connected them to long-distance exchange networks.

At some sites, a few burials had high-quantities of similar looking beads that may have been produced in a single workshop and transmitted to the site in a single episode (discussed below).

This suggests that beads may have been traded to a site for a specific person or event. In the next section I will discuss the bead shapes and types in more detail. The distribution of different bead types over time and space will allow for a more in depth understanding of trade networks and connections between different sites.

Sites with beads from non-burial contexts

In addition to the sites with beads from burial contexts discussed above. Three sites in this study also contained beads from non-burial contexts. The site of Prei Khmeng is located in the Angkor region, Siem Reap province, Cambodia (Figure 5.4) and is home to a small pre-Angkorian brick tower and lintel, one of the oldest in the Angkor area. Three excavations were undertaken by the Mission Archéologique Franco-Khmère sur l'Aménagement du Territoire Angkorien (MAFKATA), a joint project between the École Française d'Extrême-Orient and Apsara Authority led by Dr. Christophe Pottier. This project uncovered several prehistoric burials and an occupation area that dates from the 1st-6th centuries AD (Pottier, personal communication, 2009; Zoppi et al. 2004). A single short, truncated bicone carnelian bead was found in burial 12221 (Figure 5.11), but unavailable for study as it was on display in a museum exhibit. However, in addition to the bead there was also small carnelian nodule or manuport that was found in a layer that dates to sometime before 400 AD (Christophe Pottier, personal communication, 2008) (Figure 5.12). Despite the presence of this nodule, there is no evidence for stone bead manufacture at Prei Khmeng.



Figure 5.11: A short truncated bicone carnelian bead from Prei Khmeng on display at the National Museum, Phnom Penh.

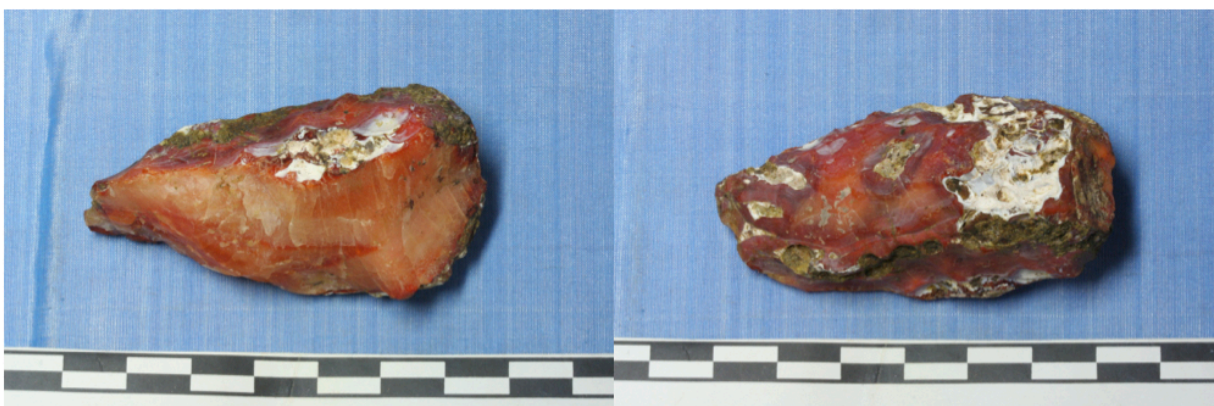


Figure 5.12: Front and back views of a carnelian nodule found at Prei Khmeng. Scale in cm.

A single bead spherical carnelian bead from Krek 52/62 was opportunistically included in this study (Figure 5.13). Krek 52/62 is a circular earthwork site located in the Red Soil region of Kampong Cham province, Cambodia (Figure 5.4). The bead was excavated from a unit that sectioned the inner wall and ditch of the earthwork. Numerous artifacts were found in this unit including glass bangle fragments and garnet beads, pointing towards the Iron Age date of this context (Haidle 2009).



Figure 5.13: Spherical carnelian bead from Krek 52/62. Scale in cm.

Excavations at Khao Sam Kaeo (Figure 5.4), lead by Bérénice Bellina and Praon Silapanth have uncovered agate and carnelian beads as well as evidence for production (discussed above). However, the beads from this excavation have already been acquisitioned by the local museum and were unfortunately unavailable for study. Numerous beads have been looted from the site by local villagers and now belong to a collection owned by the Suthiratana Foundation, Thailand. In an effort to give a preliminary context to some of these looted beads, Bérénice Bellina asked villagers to show her where many of the specific beads were found and these locations were recorded using a GPS (Figure 5.14). Based on the archaeological excavations at the site, Bellina has identified different types of hard stone bead production at different portions of the site (Bérénice Bellina, personal communication, 2010). On Hills 1 and 2 were bead production areas using siliceous stone and skilled Indian techniques in a style found at sites connected via the South China Sea coastal trade networks. Another siliceous stone industry using skilled Indian techniques was found on Hill 3. Lastly, Hill 4 contained beads made with using “mass production Indian-adapted techniques,” in styles associated with late

prehistoric sites such as Noen U-Loke or early historic sites in the Mekong Delta (Bérénice Bellina, personal communication, 2010). 18 finished and unfinished beads from the Suthirathana collection were selected by Dr. Bellina and kindly provided by Dr. Bunchar Pongpanich, director of the Suthirathana foundation, for LA-ICP-MS analysis in the United States. (Figure 5.15).

The distribution of bead shapes and types

Notable bead shapes

Thirty-five distinct bead shapes/types were identified and recorded, drawing heavily on Kenoyer's Harappan Bead Code (unpublished field manual) and H. Beck's bead classification system (1928). The Harappan Bead Code system was used for identifying many of the simpler bead shapes, however Beck's system allowed for a more specific identification of many of the faceted beads and other unusual shapes. Figure 5.16 lists the bead shapes recorded. Several bead shapes were identified that did not exist in either system, therefore these beads were given their own identifiers. Beck has defined measurements for short, standard, and long bead sizes (1928:4), however I found his definitions unsatisfactory for the purposes of my study. Instead, I determined that long beads were those whose length was more than twice their width, while short beads were those whose length was less than twice their width.

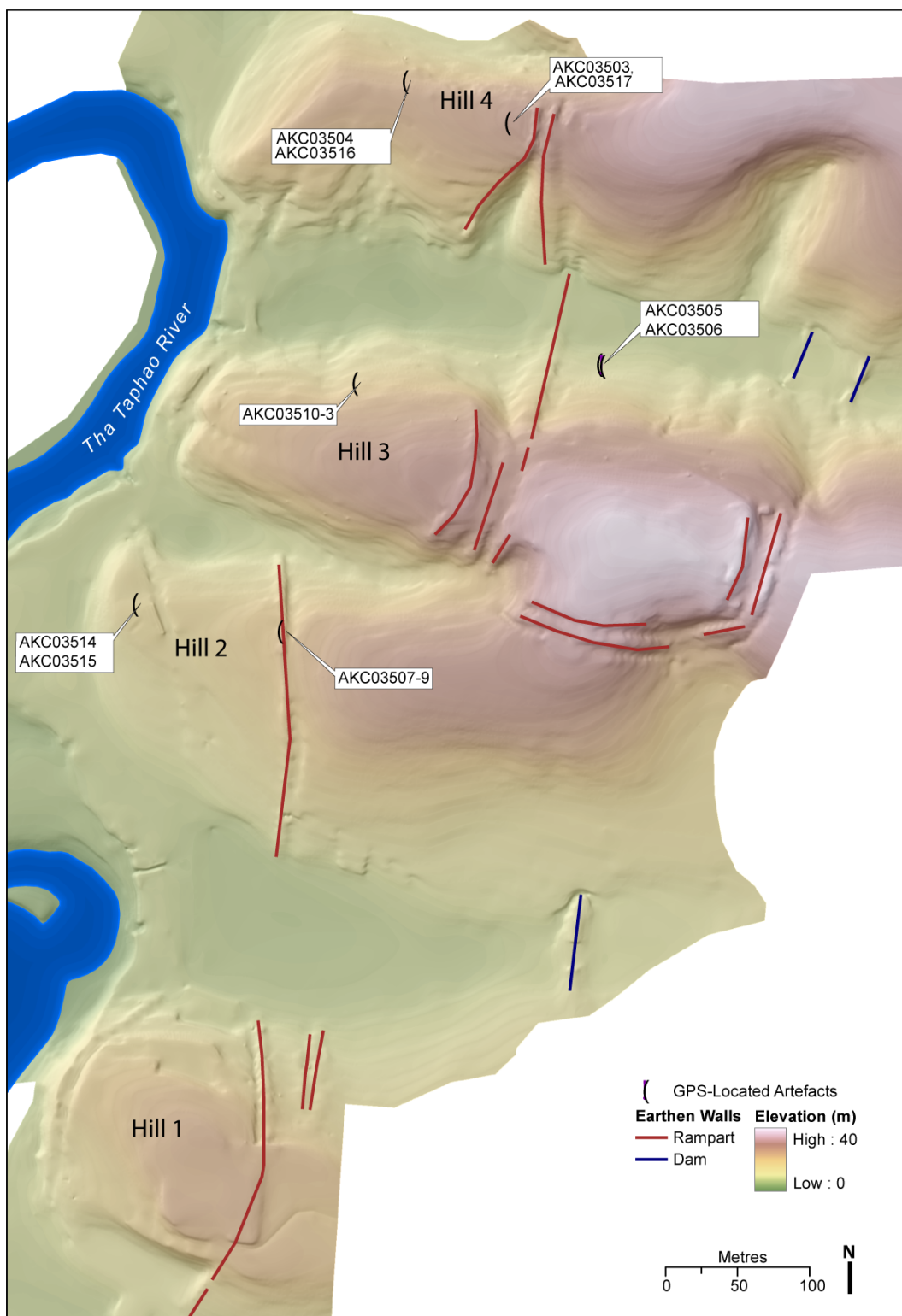


Figure 5.14: Map of Khao Sam Kaeo with general locations where beads were found. Adapted from map provided by Bérénice Bellina.

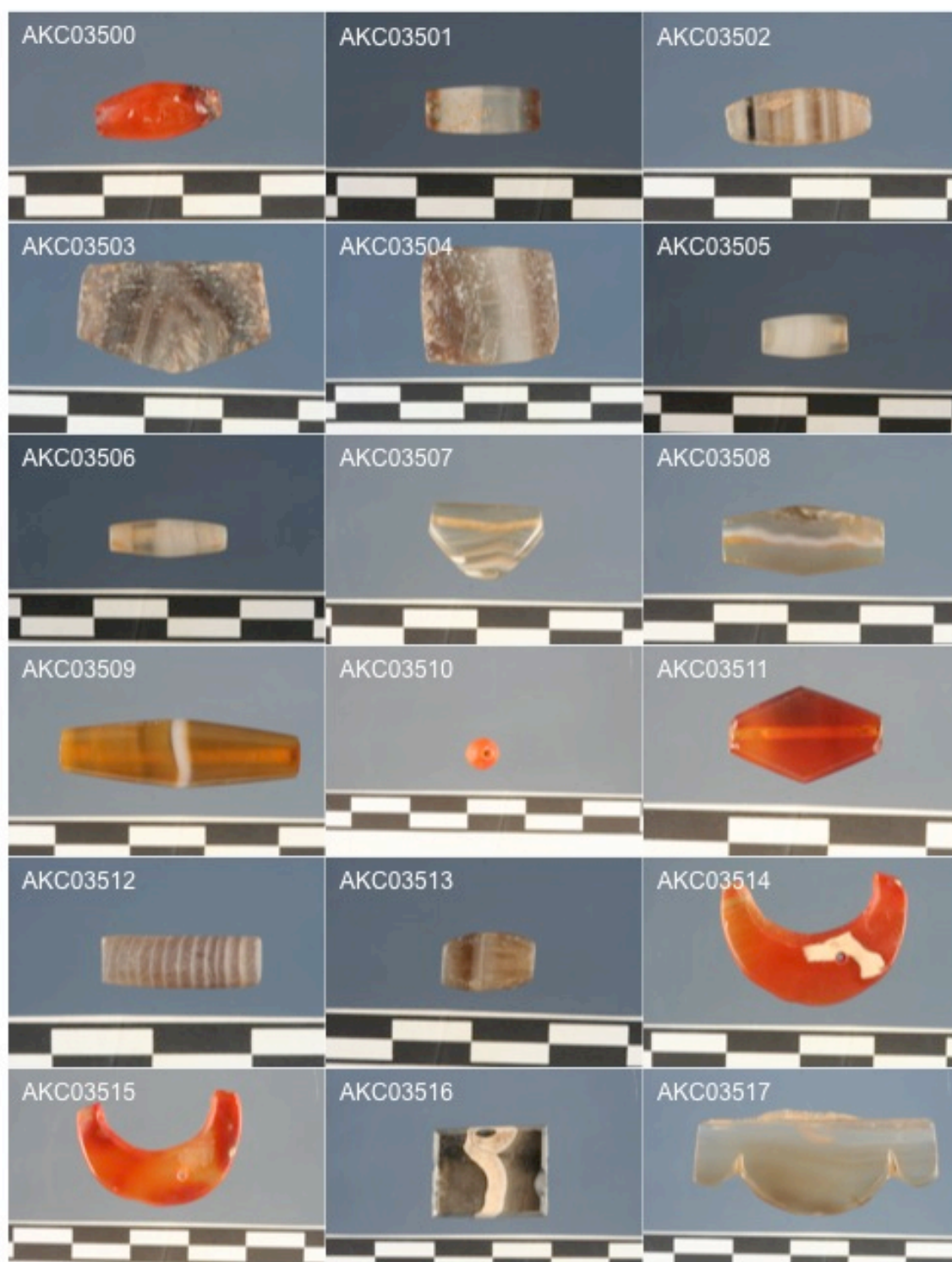


Figure 5.15: Finished and unfinished beads from Khao Sam Kaeo analyzed in the current study. Scale in cm.

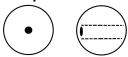
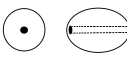
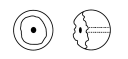
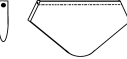
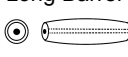
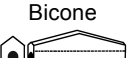
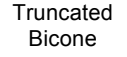
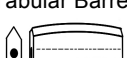
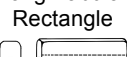
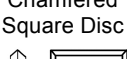
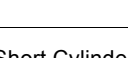
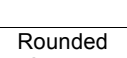
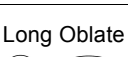
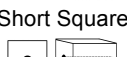
Bead Shape	Bead Code System	Simple/Complex	Notes	Bead Shape	Bead Code System	Simple/Complex	Notes
Spherical 	HBCS: Type 22	Simple		Short Oblate 	HBCS: Type 8	Simple	Found at Village 10.8
Rough Spherical 	HBCS: Type 23	Simple		Flat Leech Bead 	N/A	Complex	Found at Khao Sam Kaeo
Long Barrel 	HBCS: Type 5	Simple		Crescent 		Complex	Found at Khao Sam Kaeo
Short Barrel 	HBCS: Type 4	Simple		Hexagonal Flattened Bicone 	N/A	Complex	Bead shape name used by Theunissen (2003).
Long Bicone 	HBCS: Type 7	Simple		Tabular Truncated Bicone 	Beck: XVI D.2.f	Complex	Found at Khao Sam Kaeo
Short Bicone 	HBCS: Type 6	Simple		Short Hexagonal Tabular Barrel 	N/A	Complex	Found at Promptin Tai
Bicone Barrel 	N/A	Simple	Transitional shape between bicone and barrel. Found at Village 10.8	Long Tabular Rectangle 	Beck: IX D.2.b	Simple	Found at Ban Non Wat
Long Cylinder 	HBCS: Type 2	Simple		Chamfered Square Disc 	Beck: IX.A.2.b	Complex	Found at Khao Sam Kaeo
Short Cylinder 	HBCS: Type 1	Simple		Rounded Square 	N/A	Simple	Found at Ban Non Wat
Long Oblate 	HBCS: Type 9	Simple	Found at Village 10.8	Short Square 	HBCS: Type 24	Simple	Found at Promptin Tai

Figure 5.16: List of bead shapes recorded in the current study (continued below).

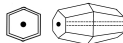
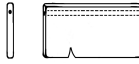
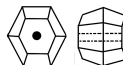
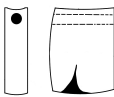
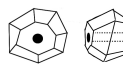
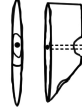
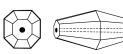
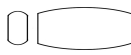
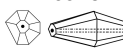
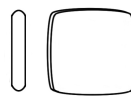
Bead Shape	Bead Code System	Simple/Complex	Notes	Bead Shape	Bead Code System	Simple/Complex	Notes
Long Triangular Faceted Barrel 	Beck: VIII D.1.b	Complex	Found at Ban Non Wat	Broken Pendant, 1 notch 	N/A	Complex	Found at Ban Non Wat
Long Hexagonal Bicone 	Beck: XIII.C.2.e	Complex		Pendant, 1 notch 	N/A	Complex	Found At Promptin Tai
Short Hexagonal Bicone 	Beck: XIII.B.2.e	Complex	Found at Angkor Borei	Broken Pendant, notch? 	N/A	Complex	Found at Promptin Tai
Short Hexagonal Bicone, Rough 	N/A	Complex	Roughly made with uneven facets/shape. Found at Phum Snay and Angkor Borei (quartz)	Broken Pendant, no notch 	N/A	Complex	Found at Promptin Tai
Long Octagonal Bicone 	Beck XIVC.2.e	Complex	Found at Village 10.8	Long unfinished barrel 	N/A	Unknown	Found at Khao Sam Kaeo
Short Polygonal Bicone 	Beck: XV.C.2.e	Complex	7 facets. Found at Village 10.8	Short unfinished barrel (truncated?) 	N/A	Unknown	Found at Khao Sam Kaeo
Long Hexagonal Faceted Barrel 	Beck: XIII C.2.b	Complex		Unfinished tabular square 	N/A	Unknown	Found at Khao Sam Kaeo
Broken Pendant, 2 notches 	N/A	Complex	Found at Khao Sam Kaeo				

Figure 5.16: List of bead shapes recorded in the current study (continued from above). Drawings by P. Madavi

while several shapes were found exclusively at only one site (Table 5.11). Beads from Ban Non Wat were recorded in only a limited fashion and so there were several beads for which I do not have specific bead shape data recorded. For example, there are 15 black and white agate beads found with AKC02071 that could be classified as either short bicones or short barrels, but require closer examination before making a final determination. Three hexagonal faceted barrels were also noted, but it is not clear if they would be classified as either long or short barrels, as measurements were not taken. Additionally, agate pendants in a variety of shapes were also noted. The bead shapes from Ban Non Wat that are noted in the tables below were those that were recorded in more detail.

It is important to note that the distribution of different bead types is not complete, as difficulties with looting and sample size has affected the presence or absence of bead types at each site. Khao Sam Kaeo was heavily looted and many additional bead types and shapes exist outside of the small number I recorded (see examples in Pongpanich 2009). More recent excavations at Phum Snay have identified 99 additional carnelian beads, of which 77 were spherical (Yoko Nojima, personal communication 2011). Excavators report that looted beads from Prohear also came in additional shapes (Reinecke et al. 2009: 119). Nevertheless, from the limited information collected we can begin to discern patterns in the distribution of different beads at sites across the region. Several specific bead shapes are notable and deserve further discussion.

	Spherical	Rough Spherical	Long Barrel	Short Barrel	Long Bicone	Short Bicone
Angkor Borei	3	5	1	0	0	1
Phnom Borei	2	0	0	0	0	0
Prohear	0	0	0	1	1	0
Bit Meas	0	0	2	1	0	0
Village 10.8	1	0	9	8	8	0
Krek 52/62	1	0	0	0	0	8
Phum Snay	22	16	0	0	0	0
Ban Non Wat	3	0	0	24	4	1
Promptin Tai	3	8	6	1	0	5
Khao Sam Kaeo	1	0	0	1	2	0
Total	36	29	20	17	18	15

Table 5.9: The most common bead shapes and the quantity recorded at each site as part of this study.

	Long Hexagonal Bicone	Short Hexagonal Faceted Bicone, (Rough)	Long Hexagonal Barrel	Hexagonal Flattened Bicone	Long Cylindrical	Pendants (with and without notches)
Angkor Borei		1 (quartz)				
Prohear				2	1	
Bit Meas	1					
Village 10.8	4				1	
Phum Snay		10				
Ban Non Wat			1		1	1
Promptin Tai	1		2	1	1	3
Khao Sam Kaeo				1	1	1
Total	6	11	3	4	5	5

Table 5.10: Less frequently encountered bead shapes and their quantities.

Site	Bead Shape(s)
Angkor Borei	Hexagonal Short Bicone
Village 10.8	Long Octagonal Barrel (n=2), Short Polygonal Bicone, Bicone-Barrel (n=15), Short Oblate, Long Oblate (n=2)
Ban Non Wat	Triangular Faceted Barrel, Rounded Square, Long Tabular Rectangle,
Promptin Tai	Short Hexagonal Tabular Barrel, Short Square, Short Cylinder (n=4)
Khao Sam Kaeo	Tabular Truncated Bicone, Chamfered Tabular Square, Crescent (n=2), Flat Leech Bead (n=2), Long Unfinished Barrel, Short Unfinished Barrel (truncated?), Unfinished Tabular Square

Table 5.11: Bead shapes found exclusively at one site. Unless otherwise noted, only a single version of each shape was recorded.

Perhaps the most unique bead shapes recorded in this study are the agate pendants (Figure 5.18) (Theunissen 2007). These pendants are somewhat similar to leech pendant beads (Figure 5.19) commonly found in South Asia (Beck 1941:7), but are a distinctly Southeast Asian bead shape. In the current study, these beads were found exclusively at sites in Thailand: Ban Non Wat, Promptin Tai, and Khao Sam Kaeo. There were several varieties of these pendants represented, including two broken fragments from Promptin Tai whose notches are missing or unclear. Previous studies have shown that these pendants are predominantly found in Northeast Thailand, especially at the sites of Noen U-Loke, Non Muang Kao, and central Thailand in the Lopburi, Saraburi, and Chonburi areas (Theunissen 2003:130). Therefore, it should not be surprising that additional pendants were found in these areas in the current study. However, the unfinished notched pendant at Khao Sam Kaeo is notable (Figure 5.18, lower right corner). The pendant was found on Hill 4, in an area producing beads similar to those found at late prehistoric and early historic period sites. The beads appear to have been mass-produced using “Indian-adapted” techniques (Bellina, personal communication, 2010). Earlier studies have suggested that these beads may have been produced in Northeast Thailand or at Oc Eo in the Mekong Delta (Theunissen et al. 2000; Theunissen 2003, 2007). However, evidence for bead production at Oc

Eo is problematic and no beads of this type have been found in archaeological contexts at sites in Cambodia, although a notched agate pendant has been reported from Phum Snay from a looted context (Lapteff 2007). Evidence for stone bead production at Khao Sam Kaeo, including this broken pendant suggests this may be a more likely production center for these beads.

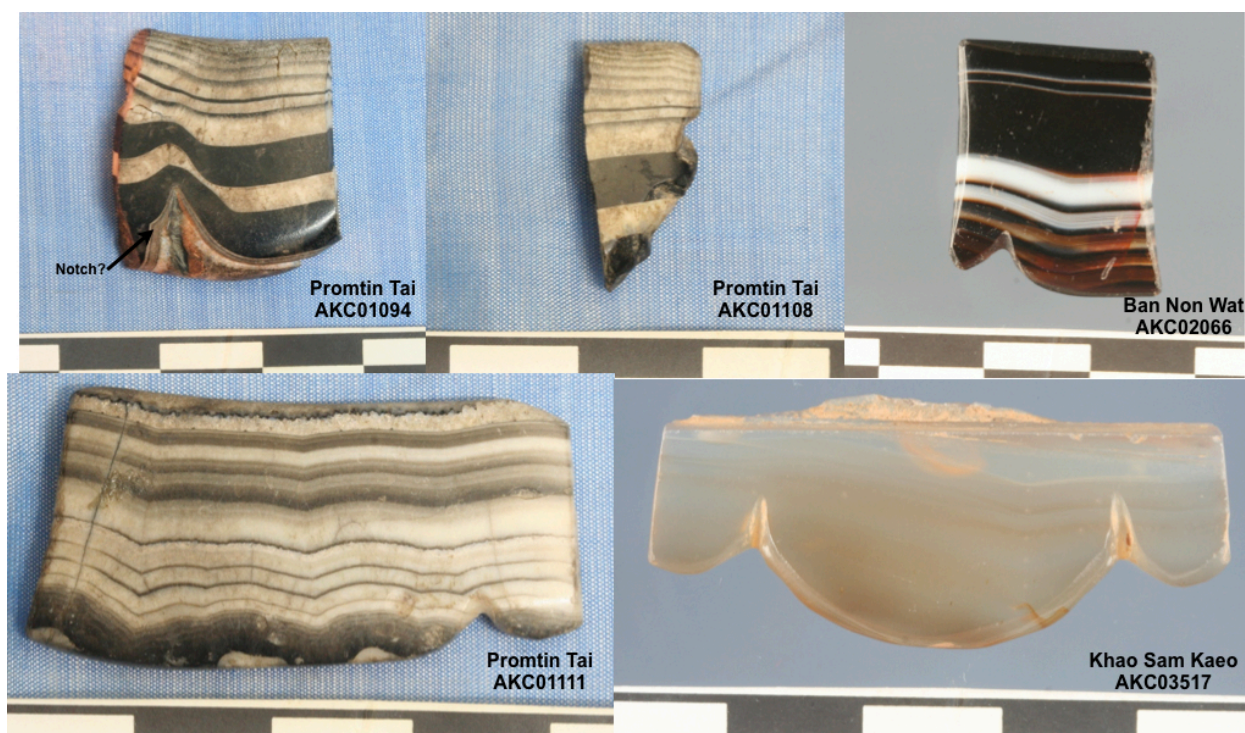


Figure 5.17: Examples of notched and unnotched pendants from Promptin Tai, Ban Non Wat, and Khao Sam Kaeo. Additional examples of pendants from Ban Non Wat can be seen in Higham et al. 2009:240. Scale in cm.

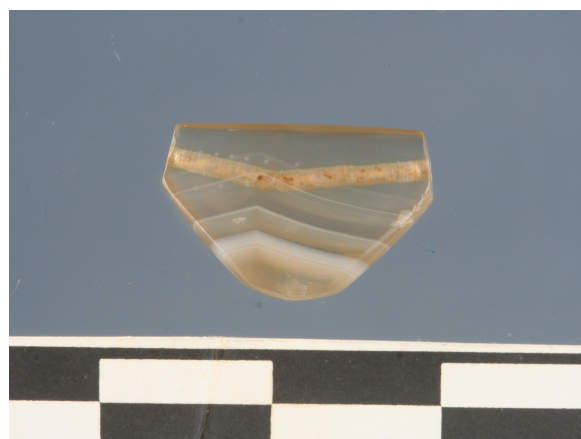


Figure 5.18: Example of a leech bead from Khao Sam Kaeo. Scale in cm.



Figure 5.19: A long hexagonal barrel bead from Promptin Tai. Scale in cm.

Another notable type of bead is the long hexagonal barrel (Figure 5.20). Previous studies have noted that this bead type is also predominantly found in Northeast and Central Thailand (Theunissen 2003: 130). Following this pattern, hexagonal barrel beads were also recorded at Ban Non Wat and Promptin Tai. Theunissen notes that both the faceted barrels and notched pendants have also been reported from Oc Eo and that “there are likely other contemporary sites in southern Vietnam that also yield these,” (2003: 131). However, like the agate pendants, no similar beads have been reported at sites in Cambodia. This could be explained by Oc Eo and sites in Northeast and central Thailand receiving similar beads from the same source, although it is notable that these beads were not widely traded to inland sites in Cambodia.

The hexagonal flattened bicone bead is another important bead that was found at Prohear, Promptin Tai, and Khao Sam Kaeo (Figure 5.21). This is a unique bead shape that seems to primarily be found at coastal sites (Giong Ca Vo, Giong Phet, and Sa Huynh, Vietnam; Muang Thong, peninsular Thailand) or inland sites located on important trade networks (Ban Don Ta Phet and Ban Chiang, Thailand) (Theunissen 2003:124) (Figure 5.22). Researchers have already

noted the similarities in the bead collections, including these beads, that have been found at Ban Don Ta Phet, Khao Sam Kaeo and coastal Sa Huynh culture sites (Glover and Bellina 2011). The presence of this bead type at Prohear and Promptin Tai highlight their connections to these early coastal exchange networks.

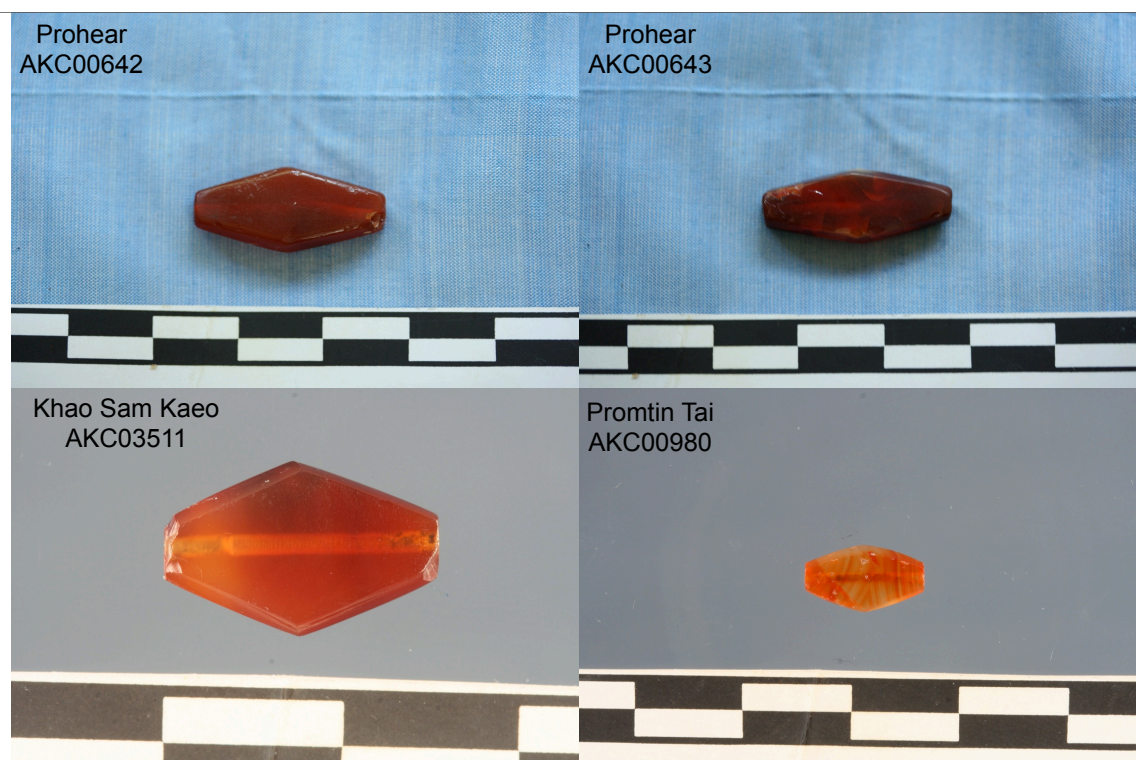


Figure 5.20: Hexagonal flattened bicone beads from Khao Sam Kaeo, Prohear, and Promptin Tai. Scale in cm.

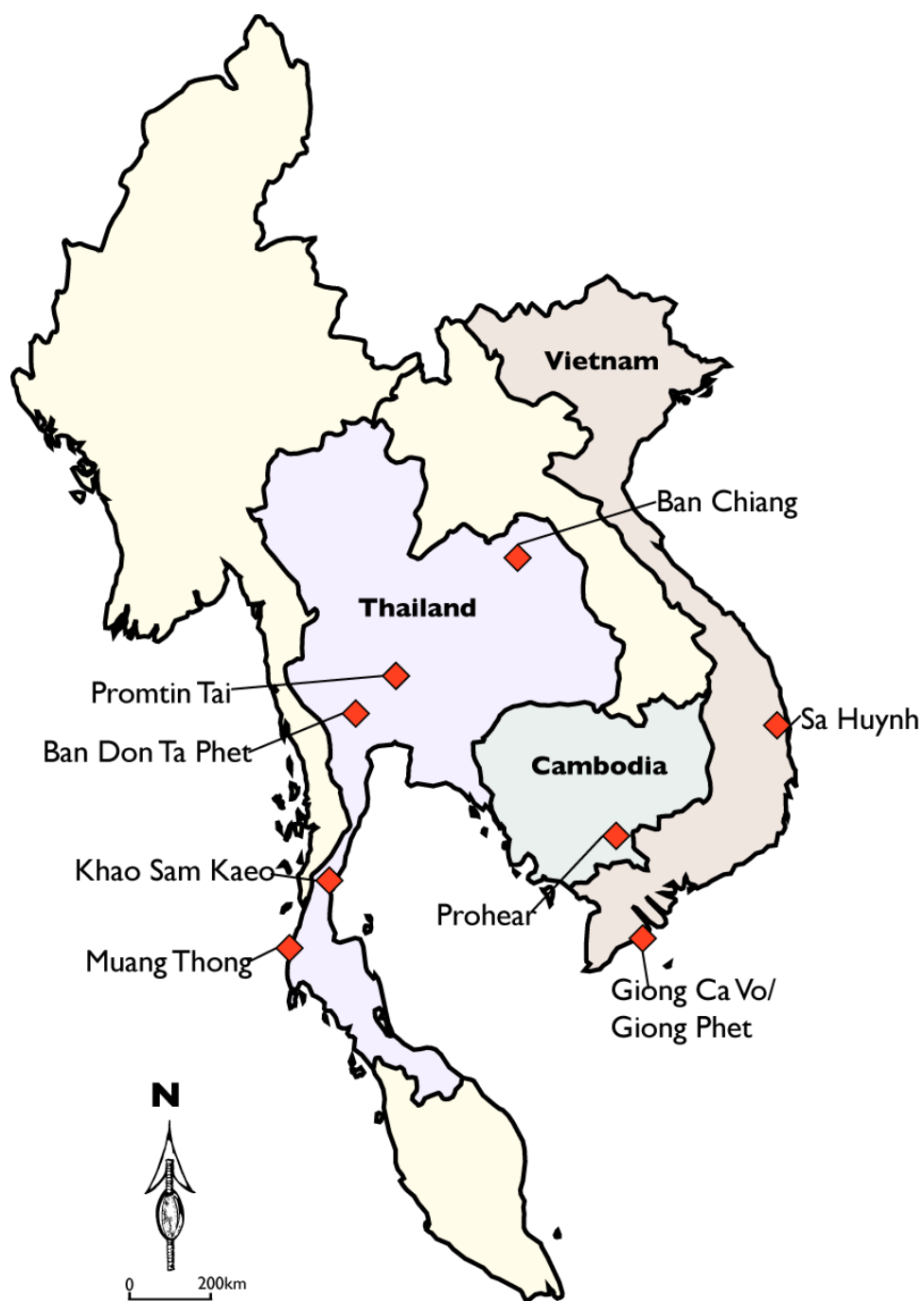


Figure 5.21: Sites with hexagonal flattened bicone beads. Adapted from Theunissen 2003: 124.

Although several sites contained unique bead shapes in small quantities, two sites had unusual bead types in larger quantities. At Phum Snay, there were numerous short, hexagonal

beads found at Phum Snay (Figure 5.23). These are notable for their low quality manufacturing, as the facets were uneven and the beads were not well polished, with the surface also covered in nicks, scrapes, and small chips. Nine of the ten beads were found in Burial 9, a single bead from Burial 2 might also belong to this category. The similarity in shape and rough manufacturing style suggest that these beads were the product of a single workshop that were traded to Phum Snay together. Other beads from Phum Snay were of a similar low quality, most notably the Rough Spherical beads, which were drilled from one side, resulting in a pop out or depression on the opposing side of the bead. This is a less careful or more expedient method of drilling a bead, but the resulting beads have an uneven shape.



Figure 5.22: Hexagonal faceted bicone beads from Phum Snay. Scale in cm.

A group of beads I have classified as bicone-barrel were found at Village 10.8 (Figure 5.24). These beads represent a transitional bead type, with some slight tapering towards the ends as in a traditional bicone, but lacking the clear mid-point seen in traditional bicones making them

more similar to barrels. Unlike at Phum Snay, these beads were found in multiple burials. However, Village 10.8 is notable for its large numbers of bicones, barrels, and bicone-barrels, with larger numbers of this bead type than any other site (Table 5.16). While this may also suggest that people in Village 10.8 were receiving beads from a single location, it could also indicate that people at Village 10.8 were specifically choosing these bead types over others.



Figure 5.23: Examples of Bicone-Barrel beads from Village 10.8 Scale in cm.

The distribution of agate and carnelian beads

Figure 5.25 displays the quantity of agate versus carnelian beads found at these sites. As is clear from this figure, beads from the Thai sites of Promptin Tai and Ban Non Wat have higher quantities of agate beads than other sites. In fact, agate beads made up nearly 50% or more of the total bead collections at Ban Non Wat, Khao Sam Kaeo, Prohear, and Promptin Tai. Conversely, carnelian beads dominated Phum Snay and Angkor Borei.

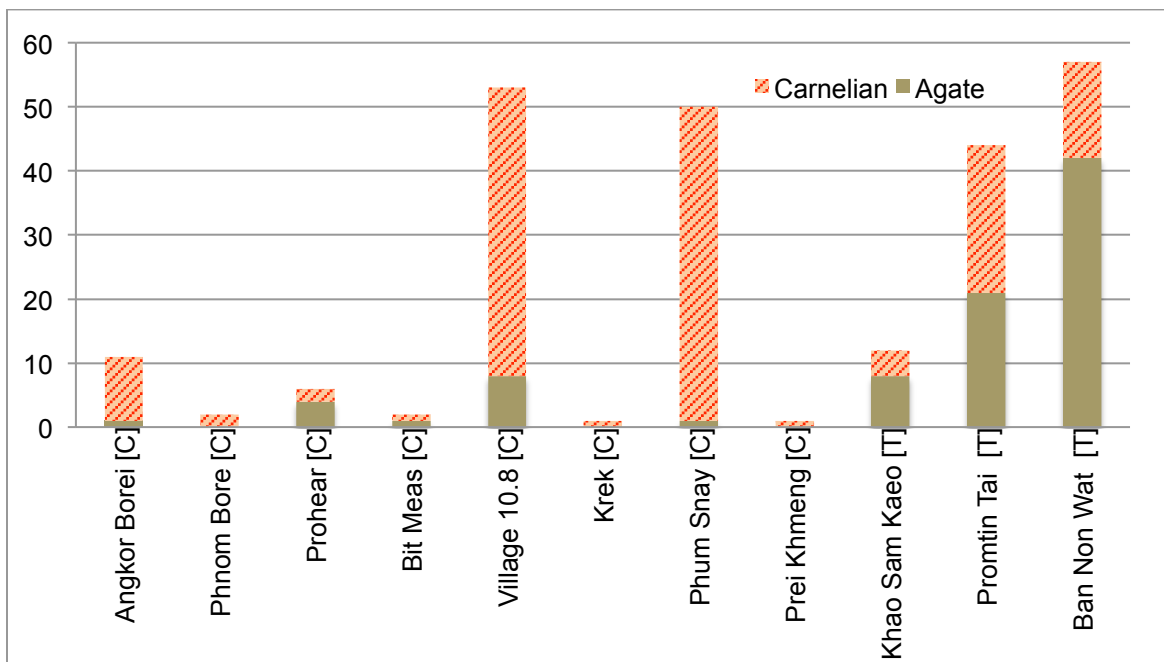


Figure 5.24: The distribution of agate and carnelian beads by site. Sites in Cambodia are marked by a [C] and sites in Thailand by a [T].

Agate beads appear to have made in a limited number of shapes. In this study, agate beads were only found in rectangular or square shapes, barrels, bicones, cylinders, and as pendants or leech beads. The most numerous kind were small agate beads, generally barrel, bicone, or cylinder shape, with an opaque center and brown or black bands on either end (Figure 5.26). This particular type of bead was found at Khao Sam Kaeo, Ban Non Wat, Village 10.8, Prohear, Promptin Tai, and Bit Meas. Theunissen has noted that this bead type is common with a fairly even distribution across mainland Southeast Asia (2003: 122). Pendants, both notched and un-notched, were exclusively made in agate and not carnelian.



Figure 5.25: A black and white banded agate bead from Village 10.8. Scale in cm.

Other scholars have noted a difference in the distribution of agate and carnelian beads across Southeast Asia. For example, agate etched beads, or beads with a white design on the surface are more commonly found in Southeast Asia, while carnelian etched beads are more common in India (Bellina 2007: 31; Glover and Bellina 2003). Agate beads in general appear to be more predominant in the upper Mun River Valley, Northeast Thailand, while carnelian beads tend to dominate bead collections at other sites in mainland Southeast Asia (Theunissen 2003:112). This discrepancy could be related to a preference for agate beads versus carnelian beads at these sites. However, Theunissen has argued that the upper Mun River Valley appears to have a unique exchange sphere. Agate beads in Cambodia are primarily concentrated at sites in southeast Cambodia. It appears then, that agate beads had a fairly restricted distribution and were exchanged within two regions of mainland Southeast Asia that were separated geographically and possibly temporally. There are some important distinctions in the types of agate beads found in both regions, therefore it does not appear that the agate beads were coming from the same source, but rather multiple sources. Conversely, carnelian beads were exchanged more widely and in higher quantities.

Comparing morphological characteristics

The limited distribution of several bead types points towards the existence of specific bead trade networks connecting regions of Southeast Asia. As discussed earlier, previous research by Bellina and Glover (2004) have identified two phases or periods of interaction with South Asia based on the distribution and types of artifacts found in Southeast Asia. Bellina (2007) has specifically identified morphological differences in the agate and carnelian beads between these two periods (Table 5.12).

Earlier Southeast Asian beads (Period 1 Type Beads)	Later Southeast Asian beads (Period 2 Type Beads)
-Complex morphologies (faceted beads) and geometric shaped beads (octahedrons, icosahedrons)	-Simple morphologies (spherical or elliptical beads etc.)
-Smaller overall mean sizes	-Larger overall mean sizes
-Higher quality stone	-Middle quality stone
-Smaller perforation diameters	-Larger perforation diameters
-Polishing of beads generally performed using a rotary grinding stone	-Polishing of beads generally in a drum
-Higher standard of craftsmanship/higher quality beads	-Lower standards of craftsmanship/lower quality beads

**Table 5.12: Morphological differences between earlier and later period beads found in Southeast Asia.
Adapted from Bellina 2007:32.**

Beads in the current study were classified as belonging to either the “Period 1 Type” or “Period 2 type” drawing from three of the characteristics described above: simple versus complex bead shapes, overall quality of beads, and perforation diameter. I was unable to carefully address other characteristics noted by Bellina as stone quality was not carefully recorded while in the field. Additionally, Bellina’s determination of polish types relied on casts of the surface of beads that were examined using a scanning electron microscope, and I was precluded from taking similar impressions of the bead surface due to time and budget limitations.

Simple vs. Complex bead shapes

Following work by Bellina, agate and carnelian beads were first classified as simple or complex (Figure 5.16). Figure 5.27 below shows examples of simple and complex beads from Bellina's research. Simple shapes included beads that were spherical, barrel shaped, bicones, or cylindrical. Complex beads include pendants, faceted beads, and other complex geometric shapes. Table 5.13 lists the total number of simple and complex bead shapes at each site and the total number of beads classified as either simple or complex. Figure 5.28 visualizes the first 3 columns of Table 5.13.

	# of simple shapes	# of complex shapes	Unknown or unfinished bead shapes	Total # of bead shapes	# of simple shaped beads	# of complex shaped beads	Unknown or unfinished shapes	Total # of beads
Angkor Borei	4	2	0	6	10	2	0	12
Ban Non Wat	7	9	0	16	38	19	0	57
Bit Meas	1	1	0	2	1	1	0	2
Khao Sam Kaeo	5	7	2	14	7	9	2	18
Krek Earthwork 52/62	1	0	0	1	1	0	0	1
Phnom Borei	1	0	0	1	2	0	0	2
Phum Snay	3	1	0	4	40	10	0	50
Prohear	4	1	0	5	3	3	0	6
Promptin Tai	9	8	1	18	33	9	1	43
Village 10.8	10	3	0	13	46	7	0	53

Table 5.13: The number of simple and complex bead shapes and number of beads classified as either simple or complex at each site.

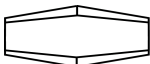
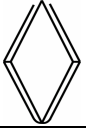
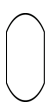
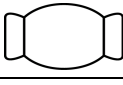
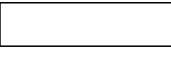
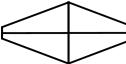
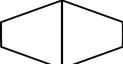
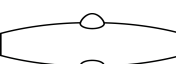
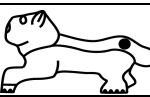
PERIOD I		PERIOD II	
front view	profil view	front view	profil view
			
			
			
			
			
			
			
			
			
			
			
			
			

Figure 5.26: Bead shapes typically found in Period 1 (more complex) and Period 2 (less complex) from Bellina 2003. Image courtesy of Bérénice Bellina.

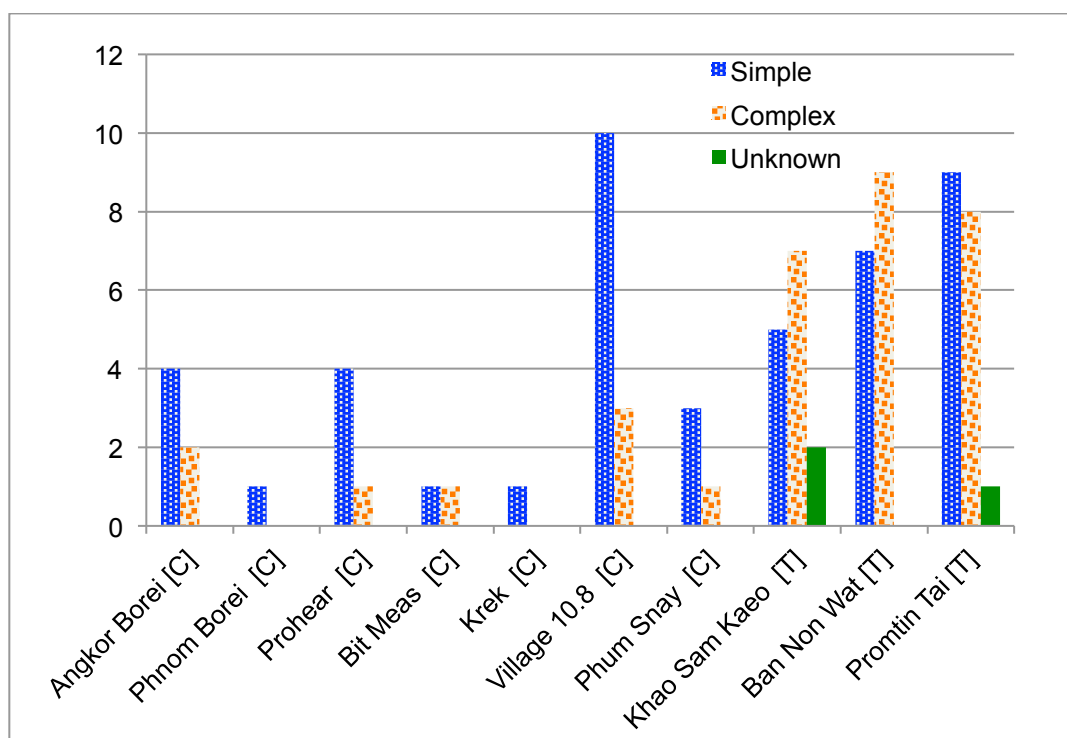


Figure 5.27: The quantity of different simple and complex bead shapes at each site. Sites in Cambodia are marked by a [C] and sites in Thailand by a [T].

If we look only at the number of bead shapes or types at each site we see that the Thai sites had a higher quantity of complex bead shapes than the Cambodian sites. Ban Non Wat contained nine different types of complex beads, Promtin Tai had eight different complex shapes, and Khao Sam Kaeo had seven different complex shapes. However, as noted previously, the number of bead shapes at Khao Sam Kaeo is low, as only a portion of the bead collection was available for study. The Cambodian sites generally did not have many different types of complex shaped beads, however Village 10.8 had the highest number of recorded bead shapes of any of the Cambodian sites (n=13). If we look at the quantity of beads classified by either simple or complex it is clear that there are generally higher numbers of simple shaped beads in circulation (Figure 5.29). I believe these differences are largely related to these bead types

circulating in two different bead trade networks, which is discussed more at the end of this chapter.

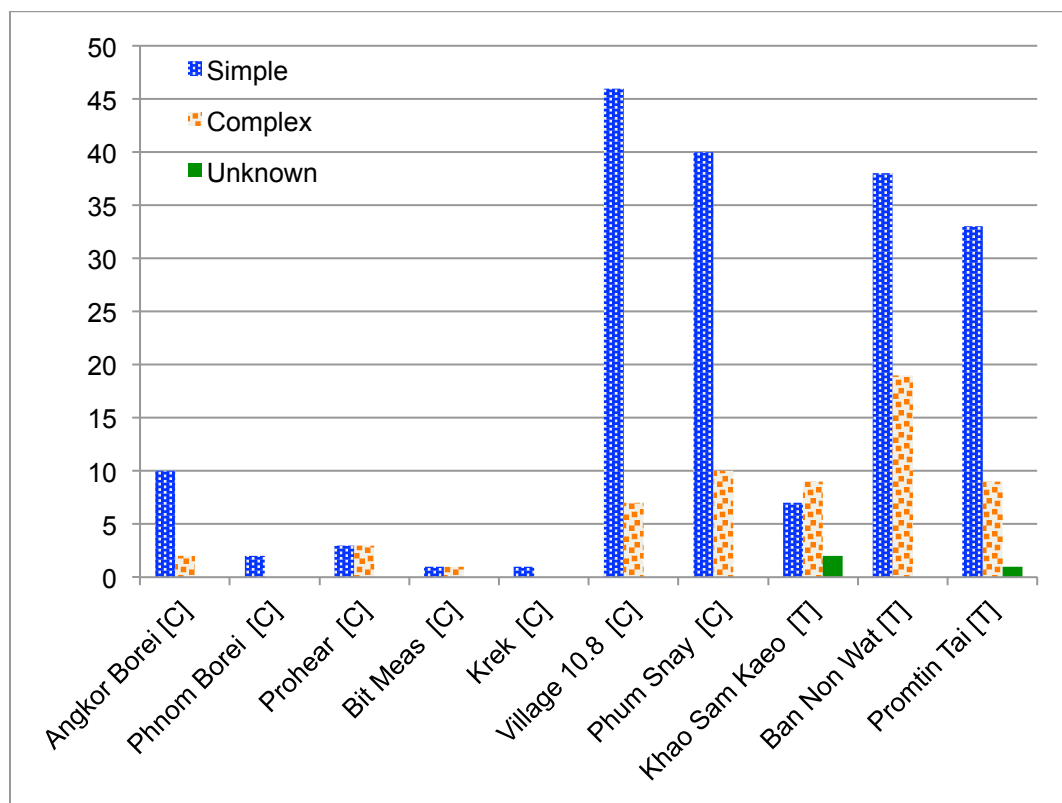


Figure 5.28: The total number of beads classified as either simple or complex by site. Sites in Cambodia are marked by a [C] and sites in Thailand by a [T].

Overall bead quality

The perceived quality of these beads was also assessed (see Appendix 5.1). Misshapen beads, those made from poor quality stone, or those with many chips and surface scratches were classified as low quality. Conversely, well-made beads with a smooth, high polished surface were labeled as high quality. Some seemingly well-made beads did have scratched or nicked surfaces, however this may have been from use or post-depositional activities, and were therefore still classified as high quality beads. Additionally, some well-made beads appear to have been broken or chipped during drilling, these were assessed on a case-by-case basis. The

entire collection of beads from Ban Non Wat were examined only briefly, therefore quality assessments were only made for those beads analyzed using LA-ICP-MS and 29 additional beads from burials for which notes and photographs were available. Sixteen beads from Ban Non Wat were not included. Figure 5.30 presents the number of high quality, low quality, and unfinished beads at each site. Village 10.8, Promtin Tai, and Khao Sam Kaeo are notable for their large numbers of high quality beads. Conversely, Phum Snay and Angkor Borei, and Ban Non Wat had larger numbers of low quality beads.

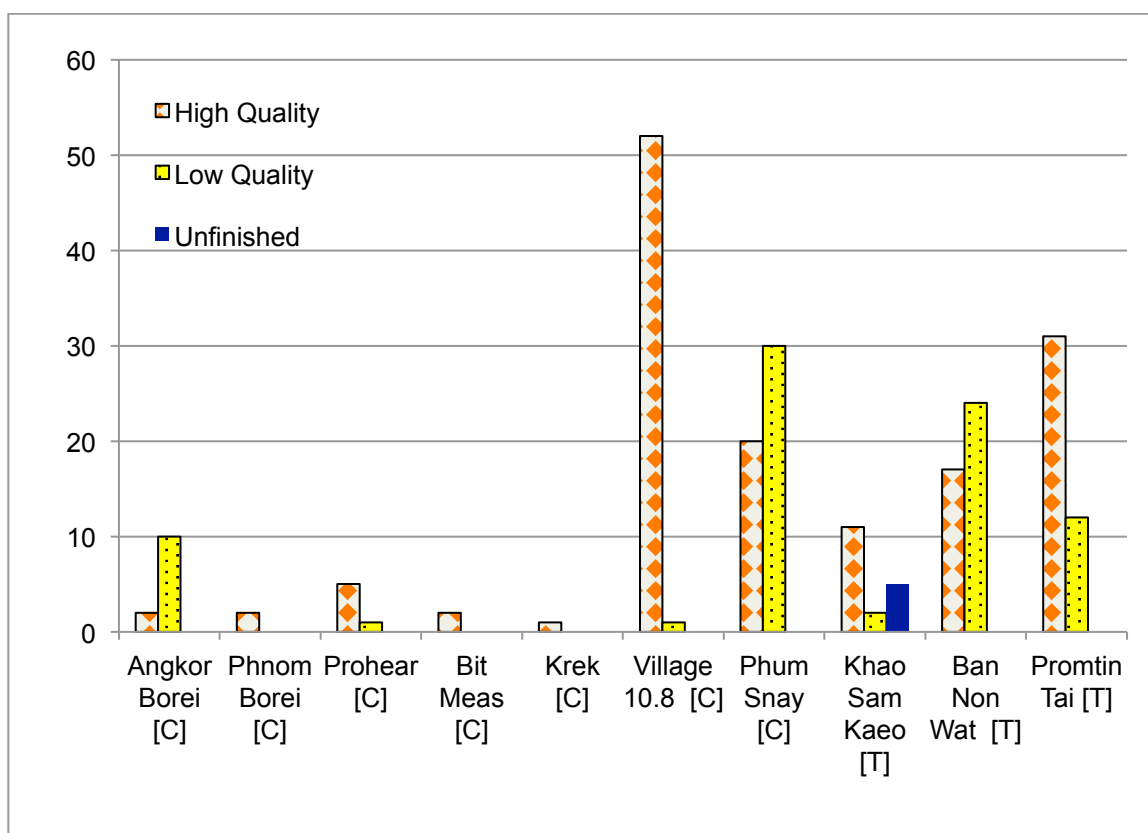


Figure 5.29: Quantity of high quality, low quality, and unfinished agate/carnelian beads by site.

Bead perforation size

Bead perforations for all stone beads were measured and the mean and standard deviation were calculated for each site (Table 5.14). Perforation sizes from both sides of a single bead were

included in this calculation. In some cases, beads had two different sized perforations, with one side of a bead having a larger hole than the other. Beads from Bit Meas, Phnom Borei, and Krek were omitted due to their small samples size. By looking at Table 5.14, we can see that Khao Sam Kaeo, Promtin Tai, and Village 10.8 all have smaller perforations (less than 1.5mm) while Prohear, Angkor Borei, and Ban Non Wat all have perforations above 1.5mm.

	Mean	Standard Deviation
Angkor Borei	1.63	0.26
Ban Non Wat	1.66	0.68
Khao Sam Kaeo	1.24	0.25
Phum Snay	1.72	0.30
Prohear	1.59	0.47
Promptin Tai	1.47	0.33
Village 10.8	1.33	0.27

Table 5.14: Mean and standard deviation of perforation hole sizes for all the agate and carnelian beads at each site.

In order to determine if the differences in perforation sizes were real, a single factor between-subjects analysis of variance test (ANOVA) was performed using the software program Aabel 3. ANOVA can be used to determine if there is a significant difference in the means of different groups, in this case it was used to determine if the difference in mean perforation sizes was significant. The results of the ANOVA test were significant (Table 5.15) indicating that there is a very small probability that the differences between the perforation sizes at each site these groups is related to the vagaries of sampling. Figure 5.31 presents the diamond mean comparison plot for the perforation sizes at each of the seven sites. From this figure it appears that Khao Sam Kaeo and Village 10.8 have much smaller perforations than the other sites.

Single-Factor Between-Subjects ANOVA (Independent Samples)					
Source	Sum of Squares	df	Mean Square	F	p
Between Groups	8.98016	6	1.49669	13.2447	< 0.001
Within Groups (Error)	38.8731	344	0.113003		
Total	47.8532	350			

Table 5.15: Results of ANOVA test showing significant difference between the mean perforation sizes.

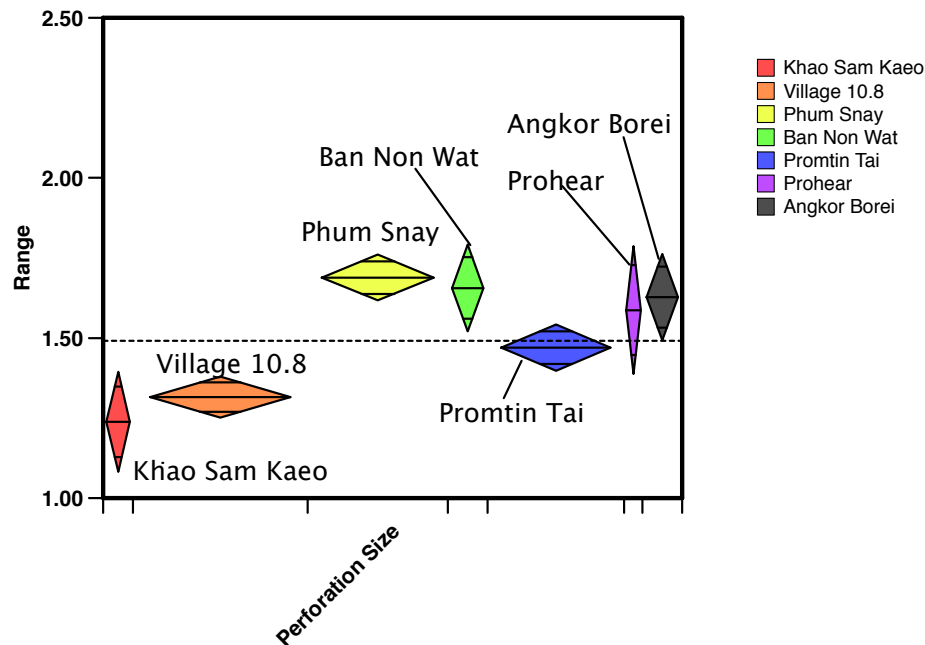


Figure 5.30: Diamond mean comparison plot for perforation size. The horizontal dashed line refers to the overall mean for all of the sites. The line in the middle of the center of the diamond denotes the group mean, with the top and bottom reflecting the 95% confidence limits. The width of the diamonds corresponds to the sample size at each site.

In order to better understand how the perforation sizes at the different sites a Scheffé test was performed. This test, which is included in the Aabel software package, can be used to determine which means or group of means is significantly different from one another. The Scheffé can be used when samples sizes are unequal, as in the current dataset. The results of this test are presented in Table 5.16; Figure 5.32 presents this table in visual form. The number in parentheses in Table 5.16 represents the number of beads measured; in most cases two perforations were measured per bead. The results show we can create several overlapping groups

of sites with similar bead perforation sizes. In the first group are Khao Sam Kaeo, Prohear, Promptin Tai, and Village 10.8, whose bead perforation sizes were determined not to be significantly different from one another, suggesting they could have been drawn from the same sample population. Bead perforation sizes from Prohear and Promptin Tai were also determined to be not significantly different from Angkor Borei and Ban Non Wat. However Phum Snay only shared similar bead perforation sizes with Angkor Borei, Ban Non Wat, and Prohear. That bead perforations from Prohear were not significantly different from any of the other sites may be due to the small sample size from this site.

Scheffé Test				
$\alpha = 0.05$				
Groups	Difference	Statistic	Critical Value	Significant
Khao Sam Kaeo (n=10) vs. Village 10.8 (n=53)	-0.077	0.902	3.571	No
Khao Sam Kaeo (n=10) vs. Phum Snay (n=50)	-0.451	5.166	3.571	Yes
Khao Sam Kaeo (n=10) vs. Ban Non Wat (n=12)	-0.418	3.987	3.571	Yes
Khao Sam Kaeo (n=10) vs. Promptin Tai (n=43)	-0.231	2.648	3.571	No
Khao Sam Kaeo (n=10) vs. Prohear (n=6)	-0.349	2.712	3.571	No
Khao Sam Kaeo (n=10) vs. Angkor Borei (n=12)	-0.389	3.713	3.571	Yes

Village 10.8 (n=53) vs. Phum Snay (n=50)	-0.373	7.627	3.571	Yes
Village 10.8 (n=53) vs. Ban Non Wat (n=12)	-0.341	4.482	3.571	Yes
Village 10.8 (n=53) vs. Promptin Tai (n=43)	-0.154	3.128	3.571	No
Village 10.8 (n=53) vs. Prohear (n=6)	-0.272	2.551	3.571	No
Village 10.8 (n=53) vs. Angkor Borei (n=12)	-0.312	4.104	3.571	Yes
Phum Snay (n=50) vs. Ban Non Wat (n=12)	0.033	0.421	3.571	No
Phum Snay (n=50) vs. Promptin Tai (n=43)	0.219	4.225	3.571	Yes
Phum Snay (n=50) vs. Prohear (n=6)	0.102	0.944	3.571	No
Phum Snay (n=50) vs. Angkor Borei (n=12)	0.061	0.791	3.571	No
Ban Non Wat (n=12) vs. Promptin Tai (n=43)	0.186	2.394	3.571	No
Ban Non Wat (n=12) vs. Prohear (n=43)	0.069	0.564	3.571	No
Ban Non Wat (n=12) vs. Angkor Borei (n=12)	0.029	0.296	3.571	No
Promptin Tai (n=43) vs. Prohear (n=6)	-0.118	1.089	3.571	No
Promptin Tai (n=43) vs. Angkor Borei (n=12)	-0.158	2.025	3.571	No
Prohear (n=6) vs. Angkor Borei (n=12)	-0.04	0.329	3.571	No

Table 5.16: Results of Scheffé test.

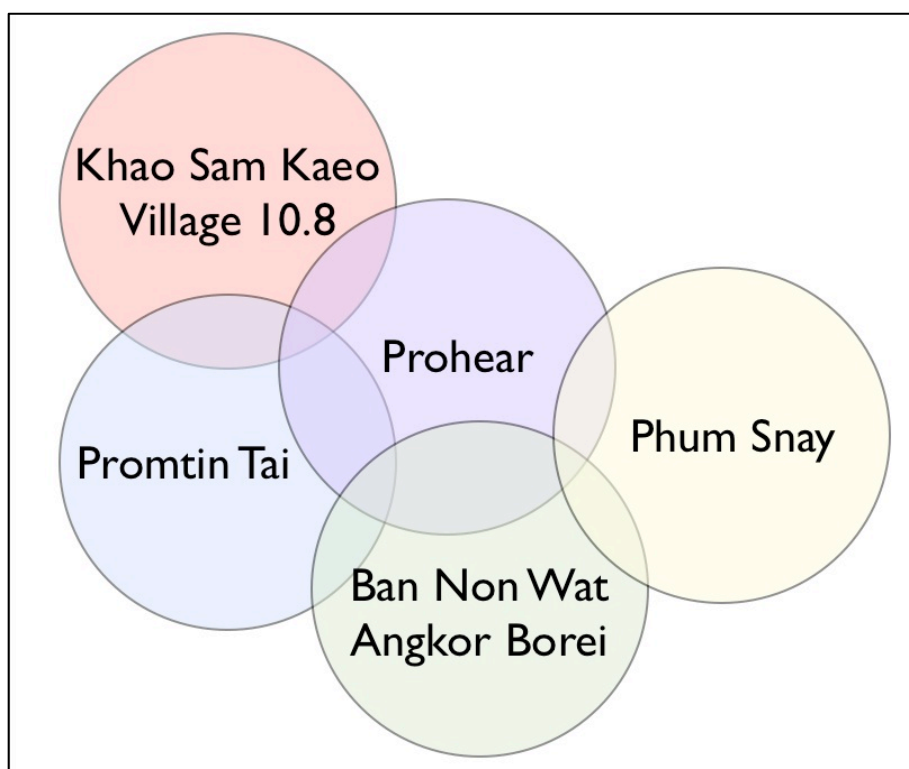


Figure 5.31: Based on results from the Scheffé test, this figure visualizes the similarity in bead perforation measurement by site.

Interpretation from metric and morphological analyses

If we examine all of the morphological data together, including the quantity and type of simple and complex bead shapes, the quality of beads, and their perforation sizes, I believe a pattern emerges in which some sites have beads that appear to belong to Bellina’s “Period 1 Type beads”, while other sites have beads that can be classified as belonging to Bellina’s “Period 2 Type beads” (Table 5.16). I follow Bellina (2003, 2007) and Bellina and Glover (2004) in arguing that archaeological evidence suggests two different phases of contact with South Asia and that these differences are reflected in the different types of beads in circulation during each period. In Bellina and Glover’s model Phase 1, dates from the fourth century BC through the second century AD and involves sporadic trade with South Asia. Phase 2 involves more intensive trade with South Asia and expanded trade contacts within Southeast Asia and dates to

the second through fourth centuries AD. However, it is likely that changing interaction and trade networks happened in different parts of Southeast Asia at different times, and as I argue below, there was likely a chronological overlap between these changing trade networks.

As noted earlier, Period 1 Type beads are generally of a higher quality, with more complex shapes, and smaller perforation sizes. The beads from Village 10.8 and Khao Sam Kaeo appear to fit in this category. This should not be surprising as both sites are amongst the earliest examined in the current study: the stone bead industry at Khao Sam Kaeo dates from the 4th- 2nd century BC while Village 10.8 has been radiocarbon dated from 400 BC- AD 50. Promtin Tai may also belong to the Period 1 group as the site had a fairly large number of complex bead shapes, small perforations, and numerous high quality beads. Furthermore, Promtin Tai and Khao Sam Kaeo share several additional characteristics including large numbers of agate beads in comparison with carnelian beads, agate pendants, and hexagonal flattened bicone beads.

Period 2 beads, in contrast, have more simple morphology, are generally of a lower quality, and have larger perforation sizes. In Bellina's model, beads with Period 2 Type beads generally date to the later Iron Age, or the first few centuries AD. Following these characteristics, I argue that beads from Angkor Borei and Phum Snay belong in this category. These sites also date slightly later than the Period 1 sites above, as the cemetery at Angkor Borei dates from 200 BC – AD 200 and Phum Snay has been radiocarbon dated from 350 BC- AD 200. Although the sample size was too small to consider in depth, I also argue that beads from Phnom Borei may belong to the Period 2 category, largely due to its proximity to Angkor Borei both temporally and geographically. However, this will need confirmation with additional fieldwork.

There are four sites for which determining the period in which the beads may belong is more difficult. The small sample size of beads from Prohear is problematic, however beads were generally of high quality with several complex shapes, including a hexagonal flattened bicone bead that links this site to both Khao Sam Kaeo and Promptin Tai. Furthermore, Prohear had several agate beads, a characteristic shared by all of the sites with Period 1 Type beads. For this reason, I believe that beads from Prohear can be classified as belonging to the Period 1 Type. Bit Meas is believed to be contemporary with Prohear and the beads from this site are reported to be similar to Prohear, for this reason I also classify Bit Meas as having Period 1 Type beads.

The difficulty of classifying the beads at Ban Non Wat as belonging to either the Period 1 or Period 2 category is likely due to the long occupation sequence. Although Ban Non Wat shares many characteristics with other sites that have Period 1 beads, including large numbers of agate beads and complex bead shapes, the unusual agate pendant beads found at Ban Non Wat are primarily from Iron Age 4 burials that date several hundred years after a similar notched pendant from Khao Sam Kaeo. For this reason, I cannot confidently assign Ban Non Wat to either Period 1 or Period 2 as it likely contains beads that belong to both periods. Lastly, the sample size from Krek 52/62, a single bead, was too small to assign to either period.

Period 1 Beads: Smaller perforation, more complex shape, higher-quality beads	Period 2: Larger perforation, simpler shapes, lower-quality beads	Unsure/Unknown
Khao Sam Kaeo Village 10.8 Promptin Tai <i>Prohear</i> <i>Bit Meas</i>	Angkor Borei Phum Snay <i>Phnom Borei</i>	Ban Non Wat (both periods?) Krek 52/62

Table 5.17: Period 1 and Period 2 beads as determined by morphological characteristics. Sites in italic are those that have been tentatively classified as belonging to either Period 1 or Period 2.

Conclusion: Implications for agate and carnelian bead trade networks

In this chapter I presented contextual, morphological, and metric data on agate and carnelian artifacts from 11 sites in Cambodia and Thailand. I have aimed to demonstrate that agate and carnelian beads were important prestige objects that had a restricted distribution both at the site level and regionally. Classification of bead shapes allowed for the identification of unique bead types that appear to link sites to one another or to a specific trade network. Furthermore, analysis of morphological and metric characteristics has allowed for the classification of beads from the sites in this study as belonging to either Bellina's Period 1 bead type, associated with trade networks dating to the mid-late centuries BC, or Period 2 Type beads associated with the later Iron Age period trade networks. Although Bellina and Glover have divided the phases of trade chronologically, the presence of Period 1 type beads at Prohear and Period 2 type beads at Angkor Borei – two sites that are contemporaneous with one another – suggests that these trade networks may have also overlapped briefly in time. In the introduction to this chapter I introduced two questions that I would now like to address in more detail.

Based on morphological analysis, is there a pattern in the type of beads being traded over time and space?

Based on the morphological analysis of bead shape, quality, and perforation size I suggest that beads can be classified into two broad categories that are related to different trade networks and phases of trade with South Asia. Period 1 Type beads found at Khao Sam Kaeo, Village 10.8, Promtin Tai, as well as Prohear and Bit Meas were generally of a higher quality and contained shapes that connected them to other sites in the region. In Bellina's (2007: 41) study, she argued that early Period 1 Type agate and carnelian beads were likely entering into a

pre-existing long-distance prestige goods exchange network that connected various communities to one another. The beads were important symbols that were recognized by all parties involved in the exchange as important signifiers of status or power within a community (Bellina 2007).

Based on the co-occurrence of Period 1 type agate and carnelian beads with nephrite ear ornaments (discussed in Chapter 9) I agree with both Bellina and other scholars (e.g. Christie 1990, 1995; Dzung 2011; Theunissen 2003) who have argued that during Phase 1 trade with South Asia, agate and carnelian beads were likely entering into pre-existing long-distance exchange networks. These pre-existing exchange networks appear to be largely tied to the Sa Huynh culture and their broad interaction sphere. Evidence from numerous Vietnamese Sa Huynh culture sites demonstrate that they were participating in both inter- and intra-regional trade networks that linked communities in Southeast Asia with both India and China (Lam Thi My Dzung 2009). I argue that sites I have classified as having Period 1 agate and carnelian beads, namely Khao Sam Kaeo, Village 10.8, Prohear, Bit Meas, and Promtin Tai, also had connections to these early coastal exchange networks. However, other sites including Angkor Borei, Phnom Borei, and Phum Snay have Period 2 Type beads, which are more strongly associated with the expanding trade networks with South Asia during the early centuries of the first millennium AD. I suggest, based on the data presented in this chapter, that elites at these sites were not heavily participating in early coastal exchange networks but instead connecting sites in the Mekong Delta with sites further inland in new trading networks.

Does evidence from trade patterns suggest that sites in the Mekong Delta were influencing trade of these objects?

Although contextual data demonstrates that agate and carnelian beads were not evenly distributed among the sites studied, the current morphological and metric study does not strongly suggest that trade of beads was tightly controlled by elites in the Mekong Delta. Certain types or styles of beads seem to have had a limited distribution in certain regions, such as notched agate pendants that were found predominantly in Northeast and central Thailand. These beads may have held certain significance for communities in this region and appear to be indicative of a strong regional trading network. However, it is not clear as Theunissen (2003) has suggested, that communities in Southeast Asia were controlling both the manufacture and distribution of these objects.

What is notable, however, is that communities in the Mekong Delta do not appear to have been participating in the earliest trade networks. Instead, I suggest that the bead distribution data at these sites and the inland site of Phum Snay show that they are not participating in trade until trade with South Asia began to expand and intensify in the early centuries AD. It is possible that Mekong Delta communities were taking advantage of expanding trade networks and greater numbers of agate and carnelian beads to expand their connections with elites at inland sites like Phum Snay. Data from glass beads supports this hypothesis and is discussed further in Chapter 7.

Bellina and Theunissen have both suggested that the higher quantities of beads available during the Phase 2 trading period were due in part to local manufacture of agate and carnelian in communities in Southeast Asia. In the next chapter, I will discuss my test of this hypothesis

more thoroughly through geochemical examinations of a selection of the agate and carnelian artifacts.

Chapter 6: Agate and Carnelian Beads- Geochemical Analysis

This chapter is an extension of the work from the previous chapter in which morphological, contextual, and metric data were used to identify patterns in the distribution of agate and carnelian beads. In this chapter I present the results of geochemical compositional analysis using Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry (LA-ICP-MS) on a group of 79 agate and carnelian beads as well as raw material samples from 12 geologic sources located in South and Southeast Asia. I use these data to address three questions:

- Were different stone sources being used to produce Period 1 Type beads versus Period 2 Type beads?
- Is there evidence that certain bead types were being made from specific geologic sources?
- Is there geochemical evidence for the use of agate and carnelian from Southeast Asian sources for local bead production?

Ideally, compositional analysis should identify if different types of beads were being produced using a particular stone source, which may in turn allow for the identification of bead production workshops. Geochemical analysis will also assist in determining if raw material resource exploitation was changing over time. This is especially related to questions regarding the manufacture of agate and carnelian beads using Southeast Asian geologic sources. Previous studies have emphasized the use of Indian manufacturing techniques used to produce agate and carnelian beads found in Southeast Asia (Bellina 2001, 2003; Theunissen 2003). If both South and Southeast Asians were using the same methods to produce beads, it may be nearly

impossible to prove which group made the beads. However, the use of local raw material sources has implications regarding control over resources by Southeast Asian elites and could be a proxy for the presence of local Southeast Asian beadmakers. Additionally, control over local raw material sources to make agate and carnelian beads would indicate that local elites were controlling not just the production of beads, but also the raw material sources used to make these objects. Control over both the complex bead production technology and local raw material sources is an aspect of craft production most commonly seen in complex state-level societies (Vidale and Miller 2000).

I begin this chapter by reviewing previous geochemical provenience studies on agate and carnelian artifacts. This study represents an improvement over these previous studies due to the measurement of a greater number of elements and the use of a larger dataset. Following this review, I introduce the geologic sources and artifacts that underwent LA-ICP-MS analysis. A summary of the methods used to determine which elements were used in statistical analyses and their variability within the samples is also presented. Following this I present the results of my analysis and conclude that most of the beads found at sites in Southeast Asia were made from an Indian geologic source known as the Deccan Traps. As it was difficult to geochemically distinguish between the Deccan Traps sources, I was unable to determine more fine-grained resource exploitation patterns. One quarter of the beads ($n=20$) were from non-Deccan Traps sources. Although the exact geologic source used to produce these beads is thus far unknown, I present several suggestions. Some specific bead shapes do appear to be from unique non-Deccan Traps sources, however these conclusions are preliminary and require more research. Lastly, I return to the three questions presented above.

Previous compositional studies of agate and carnelian

There have been several small studies that have sourced agate and carnelian artifacts in order to better understand trade networks. Attempting to answer questions regarding the local manufacture of artifacts in Southeast Asia, Robert Theunissen and others (2000) used a non-destructive technique, PIXE/PIGME, to analyze beads from the Thai Iron Age sites of Noen U-Loke (n=9) and Ban Don Ta Phet (n=9). As comparative source material they analyzed carnelian fragments from Arikamedu, south India (n=10), bead rough-outs from the site of Limodra in Gujarat (n=5), carnelian beads from a production site in Orissa, northeast India (n=3), carnelian samples from the Sri Lankan bead production site of Anuradhapura (n=16), and samples from a Thai agate source in Lopburi province, central Thailand (n=2). Their study found that PIXE/PIGME could discriminate between the various geologic source and artifacts and they concluded that the beads from the Thai sites of Ban Don Ta Phet and Noen U-Loke were compositionally distinct from the Indian geologic sources they sampled. Also significant was that the beads from Ban Don Ta Phet and Noen U-Loke were compositionally distinct from one another. There was some overlap between the Sri Lankan sources and the beads from Thailand, suggesting a possible origin for beads from this location. However, they also argued that there was a compositional similarity between the two Thai agate sources and the carnelian and agate artifacts. Although it is difficult to make strong conclusions when only using two geologic source samples, they authors argue it was suggestive of local manufacture of beads using local raw materials and suggested additional research to further test this hypothesis (Theunissen et al. 2000:98).

Theunissen's study raised several important points including the importance of questioning the Indian origin for all the agate and carnelian beads in Southeast Asia, instead focusing on a more complex and multi-source origin for these materials. Theunissen also suggested that compositional analysis could aid in identifying and tracing the movement of specific bead types. However, as the authors concede, their study had an extremely small sample size, which limited the interpretations they were able to make with their data.

Timothy Insoll and others (2004) used UV-LA-ICP-MS in order to examine carnelian trade between India and Africa. However, as with the previous study, the geologic source samples were problematic. Thirteen artifacts from sites in western Africa were compared with 13 geologic samples from a single widespread deposit in Ratanpur in Gujarat state, India. Although the authors found some overlap between the two groups, there were also samples that were compositionally distinct from the Ratanpur source and the study was limited by the lack of comparative geologic samples.

More recent studies using larger numbers of geologic source samples and a destructive technique, Instrumental Neutron Activation Analysis (INAA), have been more successful at distinguishing between geologic sources and assigning artifacts to these sources (Law 2011; Law et al. 2012). However, the destructive nature of this technique is not ideal for analyzing archaeological artifacts. For this reason, I used the virtually non-destructive technique of LA-ICP-MS. Furthermore, I wished to expand on previous studies by analyzing a higher quantity of geologic source samples in order to more accurately characterize numerous sources.

Agate and Carnelian Geologic Sources

With increasing evidence that beads were produced in both South and Southeast Asia, there are numerous potential sources that could have been used to make beads. Although it would be ideal to analyze all potential sources, this was of course not possible due to limits in finances, time, and access. Nevertheless, a total of 12 potential sources were analyzed, making this the largest compositional study of agate in Southeast Asia yet undertaken (Table 6.1). I attempted to analyze at least 12 samples from each geologic source in order to accurately characterize the variation within that source. Unfortunately, the limited availability of samples from some sources required that I analyze smaller quantities.

Source Name	Number of specimens analyzed
Khandek, Gujarat State, India	15
Mardak Bet, Gujarat State, India	15
Ratanpur, Gujarat State, India	15
Mahurjhari, Maharashtra State, India	25
Paithan, Maharashtra State, India	15
Undhari, Maharashtra State, India	14
Shahr-i-Sokhta, Iran	17
Ban Khao Mogul, Lopburi Province, Thailand	17
Kon Tum, Vietnam	9
Gia Lai, Vietnam	4
Dong Nai, Vietnam	6
Pacitan, East Java, Indonesia	9

Table 6.1: Names and quantity of geologic source samples analyzed using LA-ICP-MS

South and Central Asian agate and carnelian sources

Perhaps the most well known agate and carnelian sources are those that lie in the Indian state of Gujarat and have been exploited by beadmakers dating back more than 4000 years (Allchin 1979; Barbosa 1517; Foster 1906; Huntingford 1980; Khan 1756; Kenoyer et al. 1991, 1994; McCrindle 1885; Poessehl 1981; Roux 2000). The Gujarati city of Khambhat (Cambay) has been a major bead production center since at least the 16th century AD (Arkell 1936). Three

Gujarati agate/carnelian sources were analyzed as part of this study. Additionally samples from three sources located in the nearby Maharashtra state were also analyzed. Historic and archaeological data discuss bead production in this region. Lastly, samples from the Iranian site of Shahr-i-Sokhta (Law et al. In Press; Tosi 1968) were included.

The agate from Gujarat and Maharashtra part of a larger geologic formation known as the Deccan Traps, a large igneous province that consists of a series of flood basalt layers (Mahoney 1988) (Figure 6.1). The Deccan Traps are not a homogeneous formation, but were rather formed through a succession of volcanic events. Agate, carnelian, and other microcrystalline silicates formed within the vesicles and can be found in both their primary geologic context or in secondary geologic sources, in which the agate and carnelian nodules have eroded from their host rock and been carried to a secondary location (Merh 1995). The famous source of Ratanpur is located within a well-known secondary deposit known as the Babaguru Formation that contains materials from potentially a large geographic area brought to the site through fluvial processes (Gadekar 1977; Law 2011). Despite these complications, previous geochemical studies on agate from Ratanpur have been able to differentiate it from other sources (Law 2011).

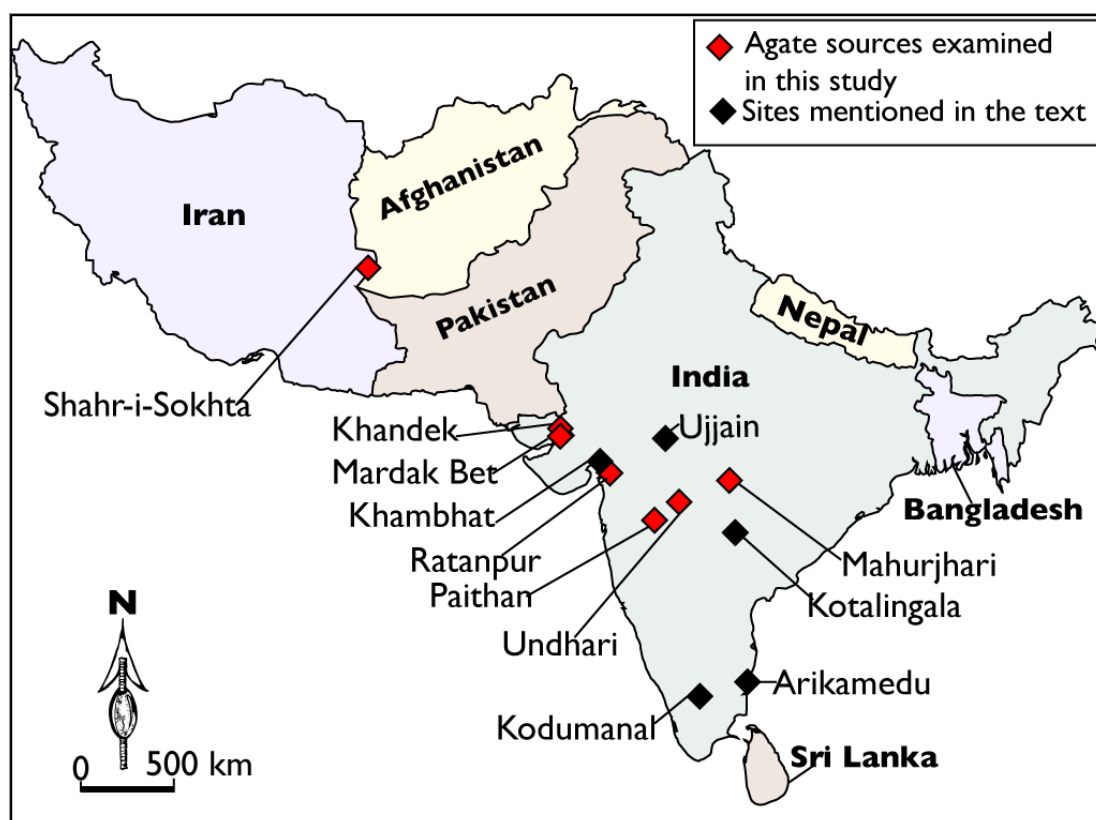


Figure 6.1: Map of Central and South Asian geologic sources and sites mentioned in the text.

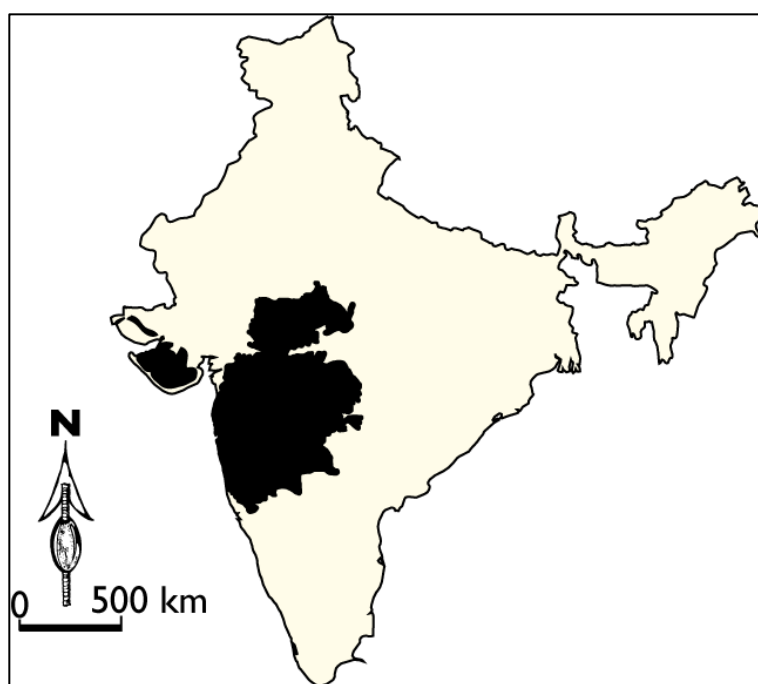


Figure 6.2: Map of the approximate location of the Deccan Traps. Adapted from Mahoney 1988.

Khandek

The Khandek agate/carnelian source is located in Gujarat province about 5 km from the Indus site of Surkotada (Map Figure 6.2). The source is approximately 4 hectares in size with a variety of loose agates and other microcrystalline silicates on the surface (Law 2011). Dr.

Randall Law collected samples from this source and kindly provided them for use in this study (Figure 6.3). Law (2011: 272-3) reports that it appears the source had been exploited in the past, although it was unclear when.



Figure 6.3: Geologic agate samples from Khandek, Gujarat Province, India. Photo courtesy of Randall Law. Scale in cm.

Mardak Bet

Mardak Bet is a small island located in the “Little Rann” of Kutch (Figure 6.2). The site was visited by Law (2011: 277), who observed are two primary agate beds with a range of microcrystalline silicates. Additionally there is evidence that there were “numerous agate and jasper flakes, some with a heavy patina suggesting great antiquity.” Samples were taken from both beds and treated as a single source due to their geographic proximity to one another (Figure 6.4).



Figure 6.4: Geologic agate samples from Mardak Bet, Gujarat Province, India. Scale in cm.

Ratanpur

There are numerous well-known agate mines around the village of Ratanpur (Figure 6.2 and Figure 6.5). The sources are all within a short distance of a hilltop shrine to Baba Ghor (or Gori Pir), an Islamic saint who is said to have initiated beadmaking in the region around the 15th century AD (Francis 1986; Kenoyer and Bahn 2004). As discussed above, this region belongs to

the Babaguru Formation, a secondary agate deposit. The agate mines at Ratanpur are a major source for the historic and modern bead-making industry in Khambhat (Law 2011: 268).

Samples were collected by Law from agate mining areas in a 3km area around the base of the Gori Pir hill (Figure 6.6).

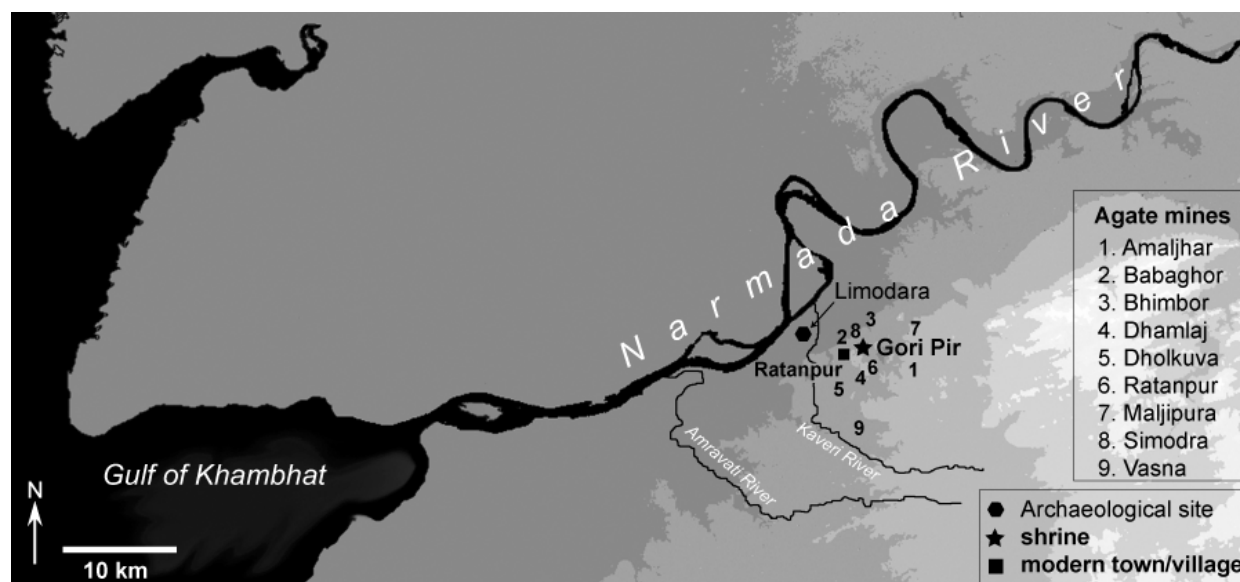


Figure 6.5: Map of notable agate mine locations around the village of Ratanpur. Map provided by Randall Law.



Figure 6.6: Geologic agate samples from Ratanpur, Gujarat Province, India. Photo courtesy of Randall Law. Scale in cm.

Mahurjhari

Mahurjhari (Figure 6.2) located in Maharashtra state, is not a geologic source, but rather an archaeological site with evidence for bead manufacturing activities dating from the Megalithic through Early Historic periods (6-7th century BC- 4-5th century AD) (Mohanty 1999). Nodules, flakes, finished, and unfinished beads from surface collection were obtained by Dr. Mark Kenoyer and used as a proxy for an unknown nearby agate/carnelian source (Figure 6.7).

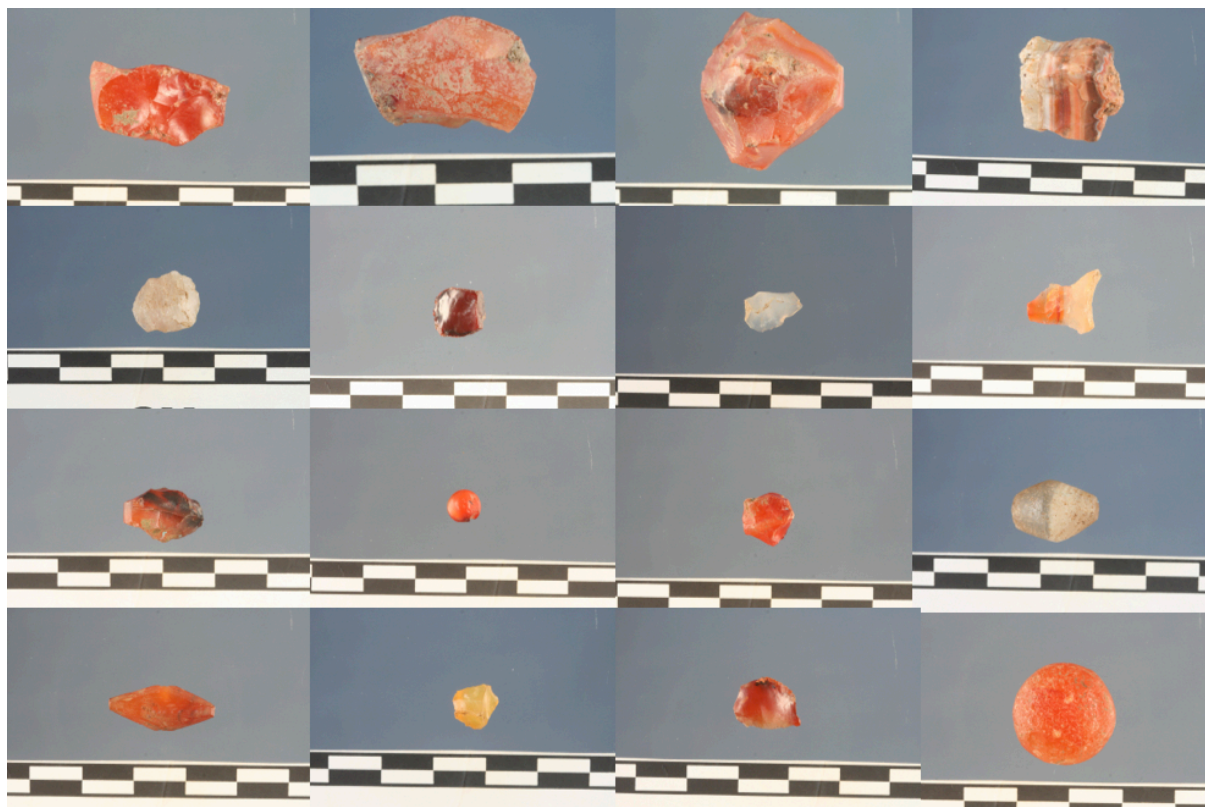


Figure 6.7: Samples from Mahurjhari, Maharashtra Province, India. Scale in cm.

Paithan

Paithan is located in interior Maharashtra (Figure 6.2) in central India and is a famous source of raw material that was mentioned in the Periplus of the Erythraean Sea (Francis 2002). Dr. Randall Law collected samples (Figure 6.8) from the bed of the Godavari River south of

Paithan town and noted that there were high-quality banded agates found at this location (Randall Law, personal communication, 2012).



Figure 6.8: Left-Agate nodules in the Godavari River near Paithan, Maharashtra Province, India. Right-Detail of agate nodules at Paithan. Photos courtesy of Randall Law.

Undhari

Undhari is also located in interior Maharashtra province, India (Figure 6.2). Samples were collected by Dr. Randall Law, who reports fairly large nodules on the surface (Figure 6.9). Law (personal communication, 2012) was told that some of the nodules were being sent to Cambay for use in bead manufacture and he notes that they were visually similar to agate from Ratanpur. Two samples from Undhari were also contributed by Dr. J. Mark Kenoyer and had been collected by colleagues from an area approximately 2 km northeast of Undhari village.



Figure 6.9: Left- Agate-filled agricultural fields at Undhari, Maharashtra province, India. Right- A large agate nodule from Undhari. Photos courtesy of Randall Law.

Shahr-i-Sokhta

Also included in this study were flakes and nodule fragments from the prehistoric site of Shahr-i-Sokhta, Iran, that were provided to Randall Law by Dr. Maurizio Tosi (Figure 6.2). Several Iranian agate sources have been discussed in the literature (see Law 2011: 282), however the Shahr-i-Sokhta samples were treated as a proxy for an unknown agate source in eastern Iran (Figure 6.10). Although it is unlikely that this region was a major producer of beads being traded to Southeast Asia, there are known contacts between Persia and Southeast Asia during the first millennium AD (Ritter 2010).



Figure 6.10: Archaeological agate samples from Shahr-i-Sokhta. Photo courtesy of Randall Law. Scale in cm.

Southeast Asian agate and carnelian sources

Agate and carnelian is present in Southeast Asia, although exploited in smaller quantities than in South Asia. Decorative pieces of agate, carnelian, and other microcrystalline quartz are exported from Indonesia (David Bernstein, personal communication 2010). In Vietnam, agate used in jewelry, has been reported from Loc Ninh in Binh Phuoc province (Pham Van Long et al. 2004; Reinecke et al. 2009: 163). As noted earlier, there is strong evidence for bead production using local carnelian, chalcedony, and fossil wood sources in Myanmar (Campbell Cole 2003; Moore 2007:100). An agate/carnelian source in Lopburi province near the town of Ban Khao Mogul has been suggested as a possible source for locally produced beads by several scholars (Glover 1989; Theunissen et al. 2000). On a recent trip to Thailand I saw replica beads being sold in the markets that sellers said were coming from an agate/carnelian source in Lopburi. Agate and carnelian from Java has also been suggested as a possible source for raw material

(Bellina 2007:68). However, scholars have also suggested it is likely that raw material may have also been imported to Southeast Asia from elsewhere (Bellina 2007:68). With the exception of Myanmar, there is little evidence for exploitation of Southeast Asian agate/carnelian sources in the past. If local sources were being used for bead production, their identity and location has not been passed down. However, some small-scale sources are currently being exploited and it is valuable to analyze these materials in case they were also being used by beadmakers in the past.

Ban Khao Mogul, Lopburi Province, Thailand

The Ban Khao Mogul agate source has been discussed multiple times as a possible source for Iron Age beadmakers in central Thailand (Figure 6.11). In February 2007, I traveled to this location to collect samples for analysis. The deposit consists of small nodules of agate and other microcrystalline materials eroding from a small limestone outcrop. The age of the quarry at this location is not known. As recently as 15 years ago, several villagers were producing polished stones and cabochons from the local agate to use as ring settings (Nigel Chang personal communication, 2007). However, during my visit only one villager was still practicing this craft. Many samples were collected (Figure 6.12) of which 17 were analyzed.



Figure 6.11: Agate and carnelian samples from Ban Khao Mogul, Lopburi Province, Thailand. Scale in cm.



Figure 6.12: Map of Southeast Asian agate and carnelian geologic sources analyzed in the current study.

Kon Tom and Gia Lai, Vietnam

In 2009 Dr. Andreas Reinecke, alerted me to several agate sources in Vietnam. Through assistance from a Vietnamese colleague I was able to obtain several small samples of agate/carnelian from sources in two provinces of the Central Highlands of Vietnam (Figure 6.11).

Figure 6.13 shows samples from Kon Tum province and Figure 6.14 the samples from Gia Lai province. These samples were broken into smaller fragments to facilitate LA-ICP-MS analysis. Kon Tum and Gia Lai are both located on the Kon Tum massif, a large area of exposed high-grade metamorphic rocks dating to the Precambrian period. Igneous rocks are also associated with this complex (Workman 1977). Diamonds have been found in Kon Tum along with other gemstones such as garnet, zircon, and tektites. Amethyst and peridot have been mined in Gia Lai. Unfortunately, the specific geologic context for these agate/carnelian samples is unknown.

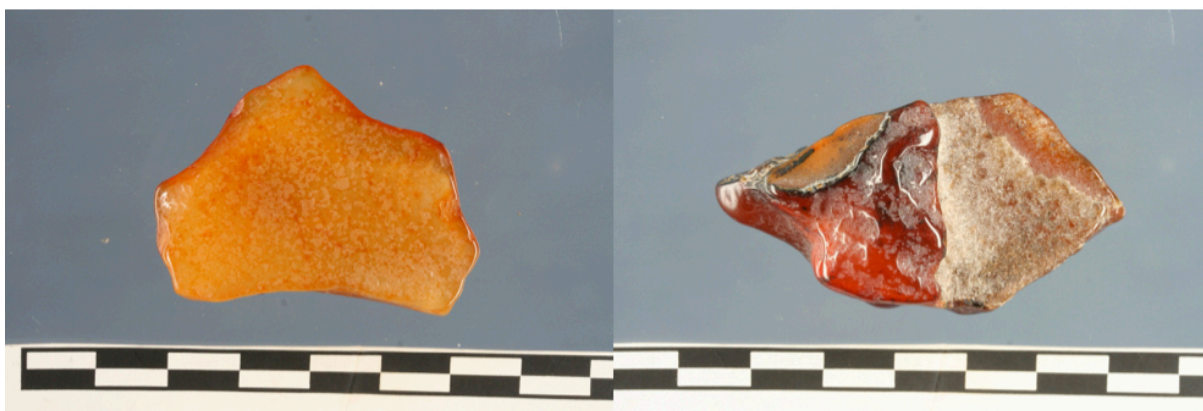


Figure 6.13: Carnelian samples from Kon Tum province, Vietnam. Scale in cm.

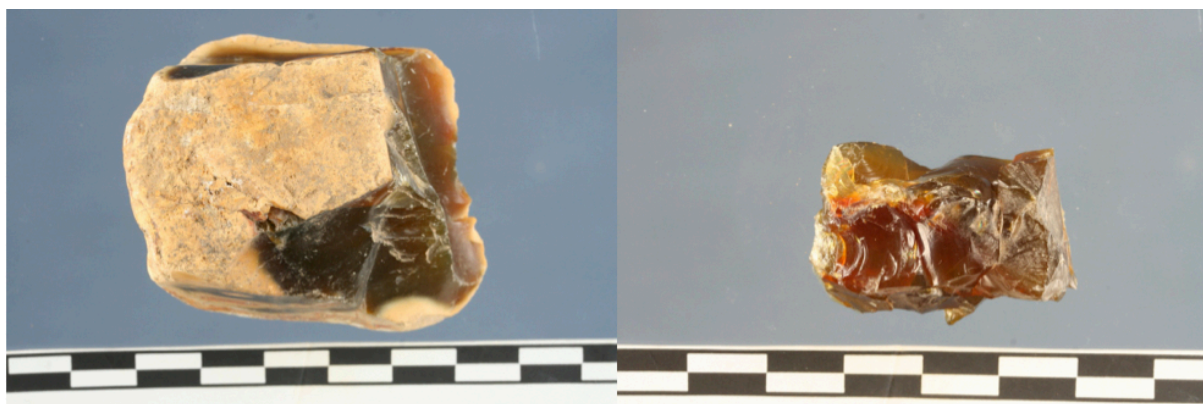


Figure 6.14: Agate samples from Gia Lai province, Vietnam. Scale in cm.

Dong Nai, Vietnam

Samples from Dong Nai (Map Figure 6.11) were found by chance while checking online gemstone retailers for possible geologic samples from Southeast Asia. Several carved pieces of agate were listed for sale on eBay and eight were purchase for this study (Figure 6.15). The seller said that the raw materials came from Dong Nai province, and were carved in Da Nang. Although it is impossible to be sure these samples came from Dong Nai province, they are treated as such for the purposes of this study. The pieces are approximately 3-6 cm in size and described as “natural” stone in that the backs of the pieces are uneven and appear unworked, although they are highly polished (Figure 6.16).



Figure 6.15: Carnelian carved figures from Dong Nai province, Vietnam.



Figure 6.16:Back side of carnelian figures, showing their unworked “natural” appearance.

Pacitan, East Java, Indonesia

Numerous agate sources in East Timor, Java, and Sumatra have been recently mined for jewelry and other decorative objects. I acquired several pieces of agate from David Bernstein, a wholesale gemstone and mineral exporter (Figure 6.17). The samples are from a source in Pacitan, East Java (Figure 6.11). This region of Indonesia is well known for its agate and there has recently been a push to recognize the Pacitan agate industry, with several hundred craftsmen producing numerous artifacts for souvenirs. As with Ban Khao Mogul, it appears that one popular product are cabochons for ring or jewelry settings (Bakti 2001).



Figure 6.17: Carnelian samples from Pacitan, East Java, Indonesia. Scale in cm.

Agate and Carnelian Artifacts analyzed

Seventy-nine agate and carnelian artifacts were analyzed using LA-ICP-MS. As permission was needed to take materials out of the country, only a portion of the beads from each site were selected. While I tried to choose beads from secure burial contexts, I also selected interesting or unusual samples from non-burial contexts. Beads were selected to represent the variety of beads from a site. All the stone beads from Angkor Borei were analyzed, as the entire collection was available for study. Appendix 6.1 summarizes the artifacts and their context.

LA-ICP-MS analysis of the geologic sources

The artifacts and geologic sources samples discussed above were analyzed using LA-ICP-MS using the method discussed in Chapter 4. Final measurements for all archaeological and geologic samples are listed in Appendix 6.2. 55 elements are included with major and minor elements listed as percent oxide and trace elements as parts per million (ppm). Appendix 6.3 lists the standardized canonical discriminant function coefficients for all CDA figures in this chapter.

Scholars have noted that the heterogeneous objects may be difficult to characterize using LA-ICP-MS (e.g. Roll et al. 2005:60). In order to understand the amount of variation within the agate and carnelian samples, I developed a methodology that determined which elements were “less variable,” “variable,” and “most variable.” During statistical analysis an attempt was made to use elements that were “less variable” or “variable” in order to minimize this heterogeneity. This information is presented in detail in Appendix 6.4.

Appendix 6.5 presents a summary of the geochemical compositions of the different geologic sources and discusses how they differed from one another compositionally. What is important to note is that there was some overlap between the different geologic sources, and especially the Deccan Trap agate and carnelian sources. It is not surprising that the agate and carnelian source samples from the Deccan Traps appear to be compositionally similar to one another. As noted above, the Deccan Traps are a massive geological formation and the sources sampled may belong to secondary deposits. I believe that the overlap between Deccan Traps sources is not a limitation of LA-ICP-MS, but instead reflects the difficulty of distinguishing between the geochemically analogous Deccan Traps agate sources. I had hoped that the different sources would be compositionally distinct from one another, allowing for a more detailed analysis of agate exploitation over time and space. It is possible that analyses of additional samples from individual sources may increase the ability to distinguish between these sources. For the time being, assignments made to specific geologic sources within the Deccan Traps must be considered with caution.

Heat-treatment of agate and carnelian

As noted in the previous chapter, agate and carnelian beads are often modified through heat-treatment to change or deepen their color. However, the geologic samples used to characterize the sources are raw or unheated. We may wonder then about the affect of heat-treatment on the geochemical composition of a sample or artifact. To address this question, three pieces of a single sample from Ratanpur were analyzed (Figure 6.18). The first was unheated, the second was heated once at approximately 400° C, and the third was heated multiple times at 400° C. Using the elements Ag, Al, Ba, Be, Bi, Ce, Cs, Cu, La, Li, Lu, Mg, Na, Ni, Sb, Sc, Si, Sm, Sn, Ta, Tb, Ti, U, V, W, Yb, and Zr, I performed Canonical Discriminant Analysis (CDA), using the method described in Chapter 4. 11 of the 12 Ratanpur source samples were successfully cross-validated to the Ratanpur group, one sample was misclassified as belonging to the Undhari group. The heat-treated samples were included as ungrouped cases and based on their discriminant scores, were assigned to a group whose group centroid they are nearest. This is the predicted group membership (PGM). However, a second highest PGM is given to the group with the next lowest Mahalanobis distance value to the group centroid (see Chapter 4 for further discussion). The first and second PGM for the heat-treated Ratanpur samples are listed in Table 6.2. Figure 6.19 displays the sources and heat-treated samples as plotted by their first, second, and third discriminant scores. Only one of the samples, RTP_Unheated was assigned to the Ratanpur source and the other two samples were assigned to the Mardak Bet source. However, looking at the second PGM for the other two samples shows that the RTP_HeatedOnce sample was assigned to Undhari, and the RTP_Heated sample was assigned to the Ratanpur source. As noted above and discussed in Appendix 6.5, the Deccan Traps sources

are geochemically analogous to one another resulting in a low cross-validation rate between the sources. As Randall Law has noted, geochemical similarities between deposits can “result in a degree of overlap among the individual cases making them up,” (2011: 224). I believe that these misclassifications are most likely explained by the compositional similarities between the Deccan Trap sources, and not geochemical changes due to heat-treatment. I argue that this small experimental study indicates that heat-treatment of agate and carnelian does not dramatically change their geochemical composition.

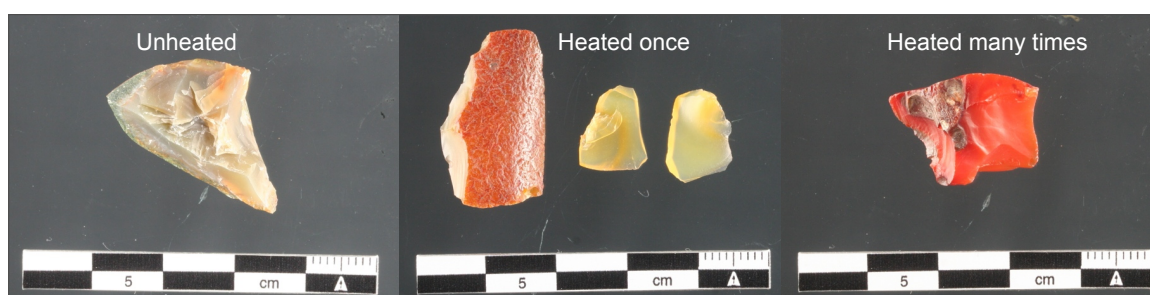


Figure 6.18: Heated and unheated geologic samples from the Ratanpur source. Only one of the samples in the “heated once” group was analyzed using LA-ICP-MS.

Source sample	1 st PGM	2 nd PGM
RTP_Unheated	Ratanpur	Mardak Bet
RTP_HeatedOnce	Mardak Bet	Undhari
RTP_HeatedManyTimes	Mardak Bet	Ratanpur

Table 6.2: First and second predicted group membership (PGM) for the heat-treated Ratanpur samples

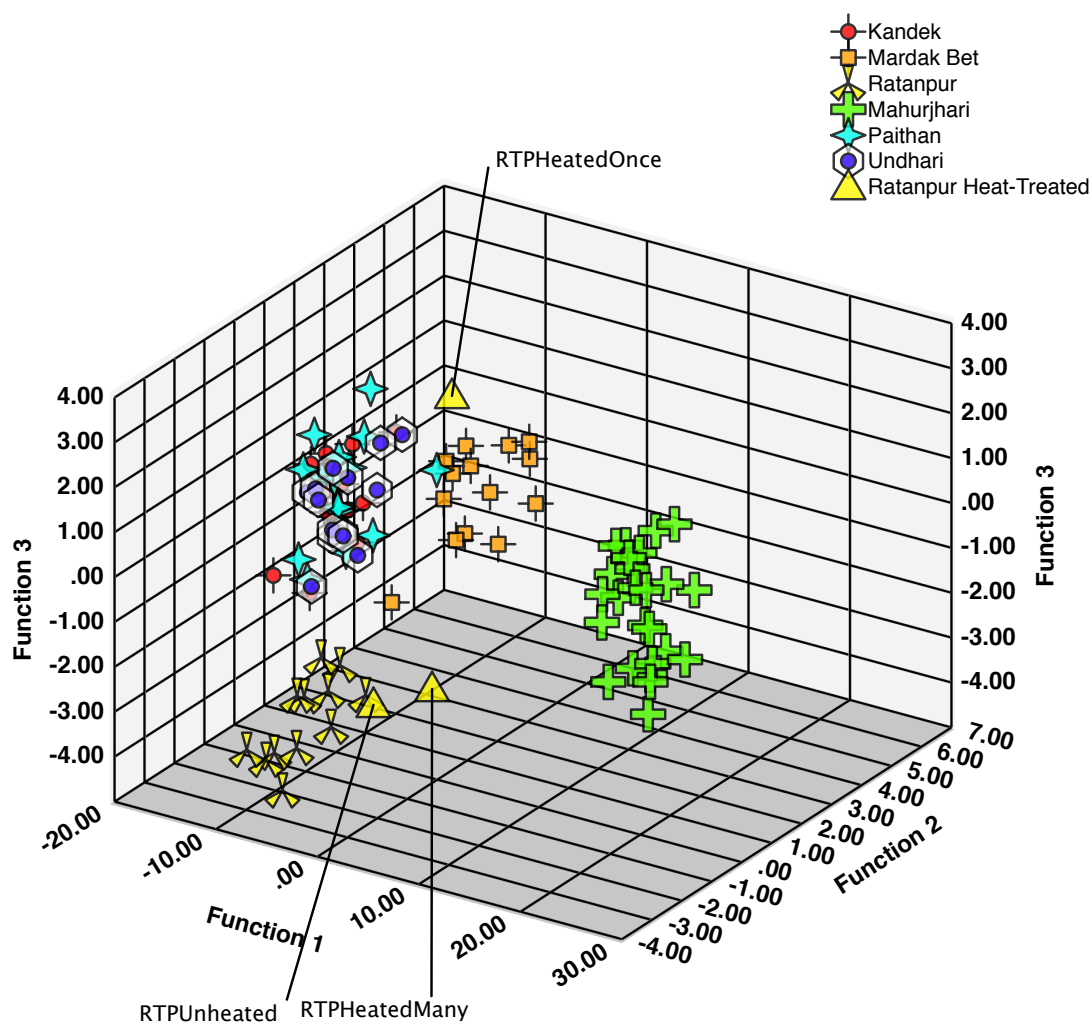


Figure 6.19: The Deccan Trap agate sources plotted by their first, second, and third discriminant functions. Three samples from Ratanpur (yellow triangles) were plotted as ungrouped cases.

Assigning agate and carnelian artifacts to geologic sources

After statistically distinguishing between the geologic sources, the next step was to examine the artifacts and determine which, if any, were geochemically analogous to the sources tested. As with the heat-treated samples discussed above, the artifacts were included as ungrouped cases, compared to the compositional groups, and then assigned to the source whose centroid they are nearest. In my initial CDA, I compared the artifacts to all 12 of the geologic

sources using the elements: Ag, Al, Au, B, Ba, Bi, Co, Cs, Dy, Eu, In, La, Li, Mg, Na, Nd, Ni, Pb, Sb, Sc, Si, Sn, Sr, Tb, Th, Ti, Y, Zn, and Zr. As was expected, the cross-validation rate was low with only 72% of the cross-validated cases classifying correctly (Figure 6.20). The majority of the misclassification was between Deccan Trap sources as well as between the Kon Tum and Dong Nai sources. A single Kon Tum sample was misclassified as belonging to the Undhari source. Table 6.3 below lists the primary PGM assignment for the 79 artifacts in this analysis. The majority of the artifacts were assigned to one of the Deccan Traps sources, however ten artifacts were assigned to one of the Southeast Asian sources. Due to the considerable overlap between the sources, I believe these initial artifact assignments must be treated with caution. As demonstrated above in the heat-treating example, the geochemical similarity between the Deccan Traps sources allows for artifacts to be misclassified between the different Deccan Traps sources. Therefore, I performed a second CDA with the Deccan Traps sources grouped together.

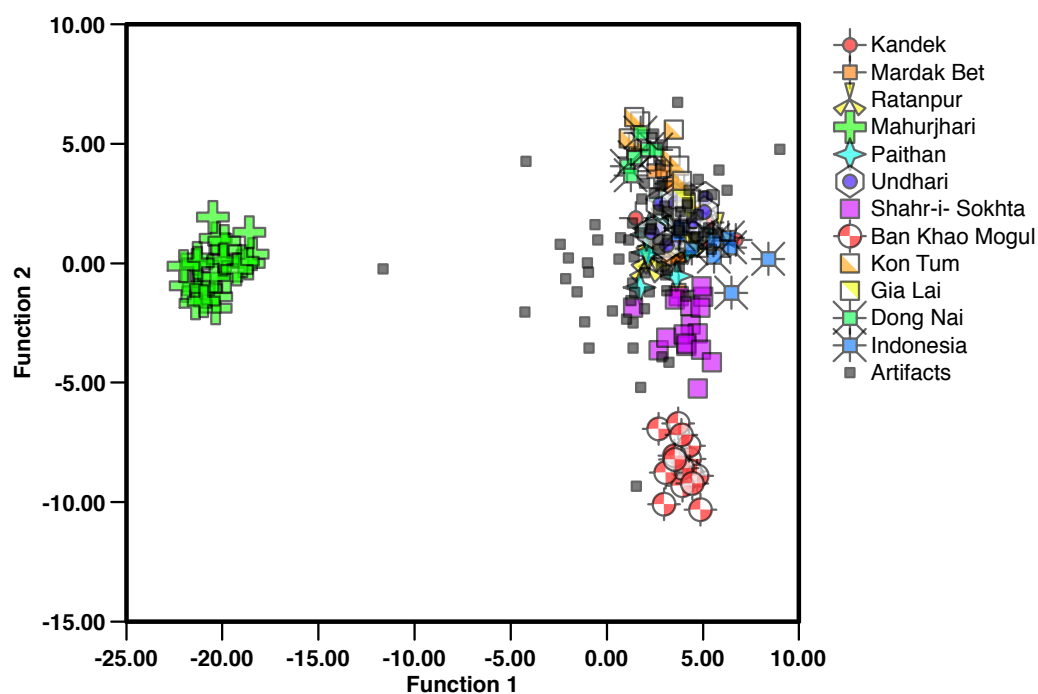


Figure 6.20: Geologic sources and artifacts plotted by their first and second discriminant scores.

In the second CDA, the artifacts were compared to the individual Southeast Asian sources, the Shahr-i-Sokhta source, and the grouped Deccan Traps source. Using the same elements as in the previous CDA a cross-validation rate of 93.8% was achieved. Figure 6.21 shows the artifacts, Deccan Traps, and Southeast Asian sources plotted by their first and second discriminant scores. The Mahurjhari source has been omitted from the scatterplot for clarity. A majority of the artifacts (n=59) were assigned to the Deccan Traps agate source group (Table 6.3 below). All ten of the artifacts that had been previously assigned to a Southeast Asian source were again assigned to the same Southeast Asian source (Figure 6.22). However, an additional ten artifacts that were assigned to one of the Deccan Traps sources in the previous analysis were assigned to a Southeast Asian source. I will return to these 20 artifacts below, however I will first discuss the artifacts assigned to the Deccan Traps sources in more depth.

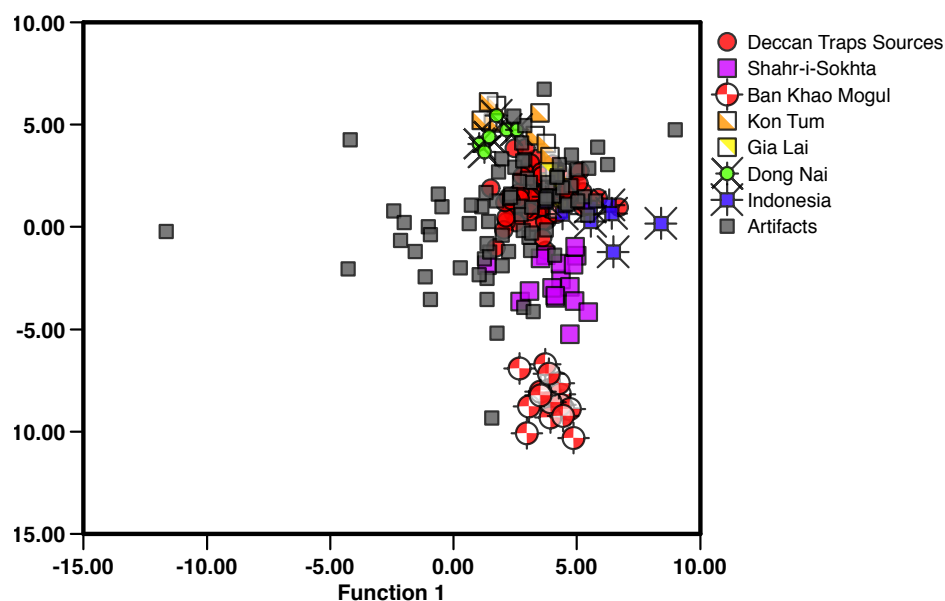


Figure 6.21: Geologic sources and artifacts plotted by their first and second discriminant scores. All of the Deccan Trap sources have been combined into a single group. The Mahurjhari source was omitted for visual clarity.

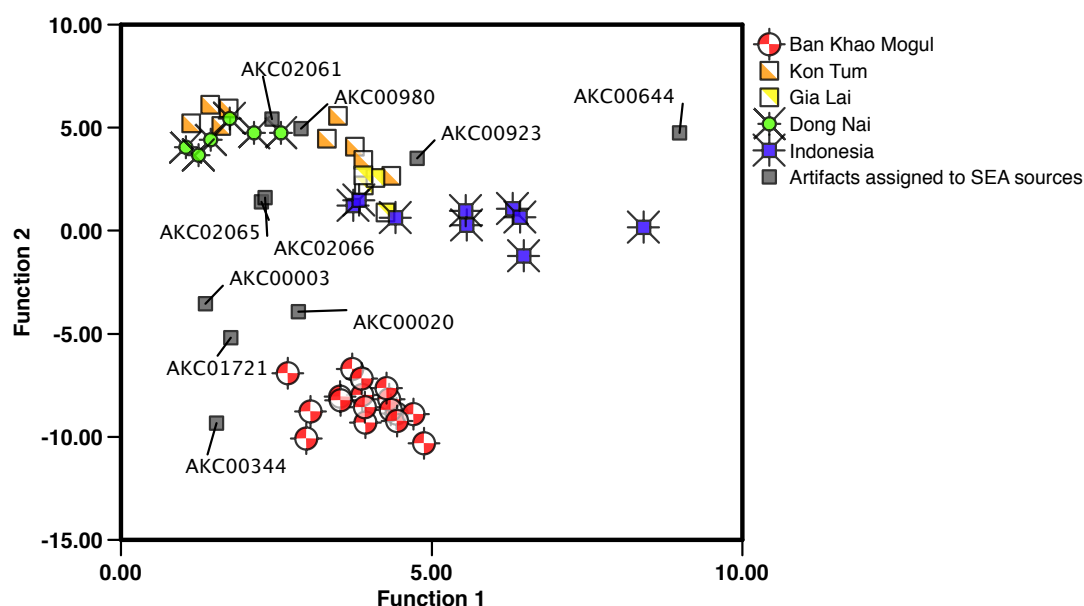


Figure 6.22: Southeast Asian geologic source and the 10 artifacts that were assigned to these sources plotted by their first and second discriminant scores.

Agate and carnelian beads assigned to the Deccan Trap sources

The 69 artifacts initially assigned to the Deccan Trap sources were analyzed an additional time, but in this discriminant analysis were only compared to the Deccan Trap sources. Three geologic source samples with missing values were eliminated (Mardak Bet 12, Khandek 15, Paithan 11) in order to allow for the inclusion of the elements Cu and Tm, which assisted with the improving the discrimination between the sources. CDA was performed using the elements Ag, Al, Au, B, Ba, Bi, Ca, Cs, Co, Cu, Eu, In, La, Li, Mg, Na, Nd, Ni, Sc, Si, Sn, Sr, Th, Tm, and Zr. As with previous analyses focusing on the Deccan Traps, the cross-validation rate was low at 65.6% as only the Mahurjhari samples cross-validated correctly (Figure 6.23).

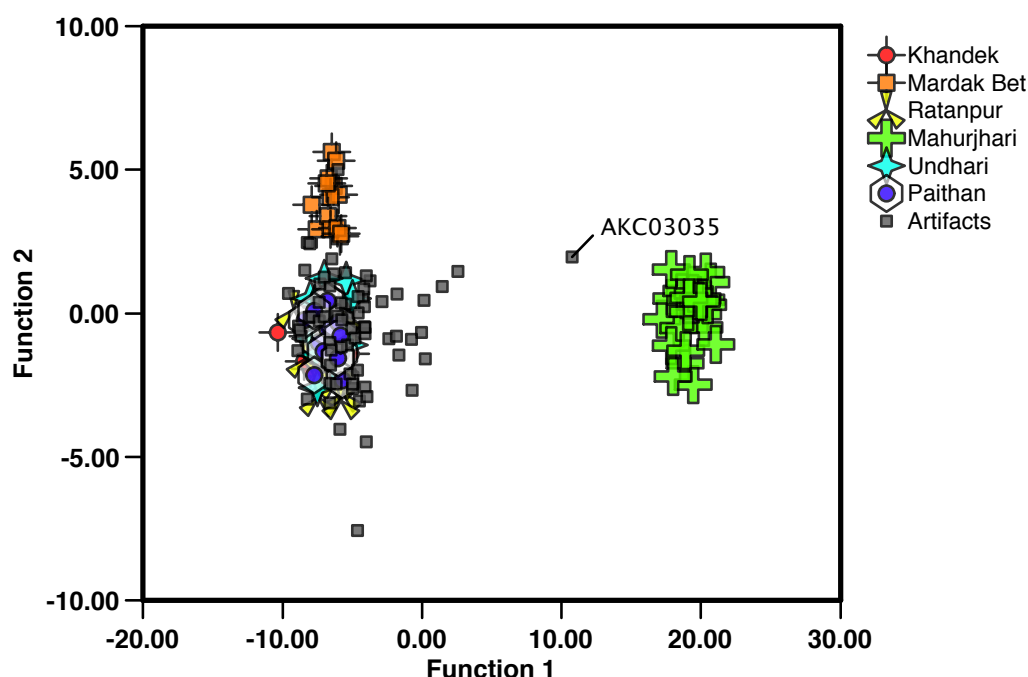


Figure 6.23: Deccan Traps sources and 69 agate and carnelian artifacts plotted by their first and second discriminant scores. AKC03035 is the only artifact assigned to the Mahurjhari source.

Table 6.3 lists the first PGM for all artifacts during their first (all geologic sources included), second (Deccan Traps sources grouped together), and third (only Deccan Traps sources) discriminant function analyses. When we focus just on those artifacts that were consistently assigned to the Deccan Traps sources, all but 13 classified with the same source during the first and third CDA. The majority of these samples ($n=31$) were assigned to the Ratanpur source, with eight artifacts each assigned to Undhari and Paithan, six artifacts assigned to Khandek, two to Mardak Bet, and one to Mahurjhari.

	<i>1st CDA: All sources, all beads</i>	<i>2nd CDA: Grouped DT sources, all beads</i>	<i>3rd CDA: DT sources, 69 beads</i>		<i>1st CDA: All sources, all beads</i>	<i>2nd CDA: Grouped DT sources, all beads</i>	<i>3rd CDA: DT sources, 69 beads</i>
Database ID	1st PGM	1st PGM	1st PGM	Database ID	1st PGM	1st PGM	1st PGM
AKC00003	Indonesia	Indonesia	N/A	AKC02063	Paithan	DT	Paithan
AKC00016	Ratanpur	DT	Ratanpur	AKC02064	Ratanpur	DT	Ratanpur
AKC00020	BKM	BKM	N/A	AKC02065	Kon Tum	Kon Tum	N/A
AKC00025	Ratanpur	DT	Ratanpur	AKC02066	Kon Tum	Kon Tum	N/A
AKC00026	Ratanpur	DT	Ratanpur	AKC02067	Undhari	Kon Tum	Undhari
AKC00035	Ratanpur	DT	Ratanpur	AKC02068	Ratanpur	DT	Ratanpur
AKC00044	Ratanpur	Indonesia	Ratanpur	AKC02069	Khandek	DT	Khandek
AKC00053	Ratanpur	DT	Ratanpur	AKC02070	Paithan	DT	Paithan
AKC00056	Ratanpur	DT	Ratanpur	AKC02071	Khandek	DT	Khandek
AKC00303	Ratanpur	Indonesia	Ratanpur	AKC03035	Mahurjhari	Mahurjhari	Mahurjhari
AKC00308	Paithan	DT	Paithan	AKC03036	Paithan	DT	Paithan
AKC00344	BKM	BKM	N/A	AKC03037	Ratanpur	DT	Ratanpur
AKC00348	Ratanpur	DT	Ratanpur	AKC03038	Ratanpur	DT	Ratanpur
AKC00364	Ratanpur	DT	Ratanpur	AKC03039	Ratanpur	DT	Ratanpur
AKC00433	Ratanpur	DT	Ratanpur	AKC03040	Khandek	DT	Khandek
AKC00437	Ratanpur	Indonesia	Ratanpur	AKC03041	Ratanpur	Kon Tum	Ratanpur
AKC00643	Ratanpur	Indonesia	Ratanpur	AKC03042	Undhari	DT	Ratanpur
AKC00644	Indonesia	Indonesia	N/A	AKC03043	Undhari	DT	Undhari
AKC00646	Ratanpur	DT	Ratanpur	AKC03044	Undhari	DT	Undhari
AKC00647	Ratanpur	DT	Ratanpur	AKC03045	Undhari	DT	Undhari
AKC00730	Ratanpur	Indonesia	Ratanpur	AKC03046	Ratanpur	DT	Undhari
AKC00732	Ratanpur	DT	Ratanpur	AKC03500	Khandek	DT	Undhari
AKC00902	Paithan	DT	Paithan	AKC03501	Undhari	DT	Paithan
AKC00922	Ratanpur	DT	Ratanpur	AKC03502	Ratanpur	DT	Undhari
AKC00923	Kon Tum	Kon Tum	N/A	AKC03503	Ratanpur	DT	Ratanpur
AKC00932	Undhari	DT	Undhari	AKC03504	Paithan	DT	Paithan
AKC00980	Kon Tum	Kon Tum	N/A	AKC03505	Paithan	DT	Paithan
AKC00995	Undhari	DT	Ratanpur	AKC03506	Khandek	DT	Khandek
AKC00999	Undhari	DT	Ratanpur	AKC03507	Undhari	DT	Khandek
AKC01051	Undhari	DT	Undhari	AKC03508	Khandek	DT	Khandek
AKC01061	Undhari	DT	Undhari	AKC03509	Khandek	DT	Khandek
AKC01062	Undhari	DT	MB	AKC03510	MB	DT	Khandek
AKC01108	Ratanpur	Indonesia	MB	AKC03511	Ratanpur	DT	Ratanpur
AKC01111	Paithan	DT	MB	AKC03512	MB	DT	MB
AKC01721	BKM	BKM	N/A	AKC03513	Ratanpur	DT	Ratanpur
AKC01950	Ratanpur	DT	Ratanpur	AKC03514	Ratanpur	Dong Nai	Ratanpur
AKC01951	Ratanpur	DT	Paithan	AKC03515	Ratanpur	Dong Nai	Ratanpur
AKC02060	Paithan	DT	Paithan	AKC03516	MB	DT	MB
AKC02061	Gia Lai	Gia Lai	N/A	AKC03517	Ratanpur	DT	Ratanpur
AKC02062	Undhari	DT	Undhari				

Table 6.3: Table of first predicted group memberships (PGM) for the agate and carnelian artifacts. BKM= Ban Khao Mogul, DT=Deccan Traps, MB=Mardak Bet.

Due to the high overlap between the Deccan Trap geologic source samples I am cautious about accepting the PGM assignments without question. We can expect that the overall geochemical similarity between these sources will result in misclassifications amongst the artifacts. Furthermore, CDA will always assign an artifact to a group, even if they do not actually belong to that group. In a study with a limited number of sources there is always the possibility that the artifacts do not belong to any of the groups in the dataset. However, I do feel confident in making a regional assessment about the artifact assignments. Although one might not be able to say that the artifacts assigned to the Deccan Traps sources definitely derived from these sources, we can confidently state that the artifacts are *not* geochemically analogous to the Southeast Asian sources.

Despite these qualifications, I argue that at least 45 of the 79 agate and carnelian artifacts were made from raw material from the Deccan Traps. Although I am not comfortable assigning them to a specific source within this geologic formation, the large number of artifacts that were assigned to the Ratanpur source is not surprising based on historical and archaeological data indicating its importance in bead production. As discussed earlier, Ratanpur has been a major source of raw materials for bead production for hundreds of years (Arkell 1936; Francis 1986, 2002;) and was likely exploited as far back as the Harappan period (Law 2011). During the first or second century AD the Greek writer Ptolemy noted the export of onyx stones to Egypt from a region some have suggested may have been Ratanpur (McCrindle 1885: 77, 334).

Paithan is another important source used in bead production and also mentioned by Ptolemy as an exporter of onyx stones (Huntingford 1980: 49; Francis 2002: 104-5). The nearby

city of Ujjain (Map Figure 6.2) was also a well-known beadmaking center from approximately 500-200 BC (Banerjee 1959:190). The beadmaking center of Cambay (or Khambhat) (Map Figure 6.2) is also believed to have been in operation since the early first millennium AD (Arkell 1936:304). It is likely then, that this region could have been a source of both the raw materials and finished beads found in Southeast Asia. Little is known about the exploitation of the Undhari source and the Khandek and Mardak Bet sources were exploited during the Harappan period (Law 2011).

Only one bead was assigned to the Mahurjhari source group, a spherical carnelian bead from Angkor Borei (Figure 6.24). As discussed in Appendix 6.5, the Mahurjhari samples are notable for its high levels of tin (Sn). The Angkor Borei bead has higher levels than other artifacts analyzed (67 ppm), although not as high as the other materials from this site and therefore plots somewhat away from this source (Figure 6.23). The Angkor Borei bead may be an outlier of the geologic source used to make beads at Mahurjhari, or it could also derive from an untested source. Excavators believe the bead manufacturing began at Mahurjhari site around the 6 or 7th century BC and continued until the 4-5th century AD. Although Deccan Trap agates were thought to have been used by bead production centers throughout much of India, the scholar R.K. Mohanty has postulated that beadmakers at Mahurjhari might have been exploiting a central Indian raw material source (1999: 84). The distinctness of the Mahurjhari samples indicates they may in fact come from a non-Deccan Trap source, although this location is still unknown. Finished products from Mahurjhari are believed to have been traded to western and southern India as well as possibly Central Asia and Rome (Mohanty 1999: 84). However, Francis has argued that Mahurjhari likely did not “export its beads outside its neighborhood,”

(2002: 116). The single bead assigned to this source indicates that the large quantities of beads, if any, were likely not exported to Southeast Asia from this site.



Figure 6.24: Spherical carnelian bead from Angkor Borei (AKC03035) assigned to the Mahurjhari source. Scale in cm.

14 artifacts were consistently assigned to the Deccan Traps sources, but when plotted by their discriminant scores plot somewhat away from the Deccan Traps sources (Figure 6.25). Two of these beads are rough carnelian hexagonal faceted short bicones from Phum Snay (AKC00016 and AKC00025), as well as two faceted bicone beads from Angkor Borei: a rough hexagonal faceted quartz bead (AKC03046) and a more finely made hexagonal short bicone (AKC03037). Also included in this group are spherical beads from Phum Snay (AKC00035) and Krek 52/62 (AKC00647), a rough spherical bead from Angkor Borei (AKC03041) and a short bicone bead from Angkor Borei (AKC03044). One broken long cylindrical agate bead from Ban Non Wat (AKC02070) also plotted away from the Deccan Trap sources, as did the five unfinished, unpolished agate beads from Khao Sam Kaeo (AKC03502-4, AKC03512-3).

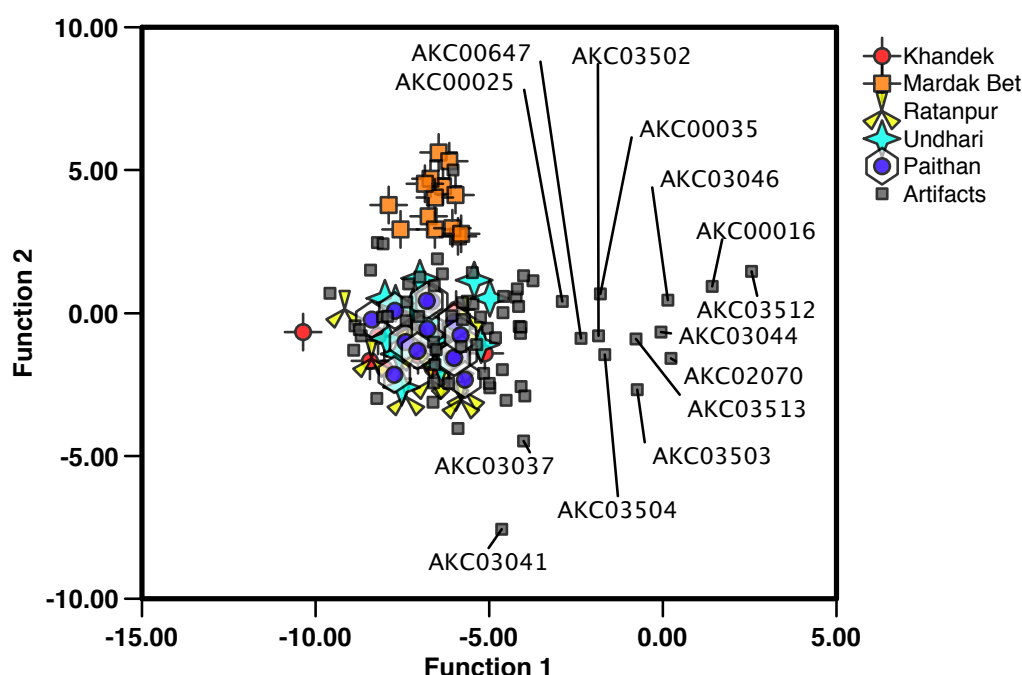


Figure 6.25: Deccan Traps sources and 69 archaeological artifacts plotted by their first and second discriminant scores from the third CDA. The labeled artifacts are those that plot away from the Deccan Trap sources group. The Mahurjhari source has been omitted for visual clarity.

All beads, except AKC03041, were assigned to the Deccan Traps sources in all three CDAs. Some of these beads may simply be outliers of the Deccan Traps sources. I believe this may especially be the case for the rough hexagonal faceted bicones from Phum Snay (AKC00016 and AKC00025), as a similar bead from the same burial (AKC00026) plotted more closely with the Deccan Traps sources. However, we must also consider that some of these beads derive from an as-of-yet untested source located in either South or Southeast Asia. Several of the beads discussed above are unique beads within the collections examined at the site. For example, the quartz bead and short carnelian faceted bicone from Angkor Borei are both the only examples of these types recorded in this study. The cylindrical bead from Ban Non Wat had one of the largest perforation sizes of any bead recorded, suggesting it may derive from different

workshop than beads with smaller perforations. Lastly, the five unpolished and undrilled agate beads from Khao Sam Kaeo (AKC03502-4 and AKC03512-3) found on Hill 3 and Hill 4 appear to belong to a distinct group. Analyses of additional geologic sources may help clarify the origins of these specific beads.

Agate and carnelian beads assigned to Southeast Asian geologic sources

Approximately one-quarter of the agate and carnelian beads were assigned to a Southeast Asian source, in either the first or second CDA (Table 6.3). In order to investigate these assignments more closely, these 20 artifacts were compared as ungrouped cases to the five Southeast Asian geologic sources and the Ratanpur source, which acted as a proxy for the Deccan Traps sources. Using the elements Ag, Au, B, Ba, Bi, Co, Mg, Mn, Pr, Rb, Si, Sr, Tm, Ti, and Y a cross-validation rate of 96.7% was achieved. A single Kon Tum sample misclassified with the Dong Nai source group and an Indonesian source sample classified with the Ratanpur source group. The PGMs for all four CDA analyses for these artifacts are listed in Table 6.4.

Only seven of these 20 artifacts were consistently assigned to the same Southeast Asian geologic source (marked in italic in Table 6.4), while the remaining thirteen artifacts were assigned to different Southeast and South Asian geologic sources throughout all four discriminant function analyses. Eight of these artifacts were reassigned to the Ratanpur source, despite having been assigned to a Southeast Asian source during at least one previous discriminant function analysis. Several of these artifacts appear to plot between two potential sources, and were assigned to either one or the other depending on elements used in the discriminant analyses.

	<i>First CDA: All sources, all artifacts</i>	<i>Second CDA: Grouped Deccan Traps sources, all artifacts</i>	<i>Third CDA: Deccan Traps sources, 69 artifacts</i>	<i>Fourth CDA: SEA sources, Ratanpur, and 20 artifacts</i>
AKC00003	<i>Indonesia</i>	<i>Indonesia</i>	<i>N/A</i>	<i>Indonesia</i>
AKC00020	BKM	BKM	N/A	Ratanpur
AKC00044	Ratanpur	Indonesia	Ratanpur	Indonesia
AKC00303	Ratanpur	Indonesia	Ratanpur	Ratanpur
AKC00344	<i>BKM</i>	<i>BKM</i>	<i>N/A</i>	<i>BKM</i>
AKC00437	Ratanpur	Indonesia	Ratanpur	Ratanpur
AKC00643	Ratanpur	Indonesia	Ratanpur	Ratanpur
AKC00644	<i>Indonesia</i>	<i>Indonesia</i>	<i>N/A</i>	<i>Indonesia</i>
AKC00730	Ratanpur	Indonesia	Ratanpur	Indonesia
AKC00923	<i>Kon Tum</i>	<i>Kon Tum</i>	<i>N/A</i>	<i>Kon Tum</i>
AKC00980	<i>Kon Tum</i>	<i>Kon Tum</i>	<i>N/A</i>	<i>Kon Tum</i>
AKC01108	Ratanpur	Indonesia	Mardak Bet	Ratanpur
AKC01721	BKM	BKM	N/A	Ratanpur
AKC02061	<i>Gia Lai</i>	<i>Gia Lai</i>	<i>N/A</i>	<i>Gia Lai</i>
AKC02065	<i>Kon Tum</i>	<i>Kon Tum</i>	<i>N/A</i>	<i>Kon Tum</i>
AKC02066	Kon Tum	Kon Tum	N/A	Ratanpur
AKC02067	Undhari	Kon Tum	Undhari	Kon Tum
AKC03041	Ratanpur	Kon Tum	Ratanpur	Indonesia
AKC03514	Ratanpur	Dong Nai	Ratanpur	Kon Tum
AKC03515	Ratanpur	Dong Nai	Ratanpur	Ratanpur

Table 6.4: List of first predicted group measurements for the 20 artifacts that grouped with the Southeast Asian geologic sources. Artifacts in italics denote those that were consistently assigned to the same source during all four discriminant function analyses.

Figure 6.26 shows 11 such artifacts that do not appear to plot closely to any sources, or plot between two sources. While many of these artifacts may be outliers of the sources to which they are assigned, it is also possible that they may belong to an untested geologic source. Of special note is AKC01721, the carnelian nodule found at Prei Khmeng. Due to the small quantity of carnelian artifacts found at this site and lack of evidence for bead production, it is highly unlikely that this nodule was transported over long-distance exchange networks from South Asia. Instead, it is more probable that this nodule derives from an unknown local stone source. Two artifacts, AKC00303 and AKC01108 plot more closely to the Ratanpur source (Figure 6.27), and were assigned to a Deccan Traps geologic source in three of the four discriminant function

analyses. Although these objects were assigned to the Indonesian source during the second CDA, I propose that both may in fact derive from the Deccan Traps sources. However, I cannot yet rule out that they may belong to an unidentified source.

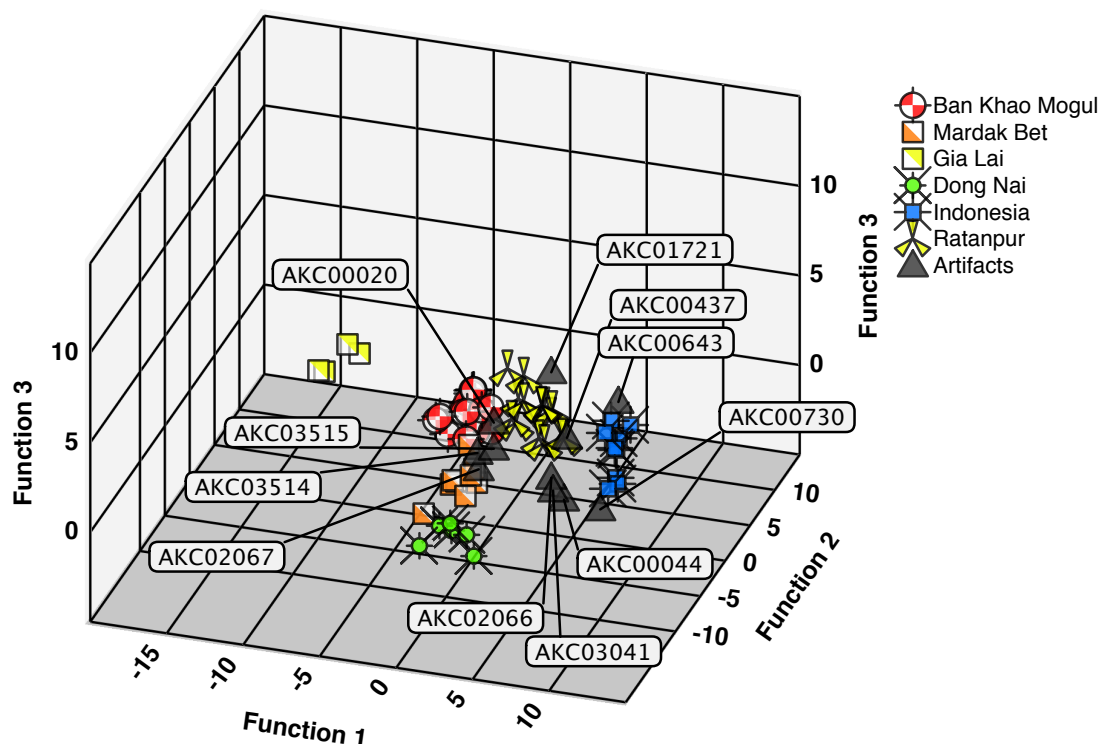


Figure 6.26: Geologic sources and artifacts from the fourth CDA plotted by their first, second, and third discriminant function. Labeled artifacts are those that appear to plot away from or in between the sources to which they were assigned.

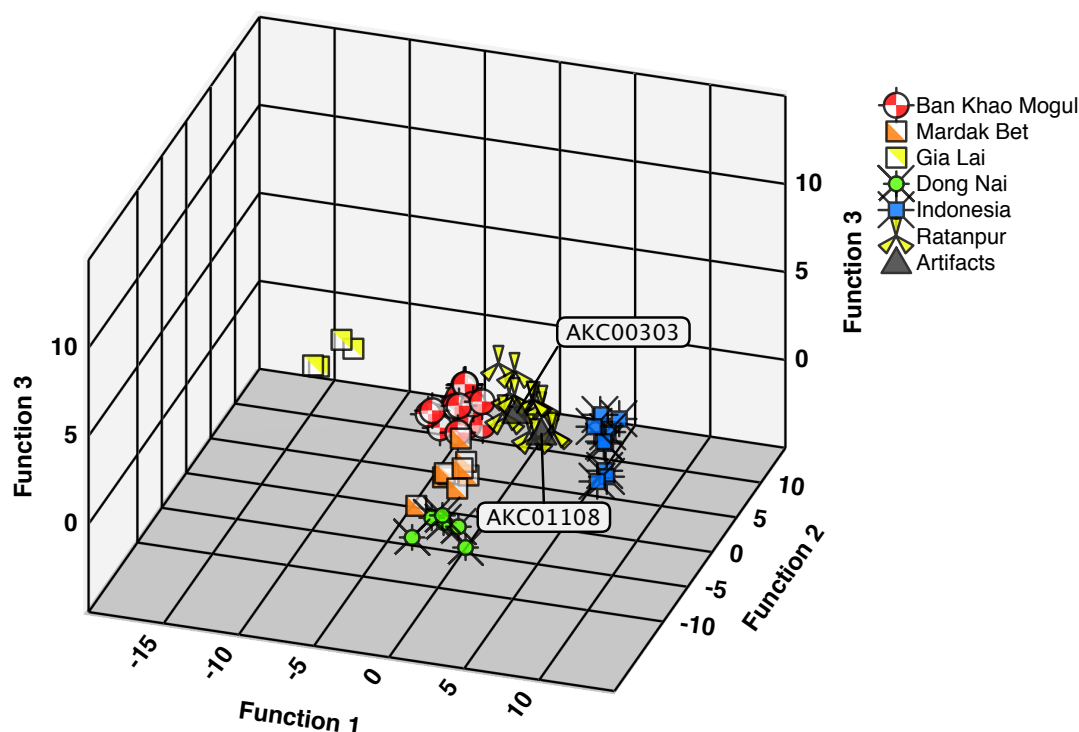


Figure 6.27: Geologic sources and artifacts from the fourth CDA plotted by their first, second, and third discriminant scores. The two artifacts noted in the scatterplot are those that appear to plot closely with the Ratanpur source.

The seven artifacts that were consistently assigned to the same Southeast Asian geologic source deserve a closer examination. These artifacts are shown in Figure 6.28, plotted by their first, second, and third discriminant scores. Two of these beads have characteristics that set them apart from other beads examined in this study. AKC02061 is a long carnelian barrel bead with the second largest drill hole size of all the beads examined, approximately 3mm (Figure 6.29). This bead was assigned to the Gia Lai source, but plots well away from it. However, the bead appears visually similar to carnelian beads found in the Samon Valley, Myanmar (see Moore 2007: 75); further investigation of raw materials from this region may confirm this hypothesis.

A short carnelian bicone from Village 10.8 (AKC00344) was assigned to the Ban Khao Mogul source. This bead was notable due to its low polish, with an almost matte finish (Figure 6.30). Although this bead does appear to plot near the source, the same cautions apply in regards to assigning the bead to this source. There is no evidence for bead production at Ban Khao Mogul, and no other beads from Village 10.8 were assigned to this source. Furthermore, it is unusual that no additional BKM beads were identified from geochemical analysis from sites closer to the source such as Promtin Tai or Ban Non Wat. That this bead was consistently assigned to the Ban Khao Mogul sources should be taken to mean that the bead is *not* geochemically analogous to the other sources tested, and not that the bead is geochemically comparable to the Ban Khao Mogul source. Therefore, I argue that this bead was likely made from an untested source, likely located somewhere in South or Southeast Asia.

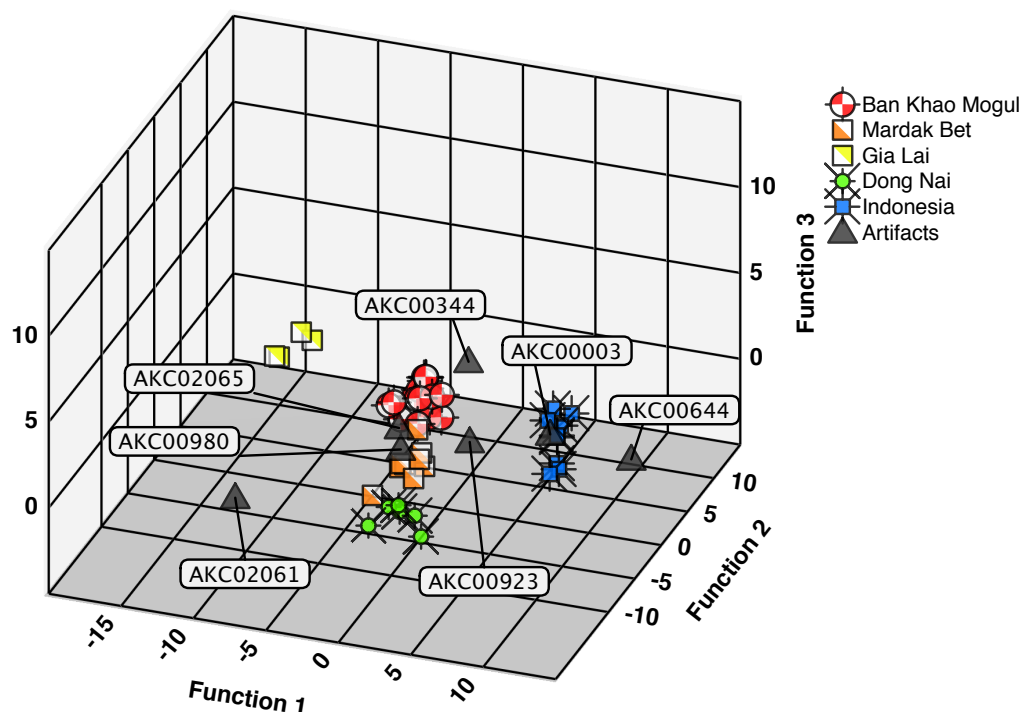


Figure 6.28: Artifacts consistently assigned to Southeast Asian sources plotted by their first, second, and third discriminant scores.



Figure 6.29:AKC02061 a long carnelian barrel bead from Ban Non Wat that may derive from a geologic source in Myanmar.



Figure 6.30: AKC00344, a short bicone bead from Village 10.8 with low polish.

Four agate barrel and bicone beads from four different sites were also consistently assigned to either the Indonesian or Kon Tum sources (Figure 6.31). Two beads were assigned to the Indonesian source, one from Phum Snay (AKC00003) and one from Prohear (AKC00644). These beads look similar to agates from the Gangetic region, which were used to produce barrel beads during the pre-Mauryan period, although the source for these beads is unknown (J. Mark

Kenoyer, personal communication, 2013). Both beads are long agate barrels, with dark brown/black and opaque white coloring. A second set of long barrel beads from Promptin Tai (AKC00923) and Ban Non Wat (AKC02065) were assigned to the Kon Tum source. The bead from Ban Non Wat (AKC02065) appears to have been burned and whitened, and may have been originally been a different color, perhaps red and white banded agate (J. Mark Kenoyer, personal communication, 2013). The agate bead from Phum Snay was the only agate bead recorded from this site, however similar agate beads were found at Ban Non Wat, Promptin Tai, and Prohear that were assigned to the Deccan Traps sources. Without stronger evidence for agate bead production in Vietnam or Indonesia, I hesitate to confidently state that these beads derive from these sources. However, it does appear that these beads are distinct from other beads in this collection and their similarity to one another points toward the possibility that they may have been produced from a single unknown geologic source. A carnelian flattened hexagonal bicone from Promptin Tai (AKC00980) was also assigned to the Kon Tum source. As discussed earlier, this bead shape was also identified at Khao Sam Kaeo and Prohear, however this group of beads does not appear to be made using the same raw material source. This suggests that multiple workshops may have been making beads in this shape.

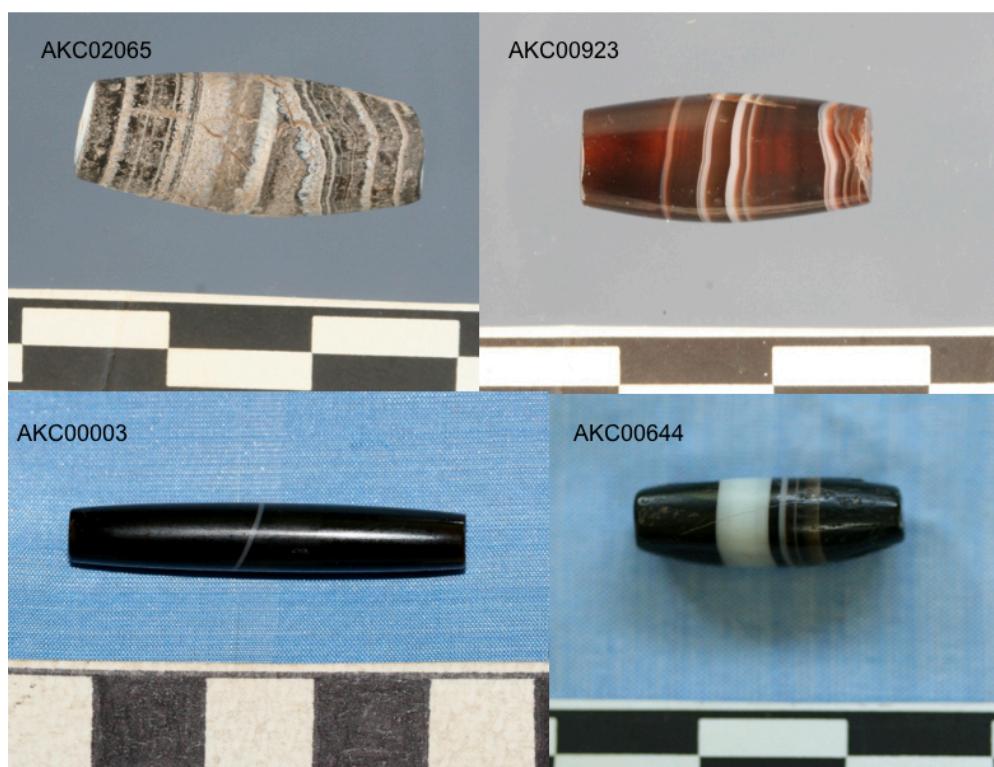


Figure 6.31: Agate beads assigned to the Kon Tum geologic source (top row) and Indonesian source (bottom row).

Summary of conclusions from the agate and carnelian bead composition data

To summarize the data presented above, geochemical analysis of agate and carnelian beads suggests that the majority ($n=45$) of the agate and carnelian artifacts were made from raw materials from the Deccan Traps. An additional 13 artifacts were consistently assigned to the Deccan Traps sources, however when plotted by their first and second discriminant scores, these beads appear to plot away from these sources. That these beads were consistently assigned to the Deccan Traps indicates that they are geochemically distinct from the Southeast Asian sources, however it is also possible that they do not belong to the Deccan Traps sources and were made from an untested raw material source. Several of these 13 beads are similar to beads assigned to the Deccan Traps sources and may in fact originate from sources, such as two short hexagonal faceted bicones from Phum Snay (AKC00016 and AKC00025) that are morphologically similar

to similar beads AKC00026 and AKC00053, which were assigned to the Deccan Traps.

However, other beads are more unusual and could in fact represent beads that derive from an untested source. This includes the quartz bead (AKC03046) and the short hexagonal faceted bicone bead (AKC03044) from Angkor Borei, the broken agate cylinder bead with the larger perforation size from Ban Non Wat (AKC02070), and the group of unfinished agate beads from Khao Sam Kaeo (AKC03502-4, AKC03512-3). One carnelian bead from Angkor Borei (AKC03035) is fairly distinct due to high-levels of tin, however it is unclear if this bead is compositionally similar to the Mahurjhari source or if it belongs to a different untested source.

The remaining 20 beads were assigned to the Southeast Asian sources at least once during the course of statistical analysis of the compositional results, with seven beads consistently assigned to the same Southeast Asian source. While this compositional data supports the interpretation that these beads were not made from Deccan Traps agate sources, I do not believe that we can confidently assign them to a Southeast Asian source based on compositional data alone. There are still numerous potential untested sources in both South and Southeast Asia, and none of the sources included in this study have strong archaeological evidence for their involvement in ancient bead production. Despite these qualifications, there are still several beads in this group that do appear to be different from the larger collection and could be indicative of beads from a workshop not affiliated with the Deccan Traps sources. This includes the group of unfinished beads from Khao Sam Kaeo, the group of agate barrel beads from various sites discussed above, as well as the carnelian barrel bead with the large perforation from Ban Non Wat. Also of note are the two carnelian crescents from Khao Sam Kaeo (AKC03514-5) and two pendants, one from Ban Non Wat (AKC02066) and one from Promtin

Tai (AKC01108). Table 6.5 presents my preliminary assessments for the provenience of the 79 artifacts in this study.

Database ID	Site Name	Possible geologic source provenience	Database ID	Site Name	Possible geologic source provenience
AKC00003	Phum Snay	Assigned SEA, but likely from an untested source	AKC02063	Ban Non Wat	Deccan Traps
AKC00016	Phum Snay	Assigned to Deccan Traps, but plots away from group. Similar to ACK00026, could be an outlier of DT sources?	AKC02064	Ban Non Wat	Deccan Traps
AKC00020	Phum Snay	Assigned to both SEA/SA, but likely from an untested source	AKC02065	Ban Non Wat	Assigned SEA, more likely from an untested source
AKC00025	Phum Snay	Assigned to Deccan Traps, but plots away. Similar to ACK00026, so could be an outlier of DT sources?	AKC02066	Ban Non Wat	Assigned to both SEA/SA, more likely from an untested source
AKC00026	Phum Snay	Deccan Traps	AKC02067	Ban Non Wat	Assigned to both SEA/SA, more likely from an untested source
AKC00035	Phum Snay	Assigned to Deccan Traps, but plots away and could be from an untested source.	AKC02068	Ban Non Wat	Deccan Traps
AKC00044	Phum Snay	Assigned to both SEA/SA, more likely from an untested source	AKC02069	Ban Non Wat	Deccan Traps
AKC00053	Phum Snay	Deccan Traps	AKC02070	Ban Non Wat	Assigned to Deccan Traps, but plots away and could be from an untested source.
AKC00056	Phum Snay	Deccan Traps	AKC02071	Ban Non Wat	Deccan Traps

AKC00303	Village 10.8	Assigned to both SEA/SA, but could belong to Deccan Traps.	AKC03035	Angkor Borei	Deccan Traps (Mahurjhari?)
AKC00308	Village 10.8	Deccan Traps	AKC03036	Angkor Borei	Deccan Traps
AKC00344	Village 10.8	Assigned SEA, more likely from an untested source	AKC03037	Angkor Borei	Assigned to Deccan Traps, but plots away and could be from an untested source.
AKC00348	Village 10.8	Deccan Traps	AKC03038	Angkor Borei	Deccan Traps
AKC00364	Village 10.8	Deccan Traps	AKC03039	Angkor Borei	Deccan Traps
AKC00433	Village 10.8	Deccan Traps	AKC03040	Angkor Borei	Deccan Traps
AKC00437	Village 10.8	Assigned to both SEA/SA, more likely from an untested source	AKC03041	Angkor Borei	Assigned to both SEA/SA, more likely from an untested source
AKC00643	Prohear	Assigned to both SEA/SA, more likely from an untested source	AKC03042	Angkor Borei	Deccan Traps
AKC00644	Prohear	Assigned SEA, more likely from an untested source	AKC03043	Angkor Borei	Deccan Traps
AKC00646	Prohear	Deccan Traps	AKC03044	Angkor Borei	Assigned to Deccan Traps, but plots away and could be from an untested source.
AKC00647	Krek 52/62	Assigned to Deccan Traps, but plots away and could be from an untested source.	AKC03045	Angkor Borei	Deccan Traps
AKC00730	Bit Meas	Assigned to both SEA/SA, more likely from an untested source	AKC03046	Angkor Borei	Assigned to Deccan Traps, but plots away and could be from an untested source.
AKC00732	Bit Meas	Deccan Traps	AKC03500	Khao Sam Kaeo	Deccan Traps
AKC00902	Promptin Tai	Deccan Traps	AKC03501	Khao Sam Kaeo	Deccan Traps
AKC00922	Promptin Tai	Deccan Traps	AKC03502	Khao Sam Kaeo	Assigned to Deccan Traps, but plots away and could be from an untested source.

AKC00923	Promptin Tai	Assigned SEA, more likely from an untested source		AKC03503	Khao Sam Kaeo	Assigned to Deccan Traps, but plots away and could be from an untested source.
AKC00932	Promptin Tai	Deccan Traps		AKC03504	Khao Sam Kaeo	Assigned to Deccan Traps, but plots away and could be from an untested source.
AKC00980	Promptin Tai	Assigned SEA, more likely from an untested source		AKC03505	Khao Sam Kaeo	Deccan Traps
AKC00995	Promptin Tai	Deccan Traps		AKC03506	Khao Sam Kaeo	Deccan Traps
AKC00999	Promptin Tai	Deccan Traps		AKC03507	Khao Sam Kaeo	Deccan Traps
AKC01051	Promptin Tai	Deccan Traps		AKC03508	Khao Sam Kaeo	Deccan Traps
AKC01061	Promptin Tai	Deccan Traps		AKC03509	Khao Sam Kaeo	Deccan Traps
AKC01062	Promptin Tai	Deccan Traps		AKC03510	Khao Sam Kaeo	Deccan Traps
AKC01108	Promptin Tai	Assigned to both SEA/SA, but could belong to Deccan Traps.		AKC03511	Khao Sam Kaeo	Deccan Traps
AKC01111	Promptin Tai	Deccan Traps		AKC03512	Khao Sam Kaeo	Assigned to Deccan Traps, but plots away and could be from an untested source.
AKC01721	Prei Khmeng	Assigned to both SEA/SA, more likely from an untested source		AKC03513	Khao Sam Kaeo	Assigned to Deccan Traps, but plots away and could be from an untested source.
AKC01950	Phnom Borei	Deccan Traps		AKC03514	Khao Sam Kaeo	Assigned to both SEA/SA, more likely from an untested source
AKC01951	Phnom Borei	Deccan Traps		AKC03515	Khao Sam Kaeo	Assigned to both SEA/SA, more likely from an untested source
AKC02060	Ban Non Wat	Deccan Traps		AKC03516	Khao Sam Kaeo	Deccan Traps
AKC02061	Ban Non Wat	Assigned SEA, more likely from an untested source		AKC03517	Khao Sam Kaeo	Deccan Traps
AKC02062	Ban Non Wat	Deccan Traps				

Table 6.5: Preliminary geologic source provenience assignment for the 79 agate and carnelian artifacts analyzed using LA-ICP-MS.

Other potential sources for raw materials and finished beads

As discussed above, it is likely that approximately 34 beads were made with raw material sources that have not yet been geochemically tested and identified. There are numerous potential sources in South and Southeast Asia that deserves future testing and evaluation. The South Indian bead production industry is well known, as numerous sites have evidence for stone bead manufacture, including the port site of Arikamedu (Figure 6.2) and Kodumanal (Francis 2002, 2004; Kelly 2009). Many of these South Indian bead production sites made beads using a variety of raw materials including quartz and amethyst, as well as carnelian and agate (Francis 2002). Unfortunately, it is unclear what sources were being used to produce beads. Some scholars have suggested that agate and carnelian were being imported from northern India (Rajan 1990:102; Francis 2002: 117), however there are other sources located within the region that may have also been exploited. Francis describes nodules from the Deccan Traps found in the Godavari and Krishna riverbeds (2002: 117), however if these nodules were used they may geochemically indistinguishable from the other Deccan Traps sources. Distinct veins of agate and carnelian may be located elsewhere in South India, Francis suggests a possible vein of banded agate near the site of Kotalingala (Figure 6.2) (2002: 117), although the exact location of these sources is currently unknown. Further examination of bead production debris may assist in at least identifying a proxy for local South Indian agate and carnelian sources.

Another important potential source location for the purposes of this study would be agate and carnelian deposits located in eastern India, bordering Southeast Asia, and specifically those in Orissa state. Theunissen has noted that there may have been overland trade into Southeast Asia through east India and that bead production sources in this region should be considered as

potential sources for beads found in Southeast Asia (Theunissen et al. 2000; Theunissen 2003).

Several scholars have reported evidence for bead production in Orissa (Mohanty and Mishra 1999 in Theunissen et al. 2000). As discussed above, there is also evidence for both raw materials and stone bead production in Myanmar. A single carnelian bead from Ban Non Wat shared a visual similarity with beads from the Samon Valley, indicating that further investigation within this region is needed. It is hoped that with continued research and analysis the raw material source for all the agate and carnelian beads will be identified.

Conclusion

This chapter has presented geochemical data on agate and carnelian artifacts from 11 sites in Cambodia and Thailand. By performing geochemical compositional analysis on a selection of agate and carnelian beads I was able to see clear patterns in the exploitation of stone sources, although these patterns were not as fine-grained as I had originally intended. Nevertheless, the compositional data indicate that most (n=59) of the agate and carnelian beads in this study were made using Deccan Traps agate sources. Approximately one quarter, or 20 beads, appear to have been made using non-Deccan Traps sources, however the explicit use of a Southeast Asian raw material source to make beads is not yet clear. While I cannot yet clearly identify the sources used to make these beads, it is possible that sources in both South and Southeast Asia may have been used to make beads. In the beginning of this chapter I introduced several questions that I would now like to address in more detail.

Were different stone sources used to produce Period 1 and Period 2 Type beads?

Metric and morphological differences in agate and carnelians showed a distinction between Period 1 Type beads and Period 2 Type beads. However, results show that there did not

appear to be strong compositional differences between the Period 1 and Period 2 Type beads.

These two types of beads also appear to be related to changing trade networks with South Asia and between sites in Southeast Asia. As the quality of beads was changing over time and there also appears to have been an increase in the quantity of beads during the later Iron Age, one could wonder if this required the participation of new bead production workshops that were exploiting different stone sources to produce their beads. While LA-ICP-MS has proven to be an ideal method for distinguishing between sources and assigning artifacts to those sources, similarities in the composition of the Deccan Traps sources and a limited dataset have prevented me from achieving the fine-grained analysis of the agate and carnelian artifacts that I had expected. However, the geochemical data can be used to make regional assessments about the provenience of the beads. Approximately two-thirds of the beads analyzed from sites with Period 1 Type beads and Period 2 Type beads appear to derive from Deccan Traps geologic sources (Tables 6.6 and 6.7). A Fisher's Exact test provided a p-value of .2134, indicating there are not statistically significant differences between the sources used to produce the Period 1 and Period 2 beads. These results indicate that there were not major changes in the geologic raw material source being used between the two Periods. I argue that this evidence suggests the Deccan Traps geologic sources were the primary suppliers of raw materials used to produce both the Period 1 and Period 2 bead types found in Southeast Asia. If a non-Deccan Trap sources was being used to produce more beads in either Periods 1 or 2, it is not yet clearly identifiable. It is possible that the sources for the beads believed to have been made from non-Deccan Traps sources changed over time. However these assessments should be confirmed with further research in order to better identify the sources used to produce these beads.

Site Name	Number of beads assigned to Deccan Traps sources	Number of bead assigned to Non-Deccan Traps sources
Village 10.8	5	2
Khao Sam Kaeo	11	7
Promptin Tai	10	2
Prohear	1	2
Bit Meas	1	1
Total	28	14

Table 6.6: The total number of beads assigned to Deccan Trap and non-Deccan Traps sources from sites with Period 1 Type beads.

Site Name	Number of beads assigned to Deccan Traps sources	Number of bead assigned to Non-Deccan Traps sources
Angkor Borei	8	4
Phnom Borei	2	0
Phum Snay	5	4
Total	15	8

Table 6.7: The total number of beads assigned to Deccan Trap and non-Deccan Traps sources from sites with Period 2 Type beads.

Is there evidence that certain bead types were being made from specific geologic sources?

Results show that a small number of beads do appear to be both morphologically and geochemically distinct and could represent the products of various different workshops that exploited a non-Deccan Traps source. Morphological analysis identified specific bead types, such as the flattened hexagonal bicones and notched agate pendants that appeared to be associated with specific trade networks or regions. I wondered if these unique bead types were made from distinct geologic sources indicating that perhaps they were the product of single workshops. Several bead types do appear to be geochemically distinct, including a group of unfinished beads from Khao Sam Kaeo, a group of agate barrel beads from Ban Non Wat, Phum Snay, Prohear, and Promptin Tai, and the carnelian bead from Ban Non Wat that may be from

Myanmar. In their earlier study, Theunissen and others also provided evidence for distinct bead types that may have been the product of specific workshops using a discrete stone source (2000: 102). I propose that these additional data indicate that continued geochemical analysis of bead shapes and raw materials sources from a variety of sites might be able to identify the products of specific workshops.

Is there geochemical evidence for the use of agate and carnelian from Southeast Asian source for local bead production?

In the current study I was unable to find clear evidence that beads were being made using Southeast Asian stone sources. As discussed in the previous chapter, Bellina (2001, 2003, 2007) and Theunissen (2003; Theunissen et al. 2000) have suggested that agate and carnelian beads may have been produced in Southeast Asia. According to Bellina's (2001, 2003, 2007) hypothesis, local production of beads increased during Period 2, when local bead manufacturers began mass-producing lower-quality beads for trade to inland sites. One would expect that if there were a change in how bead production was organized during Period 2, including the possible exploitation of local stone sources, that this would be identifiable geochemically. However, data from the current study suggests that there is not yet a clear geochemical difference between Period 1 and Period 2 sites. Furthermore, Theunissen (2003; Theunissen et al. 2000) has specifically suggested that craftsmen may have been exploiting local stone resources in central Thailand to produce beads during this period. I was unable to find evidence that beads were being produced using this raw material source. Although several beads were assigned to Southeast Asian sources, it was not clear that these beads originated from these sources. Combined with a lack of archaeological evidence for production in or around the source sites

examined, I argue that this evidence indicates that beads were not locally produced using Southeast Asian stone sources. Nevertheless, this does not mean that beads were not manufactured in Southeast Asia, as data from Khao Sam Kaeo provide evidence for local production of hard stone beads.

It should be noted that Bellina has mentioned that raw materials for beads were likely imported via maritime trade (2007: 68) and the current evidence supports this theory. In fact, it appears that raw materials from multiple different sources were being exploited at Khao Sam Kaeo in particular. Several finished beads from Khao Sam Kaeo as well as and polished but undrilled or partially drilled beads were assigned to the Deccan Traps sources. However, a small group of unpolished and undrilled beads appear to be from a non-Deccan Traps source.

More recent ethnographic research on the Khambhat bead industry highlights the tight control and protection over both raw materials and finished products by important merchant families (Kenoyer et al. 1991). We may hypothesize that both raw materials and the knowledge used to produce finished products would have been as tightly controlled in the past. If so, this would make it unlikely that South Asian beadmakers would be willing to teach their technology to Southeast Asian craftspeople. The long apprenticeship and technological knowledge required to make agate and carnelian beads did not lend itself towards being easily copied. The current evidence does not support the theory that some Southeast Asian elites were expanding their jurisdiction over bead production by exploiting local raw material sources they could directly control. Instead it appears that Indian beadmakers and/or importers of raw material played an important role in the production of beads in Southeast Asia. If Southeast Asian's were involved in some aspect of local production the compositional data presented in this chapter suggest they

had to work with and rely on the importation of raw material controlled by another party, and likely from Deccan Traps sources. However, I argue that during the early centuries AD Southeast Asian elites in the Mekong Delta were becoming more involved in the trade of finished products to inland sites.

In the following chapter I shift my focus to glass beads. Compositional analysis shows evidence for changing glass bead types over time, a pattern similar to that of the agate and carnelian.

Chapter 7: The Glass Beads

Glass beads are perhaps the most ubiquitous bead artifacts found at Iron Age sites in Southeast Asia and previous research has identified numerous glass types in circulation during this period (Lankton and Dussubieux 2006). The majority of the glass beads at sites in Cambodia and Thailand were small oblate, monochromatic beads known as Indo-Pacific beads. However, there were also small amounts of other bead types as well as glass earrings, ring, and bangle fragments. The following questions will be addressed:

- How does the distribution of glass beads and artifacts change through time and space?
- Does evidence from glass bead trade patterns suggest increased participation in trade by elites at sites in the Mekong Delta?

Glass artifacts from ten sites in Cambodia and Thailand were examined as part of this study (Figure 7.1). Before looking at specific types of beads, it is important to first discuss glass technology and how glass beads and artifacts are made. I then focus specifically on Indo-Pacific beads, as these were the most common glass artifacts encountered. Next a discussion of glass bead research in Southeast Asia is provided, including an overview of the most common glass types found during the Iron Age. Following this discussion, the bead collections from ten sites in Cambodia and Thailand are presented. The types of glass artifacts, their context, and the distribution of glass colors at each site will be examined and preliminary patterns from these data will be identified. I then move into a discussion of the results of compositional analysis of glass artifacts from each site. Glass artifacts may often look similar to one another but actually be made from a different glass recipe. I conclude this chapter by identifying several different glass

bead trade networks. Some bead distribution patterns highlight the importance of regional exchange networks during the Iron Age period. However, it also appears that there was increased access to high alumina soda glass beads over time and that this may be related to the expansion of trade networks by elites in the Mekong Delta.

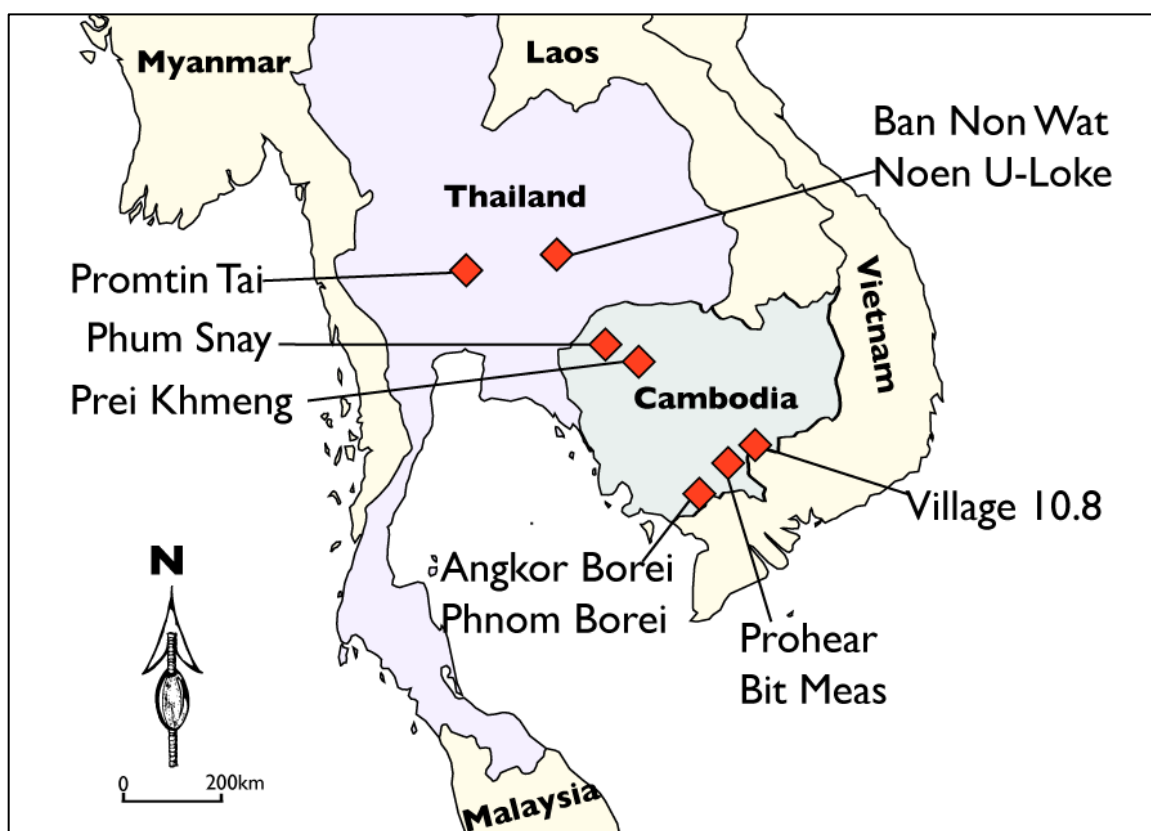


Figure 7.1: Map of sites with glass artifacts analyzed as part of this study.

What is glass?

Ancient glasses were made from four important components: silica, fluxing agents, stabilizing agents and colorants. The primary component of glass is silica (SiO_2), the source of which was generally sand or quartz pebbles (Henderson 2000). Because silica has a high melting point, fluxing agents were added in order to facilitate the melting process. The two principal fluxing agents were potassium oxide (potash, K_2O) or sodium oxide (soda, Na_2O). These fluxing

agents were often derived from plant sources, including such high-soda desert plants as Salicornia or Sasola; however soda from mineral deposits was also used (Henderson 2000). The magnesia (MgO) levels in a sample are useful for determining if the glass was made using a mineral vs. plant ash flux. Glass made with a mineral alkali flux generally has below 1.5 weight percent (wt%) MgO, while glasses made with a plant ash flux have MgO levels above 1.5 wt% (Sayre and Smith 1961; 1967). The last important component of glass was the stabilizer, which prevented the glass from dissolving in water; the most common stabilizers were lime (calcium oxide, CaO) and Alumina (aluminum oxide, Al_2O_3) (Turner 1956b). Other elements found in glass include intentionally added opacifiers or coloring agents, such as antimony, tin, cobalt, copper, lead and iron, along with naturally occurring impurities. Glass recipes can vary depending on the different types and amounts of silica, fluxing agents, and stabilizers used. Previous research has identified some of the raw materials that may have been used to produce glass found in Iron Age Southeast Asia, such as reh, an efflorescent salt that may have been used in the production of high alumina soda glass (Lankton and Dussubieux 2006: 132-3).

Raw glass is produced at workshop sites known as primary glass production centers. This glass may then be worked into artifacts or sent in bulk to secondary glass workshops where the glass is then melted and worked into beads, bangles, and other objects. While one may assume that raw glass produced at a single workshop may all have similar compositions, scholars have found that glass recipes within a glass production centers can vary greatly (Lankton and Dussubieux 2006: 122). In this chapter certain glass recipes will be discussed that have been linked to specific workshop sites, while other glass types are unknown. Although we may not always be confident where the primary or secondary glass production site was located, we are

still able to trace patterns in the distributions of specific glass types over time and space. These data can in turn tell us about trade and exchange networks between these communities, even if we do not yet know the ultimate origin for the glass itself.

Indo-Pacific beads

Indo-Pacific beads are the most common glass bead type found in Southeast Asia (Figure 7.2). The term “Indo-Pacific bead” does not refer to the composition of the glass used to make these beads, but instead the method of making beads from drawn glass. Archaeological and ethnographic data have helped scholars understand how Indo-Pacific beads were made (Francis 1990, 2002; Kanungo 2000). After acquiring raw glass, it is placed in a clay and mud-brick low-domed furnace. At Papanaidupet, the only remaining Indo-Pacific beadmaking site in India, the glass furnace has four openings. One side is used to feed fuel into the furnace while the other openings have more specialized functions related to glass production that have not been found in other examples (Francis 2002: 22). The furnace requires near constant maintenance and must be covered with fresh clay several times a week. After the glass begins to melt, a tool called a *geddu paru* is used to stir and kneed the molten glass (Francis 2002; Kanungo 2000). Once the glass has been sufficiently melted, it is removed and placed an iron tube called a *lada*. Using the *lada*, the glass is then placed into the furnace once more and shaped into a cone. A different tool called a *cheatlek* is then used to pierce the cone to make a hole. The glass is then re-inserted into the furnace, and then a metal rod with a U-shaped hook is used to grab the tip of the glass cone and draw it out into one-meter long tubes. The speed with which the tube is pulled affects the size; the faster the tube is pulled the thinner the rod (Francis 2002; Kanungo 2000).

After cooling the tubes are cut into beads, although this sometimes occurs at a different location than the glass production. The glass tubes are placed on the ground and sliced into a smaller size using a metal blade. Following this process, the beads are then brought back to the kiln for re-heating in order to soften the edges. In some cases they are sold in bulk, or strung and then sold in hanks (Kanungo 2000). Beads made using the Indo-Pacific method have telltale linear striations from the drawing process (Figure 7.3).



Figure 7.2:Example of Indo-Pacific beads in a variety of colors and size from Angkor Borei.



Figure 7.3:An Indo-Pacific bead shown at 65x magnification. Note the linear striations from the glass drawing process.

Glass bead research in Southeast Asia

Glass beads first appeared in Southeast Asia round 500 BC, marking the transition to the Iron Age period (Lankton and Dussubieux 2013). The predominance of glass beads at Iron Age sites was immediately noticed by archaeologists and researchers working in Southeast Asia (Beck 1930). As early as the mid-nineteenth century, scholars around the world were analyzing glass in order to determine the ingredients and colorants (Turner 1956b). Comprehensive chemical analyses of glass artifacts were possible as early as the early 20th century (Turner 1956b: 163). Therefore, early scholars working in Southeast Asia often undertook chemical analyses of their specimens, in addition to simply describing the shapes, colors, and suspected manufacturing methods of glass beads. The widespread trade of certain types of beads, such as opaque red beads called *mutisalah*, across the ancient world was also recognized (e.g. Lamb 1965a, 1965b). Some of these early scholars began performing chemical analysis on beads from multiple sites in South and Southeast Asia in order to determine trade patterns of specific types of glass over time and space (e.g. Harrison 1964; Lamb 1965a).

During the early and mid-twentieth century, Chinese and Near Eastern glasses were well studied and provided a useful comparison for glass found in Southeast Asia. Lamb suggested that many of the beads found in Southeast Asia might have been produced locally from glass scrap imported from the Middle East or Mediterranean (Lamb 1965a, 1965b). Later work by Brill (1993:75) identified unique glass types that were not found in India, the West, or China, although some glass types did appear to be derived from Indian glass types. The scholar Peter Francis Jr. (1990, 2002) also emphasized connections with India, especially in the production of Indo-Pacific beads. However, continued analysis also showed that there might have been some

locally produced glass during the first millennium BC, perhaps made in Southeast Asia or southern China (Glover and Henderson 1995).

In more recent years, there have been several more comprehensive studies of glass in Southeast Asia (Dussubieux 2001; Lankton et al. 2008; Lankton and Dussubieux 2013). Aided by LA-ICP-MS, these techniques have used major, minor, and trace elements to identify specific glass types. Work by Dussubieux (2001; Gratuze and Dussubieux 2003, 2010) has identified nine different glass types in circulation in South and Southeast Asia. This work was expanded by Lankton and Dussubieux (2006, 2013) and Lankton (Lankton et al. 2008). As Southeast Asia was a receiving trade goods from both East and South Asia, and even the Mediterranean and Middle East, it is unsurprising that there were multiple glass types in circulation during the Iron Age. In some cases the glass types identified by previous scholars can be tied to specific regional glass making traditions, time periods, and/or workshops. In other cases, specific glass types have been identified whose origins are more mysterious. Nevertheless, by identifying the different glass types and their proportions at sites and tracing this over time and space we can begin to understand the different glass bead trade networks in place during the Iron Age period. In the next section I will discuss the bead collections examined as part of this study in more depth.

Glass bead production in Southeast Asia

As with agate and carnelian beads, scholars have suggested that glass beads may have been produced in Southeast Asia (Glover and Henderson 1995; Lankton and Dussubieux 2006, 2013, Lankton et al. 2008). The presence of large chunks of glass cullet, and unfinished or melted beads, point towards the presence of glass production or manipulation at several Iron Age

sites in mainland Southeast Asia. A brief review of sites with evidence for glass production (Figure 7.4) will highlight the diversity of evidence for production and provide a foundation for discussions of glass composition and trade networks using data from Cambodia and Thailand.



Figure 7.4: Map of sites with evidence for glass production

Khlong Thom/Khuan Lukpad, Thailand

As discussed in Chapter 5, Khlong Thom is suspected of being both an agate and carnelian bead production site and may have also been a tin smelting and casting center, in addition to producing glass beads (Bronson 1990). Numerous large un-worked chunks of what Bronson (1990: 218) has called “bulk glass,” or glass that was later melted to make beads and bangles, have been identified. Additional evidence includes melted glass affixed to pieces of ceramics, which may have been melting pots, as well as numerous pieces of glass slag, melted glass beads, and droplets that “formed from bits of liquid falling on the ground during glass working operations,” (Bronson 1990: 218). Unfortunately most of these data comes from looted contexts, however Khlong Thom and the bead production activities are believed to date from the 1st-7th centuries AD (Lankton and Dussubieux 2013).

More recent compositional analysis on materials from Khlong Thom suggests that the melted glass beads were likely not produced at the site, but being re-melted from finished products. However there does appear to be production of a specific glass type, called m-Na-Ca-Al by Lankton and Dussubieux (2013) at Khlong Thom. Lankton and Dussubieux suggests that the high quantity of fragments of this glass as well as their large size suggest that there might have even been primary production of this glass at Khlong Thom. They suggest that this glass was part of a more widespread industrial production and trade of glass than found at Khao Sam Kaeo, which appears to have been primarily for elite production.

Khao Sam Kaeo, Thailand

Khao Sam Kaeo was noted in Chapter 5 as a site with strong evidence for stone bead production. However, there is also evidence for other crafts including ceramics, metallurgy, and

glass. Glass waste and cullet, worked fragments with evidence for glass working tools, and finished products, including both beads and bangles, have all been found in abundance at this site. Khao Sam Kaeo was a secondary glass production site and may have been involved with primary glass production, however this evidence has only come from a disturbed area of the site (Lankton et al. 2008). Compositional analysis of glass at this site has identified two types that are unique to Khao Sam Kaeo and appear to have been produced there (Lankton et al. 2008; Lankton and Dussubieux 2013). The first is a type of high alumina soda glass (m-Na-Al KSK) that was the most common glass type at the site and used to make bangles and lapidary worked beads. This high alumina soda glass is compositionally distinct from high alumina soda glass found in South Asia and was generally an emerald green color (Dussubieux et al. 2010, and Dussubieux and Gratuze 2013).

A second glass type unique to Khao Sam Kaeo is a type of mixed alkali glass (mixed alkali KSK), generally a copper blue or red color, and was used to produce bangles as well as drawn glass beads (Lankton and Dussubieux 2013). Waste fragments from bangle production have been found, although similar waste products for drawn beads have not been uncovered. However, villagers at Khao Sam Kaeo did find iron tools that are similar to the *ladas* used to produce drawn glass beads in India (Lankton and Dussubieux 2013).

Two additional glass types show evidence for working at Khao Sam Kaeo, although they may not have been produced at the site. The first, mineral soda potash glass with moderate amounts of lime and alumina (m-K-Ca-Al) and was used to produce both bangles and drawn beads in copper or cobalt blue as well as an opaque red color. As with the m-Na-Al glass above, waste products from bangle production have been found, but evidence for drawn bead production

is lacking. Lankton and Dussubieux (2013: 428) note that this potash glass type is fairly widespread across Southeast Asia, especially in southern and northern Vietnam, “raising the possibility of multiple primary production areas.” There is also evidence for drawn bead and bangle production using a low lime potash glass (m-K-Al), primarily in a copper blue. This glass appears to be distinct from the moderate lime and alumina potash glass, although Lankton and Dussubieux (2006, 2013) note that more research needs to be done in order to better understand these differences. Taken together, Khao Sam Kaeo has some of the strongest evidence for glass working and bead production in Southeast Asia.

Ban Don Ta Phet, Thailand

Many of the glass beads found at Ban Don Ta Phet are a mixed alkali glass that appear to have been imported from Khao Sam Kaeo and points towards a robust trade network between the two sites. However, an additional type of bead has been found at Ban Don Ta Phet in which chunks of glass were ground and drilled using a lapidary technique, similar to what was used to produce stone beads (Francis 2002; Lankton and Dussubieux 2013). Chemical analyses of the lapidary worked beads show that they were low alumina potash glass, distinct from the potash glass found at Khao Sam Kaeo (Lankton and Dussubieux 2013). Lankton and Dussubieux speculate that there may be a primary glass production site near Ban Don Ta Phet where this glass was made and then a separate workshop where it the glass was made into beads.

Giong Ca Vo, Vietnam

The coastal Sa Huynh culture of Giong Ca Vo has long been suspected of working glass, primarily due to the existence of glass versions of distinctly Sa Huynh ornaments, such as the lingling-o or double-animal headed earrings (Francis 1995). Giong Ca Vo represents the most

probable Sa Huynh glass manufacturing location thus far reported. Excavations at Giong Ca Vo in the 1990s have uncovered pits filled with sand that could have been used in glass production, as well as slag and waste materials (Francis 1995, 2002; Nguyen et al. 1995; Salisbury and Glover 1997). Only a small number of compositional analyses have been performed on glass artifacts from Giong Ca Vo. Preliminary analysis of these finished ornaments show evidence for both a low-alumina potash glass and high alumina soda glass, but it is not clear if any of the finished products may have been produced at the site (Salisbury and Glover 1997). However, later analyses show evidence for contact with Khao Sam Kaeo in the form of artifacts made from the m-Na-Al KSK glass (Lankton and Dussubieux 2013). Lankton and Dussubieux have noted “low alumina potash glass is not found in South Asia, suggesting a manufacturing site farther toward Southeast Asia,” (2006: 137). It is possible that Giong Ca Vo could be a source for this glass (Lankton and Dussubieux 2006), however more research is needed.

Oc Eo, Vietnam

In his excavations at Oc Eo in the 1940s, Louis Malleret (1962: 147-8) suggested that glass was produced at this site based on the high numbers of finished beads, as well as by the presence of glass fragments, slag, and crucible fragments. More recent research at the site has also suggested similar evidence (Manguin and Vo Si Khai in Stark and Dussubieux 2002). Dussubieux has also noted that Oc Eo has access to granite sources that could be used in primary glass production (Dussubieux 2001; Lankton and Dussubieux 2006). Both Angkor Borei and Oc Eo have large numbers of high alumina soda glass in comparison with other sites in the region, evidence that taken together may suggest local production of high alumina soda glass beads in

the Mekong Delta. However, strong evidence for glass bead production at this site has not yet been identified (Stark and Dussubieux 2002).

Ban Chiang Culture

Although many glass beads are described as coming from the site of Ban Chiang, Thailand, most of these are actually from looted sites or unknown contexts and are therefore better described as belonging to the Ban Chiang culture (Francis 2002:133). A specific type of wound truncated bicone in blue or green glass has only been found in the Ban Chiang region, suggesting they may have been produced nearby. Another unique type of long tubular glass bead appears to be imitating similar beads found in the region made of stone. Although there is not clear evidence for glass working in this region, the presence of these unusual bead shapes found only in this region is suggestive of a nearby local production center (Francis 2002).

Northern Vietnam/Southern China

As noted earlier, scholars have long suspected that there may have been potash glass production in northern Vietnam or southern China (Glover and Henderson 1995; Lankton and Dussubieux 2006). Lankton and Dussubieux (2006: 137) specifically suggest that low lime potash glass may originate in this region, due to the predominance of this glass type in northern Vietnam, China, Japan and Korea. Unfortunately, no glass production sites in this region have yet been identified, and so further research is needed to confirm this argument.

The organization of glass production in Southeast Asia

There is not yet clear evidence about how glass bead production was organized in Southeast Asia, and the identification of glass workshops has been hampered by looting and site destruction. Furthermore, the identification of glass production workshops may be difficult even

without site disturbance as glass waste can easily be recycled. Furthermore, ethnographic research has shown that aspects of bead production can take place in multiple locations away from the furnace where beads are produced and that debitage from the production processes can travel locations where beads are strung, for example, but not made (Kanungo 2000). While archaeological evidence may be lacking, compositional analysis has begun to shed light on many questions regarding bead production and exchange in Iron Age Southeast Asia. As many beads may look visually similar, compositional analysis is needed in order to distinguish beads made from specific glass recipes, some of which may be tied to a specific workshop or region.

Most archaeologists suspect that glass technology was brought to Southeast Asia and then adapted, although much like the stone beads it is not clear who- Indians or Southeast Asians- were producing the beads (Lankton et al. 2008). Francis (2002) suggested that there might have been a league of Indo-Pacific bead makers, which he calls the Arikamedu league, which connected beadmaking in South and Southeast Asia and whose beadmakers traveled between various sites. However, chemical analysis has all but disproven this theory, as the glass at Arikamedu is distinctly different from high alumina soda glass found at many Southeast Asian sites (Lankton and Dussubieux 2013). Further archaeological evidence will be needed in order to understand this aspect of bead production.

Common glass types found in Southeast Asia

Work by Dussubieux has identified nine types of glass that were in circulation in South and Southeast Asia during the Iron Age period (Table 7.1) (Dussubieux 2001; Dussubieux and Gratuze 2003). These different types were more recently defined and clarified by Lankton and Dussubieux (2006; 2013). Specific glass types have also been discussed in more depth in

additional studies (e.g., Dussubieux et al. 2010; Lankton et al. 2008). In this study, I am using Lankton and Dussubieux's definition of these various glass types as a foundation for my own research. Glass compositions were compared to these existing glass types and assigned to one of these groups using Lankton and Dussubieux's (2006: 140-2) glass identification algorithm. The major glass types encountered in this study are discussed below. A small number of artifacts did not fit into these pre-existing groups and these will be discussed in more depth later in this chapter.

		Flux				
		Soda				
		<i>Mineral deposits</i>		<i>Plant ash</i>	<i>Potash</i>	<i>Mixed soda potash</i>
Sand	<i>High Al</i>	High alumina soda glass (m-Na-Al Type 1)			Low lime potash (m-K-Al)	Mixed alkali glass
	<i>Moderate Al and Ca</i>	Mineral soda glass with moderate amount of Ca and Al (m-Na-Ca-Al)	"Arika" glass			
	<i>Ca with moderate Al</i>				Potash with moderate Ca and Al (m-K-Ca-Al)	
	<i>High Ca</i>			v-Na-Ca	Low alumina potash (m-K-Ca)	

Table.7.1: Table of glass types identified by Dussubieux and discussed in this chapter. Lead glass is not listed in this table but has been found in Southeast Asia. Adapted from Dussubieux 2001 and Dussubieux and Gratuze 2003.

Potash Glass

Potash glass, which uses potash (K_2O) as a flux to lower the melting point of the glass, is one of the most common types of glass found in Southeast Asia, however it has also been described as one of the “least understood” (Lankton and Dussubieux 2006:135). The potash glass sub-types vary by differing levels of CaO and Al_2O_3 , which are added as glass stabilizers, although the boundaries between these different sub-types are still nebulous. The three currently classified potash glass sub-types are: potash glass with moderate amounts of CaO and Al_2O_3 (m-K-Ca-Al), potash glass with low calcium oxide (m-K-Al low C), and potash glass with low alumina (m-Ka-Ca low A). No potash glass workshops have yet been discovered, however the presence of these different sub-types of potash glass indicate the possibility of multiple production centers, with some possibly located in Southeast Asia, specifically northern Vietnam or southern China (Lankton and Dussubieux 2006). Although the large quantity of potash glass with moderate CaO and Al_2O_3 , along with evidence for glass working, at the site of Arikamedu, India, also points toward this location as a possible primary manufacturing center (Lankton and Dussubieux 2006). Potash glass is also fairly common at the peninsular Thai site of Khao Sam Kaeo, where there is evidence for secondary glass working in the form of bracelet manufacture using potash glass (Lankton and Dussubieux 2013). The low alumina potash glass type remains poorly understood, but most likely dates to the 4th to 2nd century BC, with most examples found in Thailand at the site of Ban Don Ta Phet. Lastly, large numbers of the low CaO potash glass artifacts been found in many areas of Southeast Asia, with dates ranging from the 4th to 2nd century BC into the 2nd century AD (Lankton and Dussubieux 2006). Until glass production

workshops are identified archaeologically, the exact manufacturing location(s) for potash glass, with its various sub-types, remains unknown

High alumina Soda Glass

High alumina soda glass (m-Na-Al) is the most abundant type of glass found in South and Southeast Asia. In contrast to potash glass, high alumina soda glass uses soda (Na_2O) as a flux and high levels of alumina (Al_2O_3) as a stabilizer. Dussubieux et al. (2010) have identified five different types of mineral soda alumina glass, of which m-Na-Al Type 1, recognized by its low uranium and high barium content, is the most prevalent during the Iron Age of Southeast Asia. The M-Na-Al Type 1 glass is often found in a wide variety of colors including opaque red, opaque orange, opaque yellow, opaque green, opaque light blue, black and translucent light blue. However, beads in this glass type were not colored with cobalt, and so there are no high alumina soda glass beads that appear in a dark blue cobalt color (Dussubieux et al. 2010). This glass type is believed to have been manufactured in South Asia, with evidence for primary glass production in the form of furnaces with vitrified glass and blocks of raw glass at the site of Giribawa, Sri Lanka (Dussubieux 2001; Lankton and Dussubieux 2006).

Mineral soda glass with variable amounts of alumina and lime (m-Na-Ca-Al)

In Lankton and Dussubieux initial article on glass types (2006) this glass type was described as a high-lime mineral soda glass (m-Na-Ca). However, in their more recent work, this glass type was revised to reflect “that both lime and alumina are continuously variable over a range of values, with no clear demarcations between examples lower or higher in either oxide,” (Lankton and Dussubieux 2013: 436). Although these beads can be difficult to distinguish from high alumina soda glass, one notable difference is that in the current study many m-Na-Ca-Al

beads were a cobalt blue color. As cobalt blue beads are not present in the m-Na-Al Type 1 glass type, they can be more confidently assigned to the m-Na-Ca-Al glass type.

The m-Na-Ca-Al glass type has been found at locations across south India, Sri Lanka, and Southeast Asia (Carter 2010; Dussubieux and Gratuze 2010; Lankton and Dussubieux 2013), and the variations in major and trace elements make it likely that there is more than one variation of this glass type, with different archaeological meanings. The manufacturing locations may include Arikamedu, India, where the glass previously identified as ‘Arika’ has an m-Na-Ca-Al composition (Dussubieux and Gratuze 2013). Similar m-Na-Ca-Al glass has been found at the site of Phu Khao Thong, Thailand (Dussubieux and Gratuze 2010), although it remains rare at other, seemingly contemporaneous, peninsular sites. A different m-Na-Ca-Al glass, often cobalt blue, was probably produced at Khlong Thom/Khuan Lukpat on the west coast of the Thai/Malay peninsula (Lankton and Dussubieux 2013).

Mixed Alkali Glass

Mixed alkali glass describes glass that contains both over 5% of both NaO and K₂O and predominantly found in an opaque red or orange color. Lankton and Dussubieux note that this glass appears to be related to high alumina soda glass (2006: 138). More recent research at Khao Sam Kaeo has identified a local variation called Mixed Alkali KSK that was often red or copper blue in color (Lankton et al. 2008; Lankton and Dussubieux 2013). Recent research suggests that there were actually multiple types of mixed alkali glass in circulation (Carter and Lankton 2012; discussed further below).

Arika Glass

Arika glass refers to a unique glass composition, perhaps related to the m-Na-Ca-Al glasses, first identified in large quantities from the site of Arikamedu, India (Dussubieux 2001). Arika glasses are generally red, green, or black in color. Arikamedu was an important glass production site and believed to have been producing glass beads that were widely traded around the world (Francis 1990, 2002). However, compositional analysis has shown that this glass type was not well circulated in Southeast Asia, save for a fairly large quantity found at the peninsular Thai site of Phu Khao Thong (Dussubieux and Gratuze 2013: 406). The large quantity of this glass type at Phu Khao Thong has led some scholars to speculate that it may have also been a bead production center (Dussubieux and Gratuze 2013; Dussubieux et al. 2012).

Lead Glass

Lead glasses are generally believed to be imports from China. Lead beads are rare at Southeast Asian archaeological sites. Dussubieux's study (2001) identified only six lead beads: three from the site of Angkor Borei and three from the later 9th century AD site of Sarawak in Indonesia. Recent research indicates that there are also lead glass beads at the Sa Huynh site of Lai Nghi, Vietnam (Karsten Brabender, personal communication, 2008). It is possible that with continued study lead glass beads could be found to be more common. There also appears to be considerable variability within the lead glass type. The lead glass beads at Angkor Borei were notable for their high barium content, a characteristic usually thought to indicate a Chinese origin (Stark and Dussubieux 2002). Lead isotope analyses may assist in better understanding when and where these beads were manufactured (e.g. Henderson et al. 2005).

Changing glass types over time

As discussed in Chapter 3, Bellina and Glover (2004) have identified a change in the type and intensity of trade between South and Southeast Asia during the Iron Age period. This shift was also identifiable in the type and quality of agate and carnelian beads (Bellina 2003). The scholars Lankton and Dussubieux (2006, 2013) have identified a similar change in glass types over time as well. During the late first millennium BC, potash glass artifacts are common at many Iron Age sites in Southeast Asia. However, during the early centuries AD, there appears to be a shift and Iron Age sites become dominated by high alumina soda glass. Lankton and Dussubieux (2013: 433) argue “the different glass compositional groups change more by the dates of the sites, rather than by their locations within Southeast Asia. Whatever happened was a *regional phenomenon*, occurring across the expanse of Southeast Asia” (emphasis added). Dussubieux’s study of glass from the Angkor Borei cemetery found no potash glass artifacts, suggesting the dates for the cemetery (200 BC- AD 200) could pinpoint this shift (Dussubieux 2001; Stark and Dussubieux 2002; Lankton and Dussubieux 2013).

This compositional shift is also tied to a change in how glass production was organized. During the early Iron Age, glass appears to have been produced in Southeast Asia for Southeast Asian markets, but during the late Iron Age this had shifted to an influx of imported South Asian produced glass with “the selective production of other glass artifacts destined for markets near and far,” (Lankton and Dussubieux 2013). Furthermore, scholars note the increased presence of glass from farther-flung regions, such as the Middle East, suggesting that trade networks were expanding in the early centuries AD (Dussubieux and Gratuze 2010). In this chapter I present

evidence from Cambodia and Thailand showing a similar shift in glass types over time, which I argue is related to changing trade networks and expansion of influence from the Mekong Delta.

Glass beads in Cambodia and Thailand

Glass bead collections from 10 sites were measured, photographed and recorded (Table 7.2). Appendix 7.1 lists the contextual, morphological, and metric data from all the glass beads recorded in this study. A selection of these beads were then chosen for compositional analysis using LA-ICP-MS in order to determine the types of glass found at each site and the proportions of the different glass types at each site. These data were then used to better understand the glass bead trade networks in which each site was participating. Glass collections from two sites were not examined. Glass artifacts from Khao Sam Kaeo were not available for study, but have already been comprehensively examined elsewhere (see Lankton et al. 2008). Glass artifacts from Krek 52/62 were also not available for study, but a small number of artifacts were analyzed and I will refer to this research later in this chapter as well (Haidle and Neumann 2004). Before discussing the results of LA-ICP-MS analysis, I will first introduce the bead collections by site, paying special attention to the context in which the beads were found.

One aspect of recording that proved difficult involved the terms used to describe the different colors of glass artifacts. This was especially true for the blue and green glasses, which range from light to dark in color, with no clear discrete differences between colors. Future researchers may benefit from a newly published Munsell Bead Color Book (2012), however this resource was not available during bead recording. Instead, I have chosen to use more general categories for glass colors. The colors recorded include: red, orange, yellow, green, light blue, dark blue, blue-green, black, purple, grey, brown, and white or off-white. The opacity and

transparency of glass was also recorded and noted in Appendix 7.1, however, it is not discussed in detail here as I found this information was not relevant to the research questions being discussed. However, red, orange, yellow, green, white, and black beads were almost always opaque. High alumina soda glass green beads were generally a light opaque green color, while some dark greens were found to be potash glass. Light blues glass could be either opaque or translucent, however dark blue glass was generally translucent or semi-translucent. Some glass beads that were recorded as black later were discovered to be a semi-translucent dark purple. Red beads were sometimes found to have streaks of opaque orange, while others were a more brownish red or brick red. It should be remembered that color descriptions in Appendix 7.1 are by nature subjective.

The results from compositional analysis of glass beads from Cambodia and Thailand show that there were many different glass types in circulation during the Iron Age. However, the two most predominant types – potash glass and high-alumina soda glass – differed in their distribution. Sites in southeast Cambodia, as well as Promptin Tai in Thailand contained large amounts of potash glass, while the remaining sites contained large quantities of high-alumina soda glass. I argue that the distribution of these two glass types is representative of two different but overlapping bead trade networks. The potash glass distribution represents a coastal exchange network, while the high-alumina soda glass distribution represents an expanded trade network from the Mekong Delta.

Site Name	Date	Beads from Burial contexts	Burials with glass beads/Total number of burials	Beads from Non-burial Contexts	Total
Angkor Borei, Cambodia	200 BC – AD 200	720	29/111	648	1368
Ban Non Wat, Thailand	420 BC – AD 600	574	13/160	172	746
Bit Meas, Cambodia	Contemporary with Prohear?	0	N/A	6	6
Noen U-Loke, Thailand	420 BC – AD 600	N/A	56/120	N/A	3531
Phnom Borei, Cambodia	200 BC- 0 BC/AD	0	0/9	48	48
Phum Snay, Cambodia	350 BC – AD 200	194	7/23	91	285
Prei Khmeng, Cambodia	1 st -6 th centuries AD	2011	3/7	45	2056
Prohear, Cambodia	200 BC – AD 200	476	46/52	74	550
Promptin Tai, Thailand	500 BC – AD 500?	125	8/35	835	960
Village 10.8, Cambodia	400 BC – AD 50	201	6/50	8	209

Table 7.2 Number of glass beads examined by site.

Glass beads in context

Angkor Borei

Over 1300 glass beads were found at Angkor Borei within the cemetery matrix, of which just nearly half were associated with a burial (n=720). Almost all of them were Indo-Pacific beads in a variety of colors and sizes. These beads were previously studied as part of Esme Hammerle's (2004) undergraduate research at the University of Hawai'i-Manoa and almost 100 glass beads were analyzed using LA-ICP-MS as part of Laure Dussubieux's doctoral dissertation research (2001). More recently, these beads were recorded as a part of this study and entered into FileMaker Pro.

Angkor Borei Burial Number	Sex (Age)	Glass Artifacts	Other grave goods
F1	Male (young adult) Male (7-10 years)	5 glass beads: yellow (n=3), orange (n=1) and red (n=1)	Ceramics
F2	Female (20-25 years) Male (adult) Unidentified skeletal remains of third individual.	1 yellow glass bead.	N/A
F3	Female (middle-aged)	1 orange bead and 1 green bead found at skull	Animal rib bone.
F4	Female (40-50 years) Male (young adult) Female (16-20 years) Remains of 4 additional males and 1 female	7 glass beads: green (n=6) and orange (n=1)	Ceramics and pig remains.
F5	Female (19-21 years) Adult male Unknown (12-16 years)	45 glass beads: cream/off-white (n=43), orange (n=1), and red (n=1).	1 garnet bead and animal (pig?) bones
F8	Male (19-25 years) Female (middle-aged) Fragments of 2 infants.	29 glass beads: orange (n=13), red (n=7), green (n=6), blue (n=1), black (n=2)	N/A
F10	Male (35-40 years old) Male (adult) Female (adult) Child (7-12 years)	9 glass beads: yellow (n=4), orange (n=3), green (n=2).	N/A
F11	N/A	1 red bead	N/A
F16	Female (25-30 years) Unknown (12-20 years) Male (young adult)	8 glass beads: dark blue (n=7) and yellow (n=1).	1 garnet bead
F17	Male (30-40 years) 2 Females (adult) 2 Males (adult)	1 dark blue glass bead	Ceramics

F20	Female (18-25 years) Female? (10-12 years) Child (9-10 years)	5 yellow beads	Animal bones, ceramics
F22	Female? (young adult) Child (6-8 years)	7 glass beads: orange (n=6) and red (n=1)	N/A
F25	Male (9.5-11 years) Male (adult)	1 orange bead	N/A
F26	N/A	1 light green bead	N/A
F27	Male (young adult)	32 glass beads: light green (n=25), yellow (n=4), black (n=1), and orange (n=2)	N/A
F30	Part of Burial F35 below	1 yellow bead	N/A
F31	Female? (3-5 years) Male (25-35 years)	12 glass beads: yellow (n=10), green (n=1), and black (n=1).	One tooth pendant.
F35 Includes disturbed remains from F30	Female (17-20 years) Child (3-5 years)	212 glass beads: green (n=132), black (n=42), orange (n=19), red (n=15), and yellow (n=4).	4 gold beads
F36	Male (34-45 years) Male? (middle-aged)	175 glass beads: orange (n=122), green (n=32), black (n=16), red (n=4), and white (n=1).	3 tooth pendants, orange ceramic anvil, and animal bones.
F37	Male? (18-19 years)	8 glass beads: yellow (n=3), green-yellow (n=1), red (n=3), and black (n=1).	

F39	Female (young adult) Male (young-middle aged adult) Male (young adult)- may belong to F56.	12 glass beads: orange (n=3), green (n=6), blue- green (n=1), light blue (n=1), and yellow (n=1).	2 gold beads
F42	Adult Male?	1 red bead	Ceramics and pig mandibles.
F43A Includes some bones from Feature 49	Male (35-45 years)	1 orange bead	
F43B	Male (45-55+ years)	1 green bead	
F44	Female (35-45 years) Female (young adult)	82 glass beads: orange (n=46), black (n=35), and dark green (n=1).	1 carnelian bead and 10 gold beads
F48	Female (30-35 years) Male (adult)	60 glass beads: orange (n=43), black (n=16), and white (n=1).	1 garnet bead
F51	Female (1.5-2 years)	N/A	1 carnelian bead, and animal bones
F52	Female (middle-aged) Female? (6-8 years)	1 green bead	Animal remains

Table 7.3: Burials with glass beads at Angkor Borei.

Table 7.3 lists the burials with glass beads at Angkor Borei recorded by the author in the current study. Figure 7.5 lists the color distribution of the glass beads found at Angkor Borei, where it is notable that green glass make up a large portion of the assemblage, with high numbers of yellow, red, and orange. Glass beads were found in a greater number of burials than stone beads, with two burials (F35 and F36) having over 150 glass beads. Some burials also included gold beads (F35, F39, and F44), while several burials contained both garnet and glass beads (F5, F16, and F48) and carnelian and glass beads (F44 and F51). However, due to the dense cemetery

at Angkor Borei it is difficult to determine if beads belonged with one specific individual in a burial or multiple individuals.

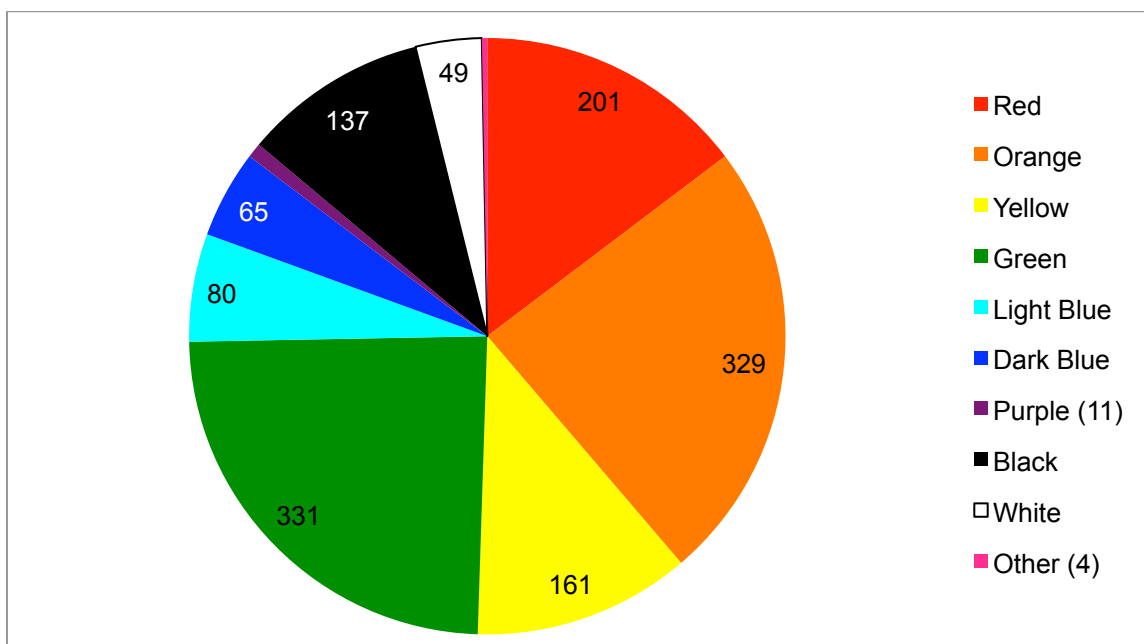


Figure 7.5: The distribution of glass bead colors at Angkor Borei (n=1268). Quantities for colors with less than 20 beads are listed in parentheses.

Phnom Borei

48 Indo-Pacific glass beads were uncovered in the small excavation at Phnom Borei. The majority of these beads from Phnom Borei were red (Figure 7.7). None of the glass beads actually came from burial contexts, but were instead found within the first and second layers of excavation and could be related to backfill from digging a pond nearby (Phon 2004). Although the context of these beads is not ideal, they still provide valuable information about the glass bead distribution at sites in the Mekong Delta and provide a useful comparison with the nearby site of Angkor Borei.

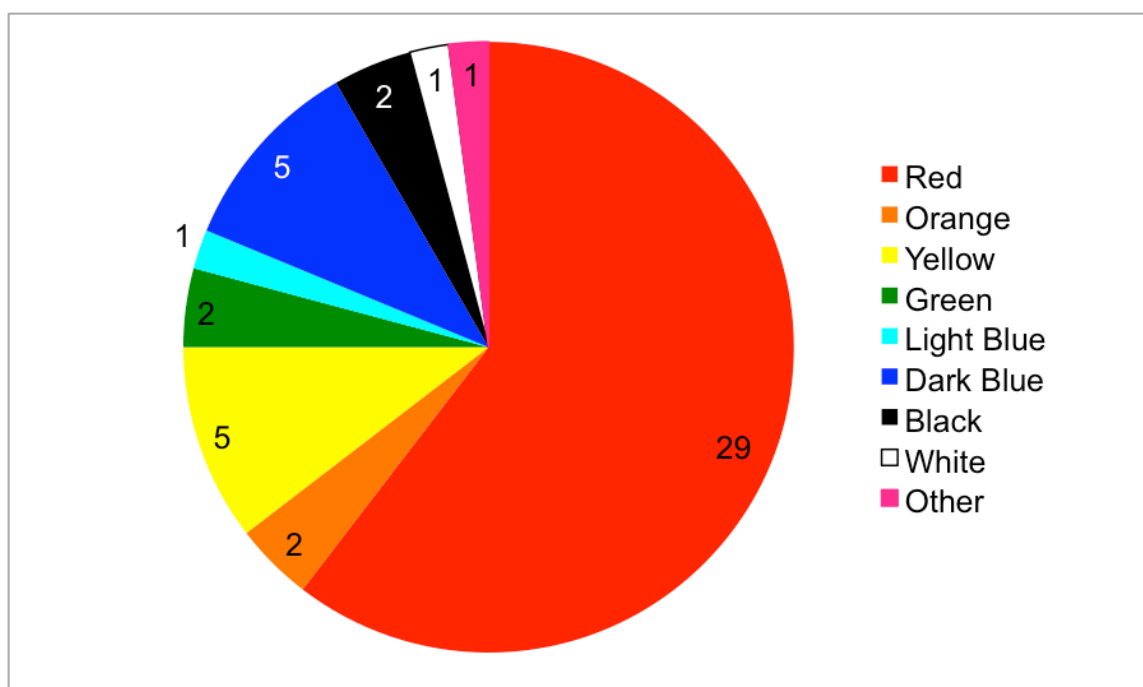


Figure 7.6: Distribution of glass bead colors at Phnom Borei (n=48).

Prohear and Bit Meas

Glass was very common at Prohear, occurring in nearly all of the 52 burials, save for 6 looted and disturbed burials. Unfortunately, not all of the glass beads were available for study; therefore I was only able to record 550 glass beads of which the majority (n=476) came from 25 burials. The majority of these beads were monochromatic Indo-Pacific beads, although several bangle or ring/earring fragments were also identified (Figure 7.8). Most of the beads were a dark blue color (Figure 7.9 and 7.10). As noted in earlier chapters, there were two burial phases identified at Prohear: an earlier Phase 1, which dates from 500 BC -150/100 BC and a later Phase 2, which dates from 150/100 BC- AD 100. Table 7.4 summarizes the glass bead data for the beads from burial contexts examined in this study, however this information should not be considered complete as not all beads from this site were available for study.

Many of the burials I recorded had only a small number of beads, although there were several notable burials with higher quantities of beads. This included the very rich burial of an elderly female with 91 glass beads and 2 rings/earrings (Burial 4) and Burial 14 that contained 138 glass beads, many of which were found in the wrist area. Burials 24, 33, and 34 are all reported as having over 150 glass beads, however I was only able to record smaller quantities. Also of note is Burial 46, which contained over 500 beads, although these were also not available for study (Reinecke et al. 2009: 118). Seven burials of those I recorded contained both stone and glass beads, although based on the currently recorded information it does not seem that any burials contained glass, garnet, and agate/carnelian beads together. Beads from Bit Meas were all from a looted context, however six glass beads were recorded. Of these, four were dark blue in color and 2 were light blue.

Prohear Burial Number	Dates	Sex/Age	Glass Artifacts	Other Artifacts
Burial 2	Phase 2b (100/50 BC- AD 100)	Male/unknown	1 blue-green glass earring/ring fragment and weathered/disintegrated bead fragments bead.	2 agate beads, bronze drum fragments, stone pestle, bronze/iron tools and jewelry, gold jewelry.
Burial 3	Phase 2b (C14 dates: 203-55 BC)	Female/20-30 years old	9 dark blue glass beads	Gold and silver jewelry, spindle whorls.
Burial 4	Phase 2b (C14 dates: 44 BC – AD 51)	Female/ Elderly	2 dark blue glass earring/rings. 91 glass beads: Dark purple (n=29), dark blue (n=43), black (n=18), white (n=1).	2 agate beads, bronze drum, ceramics, buffalo bracelet, gold and silver jewelry.
Burial 6	Disturbed by looters	N/A	1 dark blue bead and 1 blue-green earring fragment	N/A
Burial 7	Phase 1 (C14 dates: 513-397 BC)	Infant	1 dark blue bead	Jar Burial

Burial 8	Phase 2 (150/100 BC- AD 100)	N/A	1 black earring fragment and 3 glass beads: dark blue (n=2) and purple (n=1).	N/A
Burial 9	Phase 2 (150/100 BC- AD 100)	N/A	1 black/dark purple earring/ring fragment and 3 glass beads: dark blue (n=2) and black (n=1).	Ceramics, bronze bracelets, water buffalo teeth.
Burial 10	Phase 2 (150/100 BC- AD 100)	N/A	35 dark blue beads.	Bronze drum fragments, gold and silver finger rings. Some looting damage.
Burial 11	Phase 2 (150/100 BC- AD 100)	Male	5 glass beads: dark blue (n=3), red (n=1), and black (n=1).	Garnet beads, stone pestle.
Burial 12	Phase 2 (150/100 BC- AD 100)	Male?	8 dark blue glass beads.	Ceramics, gold/silver jewelry, spindle whorl. Ceramic goblet covered skull.
Burial 14	Phase 2 (150/100 BC- AD 100)	N/A	138 glass beads: dark blue (n=136), light blue (n=2).	Glass beads were worn at wrists and found stuck to iron bracelets, gold jewelry.
Burial 15	Phase 2 (150/100 BC- AD 100)	Male/Adult	1 dark green weathered bead.	Garnet beads found near mouth. Other glass beads reported but not recorded, iron tools, bronze bracelets.
Burial 16	Phase 2 (150/100 BC- AD 100)	N/A	1 black glass earring/ring fragment and 10 dark blue beads.	Ceramics
Burial 18	Phase 2 (150/100 BC- AD 100)	N/A	2 dark blue glass beads.	Gold finger ring, food offering?
Burial 20	Phase 2 (150/100 BC- AD 100)	N/A	56 glass beads: dark blue (n=55) and light blue (n=1).	Garnet bead, ceramics, iron bracelets, gold and silver jewelry.
Burial 22	Phase 2 (150/100 BC- AD 100)	N/A	17 dark blue beads	Iron bracelets, gold and silver jewelry.

Burial 23	Phase 2 (150/100 BC- AD 100)	N/A	1 dark blue bead and 1 brown glass bead.	Glass beads found at wrists with iron bracelets. Additional glass beads not recorded.
Burial 24	Phase 2 (150/100 BC- AD 100)	N/A	1 black glass ring/earring fragment and 71 glass beads: dark blue (n=57) and red (n=14).	2 carnelian beads, iron bracelets, gold and silver jewelry. Over 150 blue glass beads reported but only 54 were available for study.
Burial 25	Phase 2 (150/100 BC- AD 100)	N/A	2 dark blue glass beads and 1 black glass bead	Gold and silver jewelry.
Burial 28	Phase 2 (150/100 BC- AD 100)	N/A	1 light blue bangle fragment	
Burial 31	Phase 2 (150/100 BC- AD 100)	N/A	1 light blue earring fragment	
Burial 33	Phase 2b (100/50 BC- AD 100)	Female (based on presence of spindle whorls)	1 light blue bead	Garnet and carnelian beads, over 150 additional green and dark blue glass beads, gold jewelry, bronze bowl placed over the face, iron bracelets, spindle whorl.
Burial 34	Phase 2 (150/100 BC- AD 100)	Female (based on presence of spindle whorls)	1 dark blue bead and 1 black bead.	Over 150 black and red glass beads reported but not examined. Iron bracelets, gold and silver jewelry, spindle whorls.
Burial 42	Phase 2 (150/100 BC- AD 100)		1 dark blue bead and 1 black bead.	
Burial 49	Phase 1 (500- 150/100 BC)	Child	1 weathered ring or earring fragment	21 glass beads reported, garnet beads.
Burial 52	Phase 2 (150/100 BC- AD 100)		2 dark blue beads	Looted grave.

Table 7.4: Glass bead and burial data from Prohear.



Figure 7.7: Examples of ring/earring/bangle fragments from Prohear.



Figure 7.8: Example of the dark blue glass beads common at Prohear.

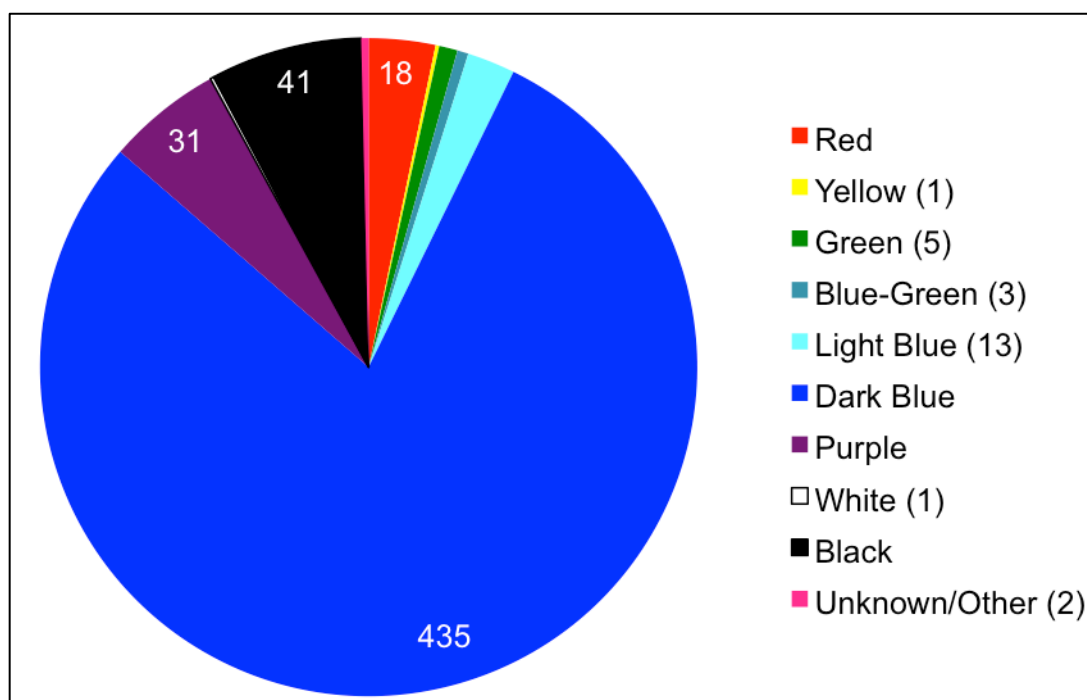


Figure 7.9: Distribution of glass colors at Prohear (n= 550). Quantities for colors with less than 15 beads are listed in parentheses.

Village 10.8

209 glass artifacts were recorded from Village 10.8, of which the majority (n=201) is believed to come from burial or possible burial contexts (Table 7.5). As with Prohear, most glass at Village 10.8 are blue in color (Figure 7.12). All of the beads appear to be Indo-Pacific beads that were drawn and cut from a glass tube. In addition to glass beads, there were also several glass rings and ring fragments (these were sometimes classified by excavators as earrings) (Figure 7.11). They primarily came in a dark purple color, but a single black glass ring was also identified. As discussed in the previous chapter, the highly acidic soil prevented most skeletal remains from being preserved, so little is known about the people who were buried with these beads. However, it is interesting to observe that in contrast to the burials at Prohear, a greater number of burials contained stone beads than glass beads and only four burials contained both

stone and glass. Of note is Burial 11, which contained 124 glass beads, the largest number of glass beads found at the site.

Village 10.7 Burial Number/Context	Glass Artifacts	Other Artifacts	Notes
Burial 1	1 blue glass bead	6 garnet beads, 6 carnelian beads, broken ceramics, iron tools and an iron bangle.	
Burial 9	2 dark blue glass beads	Broken ceramics	
Burial 11	124 glass beads. Blue-green (n=1), black (n=4), dark blue (n=119)	An iron ring and broken ceramics.	
Burial 15	27 glass beads. Blue-green (n=2), dark green (n=23), dark blue bead (n=2)	2 carnelian beads and broken pottery.	
Burial 28	6 dark purple glass rings	8 agate beads, 1 garnet bead, broken ceramics, and iron tools	
Burial 48	24 dark blue glass beads	10 carnelian beads, as well as a dagger, a knife, two iron bangles, a spade and pottery fragments.	
Unit EI Square T/92 Number 39	6 dark blue glass beads		Could be associated with Burial 3 or 4?
Unit EI Square U91 Number 6	1 black glass ring		Could be associated with Burial 3 or 4?
Unit EIX Square Q89 Numbers 38 and 39	1 black and 1 dark blue glass bead		Could be associated with Burial 11 or 12?
Unit EIX Square Q90 Number 18	8 dark blue glass beads		Could be associated with Burial 11 or 12?

Table 7.5: Glass artifacts from burial or possible burial contexts from Village 10.8.



Figure 7.10: Example of a glass ring from Village 10.8.

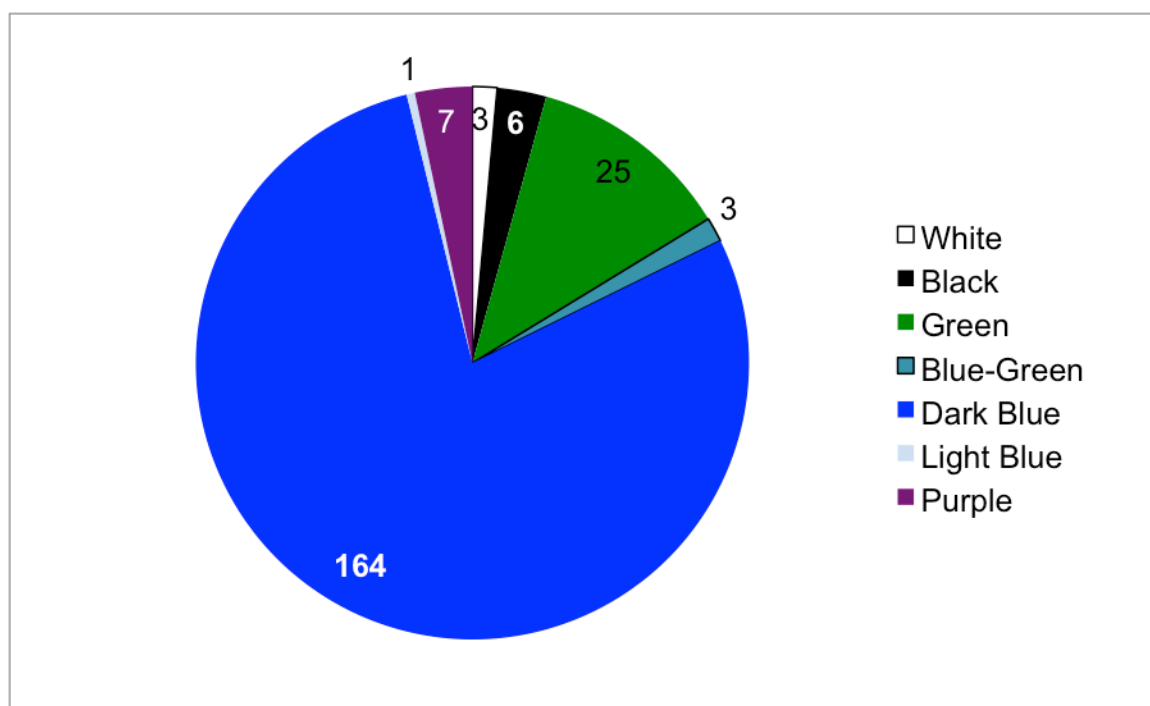


Figure 7.11: The distribution of glass bead colors at Village 10.8 (n=209).

Phum Snay

285 glass beads were recorded at Phum Snay and all of the beads were Indo-Pacific glass beads, however, there were also a few small ring, earring, and bangle fragments (Figure 7.13). Of note were a large number of extremely small Indo-Pacific beads, often measuring

approximately 1mm, which I call microbeads (Figure 7.14). Additionally, there are also numerous Indo-Pacific beads made with a mixed opaque red-orange glass. These beads often appear to be orange with red streaks (Figure 7.15). Although they are uncommon, similar bi-color beads have also been found at sites in South India and Sri Lanka (Dussubieux and Gratuze 2013), as well as Angkor Borei, Cambodia (Dussubieux 2001), Khlong Thom and Takua Pa in peninsular Thailand, Sungai Mas, Malaysia (Francis 2002), Noen U-Loke in Northeast Thailand, and Ban Non Noen in central Thailand (Pilditch 1992). Phum Snay was the first site recorded during fieldwork, and due to my inexperience many of these beads were initially recorded as only being orange glass beads, instead of red-orange beads. Therefore, the distribution of glass colors (Figure 7.16) lacks this distinction. It should be noted that while orange opaque glass dominated the assemblage from Phum Snay, many of these beads were not found in a burial context.

Of the 285 beads recorded, 194 of them were found in seven burials (Table 7.6). More burials contained glass beads than agate and carnelian, however the burial with the highest number of glass beads, Burial 9, also contained the largest number of stone beads. Several of the burials with beads also contained a large number of grave goods, with unique objects such as jewelry and decorative objects with a buffalo horn motif (Burials 7 and 13) or weapons such as iron swords or projectile points (Burials 6 and 7).

Burial Number/Context	Sex/Age	Glass Artifacts	Other Artifacts	Notes
Burial 1 (2001)	Adult male	58 orange microbeads	N/A	Disturbed burial
Burial 1 (2003)	Older adult female	1 orange microbead	2 bronze artifacts	
Burial 6 (2001)	Young adult male	Glass bangle/earring fragment. Glass beads were also reported in the thoracic area of the skeleton, but not available for study.	Buried with a long iron sword and a second iron weapon, iron projectile points, sun bear canine, 2 ivory bangles, a bronze object, bronze finger rings, ceramics, and a deer leg.	Teeth were ablated, skeleton also showed evidence for spinal degeneration (Domett and O'Reilly 2009).
Burial 7 (2003)	Middle aged adult female	5 blue beads. A glass earring was also reported, but not examined.	Iron projectile points, bronze finger ring with buffalo horns, pottery, spindle whorls, bronze rings, additional bronze and iron artifacts, and a bronze torque around the neck.	Extremely tall woman; may have been immigrant to the community (Domett and O'Reilly 2009).
Burial 9 (2001)	Young adult female?	Some black glass beads with skeleton.	Spindle whorl, a complete pot, bronze rings, and buffalo hooves and a horn.	Beads not available for study
Burial 9 (2003)	Adult female	105 glass beads associated with the burial. Additional 15 glass beads may be associated with the burial.	35 carnelian beads, gold bead, spindle whorls, bronze rings and bangles, iron tools, ceramics including a Phimai black bowl, and a bronze bowl covering her face.	Orange opaque glass (n=3), light blue translucent (56), dark blue translucent (n=3), red opaque (n=9), yellow opaque (n=48), dark green translucent (n=1).

Burial 13 (2003)	Young adult female	1 dark blue ring or earring fragment. 2 additional ring/earring/fragments may be associated with this burial.	Spindle whorls, red ochre, iron artifacts, an iron torque around the neck, three bronze bangles, a bone bangle, finger rings, and a ceramic epaulette with miniature iron buffalo horns.	Body was buried on her back with her knees flexed upward.
Unidentified Burial (2003). Unit A/B Layer 3:1 Feature 2	Adult	Three orange microbeads	2 spindle whorls, ceramics, a clay pellet, and an iron object.	Originally classified as a feature, but changed to burial after discovery of an adult skull (O'Reilly et al. 2004: 220).

Table 7.6: Glass beads from burial contexts at Phum Snay. Beads from Burial 9 (2001) were not included in the current study.



Figure 7.12: Glass ring or earring fragments from Phum Snay.

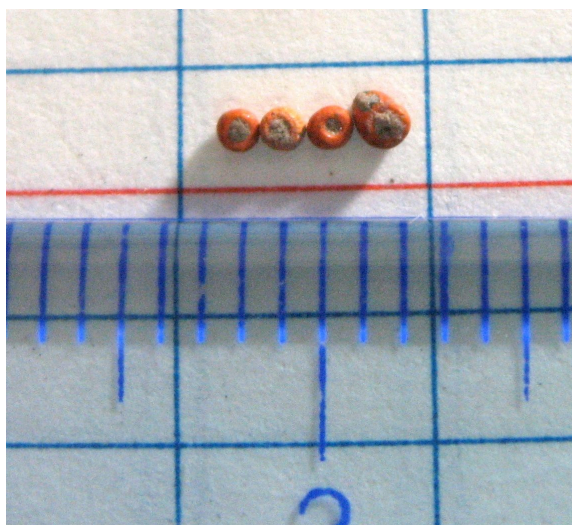


Figure 7.13: Example of orange opaque glass microbeads from Phum Snay Scale in mm.



Figure 7.14: Orange-red mixed glass bead from Phum Snay. Taken using a Dino-Lite digital microscope at 50x magnification.

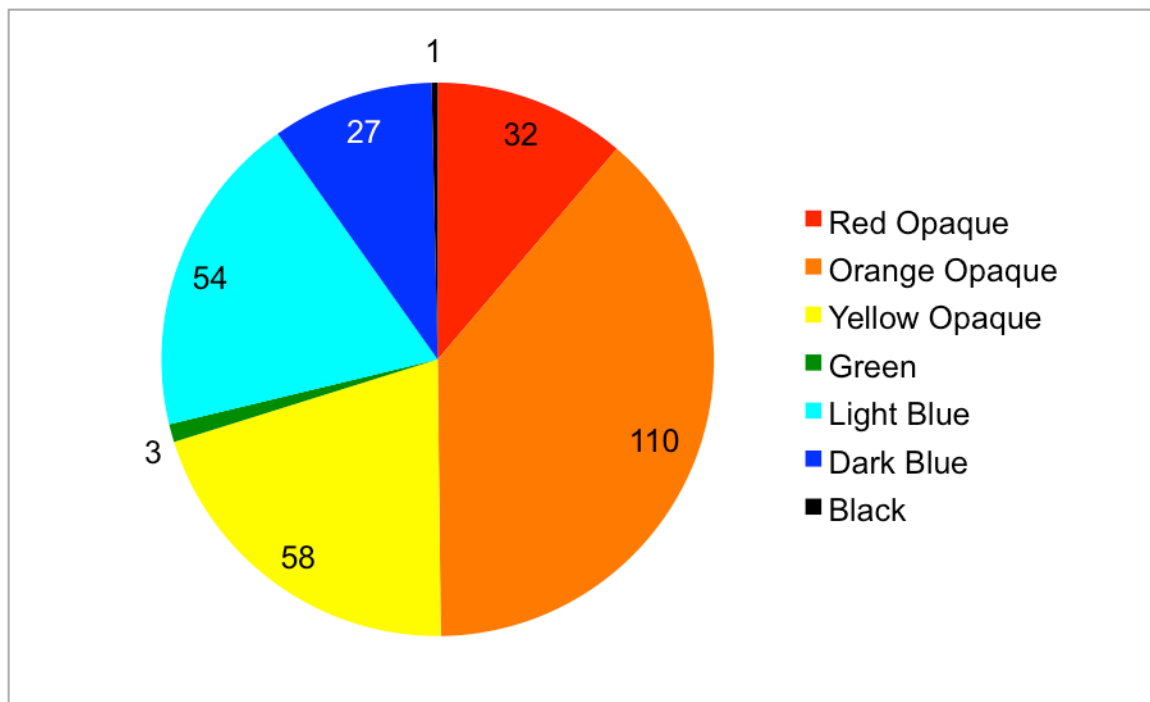


Figure 7.15: Distribution of glass colors at Phum Snay (n=285).

Prei Khmeng

As noted in earlier chapters, burials at Prei Khmeng had almost no agate and carnelian beads, but did contain over 2000 (n=2056) glass beads. As with other sites discussed in this chapter, nearly all the beads were drawn Indo-Pacific beads in a variety of colors (Figure 7.18). However, there was also a short bicone opaque black glass bead with a red stripe around the outer edge (Figure 7.17). Approximately 45 beads were from non-burial contexts) with the remainder in burials or possible burials (i.e. pits with some objects but no skeletal material)(Table 7.7). Three burials with beads were examined, from a total of 7 burials that were excavated. Radiocarbon dates from two burials suggested the cemetery was used from the 1st through 6th centuries AD (Zoppi et al. 2004). Prei Khmeng is home to one of the earliest Angkorian period temples in the Angkor region, however the burials from Prei Khmeng are

different from “Indianized” burials of the later periods. Beads from two burials (Bony II and Bony IV) were previously analyzed using EDXRF, in which it was suggested the beads from Prei Khmeng were of an Indian origin (Latinis 2004).

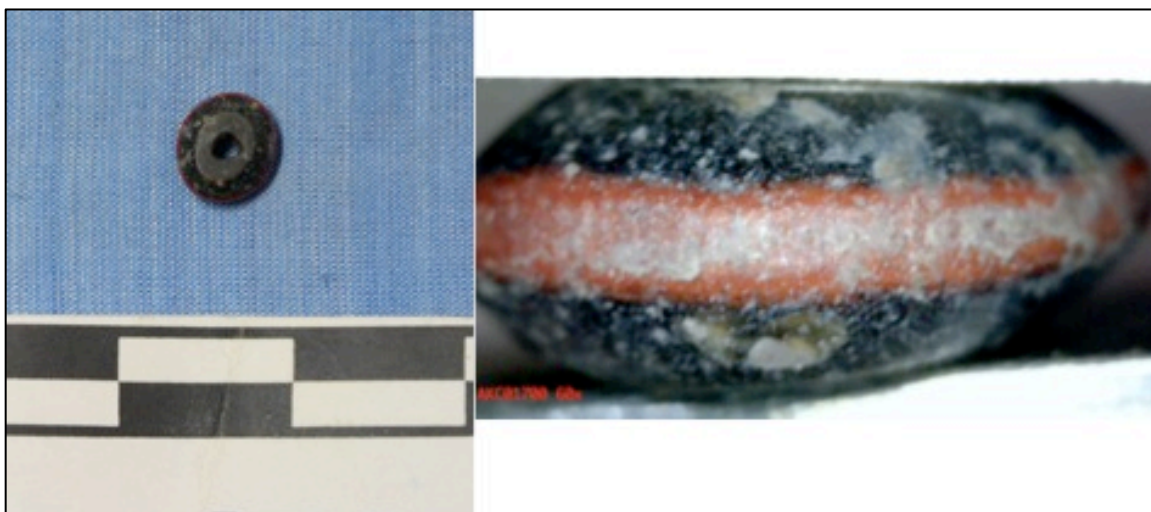


Figure 7.16: Black glass short bicone bead with a red stripe from Prei Khmeng. The image on the right is a close-up of the red stripe at 60x magnification.

Prei Khmeng Context	Sex/Age	Glass Artifacts	Other Artifacts	Notes
Burial 2 (Bony II) Context 16016/ 15017	Juvenile	11 blue glass beads and 1 yellow glass bead	An iron plate placed under the head, other undetermined long iron objects, a bronze bracelet and finger ring, a wooden artifact inserted into the mouth, and ceramics.	Blue glass beads collected from shoulder of skeleton. An additional 24 glass beads were analyzed in an earlier study (see Latinis 2004).
Burial 3 (Bony III) Context 21040	Female, approx. 28 years old	144 glass beads: red opaque (n=8), yellow opaque (n=16), yellow translucent (n=2), dark green (n=5), blue-green (n=6), light blue (n=11), dark blue (n=38), black (n=9), grey translucent (n=33), and brown/violet (n=16).	Ceramics, bronze or copper bracelets, copper earrings, ceramics, spindle whorls and, 2 iron adzes.	Beads were found under the skull and mandible.

Burial 4 Context 21045 (Bony IV)	Female 25-28 years old	1750 glass beads: orange opaque (n=1078), black (n=564), yellow translucent (n=16), dark blue (n=3), and brown (n=1).	Ceramics, some metal jewelry, iron objects including knives, and a pig's head offering.	Beads were found around the skull and neck. An additional 16 beads were analyzed in an earlier study (see Latinis 2004).
Context 15021		2 opaque yellow beads, 1 dark blue bead, and 1 black bicone with red stripe.		Possible burial context, but no skeletal material
Context 21025		50 glass beads: 1 dark blue bead, 23 opaque yellow beads, and 26 light blue beads.		Possible burial context, but no skeletal material
Context 21038		3 beads: opaque orange bead (n=1) and dark blue beads (n=2).		Possible burial context, but no skeletal material
Context 21052		5 beads: orange opaque (n=4) and red opaque (n=1).		Possible burial context, but no skeletal material

Table 7.7: Glass beads from burial and possible burial contexts at Prei Khmeng. Burial data from Baty 2003, Demeter 2004ab, and Pottier 2001.

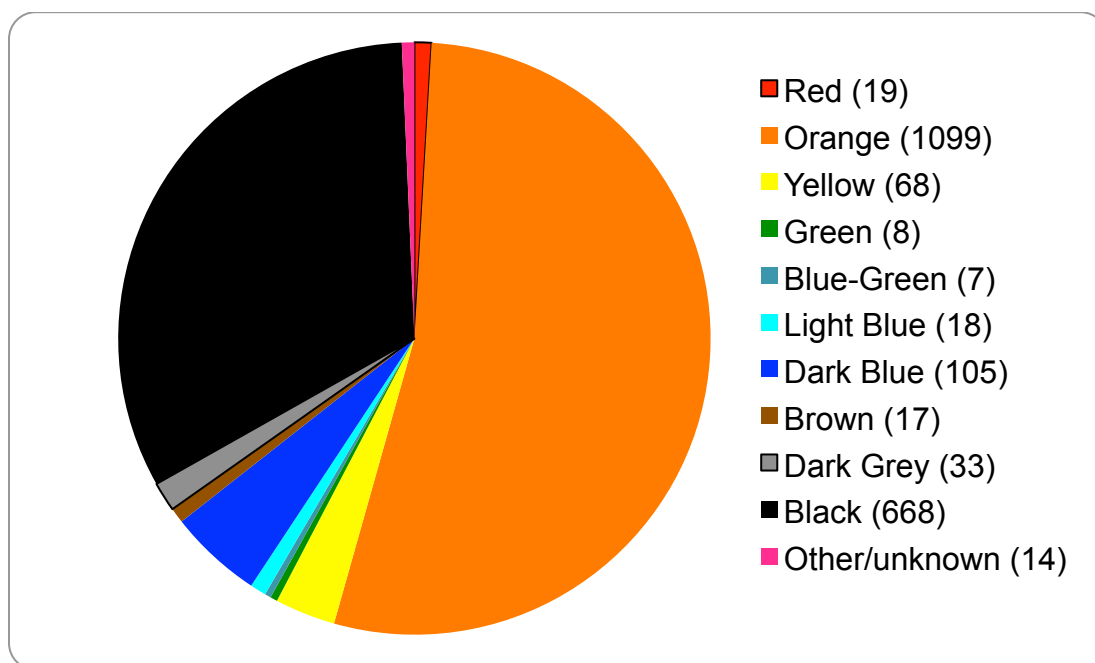


Figure 7.17: Glass bead color distribution at Prei Khmeng (n=2056).

Promptin Tai, Thailand

Almost one thousand (n=960) glass beads were analyzed from the site of Promptin Tai, Lopburi province in central Thailand. While most of the beads were Indo-Pacific drawn beads, Promptin Tai also had a small but diverse group of other types of glass beads, including gold-glass beads, a ring or earring fragment similar to those found at Phum Snay, polychrome beads, and faience beads. These beads will be discussed in more depth below. A majority of the beads were found in the Promptin Tai cemetery matrix (n=835) and the remainder was found in eight of the 35 burials excavated at the site (Table 7.8).

The cemetery is believed to span the entire Iron Age (500 BC- AD 500) and into the Early Historic period. However, it is believed that material from 170cm below datum and deeper date to the Iron Age period. Some glass beads recorded in this study were from these upper layers and may date to the mid-first millennium AD (see Appendix 7.1 for more specific information on the context of these objects). Based on the burial depth, graves were divided into an earlier or later period (Table 7.8); all except Burial 6 were classified as belonging to the earlier period (Liu 2012). Five of the six burials with agate and carnelian beads also had glass beads. Burial 20 is notable for having large numbers of both glass and stone beads. Figure 7.18 shows the glass color distribution at Promptin Tai. As at Phum Snay, some of the beads were a red-orange mixed glass, but have been classified as opaque orange in the figure.

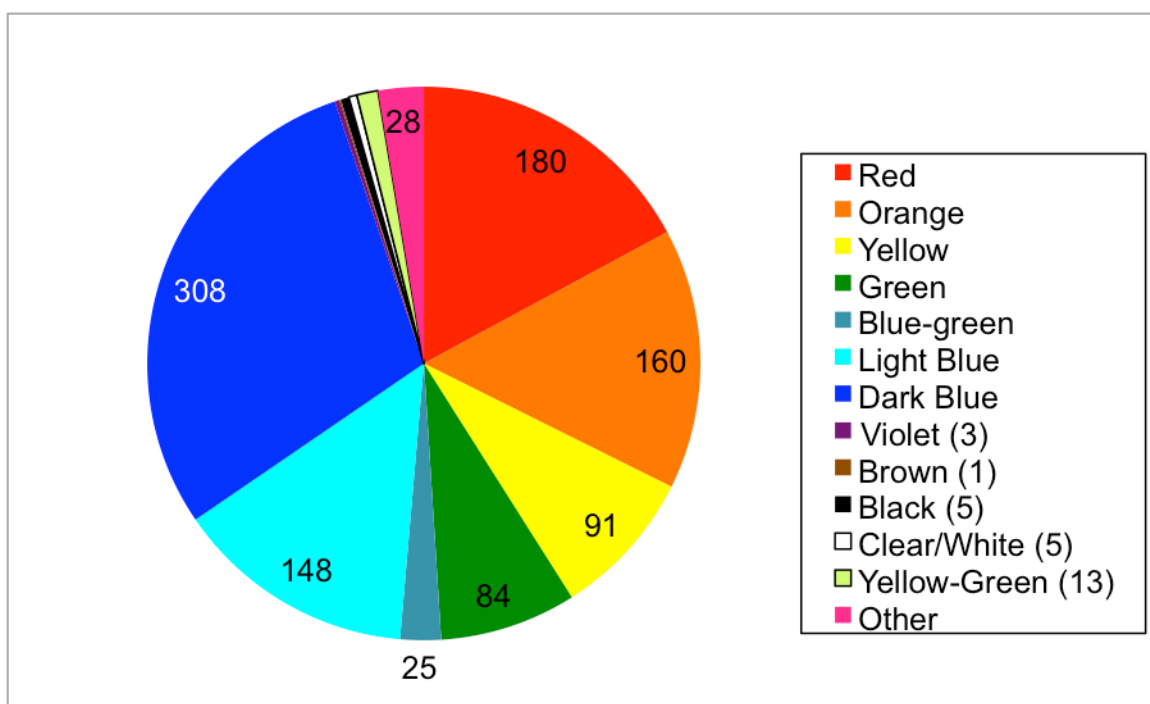


Figure 7.18: Glass bead color distribution at Promptin Tai (n=960). Glass colors with a small number of beads are listed in parenthesis.

Promptin Tai Burial Number	Sex	Age	Beads found in burial	Associated grave goods
Burial 6	Unknown	Subadult (1-2 years)	13 glass or faience tubular beads	N/A
Burial 7	Female	25-30 years	Light blue earring fragment	Pottery, 3 spindle whorls, and animal bones.
Burial 9	Unknown	Adult, 20+	32 dark blue glass beads	One greenstone bead and one agate bead.
Burial 12	Male	18-22 years	8 dark blue glass beads	Pottery, bracelets, and a bone tool.
Burial 18 (two individuals)	Unknown	Adult, 20+ and child, 3.5-4.5	1 faience collar bead	Greenstone beads, one agate bead, bronze bracelets, an iron spear, and ceramics.
Burial 19	Unknown	9.5-11	2 dark blue glass beads	14 agate beads, greenstone beads, shell bead, a bronze bracelet, 2 bronze rings, ceramics, two spindle whorls, and animal bones.

Burial 20	Female	20-25	134 glass beads: red opaque (n=1), orange opaque (n=14), blue-green (n=2), light blue (n=1), dark blue (n=107), clear beads (n=2), violet beads (n=2), black and white striped bead (n=2), gold-glass beads (n=3).	Greenstone beads, 5 agate beads, 7 carnelian beads, ceramics, and shell.
Burial 32	Unknown	Subadult	26 dark blue glass beads	Greenstone beads, four carnelian beads, ceramics, a bronze bangle and an iron tool.

Table 7.8: Glass beads from burial contexts at Promptin Tai.

Ban Non Wat and Noen U-Loke

Due to their proximity and similarity in recording the collections, the glass artifacts from Ban Non Wat and Noen U-Loke, will be considered together. Both sites are located just kilometers from one another in Northeast Thailand and due to time and access constraints, the collections from both sites were not examined in as much depth as the other sites discussed above. Nevertheless, the data recorded does provide ample information for an assessment of the collection and comparison with other sites. Table 7.9 lists the different phases at both sites and their corresponding dates. Many beads Indo-Pacific beads in a variety of colors were identified at both sites. However, another unique bead type was also common at Ban Non Wat and Noen U-Loke, these beads were opaque orange in color, with some red streaks, and were found in either a thin disc shape or as short tubular beads (Figure 7.20). Instead of being drawn like Indo-Pacific beads, these beads appear to have been made by wrapping a sheet of glass around a metal rod. In this study I refer to them as orange wrapped beads. Previous compositional analysis also

suggested that these beads were distinct from Indo-Pacific beads and made of a mixed alkali glass (Saitowitz and Reid 2001).

Ban Non Wat	Noen U-Loke
Iron Age 1: 420-150 BC	Mortuary Phase 3: 100 BC-AD 200
Iron Age 2: 150 BC-AD 200	
Iron Age 3: AD 200-400	Mortuary Phase 4: AD 200-400
Iron Age 4: AD 400-600	Mortuary Phase 5: AD 400-600

Table 7.9: Iron Age phases at Ban Non Wat and Noen U-Loke (from Higham et al. 2007; Higham et. al 2012; Higham 2011b).



Figure 7.19: Example of the two types of orange opaque wrapped glass beads found at Noen U-Loke and Ban Non Wat.

The glass data from Ban Non Wat in this chapter draws on both published information (Higham et al. 2009), data recorded during a brief examination of the collection in January 2010, and a closer examination of the 29 beads brought to the US for LA-ICP-MS analysis. Over 800 glass artifacts have been found at Ban Non Wat, of which 746 glass artifacts have been recorded in this study. Of these, approximately 77 % (n=574) came from 13 of 160 Iron Age burials (Table 7.10). With the exception of the “orange wrapped” category, all the glass colors discussed in Table 7.10 refer to Indo-Pacific beads. Six of the 13 burials contained both glass and stone beads and four burials contained over 50 glass beads. Of note are the 200 glass beads found in Burial 6, the burial of a young adult female, the 133 glass beads from the disturbed

burial of a young adult (Burial 203), and an infant jar burial (Burial 266) that contained 112 glass beads. Also of note is Burial 357, which contained two glass earrings and was one of the earliest burials to contain glass artifacts at Ban Non Wat. However, the quantity of glass found at Ban Non Wat pales in comparison to the large amount found at Noen U-Loke.

Ban Non Wat Burial Number/Context	Age/Sex	Date/Mortuary Phase	Glass artifacts	Associated grave goods
6	Young adult female	Iron Age 3 (200-400 AD)	200 orange wrapped beads (in waist area)	Ceramics, 2 carnelian beads. Glass beads buried at pelvis.
36	Old adult female and mid-adult male	Iron Age 4 AD 400-600	86 orange beads	Five carnelian beads, 2 agate pendants, ceramics, gold bead, spindle whorl, and a bronze bangle fragment.
95	Infant in a jar burial	Iron Age II (C14 dates: 250-430 AD)	4 orange beads	Small pottery vessel, iron bangles, and iron anklets.
101	Adult	Late Iron Age?	1 broken orange bead	Bronze bangles and rings, bimetallic rings, and ceramic vessels.
108	Adult	Late Iron Age? (200-400 AD?)	1 broken orange bead	Bronze bangle and finger ring, as well as a pottery vessel.
202	Disturbed- only maxilla bone present	Iron Age Period 4 (AD 400-600)	32 glass beads: orange wrapped beads (n=28), dark blue (n=2), light blue (n=2).	None

203	Disturbed burial- young adult	Iron Age Period 4 (AD 400-600)	133 glass beads: orange wrapped beads (n=115), light blue (n=3), dark blue (n=1), 14 orange glass beads (n=14).	Bronze bangles and finger rings, agate pendants, and an agate bead.
235	Subadult (10 years old)	Iron Age 1 (420-150 BC)	2 light blue earrings. A glass bead necklace is also reported.	Spindle whorls, ceramics, iron socketed artifact, iron point, and pig bones.
259	Young adult female	Iron Age 1 (420-150 BC)	1 blue-green bead	3 carnelian beads, ceramics, red ochre, and water buffalo limb bone.
266	Infant	Iron Age 4 AD 400-600	112 glass beads: yellow (n=55), light blue (n=14), dark blue (n=26), red (n=9), orange (n=6), white n=(1) black (n=1)	Agate pendant, bronze bangles, bronze ring, and ceramics.
356	Older adult female	Iron Age 1 (420-150 BC)	Weathered blue- green glass beads in chin area	1 agate bead and 1 carnelian bead, iron bangles, shell bangle, spindle whorls, stone adze, red ochre, and ceramic vessels.
357	N/A	Iron Age 1 (420-150 BC)	2 light blue earrings, heavily weathered	Spindle whorl, red ochre, and 7 ceramic vessels.
385	N/A	N/A	Broken/weathered blue/green glass bead fragments	N/A

Table 7.10: Glass beads from burial contexts at Ban Non Wat.

Over 7000 glass beads were uncovered from burial contexts at Noen U-Loke. As with the glass artifacts from Ban Non Wat, the majority of information from this collection draws on the published excavation report (Higham et al. 2007) as well as a brief recording of the collection done at the Phimai Museum in December 2009. Unfortunately, many of the objects from the

Noen U-Loke excavations had been accessioned by the museum, a process in which all context information for the artifacts is removed. Additionally, not all beads in the museum were available for study, notably the beads from Mortuary Phase 4C. For this reason, I was only able to record 3531 glass artifacts from Noen U-Loke in this study, including 29 objects analyzed using LA-ICP-MS. Table 7.11 lists the context information for the 29 objects analyzed using LA-ICP-MS. Information on specific burials, when available, comes primarily from the published excavation report (Higham et al. 2007).

Noen U-Loke Database ID	Cat. No	Artifact	Color	Context Information	Period	Date
AKC02001	1465	Broken oblate bead	Black translucent	X1 3:13	MP4A	AD 200-400
AKC02002	141	Broken oblate bead	Yellow opaque	3:6 Feature 1	N/A	AD 250-650
AKC02003	1457	Broken short cylinder	Blue translucent	T9B3	MP4A	AD 200-400
AKC02004	1417	Broken oblate bead	Grey translucent	T9B9	N/A	Unknown
AKC02005	1414	Broken short cylinder	Dark blue translucent	T9B2	MP5	AD 400-600
AKC02006	1414	Broken oblate bead	Dark Blue Trans broken	T9B1	MP5	AD 400-600
AKC02007	1457	Broken short cylinder	Dark Blue Trans Broken	T9B8	MP4A	AD 200-400
AKC02008	1457	Broken oblate bead	Dark turquoise translucent	T9B4	MP4A	AD 200-400
AKC02009	1457	Broken oblate bead	Dark blue turquoise	T9 B7	MP4A	AD 200-400
AKC02010	207	Broken oblate bead	Bright blue translucent	Burial 8	MP5	AD 400-600
AKC02011	1417	Broken oblate bead	Corroded	3:9 Feature 1 T9 B10	MP3A	100 BC-AD 200

AKC02012	1502	Broken oblate bead	White translucent	Burial 105	MP4A	AD 200-400
AKC02013	1417	Oblate bead	Dark turquoise translucent	3:9 Feature 1	N/A	AD 250-650
AKC02014	1417	Broken short cylinder	Blue-green translucent	3:9 Feature 1	N/A	AD 250-650
AKC02015	1414	Broken oblate bead	Dark Blue Trans Broken	T8B8	MP5	AD 400-600
AKC02016	1414	Broken short cylinder	Dark blue/purple translucent	T8B8	MP5	AD 400-600
AKC02017	N/A	Broken barrel bead	Red, white, blue, yellow opaque mixed glass	Unknown	N/A	Unknown
AKC02018	207	Oblate seed bead	Yellow opaque	Burial 8	MP5	AD 400-600
AKC02019	207	Oblate bead	Turquoise translucent	Burial 8	MP5	AD 400-600
AKC02020	207	Oblate bead	Dark blue translucent	Burial 8	MP5	AD 400-600
AKC02021	207	Oblate bead	Dark blue translucent	Burial 8	MP5	AD 400-600
AKC02022	207	Oblate seed bead	Red core with orange coating	Burial 8	MP5	AD 400-600
AKC02023	207	Oblate seed bead	Red core with orange coating	Burial 8	MP5	AD 400-600
AKC02024	207	Oblate seed bead	Red core with orange coating	Burial 8	MP5	AD 400-600
AKC02025	207	Oblate seed bead	Red core with orange coating	Burial 8	MP5	AD 400-600
AKC02026	207	Oblate seed bead	Red core with orange coating	Burial 8	MP5	AD 400-600
AKC02027	N/A	Short tube	Orange opaque	Burial 37	MP3A	100 BC-AD 200
AKC02028	N/A	Oblate bead	Bright blue translucent	Burial 37	MP3A	100 BC-AD 200
AKC02029	N/A	Wound disc bead	Orange opaque	Burial 37	MP3A	100 BC-AD 200

Table 7.11: List of beads from Noen U-Loke that were analyzed using LA-ICP-MS.

A higher quantity of burials at Noen U-Loke had glass beads than at Ban Non Wat and the number of glass beads found within burials is also much higher. Twelve burials contained over 50 glass beads with one burial, Burial 13 of an infant, contained over 1700 glass beads. This discrepancy is notable when we consider that over 900 square meters have been excavated at Ban Non Wat during the 2002-2007 field seasons, while only 220 square meters were excavated at Noen U-Loke over two field seasons. However, the difference in glass bead quantities appears to be related to the dates of occupation at both sites. The majority of burials at Ban Non Wat date to the earlier Iron Age 1 period. Charles Higham has noted that the earliest glass artifacts appear at Ban Non Wat, and are not beads but glass earrings (Higham and Kijngam 2009). Glass does not appear at Noen U-Loke until Mortuary Phase 3 (100 BD- AD 200), with a peak in the quantity of glass occurring during Mortuary Phase 4 at Noen U-Loke (AD 200-400) (Talbot 2007), which is less well represented than at Ban Non Wat. This increase in mortuary wealth over time, as noted in the previous chapter, also makes it difficult to compare the status of graves from the early Iron Age with those from the later Iron Age. Nevertheless, when we look at both sites together we are able to see a broad shift in the types of glass over time. Figure 7.21 shows the distribution of glass colors at Ban Non Wat and Noen U-Loke over time.

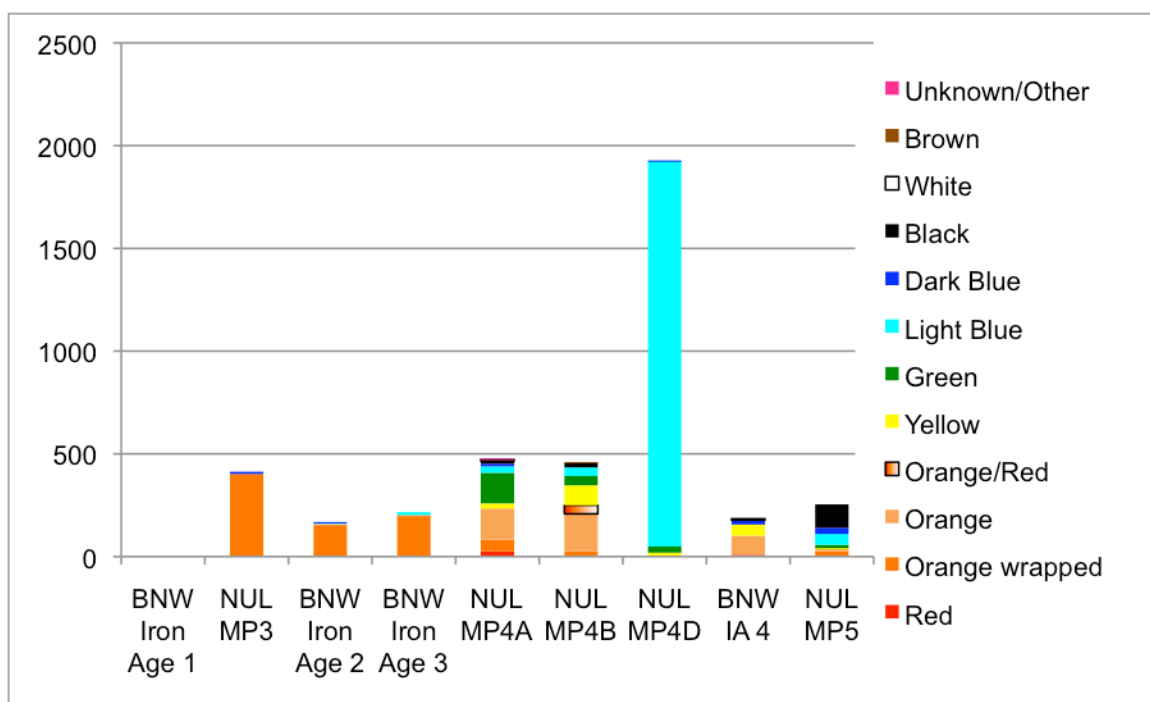


Figure 7.20: The distribution of glass colors at Ban Non Wat and Noen U-Loke.

Glass beads in context: A summary

An overall examination of the glass beads from these ten sites shows an immediate difference in the distribution of glass bead colors, with sites in southeast Cambodia (Village 10.8, Prohear, and Bit Meas) having a large number of dark blue beads, while the remaining sites had smaller quantities of dark blue and higher numbers of red, orange, yellow, green, light blue, and black beads. As demonstrated in the next section, these color differences are also related to differences in glass composition.

Glass beads are also found in a greater number of burials than agate and carnelian beads (Table 7.12). However, the frequency of beads in burials varies by site. At Prohear, nearly all of the burials contained glass artifacts, while at Village 10.8 or Ban Non Wat only 10-12% of burials contained glass beads and artifacts and at Phnom Borei no burials contained glass. It is

notable, however, that at Village 10.8 a higher number of burials (n=10) contained agate and carnelian beads than glass beads. At some sites glass beads were available in very high quantities, however this may have something to do with the availability of glass beads over time. The two burials with over 1000 beads, Prei Khmeng and Noen U-Loke, both date to the early-mid first millennium AD. As observed in the previous chapter, there are numerous factors that could have influenced the quantity of burials with beads observed in this study, such as issues regarding looting or changing mortuary rituals over time. Additionally, variation in the quantity of burials with beads as well as the total number of beads in burials may be related to cultural choices by the different communities regarding the depositing of glass beads in burials. Therefore, the burials noted in this chapter should not be taken as a representative sample. However, certain observations may be indicative of broader trends. For example, taken together the data support the interpretation that glass beads were generally more accessible and widespread than agate and carnelian beads there was still some variation in the availability of glass objects over time and space.

	Total Burials	Burials with glass artifacts
Angkor Borei	111	29 (26%)
Ban Non Wat	160	13 (8%)
Noen U-Loke	120	56 (47%)
Phnom Borei	9	0 (0%)
Phum Snay	23	7 (30%)
Prei Khmeng	7	3 (43%)
Prohear	52	46 (75%)
Promptin Tai	35	8 (23%)
Village 10.8	50	6 (12%)

Table 7.12: The number of burials with glass artifacts by site.

As noted in the previous chapter, the trend of women buried with large numbers of beads continued, although with a few notable exceptions (Table 7.13). Eight female burials at these

sites contained high quantities of glass beads, at least over 100, in comparison with the other burials at their site. However, there were also male burials, an infant burial, and other unknown burials that contained large numbers of glass beads. Scholars have noted that at Noen U-Loke, glass beads are found in fairly equal numbers of male and female burials during Mortuary Phase 3, but become more common in male burials during Mortuary Phase 4, although they also appeared in several unsexed burials (Talbot 2007: 338-340). At some sites, the value of glass beads may have changed over time as did the reasons one may earn or inherit such beads.

Site	Burial Number	Sex	Number of beads
Angkor Borei	F35	Adult female and child	254 glass beads
Angkor Borei	F36	2 adult males	248 glass beads
Prohear	Burial 46	Unknown	Over 500 glass beads
Prohear	Burial 24	Unknown	Over 150 glass beads
Prohear	Burial 33	Female	Over 150 glass beads
Prohear	Burial 34	Female	Over 150 glass beads
Village 10.8	Burial 11	Unknown	124 glass beads
Phum Snay	Burial 9	Female	105 glass beads
Prei Khmeng	Burial 3	Female	144 glass beads
Prei Khmeng	Burial 4	Female	1750 glass beads
Promptin Tai	Burial 20	Female	134 glass beads
Ban Non Wat	Burial 6	Female	200 glass beads
Ban Non Wat	Burial 203	Unknown	133 glass beads
Ban Non Wat	Burial 266	Infant	112 glass beads
Noen U-Loke	Burial 13	Infant	1750 glass beads

Table 7.13: Table noting burials at each site that contained a large quantity of glass beads.

During the early Iron Age, some of the earliest glass artifacts were not beads but glass rings or earrings. Data from Ban Non Wat and Noen U-Loke, which cover the entire Iron Age, show increased quantities of glass beads over time. The Prei Khmeng and Noen U-Loke burials with over 1000 glass beads of one or two colors also indicates that in certain periods, these beads were moving through trade networks in bulk. Most of these beads were monochromatic Indo-Pacific beads. While many of these beads look visually similar to one another, they were often made using different glass bead recipes. In the next section, I discuss the results of compositional analysis of glass beads, which show that there were multiple bead exchange

networks in play during the Iron Age period and that different sites were participating in different trade networks.

Compositional analysis of glass beads from Cambodia and Thailand

As discussed above, a selection of beads from each site were brought to the US for LA-ICP-MS analysis in the Elemental Analysis Facility at the Field Museum in Chicago, IL (Table 7.14). Beads were chosen in order to represent the diversity of beads found at each site, but they do not reflect a statistically significant sample. Beads were primarily chosen from burial contexts, although unique or unusual beads from non-burial contexts were also examined. In this section I will discuss the results of the LA-ICP-MS analysis and my interpretations for the overall glass bead collections at each site. Final measurements from LA-ICP-MS analysis are listed in Appendix 7.2. Major elements are listed as weight percent and minor and trace elements as parts per million (ppm).

Site Name	Total number of glass artifacts recorded	Number of glass artifacts analyzed using LA-ICP-MS
Angkor Borei, Cambodia	1368	15
Bit Meas, Cambodia	5	5
Phnom Borei, Cambodia	48	6
Phum Snay, Cambodia	285	30
Prei Khmeng, Cambodia	2056	42
Prohear, Cambodia	550	59
Village 10.8, Cambodia	209	14
Ban Non Wat, Thailand	746	29
Noen U-Loke, Thailand	3531	29
Promptin Tai, Thailand	1050	23

Table 7.14: Quantity of glass beads from each site analyzed using LA-ICP-MS.

Results from LA-ICP-MS analysis of glass artifacts

In this section I present the results of LA-ICP-MS analysis on glass bead and artifacts. Glass beads were analyzed providing a baseline for the distribution of glass types at each site.

However, as I did not select beads for analysis in a statistically significant way, I then estimated the overall distribution of four different glass types (high alumina soda glass, potash glass, m-Na-Ca-Al glass, and other) at each site based on visual similarities of the analyzed beads with known types and their context. For example, if a single blue bead of a group of 50 was found to be made from high alumina potash glass I estimated that the remaining 49 beads in this group were also made from the same glass. These estimates provide a general picture of the quantity and distribution of the different glass types by site.

Angkor Borei

As part of her doctoral dissertation research, Laure Dussubieux (2001) analyzed 97 glass beads from the Angkor Borei cemetery excavation. In her study, the majority of Indo-Pacific glass beads from Angkor Borei in a variety of colors were found to be high alumina soda glass (n=79). A small number (n=9) of green and yellow opaque glass beads were found to belong to the m-Na-Ca-Al type, while four dark blue beads were assigned to the v-Na-Ca glass type. Three beads, blue, yellow, and blue-green in color, were found to be lead glass. Two glass beads were classified as “other,” (Dussubieux 2001). Scholars have noted that the high alumina soda glass type was over-represented at Angkor Borei when compared to other sites in Southeast Asia and that there was a notable lack of potash glass beads (Stark and Dussubieux 2002). Dussubieux’s analyses from the Oc Eo site also showed a large number of high alumina soda-glass beads (Dussubieux 2001; Stark and Dussubieux 2002). Estimates from the current study confirm this earlier research (Table 7.15).

Glass bead type	Number of glass beads identified	Estimated number of glass beads of this type in total collection
High alumina soda glass (m-Na-Al)	82	1127+
Potash glass	0	0
m-Na-Ca-Al	12	65
Lead	3	176
v-Na-Ca	7	
Other/weathered/Unknown	8	

Table. 7.15: The distribution of different glass types at Angkor Borei. All of the yellow bead were placed in the other category is compositional analysis is needed to confirm if they belong to the lead glass or another category.

Fifteen additional beads were analyzed as part of the current study (Figure 7.22). Several beads were misclassified as stone beads and analyzed while undertaking this research. Other dark blue beads were specifically chosen in order to determine if they may have been made of potash glass, a glass type not found in Dussubieux's study (2001). Three additional beads were chosen for their unusual appearance. The results are consistent with the findings in Dussubieux's earlier study. Six beads were classified as belonging to the high alumina soda glass type; this included a translucent yellow bead (AKC02519), a dark blue-green translucent spherical bead (AKC02589), and one purple bead initially classified as garnet (AKC02590). Three additional purple glass beads (AKC02584, AKC02585, AKC02590) beads originally classified as garnet had compositions similar to high alumina soda glass, but had lower alumina levels (approximately 5%). Additionally, their Zr levels were too high to be considered as part of the m-Na-Ca-Al group. This glass type is unusual and have thus far found no other examples of this glass type in the current study or in published reports from other contemporary sites. For the moment, these three beads remain uncategorized. Three dark blue beads were classified as belonging to the m-

Na-Ca-Al type (AKC02586-2588) and three dark blue beads, including a square barrel, were classified as belonging to the v-Na-Ca type (AKC02592, AKC02594b, AKC02595). Two beads were too weathered to properly classify (AKC02594, AKC02596). However one yellow bead (AKC02594) may be a faience bead, although no similar beads have yet been identified in this study. It is significant that no potash glass beads were found in this additional study. Lankton and Dussubieux have noted that the lack of potash glass in the Angkor Borei cemetery could date the transition from potash to high alumina soda glass across Southeast Asia (2006, 2012). However, additional data may complicate this hypothesis (Carter 2010; discussed further below).



Figure 7.21: Glass beads analyzed from Angkor Borei. AKC02585 not pictured as bead was too fragmentary.

Phnom Borei

Six Indo-Pacific glass beads from Phnom Borei were analyzed using LA-ICP-MS (Table 7.16). Four of the beads were found to be high alumina soda glass (m-Na-Al Type 1), including an opaque orange bead with slightly elevated levels of MgO. Lankton and Dussubieux (2006) have noted that certain glass colors including opaque orange appear to have higher levels of MgO, making them look like plant ash glasses. Despite these elevated levels of MgO, I believe this opaque orange bead belong to the m-Na-Al Type 1 group. Two glass beads were classified as belonging to the potash glass group. One dark blue glass bead was classified as a low lime potash glass (m-K-Al, low C) and the other dark blue bead was classified as a potash glass with moderate amounts of alumina and lime (m-Ka-Ca-Al). Based on visual similarities, I believe that the majority of beads at Phnom Borei belong to the high alumina soda glass type. A single bead was too weathered/deteriorated to determine its glass type and is classified as “other.”

The presence of potash glass at Phnom Borei is significant, as previous work at the nearby site of Angkor Borei found no potash glass, suggesting that the glass bead trade at these sites post-dated the potash/high alumina soda glass transition. However, the presence of potash glass at Phnom Borei does suggest that the potash glass beads were circulated in the Mekong Delta region.

Glass bead type	Number of glass beads identified	Estimated number of glass beads of this type in total collection
High alumina soda glass (m-Na-Al)	4	39
Potash glass with low lime (m-Ka-Al, low C)	1	8
Potash glass with moderate amounts of lime and alumina (m-Ka-Ca-Al)	1	
Other/weathered		1

Table 7.16: The distribution of different glass types at Phnom Borei.

Village 10.8

12 glass beads and 2 glass ring fragments from Village 10.8 were analyzed and all of the artifacts were classified as belonging to one of two potash glass sub-types (Table 7.17). Of note is that both ring fragments (AKC00323 and AKC00327) were classified as belonging to the m-K-Ca-Al subtype. The remaining dark blue, black, and dark purple beads were classified as either m-K-Ca-Al glass or low lime potash glass. Unfortunately, four beads (AKC00376, AKC00381, AKC00389, AKC00424) were too weathered to produce meaningful results. This included a polychrome bead made of light blue or green glass with a white stripe. An estimate of the remaining glass collection suggests that Village 10.8 was dominated by potash glass beads (Table 7.17).

Glass bead type	Number of glass beads identified	Estimated number of glass beads of this type in total collection
Potash glass with low lime (m-Ka-Al, low C)	5	180
Potash glass with moderate amounts of lime and alumina (m-Ka-Ca-Al)	5	
Other/weathered	4	29

Table 7.17: The distribution of different glass types at Village 10.8.

Prohear

Forty-six glass beads or bead fragments, three bangle fragments, and ten ring or earring fragments (n=59 total) were analyzed using LA-ICP-MS. Of these five ring/earring fragments, one bangle fragment, and one dark blue bead were too weathered to produce reliable results. One white glass bead also had an unusual composition and may have been a modern bead that found its way into the archaeological record; it will not be discussed in detail here. The remaining artifacts were predominantly various subtypes of potash glass, however there were also more

unusual types including Arika glass, lead glass, and m-Na-Ca-Al glass beads (Figure 7.23, Table 7.18).

Glass bead type	Number of glass beads identified	Estimated number of glass beads of this type in total collection
Potash glass with low lime (m-Ka-Al, low C)	16	467
Potash glass with low alumina (m-K-Ca, low A)	1	
Potash glass with moderate amounts of lime and alumina (m-Ka-Ca-Al)	21	
m-Na-Ca-Al glass	8	65
Arika glass	4	18
Lead glass	1	
Other/weathered	15	

Table 7.18: The distribution of glass types from Prohear.

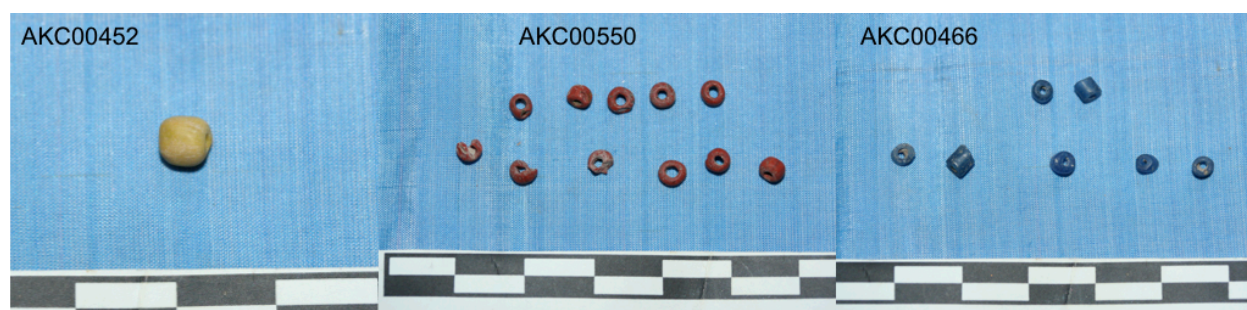


Figure 7.22: From left to right: A yellow lead glass bead, several Arika red glass beads, and blue m-Na-Ca-Al glass found at Prohear.

Interestingly, the glass rings and bangles were split between the different potash glass sub-types. Two light blue bangle fragments and a dark blue ring/earring were found to belong to the m-K-Ca-Al type, while a black, dark purple, and blue rings/earrings were found to belong to the m-K-A, low C type. A black ring/earring was the only artifact found to belong to the m-K-Ca, low A type. The m-Na-Ca-Al beads were all colored with cobalt (approximately 500 ppm Co). These beads were dark blue, but not as dark in color as the potash glass beads and appear to be different from the m-Na-Ca-Al glass beads found at Promptin Tai (below). Three red beads and a black bead were found to be Arika glass (Figure 7.23) and a single yellow bead was found to

contain high levels of lead (30 weight percent) (Figure 7.23), which was also often used to color yellow glass. The presence of Arika glass at Prohear is significant, as it was the only site in this study with evidence for this glass type. Although it was only present in small numbers, it does suggest some kind of connection with a trade network that originated in southern India or perhaps Phu Khao Thong in peninsular Thailand (Dussubieux et al. 2012). The remaining beads, primarily dark blue in color but also purple, green, and black, were classified as either m-K-Ca-Al or m-K-Al, low C potash glass.

Bit Meas

As noted earlier, Bit Meas was heavily looted and only five dark blue glass beads from this site were examined. All five glass beads were classified as potash glass, with one dark cobalt blue bead (over 800 ppm Co) belonging to the m-K-Ca-Al type while the remaining four dark blue (n=2), blue-green, and purple beads were assigned to the m-K-Al, low C subtype. Due to the looting at the site, it is impossible to estimate the overall distribution of different glass types at Bit Meas (Table 7.19).

Glass bead type	Number of glass beads identified	Estimated number of glass beads of this type in total collection
Potash glass with low lime (m-Ka-Al, low C)	1	N/A
Potash glass with moderate amounts of lime and alumina (m-Ka-Ca-Al)	4	N/A

Table 7.19: The distribution of glass types from Bit Meas.

Phum Snay

Three ring/earring fragments and 26 glass beads were analyzed from Phum Snay. A single bead (AKC00232) was too weathered to produce reliable results. The three ring/earring fragments were all classified as m-K-Ca-Al glass, similar to those found at Village 10.8 and Prohear. 25 of

the 26 beads belonged to the m-Na-Al Type 1 glass type, and included a variety of glass colors. Perhaps the most unusual find was a single dark blue bead was classified as v-Na-Ca glass, or plant ash soda lime glass (Figure 7.24). This glass type is strongly associated with Middle Eastern glass production and during later periods was likely imported from this region. However, Lankton and Dussubieux note the presence of v-Na-Ca glass at early sites in Sri Lanka and common in Southeast Asia from the 3rd century AD, and question its Middle Eastern origin during this early phase. At present, current evidence leaves the origin of this glass unclear (Lankton and Dussubieux 2013).

There have been several previous compositional studies of glass from Phum Snay examining both looted beads (Gratuze 2005; Vanna 2007) and excavated materials (Sophy 2008). These previous studies found generally similar patterns in the distribution of glass types from Phum Snay as found in the current study. Analysis of materials from the 2001 and 2003 excavations identified a majority of high alumina soda glass as well as 16 potash glass beads from all three subtypes, and four beads described as soda lime glass. Three of these beads may be the v-Na-Ca glass, due to the high-levels of MgO signally a plant ask alkali source. However, one bead may belong to the m-Na-Ca-Al subtype (Sophy 2008). An additional study of looted materials from Phum Snay identified four additional v-Na-Ca glass beads (Gratuze 2005; Vanna 2007). Taken together theses analyses suggest that Phum Snay was dominated by high alumina soda glass, but contained a small but diverse group of other glass types. The estimates in Table 7.20 likely underestimate the glass diversity at Phum Snay.

Glass bead type	Number of glass beads identified	Estimated number of glass beads of this type in total collection
High alumina soda glass (m-Na-Al)	25	278
Potash glass with moderate amounts of lime and alumina (m-Ka-Ca-Al)	3	6
Plant ash soda lime glass (v-Na-Ca)	1	1
Other/weathered		

Table 7.20: The distribution of glass types at Phum Snay.

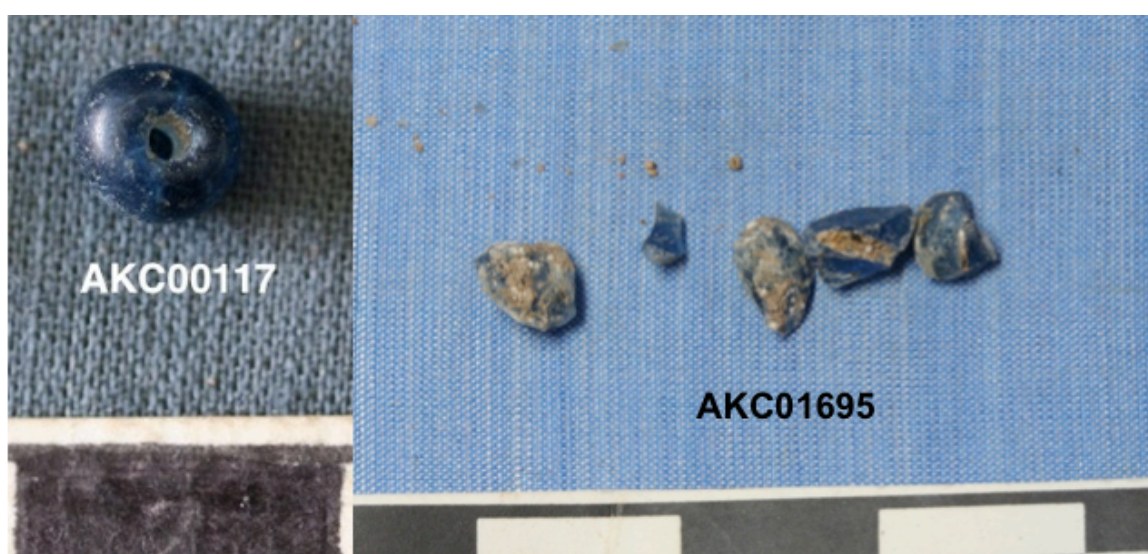


Figure 7.23: Example of the v-Na-Ca glass from Phum Snay (left) and Prei Khmeng (right).

Prei Khmeng

42 glass beads from Prei Khmeng were analyzed and of these 40 belonged to the high alumina soda glass sub-type (m-Na-Al Type 1). Only two objects, broken fragments of a blue glass bead (Figure 7.24) and the black bicone with red trip (Figure 7.17) were assigned to the v-Na-Ca glass type, similar to the bead from Phum Snay discussed above. As Prei Khmeng is the latest site examined in this study, dating from the 1st-6th centuries AD, it should not be surprising

that so many of the beads from this site were classified as high alumina soda glass, as this glass type is common in Southeast Asia during the 1st millennium AD.

Glass bead type	Number of glass beads identified	Estimated number of glass beads of this type in total collection
High alumina soda glass (m-Na-Al)	40	2035
Plant ash soda lime glass (v-Na-Ca)	2	21
Other/weathered		

Table 7.21: The distribution of glass types at Prei Khmeng.

Promptin Tai

17 glass Indo-Pacific beads were analyzed from Promptin Tai as well as several more unique glass artifacts including two faience beads, two polychrome black and white beads, a light blue earring fragment, and a gold-glass bead (Figure 7.25). Of the 23 glass artifacts analyzed the blue glass earring fragment was too weathered to produce results and a single bead was not glass but shell. The remaining 21 glass artifacts will be discussed here.

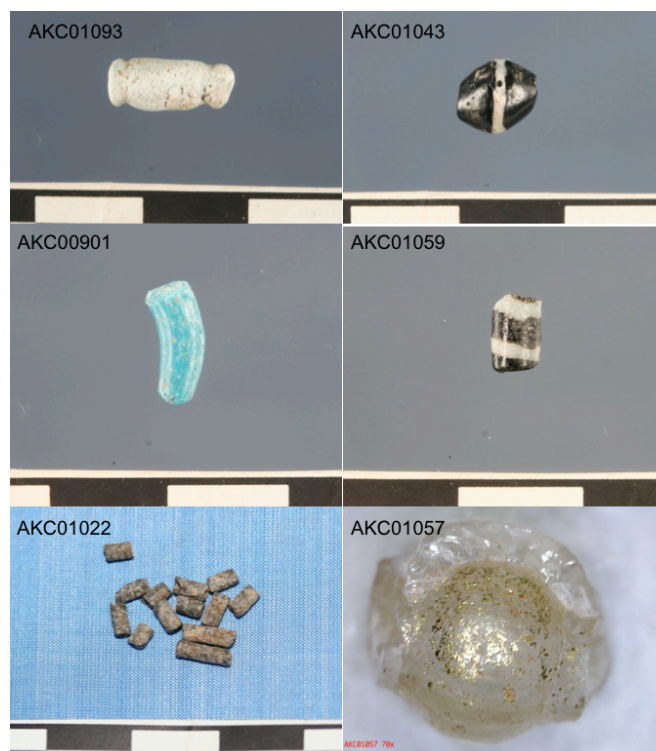


Figure 7.24: Examples of some of the unusual beads found at Promptin Tai.

Two dark blue beads were assigned to the m-K-Ca-Al subtype, and four glass beads were identified as belonging to the m-K-Al, low C subtype, including one large clear glass bead, two dark blue glass beads, and one dark purple bead. Three dark blue beads were assigned to the m-Na-Ca-Al group. Although the potash glass and m-Na-Ca-Al dark blue beads looked similar to one another, the m-Na-Ca-Al beads tended to be slightly smaller (2.5-5 mm) than the potash glass beads (4-5mm) and a much deeper cobalt blue color (Figure 7.26). Eight high alumina soda glass beads were identified at Promptin Tai, however only a small number, an estimate of approximately 16 beads, appear in burial contexts. Several hundred high alumina soda glass beads were found in the burial matrix and upper layers of the site. One of the polychrome beads, the black bicone with a white stripe, may also be related to the high alumina soda glass group (AKC01043 in Figure 7.25). The opaque black glass base appears to be consistent with the m-Na-Al Type 1 glass group, although there are elevated levels of magnesium perhaps related to the coloring of the glass (Lankton and Dussubieux 2006: 133-4). The white stripe appears to sit on the surface of this glass and its composition is unique. The white portion of the bead appears to be corroded, as it has very low levels of Na_2O . A nearly identical black and white bicone bead from southern Thailand is pictured in Pongpanich (2009: 48).



Figure 7.25: Example of m-Na-Ca-Al beads (left) and potash glass beads (right) from Promptin Tai.

The other black and white bead, which appears to be imitating a striped agate bead, is more mysterious (AKC01059 in Figure 7.25). The bead, found in Burial 20, has three white stripes. Both the black and white portions of the broken bead were analyzed using LA-ICP-MS and found to be the same unusual glass type: a variety of potash glass with high levels of Na_2O . Only a few other beads have been identified with a similar composition, including a blue-green glass bead from Ban Don Ta Phet and beads from southern India and Sri Lanka (Lankton and Dussubieux 2006: 139). It has been suggested that this high Na_2O potash glass is a mixture of potash glass and Arikamedu glass, and that this particular glass type may have been made at Arikamedu (Lankton and Dussubieux 2006:140). However, the unbroken bead appears to have been made using a folding technique typical of beads made in the Middle East (see Francis 2002:93). An assortment of similar imitation stone beads has been found at sites in southern Thailand (Pongpanich 2009: 48-9). For the moment, this bead presents a puzzle and there is no clear answer as to the location of its manufacture.

Three gold-glass beads were found in Burial 20 at Promptin Tai (AKC01057 in Figure 7.25). These small beads were originally segmented, and later broken into individual beads leaving a spherical bead with a jagged protrusion around the bead hole. One bead was analyzed as part of the current study and found to be made from a soda-lime glass, typical of Mediterranean glasses made with a natron flux. Gold-glass beads first appeared in Egypt during the Ptolemaic period but continued to be manufactured during the Roman period, where they are found at sites across the Roman Empire (Boon and Dekowna 1977; Francis 2002). Compositionally and stylistically, this bead seems quite similar to gold glass beads from the sites

of Caerleon in the United Kingdom as well as a burial from the Nubian site of Faras, which date to the second and third centuries AD (Boon and Dekowna 1977).

Gold-glass beads were believed to have been imported from Egypt and the Mediterranean to India and from there been traded into Southeast Asia, including the sites of Oc Eo, Vietnam, Kuala Selinsing, Malaysia, Ban Tha Kao, Thailand, and even Guangzho, China (Francis 2002; Lankton and Dussubieux 2006). Similar gold-glass beads have also been reported at Khlong Thom and analysis indicates they were also made from a Syro-Palestinian or natron glass (Lankton and Dussubieux 2010).

A group of three collared white faience beads were found in Burial 18 and one bead was selected for analysis (AKC01093 in Figure 7.25). This particular type of faience bead is fairly common at South Indian sites, including Arikamedu (Francis 2004:510). In Southeast Asia collared faience bead have also been found at the peninsular Thai site of Ta Chana (Pongpanich 2009:64-5) and Ban Bon Noen in central Thailand (Pilditch 1992). The beads appear to be unglazed, however Pilditch reports that a blue-green glaze was visible on some of the faience beads from Ban Bon Noen under a microscope. Francis argues that these beads may have been manufactured in South India, (Francis 2004:510).

Unfortunately, few faience beads have been analyzed compositionally. Lankton (personal communication, 2010) has analyzed faience glass beads from Johore Lama, Malaysia and Thung-thon, Vietnam. At Thung-thon there appear to be two different types of faience beads, a low-alkali and a mixed alkali. At Johore Lama the high silica levels point towards weathering. The faience bead from Promtin Tai has an extremely high level of silica (approximately 96 weight percent) with all other major elements under one weight percent except for alumina and

potassium oxide. This indicates the bead is also corroded, making its original composition difficult to determine. However, it does seem that there were multiple recipes used to create faience glass beads. Further research must be done in order to understand how and where these beads were made.

Lastly, the most unusual bead examined was a small tubular black bead with a heavily weathered surface from a group of thirteen similar beads from Burial 6 (AKC01022 in Figure 7. 25). This bead was quite curious in that it had high levels of alumina (16 weight percent) and iron (five weight percent). The weathering and corrosion makes further interpretation of this bead impossible at this time.

The glass artifact collection at Promptin Tai was quite varied, with numerous unusual bead types not found at other sites in this study, suggesting that Promptin Tai was a part of multiple diverse glass bead trade networks. Several of the unusual bead types including the gold glass beads, the faience, and the black and white bicone are similar to beads found in peninsular Thailand and other coastal sites in Southeast Asia and suggest that Promptin Tai may have been at the periphery of this broader coastal interaction sphere. The low number of high alumina glass beads in the burial contexts indicates that the burials may pre-date this shift. Of interest is Burial 20, which contained both potash glass and high alumina soda glass. Radiocarbon dates from this burial would illuminate this transition.

Glass bead type	Number of glass beads identified	Estimated number of glass beads in total collection
High alumina soda glass (m-Na-Al)	8	690
Potash glass with low lime (m-Ka-Al, low C)	4	184
Potash glass with moderate amounts of lime and alumina (m-Ka-Ca-Al)	2	
m-Na-Ca-Al glass	3	131
Other/weathered	6	48

Table 7.22: The distribution of glass types at Promptin Tai.

Ban Non Wat

29 glass artifacts were analyzed from Ban Non Wat. The first group of 14 artifacts from the 2005- 2006 field season was analyzed in 2008. A second group of 15 glass artifacts from multiple excavation seasons was analyzed in 2010. The majority of the glass artifacts studied were Indo-pacific beads. However there were additional bead types including a flattened bicone (AKC02033), two coiled beads (AKC02031 and AKC02053, not pictured), earring or bangle fragments (n=9), a fragment of vessel glass (AKC02044), and one other unidentified blue glass fragment (AKC02057) (Figure 7.28). Unfortunately, four earring and bangle fragments as well as one bead were too weathered to produce confident results. As there is extensive information on the different layers and mortuary phases at Ban Non Wat, I was able to estimate the quantities of the three most common glass types at Ban Non Wat through time (Figure 7.30). Table 7.27 lists the different glass types identified at Ban Non Wat.

Glass Type	Quantity identified in LA-ICP-MS analysis
Potash glass with moderate amounts of lime and alumina (m-Ka-Ca-Al)	4
High alumina soda glass (m-Na-Al)	10
Lead glass	4
m-Na-Ca-Al	1
v-Na-Ca	2
Mixed Alkali	1
Potash lime glass with plant ash flux	2
Weathered	5

Table 7.23: The different glass types identified at Ban Non Wat.

All potash glass artifacts were classified as belonging to the m-K-Ca-Al potash sub-group; they included three ring/earring fragments and one unidentified fragment of glass. All objects were blue or blue-green in color. Two of the samples (were found in a burial context dated to the Iron Age 1 period (400-200 BC) while the third sample (AKC02038) was dated to the later late Iron Age period (AD 200-400). These ring/earring fragments share a similar composition to those found at Phum Snay, Village 10.8 and Prohear. It is likely that the weathered earring and bangle fragments also belong in this category, although their corrosion makes this difficult to confirm.

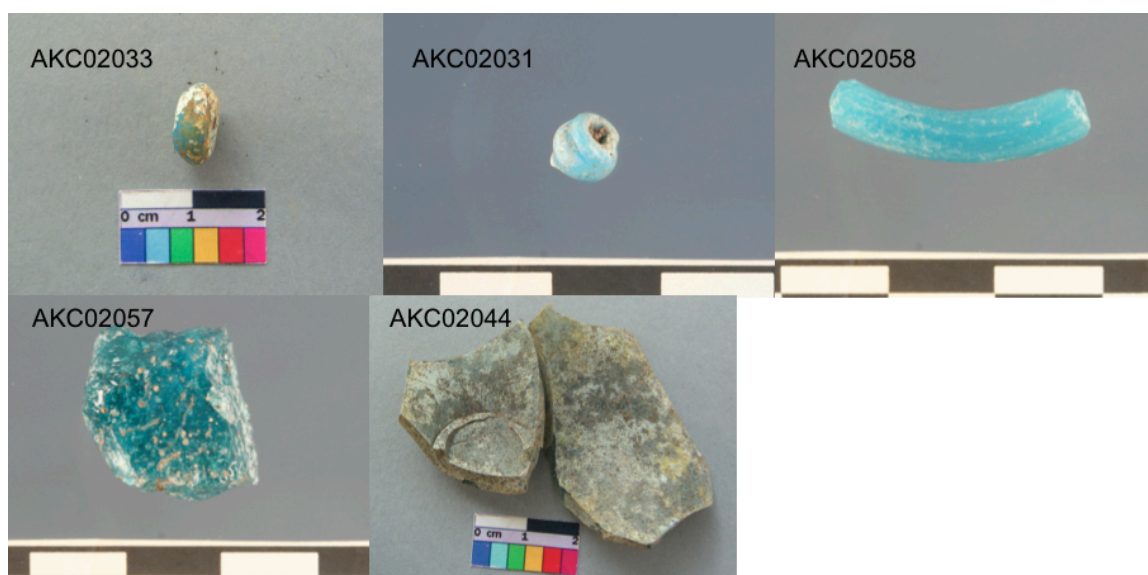


Figure 7.26: Examples of some of the more unusual glass beads and artifacts from Ban Non Wat. Photos of AKC02033 and AKC02044 taken by James Lankton.

Ten glass beads were assigned to the high alumina soda glass group (m-Na-Al Type 1). All the beads of this type were found in Layer through Layer 1, dating from approximately 200 BC- AD 600. Seven beads were from Burial 266, an infant jar burial dated to the late Iron Age, approximately AD 400- 600 (Higham and Kijngam 2009:73). Three other glass beads from non-burial contexts were also placed in the m-Na-Al Type 1 category. All three beads were from layer 2 and have been dated to approximately 200-400 AD. Based on similarities in color and form, it is believed that approximately 232 additional beads in burial and non-burial contexts may also be classified as high alumina mineral soda glass (Figure 7.30). These include Indo-Pacific beads in red, orange, yellow, green, turquoise blue, black, and white colors with a majority of this glass type found in layer 2. It is possible that some of the yellow beads are actually lead glass (see below) and not high alumina mineral soda glass, but this cannot be confirmed without additional compositional analysis.

Four beads from had high levels of PbO (30-50 wt%), classifying them as lead glass. The lead glass beads include two coiled light blue beads, an opaque blue flattened bicone bead, and a yellow oblate bead. All four samples date to the late Iron Age period (200-400 AD). During initial analysis, one bead (AKC02031) was described as a possible collared bead, however, during later excavations additional similar beads were found that appear to have been wound or coiled, and this classification was reassessed. In this method, the beads are produced by winding or coiling glass around a metal rod. These beads look remarkably similar to Chinese coil beads described by Francis (2002, color plate 16). However, Francis argues that the earliest Chinese coil beads date to the eighth century AD and that these beads were not common until the decline of Indo-Pacific beads during the 12th century AD (Francis 2002:76). These beads may represent early examples of this bead type that become common during a later period.

Also notable is that the lead glass beads from Ban Non Wat do not have a high barium content. Of the four lead glass beads analyzed, the yellow bead (AKC02053) has extremely low levels of CaO and high levels of SnO₂ in comparison to the other samples. The blue bicone bead and one of the coiled beads have much higher levels of Na₂O. It is possible that these beads belong to the early period high-lead glasses without barium, which are characterized as containing higher levels of arsenic (Brill 1991). These glass samples do contain elevated levels of arsenic in comparison to the other beads studied; especially AKC02035 that contained 3876 ppm arsenic. As noted above, it is clear that further research is needed to better understand these beads and the lead glass type.

Thus far, only one bead has been identified as mineral soda glass with variable amounts of alumina and lime (m-Na-Ca-Al), although there are probably additional beads that fall into

this category. This bead was one of a group of seven similar beads found amongst a larger group of high alumina mineral soda glass beads in Burial 266 (noted above). The beads are unusual in that they are tubular with sharp, not rounded, edges and colored with cobalt (Figure 7.29).



Figure 7.27: Example of the m-Na-Ca-Al bead (circled) from Burial 266 at Ban Non Wat.

Two artifacts were classified as soda-lime glass with a plant-ash alkali source (v-Na-Ca). The first is a fragment of a glass vessel (AKC02044) that dates to the late Iron Age period (AD 200-400). The other is a light blue glass fragment (AKC02054), which may come from an earring or bangle. The glass fragment was found in a later Iron Age context, based on the presence of Phimai black pottery (Higham and Kijngam 2009: 137). Unlike the v-Na-Ca glass beads from Phum Snay and Prei Khmeng noted earlier, these glass fragments might be imports. The v-Na-Ca composition of the vessel glass is quite similar to that of a group of high magnesia (hMg type 1) glass fragments from the Sasanian-controlled site of Veh Ardasir (3rd- 6th centuries AF) in central Iraq (Mirti et al. 2009), and its presence in Southeast Asia may be

interpreted in the context of increased control of Indian ocean trade by the Sasanians during the 4th- 6th centuries AD (Lankton and Dussubieux 2006).

An orange disc bead (AKC02036) is the only sample to be classified as mixed-alkali glass, however there are numerous additional beads that may also fall in this category and will be discussed in more detail below after reviewing the evidence from Noen U-Loke. Lastly, two beads found in Layer 1 were of an unusual potash lime glass type, with a plant-ash flux. One colorless glass bead was about 10mm in diameter, while the other was a transparent greenish-blue bead and approximately 8mm in diameter. Both beads appear to have been wound. The beads have high levels of MgO (approximately 5 wt%) and CaO (13-15 wt%), as well as 6-10 wt% K₂O and 5 wt% Al₂O₃. The beads are similar in composition to wound beads found in burials of members of the ma, K'ho, and Ru tribes in Vietnam, dating from the 16th-18th centuries AD (Brill 1999). These beads fall well outside the Iron Age period and therefore will not be explored in depth.

Noen U-Loke

29 glass artifacts were analyzed from Noen U-Loke and were chosen by the project director, Dr. Charles Higham. This analysis follows an earlier study of glass from this site by Saitowitz and Reid (2001), which included approximately 50 glass beads, as well as an object described as glassy slag found on a piece of black ceramic. Electron probe microanalysis (EPMA) was used to measure the major elements and LA-ICP-MS to analyze trace elements. Most of the beads from this earlier study were Indo-Pacific trade beads made from a high alumina soda glass (n=37), including a group of the red-orange beads (discussed earlier). Also identified were mixed alkali orange wrapped beads (n=5), four low-alumina potash glass (m-K-

Ca, low A) objects, three soda lime glass artifacts with plant-ash alkali (v-Na-Ca), and two m-Na-Ca-Al beads.

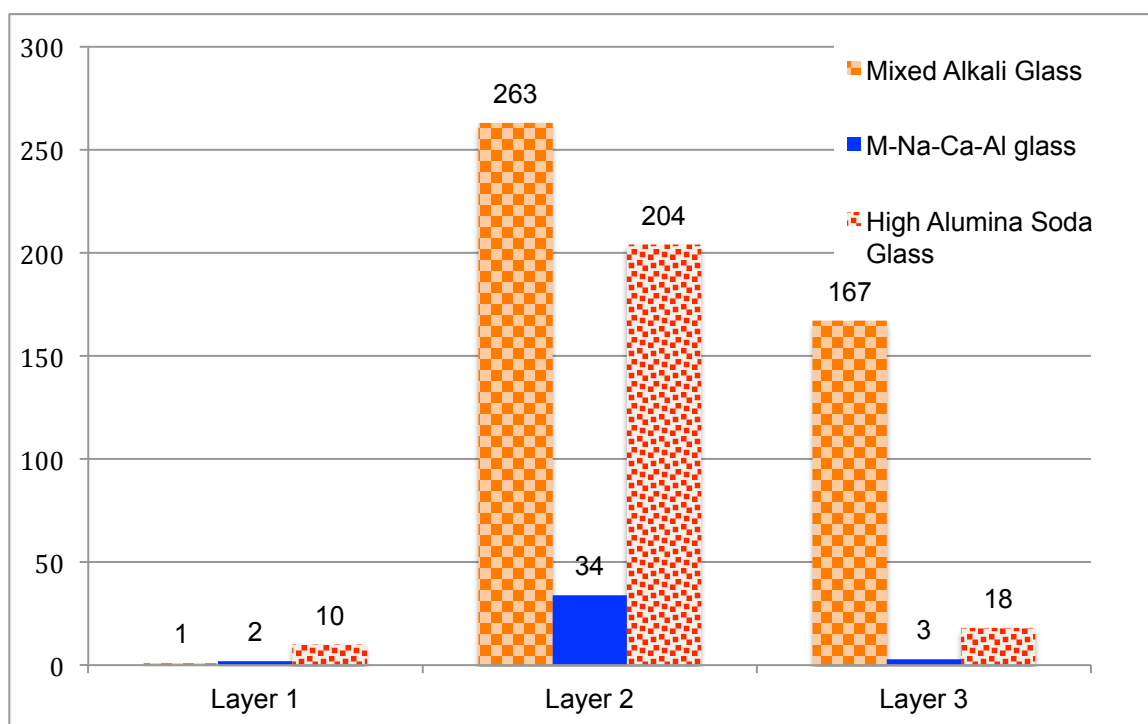


Figure 7.28: An estimate of the distribution of major glass types through time at Ban NonWat.

As LA-ICP-MS has expanded greatly since Saitowitz and Reid's earlier study, it was decided that an additional group of artifacts would be analyzed. These data, combined with the recording of the available Noen U-Loke glass collection (discussed earlier in this chapter) provides for a more comprehensive understanding of the glass collection at Noen U-Loke, how it changed over time, and how it compares with the glass collection at Ban Non Wat. Table 7.23 lists the different glass types identified during LA-ICP-MS analysis and their quantities. It should be noted that two of the 29 beads will not be included in the current discussion. The first,

AKC02011, was too corroded to provide confident results. The other, AKC02017, is an unusual polychrome bead that lacks adequate provenance information.

Four beads were classified as potash glass beads, although three of these (AKC02006, AKC02010, AKC02029) have relatively low levels of CaO and could be classified as m-K-Ca-Al glass, since they lack the high rubidium and high rubidium/strontium ratios that characterize the m-K-Al potash glass subtype. A dark blue purple bead (AKC02016) was classified as m-K-Ca-Al glass as well. Three of these potash beads were found in a Mortuary Phase 5 (MP5) context (AD 400- 600), however one bead (AKC02029) was found in Burial 37, which dates from 100 BC- AD 200 (MP3). This wide spread in composition and date provides evidence that there may in fact be more than one primary production center for m-K-Ca-Al glass in Southeast Asia.

Seventeen glass beads were assigned to the high alumina soda glass type (m-Na-Al Type 1). Nine beads were from Burial 8, which dates to MP5 (AD 400-600). Other glass beads were from MP4A (AD 200-400). Also found in Burial 8 were bicolor red-orange glass beads, identical to those described earlier at Phum Snay; these beads were also found to belong to the m-Na-Al Type 1 glass group. Four beads were classified as m-Na-Ca-Al glass. As with earlier examples of this glass discussed in this chapter, all four beads were colored with cobalt. Two of the beads were broken, but all appear to be tubular beads with sharp edges, similar to the bead from Ban Non Wat discussed above. These beads were found in contexts associated with MP4A and 5 (approximately AD 200-600).

Two orange opaque beads were identified as being mixed-alkali beads: a tubular bead and a disc bead (Figure 7.20). Both appear to have been wrapped, as discussed earlier in this

chapter. These two examples were from Burial 37, an adult female from MP3A (100 BC- AD 200) who was found with over 200 similar beads (Higham and Thosarat 2007:156). The high number of orange opaque disc beads at both sites is unusual when compared to other sites in Southeast Asia (see Lankton and Dussubieux 2013). Mixed-alkali glass is present, although rare, at the peninsular Thai site of Khao Sam Kaeo (Lankton and Dussubieux 2013). Additional orange wrapped beads have been found near Ban Non Wat at the sites of Non Muang Kao (Saitowitz and Reid 2001) and possibly Ban Bon Noen (Pilditch 1992). I recently identified one wrapped bead from the glass collection of Phum Sophy in northwest Cambodia. Similar orange and red opaque disc beads have also been reported at sites in southern India and Sri Lanka, where they may have been manufactured, as well as Chombeung, Thailand, Giong Ca Vo, Vietnam (Dussubieux 2001; Lankton and Dussubieux 2006), Ban Chiang (White 1982), and the peninsular Thai site of Ta Chana (Pongpanich 2009:51). However, Francis noted that many orange and red disc beads were not wrapped, but instead made from solid canes of glass that were sliced into discs and then perforated by drilling (Francis 2002: 136-7). While these disc beads appear to share a similar glass type and bead shape as the objects found at Ban Non Wat, their manufacturing method would appear to distinguish them from the wrapped beads found in northeast Thailand.

In order better to understand where the beads from Ban Non Wat and Noen U-Loke fall within the spectrum of mixed-alkali glass, the composition of beads from both sites were compared to orange mixed- alkali glass beads from several other sites in South and Southeast Asia. The compositions were evaluated using principal component analysis (PCA). Figure 7.31 shows the first three principal components, which account for 69.5% of the variance, graphed as

a scatterplot. PCA scores for this scatterplot are listed in Appendix 7.3. The scatterplot shows multiple possible groups of mixed-alkali glass beads, with those from the peninsular Thai sites of Khao Sam Kaeo and Phu Khao Thong being distinct from the mixed-alkali glass found at other sites in India and Southeast Asia. However, the Ban Non Wat and Noen U-Loke mixed-alkali glass may share a compositional similarity with beads found at the peninsular Thai site of Ta Chana, the central Thai site of Chombeung, and the northeast Thai site of Don Klang, as well as two sites in India: Dhalbhum and Dulhikotta. It should be noted that these groupings are only preliminary and cannot yet tell us where or when the beads were manufactured. Additional research on both the composition and manufacturing method of mixed-alkali beads is needed before confidently distinguishing between these clusters. Indeed, future research may find that the distinctions between the groups will change. However, this preliminary analysis does indicate the presence of several types of mixed-alkali glass in circulation during the Iron Age period (Carter and Lankton 2012).

Glass Type	Quantity identified in LA-ICP-MS analysis
Potash glass with moderate amounts of lime and alumina (m-Ka-Ca-Al)	1
m-K-Ca-Al glass or m-K-Al, low C	3
High alumina soda glass (m-Na-Al)	17
m-Na-Ca-Al	4
Mixed Alkali	2
Weathered/Other	2

Table 7.24: The different glass types identified at Noen U-Loke and their quantities.

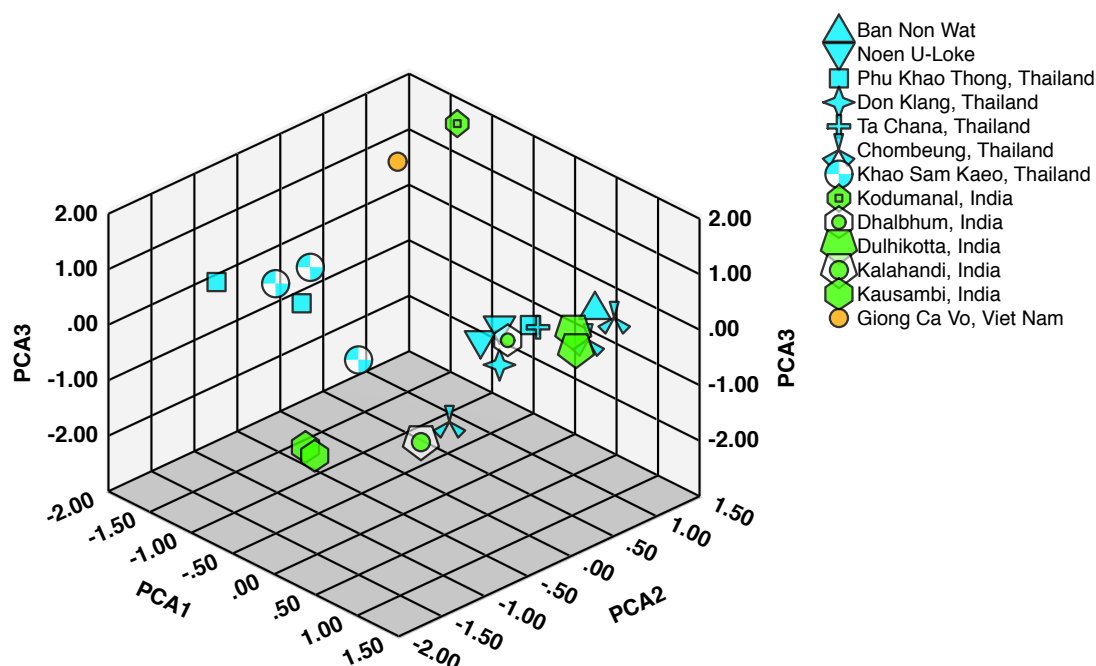


Figure 7.29: A 3D PCA scatterplot of the compositions of opaque orange mixed alkali beads from various sites in South and Southeast Asia. Beads from sites in Thailand are blue, beads from sites in India are green, and a bead from a site in Vietnam is orange. Data for the scatterplot taken from Dussubieux 2001 and from unpublished data courtesy of Laure Dussubieux and Bernard Gratuze.

Ban Non Wat and Noen U-Loke: Change over time

Overall, the glass types found at Ban Non Wat and Noen U-Loke are quite similar to one another, which is not surprising as the sites are less than 2 km apart. While the earliest glass artifacts appear at Ban Non Wat during the Iron Age 1 period (420-100 BC), glass does not appear at Noen U-Loke until MP3 (100 BC-AD 200), with a peak in the quantity of glass beads during MP3 and MP4 (AD 200-400) (Talbot 2007). Taken together, we are able to see a broad shift in glass types over time (for further discussion and comparison of these two sites see Carter and Lankton 2012). Figure 7.32 displays an estimate of the quantities of different bead types and their change over time at both sites. The figure is not representative of all the glass beads uncovered at both sites, as not all of the beads were available to be recorded. For example, exact

numbers of the glass beads found in Mortuary Phase 3C at Noen U-Loke are unavailable, as are specifics regarding over 700 beads found in a burial during MP3b. Nevertheless, it does allow one to see the general distribution of glass types over time and space. We still do not know where the mixed alkali wrapped beads were made, although their limited circulation and compositional similarity to other beads found in Thailand may point toward a nearby manufacturing center.

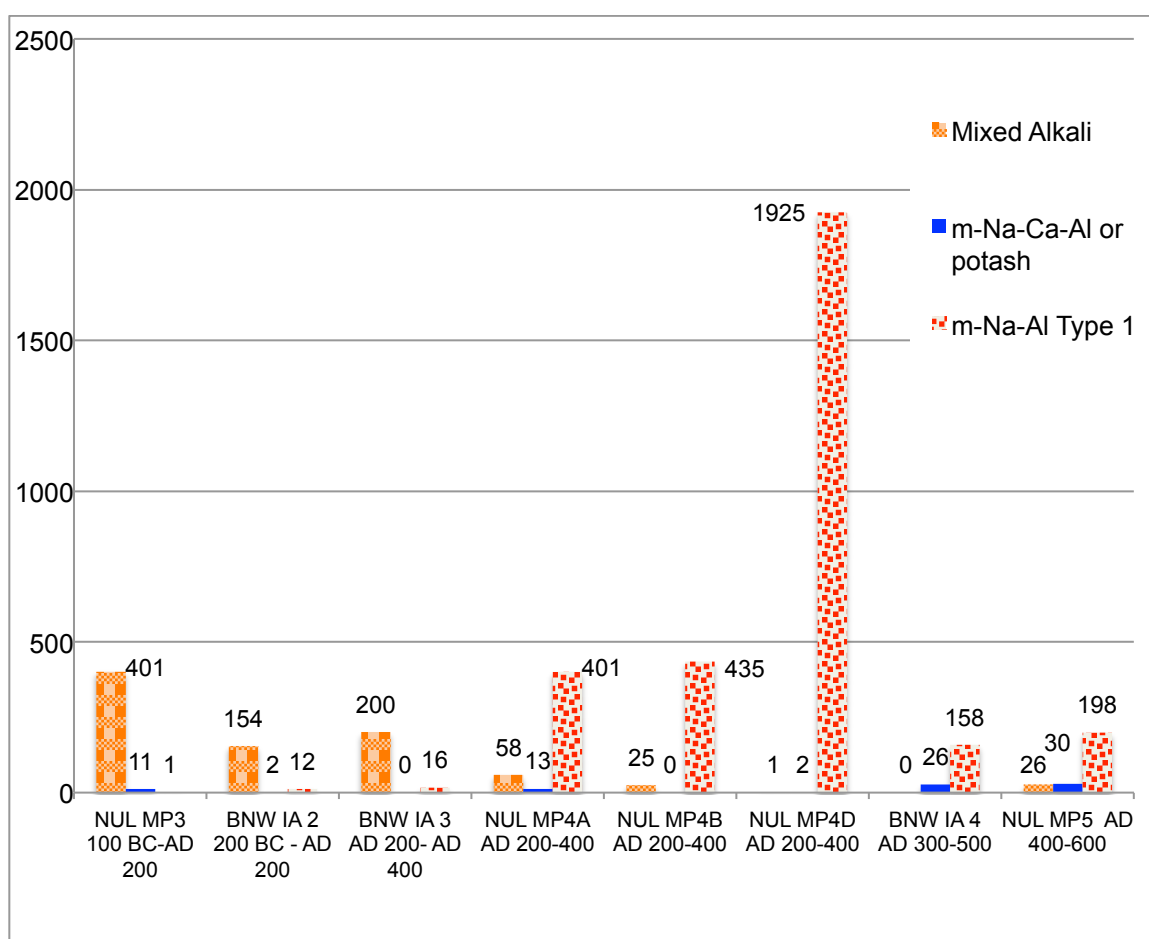


Figure 7.30: An estimate of the quantity of different glass types at Ban Non Wat and Noen U-Loke through time.

Conclusion: The distribution of glass types within Cambodia and Thailand

Compositional analysis of glass beads has highlighted the diversity of different glass types found at each site, even if many of the beads looked visually similar. These analyses also confirmed that earlier differences in the distribution of glass colors (i.e., sites in southeast Cambodia were dominated by dark blue glass) are related to differences in glass type, and by extension, different glass bead trade routes. At the beginning of the chapter I asked two broad questions regarding the glass artifact data that I will now consider in more detail.

How does the distribution of glass beads and artifacts change over time and space?

There are several patterns visible in the distribution of glass beads over both time and space. I will address these patterns point by point.

Potash glass as the earliest glass type in Southeast Asia

As noted earlier in this chapter, glass bangles, rings, and earrings were among the earliest glass artifacts found at several sites in Cambodia and Thailand. Compositional analysis of these artifacts shows that these objects were made of potash glass, specifically potash glass with moderate amounts of alumina and lime. (However, there is one exception to this at Prohear: a low alumina potash glass ring). Table 7.24 displays the sites with these artifacts and their dates, it is likely that the ring/earring fragment from Promtin Tai belongs in this group, however the sample was too weathered to produce reliable results.

Site Name	Dates	Potash ring/earring/bangle artifacts
Village 10.8	400 BC- AD 50	2 ring fragments
Prohear	200 BC- AD 200	2 bangles, and 2 ring/earring fragments
Phum Snay	350 BC- AD 200	3 ring earring fragments
Ban Non Wat Iron Age I	420-200 BC	3 ring/earring fragments and unidentified piece of glass

Table 7.25: Table of ring/earring/bangle artifacts made from Potash glass.

At two of the sites in Table 7.24 potash glass appears only sporadically and does not make up a major portion of the overall glass bead collection. However, at Prohear, Bit Meas, and Village 10.8 potash glass dominates the collection. In fact, potash glass is the only major glass type identified at Village 10.8, the earliest site examined in this study. Potash glass beads were also identified at the nearby circular earthwork site of Krek 52/62 (Haidle and Neumann 2004). This evidence adds weight to Lankton and Dussubieux's (2006) observation that potash glass is predominant at early Iron Age sites in Southeast Asia. It appears that early glassmakers were experimenting first with drawn rings, earrings, and bangles before beginning to make beads. Also of note is that blue potash glass appears to have been preferred by, or was the predominant color available to people living at sites in southeast Cambodia.

Potash glass and coastal exchange networks

Although it is unfortunate that we do not have a clear understanding of where potash glass was made or its three sub-types, research does show that potash glass is strongly associated with coastal exchange networks and sites that appear to have been trading centers. Potash glass has been found in high quantities at several important coastal sites and sites with connections to these coastal trading networks including Ban Don Ta Phet, Thailand, Khao Sam Kaeo and Phu Khao Thong in peninsular Thailand, Sa Huynh sites in southern Vietnam, Dongson sites in northern sites Vietnam, sites in the Samon Valley, Myanmar, and some sites in central and Northeast Thailand (Lankton and Dussubieux 2013: Figure 3). In addition to potash glass, these sites also have evidence for the long-distance trade of other artifacts including Dongson drums and personal ornaments made of nephrite (Calo 2009; Hung et al. 2007). There is also evidence for connections with coastal networks in this region during the very early Iron Age. At Krek

52/62, a site believed to date from the Neolithic/Bronze Age into the very early Iron Age, several fragments of glass bangles have been found that may have been produced at Khao Sam Kaeo (Haidle and Nuemann 2004; Lankton et al. 2008).

I argue that the large number of potash glass beads found at Village 10.8, Prohear, and likely at Bit Meas, are reflective of participation in these early coastal exchange networks. Dongson drums or drum fragments were found at both Village 10.8 and Prohear, as well as other objects likely exchanged on this long-distance coastal network (Reinecke et al. 2009; Heng Sophady 2004, 2005). Sites like Angkor Borei and Oc Eo were important trading centers in the first millennium AD and yet potash glass has only been infrequently found in this region. I believe that this indicates that these sites, as well as additional sites with lesser quantities of potash glass such as Phum Snay, Promtin Tai, and Ban Non Wat, likely did not intensively participate in these coastal networks and may have obtained these glass artifacts through other means, such as down-the-line exchange.

Potash glass and high alumina glass: Evidence for shifting trade networks?

As discussed earlier in this chapter, Lankton and Dussubieux have observed a shift in the availability of potash glass and high alumina soda glass over time; with the former being replaced by the later around approximately 200 BC –AD 200 (Lankton and Dussubieux 2006, 2013). Lankton and Dussubieux have noted that this shift appears to be “sudden,” regional, and may be reflective of the changing nature of trade with South Asia as proposed by Bellina and Glover (2004) and discussed in Chapter 3.

Glass evidence from Angkor Borei and Prohear provide depth to this hypothesis. Both sites date to approximately 200 BC- AD 200. No high alumina soda glass beads have been

found at Prohear and no potash glass has been found at Angkor Borei, although a very small quantity was noted at the nearby site of Phnom Borei. Both communities share similarities in certain unique ceramic forms, and it is presumed that they were aware of one another (Reinecke et al. 2009: 41, 165). Nevertheless, the glass bead collections at both sites are extremely different. While the shift in glass types may have been relatively sudden, I argue that evidence from these two sites suggest that for at least several hundred years the two glass types were found in coexisting, perhaps competing, trade networks with little overlap.

With the shift to high alumina soda glass, more sites appear to have had access to glass beads and access to higher quantities of beads than in earlier periods. As evidence from Noen U-Loke and Prei Khmeng attest, extremely large quantities of high alumina soda glass was being traded in exchange networks across mainland Southeast Asia by 200-400 AD. Inland sites, such as Prei Khmeng, which appears to have had little contact with pre-existing coastal networks, were able acquire to high alumina glass beads.

The distribution of less common glass types

Three less common types of glass were found at multiple sites, and it is worth examining them in more depth, despite the small amount of evidence. Beads made from the m-Na-Ca-Al glass type, often in cobalt blue, have been found at Angkor Borei, Prohear, Promtin Tai, Ban Non Wat, and Noen U-Loke. As noted above, Dussubieux and others (Dussubieux and Gratuze 2013; Lankton and Dussubieux 2013) have suggested that this glass type may have been manufactured at different locations. Therefore, it is not yet clear that beads from all five sites derived from the same workshop. However, it is notable that both Prohear and Angkor Borei

have m-Na-Ca-Al glass, which could mean these beads may have been traveling on different trade routes than the potash or high alumina soda glass beads.

Phum Snay, Angkor Borei, and Prei Khmeng also contained v-Na-Ca glass. All of the beads, except for the bi-color black and red bead from Prei Khmeng, were a dark blue color. One blue bead from Angkor Borei was a different shape, a square barrel. The extremely small quantities of these beads make it difficult to determine the trade networks used to move them over the region. However, the presence of this glass links these three sites to one another and I argue is another line of evidence pointing towards the expansion of bead trade networks out of the Mekong Delta.

Lastly, the mixed alkali orange wrapped glass beads were found only at Ban Non Wat and Noen U-Loke and in very high quantities. This glass type appears to have had a limited distribution in central and Northeast Thailand. I argue that this glass type highlights the importance of regional exchange networks during the Iron Age.

The importance of regional exchange networks

I believe that the glass data presented in this chapter underscores the importance of regional exchange networks during the early Iron Age period. Village 10.8 and Prohear, as well as Bit Meas and Krek 52/62 in southeast Cambodia were linked to one another and a broader coastal exchange network trading in potash glass artifacts. Conversely, the dominance of opaque orange mixed-alkali glass at Ban Non Wat, Noen U-Loke, and other sites in Northeast and central Thailand points toward a strong regional exchange network in this area. At Promtin Tai, I argue that the diverse set of glass types and bead shapes indicates that this region of central Thailand may have been involved in exchange with peninsular Thai sites. While many of these

glass artifacts may have originated outside of these regional networks, their presence at most of these sites does not necessarily indicate a direct connection to these long-distance trading networks. Instead, it appears that goods may have entered into these regional networks through a distribution point, perhaps a coastal site with direct access to long-distance coastal networks. Goods were then exchanged between sites within a regional network that connected these sites to one another. I believe these regional networks become even more apparent when all of the stone and glass bead data are examined together, and this will be discussed in the final chapter.

Does evidence from glass bead trade patterns suggest increased participation in trade by elites at sites in the Mekong Delta?

Over time potash glass, mixed alkali glass, and other glass types appear to decline as they are replaced by large quantities of high alumina soda glass beads. I agree with Lankton and Dussubieux's (2013) assessment that this shift could be related to more intensive trade and interaction with South Asia observed by Bellina and Glover (2004). Based on work by Dussubieux (2001; Dussubieux et al. 2010), the high alumina beads were likely being imported from South Asia. What is significant, however, is that the high alumina soda glass beads do not appear to be entering into the pre-existing coastal exchange networks in large quantities; sites with large quantities of potash glass are not suddenly flooded with high alumina soda glass beads. Instead, this glass type is often found in large numbers at sites that do not appear to have been participating in these earlier coastal exchange networks, such as Angkor Borei and Oc Eo in the Mekong Delta. I argue that the arrival of high alumina soda glass reflect the emergence of new trade networks connecting inland and coastal sites that had not been active participants in the earlier coastal exchange networks. In this way, we can view beads as markers of expanded

interaction and economic networks between elites in the Mekong Delta and communities further inland.

Although there is not clear evidence for the manufacture of high alumina soda glass in the Mekong Delta, nor strict control over the distribution of these artifacts, I do not think it is coincidental that this glass type becomes more predominant during a period when this region appears to have been expanding in power and influence. Glass beads, as artifacts made from a new material and technology, were likely considered to be prestige objects by Southeast Asian people. As they were appear to have been available in large quantities at sites in the Mekong Delta (Dussubieux 2001; Stark and Dussubieux 2002), their exchange could have facilitated the expansion socio-political and economic networks in the Mekong Delta and its emergence as an important center during the early first millennium AD. High alumina soda glass beads from the Mekong Delta could have been traded through inland riverine trading networks to Phum Snay, Prei Khmeng, Noen U-Loke, and Ban Non Wat, sites that did not previously have regular access to the coastal potash glass bead trade network.

This hypothesis is complicated by the relatively small excavations at Angkor Borei as well as problems with looting at possible manufacturing sites across Southeast Asia. Nevertheless I propose that the existing evidence suggests that the communities in the Mekong Delta may have been taking advantage of increased trade with South Asia and increased availability of prestige objects like glass beads to expand their influence across the region. Current archaeological data does not suggest that people at Angkor Borei and Oc Eo were active participants in the early Bronze and Iron Age coastal exchange networks, although sites nearby, such as Giong Ca Vo in Vietnam were. Perhaps people from these coastal sites established

communities in the Angkor Borei/Oc Eo region to take advantage of the increased trade with South Asia. Or perhaps these may have been competing communities who were actively seeking out alternate trading partners.

In the final chapter I examine these questions in more depth and look at all of the glass and stone data together in order to better understand trade and exchange networks in mainland Southeast Asia during the Iron Age and the emergence of socio-political complexity in the Mekong Delta. However, in the next chapter I look at a unique artifact found at only a small amount of sites: garnet beads.

Chapter 8: The Garnet Beads

A small number of garnet beads were recorded from Angkor Borei, Village 10.8, Prohear, and Bit Meas. The shaped and polished beads from Angkor Borei were clearly different from the unshaped and unpolished beads identified from the sites in southeast Cambodia and a comparison between the two groups provided an opportunity to explore questions regarding the manufacture and trade of these objects. In this chapter I address the following questions:

- What are the morphological and manufacturing differences between the Angkor Borei garnets and garnet beads from Village 10.8, Prohear, and Bit Meas?
- Are there geochemical differences between beads from Angkor Borei and beads from Prohear, Bit Meas, and Village 10.8, and is there geochemical evidence for production of garnet beads using Southeast Asian stone sources?
- What can these beads tell us about trade and exchange networks during this period?

This chapter begins with an introduction to garnet and a background on previous research on garnet beads in Southeast Asia. Following this overview, the garnet beads in this study are examined in more detail, focusing on their morphology and the methods used to make the beads. Impressions were taken of the bead perforations and examined using a scanning electron microscope in order to understand how the beads were drilled. Following this discussion, results from compositional analysis of the garnet beads are presented. An examination of previous studies shows that geochemical analysis of garnet has proven moderately successful at differentiating between garnet artifacts. Using LA-ICP-MS, 13 garnet beads and nine sources were analyzed in order to determine the geologic source used to produce these beads. I conclude

this chapter by arguing that the garnet beads from Village 10.8, Bit Meas, and Prohear were manufactured in Southeast Asia and had a limited distribution amongst a certain group of communities, while the beads from Angkor Borei were likely imported from South Asia.

Garnet: Definitions

Garnet is a type of gemstone commonly found in metamorphic as well as igneous rocks and detrital sediments (Deer W.A. et al. 1982). Garnets can be found in a variety of colors, from the more common deep red and purple, to orange, yellow, and green. The garnet group contains several species all of which share the same chemical formula: $X_3Y_2Z_3O_{12}$ (Table 8.1). The different species of garnet have been sub-divided into two series in which there is fairly continuous variation between the species within the series. The pyrospite series contains pyrope, almandine, and spessartine garnets and is the primary focus of the current study. The ugrandite series contains uvarovite, grossular, and andradite garnets. However, garnets rarely occur in their pure end-member forms and a single sample can often contain a mix of these species. Geochemical analysis of garnet is an ideal way to identify the different elements within a sample and recent research can assist with the conversion of these data into molar proportions of various end-member components (Locock 2008). It should also be noted that previous geochemical studies of garnets have identified instances of chemical zoning, in which certain elements are not evenly distributed throughout the sample (Deer et al. 1982: 546). Zoning and heterogeneity was identified amongst the garnet samples in the current study. However as with the agate and carnelian materials, this heterogeneity is not believed to adversely affect the differentiation of garnet sources and assignment of archaeological samples to these sources. This topic is discussed further in Appendix 8.1.

Due to the varying proportions of different garnet species in a single sample, geochemical analysis of garnets have assisted with the identification of specific optical and physical characteristics that can be used to classify species of garnet using standard gem-testing equipment (Manson and Stockton 1985). Geologically, garnets have also been used in sediment provenance studies (Morton 1985). Different species of garnet are also known to be strongly associated with specific rock types (Wright 1938) and therefore have been used as indicator minerals for more valuable stones, such as diamonds. For the purposes of this study, it is significant that the composition of garnets is “related to that of the original host rock,” (Bimson et al. 1982: 51). While major and minor elements can assist with determining the type of garnet and perhaps identifying the type of host rock in which garnets were formed, it was expected that the additional minor and trace elements associated with the host rock should assist in providing a unique fingerprint for garnets from specific sources.

Pyrope	$\text{Mg}_3\text{Al}_2\text{Si}_3\text{O}_{12}$
Almandine	$\text{Fe}_3\text{Al}_2\text{Si}_3\text{O}_{12}$
Spessartine	$\text{Mn}_3\text{Al}_2\text{Si}_3\text{O}_{12}$
Grossular	$\text{Ca}_3\text{Al}_2\text{Si}_3\text{O}_{12}$
Andradite	$\text{Ca}_3(\text{Fe}^{3+}, \text{Ti})_2\text{Si}_3\text{O}_{12}$
Uvarovite	$\text{Ca}_3\text{Cr}_2\text{Si}_3\text{O}_{12}$
Hydrogrossular	$\text{Ca}_3\text{Al}_2\text{Si}_2\text{O}_8(\text{SiO}_4)_{1-m}(\text{OH})_{4m}$

Table 8.1: Chemical formulas for the different varieties of major garnet species (from Deer et al. 1982: 468).

Garnet Beads in Southeast Asia

Garnet beads are fairly unusual at Southeast Asian archaeological sites, but have primarily been found at coastal sites in Vietnam and Thailand (Figure 8.1). 51 spherical, hexagonal prism, elliptical and oblate shaped garnet beads have been reported from the southern coastal site of Giong Ca Vo (Nguyen Kim Dung 2001). Garnet beads in a variety of shapes were

also found at the site of Oc Eo, Vietnam (Malleret 1962: 221-2). Small spherical garnet beads have also been reported from the central Vietnamese coastal site of Lai Nghi (Andreas Reinecke, personal communication, 2011). Garnet beads from looted contexts have been found in peninsular Thailand (Bunchar Pongpanich, personal communication, 2011). A small piece of raw garnet was recently found at the site of Phu Khao Thong in peninsular Thailand and is discussed further below.

Unshaped and unpolished garnet beads, similar to those found in southeast Cambodia have been reported in the upper layers of the Krek 52/62 earthwork site in Cambodia (Albrecht et al. 2001). While 19 beads from Go O Chua have been found in either burial or likely burial contexts (Andreas Reinecke, personal communication, 2011) (Figure 8.2). No comprehensive studies of garnet beads from Southeast Asian sites have yet been undertaken and so other sites with additional garnet beads may exist.



Figure 8.1: Photo of garnet beads from Go O Chua, courtesy of Andreas Reinecke.

Garnet beads from Cambodia

A total of 23 garnet beads were recorded from four sites (Figures 8.2 and 8.3). Appendix 8.2 lists garnet beads in this study, their context, measurements, and morphological information. As discussed in previous chapters, Village 10.8, Prohear, Bit Meas, and Angkor Borei are all roughly contemporary with one another. Village 10.8 is the earliest of the sites, dating from 400

BC- AD 50, while the remaining three sites are believed to date from approximately 200 BC- AD 200.

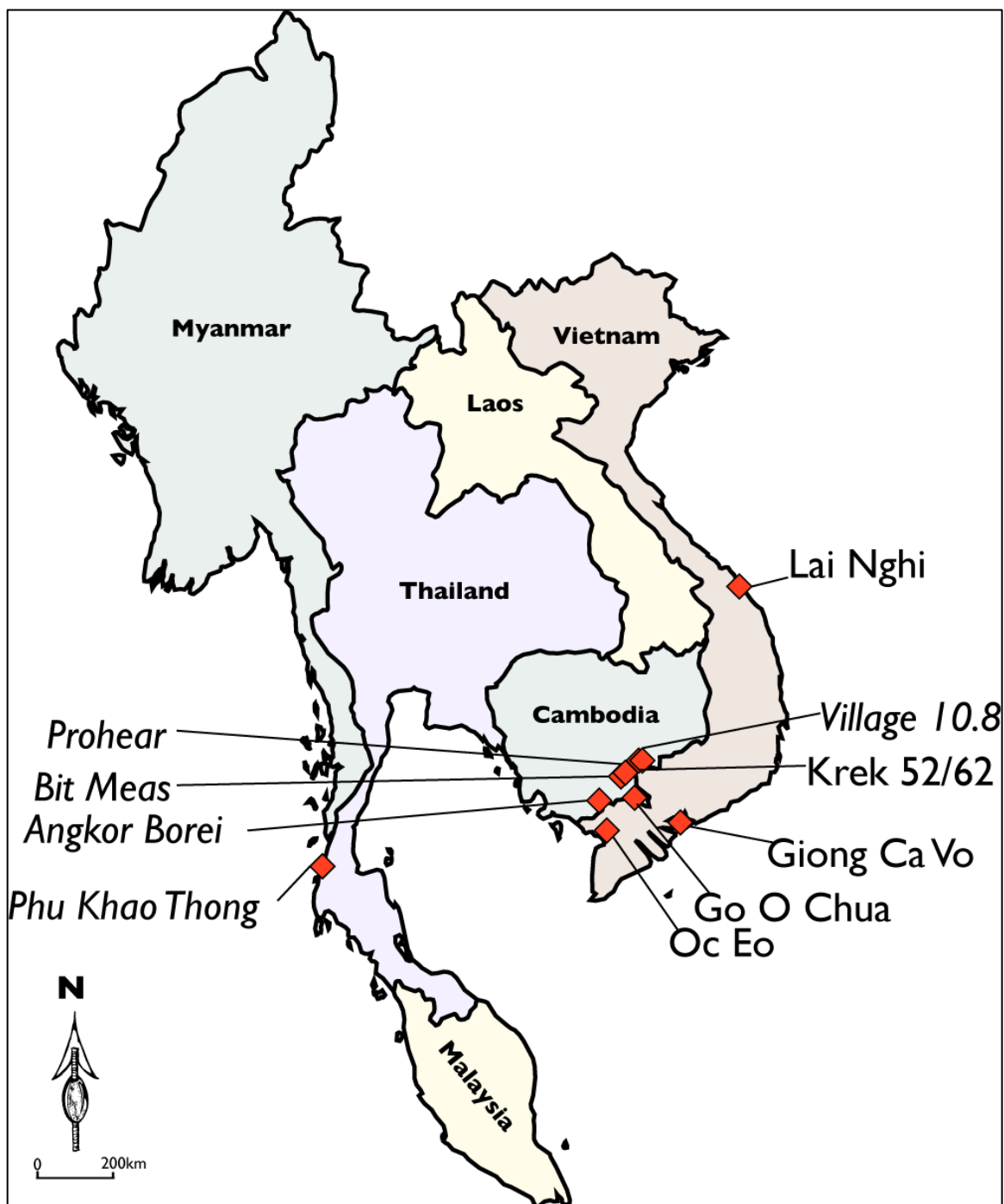


Figure 8.2: Map of sites discussed in this chapter. Sites in italic are those with artifacts analyzed in this study.



Figure 8.3: Map of site in Cambodia with beads analyzed in this study.

Garnet beads from southeast Cambodia

18 beads from sites in southeast Cambodia, Village 10.8, Prohear, and Bit Meas, were recorded primarily from burial contexts (Table 8.2). All of the beads were notable for their natural, unmodified appearance (Figure 8.4). Beads were approximately 5-12mm in length,

made of a dark purple stone, and generally a rough oblate or barrel shaped. The surface of the beads was not polished and some had small nicks, chips, or imperfections. It seems that these garnet beads were simply picked up and drilled with no further modification. The bead perforations were also large and unusual.

Database ID	Site	Context information	Perforations examined using SEM	Analyzed using LA-ICP-MS
AKC00651	Bit Meas	Unknown		x
AKC00652	Bit Meas	Unknown		
AKC00653	Bit Meas	Unknown		
AKC00654	Bit Meas	Unknown		
AKC00731	Bit Meas	Unknown		x
AKC00606	Prohear	Burial 11	x	x
AKC00590	Prohear	Burial 20		x
AKC00334	Village 10.8	Burial 1	x	
AKC00335	Village 10.8	Burial 1		
AKC00337	Village 10.8	Burial 1		
AKC00338	Village 10.8	Burial 1	x	x
AKC00340	Village 10.8	Burial 1		
AKC00341	Village 10.8	Burial 1		
AKC00336	Village 10.8	Burial 3	x	
AKC00339	Village 10.8	Burial 3		x
AKC00333	Village 10.8	Burial 4	x	
AKC00310	Village 10.8	Burial 28		x
AKC00311	Village 10.8	Burial 34		x

Table 8.2: Beads from Bit Meas, Prohear, and Village 10.8 examined as a part of this study.

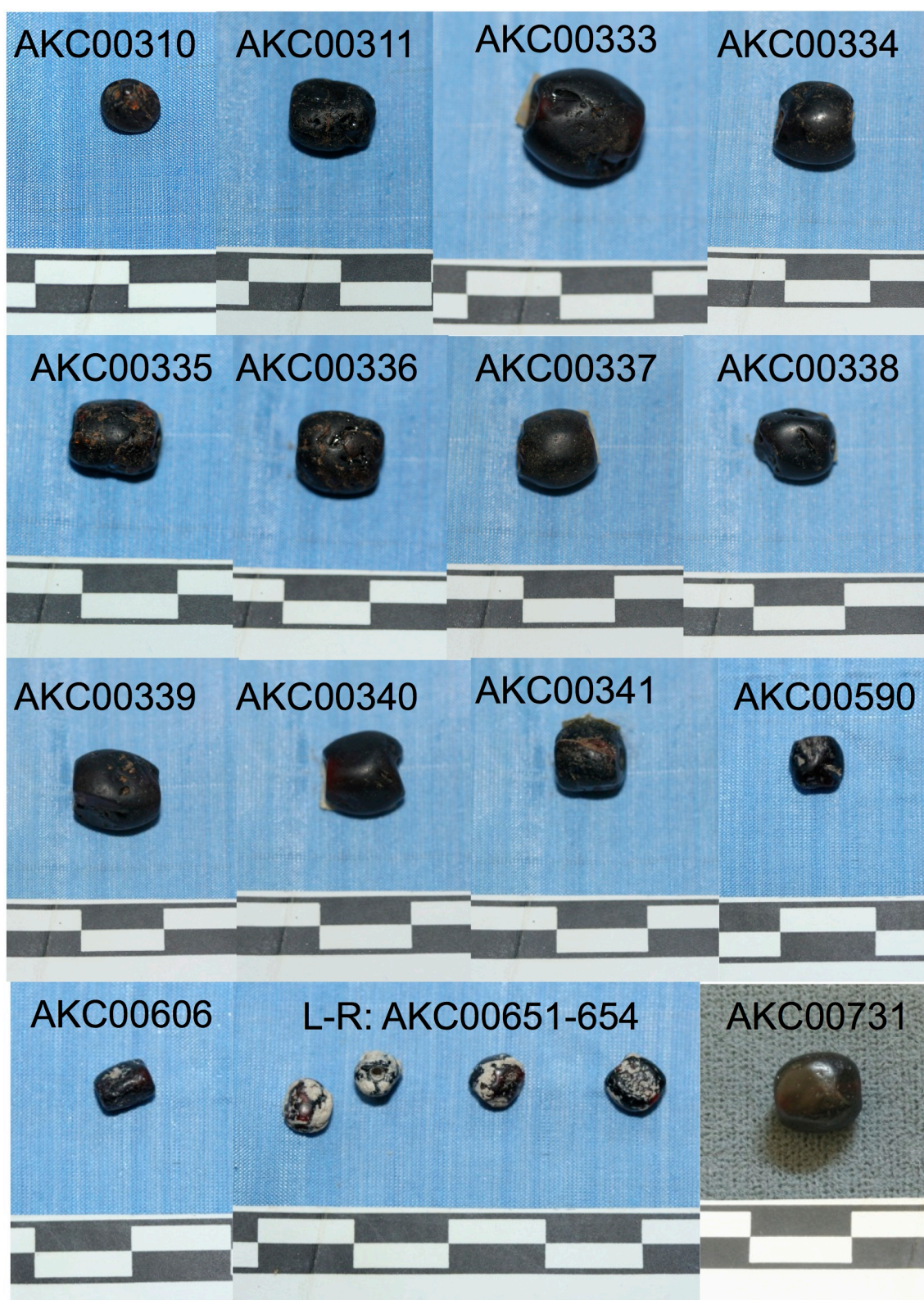


Figure 8.4: The 18 beads from southeast Cambodia recorded in this study.

Garnet beads from Village 10.8

Garnet beads from Village 10.8 were from 4 burials, all of which also contained agate and carnelian beads, glass artifacts, and other objects (Table 8.3). As discussed in Chapter 5, the burials from Village 10.8 lacked skeletal material due to the highly acidic soil. Burial 1 contained the highest number of garnet beads ($n=6$), as well as six carnelian beads. Other burials that contained higher numbers of carnelian beads did not also contain a high quantity of garnet beads. Half as many burials contained garnet beads ($n=5$) as those that contained agate and carnelian beads ($n=10$). It would appear that the garnet beads were more unusual or rare than agate and carnelian beads, which appeared at Village 10.8 in higher quantities.

Burial Number	Beads found in burial	Associated grave goods
Burial 1	Six garnet beads	Six carnelian beads, two glass beads, broken ceramics, iron tools and an iron bangle
Burial 3	Two garnet beads	14 carnelian beads, glass beads, iron bangle, and broken ceramics.
Burial 4	One garnet bead	One carnelian bead, an iron tool, broken ceramics.
Burial 28	One garnet bead	Eight agate beads, glass rings, broken ceramics, iron tools.
Burial 34	One garnet bead	Two carnelian beads, glass beads, an iron bangle, an iron spade, broken ceramics.

Table 8.3: A list of burials with garnet beads from Village 10.8 and their associated grave goods.

Garnet beads from Prohear and Bit Meas

Two garnet beads from Prohear were available for study, however about 200 beads have been recovered from a total of 76 burials excavated in the 2008, 2009, and 2011 field seasons (Andreas Reinecke, personal communication, 2011). The first bead examined was from Burial 11, which may be of a male, and was found with a stone pestle buried between his legs, bronze bracelets, iron objects, and blue glass beads. The other garnet bead was found in Burial 20, which also included iron bracelets. Garnet beads were also found at the nearby looted site of Bit

Meas, believed to be contemporary with Prohear (Reinecke et. al 2009). All five of the garnet beads studied from Bit Meas are from an unknown context.

Garnet beads from Angkor Borei

Five spherical garnet beads were recorded from the Angkor Borei bead collection (Figure 8.5). In contrast to the beads from southeast Cambodia discussed above, the Angkor Borei beads are a deep reddish-purple, round or spherical in shape, and range from approximately 3-4mm in diameter, with one bead being slightly larger at about 5-6mm in diameter. The five beads were excavated from the densely packed Angkor Borei cemetery and are thus far the only garnet beads found at the site (Table 8.4). A single garnet bead, as well as several glass beads, was found in Burial 16, which contained the remains of a 25-35 year old female, a 12-20 year old male, and a young adult male. Burial 21 contained a single garnet bead and was found in a grave that contained portions of four skeletons: a 17-18 year old female, 30-35 year old male, a 30-50 year old male, and an unidentified adult. Lastly, a garnet bead was found in Burial 48, a burial that contained the remains of a 30-35 year old female and adult male. Burial 48 also contained several glass beads. Two other beads were found within the cemetery excavation but not directly associated with a burial.

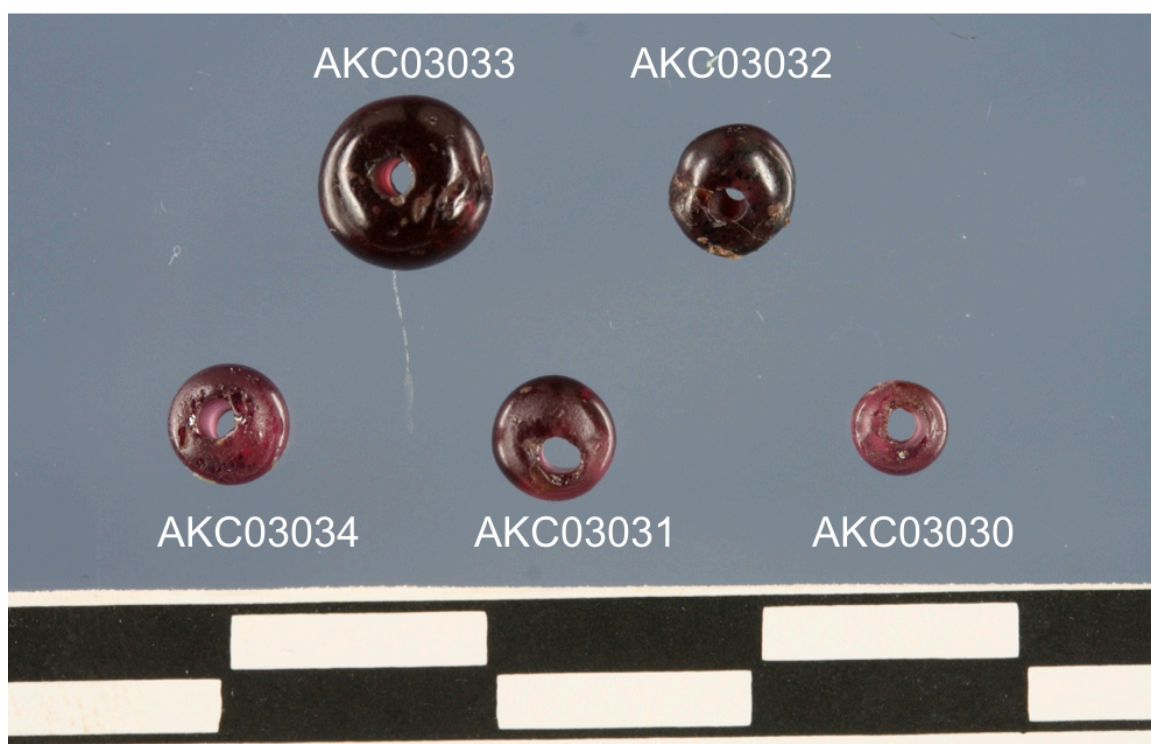


Figure 8.5: Garnet beads from Angkor Borei.

Database ID	Context	Sex/Age	Number of beads	Associated grave goods
AKC03030	Burial F16 Cat # 1767	F, 25-35 years old M, 12-20 years old M, Young adult	1	Glass beads
AKC03032	Burial F21 Cat # 1835	F, 17-18 years old M, 30-35 years old M, 30-50 years old Unidentified adult	1	N/A
AKC03031	Burial F48 Cat #3284	F, 30-35 years old M, Adult	1	Glass beads
AKC03033	Unit AB7 Block 4S Layer 5, Level 26 Cat # 2801	N/A	1	N/A
AKC03034	Unit AB7 Block 4N Layer 5, Level 30 Cat # 3333	N/A	1	N/A

Table 8.4: A list of garnet beads found at Angkor Borei.

Examining the bead perforations

In addition to the clear morphological differences, the bead perforations on the garnet beads from southeast Cambodia were irregular or conically shaped and visually distinct from the cylindrical perforations seen on the garnet beads found at Angkor Borei, as well as the agate and carnelian beads (Figure 8.6). For this reason, I decided to take impressions of the perforations using dental impression material for further investigation using a scanning electron microscope (SEM). Investigating the method used to drill a bead is important because the different technologies and methods used are often related to distinct cultural traditions (Kenoyer 1992). Previous research using dental impression material to examine bead perforations has successfully identified unique traits related to specific drilling methods (see Gorelick and Gwinnett 1988; Gwinnett and Gorelick 1986, 1998; Gorelick et al. 1996;). Additional research has emphasized the importance of using high-resolution SEM images to determine the different drill types (Kenoyer and Vidale 1992; Kenoyer 1997). Impressions were taken on all of the beads recorded and a selection of beads was chosen for SEM analysis in the Biological & Biomaterials Preparation, Imaging, and Characterization Laboratory (BBPIC) at the University of Wisconsin-Madison. Results from SEM analysis show clear differences between the Angkor Borei garnet bead perforations and the beads from Southeast Cambodia. It also appears that the beads from southeast Cambodia were drilled using multiple methods.

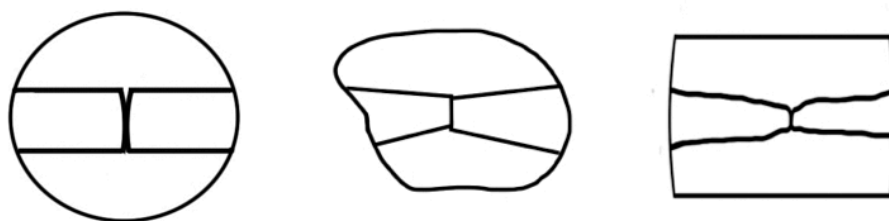


Figure 8.6: Drawing showing the difference between the cylindrical Angkor Borei perforations (left) and the bi-conical (middle) and irregular (right) perforations on garnet beads from southeast Cambodia.

Garnet bead perforations from Angkor Borei

Drill hole impressions from two of the five garnet beads from Angkor Borei were analyzed using SEM (AKC03031 and AKC03033). The drill holes and their impressions were cylindrical with parallel drilling striae and rough cutting surface, typical of beads drilled using a diamond drill (Gorelick and Gwinnett 1988; Kenoyer and Vidale 1992). Under SEM the impressions displayed a pattern of regular, spiraling striae or grooves also representative of the double-diamond drilling technique (Gorelick and Gwinnett 1988) (Figure 8.7). Double-diamond drilling involves the use of a drill with two diamond chips mounted on the drill tip (Gorelick and Gwinnett 1988; Kenoyer and Vidale 1992). A similar drilling method is also assumed for the three additional beads that did not undergo SEM analysis, based on visual inspection of the impressions using a desktop digital microscope.

As noted in Chapter 5, diamond-drilling techniques have been practiced in India since at least 600 BC (Kenoyer 2003) and are strongly associated with the peninsular Indian bead industry (Kenoyer et al. 1991). Single diamond drills, in which a single diamond chip is inserted into the tip of a metal drill, were also used. However this drill type is more commonly found in the northern and western parts of Asia (Kenoyer 1992, 2003). It should be noted that no ethnographic or archaeological studies have been conducted on garnet bead production in either

South or Southeast Asia and that the aforementioned experimental and archaeological studies have focused on the bead production techniques and drill patterns produced on agate or quartz. However, it is expected that similar drill patterns would be produced on garnet beads, as garnet has a hardness of Mohs 6.5-7.5, while agate and carnelian have a hardness of Mohs 6.5-7.0.

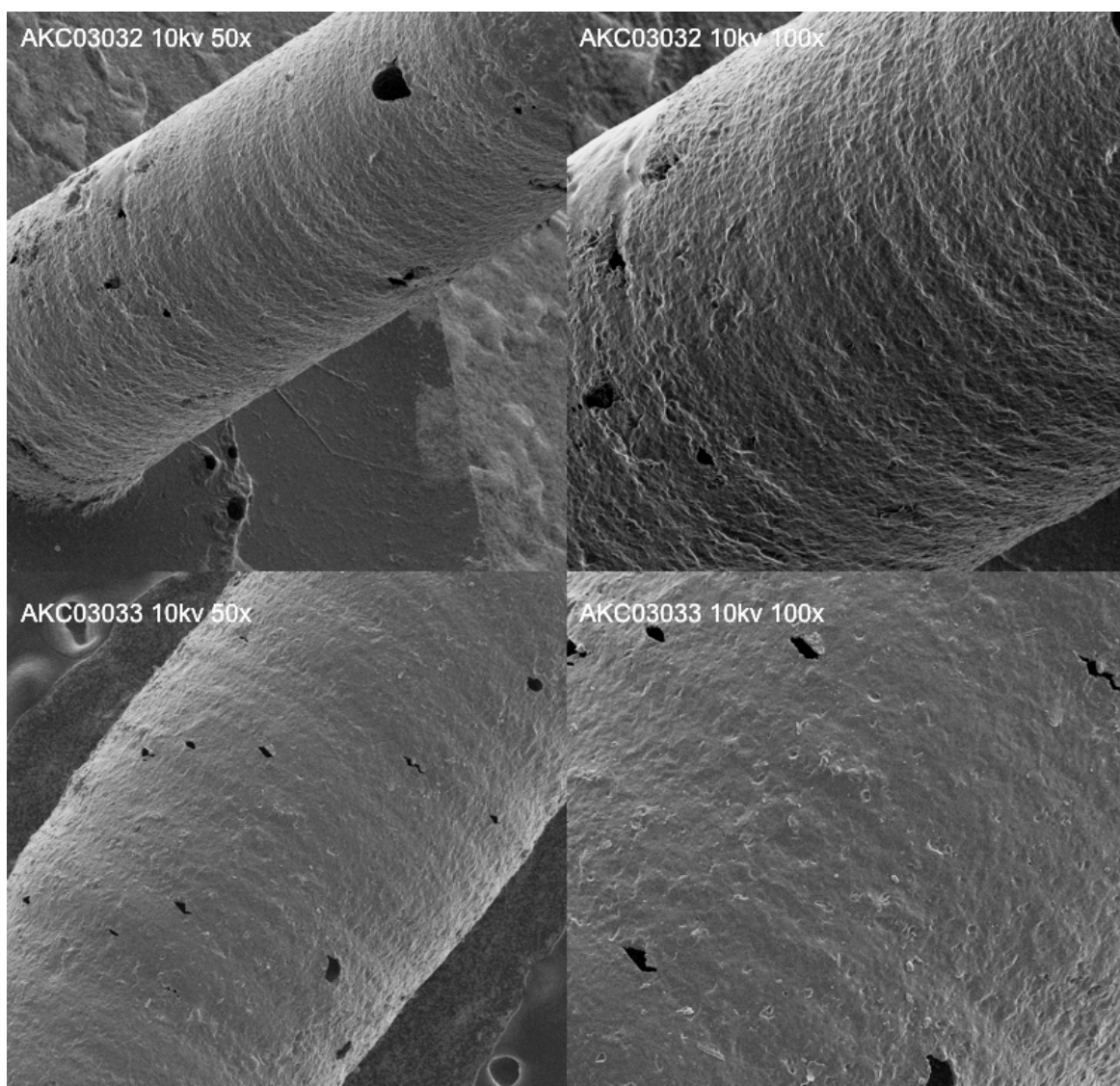


Figure 8.7: SEM images of bead perforations from Angkor Borei.

Garnet bead perforations from sites in southeast Cambodia

The drill hole impressions from beads found in southeast Cambodia displayed a variety of shapes, from bi-conical drill holes, to those that were generally cylindrical but with irregularities. Drill hole impressions from five beads were analyzed using SEM (Table 8.5). The drill holes and impressions of two beads (AKC00333 and AKC00334) showed a tapered bi-conical shape (Figure 8.8 and 8.9). The side wall of the drill holes is rough, without any of the concentric lines or grooves as seen with the diamond-drilled beads. This rough side wall pattern has been replicated in experimental studies using copper drills with abrasive on both marble and hematite (Gwinnett and Gorelick 1987b). However, ongoing experimental studies using stone drills have also produced similar rounded impressions and rough side walls (Jonathan Mark Kenoyer, personal communication, 2011). Recent experimental studies undertaken by the author have used a chert drill with an abrasive. Garnet is a harder stone than both hematite and marble, and other garnet beads from this collection believed to have been drilled with a copper drill have a different impression. For this reason, AKC00333 and AKC00334 are tentatively classified having been drilled using a stone drill, possibly with abrasive.

Site Name	Database ID	Proposed Drilling Method
Village 10.8	AKC00333	Stone drill (with abrasive?)
Village 10.8	AKC00334	Stone drill (with abrasive?)
Village 10.8	AKC00336	Copper drill with abrasive
One drill Village 10.8	AKC00338	Copper drill with abrasive
Prohear	AKC00606	Unknown

Table 8.5: Beads from southeast Cambodia whose perforations were examined using SEM.

Another garnet bead, AKC00606 also has a biconical drill hole impression, although with an important difference. While one side showed a rounded tip (AKC00606a) similar to that seen in AKC00333 and AKC00334, the other side (AKC00606b) has a dimple or central depression

(Figure 8.10). Similar depressions were found in experimental studies in which the leading edge of the drill becomes worn over time resulting in a tapered tip, and the subsequent creation of a depression in the stone bead being drilled (Gwinnett and Gorelick 1979). This result was found when using both wooden (Gwinnett and Gorelick 1979) and copper drills (Gwinnett and Gorelick 1987). The exact drilling method of this bead is currently unknown.

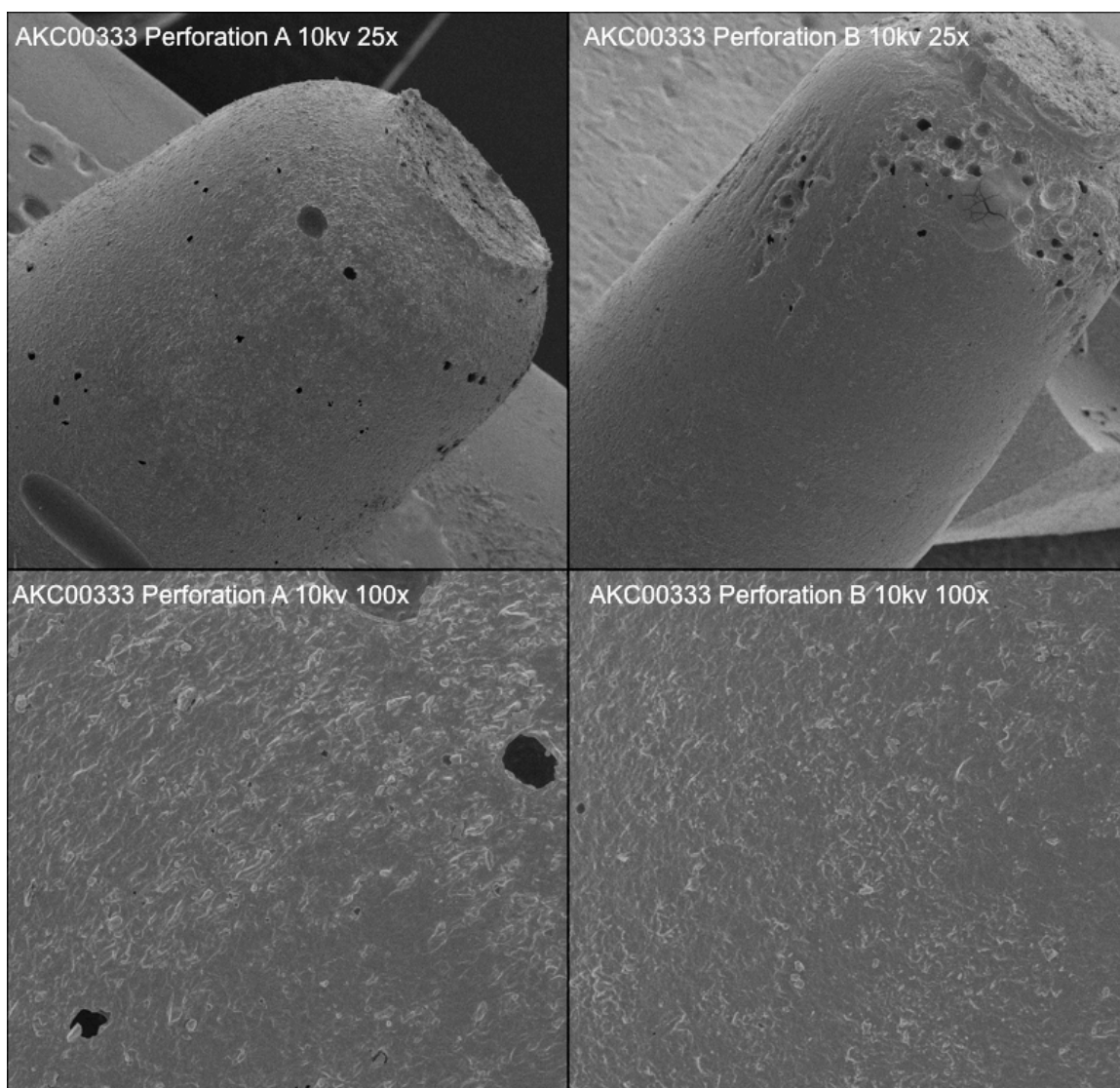


Figure 8.8: SEM images of perforations from AKC00333

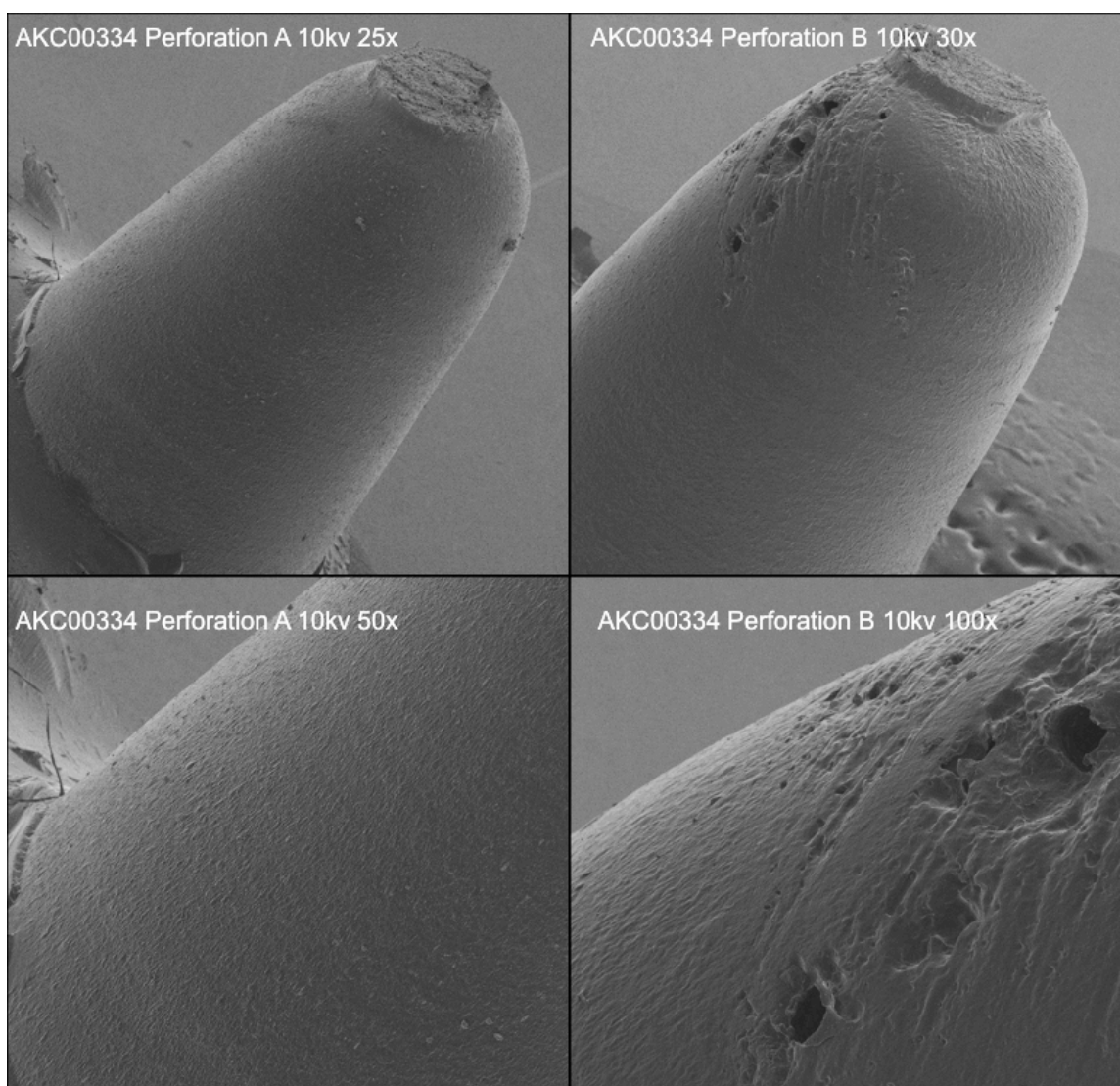


Figure 8.9: SEM images of perforations from AKC00334

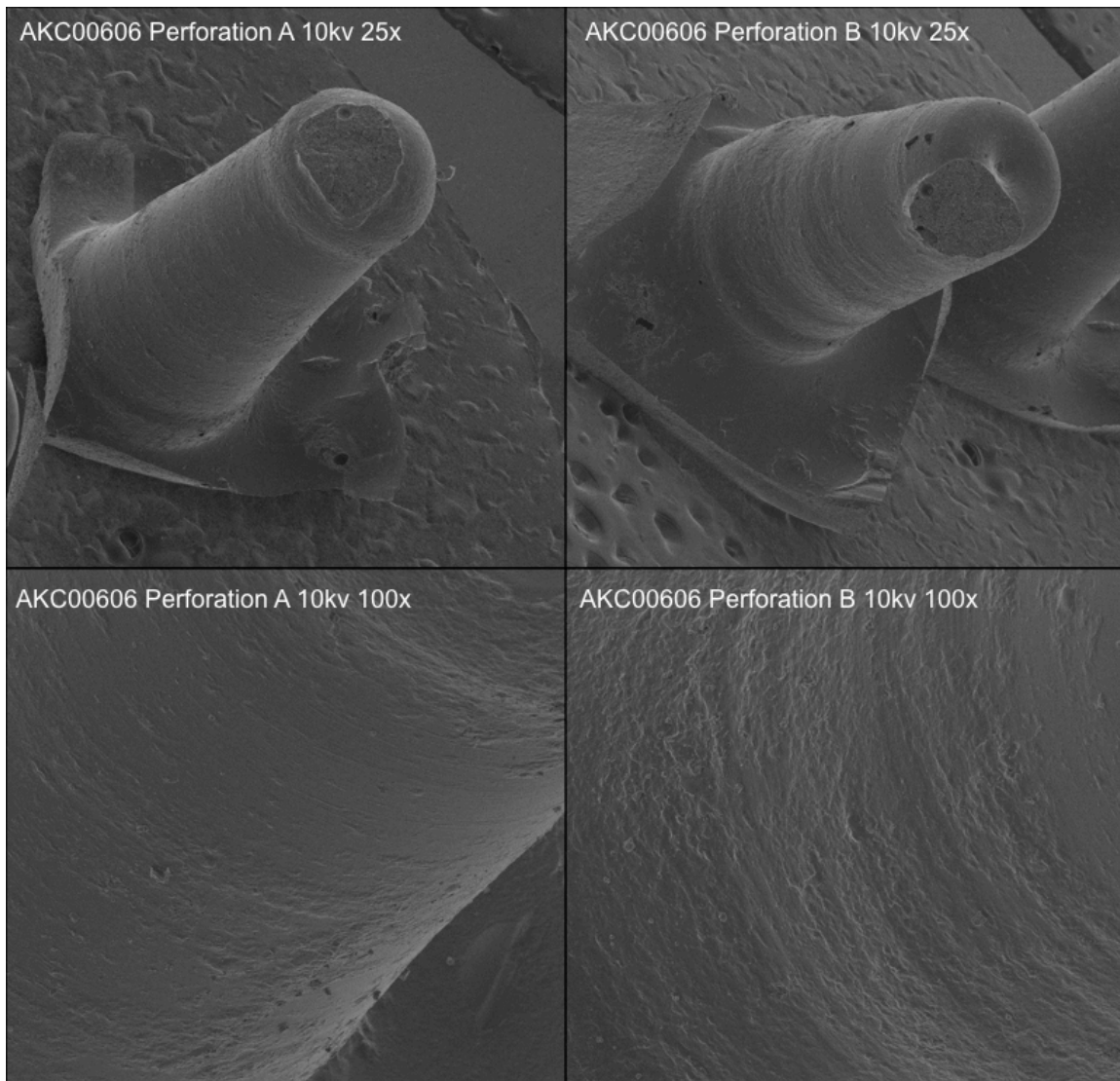


Figure 8.10: SEM SEM images of perforations from AKC00606

Two other beads (AKC00336 and AKC00338) have fairly cylindrical impressions, though they are irregular and not as straight as seen with the diamond-drilled beads (Figures 8.11 and 8.12). Unlike the AKC00333 and AKC00334 beads, these impressions show evidence for uneven lines and grooves in the side wall of the drill holes. Gwinnett and Gorelick observed similar irregular lines or bulges in their experimental studies when using a copper drill, noting that “the combination of pressure and heat during drilling produce[s] plastic deformation at the

leading edge of the copper drill” (1989: 41). This deformation, or flaring, of the copper drill then leaves the distinct bulges or collars in the side wall of the drill holes. Additionally, the concentric lines seen in these impressions could have been produced by the addition of a hard abrasive such as emery or corundum (Gwinnett and Gorelick 1987: 23). This type of bulging pattern has been seen on both solid copper and copper tubular drills in experimental studies (Jonathan Mark Kenoyer, personal communication, 2011). Both beads are believed to have been drilled using a copper drill with abrasive.

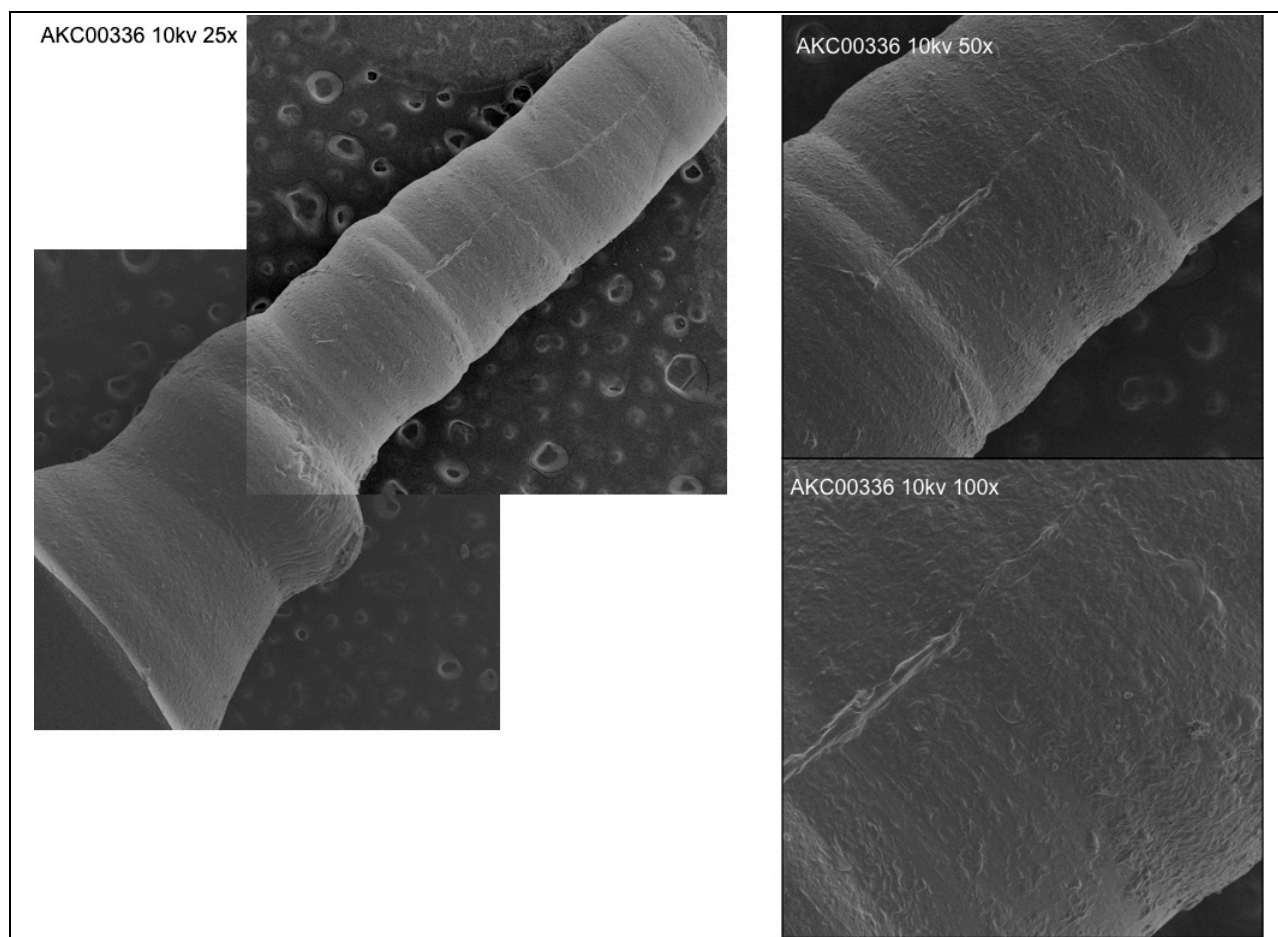


Figure 8.11: SEM images of perforations from AKC00336

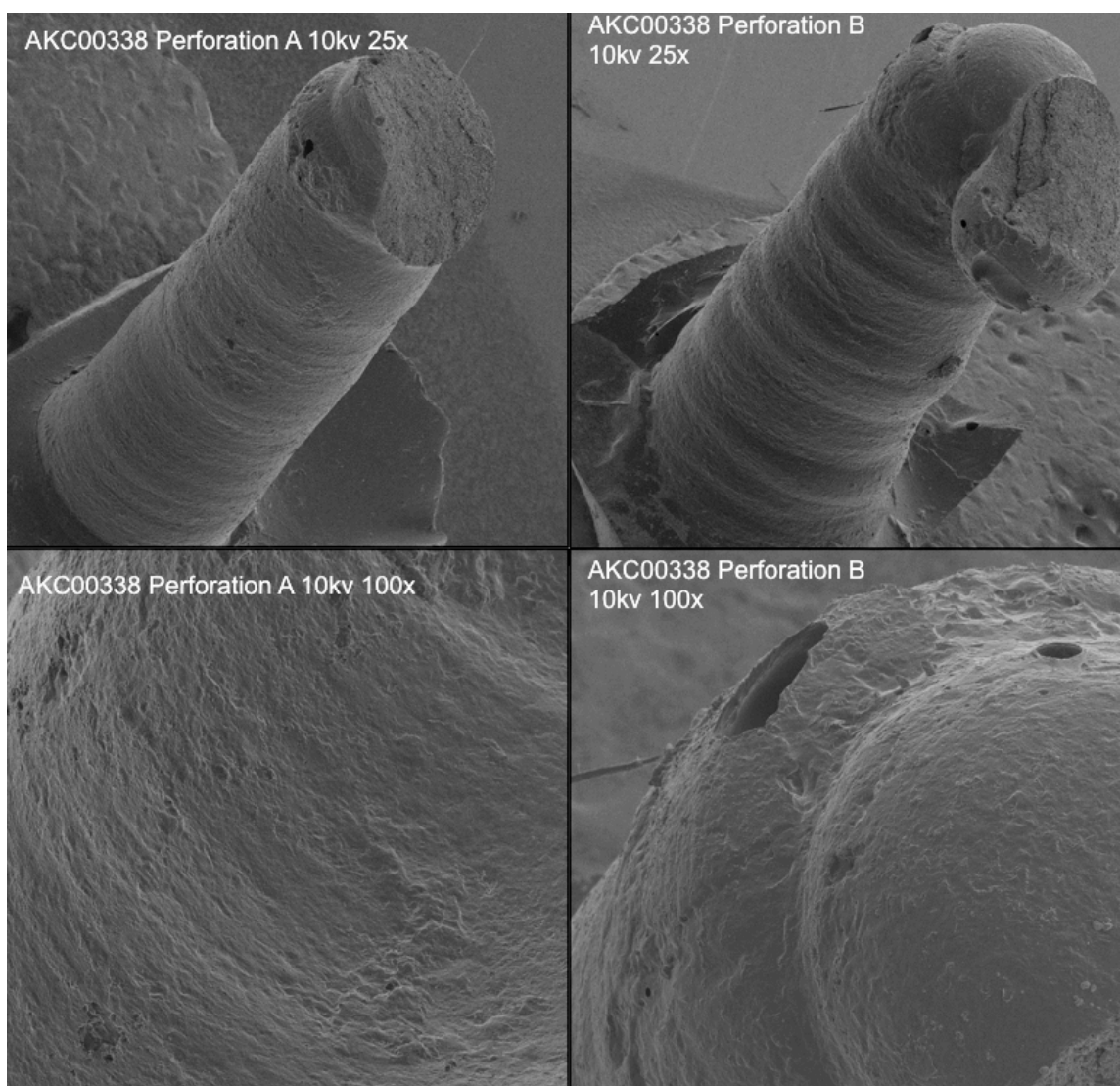


Figure 8.12: SEM images of perforations from AKC00338

It is clear that garnet beads from Village 10.8, Prohear, and Bit Meas were not drilled using a double-diamond drill, and that multiple drilling techniques were used, such as copper, stone, and wooden drills with an abrasive. Archaeologists have noted the use of bamboo drills with abrasive to perforate objects made of nephrite at both East and Southeast Asian sites (Hansford 1950; Nguyen Thi Kim Dung 1996). At the Bronze Age Trang Khanh jewelry workshop in northern Vietnam, researchers have identified stone drills with a ground circular

cross section as well as a bronze drill used to produce nephrite beads (Nguyen Thi Kim Dung 1996). Nephrite has a comparable hardness as some garnets (Mohs 6.5). Therefore it is possible that similar drilling methods were used on softer garnets to make beads. However, harder garnet beads would have to be drilled with corundum or emery. While these beads may have been drilled using locally known drilling techniques, they are distinct from the local nephrite jewelry tradition in that the beads were not shaped or polished, nor do they seem to have been widely traded outside of this regional area. Experimental studies using different drilling methods will help clarify the different methods used to drill the garnet beads and future studies may update and correct these classifications.

LA-ICP-MS Analysis of garnet beads

The morphological and bead perforation differences between the garnet beads from Angkor Borei and the garnet beads from southeast Cambodia point towards the presence of two distinct bead making traditions. The diamond drill technique used on the Angkor Borei garnets tie these beads in with a South Asian beadmaking tradition, however the beads from southeast Cambodia may be representative of a local beadmaking tradition. Unfortunately, the identification of a local bead production workshop may be difficult as it appears natural stones were drilled without having been shaped or polished. As noted in Chapter 5, Ethnoarchaeological studies of contemporary agate and carnelian bead-making workshops in India have highlighted the importance of debitage and flaking debris in identifying ancient bead workshops (Kenoyer et al. 1991). While ongoing experimental studies will assist in the better understanding how these garnet beads were drilled, drilling natural stones produces little material evidence that would be visible archaeologically. For this reason, compositional analysis was performed on the garnet

bead artifacts in order to determine if the Angkor Borei and southeast Cambodia garnets were geochemically distinct from one another. These artifacts were also compared with several South and Southeast Asian geologic source samples in an attempt to identify the raw material source used to produce the beads. All five garnets from Angkor Borei and eight beads from the southeast Cambodia sites as well as 68 samples from nine geologic sources were analyzed using LA-ICP-MS.

Two additional samples were opportunistically included in LA-ICP-MS analysis. Both were part of a larger selection of glass artifacts analyzed by Laure Dussubieux at the Field Museum's Elemental Analysis Facility. The first is a garnet bead from the site of Porunthal in south India (Figure 8.14). This bead appears to have been a natural pebble that was polished and drilled. The exact archaeological context of this garnet bead is unknown, however a cultural deposit containing thousands of glass beads and other materials has been tentatively dated from the 1st century BC to 3rd century AD (Rajan 2009). The second is a piece of raw garnet found in excavations at the site of Phu Khao Thong (Figure 8.14). Phu Khao Thong is located on the Thai peninsula, close to the important trading and craft production site of Khao Sam Kaeo (Map Figure 8.2). These samples were compared with the geologic sources and artifacts from Cambodia. Appendix 8.3 lists the final measurements for all archaeological and geologic samples. 42 elements are included with major and minor elements listed as percent oxide and trace elements as parts per million (ppm).



Figure 8.13: Garnet artifacts from Porunthal, India (left) and Phu Khao Thong, Thailand (right)

Previous compositional studies of garnet artifacts

There have been several recent archaeological studies attempting to provenience garnets using a variety of methods including PIXE (Calligaro et al. 2002; Farges 1998; Mathis et al. 2008; Perin et al. 2007) electron microprobe (Rösch et al. 1997; Quast and Schüssler 2000; (Velde and Courtois 1983), X-ray fluorescence analysis (Bimson et al. 1982) and X-ray diffraction analysis (Schüssler et al. 2001). While these studies were able to successfully analyze garnets using non-destructive methods, they were only able to provide preliminary conclusions about the source of garnet artifacts because no geological source samples were analyzed. Several studies relied on previously published data of non-specific sources from Europe and South Asia from Quast and Schüssler (2000) (e.g. Calligaro et al. 2002; Perin et al. 2007). Other studies focused more specifically on classifying the garnet end-member components and determining different groups, but not identifying their source, or else only compared analyzed samples to other archaeological garnets (Bimson et al. 1982; Farges 1998; Mathis et al. 2008; Rösch et al. 1997; Schüssler et al. 2001). The current study is an improvement on this previous research in that both geologic sources and artifacts were analyzed together, thus beginning a database of potential garnet sources that can be used by other scholars in the future.

Garnet Geologic Sources

Nine geologic samples were analyzed in the current study, including seven sources in South and Southeast Asia (Table 8.7). However, unlike the agate and carnelian geologic samples, all samples used in this study were acquired through gem dealers as there was not time or funding to visit sources in person. For this reason, many samples have only general regional identifications. Additionally, I cannot be certain that all of these geologic sources came from the location I was told they originated from. Despite these caveats, this study provides an important first step in creating a database of potential garnet geologic sources. Garnets from the Anthill garnet source in Arizona, and garnets from a garnet mine Mozambique, Africa, well-known sources outside of Asia, were also sampled to determine if LA-ICP-MS could accurately distinguish between these samples and those collected from Asian sources.

Source name	Number of samples analyzed	Range of Sum-Normalized Ca	Range of Sum-Normalized Fe	Range of Sum-Normalized Mg	Range of Sum-Normalized Mn
Sri Lanka Group 1	9	3-5%	71-76%	8-11%	4-17%
Sri Lanka Group 2 (Ratnapura?)	6	2-5%	82-87%	7-14%	<1-2%
South India	10	4-5%	80-82%	8-11%	1-7%
Phu Tho province, Vietnam	10	5-12%	53-67%	19-37%	1-9%
“India”	9	1-5%	68-77%	20-25%	1-2%
Orissa, India	10	3-9%	59-73%	23-36%	1-4%
Anthill, Arizona	6	15-35%	31-54%	22-53%	1-2%
Mozambique, Africa	6	10-13%	53-58%	29-34%	2-3%
Lam Dong province, Vietnam	2	1%	11-16%	<1%	83-87%
Total	68				

Table 8.6: Geologic sources analyzed in the current study

Three geologic samples from India were acquired from gem dealers, including samples from south India, Orissa, and an additional unknown source location in India, called “India” in

the table above (Figure 8.14). The exact location of the south Indian source is unknown, however garnet is currently mined in Tamil Nadu and Andhra Pradesh (Shigley et al. 2010). Additionally, the south Indian village of Kondapalli, Andhra Pradesh, has “long been famous” for its garnets and garnet gemstones (Bauer 1968: 354), as well as the sites of Mahurjhari, Arikamedu, and Kodumanal (Francis 2002).



Figure 8.14: South Asian garnet sources and sites discussed in this chapter.

Two groups of samples were acquired from Sri Lanka, including one group from an unknown source (Sri Lanka Group 1) and a second (Sri Lanka Group 2) that may be from the mines at Ratnapura (Katie Lindstrom, personal communication, 2010) (Figure 8.14). Sri Lanka is an important center for gemstones and may have been discussed by ancient travelers as early as the 4th century BC (Zwaan 1982). Garnet beads may have been produced at two Early Historic period sites of Anuradhapura and Tissamahara (Coningham et al. 2006; Hannibal-Deraniyagala 2001; 2005) (Figure 8.14). Currently, almandine and pyrope-almandine garnets are mined in central Sri Lanka, especially at the mines of Elahera (Gunawardene and Rupasinghe 1986) and in the southern part of Sri Lanka, including the famous mine of Ratnapura (Dissanayake et al. 2000:14; Shigley et al. 2010)(Figure 8.14).

Garnet is also quite widespread across mainland Southeast Asia, however it is not mined in the quantities seen in India and Sri Lanka. Gem quality garnets have been found in Myanmar (Shigley et al. 2010), Thailand (Aranyakanon Payome 1983), Cambodia (Chrea Vichett et al. 1999), and Vietnam (Van Long et al. 2004). Two groups of garnet geologic samples were obtained from sources in Vietnam (Figure 8.15). The first are from a garnet mine in Phu Tho province in northern Vietnam. The second set of samples consists of two garnet inclusions in a piece of quartz from Lam Dong province in southern Vietnam. This source was selected for analysis based on a suggestion that garnets from Lam Dong province may have been the source of the garnet beads found at the Early Historic site of Oc Eo, Vietnam (Francis 2002:142).



Figure 8.15: Southeast Asian garnet sources and potential source areas discussed in this chapter.

Analysis and results: Distinguishing between the geologic sources

Following LA-ICP-MS analysis, the first step was to determine which garnet species were present. As noted earlier, garnets rarely occur in their pure end-member form, and are

often a mixture of several sub-species. Recent research has provided a way to easily convert chemical analyses into molar proportions of various end-member components (Locock 2008). However, this method assumes a different stoichiometry than used in the current analysis, therefore a different approach was needed. For this reason, the major elements of almandine (Fe), pyrope (Mg), spessartine (Mn), and ugrandite series garnets (Ca) were sum-normalized to 100% as a proxy to determine the major sub-species present within a single garnet sample (Table 8.7). Based on the varying quantities of these major elements, the garnet sources were divided into three groups (Figure 8.16). Principal Components Analysis (PCA) and bivariate plots were also performed to identify more specific differences between the sources. This is discussed in more detail in Appendix 8.4. Principal Component scores used in the PCA plots in this chapter are listed in Appendix 8.4.

The almandine-rich group contained samples from Sri Lanka Group 1, Sri Lanka Group 2, and South India. Per the sum-normalized table, garnets in this group were predominantly iron rich almandine (70-87% Fe) with moderate amounts of pyrope (7-14% Mg) and lesser amounts of spessartine and ugrandite-series garnet. The second group, which I will call almandine-pyrope, contained garnets with a high percentage of Fe (44-77%), but higher levels of pyrope than the almandine group. These garnets also contained higher concentrations of Ca than Mn (Table 8.7). The sources in this group included Phu Tho, the unknown Indian source, Orissa, Anthill, and garnets from Mozambique. The final group consisted of garnets from a single source: Lam Dong. Although only two garnets were analyzed, these samples were clearly different from the other sources and artifacts due to the high levels of Mn (83-87%), classifying them as spessartine garnets.

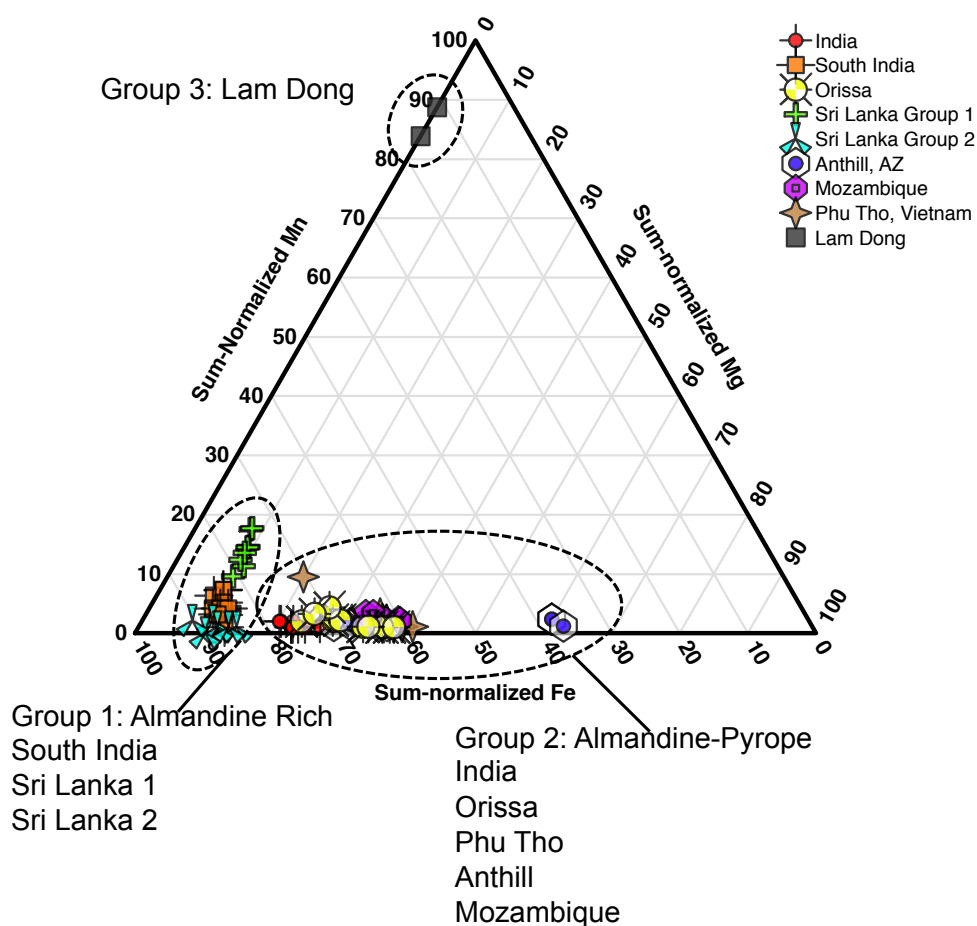


Figure 8.16: Ternary diagram of sum-normalized Fe, Mn, and Mg noting three different groups of garnets: group 1 (almandine rich), group 2 (almandine-pyrope), and group 3 (Lam Dong garnet).

Assigning garnet artifacts to geologic sources

As with the geologic sources, the first step when examining geochemical data from the garnet artifacts was to classify them into different groups based on the sum-normalized totals of their major elements (Table 8.8). The Angkor Borei and Porunthal garnet artifact belonged to the

almandine rich group. However, despite similarities with the major elements, these artifacts were clearly distinct from the geologic sources in this group. In order to identify similarities and differences between these archaeological samples and the almandine-rich garnet sources, a PCA was performed using the elements Co, Tb, V, and Zn. Figure 8.17 shows both the artifacts and source samples plotted by their first and second components. These artifacts plot near to the South India source, although they are distinct from this source due to higher levels of Co and Zn. It is also notable that the Angkor Borei garnet beads and Porunthal garnet share a similar composition. Although it is clear that the geologic source material for these artifacts has not been found, it appears that they may derive from the same source. Although I was unable to take an impression of the Porunthal perforation visual inspection indicates that the drill hole was cylindrical and similar to the Angkor Borei perforations and beads drilled using a diamond drill. It is likely that the source for both beads may be in South Asia, due to the abundance of possible sources and the predominance of this unique drilling technique. However, a Southeast Asian source cannot yet be ruled out.

Database ID	Site	Sum-Normalized Ca	Sum-Normalized Fe	Sum-Normalized Mg	Sum-Normalized Mn
AB1767	Angkor Borei	1.75%	87.02%	5.72%	5.51%
AB1835	Angkor Borei	1.69%	89.91%	5.79%	2.62%
AB2801	Angkor Borei	1.64%	88.25%	6.55%	3.56%
AB3284	Angkor Borei	1.85%	89.03%	6.56%	2.55%
AB3333	Angkor Borei	1.94%	89.77%	5.85%	2.44%
AKC00310	Village 10.8	20.36%	36.68%	41.54%	1.42%
AKC00311	Village 10.8	20.23%	39.52%	38.79%	1.46%
AKC00338	Village 10.8	19.27%	36.66%	42.68%	1.39%
AKC00339	Village 10.8	19.06%	35.11%	44.59%	1.24%
AKC00590	Prohear	19.18%	43.31%	35.91%	1.59%
AKC00606	Prohear	18.88%	43.43%	36.12%	1.57%
AKC00651	Bit Meas	18.74%	37.54%	42.29%	1.43%
AKC00731	Bit Meas	19.54%	39.24%	39.75%	1.47%

Porunthal Garnet	Porunthal, India	1.46%	89.97%	5.25%	3.33%
PKT Garnet	Phu Khao Thong, Thailand	14.49%	54.07%	28.60%	2.84%

Table 8.7: Garnet artifacts analyzed in this study and their sum-normalized major elements.

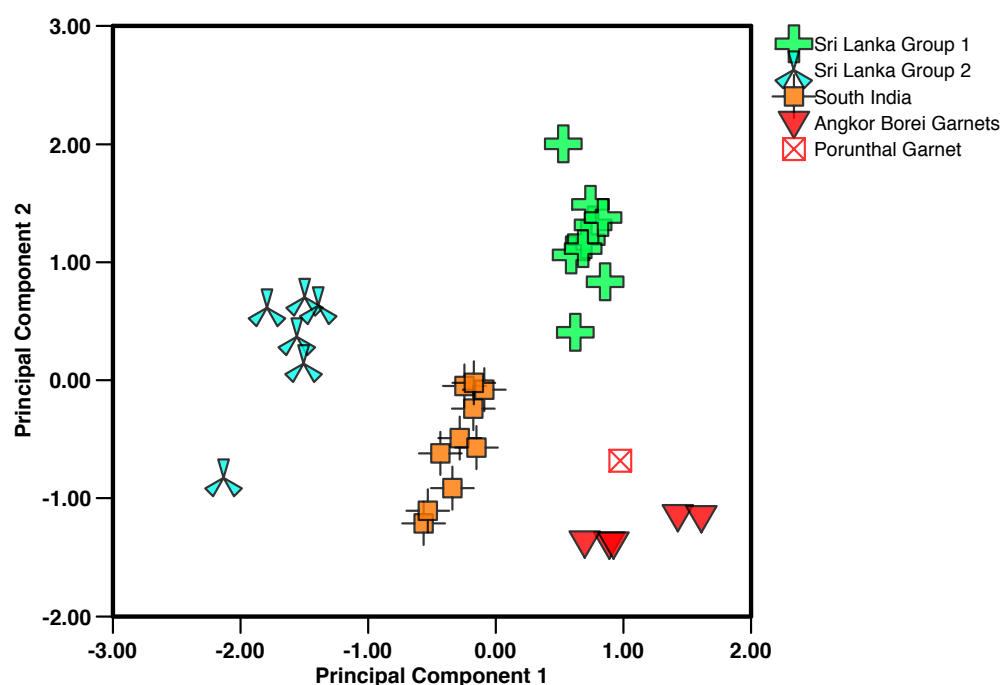


Figure 8.17: Principal component analysis of the Group 1 almandine garnets and artifacts from Angkor Borei and Porunthal. The first component summarizes 59% of the variance and the second component accounts for 32%.

The Southeast Cambodia garnets and Phu Khao Thong garnet were placed in the almandine-pyrope group, although these artifacts differed from one another. The Southeast Cambodia garnets had nearly equal proportions of Fe and Mg, a high concentration of Ca (19-20%) and a small concentration of Mn. The Phu Khao Thong garnet had higher levels of Fe and lower levels of Mg. However, when included in PCA with the almandine-pyrope geologic source groups, these artifacts clearly plot away from the other sources (Figure 8.18). The Southeast Cambodia garnets are distinctive for their moderate levels of Ca and extremely high levels of Ti

(over 2000 ppm), the highest of any garnet artifact or source sampled in this study (Figure 8.19).

This composition is similar to the group 3 “common eclogite group” garnets identified by Dawson and Stephens (1975:603). Diamonds are also commonly found within the common eclogite group, and thus examining material from contemporary diamond mining operations in South and Southeast Asia may assist in also identifying this garnet source.

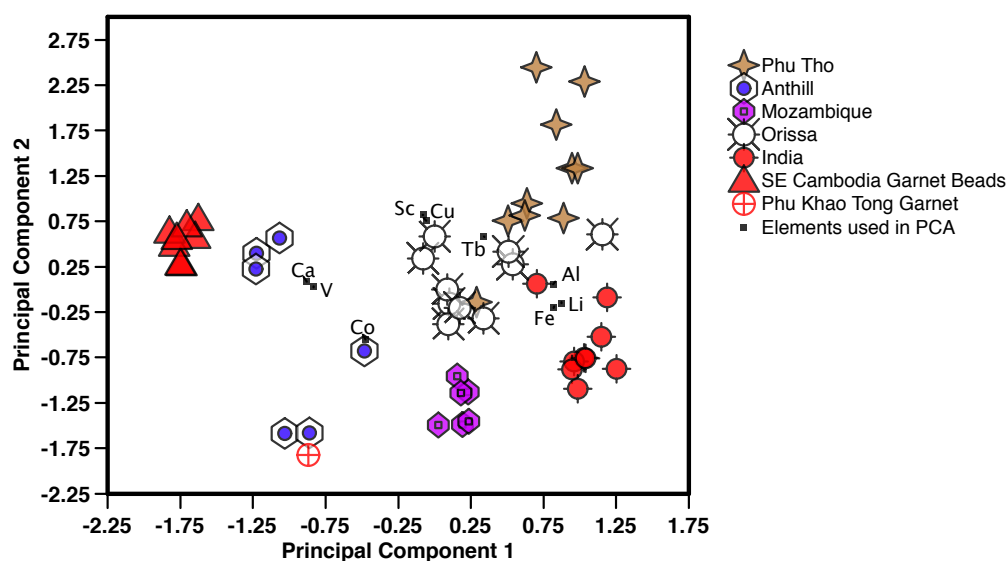


Figure 8.18: Principal component analysis of the group 2 almandine-pyrope garnets and artifacts from southeast Cambodia and Phu Khao Thong. The first component summarizes 44% of the variance and the second component accounts for 22%.

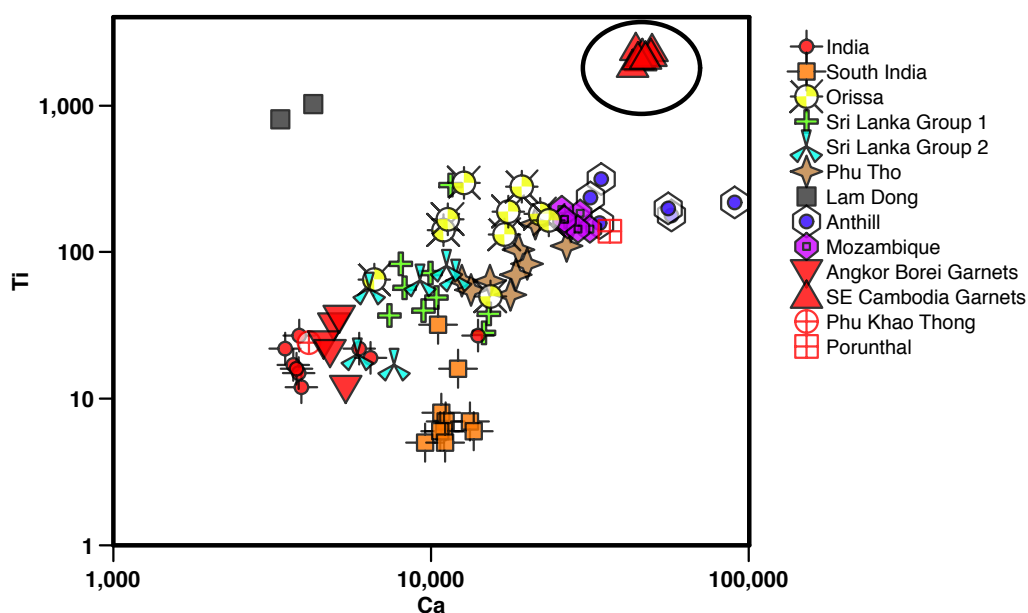


Figure 8.19: Bivariate plot of Ca vs Ti (logged). The Southeast Cambodia garnets (circled) have a high concentration of Ti in comparison with the other sources and artifacts.

The Phu Khao Thong garnet is distinguished by low concentrations of several elements, including Sc, V, and Y. Although the Phu Khao Thong garnet plots near the Anthill sources, it is clear that this garnet piece did not come from Arizona. Rather, it is more likely that the Phu Khao Thong artifact derives from an unknown source that shares a similar composition to the Anthill source. It is notable that this sample is also compositionally distinct from the other garnet artifacts, and points toward the complex bead production and trade networks in play during the Iron Age period. Phu Khao Thong was an important international trading center during the Iron Age and Early Historic period with numerous artifacts from South Asia (Noonsuk 2005: 42); therefore it is possible that this piece could derive from a source in either South or Southeast Asia.

Other potential sources

Although the sources for the archaeological garnets have not yet been found, there are numerous potential sources in South and Southeast Asia. As noted above, diamond-mining sites in Vietnam often yield garnet deposits. Kane and others have also noted the widespread presence of garnets associated with sapphire, zircon, and ruby deposits in southern Vietnam (1991: 153). Large garnets have also been discovered near Bien Ho in central Vietnam (Figure 8.15) (Kane et al. 1991). It is possible that one of these deposits could be the source location for the SEA Garnet Beads. However, the restricted distribution of these artifacts strongly suggests a source located somewhere in southeast Cambodia or southern Vietnam. Further analysis will be needed to confirm to identify this source.

In their recent study, Calligaro and others (2002) identified three garnets that they believe originated from South Asia. Type 1 from an unknown Indian source is described as quasi-pure almandine, Type II believed to be from Rajasthan, India was classified as almandine with manganese, while Type III an intermediate “rhodolite” or almandine-pyropite, was believed to come from Sri Lanka. Although compositional data was only provided for the elements Fe, Mg, Ca, Mn, Cr, and Y (see Calligaro et al. 2002 Table 1), it appears that the South Asian garnets in this study are distinct from the sources studied by Calligaro. This highlights the great diversity of garnet sources found across South Asia. Opportunistic analysis of the garnet samples from Porunthal and Phu Khao Thong India point toward at least three distinct garnet sources used during the Iron Age period. A more comprehensive study using well-provenienced sources would have much archaeological value.

Conclusion

This chapter presented morphological evidence, SEM analysis of bead perforations, and geochemical compositional data to demonstrate that the beads from Angkor Borei and sites in southeast Cambodia (Village 10.8, Prohear, Bit Meas) are different from one another. Although LA-ICP-MS was able to successfully measure and differentiate between geologic sources and artifacts, the inability to accurately characterize the proportion of garnet end-members within a sample using Locock's methodology (2008) is a drawback to this technique. Future studies may wish to combine LA-ICP-MS with techniques such as SEM-EDS to measure major elements. Additionally, future studies may wish to use more than five point ablations per sample in order to better account for the zoning of elements, as well as including additional samples in order to better characterize and understand the variation within a single source.

Despite these caveats, I argue that the geochemical and morphological evidence suggests that there was both importation and local manufacture of garnet beads. In the beginning of this chapter I introduced several questions that I would like to consider in more detail.

What are the morphological and manufacturing differences between the Angkor Borei garnets and garnet beads from Village 10.8, Prohear, and Bit Meas?

The Angkor Borei garnets have been shaped and polished. Additionally SEM analysis of drill hole impressions indicates that these beads were drilled using a diamond-drilling technique. This technique is strongly associated with the South Asian beadmaking industry. Conversely, the beads from southeast Cambodia do not appear to have been shaped or polished. SEM analysis of the drill hole impressions suggest beads were drilled using copper, wood, or stone

drills with an abrasive, techniques that were likely used in the local nephrite jewelry production industry. I argue that the SEA Garnet Beads are the product of a local bead production industry.

Are there geochemical differences between beads from Angkor Borei and beads from Prohear, Bit Meas, and Village 10.8, and is there geochemical evidence for production of garnet beads using Southeast Asian stone sources?

LA-ICP-MS analysis confirms that there are clear geochemical differences between the two sets of beads. However, the limited number of geologic sources analyzed did not allow for the identification of the geologic sources used to produce either set of beads. Therefore, there is not yet clear geochemical evidence for production of beads in Southeast Asia. Nevertheless, a compositional similarity between the Angkor Borei beads and the bead from Porunthal, as well as the diamond drilling technique used, and the long history of bead production in South Asia strongly suggest an origin for these beads in South Asia. This connection with South Asia is not surprising, as noted earlier Angkor Borei is believed to have been an important trading center. Evidence from agate and carnelian beads suggests connections with South Asia. However, we cannot yet rule out possible bead production in Southeast Asia. Oc Eo was believed to have been a stone bead production center (Malleret 1962) and Francis has argued that bead-making traditions at Oc Eo may have ultimately derived from Arikamedu, India (2002). Despite their unknown manufacturing location, it is interesting to note that similar garnet beads have not yet been recorded at other Iron Age sites in Cambodia and only in small quantities at other sites in the region, and thus were not broadly distributed like agate, carnelian, and glass beads.

Although there is not yet clear geochemical evidence for the local production of the garnet beads from southeast Cambodia, the limited distribution of the unique garnet beads found

at sites in Southeast Cambodia and southern Vietnam suggests that bead were likely locally produced. Southeast Asian craftsmen were familiar with hard-stone jewelry production, as objects made from nephrite had been manufactured and widely distributed in Southeast Asia since the Neolithic period (e.g. Hung et al. 2007; Nguyen 1996). In contrast, SEA Garnet Beads seem to have been manufactured in smaller quantities and had a more localized distribution. They reflect a different scale and type of craft manufacturing and distribution from the local nephrite jewelry industries.

Nevertheless, as the exact geologic sources for these beads have not yet been identified, I cannot yet rule out that the beads from southeast Cambodia may have been imported. Garnet beads made from natural stones have also been reported from sites in southern India, including Arikamedu (Francis 2004: 493), Kodumanal (Gwen Kelly, personal communication, 2011) and Porunthal, although some of the beads from this site appear to have been polished. However, there has not yet been in-depth examination of the drilling method used to make these beads and it is possible they share similar drilling patterns as seen with the garnet beads found in Southeast Cambodia. Drilling techniques in India did vary by region and workshop, for example Peter Francis has noted that copper drills and abrasives were being used in western and southern India. However, he argued that by the time India began more extensive maritime relations with Southeast Asia “the double-tipped diamond drill was established” (2002: 110). Additionally, the Indian natural stone beads differ in that photographs indicate they may have been polished. Although garnet bead production is still poorly understood, the ubiquity of the double-diamond drilling technique in South Asia, the lack of this drilling technique amongst the beads from southeast Cambodia as well as their restricted distribution in southern Cambodia and Vietnam

points toward the presence of a local Southeast Asian hard stone beadmaking tradition. It is hoped that continued analysis of geologic source samples would eventually identify the raw material source for both sets of beads.

What can these beads tell us about trade and exchange networks during this period?

The limited distribution of the garnet beads from southeast Cambodia and similar beads in southern Vietnam is notable and indicates that these beads may have been produced only for a regional exchange network connecting a geographically limited set of communities. While sites in southeast Cambodia had access to goods traveling through broader trade networks, including Dongson drums and agate and carnelian beads, the garnet beads do not appear to have been traded within these networks. The limited burial data also suggest that garnet beads were not found solely within burials that had large numbers of grave goods and may have been widely accessible to community members. It is possible that these distinctive beads may have also had unique and localized meanings and values, separate from imported carnelian and glass beads, whose value may have been related to their association with foreign craft producers (e.g., Bellina 2003).

The limited distribution of shaped, polished, and diamond-drilled garnet beads, like those found at Angkor Borei also points to a more restricted exchange of these artifacts than the agate/carnelian and glass beads. Numerous garnet artifacts have been reported at coastal sites in Vietnam and Thailand and at the Mekong Delta sites of Angkor Borei and Oc Eo. However, these beads have not yet been found at inland sites. Perhaps these objects were not popular among inland communities or people in coastal communities did not choose to include these objects in exchange networks with inland communities.

Data from garnet beads at both Angkor Borei and the southeast Cambodian sites highlight that there were multiple complex trade networks in play during the Iron Age period. Some of them may have been emphasizing regional connections such as in southeast Cambodia. While the Angkor Borei garnet beads appear to be tying this site with long-distance exchange networks in South Asia, and perhaps to other coastal communities participating in similar long-distance exchange networks. In the final chapter, I consider the data from this chapter in combination with the agate and carnelian and glass data in order to address questions regarding trade networks, the control of trade, and emerging socio-political complexity in the Mekong Delta during the Iron Age period.

Chapter 9: Discussion and Conclusion

In previous chapters I presented evidence from agate/carnelian, glass, and garnet beads identifying different bead types and patterns in their geographical distribution. In this final chapter, I use these data to return to the questions raised in Chapter 1, explore in more depth the different trade and exchange networks present during the Iron Age period, and discuss the implications for socio-political development in the Mekong Delta. I begin by addressing evidence for distinctive bead trade networks over time and space. I then discuss how the glass and stone bead data can be used to identify emerging socio-political and economic networks in the Mekong Delta during the first few centuries AD. This is concluded by a brief discussion of people who had a high quantity of beads in their burial, followed by a discussion of the accomplishments of this dissertation and directions for future research.

Bead trade and exchange patterns over time and space

Connections to early coastal exchange networks

As discussed in Chapter 3, archaeological evidence across mainland Southeast Asia suggests two broad phases of interaction with South Asia (Bellina and Glover 2004): an earlier phase (Phase 1) during the mid-late first millennium BC, in which there was more sporadic trade with a variety of objects. This was followed by a later phase (Phase 2) of more intense trade during the early first millennium AD, in which there was a greater quantity of goods, but less variety than Phase 1. Scholars have noted a difference in the type of glass and stone beads available during each of these periods (Bellina 2003, 2007; Lankton and Dussubieux 2006, 2013). During Phase 1 (last half of the first millennium BC into the early centuries AD) agate and

carnelian beads are generally found in more complex shapes, are of a higher quality, and with a smaller perforation size, although generally drilled with a diamond drill (Bellina 2003, 2007). Additionally, potash glass beads are found in high quantities at sites across mainland Southeast Asia (Lankton and Dussubieux 2006, 2013).

The Period 1 type agate and carnelian beads have predominantly been found at sites on the coasts or with links to coastal exchange networks (Bellina 2007). In Bellina's (2007) study, the early sites with the Period 1 Type beads also contained nephrite ear ornaments, evidence of connections to the Sa Huynh culture and participation in these coastal exchange networks. Furthermore, potash glass predominantly has also been found at coastal sites in northern and southern Vietnam, as well as peninsular Thailand, and at the important Thai trading site of Ban Don Ta Phet (Lankton and Dussubieux 2006, 2013). I argue that agate, carnelian, and potash glass beads were being incorporated into pre-existing regional trading networks that were already linking coastal sites and important inland sites to one another through the exchange of prestige objects including nephrite ear ornaments (Christie 1990, 1995; Dzung 2011) (Figures 9.1 and 9.2). Elites appear to have been incorporating these new objects into the pre-existing repertoire of personal ornaments (Bellina 2007).

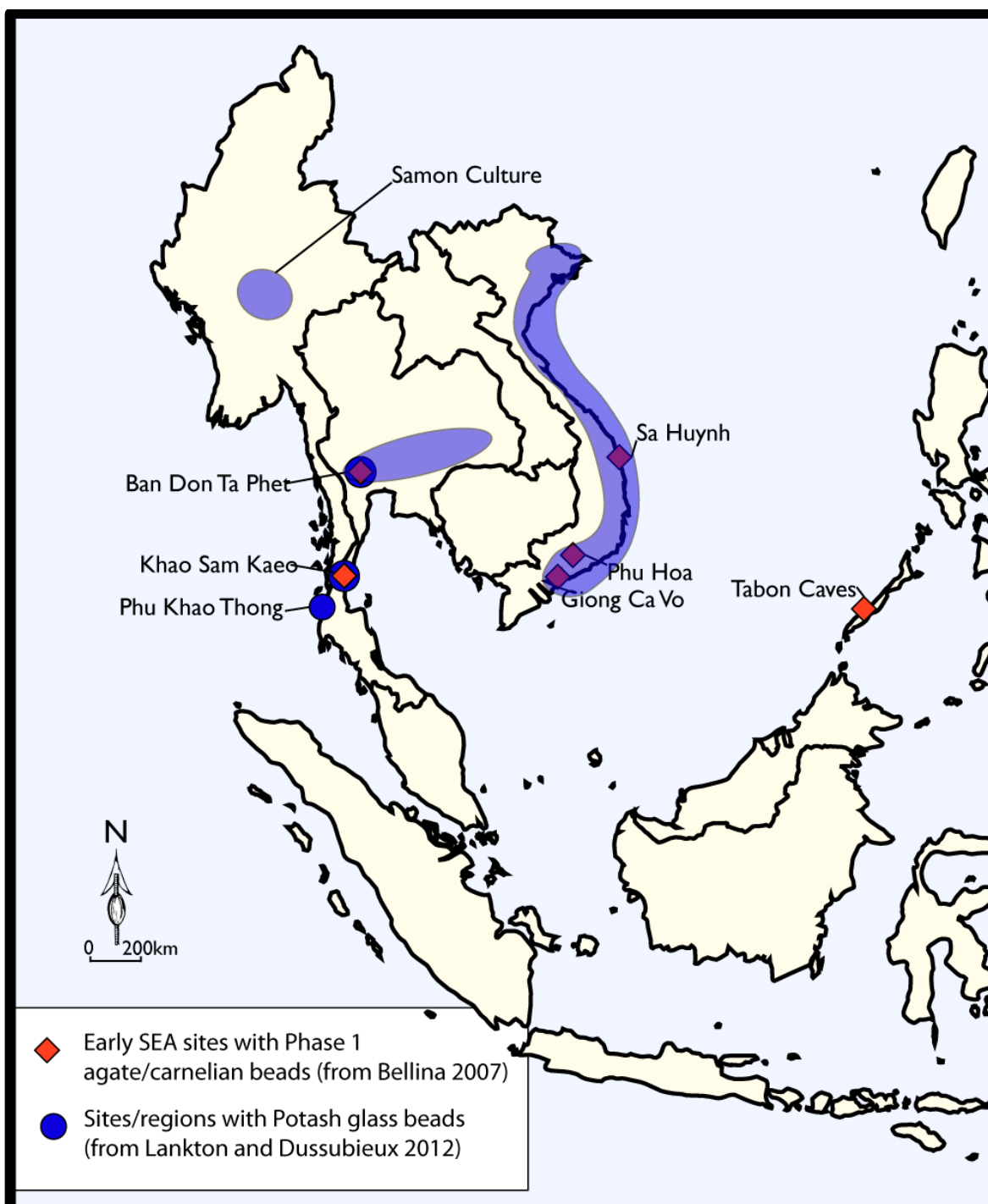


Figure 9.1: Map showing locations of sites with Phase 1 agate/carnelian beads and potash glass based on previous studies by Bellina (2007) and Lankton and Dussubieux (2013). Note the similarity in the distribution of these objects with the distribution of nephrite ear ornaments in mainland Southeast Asia noted by the blue and yellow stars in Figure 9.2 (below).

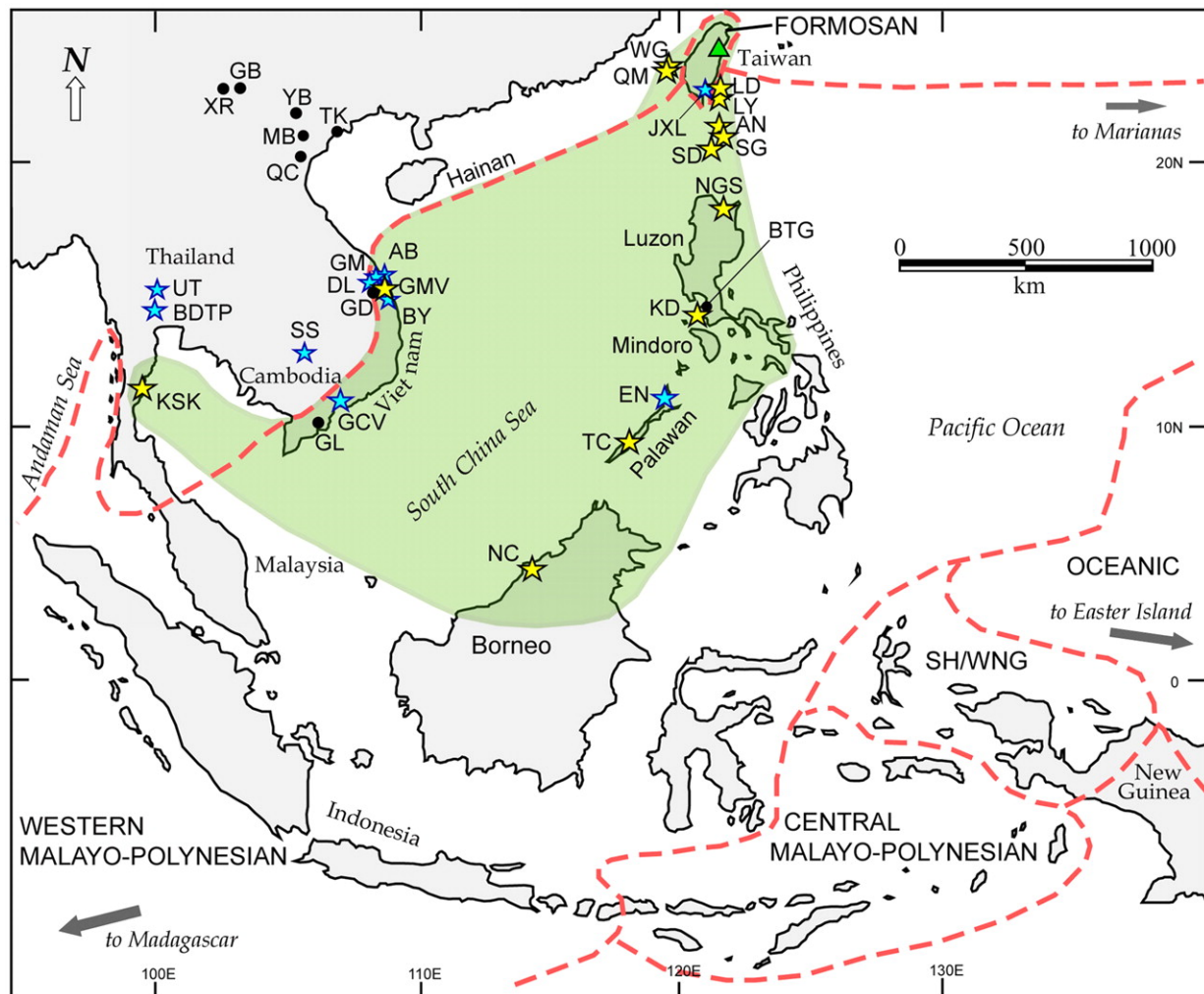


Figure 9.2: Map of the distribution of Taiwan nephrite artifacts in Southeast Asia from Hung et al. 2007 (Figure 3). The green shaded area represents the currently known distribution of Taiwan nephrite artifacts. The Fengtian nephrite deposit is noted by the green triangle. Yellow stars represent sites outside Taiwan with positively identified Fengtian nephrite artifacts and blue stars represent sites with jade artifacts of possible Fengtian origin. Black circles denote sites that have identified nephrite of non-Fengtian origin.

The question still remains if the agate, carnelian, and glass beads found at these sites during the early Iron Age actually originated in South Asia. Bellina (2007; Bellina and Glover 2011) has argued that evidence from Khao Sam Kaeo suggests that Indian craftsmen may have been living and working in Southeast Asia and several scholars (Glover and Henderson 1995; Lankton and Dussubieux 2006) have suggested that some potash glass may have been manufactured in northern Vietnam or southern China. Although more evidence is needed, one

could argue that Southeast Asians may not have associated these objects with South Asia or afforded them the prestige associated with exotic objects traded through long-distance exchange networks (Helms 1993). However, based on evidence from the current study, including the uneven distribution of stone and glass beads both within sites and between sites, I argue that stone and glass beads were considered to be prestige objects.

Based on the presence of Period 1 type agate and carnelian beads and large numbers of potash glass, I argue that sites in southeast Cambodia, Village 10.8, Prohear, and Bit Meas, as well as the peninsular Thai site of Khao Sam Kaeo had connections to these early coastal exchange networks (Figure 9.3). Promtin Tai in central Thailand may also belong to this group, but will be discussed separately below. Khao Sam Kaeo has already been considered to be an important early urban center and trading site by other scholars (Bellina 2007; Bellina and Silapanth 2006, 2008; Glover and Bellina 2011; Lankton et al. 2008). My new research using different sets of data provides additional confirmation of patterns suggested by these earlier scholars. However, my research has added new information by showing that sites in southeast Cambodia, located farther inland than other coastal sites noted above, also appear to be connected to these coastal exchange networks. Although Prohear had only a few agate and carnelian beads, the hexagonal flattened bicones are an especially diagnostic type associated with sites involved in the coastal exchange networks (Theunissen 2003). Fragments of or whole Dongson drums have also been found at all three sites (Reinecke et al. 2009; Heng 2005) and Prohear may even share connections with sites further to the northeast in southern China (Reinecke et al. 2009: 166-7).

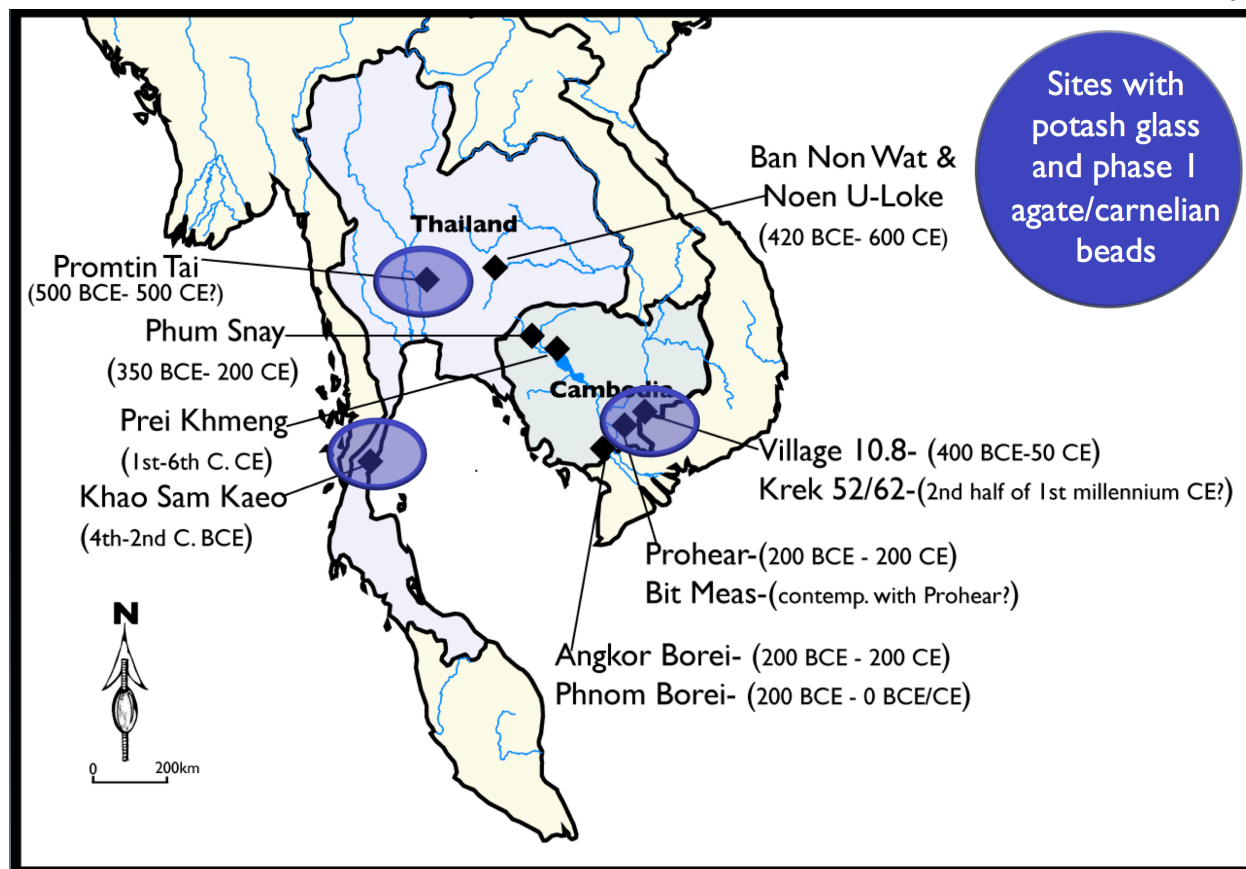


Figure 9.3: Map of sites in this study with potash glass beads and Phase 1 agate/carnelian beads.

It is likely that Krek 52/62, a circular earthwork site located near the other southeast Cambodia sites discussed above, may belong within this group as well. While the single carnelian bead included in this study was not particularly diagnostic, evidence from glass artifacts and a garnet bead link this site with both regional and coastal exchange networks. As noted in Chapter 7, potash glass beads were also found at Krek as well as a bangle fragments that appears compositionally similar to those produced at Khao Sam Kaeo. Taken together, this evidence suggests that Krek 52/62 had contact, although limited, with regional coastal exchange networks.

It is not clear how people living at these inland settlements were involved in the broader coastal exchange networks, however they likely provided natural or forest products for exchange to a coastal trading hub in a method suggested by Bronson (1977). Documents historic documents from later periods discuss the exploitation of aromatic woods, spices, and bird feathers from the forests (Reid 1988, 1992). Northeast Thailand was a well known source of salt during the prehistoric and historic periods (Nitta 1999), while the Thai/Malay peninsula was likely an important source for tin (Bronson 1992). It is unlikely that each of these sites had direct contact with a coastal site, for example, the distribution of locally made garnet beads in southeast Cambodia and mixed alkali glass in Northeast Thailand point toward a strong localized trading network connecting inland sites to one another.

These coastal exchange networks are associated with the early Iron Age period during the mid-late first millennium BC. While both Khao Sam Kaeo and Village 10.8 date to this early period, it is notable that Prohear- and perhaps Bit Meas- date to a slightly later period (200 BC – AD 200) and is contemporary with sites associated with a different trade network. I suggest that while there is a temporal dimension to the changing trade networks with South Asia, there was also a period of overlap when the two networks coexisted. During this period, elites at coastal sites may have been competing with newly emerging elites at sites in the Mekong Delta whose access to greater quantities of goods from South Asia may have allowed them to expand their influence and power.

Regional exchange: Southeast Cambodia

The sites in southeast Cambodia: Prohear, Bit Meas, Village 10.8, and possibly Krek 52/62, had both Period 1 type agate and carnelian beads and potash glass, connecting them to a

broad, regional, exchange network focused on coastal sites. However, these sites also contained another unique object: garnet beads. The garnet beads appear to have been produced locally and thus far have been found only at sites in southeast Cambodia and at one site on the Vietnamese border in southern Vietnam. I argue that these beads were important objects that connected the communities in this area to one another. The agate, carnelian, and glass beads likely circulated in similar exchange networks. Through these connections, communities may have been able to solidify alliances and in some cases may have helped buffer communities from “structural change” (White and Eyre 2010) or encouraged increased complexity through peer-polity interaction (Renfrew 1996). Future research on sites at a regional level will be able to help clarify the extent of connectedness between communities.

The presence of a garnet bead of this type in the upper layers of Krek 52/62 suggest some cultural continuity or connections between the somewhat older communities that lived in the circular earthwork sites of southern Cambodia and Vietnam and these slightly later communities. Analysis of ceramics at circular earthwork sites intimates that the earthwork sites were not exchanging ceramics with sites in the floodplains and that they were likely “a distinctive cultural grouping or tradition” (Latinis and Dega 2012: 73). The circulation of garnet beads among communities in this region may be an extension of the pre-existing, seemingly tightly knit, cultural groups in this area during the Neolithic and Bronze Age periods.

Regional exchange: Northeast Thailand

In the current study it was not clear if agate and carnelian beads from Ban Non Wat and Noen U-Loke in Northeast Thailand belonged to either the Phase 1 or Phase 2 groups. The agate and carnelian beads at Noen U-Loke were not examined in depth, and the beads from Ban Non

Wat could not be clearly classified perhaps due to the long occupation sequence at this site.

However, evidence from other archaeological artifacts found at sites in the Khorat Plateau of Northeast Thailand emphasize the strong regional exchange network among sites in this region, including the exchange of unique objects found infrequently in other parts of Southeast Asia.

Archaeologists David Welch (1995, 1989) and Judith McNeill (1991) have also noted the strong intra-regional trade network on the Khorat Plateau especially as evidenced by the widespread distribution of a pottery type known as Phimai black. These authors have proposed a possible “interaction sphere” amongst Khorat Plateau communities, similar to the Hopewell Interaction Sphere in North America (Caldwell 1964; Struever 1964). More recently archaeologists Bill Boyd and Nigel Chang have argued that the moated settlement pattern may have resulted in a strong “regional self-identity,” among the communities in this Khorat Plateau (Boyd and Chang 2010: 291).

Previous work by Theunissen (2003) on the stone beads at Noen U-Loke identified a distinctive type of notched agate pendant that was found primarily at sites in Northeast Thailand, with smaller quantities in central Thailand and elsewhere in mainland Southeast Asia. This type of pendant is unique to Southeast Asia and infrequently found India. Theunissen found this distribution pattern to be so significant that he suggested these notched agate pendants may have been manufactured in this region (Theunissen et al. 2000). However, compositional analysis does not clearly indicate that these artifacts were produced using local raw materials, as suggested by Theunissen and others (2000). In fact, the manufacturing location of these agate pendants is not clear. However we could speculate that this unique bead shape may have been commissioned by locals, similar to what may have been happening at Khao Sam Kaeo.

In my analysis of glass beads, I found that during the early Iron Age Noen U-Loke and Ban Non Wat did not have large amounts of potash glass, which would have tied them to the coastal exchange networks discussed above. Instead these sites had high quantities of wrapped orange opaque beads made from a mixed alkali glass. This type of glass appears to have been found in other regions of Northeast and central Thailand as well (Pilditch 1992; Saitowitz and Reid 2001). These beads were produced using a distinctive manufacturing method not found in other beads in this study and the composition of the mixed alkali glass was also not immediately identifiable to a specific workshop. It is possible that these beads may have been produced somewhere in Northeast or central Thailand (Carter and Lankton 2012). Taken together, I argue that sites in the Khorat Plateau participated in a strong regional interaction network that circulated specific types of objects, some of which were or may have been locally produced.

Charles Higham, in his recent summary of Iron Age socio-political and cultural development in the Mun River Valley, Northeast Thailand (2011b) has noted that a variety of factors, including the introduction of exotic new prestige goods like stone and glass beads could have provided an opportunity for individuals in a community to expand their power by controlling the exchange of these objects. Higham explicitly draws connections with examples from North America and Malawi, noting that in both regions the introduction of new long-distance exchange contacts and exotic prestige objects spurred increasing socio-political complexity and attempts to increase social status by local leaders (2011b: 139-140). The glass and stone bead evidence can be contextualized as part of these socio-political developments. However, I argue that they must also be situated as part of a long-standing regional exchange sphere. The cyclical fluorescence and decline of social status seen in burials in both the Bronze

and Iron Age periods at Ban Non Wat (Higham 2011a, 2011b) may be related to the inability of elites at any these sites to monopolize the exchange of these prestige objects over the long term. This in turn prevented the emergence of a single dominant center that may have controlled trade during this period as seen in the Mekong Delta.

The importance of regional exchange networks during the early Iron Age

The two examples presented here are part of a larger trend recognizing the diversity of Iron Age communities in mainland Southeast Asia. A recent article by White and Eyre (2010: 59-60; White 2011) examining ceramics and mortuary ritual in Thailand has identified “enduring supravillage social groupings that used stylistic and technological practices and ritual behaviors to signal, demarcate, and maintain group identities in a regional system of dynamically counterpoised and geographically situated ‘middle range societies.’” The authors argue that their work in Thailand has evidence that the emergence of social complexity was “contextually specific” (White and Eyre 2010: 60). Using a different set of data, i.e., glass and stone beads, I agree with their interpretation. Although pottery is locally produced and glass and stone beads were likely imported to these sites, both objects were used in mortuary ritual. Evidence from glass and stone beads support previous research identifying the interaction sphere connecting sites in Northeast Thailand to one another, as well as a similar regional group identity in southeast Cambodia, extending into southern Vietnam.

I believe that as archaeological research is continued, especially in Cambodia, additional regional cultural groups will be identified. Survey work in the landscape around Angkor Borei has identified numerous settlements (Stark 2006a). Work in northwest Cambodia has also identified numerous Iron Age sites including Krosaing Thmei and Phum Sophy, both located

close to Phum Snay. A preliminary examination of glass and stone beads from Sophy shows a strong similarity to the bead collections at Phum Snay. Photographs of beads from Krosaing Thmei also show a resemblance to the Phum Snay collections (Sok Keo 2005). Excavations at Phum Snay have uncovered many iron weapons and examinations of the looted skeletal material suggest a high level of violence (Domett et al. 2011). Therefore, we must wonder if the regional interactions between sites in this area may not have been entirely peaceful. A study of the bead collections from additional sites in this area may help clarify the relationships between these communities and evidence for competition between these groups.

Some of the mortuary evidence presented in this dissertation has highlighted the diverse ways in which beads were used and deposited in burial contexts. There does not appear to be any consistent pattern regarding the use of stone and glass beads in mortuary ritual across the ten sites with mortuary data. At Prohear, nearly every burial had glass beads; while at Village 10.8 there were more burials with agate and carnelian beads than with glass. At several sites there were burials with many beads that appeared to indicate elites, while at Angkor Borei jumbled and intensively used cemetery made it difficult to associated beads with specific individuals. At Noen U-Loke a child was buried with over a thousand glass beads, while at Prei Khmeng an adult female had a similar grave offering. A more comprehensive study of mortuary ritual and material culture in these areas would prove fruitful.

An emphasis on regional interaction networks can also be seen as part of earlier discussions noting the importance of peer-polity interaction (Renfrew 1992) and the emergence of socio-political complexity in mainland Southeast Asia. Research by Christie has suggested that peer-polity interaction between communities in the maritime region of peninsular and insular

Southeast Asia was crucial to the emergence of states in this area (1995). Peer-polity interactions also were important for the emergence of complex societies in the Thai-Malay peninsula. Competition between communities for access to goods and exchange networks may have encouraged increased complexity and the local adaptation of South Asian religion and socio-political organization in this region (Noonsuk 2005). Other scholars have suggested peer-polity interaction was important in northern Vietnam and southern Yunnan (Kim 2010), and the Dvaravati sites in central Thailand (Mudar 1999). Further research on Iron Age sites in Southeast Asia will likely clarify the influence that these communities had on one another.

Promptin Tai: Participation in multiple exchange networks?

The glass and stone bead data I presented from Promptin Tai implies that this site may actually span both the early and later Iron Age periods, making it unique among the sites studied in this dissertation. Unfortunately, a lack of reliable radiocarbon dates or clear burial seriation forces one to consider the bead collection as a whole. The majority of the beads found were high alumina soda glass, however approximately 17% of the beads may belong to the potash glass group indicating that people at this site had access to these materials through the early coastal exchange networks. Furthermore, the agate and carnelian beads at the site did not clearly fall into either Phase 1 or Phase 2 types. The presence of agate pendants ties Promptin Tai in with sites in Northeast Thailand where this bead shape is more common, while a flattened hexagonal bicone indicates a connection with coastal exchange networks to the south and sites like Prohear and Khao Sam Kaeo. Furthermore, the glass artifacts at Promptin Tai were amongst the most diverse of the sites studied, with ties to other sites in central Thailand as well as peninsular

Thailand and beyond. I argue that these data indicate that people at Promptin Tai had access to multiple bead exchange networks over both time and space.

Sites in central Thailand such as Promptin Tai had access to numerous trade networks through riverine networks that connected this region to the Gulf of Siam, coastal Cambodia and southern Vietnam, and sites in the Thai/Malay peninsula. Additionally, the western Chao Phraya River Valley has connections with the Three Pagodas pass and overland routes to Myanmar and eastern India. I believe that the glass and stone bead data from Promptin Tai highlights this community's access to a diverse group of beads through multiple different trade networks. More fine-grained research at additional sites in central Thailand would allow for this hypothesis to be tested further. Careful excavation and dating of burials could assist in identifying how different bead types changed over time, and the relationship changing access to various bead types had to changing trade networks.

Data from sites in central Thailand dating to the Dvaravati period, which just post-dates the Iron Age period, indicate similarities in material culture to Oc Eo and the Mekong Delta. These similarities were so strong that researchers described some of these sites as belonging to the Funan culture (Bronson 1976). However, additional research has identified them as part of a local tradition (Glover 2011). Nevertheless, there is evidence for strong archaeological connections between the Mekong Delta and central Thailand during the mid-first millennium AD. The presence of high alumina soda glass and some Phase or Period 2 agate and carnelian beads at Promptin Tai may indicate contacts between these two regions during the Iron Age period as well.

Intensification of trade networks during the later Iron Age

During the later Iron Age period, the first few centuries AD, interaction with South Asia appears to have intensified. A larger quantity of South Asian derived goods appears in the archaeological record, although the diversity of these goods is less than the previous period (Bellina and Glover 2004). Agate and carnelian beads are found in larger quantities, but most beads have simple shapes and are of varying and often lesser quality than during the previous period (Bellina 2001, 2003, 2007). Furthermore, potash glass appears to fade away and is replaced by large quantities of high alumina soda glass beads, which are found at sites across Southeast Asia. During this period, trade networks were expanding not just between South and Southeast Asia, but also within Southeast Asia (Bellina and Glover 2004). I argue that some of these expanding trade networks are tied with the expansion of polities in the Mekong Delta.

In the current study there were several sites that had both high alumina soda glass beads and Period 2 type agate and carnelian beads: Angkor Borei, Phnom Borei, and Phum Snay. Prei Khmeng had large numbers of high alumina soda glass, and only one carnelian bead that was not examined. The later phases of Ban Non Wat and Noen U-Loke also contained large numbers of high alumina soda glass, although as discussed above the classification of the agate and carnelian beads is not yet clear (Figure 9.4).

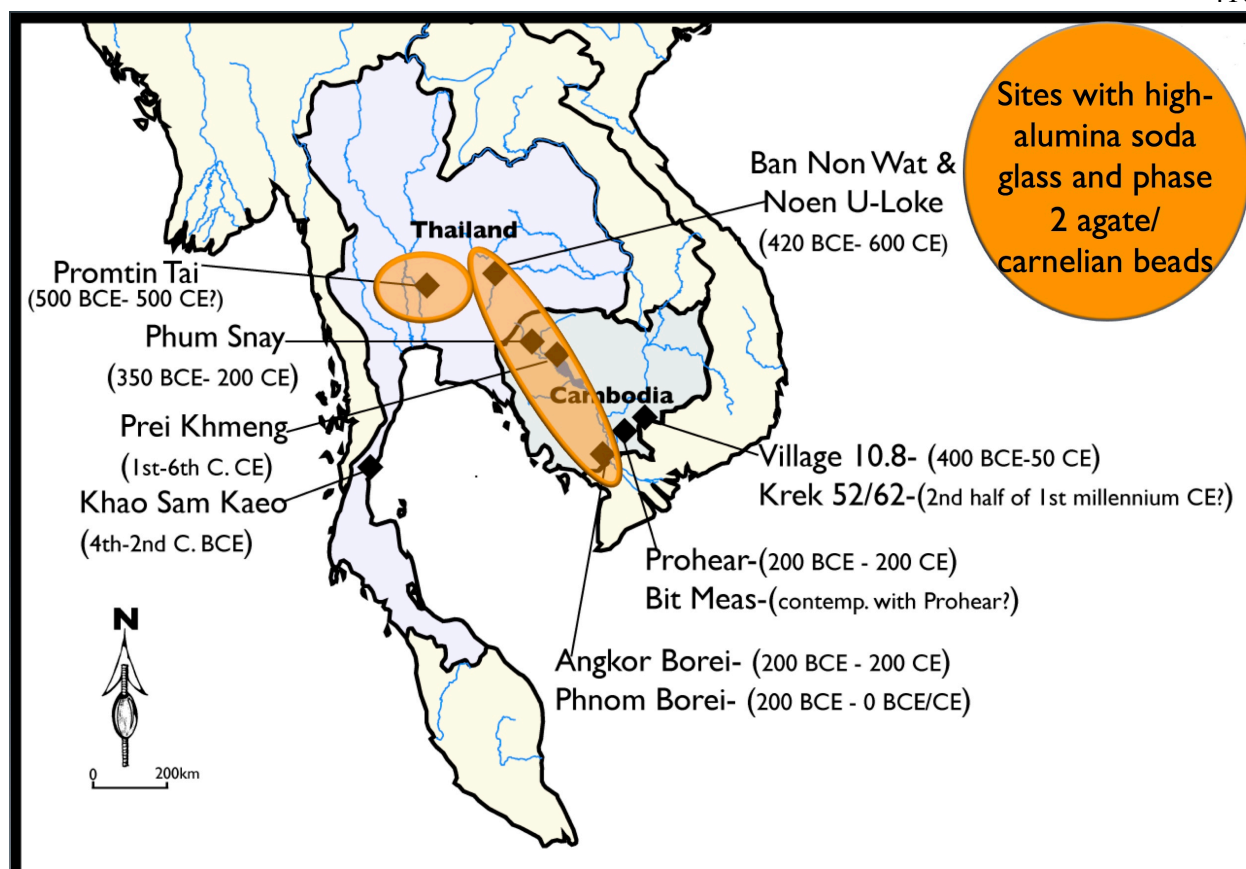


Figure 9.4: Sites in this study with high alumina soda glass beads and Phase 2 agate/carnelian beads.

Previous studies of glass artifacts from Angkor Borei and Oc Eo emphasized that these two sites had much higher proportions of high alumina soda glass than other sites in the region, arguing that this glass type was “over-represented” in this area (Stark and Dussubieux 2002). Additionally, large quantities of potash glass have not been found at either of these sites, and only a small quantity identified at the site of Phnom Borei, suggesting that this particular area of the Mekong Delta was not heavily involved in the early coastal exchange networks discussed above. Archaeologists have also noted that the appearance of Oc Eo culture sites in Vietnam is rather “sudden,” (Manguin 2009: 108). Glass and stone bead evidence from the inland sites of Phum Snay, Prei Khmeng, Ban Non Wat, and Noen U-Loke also do not appear to have been intensively involved with the early coastal exchange networks. I argue that these sites were not

active participants in long-distance bead exchange networks until the later Iron Age period when the appearance of greater quantities of stone and glass beads indicates the formation of new trade networks. The distribution of stone and glass beads can be seen as markers for expanding socio-political and economic networks between elites in the Mekong Delta and communities at inland sites.

Changing patterns of socio-political organization in the Mekong Delta

I argue that the similarity in glass and stone beads found at inland sites in Cambodia and Thailand indicates expanding influence and connections between these regions and the Mekong Delta. The lack of potash glass and Period 1 type agate and carnelian beads at these inland sites points toward the absence of a strong relationship with other pre-existing coastal centers involved in long-distance regional exchange networks. Instead, the bead collections at these sites share a greater similarity to the beads found at Angkor Borei and Oc Eo, suggesting that the Mekong Delta was the primary source for these materials. As noted in Chapter 1, the exchange of prestige goods as a means of expanding connections and alliances with other communities has been extensively examined in the archaeological literature (e.g., Dillan and White 2010; Renfrew and Shennan 1982; Sabloff and Lamberg-Karlovsky 1975; Schortman and Urban 1992). Archaeological evidence and Chinese historical documents suggest that Angkor Borei and Oc Eo were expanding as centers during the early centuries AD. This is the same period that trade networks with South Asia were expanding, allowing for an influx of stone and glass beads that could be used to build alliances with elites at inland sites.

It should be noted that there is no direct evidence for control over these objects in the form of, for example, hoards or caches of glass and stone beads in elite contexts at the Mekong

Delta sites. Additionally, while it has been suggested that Oc Eo was a manufacturing center for both stone and glass beads, the primary evidence is from looted contexts, so there is no clear understanding of workshop organization. Nevertheless, I believe that the distribution patterns of stone and glass beads at Phum Snay, Prei Khmeng, Phnom Borei, Ban Non Wat and Noen U-Loke suggest that the Mekong Delta was the primary provider of beads to these communities. Furthermore, as both Angkor Borei and Oc Eo were walled, they could have used these physical barriers to control the movement of goods inside and outside of the city (e.g., Kenoyer 1998). Beads were not evenly distributed between sites, nor were they evenly distributed within burials, therefore, the distribution of these objects was being restricted.

The exact nature of the exchanges taking place between elites in the Mekong Delta and people at inland communities is still unknown. Burial evidence suggests that beads were incorporated into mortuary rituals differently at each site. I believe that people at these inland communities may have distributing beads within their communities in culturally specific ways. For example, in some communities beads could be seen as a sign of wealth or a display of connections to long-distance exchange networks and sources of power. In other communities, beads may have been bestowed upon certain individuals due to a specific role they played in the community.

Stark has noted that the ceramic traditions in the Mekong Delta differ from those found in Northeast Thailand and northwest Cambodia (2006a: 100). Additionally, a recent compositional study of ceramics from Angkor Borei, Phum Snay, Village 10.8, and Prohear indicate that ceramics from each area were compositionally distinct from one another and likely not exchanged between sites (Feherenbach 2009). However, the types of stone and glass beads found

at many of these sites are similar to one another. This suggests that stone and glass beads were likely exchanged in a prestige goods network and not tied to the exchange of utilitarian objects like ceramics.

As prestige objects and objects for display, the influx of stone and glass beads and the similarity of the types of beads found at these later Iron Age period sites across Cambodia and Thailand may have served to incorporate elites into a broader integrated network of shared cultural symbols. This may have been especially true during the second phase of trade when stone and glass beads were being imported in greater quantities and in the case of the agate and carnelian beads, with less variety in the shapes. This can be compared with the trade of nephrite ear ornaments or Dongson drums and their use as cultural symbols during the early Iron Age period. However, with a greater number of stone and glass beads a broader group of communities could be included into these expanded networks. In this way, stone and glass beads may have been setting a foundation for a later “Integration Period,” in which several of these communities may have been incorporated under a single ruler, with shared material culture, as well as economic, religious, and socio-political ideologies. Chinese historic documents describe Funan and Chenla as kingdoms (e.g. Coedès 1968); however, archaeological research has not yet confirmed the presence of such integrated communities. Nevertheless, the creation of a loosely integrated network of elites across Cambodia and Thailand was likely an important first step to later consolidation by a powerful ruler.

It is important to note that the presence of stone and glass beads at these inland sites does not indicate that they were under the control of elites in the Mekong Delta or part of the Funan polity. Some of these communities may not have even been directly trading with elites in the

Mekong Delta. Rather, as noted above, I argue that the Mekong Delta was likely the primary source of stone and glass beads and that the distribution of these objects can be seen as proxies for these expanding connections inland. Trade with inland sites may have been to gain access to forest products, such as hardwoods, tree resin, and other valuable materials for trade (e.g. Bronson 1977). The exchange of beads was one way that elites in the Mekong Delta likely expanded their power and influence, but the emergence of socio-political complexity in this region was likely a combination of several factors (Higham 2002; Stark 2006b).

In the mid-first millennium AD, trade networks shifted to insular Southeast Asia, and power began to move further inland up the Mekong and Tonle Sap rivers (Stark 2004, 2006c). Although there has yet been little prehistoric archaeological research done in these areas, I suggest that future studies should find evidence for large quantities of high alumina soda glass beads and Phase 2 agate and carnelian beads, as elites in the Mekong Delta likely were trying to build alliances with communities in this region.

The Mekong Delta and Prohear

In his recent work on the site of Prohear, Reinecke (Reinecke et al. 2009: 170) has argued that the site of Prohear may be related to the Funan polity. Reinecke draws on an early interpretation of the Chinese historical documents describing Funan noting that the capital of Funan was located 500 *li* from the sea. The scholar George Coedès argued that this would put the capital at the site of Ba Phnom, Cambodia, a site located more closely to Prohear (Figure 9.5). As discussed in Chapter 1, copious archaeological evidence has convinced most scholars that this “capital” was instead located at Angkor Borei, despite the inconsistencies with the distance. However, Reinecke notes that if the first capital of Funan were in fact located more closely to

Prohear at Ba Phnom, this would explain the extremely rich burials found there. The cemetery of Prohear could then be interpreted as a burial of Funanese elites.

In contrast to this interpretation, I believe that evidence from the glass and stone bead support the interpretation that Angkor Borei and Prohear, though contemporary with one another, were participating in very different trade networks. Prohear's burials indicate a connection with sites in Vietnam, the Sa Huynh culture, and wealth gathered through coastal exchange networks. Conversely, evidence from Angkor Borei suggests participation in a new and different exchange network, with more intense contact with South Asia and access to large quantities of new types of stone and glass beads. Angkor Borei and Oc Eo. While there is similarity in some pottery styles between both Angkor Borei and Prohear (Reinecke et al. 2009) they are compositionally distinct (Fehrenbach 2009). I believe evidence from the glass and stone bead support the interpretation that that Prohear and Angkor Borei represent two different communities that were interacting with different cultural groups and with two different cultural trajectories.



Figure 9.5: Map showing location of Ba Phnom in relation to Angkor Borei, Prohear and Oc Eo.

The local production of beads

Control over the production of beads, especially agate and carnelian beads, is a reoccurring theme in discussions regarding the emergence of socio-political complexity in Southeast Asia (e.g. Bellina 2003, Theunissen et al. 2007). During the early Iron Age period,

jewelry producers appeared to produce objects for elites. However there is not clear evidence that they were attached craft specialists, with some arguing they may have been itinerant craftsmen (Hung et al. 2007). Bellina (2007: 54) has also suggested that the beadmakers at Khao Sam Kaeo, Thailand and Giong Ca Vo, Vietnam were also itinerant craftsmen. Additionally, Bellina (2007) has argued that some of the lower quality agate and carnelian beads found during the later Iron Age period were produced in Southeast Asia under the control of elites who were deliberately trading these materials to inland sites and keeping the higher quality Indian productions for themselves. This hypothesis can only be tested through the careful excavation of multiple bead production workshops.

However, if elites in the Mekong Delta were attempting to expand their power and control over valuable prestige objects like stone and glass beads, they would most likely shift to a system in which these craft specialists were attached to elite households where both production and distribution could be more easily controlled (Kenoyer 2000; Vidale and Miller 2000). Christie (1995: 278) has noted that “it was probably easier for would-be elites to dominate the local collecting or trading networks that produced the exports for exchange, in fact, than it was to limit access to foreign valuables.” Malleret (1959-1962) believed that Oc Eo was a bead-production center, but due to heavy looting we do not have specific information regarding the types of bead manufacture or how it was organized. However, his assessments have not stopped other scholars from assuming that such craft production was taking place (e.g. Francis 2002; Higham 2002). While I do not deny that bead production may have taken place in the Mekong Delta, we still lack specific and convincing evidence for this activity. Furthermore, we do not know if bead production was being controlled by elites, or if a system of itinerant unattached

craftspeople were responsible for producing beads as seen during the earlier period.

Compositional analysis of agate and carnelian beads does not indicate that Southeast Asian raw materials sources were being used to produce these objects. This indicates, at the very least, that Southeast Asian elites were likely not able to control access to the raw materials used to produce beads. Moreover, we must also consider that perhaps increased production in South Asia was responsible for the increase in lower quality beads, not necessarily local production.

Without clear evidence for bead production *and* evidence for control over this production, scholars must be careful about how they frame discussions regarding socio-political complexity and the production of beads in the Mekong Delta. Based on such slim evidence, one must be careful about assuming both that production was taking place and that a spectrum of associated traits associated with socio-political complexity was also present. However, if undisturbed evidence for local production were to be found we could better evaluate if specialists were attached craft specialists, indicating that elites in the Mekong Delta had reached a high level of complexity in that they were controlling both the production and distribution of prestige objects. Conversely, the presence of independent craft specialists would point toward significant autonomy and the inability of local elites to exercise control over the production of this object.

Who was involved in the trade of stone and glass beads?

Mortuary data presented in this dissertation emphasize that stone and glass beads were not evenly distributed within Iron Age communities. As noted in Chapters 5, 6, 7, and 8 agate/carnelian, garnet, and glass beads were generally found in only a small number of burials. Of these burials there were a handful of individuals that had a much higher quantity of beads than others in their community. The burial data from the previous chapters are collated and

summarized in Table 9.1. Although I am not yet certain how to interpret these data, I believe these patterns highlight the importance of investigating the individuals who were wearing and using beads. As many scholars have argued, elites in the Mekong Delta were presumably trading stone and glass beads to build alliances with elites at important inland communities (Bellina 2003, 2007, Bronson 1977; Higham 2002). If this is true, then we may speculate that burials at inland sites with large quantities of beads may have been important elites who were on the receiving end of these alliance-building exchange networks.

That many of these burials are of women may be notable and worth further investigation. Numerous historical documents from the second millennium AD emphasize the role of women in trade across mainland and island Southeast Asia (Reid 1988: 163-165). In 1296-7 a Chinese ambassador to Angkor, Zhou Daguan, wrote about life in the Angkorian capital and noted, “The local people who know how to trade are all women. So when a Chinese goes to this country, the first thing he must do is take in a woman, partly with a view to profiting from her trading abilities,” (Daguan 2007: 70). Additionally, the folktale discussed in Chapter 1 on the founding of Angkor Borei emphasizes the role that the princess took in establishing and cultivating long-distance trade contacts (Keo 2010). While her husband joins her as a co-ruler, it is the princess’ ingenuity and business savvy that spurs the establishment of an important trading center in the Mekong Delta. However in contrast to this evidence a different Cambodian folktale, Keng Kang Snake, details the story of a woman whose husband is a bead trader. His bead trading takes him away from his family for two to three years, and while he is gone the wife falls in love with a snake, with tragic consequences. In this folktale, it is specifically the man who is involved in this long-distance trade.

In some cases, one could imagine that people with large numbers of beads were individuals involved in long-distance trade for their communities and that beads were symbols of their connections to these external trade networks. However, the presence of large quantities of beads with infants or young adults, as seen at sites in Northeast Thailand, indicates that in some communities beads were not correlated with achieved status. Furthermore, many of the sites I have discussed today were heavily looted and the burials excavated by archaeologists may not be representative of the entire cemetery. At Noen U-Loke and Ban Non Wat the amount of grave goods included in burials changed over time, making it difficult to compare the relative wealth or status of burials between periods. However, the graves from these sites noted in Table 9.1 were perceived to be wealthy, high-status burials (Talbot 2007). Although I am as of yet unable to provide solid interpretations for these bead-rich burials, I believe the patterning seen in burials is significant and that more research should be done to investigate the people who were consuming beads, the roles they played within their community, and how this may have changed between communities and over time.

Site	Burial	Beads	Sex
Angkor Borei	F35	212 glass beads and 4 gold beads	Female, with child
Angkor Borei	F36	175 glass beads, 3 tooth pendants, ceramic anvil, animal bones	Male (n=2)
Angkor Borei	F44	83 glass beads, 1 carnelian bead, 10 gold beads	Female (n=2)
Ban Non Wat	6	200 orange wrapped beads, 2 carnelian beads, and ceramics.	Female
Ban Non Wat	36	86 orange beads, 5 carnelian beads, 2 agate pendants, ceramics, gold bead, spindle whorl, and a bronze bangle fragment.	Female and male
Ban Non Wat	203	133 glass beads, bronze bangles and finger rings, agate pendants and an agate bead.	Young adult
Ban Non Wat	266	112 glass beads, agate pendant, bronze bangles and rings, ceramics.	Infant

Noen U-Loke	37	Large number of glass beads	Female
Noen U-Loke	13	Over 1700 glass beads, 2 agate pendants, bimetallic rings, bronze rings and earring, iron spear point, ceramics.	Infant
Noen U-Loke	14	Over 400 glass beads, agate bead, two agate pendants, three bronze belts, 75 bronze bangles, 66 bronze finger rings, 4 bronze two rings, 2 silver-gold ear coils, ceramics, and an iron blade.	Male
Noen U-Loke	113	22 agate beads, sixty-eight gold beads, two agate pendants, four pots, a bimetallic ring, an iron knife, a silver finger ring and a silver toe ring, bronze earrings, thirty-eight bronze bangles, sixty-four bronze finger rings and nine bronze toe rings.	Female
Phum Snay	Burial 9	105 glass beads, 35 carnelian beads, spindle whorls, bronze rings and bangles, iron tools, ceramics including a Phimai black bowl, and a bronze bowl covering her face.	Female
Prei Khmeng	21045	Large number of glass beads	Female
Prohear	44	Over 500 glass beads, gold jewelry, iron bracelets	Female
Prohear	15	40 glass earrings, garnet beads, iron tools, bronze bracelets	Male
Prohear	24	Over 150 glass beads, iron bracelets, gold/silver jewelry, carnelian beads.	Unknown
Prohear	33	Over 150 glass beads, garnet and carnelian beads, iron bracelets, gold objects, bronze bowl.	Female
Prohear	34	Over 150 glass beads, iron bracelets, gold/silver jewelry.	Female
Promptin Tai	19	14 agate beads, 2 glass beads, greenstone beads, shell beads, a bronze bracelet, 2 bronze rings, ceramics, two spindle whorls, and animal bones.	Female
Promptin Tai	20	134 glass beads, greenstone beads, 5 agate beads, 7 carnelian beads, ceramics, and shell beads.	Female
Village 10.8	11	124 glass beads	Unknown
Village 10.8	28	8 agate, 1 garnet bead, 6 glass rings/earrings	Unknown

Village 10.8	48	10 carnelian beads	Unknown
Village 10.8	3	14 carnelian beads and 2 garnet beads	Unknown

Table 9.1: Table noting burials with large numbers of stone and glass beads encountered in this study.

Conclusion

This dissertation has provided the first comprehensive study of artifacts from Iron Age sites in Cambodia, filling in a crucial gap in the discussion of Iron Age trade, which has largely relied on data from English language publications of Thai archaeological sites. As the Mekong Delta of Cambodia and Vietnam was home to an important Iron Age trading center, examination of glass and stone beads allows for scholars to finally consider the impact this region had on Iron Age trade networks.

This dissertation also provides evidence for the timing of expanding socio-political and economic networks in the Mekong Delta. Stone and glass bead evidence does not suggest that communities in the Mekong Delta were participating in the late first millennium BC coastal exchange networks, but instead appear to have been intensifying during the early first millennium AD, coinciding with increased trade with South Asia. High alumina glass beads and Period 2 type agate and carnelian stone beads, found in large quantities at the Mekong Delta as well as at inland sites, can be seen as markers of the expanding socio-political and economic networks by elites in the Mekong Delta.

The methodologies employed in undertaking this dissertation research also represent significant contributions to the field. The examination of both glass and stone beads is also a unique approach that I argue provides for a more holistic understanding of trade. While earlier scholars have studied either glass or stone beads in both Cambodia and Thailand, it was by examining them together that I could see clear patterns in the distribution of different types of

stone and glass beads and how these trading networks changed over time and space. The glass and stone bead data complemented and reinforced models regarding the changing nature of trade over time and the importance of regional trade networks.

With the assistance of Laure Dussubieux, I also developed a methodology to geochemically analyze agate/carnelian and garnet objects using LA-ICP-MS and was successfully able to use this technique to differentiate between different geologic sources and assign artifacts to these sources. The ability to use LA-ICP-MS to geochemically analyze archaeological artifacts is significant as it is virtually non-destructive and requires no sample preparation. The successful implementation of this method will allow future scholars to build a database of geologic sources and confidently provenience agate/carnelian and garnet artifacts from sites around the world.

Lastly, I feel a major accomplishment of this dissertation was the ability to examine almost 10,000 beads from a diverse set of sites in both Cambodia and Thailand. I feel very honored that I was able to collaborate with so many different scholars and that they believed in the viability of this project enough to assist with the often complicated export permissions process so that beads could be examined in the United States. Without the geographic and temporal breadth of sites examined in this study, I do not believe I would have been able to see the trade and exchange patterns discussed in this dissertation.

There is still much future work to be undertaken that would expand on this current study. The number of Iron Age archaeological sites being excavated in Cambodia and Thailand continues to grow, and at the very least, future studies could follow the methodologies in this dissertation in order to understand how bead collections at new sites fit within the trade networks

identified here. Perhaps more important would be an expansion of this study to include data from other sites in Thailand, Laos, Vietnam and Myanmar. Although this kind of study would likely take up one's entire career, future studies could look more closely at regional trade networks within these locations and then fit them in with the broader trade networks identified by myself and other scholars (e.g. Bellina 2007, Lankton and Dussubieux 2013; Theunissen 2003). I am especially interested in examining bead collections from the Vietnamese side of the Mekong Delta in order to determine if my hypotheses regarding shifting glass and stone bead trade networks is consistent with the bead collections at these sites.

It is also crucial that we continue to build geologic source databases for both agate and carnelian and garnet, with a focus on Southeast Asian sources. Questions regarding the local production of stone beads cannot be resolved until the geologic sources used to produce the beads are confidently identified. In collaboration with Dr. Randall Law, I have already begun some work on building an Old World Agate Database, a project that we hope to continue in the future. I would also like to visit the region near the sites with garnet beads in southern Cambodia and Vietnam in an attempt to identify a possible raw material source for garnet in this location.

In relation to this, I also hope to complete experimental drilling studies on garnet in order to identify the drilling methods used to produce the beads in southeast Cambodia. A preliminary study has already been begun, and with continued practice drilling I hope that future studies will be able to successfully identify the drilling methods used to produce garnet and identify their relationship with pre-existing stone drilling traditions in Southeast Asia.

There was also a large collection of greenstone beads from Promptin Tai, likely made from nephrite, which were not considered in this dissertation due to time and financial restrictions

(Figure 9.6). However, the beads were measured, recorded, photographed, and impressions were taken of their drill holes. Similar beads have also been found at other sites in central Thailand (Rammanat 2009), although the ultimate origin of these objects is unknown. In the future, I would like to comprehensively examine these beads using methods from this dissertation in order to better understand where they were from, how they were made, and how and where they were traded.



Figure 9.6: Greenstone beads with carnelian and glass beads from Promptin Tai.

This dissertation has used a comprehensive analysis of stone and glass beads from Iron Age sites in Cambodia and Thailand to identify trade and exchange networks during the Iron Age period and how they varied over time and space. Using these data, I argue that during the later Iron Age elites in the Mekong Delta were becoming increasingly involved in the trade of glass and stone beads. This increased participation in trade likely coincided with the expansion of the Mekong Delta polities and points towards increased connections with communities at

inland sites that had not been previously participating in long-distance prestige goods networks.

This data is in contrast to the supposition by Christie (1995) who argued that early centers of trade in the maritime region were likely the preexisting polities that were already controlling movement between the coasts and inland areas. The earliest state level societies do not appear to have been growing out of sites involved in these early coastal exchange networks. Instead, it appears that during the early first millennium AD, elites in the Mekong Delta were taking advantage of increased quantities of goods from South Asia to expand their connections and create new exchange networks with these inland sites.

Evidence from Prohear and Angkor Borei is also important for understanding the nature of this early trade. These two sites were contemporary with one another and yet they had very different bead collections. From this data it appears that elites in the Mekong Delta were not trying to tap into the pre-existing coastal exchange networks and instead trading with inland communities that had not been a part of these coastal networks. Elites could have been using objects like stone and glass beads to create alliances with elites at inland sites, or using them to trade for goods and products that could be used in long-distance exchange (e.g. Bronson 1977).

These expanding trade networks were apparently a part of suite of changes taking place during this period, detailed in Chapter 1, which led towards the emergence of an early state-level society in the Mekong Delta. Evidence from the stone and glass bead data presented in this study point towards the first few centuries AD for the emergence of these expanded networks.

Therefore I argue that this may be the beginning of the processes leading towards the development of a state, and that the Mekong Delta may have been the home to a state level

society for several centuries prior to development of stone inscriptions and sculpture in the mid-late first millennium AD.

Examination of glass and stone bead has also allowed for the identification of smaller regional exchange networks in southeast Cambodia and Northeast Thailand. Furthermore, the distribution of beads from within burials suggests that at each site there were often a handful of individuals who had greater access to beads than the rest of their community. Although these data are still preliminary, I argue that at least some of the people buried with large numbers of beads may have held high-status positions in their community. That many of the burials with large numbers of beads were adult females suggest that women played important roles in Iron Age communities.

Unfortunately, these stone and glass beads are popular amongst contemporary collectors and many important sites have been heavily looted, including many sites that may have been involved in bead production. This has severely affected our understanding of how craft production in Iron Age and early historic Southeast Asia was organized, which in turn has implications for our understanding of the socio-political organization of these communities. I strongly feel that archaeologists and cultural heritage groups should continue to expand their outreach efforts regarding looting, so that local communities will learn to protect and curate their heritage rather than sell it on the antiquities market.

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Appendices

Appendix 5.1: Agate and Carnelian beads in this study

In this appendix I present a table of the agate and carnelian beads examined as a part of this study. This table includes:

- Database ID,
- Site Name,
- Context Information,
- Catalogue number as assigned by the excavators,
- Raw Material Type and color description
- Bead Shape
- Drill type
- Polish description
- Exterior surface description
- Quality assessment
- Metric measurements of length, width, thickness, and perforation size.

Several beads from Ban Non Wat are included at end of this table but were not carefully recorded as a part of this study and therefore lack a Database ID number, metric measurements, and clear information on the bead shape and polish. These beads were examined only briefly, but are included here as a quality assessment was made about some of these beads and discussed in more depth in Chapter 5.

Database ID	Site Name	Context	Catalogue Number	Raw Material
AKC03035	Angkor Borei, Cambodia	Unit AB7 Block 4S Layer 5 Level 30 Burial 51	3394	Carnelian
AKC03036	Angkor Borei, Cambodia	Unit AB7 Block 5S/4S Layer 4 Level 24 Burial F44	3200	Carnelian
AKC03037	Angkor Borei, Cambodia	Unit AB7 Block 3 Layer 5 Level 7	1163	Carnelian
AKC03038	Angkor Borei, Cambodia	Unit AB7 Block 3 Layer 5 Level 10	1255	Carnelian
AKC03039	Angkor Borei, Cambodia	Unit AB7 Block 5 Layer 4 Level 12	2176	Carnelian
AKC03040	Angkor Borei, Cambodia	Unit AB7 Block 4 Layer 4 Level 14	2182	Carnelian
AKC03041	Angkor Borei, Cambodia	Unit AB7 Block 4 Layer 4 Level 16	2208	Carnelian
AKC03042	Angkor Borei, Cambodia	Unit AB7 Block 2S Layer 7 Level 23	2575 (large)	Carnelian
AKC03043	Angkor Borei, Cambodia	Unit AB7 Block 2S Layer 7 Level 23	2575 (small)	Carnelian
AKC03044	Angkor Borei, Cambodia	Unit AB7 Block 2 Layer 5 Level 11	1278	Carnelian
AKC03045	Angkor Borei, Cambodia	Unit AB7 Block 4 Layer 19 Level 4	2273	Agate
AKC03046	Angkor Borei, Cambodia	Unit AB7 Block 1 Layer 3 Level 5	1080	Quartz
AKC02060	Ban Non Wat, Thailand	BNW 05/06 Burial 312	21071	Agate
AKC02061	Ban Non Wat, Thailand	BNW 05/06 Burial 356	23404	Carnelian
AKC02062	Ban Non Wat, Thailand	BNW 03/04 C3 2:4/S5 Feature 4 Bag 2290	17874	Carnelian
AKC02063	Ban Non Wat, Thailand	BNW 07 E8 3:3 Bag 11767	20455	Agate

Database ID	Site Name	Context	Catalogue Number	Raw Material
AKC02064	Ban Non Wat, Thailand	BNW 06/07 D2/E2/F2 II 3:S1 Feature 6 Bag 10612	23509	Agate
AKC02065	Ban Non Wat, Thailand	BNW 05/06 E5 4:1 Burial 356 Bag 7960	17173	Agate
AKC02066	Ban Non Wat, Thailand	BNW 02/03 B4 2:3 Bag 1334 Burial 36	3518	Agate
AKC02067	Ban Non Wat, Thailand	BNW 05/06 E7 3:3 Burial 259 Bag 8324	17391	Carnelian
AKC02068	Ban Non Wat, Thailand	BNW 02/03 B4 2:2 Bag 1332 Burial 36	3520	Carnelian
AKC02069	Ban Non Wat, Thailand	BNW 03/04 C2 2:4 Bag 2558	6034	Agate
AKC02070	Ban Non Wat, Thailand	BNW 06/07 D3 2:1 Bag 10401	22501	Agate
AKC02071	Ban Non Wat, Thailand	BNW 04 B7 3:S1 Burial 203 Bag 5932	11520	Agate
AKC00730	Bit Meas, Cambodia	N/A Looted	N/A	Agate
AKC00732	Bit Meas, Cambodia	N/A Looted	N/A	Carnelian

Database ID	Site Name	Context	Catalogue Number	Raw Material
AKC03500	Khao Sam Kaeo, Thailand	N/A	KSK008a	Carnelian
AKC03501	Khao Sam Kaeo, Thailand	N/A	KSK008b	Agate
AKC03502	Khao Sam Kaeo, Thailand	N/A	KSK008c	Agate
AKC03503	Khao Sam Kaeo, Thailand	Hill 4	KSK008d	Agate
AKC03504	Khao Sam Kaeo, Thailand	Hill 4	KSK008e	Agate
AKC03505	Khao Sam Kaeo, Thailand	Hill 3	KSK246a	Agate
AKC03506	Khao Sam Kaeo, Thailand	Hill 3	KSK246b	Agate
AKC03507	Khao Sam Kaeo, Thailand	Hill 2	KSK272a	Agate
AKC03508	Khao Sam Kaeo, Thailand	Hill 2	KSK272b	Agate
AKC03509	Khao Sam Kaeo, Thailand	Hill 2	KSK272c	Agate
AKC03510	Khao Sam Kaeo, Thailand	Hill 3	KSK033a	Carnelian
AKC03511	Khao Sam Kaeo, Thailand	Hill 3	KSK033b	Carnelian
AKC03512	Khao Sam Kaeo, Thailand	Hill 3	KSK033c	Agate
AKC03513	Khao Sam Kaeo, Thailand	Hill 3	KSK033d	Agate
AKC03514	Khao Sam Kaeo, Thailand	Hill 2	KSK133a	Carnelian
AKC03515	Khao Sam Kaeo, Thailand	Hill 2	KSK133b	Carnelian
AKC03516	Khao Sam Kaeo, Thailand	Hill 4	KSK037a	Agate
AKC03517	Khao Sam Kaeo, Thailand	Hill 4	KSK037b	Agate
AKC00647	Krek 52/62, Cambodia	Unit II Square J14 Number 45	45	Carnelian
AKC01950	Phnom Borei, Cambodia	Unit 1 Depth 167 cm	N/A	Carnelian
AKC01951	Phnom Borei, Cambodia	Unit 1 Depth 241 cm	N/A	Carnelian

Database ID	Site Name	Context	Catalogue Number	Raw Material
AKC00003	Phum Snay, Cambodia	Unit B Layer 3:3 Feature 1 Bag 20	77	Agate
AKC00004	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	322	Carnelian
AKC00005	Phum Snay, Cambodia	Unit C 2:3 Bag 6	36	Carnelian
AKC00006	Phum Snay, Cambodia	Bag 6 Unit B 2:3	34	Carnelian
AKC00007	Phum Snay, Cambodia	Unit C/E 2:4 Bag 7	285	Carnelian
AKC00008	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Bag 37	257	Carnelian
AKC00009	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Bag # 37	261	Carnelian
AKC00010	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Bag 37	265	Carnelian
AKC00011	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Bag 27	269	Carnelian
AKC00012	Phum Snay, Cambodia	Unit A 3:1 Feature 1 Bag # 12	62	Carnelian
AKC00013	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	479	Carnelian

Database ID	Site Name	Context	Catalogue Number	Raw Material
AKC00014	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Left wrist Bag 37	313 (a)	Carnelian
AKC00015	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Left wrist Bag 37 Cat 313	313 (b)	Carnelian
AKC00016	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Left wrist Bag 37 Cat 313	313 (c)	Carnelian
AKC00017	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	313 (d)	Carnelian
AKC00018	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	313 (e)	Carnelian
AKC00019	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	330 (a)	Carnelian
AKC00020	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	330 (b)	Carnelian
AKC00021	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	330 (c)	Carnelian
AKC00022	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	330 (d)	Carnelian
AKC00023	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	330 (e)	Carnelian
AKC00024	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	330 (f)	Carnelian

Database ID	Site Name	Context	Catalogue Number	Raw Material
AKC00025	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	359(a)	Carnelian
AKC00026	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	359(b)	Carnelian
AKC00027	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	359(c)	Carnelian
AKC00028	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	359(d)	Carnelian
AKC00029	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	359(e)	Carnelian
AKC00030	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	359(f)	Carnelian
AKC00031	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	359(g)	Carnelian
AKC00032	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	359(h)	Carnelian
AKC00033	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	359(i)	Carnelian
AKC00034	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	359(j)	Carnelian
AKC00035	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	359(k)	Carnelian
AKC00036	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	359(l)	Carnelian
AKC00038	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	359(m)	Carnelian
AKC00039	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	359(n)	Carnelian

Database ID	Site Name	Context	Catalogue Number	Raw Material
AKC00040	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	359(o)	Carnelian
AKC00044	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	275	Carnelian
AKC00045	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Burial 9 Bag 37	321	Carnelian
AKC00046	Phum Snay, Cambodia	Unit A 3:2 Feature 1 Bag 18	76	Carnelian
AKC00047	Phum Snay, Cambodia	Unit A East 2:4 Cat 276 Bag 7	276	Carnelian
AKC00048	Phum Snay, Cambodia	Unit B 3:4 Bag 22	113	Carnelian
AKC00049	Phum Snay, Cambodia	Unit B 3:2 Feature 2 Bag 19	68	Carnelian
AKC00050	Phum Snay, Cambodia	Unit A 2:3 Bag 6	30	Carnelian
AKC00051	Phum Snay, Cambodia	Unit B 3:6 Bag 27	157	Carnelian
AKC00052	Phum Snay, Cambodia	Unit B 3.5 Bag 26	133	Carnelian
AKC00053	Phum Snay, Cambodia	Unit A 3:4 Feature 1 Burial 2 Bag 21	70	Carnelian
AKC00054	Phum Snay, Cambodia	Unit A 3:3 Bag 16	103	Carnelian
AKC00055	Phum Snay, Cambodia	Unit C/E 2:2 Feature 1 Bag 37	268	Carnelian

Database ID	Site Name	Context	Catalogue Number	Raw Material
AKC00056	Phum Snay, Cambodia	Unit A West 3:4 Burial 2 Bag 21	364	Carnelian
AKC01721	Prei Khmeng, Cambodia	US# 22021	N/A	Agate
AKC00642	Prohear, Cambodia	Unit B Square LM/143-144	56	Carnelian
AKC00643	Prohear, Cambodia	Unit B Square LM/143-144	51	Carnelian
AKC00644	Prohear, Cambodia	Unit A Square K/107	79	Agate
AKC00645	Prohear, Cambodia	Unit A LM/104-105	10	Agate
AKC00646	Prohear, Cambodia	Unit A Square IK/104-105	8	Agate
AKC00682	Prohear, Cambodia	Unit A K/107	88	Agate
AKC00902	Promptin Tai, Thailand	PTT- S3/2 East 230- 240 cm below datum (bd). Burial 16		Agate
AKC00918	Promptin Tai, Thailand	PTT S3/2 West 240- 250 cm bd Burial 20		Carnelian
AKC00919	Promptin Tai, Thailand	PTT S3/2 West 240- 250 cm bd Burial 20		Carnelian
AKC00920	Promptin Tai, Thailand	PTT S3/2 West 240- 250 cm bd Burial 20		Carnelian
AKC00921	Promptin Tai, Thailand	PTT S3/2 West 240- 250 cm bd Burial 20		Carnelian

Database ID	Site Name	Context	Catalogue Number	Raw Material
AKC00922	Promptin Tai, Thailand	PTT S3/2 West 240- 250 cm bd Burial 20		Carnelian
AKC00923	Promptin Tai, Thailand	PTT S3/2 West 240- 250 cm bd Burial 20		Agate
AKC00924	Promptin Tai, Thailand	PTT S3/2 West 240- 250 cm bd Burial 20		Agate
AKC00931	Promptin Tai, Thailand	PTT West Burial 32		Carnelian
AKC00932	Promptin Tai, Thailand	PTT West Burial 32		Carnelian
AKC00933	Promptin Tai, Thailand	PTT West Burial 32		Carnelian
AKC00934	Promptin Tai, Thailand	PTT West Burial 32		Carnelian
AKC00979	Promptin Tai, Thailand	PTT S3/2 East 210- 220 cm bd	45	Agate
AKC00980	Promptin Tai, Thailand	PTT S3/2 East 210- 220 cm bd	45	Carnelian
AKC00990	Promptin Tai, Thailand	PTT S3 East 90-100 cm bd	3	Carnelian
AKC00995	Promptin Tai, Thailand	PTT S3 East 130- 140 cm bd	7	Carnelian
AKC00996	Promptin Tai, Thailand	PTT S3 East 130-140 cm bd	7	Carnelian
AKC00997	Promptin Tai, Thailand	PTT S3 East 130- 140 cm bd	7	Carnelian
AKC00998	Promptin Tai, Thailand	PTT S3 East 130- 140 cm bd	7	Carnelian
AKC00999	Promptin Tai, Thailand	PTT S3 East 130- 140 cm bd	7	Carnelian
AKC01028	Promptin Tai, Thailand	PTT S3/2 East 80- 90 cm bd	32	Carnelian
AKC01038	Promptin Tai, Thailand	PTT S3/2 West 130- 140 cm bd	21	Carnelian

Database ID	Site Name	Context	Catalogue Number	Raw Material
AKC01042	Promptin Tai, Thailand	PTT S3 West 150- 160 cm bd	24	Agate
AKC01045	Promptin Tai, Thailand	PTT S3 West 160- 170 cm bd	25	Agate
AKC01051	Promptin Tai, Thailand	PTT S3/2 West 190- 200 cm bd (S3L4)	60	Carnelian
AKC01055	Promptin Tai, Thailand	PTT S3/2 West 230- 240 cm bd Burial 20	63	Agate
AKC01060	Promptin Tai, Thailand	PTT S3/2 West 230- 240 cm bd Burial 20	64	Carnelian
AKC01061	Promptin Tai, Thailand	PTT S3/2 West 230- 240 cm bd Burial 20	64	Carnelian
AKC01062	Promptin Tai, Thailand	PTT S3/2 West 230- 240 cm bd Burial 20	64	Agate
AKC01067	Promptin Tai, Thailand	S3/2 West 240-250 cm bd Burial 9	65	Agate
AKC01075	Promptin Tai, Thailand	PTT S3 East 190- 200 cm bd Burial 20	13	Agate
AKC01087	Promptin Tai, Thailand	PTT S3/2 West 220- 230 cm bd Burial 19	72	Agate
AKC01089	Promptin Tai, Thailand	PTT S3/2 West 220- 230 cm bd Burial 19	72	Agate
AKC01091	Promptin Tai, Thailand	PTT S3/2 West 220- 230 cm bd Burial 18	71	Agate
AKC01094	Promptin Tai, Thailand	PTT S3/2 West 220-230 cm bd Burial 19	74	Agate
AKC01098	Promptin Tai, Thailand	PTT S3/2 West 220- 230 cm bd Burial 19	74	Agate

Database ID	Site Name	Context	Catalogue Number	Raw Material
AKC01100	Promptin Tai, Thailand	PTT S3/2 West 220- 230 cm bd Burial 19	74	Agate
AKC01106	Promptin Tai, Thailand	PTT S3/2 West 220- 230 cm bd Burial 19	74	Agate
AKC01108	Promptin Tai, Thailand	PTT S3/2 West 220- 230 cm bd Burial 19	74	Agate
AKC01110	Promptin Tai, Thailand	PTT S3/2 West 220- 230 cm bd Burial 19	74	Agate
AKC01111	Promptin Tai, Thailand	PTT S3/2 West 220- 230 cm bd Burial 19	74	Agate
AKC01112	Promptin Tai, Thailand	PTT S3/2 West 220- 230 cm bd Burial 19	74	Agate
AKC01114	Promptin Tai, Thailand	PTT S3/2 West 220- 230 cm bd Burial 19	74	Agate
AKC00300	Village 10.8, Cambodia	Unit EXXXIII Square K/85 Associated with Burial 37	25	Carnelian
AKC00301	Village 10.8, Cambodia	Unit EXXXIII Square K/85 Associated with Burial 37	26	Carnelian
AKC00302	Village 10.8, Cambodia	Unit EXXXIII Square K/85 Associated with Burial 37	27	Carnelian
AKC00303	Village 10.8, Cambodia	Unit EXXXII Square I/84 Associated with Burial 34	28	Carnelian
AKC00304	Village 10.8, Cambodia	Unit EXXXIII Square K/85 Associated with Burial 37	28	Carnelian

Database ID	Site Name	Context	Catalogue Number	Raw Material
AKC00305	Village 10.8, Cambodia	Unit EXXXII Square I/84 Associated with Burial 34	29	Carnelian
AKC00306	Village 10.8, Cambodia	Unit EXXXII Square I/83-4		Carnelian
AKC00307	Village 10.8, Cambodia	Unit EXXXII Square I/83-4		Carnelian
AKC00308	Village 10.8, Cambodia	Unit EXVIII Square N/85 Associated with Burial 28	44	Agate
AKC00309	Village 10.8, Cambodia	Unit EXVIII Square N/85 Associated with Burial 28	45	Agate
AKC00312	Village 10.8, Cambodia	Unit EXVIII Square N/85 Associated with Burial 28	26	Agate
AKC00313	Village 10.8, Cambodia	Unit EXVIII Square N/85 Associated with Burial 28	24	Agate
AKC00314	Village 10.8, Cambodia	Unit EXVIII Square N/85 Associated with Burial 28	16	Agate
AKC00315	Village 10.8, Cambodia	Unit EXVIII Square N/85 Associated with Burial 28	14	Agate
AKC00316	Village 10.8, Cambodia	Unit EXVIII Square N/85 Associated with Burial 28	17	Agate
AKC00317	Village 10.8, Cambodia	Unit EXVIII Square N/85 Associated with Burial 28	25	Agate

Database ID	Site Name	Context	Catalogue Number	Raw Material
AKC00342	Village 10.8, Cambodia	Unit EI Square T/92 Associated with Burial 3	32	Carnelian
AKC00343	Village 10.8, Cambodia	Unit E Square 21/94 Associated with Burial 1	31	Carnelian
AKC00344	Village 10.8, Cambodia	Unit E Square 21/94 Associated with Burial 1	29	Carnelian
AKC00345	Village 10.8, Cambodia	Unit EI Square T/92 Associated with Burial 3	35	Carnelian
AKC00346	Village 10.8, Cambodia	Unit EI Square T/92 Associated with Burial 3	36	Carnelian
AKC00347	Village 10.8, Cambodia	Unit EI Square T/92 Associated with Burial 3	25	Carnelian
AKC00348	Village 10.8, Cambodia	Unit EI Square T/92 Associated with Burial 3	27	Carnelian
AKC00349	Village 10.8, Cambodia	Unit E Square 21/94 Associated with Burial 1	22	Carnelian
AKC00350	Village 10.8, Cambodia	Unit EI Square T/92 Associated with Burial 3	26	Carnelian
AKC00351	Village 10.8, Cambodia	Unit EI Square T/92 Associated with Burial 3	37	Carnelian

Database ID	Site Name	Context	Catalogue Number	Raw Material
AKC00352	Village 10.8, Cambodia	Unit EI Square T/92 Associated with Burial 3	24	Carnelian
AKC00353	Village 10.8, Cambodia	Unit EI Square T/92 Associated with Burial 3	23	Carnelian
AKC00354	Village 10.8, Cambodia	Unit EI Square T/92 Associated with Burial 3	25	Carnelian
AKC00355	Village 10.8, Cambodia	Unit E Square 21/94 Associated with Burial 1	18	Carnelian
AKC00356	Village 10.8, Cambodia	Unit EI Square T/92 Associated with Burial 3	38	Carnelian
AKC00357	Village 10.8, Cambodia	Unit EI T/92 Associated with Burial 4	48	Carnelian
AKC00358	Village 10.8, Cambodia	Unit E0 R/92	19	Carnelian
AKC00359	Village 10.8, Cambodia	Unit EI 21/93 Associated with Burial 3	23	Carnelian
AKC00360	Village 10.8, Cambodia	Unit EI 21/93 Associated with Burial 3	24	Carnelian
AKC00361	Village 10.8, Cambodia	Unit E 21/94 Associated with Burial 1	30	Carnelian
AKC00362	Village 10.8, Cambodia	Unit EI 21/93 Associated with Burial 3	22	Carnelian

Database ID	Site Name	Context	Catalogue Number	Raw Material
AKC00363	Village 10.8, Cambodia	Unit E 21/94 Associated with Burial 1	23	Carnelian
AKC00364	Village 10.8, Cambodia	Unit EXII Square T/87 Associated with Burial 15	21	Carnelian
AKC00365	Village 10.8, Cambodia	Unit EXII Square T/87 Associated with Burial 15	20	Carnelian
AKC00366	Village 10.8, Cambodia	Unit EXVI R/86 Associated with Burial 25	7	Carnelian
AKC00367	Village 10.8, Cambodia	Unit EXVI R/86 Associated with Burial 25	8	Carnelian
AKC00368	Village 10.8, Cambodia	Unit EXVII Square Q/85 Associated with Burial 26	19	Carnelian
AKC00431	Village 10.8, Cambodia	Unit EXXXXIX Square Ad/87 Burial 48	6	Carnelian
AKC00432	Village 10.8, Cambodia	Unit EXXXXIX Square Ad/87 Burial 48	6	Carnelian
AKC00433	Village 10.8, Cambodia	Unit EXXXXIX Square Ad/87 Burial 48	6	Carnelian
AKC00434	Village 10.8, Cambodia	Unit EXXXXIX Square Ad/87 Burial 48	6	Carnelian
AKC00435	Village 10.8, Cambodia	Unit EXXXXIX Square Ad/87 Burial 48	6	Carnelian

Database ID	Site Name	Context	Catalogue Number	Raw Material
AKC00436	Village 10.8, Cambodia	Unit EXXXXIX Square Ad/87 Burial 48	6	Carnelian
AKC00437	Village 10.8, Cambodia	Unit EXXXXIX Square Ad/87 Burial 48	6	Carnelian
AKC00438	Village 10.8, Cambodia	Unit EXXXXIX Square Ad/87 Burial 48	6	Carnelian
AKC00439	Village 10.8, Cambodia	Unit EXXXXIX Square Ad/87 Burial 48	6	Carnelian
AKC00440	Village 10.8, Cambodia	Unit EXXXXIX Square Ad/87 Burial 48	6	Carnelian

Database ID	Color(s)	Bead Shape	Drill Hole Type	Polish	Exterior surface
AKC03035	Dark Red/Orange with White Inclusions	Spherical	Type 2	Low polish	Smooth surface, but still some imperfections around bead hole
AKC03036	Light Red/Orange with White Inclusions	Rough Spherical	Type 3	Med-high polish	Pop-out, chips on surface
AKC03037	Light Red/Orange	Short Bicone	Type 2	Medium polish	Smooth surface, but with large chip
AKC03038	Light Red/Orange with Dark Inclusions	Rough Spherical	Type 2	Medium polish	Pop-out, chips on surface
AKC03039	Dark Red/Orange with White Inclusions	Spherical	Type 2	High polish	Smooth high-polish surface
AKC03040	Dark Red/Orange	Spherical	Type 2	High polish	Smooth surface, but still some imperfections around bead hole
AKC03041	Dark Red/Orange with White Inclusions	Rough Spherical	Type 3	Low polish	Pop-out, chips on surface
AKC03042	Dark Red/Orange with White Inclusions	Rough Spherical	Type 3	High polish	Pop-out, chips on surface
AKC03043	Dark Red/Orange with White Inclusions	Rough Spherical	Type 3	Med-high polish	Pop-out, chips on surface
AKC03044	Dark Red/Orange	Short Hexagonal Bicone	Type 2	High polish	High polished, nicely made

Database ID	Color(s)	Bead Shape	Drill Hole Type	Polish	Exterior surface
AKC03045	Banded White	Long Barrel	Type 2	Medium polish	Roughly made, nicks and scratches
AKC03046	Clear	Short Hexagonal Faceted (rough)	Type 2	Low polish	Roughly made, nicks and scratches
AKC02060	Brown and Opaque White	Long Barrel	Type 2	High polish	Smooth surface, nice banding
AKC02061	Light Red/Orange	Long Barrel	Type 2	Low polish	Smooth surface, but low polish. Large bead hole
AKC02062	Light Red/Orange with decoration	Long Barrel	Type 2	High polish	Etched bead, but simple
AKC02063	Brown and Opaque White	Rounded Square	Type 2	Med-high polish	High-polish surface, slightly beveled edges?
AKC02064	Black and White Banded	Short Barrel	Type 2	Medium polish	Scratches/imperfections on surface
AKC02065	Black and White Banded	Long Barrel	Type 2	No polish	Nicely shaped, but not polished. Unfinished?
AKC02066	Black and White Banded	Notched Pendant	Type 1	Medium polish	Polished surface, although broken
AKC02067	Light Red/Orange	Spherical	Type 2	Med-high polish	Smooth surface
AKC02068	Light Red/Orange with Dark Inclusions	Long Hexagonal Faceted Barrel	Type 2	Medium polish	Smooth surface, uneven facets and chip at bead hole
AKC02069	Brown and Opaque White	Long Tabular Rectangle	Type 1	Medium polish	Smooth surface, but uneven shape
AKC02070	Brown and Opaque White	Long Cylinder	Type 1	Medium polish	High polish, some scratches on edges

Database ID	Color(s)	Bead Shape	Drill Hole Type	Polish	Exterior surface
AKC02071	Black and White Banded	Short Bicone	Type 2?	Medium polish	Stone had imperfections on surface/nicks
AKC00730	Brown and Opaque White	Short Barrel	Type 2	Low-medium polish	Smooth surface, almost bicone shape?
AKC00732	Dark Red/Orange with Yellow Inclusions	Long Hexagonal Bicone	Type 2	Low-Medium polish	Nice facets, smooth high-polish surface
AKC03500	Red-orange	Long Bicone	Type 5 (Unfinished)	Low polish	Chips on surface
AKC03501	Brown and White Translucent	Long Barrel	Type 5 (Unfinished)	High polish, but ends are not polished	Hole not drilled, chip and imperfections on surface
AKC03502	Banded dark brown and white	Long Unfinished Barrel	Type 5 (Unfinished)	Unfinished	Unfinished
AKC03503	Banded brown and white	Flat Leech Bead	Type 5 (Unfinished)	Unfinished	Unfinished
AKC03504	Brown and White Translucent	Unfinished Tabular Square	Type 5 (Unfinished)	Unfinished	Unfinished
AKC03505	Banded White	Short Barrel	Type 2	High polish	Smooth high-polish surface
AKC03506	Banded brown and white	Long Barrel	Type 2	High polish	Smooth high-polish surface
AKC03507	Banded brown/grey and white	Flat Leech Bead	Type 2	High polish	Smooth, high-polish surface
AKC03508	Banded brown/grey and white	Tabular Truncated Bicone	Type 2	High polish	High polish, small drill hole
AKC03509	Translucent brown grey and opaque white	Long Bicone	Type 2	High polish	Smooth surface, high polish

Database ID	Color(s)	Bead Shape	Drill Hole Type	Polish	Exterior surface
AKC03510	Red-orange	Spherical	Type 5 (Unfinished)	Unfinished	Low-polish, some nicks/chips
AKC03511	Dark red	Hexagonal Flattened Bicone	Type 2	High polish	Smooth, high-polish surface. Nicely beveled edges
AKC03512	Banded greyish brown and white	Long Cylinder	Type 5 (Unfinished)	Unfinished	Unfinished
AKC03513	Banded grey/brown	Short Unfinished Barrel (Truncated?)	Type 5 (Unfinished)	Unfinished	Unfinished
AKC03514	Red Orange	Crescent	Type 2	High polish	Some scratches on surface, unusual shape
AKC03515	Red-orange	Crescent	Type 2	High polish	Some scratches on surface, unusual shape
AKC03516	Onyx	Chamfered Square Disc	Type 2	High polish	Smooth, high-polish surface. May have been burnt?
AKC03517	White and brown	Broken Pendant, 2 notches	Broken	High polish	Smooth surface, nicely shaped.
AKC00647	Light Red/Orange with White Inclusions	Spherical	Type 2	Low-med Polish	Smooth surface, some chips around bead hole
AKC01950	Dark Red with Brown Inclusions	Spherical	Type 2	Low-med Polish	Smooth surface, some nicks/chips
AKC01951	Light Red/Orange with White Inclusions	Spherical	Type 2	Med-high polish	Smooth surface, some nicks/chips
AKC00003	Brown and Opaque White	Long Barrel	Type 2	Low polish	Smooth high-polish surface
AKC00004	Light Red/Orange	Spherical	Type 2	Med polish	High-polish surface, but nicks and chips

Database ID	Color(s)	Bead Shape	Drill Hole Type	Polish	Exterior surface
AKC00005	Light Red/Orange with White Inclusions	Rough Spherical	Type 3	Low polish	Pop-out, nicks/chips on surface
AKC00006	Dark Red/Orange with White Inclusions	Rough Spherical	Type 1	Low polish	Pop-out, nicks/chips on surface
AKC00007	Dark Red/Orange with Dark Inclusions	Spherical	Type 2	Med-high polish	High-polish but some nicks on surface
AKC00008	Dark Red with Brown Inclusions	Spherical	Type 1	Med-high polish	Smooth surface, high polish
AKC00009	Dark Red with Brown Inclusions	Spherical	Type 2	High polish	High-polish but some nicks on surface
AKC00010	Light Red/Orange with Dark Inclusions	Spherical	Type 2	High polish	Smooth high-polish surface
AKC00011	Light Red/Orange with White Inclusions	Spherical	Type 2	High polish	Smooth high-polish surface
AKC00012	Dark Red/Orange with Dark Inclusions	Rough Spherical	Type 3	Med-high polish	Pop-out, nicks/chips on surface
AKC00013	Dark Red with Brown Inclusions	Spherical	JMK Type 2	Low polish	High-polish but some nicks on surface
AKC00014	Dark Red/Orange with Dark Inclusions	Spherical	Type 2	Low polish	Low polish, surface has numerous nicks/chips
AKC00015	Light Red/Orange	Spherical	Type 2	High polish	Smooth high-polish surface
AKC00016	Dark Red/Orange	Short Hexagonal Bicone, Rough	Type 2	Low polish	Uneven facets, surface had scratches and nicks

Database ID	Color(s)	Bead Shape	Drill Hole Type	Polish	Exterior surface
AKC00017	Dark Red/Orange	Short Hexagonal Bicone, Rough	Type 2	Low polish	Uneven facets, surface had scratches and nicks
AKC00017	Dark Red/Orange	Short Hexagonal Bicone, Rough	Type 2	Low polish	Uneven facets, surface had scratches and nicks
AKC00018	Light Red/Orange	Short Hexagonal Bicone, Rough	Type 2	Low polish	Uneven facets, surface had scratches and nicks
AKC00019	Dark Red	Spherical	Type 2	Very low polish	Surface has numerous nicks/chips
AKC00020	Dark Red with Brown Inclusions	Spherical	Type 3	High polish	High polish, some nicks and chips
AKC00021	Light Red/Orange with Dark Inclusions	Rough Spherical	Type 2	Low polish	Pop-out, nicks/chips on surface
AKC00022	Dark Red/Orange with White Inclusions	Rough Spherical	Type 2	Low polish	Pop-out, nicks/chips on surface
AKC00023	Dark Red/Orange with Dark Inclusions	Rough Spherical	Type 3	Med polish	Pop-out, nicks/chips on surface
AKC00024	Light Red/Orange	Rough Spherical	Type 3	High polish	Pop-out, nicks/chips on surface
AKC00025	Dark Red/Orange with White Inclusions	Short Hexagonal Bicone, Rough	Type 2	Low polish	Uneven facets, surface had scratches and nicks
AKC00026	Dark Red/Orange with White Inclusions	Short Hexagonal Bicone, Rough	Type 2	Low polish	Uneven facets, surface had scratches and nicks

Database ID	Color(s)	Bead Shape	Drill Hole Type	Polish	Exterior surface
AKC00027	Dark Red/Orange	Short Hexagonal Bicone, Rough	Type 2	High polish	Uneven facets, surface had scratches and nicks
AKC00028	Dark Red/Orange	Short Hexagonal Bicone, Rough	Type 2	High polish	Uneven facets, surface had scratches and nicks
AKC00029	Dark Red/Orange with Dark Inclusions	Short Hexagonal Bicone, Rough	Type 2	Low polish	Uneven facets, surface had scratches and nicks
AKC00030	Light Red/Orange with White Inclusions	Short Hexagonal Bicone, Rough	Type 2	High polish	Uneven facets, surface had scratches and nicks
AKC00031	Light Red/Orange with Dark Inclusions	Spherical	Type 2	High polish	High-polish surface, but nicks and chips
AKC00032	Light Red/Orange with Dark Inclusions	Spherical	Type 2	High polish	High-polish surface, but nicks and chips
AKC00033	Dark Red	Spherical	Type 2	Low polish	High-polish surface, but nicks and chips
AKC00034	Light Red/Orange with White Inclusions	Rough Spherical	Type 3	High polish	Pop-out, nicks/chips on surface
AKC00035	Dark Red/Orange with Dark Inclusions	Spherical	Type 2	High polish	High-polish surface, but nicks and chips
AKC00036	Dark Red/Orange with White Inclusions	Spherical	Type 2	High polish	High-polish surface, but nicks and chips
AKC00038	Light Red/Orange with White Inclusions	Spherical	Type 2	High polish	High-polish surface, but nicks and chips

Database ID	Color(s)	Bead Shape	Drill Hole Type	Polish	Exterior surface
AKC00039	Light Red/Orange	Rough Spherical	Type 1	High polish	Pop-out, nicks/chips on surface
AKC00040	Black and White Banded	Rough Spherical	Type 2	High polish	Pop-out, nicks/chips on surface
AKC00044	Dark Red/Orange with White Inclusions	Spherical	Type 2	High polish	Smooth high-polish surface
AKC00045	Dark Red/Orange with Dark Inclusions	Spherical	Type 2	High polish	Smooth high-polish surface
AKC00046	Light Red/Orange	Spherical	Type 2	Low polish	Smooth high-polish surface
AKC00047	Dark Red with Brown Inclusions	Rough Spherical	Type 2	Med-high polish	Pop-out, nicks/chips on surface
AKC00048	Light Red/Orange with White Inclusions	Rough Spherical	Type 1	High polish	Pop-out, nicks/chips on surface
AKC00049	Dark Red with Brown Inclusions	Spherical	Type 3	High polish	Smooth high-polish surface
AKC00050	Dark Red/Orange with White Inclusions	Rough Spherical	Type 3	Med polish	Pop-out, nicks/chips on surface
AKC00051	Dark Red/Orange with White Inclusions	Rough Spherical	Type 3	Low polish	Pop-out, nicks/chips on surface
AKC00052	Dark Red/Orange	Spherical	Type 2	High polish	Smooth high-polish surface
AKC00053	Light Red/Orange with White Inclusions	Short Hexagonal Bicone, Rough?	Type 2	High polish	Uneven facets, surface had scratches and nicks
AKC00054	Light Red/Orange with White Inclusions	Rough Spherical	Type 3	High polish	Pop-out, nicks/chips on surface

Database ID	Color(s)	Bead Shape	Drill Hole Type	Polish	Exterior surface
AKC00055	Dark Red/Orange with Dark Inclusions	Rough Spherical	Type 2	High polish	Pop-out, nicks/chips on surface
AKC01721	Dark Red/Orange with White Inclusions	Agate nodule/manuport	N/A	N/A	N/A
AKC00642	Dark Red	Hexagonal Flattened Bicone	Type 2	High polish	Smooth surface, even beveled edges
AKC00643	Dark Red	Hexagonal Flattened Bicone	Type 2	High polish	Smooth surface, even beveled edges
AKC00644	Black and White Banded	Long Barrel	Type 2	Medium polish	Smooth surface, some nicks. Nice banding
AKC00645	Brown and White Banded	Long Bicone	Type 2	High polish	Smooth surface, some nicks. Nice banding
AKC00646	Brown and White Banded	Long Cylinder	Type 2	Medium polish	Smooth surface, especially at ends. High polish
AKC00682	Brown and White Banded	Short Barrel	Type 2	Medium polish	Uneven shape, polished surface but some nicks/chips
AKC00902	Brown and White Banded	Long Barrel	Type 2	Medium Polish	Smooth surface
AKC00918	Dark Red/Orange	Short Cylinder	Type 1	High polish	Smooth, high polish surface but several chips/scratches
AKC00919	Light Red/Orange with White Inclusions	Short Cylinder	Type 1	High polish	Smooth high-polish surface
AKC00920	Dark Red/Orange with White Inclusions	Short Cylinder	Type 1	High polish	Smooth high-polish surface

Database ID	Color(s)	Bead Shape	Drill Hole Type	Polish	Exterior surface
AKC00921	Dark Red/Orange with White Inclusions	Short Cylinder	Type 2	High polish	Smooth high-polish surface
AKC00922	Dark Red/Orange with Dark Inclusions	Long Hexagonal Bicone	Type 2	High polish	Smooth high-polish surface
AKC00923	Brown and White Banded	Long Barrel	Type 2	High polish	Smooth surface, high polish
AKC00924	Brown and White Banded	Long Bicone	Type 2	High polish	Smooth surface, high polish
AKC00931	Light Red/Orange	Spherical	Type 1?	High polish	Smooth high-polish surface
AKC00932	Light Red/Orange	Rough Spherical	Type 3	High polish	Pop-out, nicks/chips on surface
AKC00933	Dark Red/Orange with White Inclusions	Rough Spherical	Type 3	High polish	Pop-out, nicks/chips on surface
AKC00934	Dark Red with Brown Inclusions	Short Square	Type 1	Med-high polish	Generally smooth surface, but chips/imperfections around bead hole
AKC00979	Black and White Banded	Long Bicone	Type 2	High polish	Smooth surface, high polish
AKC00980	Light Red/Orange with White Inclusions	Hexagonal Flattened Bicone	Type 2	High polish	High polish, smooth surface
AKC00990	Dark Red/Orange with White Inclusions	Short Bicone	Type 1	Low polish	Smooth surface but some nicks
AKC00995	Light Red/Orange	Rough Spherical	Type 3	High polish	Pop-out, nicks/chips on surface
AKC00996	Dark Red/Orange with White Inclusions	Rough Spherical	Type 3	High polish	Pop-out, nicks/chips on surface

Database ID	Color(s)	Bead Shape	Drill Hole Type	Polish	Exterior surface
AKC00997	Dark Red/Orange	Rough Spherical	Type 3	High polish	Pop-out, nicks/chips on surface
AKC00998	Dark Red/Orange	Spherical	Type 2	Low polish	Round shape, but surface has scratches/nicks
AKC00999	Dark Red/Orange	Spherical	Type 2	Medium polish	Smooth surface, some nicks
AKC01028	Light Red/Orange with White Inclusions	Rough Spherical	Type 2?	Medium polish	Pop-out, nicks/chips on surface
AKC01038	Dark Red	Short Hexagonal Tabular Barrel	Type 2?	High polish	High polish, smooth surface
AKC01042	Brown and White Banded	Short Bicone	Type 2	High polish	Nice bicone shape, surface has nicks/chips
AKC01045	Brown and White Banded	Long Barrel		Medium-high polish	Smooth surface, low polish
AKC01051	Dark Red/Orange	Rough Spherical	Type 3	Medium polish	Pop-out, nicks/chips on surface
AKC01055	Brown and Opaque White	Short Bicone	Type 2	High polish	Smooth surface, some nicks
AKC01060	Dark Red/Orange	Long Hexagonal Faceted Barrel	Type 2?	High polish	High polish, smooth surface
AKC01061	Dark Red/Orange	Long Hexagonal Faceted Barrel	Type 2?	High polish	High polish, smooth surface
AKC01062	Brown and White Banded	Long Barrel	Type 2	High polish	Smooth surface, high polish, finely made.
AKC01067	Dark Brown	Long Bicone	Type 2	High polish	Smooth surface, high polish
AKC01075	Black and White Banded	Long Barrel	Type 1	Med polish	Smooth high-polish surface, some scratches

Database ID	Color(s)	Bead Shape	Drill Hole Type	Polish	Exterior surface
AKC01087	Black and White Banded	Short Barrel	Type 2	High polish	Smooth surface, but a large chip
AKC01089	Brown and White Translucent	Rough Spherical	Type 3	High polish	Pop-out, nicks/chips on surface
AKC01091	Brown and White Banded	Long Cylinder	Type 1	Medium polish	Stone quality is poor, area around one bead hole is heavily worn.
AKC01094	Black and White Banded	Broken Pendant, notch?	Type 2	High polish	Smooth surface, unique shape. Possibly burnt?
AKC01098	Black and White Banded	Long Bicone	Type 2	Medium-high polish	Smooth surface, but large chips
AKC01100	Black and White Banded	Broken fragment, shape unknown	Type 1	Medium-high polish	Portion of pendant?
AKC01106	Black and White Banded	Broken Long Bicone?	Type 2?	Low polish, broken edge us unpolished	Broken bead? Low polish.
AKC01108	Black and White Banded	Broken Pendant	Type 1 or broken Type 2?	Low-med polish	Smooth surface, unique shape. Possibly burnt?
AKC01110	Brown and White Banded	Short Bicone	Type 2	Medium polish	Smooth high-polish surface
AKC01111	Black and White Banded	Short Bicone	Type 2	Medium polish	Smooth surface, but imperfections in the stone. Possibly burnt?
AKC01112	Black and White Banded	Pendant, 1 notch	Type 2	Medium polish	Smooth surface, unique shape. Possibly burnt?
AKC01114	Black and White Banded	Long Barrel	Type 2	Medium polish	Smooth, high-polish surface but large chip at bead hole

Database ID	Color(s)	Bead Shape	Drill Hole Type	Polish	Exterior surface
AKC00300	Light Red/Orange with Dark Inclusions	Bicone-Barrel	Type 2	High polish	Smooth high-polish surface
AKC00301	Light Red/Orange	Long Bicone	Type 2	High polish	Smooth high-polish surface
AKC00302	Dark Red/Orange	Long Oblate	Type 2	Low polish	Smooth surface but some nicks
AKC00303	Light Red/Orange	Short Barrel	Type 2	Low polish	Smooth high-polish surface
AKC00304	Dark Red/Orange	Short Polygonal Bicone	Type 2	Low polish	High polish, nice facets but chipped/broken around drill hole
AKC00305	Dark Red/Orange	Bicone-Barrel	Type 2	High polish	Smooth high-polish surface
AKC00306	Light Red/Orange	Long Barrel	Type 2	Low polish	Smooth high-polish surface
AKC00307	Light Red/Orange	Long Bicone	Type 2	Medium polish	Smooth high-polish surface
AKC00308	Black and White Banded	Short Barrel	Type 2	Low polish	Smooth high-polish surface
AKC00309	Brown and White Banded	Short Barrel	Type 2	High polish	Smooth high-polish surface
AKC00312	Brown and White Banded	Long Cylinder	Type 2	Med-High polish	Smooth high-polish surface
AKC00313	Brown and White Banded	Short Barrel	Type 2	Med polish	Smooth high-polish surface
AKC00314	Brown and White Banded	Short Barrel	Type 2	High polish	Smooth high-polish surface
AKC00315	Brown and White Banded	Short Barrel	Type 2	High polish	Smooth high-polish surface
AKC00316	Brown and White Banded	Short Barrel	Type 2	High polish	Smooth high-polish surface
AKC00317	Brown and White Banded	Short Barrel	Type 2	High polish	Smooth high-polish surface
AKC00342	Light Red/Orange	Bicone-Barrel	Type 2	Low polish	Smooth high-polish surface

Database ID	Color(s)	Bead Shape	Drill Hole Type	Polish	Exterior surface
AKC00343	Dark Red/Orange	Short Bicone	Type 2	Low polish	Smooth high-polish surface
AKC00344	Light Red/Orange	Short Bicone	Type 2	Very low polish	Smooth high-polish surface
AKC00345	Dark Red/Orange	Bicone-Barrel	Type 2	Low polish	Smooth high-polish surface
AKC00346	Light Red/Orange	Bicone-Barrel	Type 2	Low polish	Smooth high-polish surface
AKC00347	Dark Red/Orange	Bicone-Barrel	Type 2	Low Polish	Smooth high-polish surface
AKC00348	Light Red/Orange	Short Bicone	Type 2	Low-Med Polish	Smooth high-polish surface
AKC00349	Dark Red/Orange	Short Bicone	Type 2	Low polish	Smooth high-polish surface
AKC00350	Dark Red/Orange	Long Oblate	Type 2	Low polish	Smooth high-polish surface
AKC00351	Light Red/Orange	Bicone-Barrel	Type 2	Low Polish	Smooth high-polish surface
AKC00352	Dark Red/Orange	Short Bicone	Type 2	Low polish	Low polish but smooth surface
AKC00353	Dark Red/Orange	Bicone-Barrel	Type 2	Low polish	Smooth high-polish surface
AKC00354	Dark Red/Orange	Short Oblate	Type 2	Med-High polish	Smooth high-polish surface
AKC00355	Light Red/Orange with Dark Inclusions	Bicone-Barrel	Type 2	Low polish	Smooth high-polish surface
AKC00356	Dark Red/Orange	Bicone-Barrel	Type 2	High polish	Smooth high-polish surface
AKC00357	Dark Red/Orange with White Inclusions	Long Bicone	Type 2	Med polish	Smooth high-polish surface
AKC00358	Light Red/Orange with White Inclusions	Spherical		Low polish	Round shape but surface has nicks/chips

Database ID	Color(s)	Bead Shape	Drill Hole Type	Polish	Exterior surface
AKC00359	Light Red/Orange with White Inclusions	Short Bicone	Type 2	Low polish	Smooth high-polish surface
AKC00360	Light Red/Orange with Dark Inclusions	Long Bicone	Type 2	Low polish	Smooth high-polish surface
AKC00361	Light Red/Orange with White Inclusions	Short Bicone	Type 2	Very low polish	Smooth high-polish surface
AKC00362	Dark Red/Orange	Bicone-Barrel	Type 2	Low polish	Smooth high-polish surface
AKC00363	Dark Red/Orange	Long Bicone	Type 2	Medium Polish	Smooth high-polish surface
AKC00364	Light Red/Orange with White Inclusions	Long Bicone	Type 2	High polish	Smooth high-polish surface
AKC00365	Light Red/Orange	Short Bicone	Type 2	Low polish	Smooth high-polish surface
AKC00366	Dark Red/Orange with White Inclusions	Bicone-Barrel	Type 2	Low- med polish	Smooth high-polish surface
AKC00367	Dark Red/Orange	Long Octagonal Bicone	Type 2	High polish	High polish, nice facets but chipped/broken around drill hole
AKC00368	Dark Red/Orange with Dark Inclusions	Long Octagonal Bicone	Type 2	Low polish	High polish, smooth surface
AKC00431	Dark Red/Orange with White Inclusions	Bicone-Barrel	Type 2	Medium polish	Smooth high-polish surface
AKC00432	Light Red/Orange	Bicone-Barrel	Type 2	Medium-high polish	Smooth high-polish surface

Database ID	Color(s)	Bead Shape	Drill Hole Type	Polish	Exterior surface
AKC00433	Light Red/Orange	Long Bicone	Type 2	Med-high polish	Smooth high-polish surface
AKC00434	Dark Red/Orange	Long Bicone	Type 2	Med-high polish	Smooth high-polish surface
AKC00435	Dark Red/Orange with White Inclusions	Long Barrel	Type 2	Med-high polish	Smooth high-polish surface
AKC00436	Light Red/Orange with Dark Inclusions	Bicone-Barrel	Type 2	High polish	Smooth high-polish surface
AKC00437	Light Red/Orange	Long Hexagonal Bicone	Type 2	High polish	High polish, smooth surface
AKC00438	Dark Red/Orange with White Inclusions	Long Hexagonal Bicone	Type 2	High polish	High polish, smooth surface
AKC00439	Light Red/Orange	Long Hexagonal Bicone	Type 2	High polish	High polish, smooth surface
AKC00440	Light Red/Orange	Long Hexagonal Bicone	Type 2	High polish	High polish, smooth surface

Database ID	Quality	Interior Perf A (mm)	Interior Perf B (mm)	Max Length (mm)	Max Width (mm)	Min Width A (mm)	Min Width B (mm)	Thickness (mm)
AKC03035	Low-quality	1.22	1.17	6.35	6.62			
AKC03036	Low-quality	1.54	1.65	10.16	11.75			
AKC03037	Low-quality	1.52	1.52	7.7	6.06	4.39	4.68	
AKC03038	Low-quality	1.44	1.44	5.12	6.12			
AKC03039	High-quality	1.74	1.74	7.49	7.65			
AKC03040	Low-quality	2.09	1.89	7.87	8.36			
AKC03041	Low-quality	1.58	1.57	5.51	6.67			
AKC03042	Low-quality	1.94	1.71	10.26	11.82			
AKC03043	Low-quality	1.78	1.54	8.49	10.47			
AKC03044	High-quality	1.22	1.24	4.59	6.28			
AKC03045	Low-quality	1.94	2.11	19.22	8.42	5.86	0	7.73
AKC03046	Low-quality	1.72	1.75	11.76	7.65	4.16	4.63	5.52
AKC02060	High-quality	1.15	1.18	35.13	7.49	5.71	5.72	
AKC02061	Low-quality	3.03	2.87	44.95	8.89	6.75	5.46	
AKC02062	High-quality	1.72	1.31	16.46	7.93			
AKC02063	High-quality	1.23	0.94	19.09	16.6			11.71
AKC02064	Low-quality	0.87	0.86	5.8	2.98			
AKC02065	Low-quality	1.36	1.51	23.52	9.62	6.64	5.56696	8.15
AKC02066	High-quality, broken	1.37	1.01	18.37	23.11			4.53
AKC02067	High-quality	1.72	1.68	9.58	9.93			

Database ID	Quality	Interior Perf A (mm)	Interior Perf B (mm)	Max Length (mm)	Max Width (mm)	Min Width A (mm)	Min Width B (mm)	Thickness (mm)
AKC02068	Low-quality	1.28	1.7	17.74	5.14			
AKC02069	Low-quality	1.78	1.78	21.55	9.76			4.95
AKC02070	High-quality, broken	3.06	3.06	28.9	11.08			
AKC02071	Low-quality	1.65	1.63	10.59	5.84	4.34	4.06	
AKC00730	High-quality	1.02	1.37	8.69	5.72			5.13
AKC00732	High-quality	1.08	1.08	19.03	6.53	4.05	3.95	
AKC03500	Low-quality	1.15		15.64	6.91	4.02	4.41	
AKC03501	High-quality, unfinished			14.39	6.02	5.23		
AKC03502	Unfinished			18.2	7.13	3.66		4.5
AKC03503	Unfinished			24.51	14.17	10.81	11.12	4.37
AKC03504	Unfinished			21.06	18.35	16.52	18.02	3.8
AKC03505	High-quality	1.42	1.82	11.53	5.82	4.79	5.25	
AKC03506	High-quality	1.67	1.48	15.61	5.02	3.28	3.73	
AKC03507	High-quality	0.96	0.96	15.49	10.2	4.41	4.46	4.17
AKC03508	High-quality	1.08	1.06	21.62	9.52	6.18	6.12	4.01
AKC03509	High-quality	1.2	1.3	30.9	8.86	5.93	6.08	
AKC03510	Low-quality	1.17		5.05	5.39			
AKC03511	High-quality	1.05	0.85	15.24	9.63	2.72	3.17	3.29
AKC03512	Unfinished			15.7	5.21	4.85	4.76	
AKC03513	Unfinished			11.38	7.36	4.97	5.45	5.52
AKC03514	High-quality	1.12	1.44	24.62				5.18
AKC03515	High-quality			27.9				4.14

Database ID	Quality	Interior Perf A (mm)	Interior Perf B (mm)	Max Length (mm)	Max Width (mm)	Min Width A (mm)	Min Width B (mm)	Thickness (mm)
AKC03516	High-quality	1.25	1.31	19.1				3.93
AKC03517	High-quality, broken		41.53	17.84	9.85	9.73	5.35	
AKC00647	High-quality	1.6	0.92	7.42	9.4			
AKC01950	High-quality	0.9	1.37	7.94	8.39			
AKC01951	High-quality	1.1	1.29	12.01	12.24			
AKC00003	High-quality	2.15	2.16	35.88				6.28
AKC00004	High-quality	1.35	1.35	7.12				7.36
AKC00005	Low-quality	1.26	1.18	5.8				7.47
AKC00006	Low-quality	1.19	1.5	6.29				7.52
AKC00007	High-quality	1.6	1.7	8.4				8.57
AKC00008	High-quality	1.9	1.9	14.33				14.65
AKC00009	High-quality	1.33	1.36	6.84				7.12
AKC00010	High-quality	1.72	1.71	7.63				8.2
AKC00011	High-quality	1.47	1.48	7.52				7.81
AKC00012	Low-quality	1.37	1.36	6.77				7.17
AKC00013	High-quality	1.9	1.91	15.56				16.51
AKC00014	Low-quality	2.5	2.62	16.32	17.5			
AKC00015	High-quality	2.07	2.08	14.46				14.78
AKC00016	Low-quality	1.96	1.87	16.4	13.06	89		
AKC00017	Low-quality	1.97	1.99	15.13	11.35	78.5		

Database ID	Quality	Interior Perf A (mm)	Interior Perf B (mm)	Max Length (mm)	Max Width (mm)	Min Width A (mm)	Min Width B (mm)	Thickness (mm)
AKC00018	Low-quality	1.96	2.05	15.13	12.11	89.2		
AKC00019	Low-quality	1.99	1.98	17.24	17.54			
AKC00020	Low-quality	1.6	1.52	8.88	9.53			
AKC00021	Low-quality	1.6	1.7	9.11	9.56			
AKC00022	Low-quality	1.62	1.62	8.64	9.35			
AKC00023	Low-quality	1.47	1.4	6.34	8.13			
AKC00024	Low-quality	1.7	1.71	8.42	8.84			
AKC00025	Low-quality	1.75	1.8	16.55	10.21	6.575		
AKC00026	Low-quality	1.78	1.83	15.72	11.33	67		
AKC00027	Low-quality	1.82	1.9	14.29	9.26	5.98752		
AKC00028	Low-quality	1.99	1.89	13.2	11.28	78		
AKC00029	Low-quality	1.88	1.88	14.4	11.84	67.9		
AKC00030	Low-quality	2.18	2.15	15.03	11.22	78.5		
AKC00031	High-quality	1.88	1.93	12.98	13.33			
AKC00032	High-quality	1.68	1.7	12.89	13.98			
AKC00033	High-quality	1.93	1.97	11.75	12.25			
AKC00034	Low-quality	2.08	1.3	9.75	11.11			
AKC00035	High-quality	2.03	1.93	10.22	11			

Database ID	Quality	Interior Perf A (mm)	Interior Perf B (mm)	Max Length (mm)	Max Width (mm)	Min Width A (mm)	Min Width B (mm)	Thickness (mm)
AKC00036	High-quality	1.87	1.89	8.8	9.41			
AKC00038	High-quality	1.83	1.76	8.45	8.71			
AKC00039	Low-quality	1.76	1.1	7.66	9.45			
AKC00040	Low-quality	1.7	1.67	7.41	8.36			
AKC00044	High-quality	1.38	1.43	7.54	7.95			
AKC00045	High-quality	1.56	1.58	8	8.29			
AKC00046	High-quality	1.81	1.87	10.04	10.04			
AKC00047	Low-quality	1.83	1.78	8.54	8.57			
AKC00048	Low-quality	1.57	1.75	9.9	11.37			
AKC00049	High-quality	1.42	2.36	10.33	10.77			
AKC00050	Low-quality	1.61	2.04	8.83	10.59			
AKC00051	Low-quality	1.92	1.98	8.83	10.2			
AKC00052	High-quality	1.51	1.54	9.47	9.58			
AKC00053	Low-quality	1.62	1.09	15.33	9.6	5.23		
AKC00054	Low-quality	1.1	1.15	6.67	7.68			
AKC00055	Low-quality	1.62	1.56	8.53	9.06			
AKC00056	Low-quality	1.25	1.15	14.84	7.06	4.58	4.26	
AKC01721	N/A			20.96	11.43			4.01
AKC00642	High-quality	1.07	0	22.39	10.17	4.6	4.82	4.68
AKC00643	High-quality	1.28	1.32	22.27	8.86	4.37	4.18	4.55

Database ID	Quality	Interior Perf A (mm)	Interior Perf B (mm)	Max Length (mm)	Max Width (mm)	Min Width A (mm)	Min Width B (mm)	Thickness (mm)
AKC00644	High-quality	2.3	1.35	18.37	7.13	4.57	4.48	6.02
AKC00645	High-quality	1.54	1.86	24.5	7.58	4.25	4.6	6.7
AKC00646	High-quality	1.2	1.53	13.74	6.06	5.41	5.8	
AKC00682	Low-quality	1.45	2.56	12.91	8.33	5.14	5.13	7.04
AKC00902	High-quality	1.22	1.55	10.13	4.93	3.95	3.83	
AKC00918	Low-quality	1.32	1.26	5.7	3.88	3.85	3.75	
AKC00919	High-quality	1.68	1.41	7.31	4.29			
AKC00920	High-quality	1.2	1.2	6.82	3.77			
AKC00921	High-quality	1.72	1.7	16.02	8.41	7.3	7.21	
AKC00922	High-quality	1.44	1.33	16.66	9.01	5.55	5.7	
AKC00923	High-quality	1.88	1.98	18.44	8.12	6.54	6.49	
AKC00924	High-quality	1.93	1.94	22.43	10.69	5.93	7.1	
AKC00931	High-quality	1.1	0.98	7.05	7.11			
AKC00932	Low-quality	1.43	1.43	5.44	6.82			
AKC00933	Low-quality	1.27	0.98	6.58	7.28			
AKC00934	Low-quality	1.48	1.49	6.67	4.08			
AKC00979	High-quality	1.24	1.21	11.2	5.84	3.96	4.04	
AKC00980	High-quality	0.9	0.95	10.81	6.05			3.11
AKC00990	High-quality	0.95	1.14	4.26	6.82			
AKC00995	Low-quality	1.56	1.56	7.62	9.67			

Database ID	Quality	Interior Perf A (mm)	Interior Perf B (mm)	Max Length (mm)	Max Width (mm)	Min Width A (mm)	Min Width B (mm)	Thickness (mm)
AKC00996	Low-quality	1.45	1.56	5.43	7.52			
AKC00997	Low-quality	1	1.02	3.51	4.13			
AKC00998	Low-quality	1.08	0.78	4.35	4.94			
AKC00999	High-quality	1.31	0.76	3.92	4.26			
AKC01028	Low-quality	1.68	1.72	6.24	7.27			
AKC01038	High-quality, broken	0.84	0	9.22	4.69	2.23	0	2.44
AKC01042	High-quality	1.64	1.7	12	7.79	3.72	3.12	
AKC01045	High-quality	1.68	1.68	11.32	5.59	3.17	3.9	
AKC01051	Low-quality	1.57	1.6	5.61	6.91			
AKC01055	High-quality	1.48	2.12	17.59	11.82	8.3	8.07	
AKC01060	High-quality, broken	1.12	0	17.38	3.39	2.91	0	
AKC01061	High-quality, broken	1.12	0	8.42	3.68	2.66	0	
AKC01062	High-quality	1.42	1.44	14.53	3.52	3.38	2.84	
AKC01067	High-quality	1.6	1.74	38.4	10.64	6.41	6.9	
AKC01075	High-quality	1.12	1.4	10.23	4.47	3.47	3.64	
AKC01087	High-quality	1.61	1.63	18.45	9.93	6.73	5.5	7.85
AKC01089	Low-quality	1.5	1.4	5.82	8.07			
AKC01091	Low-quality	1.3	150	9.45	5.23	4.61	4.66	

Database ID	Quality	Interior Perf A (mm)	Interior Perf B (mm)	Max Length (mm)	Max Width (mm)	Min Width A (mm)	Min Width B (mm)	Thickness (mm)
AKC01094	High-quality	1.32	1.48	21.52	24.17			5.54
AKC01098	High-quality	1.66	1.63	25		4.66	4.91	7.15
AKC01100	High-quality, broken	1.43	2.45	7.67	14.39			7.42
AKC01106	High-quality, broken	1.65	1.65	12.66	9.79	7.15		
AKC01108	High-quality	1.51	1.47	9.48	20.12			5.29
AKC01110	High-quality	2.23	2.26	16.38	9.85	7.79	7.52	
AKC01111	High-quality	1.68	1.63	21.25	11.34	7.8	8.83	
AKC01112	High-quality	1.67	1.72	0	4.83	17.85	20.09	
AKC01114	High-quality	1.82	1.73	21.11	9.39	6.92	7.51	8.58
AKC00300	High-quality	1.2	1.25	23.75	8.7	4.73	3.4	
AKC00301	High-quality	1.17	0.95	16.9	7.43	3.74	3.51	
AKC00302	High-quality	1.31	1.1	17.34	8.78	4.66	3.78	
AKC00303	High-quality	1.25	1.37	16.43	6.8	4.64	4.8	
AKC00304	High-quality	1.36	1.35	15.63	9.6	4.88	4.76	
AKC00305	High-quality	1.07	1.29	15.6	7.98	4.12	4.61	
AKC00306	High-quality	1.59	1.35	19.08	7.46	4.83	4.08	
AKC00307	High-quality	1.19	1.34	23.21	8.54	3.9	4.11	
AKC00308	High-quality	1.15	1.16	11.38	6.38	4.82	4.67	
AKC00309	High-quality	1.62	1.21	12.27	6.62	5.09	5.21	

Database ID	Quality	Interior Perf A (mm)	Interior Perf B (mm)	Max Length (mm)	Max Width (mm)	Min Width A (mm)	Min Width B (mm)	Thickness (mm)
AKC00312	High-quality	1.34	1.25	10.93	5.17	4.25	3.86	
AKC00313	High-quality	1.36	1.13	11.55	6.21	4.41	4.76	
AKC00314	High-quality	1.18	1.42	11.73	6.42	4.26	4.7	
AKC00315	High-quality	1.23	1.52	13.17	6.01	4.46	4.1	
AKC00316	High-quality	1.58	1.1	11.14	5.62	4.43	4.25	
AKC00317	High-quality	1.61	1.27	12.75	6.06	4.49	3.88	
AKC00342	High-quality	1.33	1.34	31.44	11.45	5.49	5.24	
AKC00343	High-quality	1.36	1.37	19.49	10.53	3.74	4.12	
AKC00344	High-quality	1.76	2	17.7	9.63	4.96	5.18	
AKC00345	High-quality	1.4	1.62	25.23	11.31	4.59	4.74	
AKC00346	High-quality	1.68	1.26	21.7	11.09	5.5	4.61	
AKC00347	High-quality	1.44	1.98	21.35	10.72	4.83	5.59	
AKC00348	High-quality	1.08	1.25	19.57	11.13	5.73	6.49	
AKC00349	High-quality	1.27	1.03	20.62	11.26	5.9	6.03	
AKC00350	High-quality	1.25	1.31	19.61	10.82	3.75	3.9	
AKC00351	High-quality	1.51	1.51	22.76	10.88	5.38	5.05	
AKC00352	High-quality	1.81	1.2	20.18	11.08	7.35	6.87	
AKC00353	High-quality	1.42	1.22	23.32	11.61	4.23	3.78	

Database ID	Quality	Interior Perf A (mm)	Interior Perf B (mm)	Max Length (mm)	Max Width (mm)	Min Width A (mm)	Min Width B (mm)	Thickness (mm)
AKC00354	High-quality	1.61	1.65	13.58	8.18	4.01	3.85	
AKC00355	High-quality	1.42	1.44	21.1	10.75	4.29	4.64	
AKC00356	High-quality	1.37	1.74	22.52	11.8	4.26	4.52	
AKC00357	High-quality	1.23	1.15	15.87	7.6	2.7	2.96	
AKC00358	Low-quality	0.67	0.94	6.37	6.37			
AKC00359	High-quality	1.68	1.71	15.17	9.42	4.79	3.72	
AKC00360	High-quality	1.14	1.38	15.37	7.61	3.97	4.43	
AKC00361	High-quality	1.22	1.77	17.83	10.62	5.23	4.96	
AKC00362	High-quality	1.71	1.73	16.59	8.19	4.17	4.84	
AKC00363	High-quality	1.36	1.02	20.79	10.89	4.22	6.05	
AKC00364	High-quality	1.34	1.29	20.2	9.84	4.39	4.42	
AKC00365	High-quality	1.33	1.26	19.42	10.26	3.64	3.57	
AKC00366	High-quality	1.31	1.28	34.44	12.25	5.12	0	
AKC00367	High-quality	1.38	1.26	26.6	9.68	0	0	
AKC00368	High-quality	1.21	1.68	26.02	10.48	3.81	0	
AKC00431	High-quality	1.01	1.1	15.78	6.57	2.95	3.89	
AKC00432	High-quality	1.16	1.32	16.74	5.79	3.26	3.65	
AKC00433	High-quality	1.23	1.02	16.47	6.5	3.31	3.75	

Database ID	Quality	Interior Perf A (mm)	Interior Perf B (mm)	Max Length (mm)	Max Width (mm)	Min Width A (mm)	Min Width B (mm)	Thickness (mm)
AKC00434	High-quality	1.18	1.01	15.02	6.36	2.94	2.83	
AKC00435	High-quality	1.28	1.22	16.29	5.84	3.77	4.04	
AKC00436	High-quality	1.3	1.24	14.94	6.49	4.29	3.58	
AKC00437	High-quality	1.3	1.11	17.38	5.91	3.7	3.31	
AKC00438	High-quality	0.92	1.02	15.47	5.59	3.64	3.24	
AKC00439	High-quality	0.8	1.08	12.88	5.19	3.18	3.22	
AKC00440	High-quality	1.3	0.91	14.34	5.18	3.7	3.52	

Ban Non Wat Beads not recorded in detail as part of this study.

Context	Cat Number	Raw Material	Color(s)	Bead Shape	Exterior surface	Quality
Burial 36	3520	Carnelian	N/A	Long Hexagonal Faceted Barrel	Smooth surface, uneven facets	Low-quality
Burial 36	3520	Carnelian	N/A	Long Hexagonal Faceted Barrel	Smooth surface, uneven facets	Low-quality
Burial 36	3520	Carnelian	N/A	Long Hexagonal Faceted Barrel	Smooth surface, uneven facets	Low-quality
Burial 36	3537	Carnelian	N/A	Long Triangular Faceted Barrel	Looks good in picture	High-quality
Burial 36	3519	Agate	N/A	Triangular pendant	The picture makes it seem as if the edges are not as smooth, stone is not great quality.	Low-quality
Burial 115	5089	Agate	N/A	Broken Pendant, 1 notch	despite being broken, looks like it's pretty good quality	High-quality
Burial 203	11520	Agate	Black and White Banded	Bicone or Barrel	Higher quality stone?	High-quality
Burial 203	11520	Agate	Black and White Banded	Bicone or Barrel	Higher quality stone?	High-quality
Burial 203	11520	Agate	Black and White Banded	Bicone or Barrel	Higher quality stone?	High-quality
Burial 203	11520	Agate	Black and White Banded	Bicone or Barrel	Imperfections on surface/nicks	Low-quality

Context	Cat Number	Raw Material	Color(s)	Bead Shape	Exterior surface	Quality
Burial 203	11520	Agate	Black and White Banded	Bicone or Barrel	Imperfections on surface/nicks	Low-quality
Burial 203	11520	Agate	Black and White Banded	Bicone or Barrel	Imperfections on surface/nicks	Low-quality
Burial 203	11520	Agate	Black and White Banded	Bicone or Barrel	Imperfections on surface/nicks	Low-quality
Burial 203	11520	Agate	Black and White Banded	Bicone or Barrel	Imperfections on surface/nicks	Low-quality
Burial 203	11520	Agate	Black and White Banded	Bicone or Barrel	Imperfections on surface/nicks	Low-quality
Burial 203	11520	Agate	Black and White Banded	Bicone or Barrel	Imperfections on surface/nicks	Low-quality
Burial 203	11520	Agate	Black and White Banded	Bicone or Barrel	Imperfections on surface/nicks	Low-quality
Burial 203	11520	Agate	Black and White Banded	Bicone or Barrel	Imperfections on surface/nicks	Low-quality
Burial 203	11520	Agate	Black and White Banded	Bicone or Barrel	Imperfections on surface/nicks	Low-quality
Burial 203	11520	Agate	Black and White Banded	Bicone or Barrel	Imperfections on surface/nicks	Low-quality
Burial 203	11525	Agate	N/A	broken pendant?	Imperfections on surface/nicks	Low-quality

Context	Cat Number	Raw Material	Color(s)	Bead Shape	Exterior surface	Quality
Burial 203	11523	Agate	N/A	Notched Pendant	Smooth surface	High-quality
Burial 259	18038	Carnelian	N/A	Spherical	Smooth surface	High-quality
Burial 259	18039	Carnelian	N/A	Spherical	Smooth surface	High-quality
Burial 266	15507	Agate	N/A	Broken pendant	Smooth surface, with repair?	High-quality
Burial 317	17866	Agate	Black and White Banded	Bicone or Barrel	N/A	N/A
Burial 321	21204	Agate	Black and White Banded	Bicone or Barrel	N/A	N/A
Burial 322	21113	Agate	Black and White Banded	Long Barrel	Smooth surface	High-quality
Burial 343	19660	Agate	Black and White Banded	Long Barrel	Smooth surface	High-quality
Burial 471	23022	Agate	N/A	Bicone	Uneven shape	Low-quality

Appendix 6.1: The agate and carnelian artifacts analyzed using LA-ICP-MS.

Site Name	Database ID	Context	Agate/ Carnelian	Bead Shape
Angkor Borei	AKC03035	Burial F51	Carnelian	Spherical
Angkor Borei	AKC03036	Burial F44	Carnelian	Rough Spherical
Angkor Borei	AKC03037	AB7 Block 3 Layer 5 Level 7	Carnelian	Short Bicone
Angkor Borei	AKC03038	AB7 Block 3 Layer 5 Level 10	Carnelian	Rough Spherical
Angkor Borei	AKC03039	AB7 Block 5 Layer 4 Level 12	Carnelian	Spherical
Angkor Borei	AKC03040	AB7 Block 4 Layer 4 Level 14	Carnelian	Spherical
Angkor Borei	AKC03041	AB7 Block 4 Layer 4 Level 16	Carnelian	Rough Spherical
Angkor Borei	AKC03042	AB7 Block 2S Layer 7 Level 23	Carnelian	Rough Spherical
Angkor Borei	AKC03043	AB7 Block 2S Layer 7 Level 23	Carnelian	Rough Spherical
Angkor Borei	AKC03044	AB7 Block 2 Layer 5 Level 11	Carnelian	Hexagonal Short Bicone
Angkor Borei	AKC03045	AB7 Block 4 Layer 19 Level 4	Agate	Long Barrel
Angkor Borei	AKC03046	AB7 Block 1 Layer 3 Level 5	Quartz	Hexagonal Faceted Bicone (rough)
Ban Non Wat	AKC02070	Unit D3 Layer 2 Spit 1	Agate	Long Cylinder
Ban Non Wat	AKC02061	Burial 356	Carnelian	Long Barrel
Ban Non Wat	AKC02060	Burial 312	Agate	Long Barrel
Ban Non Wat	AKC02065	Burial 356	Agate	Long Barrel
Ban Non Wat	AKC02063	Unit E8 Layer 3 Spit 3	Agate	Rounded Square
Ban Non Wat	AKC02069	Unit C2 Layer 2 Spit 4	Agate	Long Tabular Rectangle
Ban Non Wat	AKC02066	Burial 36	Agate	Notched Pendant (broken)
Ban Non Wat	AKC02062	Unit C3 Layer 2 Spit 4 Feature 4	Carnelian	Long Barrel
Ban Non Wat	AKC02064	Unit 3 Feature 6 Bag 10612	Agate	Short Barrel

Site Name	Database ID	Context	Agate/ Carnelian	Bead Shape
Ban Non Wat	AKC02068	Burial 36	Carnelian	Hexagonal Faceted Barrel
Ban Non Wat	AKC02071	Burial 203	Agate	Short Bicone
Ban Non Wat	AKC02067	Burial 259	Carnelian	Spherical
Bit Meas	AKC00730	No context	Agate	Short Barrel
Bit Meas	AKC00732	No context	Carnelian	Long Hexagonal Bicone
Khao Sam Kaeo	AKC03500	Unknown	Carnelian	Long Bicone (Unfinished)
Khao Sam Kaeo	AKC03501	Unknown	Agate	Long Barrel (Unfinished)
Khao Sam Kaeo	AKC03502	Unknown	Agate	Long Barrel (Unfinished)
Khao Sam Kaeo	AKC03503	Hill 4	Agate	Leech Bead (Unfinished)
Khao Sam Kaeo	AKC03504	Hill 4	Agate	Tabular Square (Unfinished)
Khao Sam Kaeo	AKC03505	Hill 3	Agate	Short Barrel
Khao Sam Kaeo	AKC03506	Hill 3	Agate	Long Barrel
Khao Sam Kaeo	AKC03507	Hill 2	Agate	Leech bead
Khao Sam Kaeo	AKC03508	Hill 2	Agate	Tabular Truncated Bicone
Khao Sam Kaeo	AKC03509	Hill 2	Agate	Long Bicone
Khao Sam Kaeo	AKC03510	North Hill 3	Carnelian	Spherical (Unfinished)
Khao Sam Kaeo	AKC03511	North Hill 3	Carnelian	Hexagonal Flattened Bicone
Khao Sam Kaeo	AKC03512	North Hill 3	Agate	Long Cylinder (Unfinished)
Khao Sam Kaeo	AKC03513	North Hill 3	Agate	Short Barrel (Unfinished)
Khao Sam Kaeo	AKC03514	Hill 2	Carnelian	Crescent
Khao Sam Kaeo	AKC03515	Hill 2	Carnelian	Crescent
Khao Sam Kaeo	AKC03516	Hill 4	Agate	Chamfered Square
Khao Sam Kaeo	AKC03517	Hill 4	Agate	Notched pendant (Broken)

Site Name	Database ID	Context	Agate/ Carnelian	Bead Shape
Krek 52/62	AKC00647	Unit II Square J14 GH 1 AH 2	Carnelian	Spherical
Phnom Borei	AKC01950	Unit 1 Level 167 Layer 3	Carnelian	Spherical
Phnom Borei	AKC01951	Unit 1 Level 241 Layer 4	Carnelian	Spherical
Phum Snay	AKC00003	Unit B Layer 3 Spit 3 Feature 1	Agate	Long Barrel
Phum Snay	AKC00016	Burial 9	Carnelian	Hexagonal Faceted Short Bicone (rough)
Phum Snay	AKC00020	Burial 9	Carnelian	Spherical
Phum Snay	AKC00025	Burial 9	Carnelian	Hexagonal Faceted Short Bicone (rough)
Phum Snay	AKC00026	Burial 9	Carnelian	Hexagonal Faceted Short Bicone (rough)
Phum Snay	AKC00035	Burial 9	Carnelian	Spherical
Phum Snay	AKC00044	Burial 9	Carnelian	Spherical
Phum Snay	AKC00053	Burial 2	Carnelian	Hexagonal Faceted Short Bicone (rough)
Phum Snay	AKC00056	Burial 2	Carnelian	Long Barrel
Prei Khmeng	AKC01721	US 22021	Carnelian	Nodule
Prohear	AKC00644	Burial 4	Agate	Long Barrel
Prohear	AKC00646	Burial 2	Agate	Long Cylinder
Prohear	AKC00643	Burial 24	Carnelian	Hexagonal Flattened Bicone
Promptin Tai	AKC01061	Burial 20	Carnelian	Hexagonal Faceted Barrel
Promptin Tai	AKC01062	Burial 20	Agate	Long Barrel
Promptin Tai	AKC00932	Burial 32	Carnelian	Rough Spherical
Promptin Tai	AKC00922	Burial 20	Carnelian	Long Hexagonal Bicone
Promptin Tai	AKC00923	Burial 20	Agate	Long Barrel
Promptin Tai	AKC01108	Burial 19	Agate	Pendant (broken)
Promptin Tai	AKC01111	Burial 19	Agate	Short Bicone
Promptin Tai	AKC00995	S3 East Section 130-130 cmbd	Carnelian	Rough Spherical
Promptin Tai	AKC00999	S3 East Section 130-130 cmbd	Carnelian	Spherical

Site Name	Database ID	Context	Agate/ Carnelian	Bead Shape
Promptin Tai	AKC00902	Burial 16	Agate	Long Barrel
Promptin Tai	AKC00980	S3/2 East Section 210-220 cmbd	Carnelian	Hexagonal Flattened Bicone
Promptin Tai	AKC01051	S3/2 West Section 190-200 cmbd	Carnelian	Rough Spherical
Village 10.8	AKC00433	Burial 48	Carnelian	Long Bicone
Village 10.8	AKC00437	Burial 48	Carnelian	Long Hexagonal Bicone
Village 10.8	AKC00308	Burial 28	Agate	Short Barrel
Village 10.8	AKC00348	Burial 3	Carnelian	Short Bicone
Village 10.8	AKC00303	Burial 34	Carnelian	Short Barrel
Village 10.8	AKC00364	Burial 15	Carnelian	Long Bicone
Village 10.8	AKC00344	Burial 1	Carnelian	Short Bicone

Appendix 6.2: LA-ICP-MS data for agate and carnelian geologic samples and artifacts

Database ID	Site	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO	MnO	Fe2O3	CuO	SnO2
AKC03035	Angkor Borei	99.5%	0.0%	0.0%	0.1%	0.0%	0.1%	0.2%	0.0%	0.1%	0.0%	0.0%
AKC03036	Angkor Borei	99.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC03037	Angkor Borei	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC03038	Angkor Borei	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC03039	Angkor Borei	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.2%	0.0%	0.0%
AKC03040	Angkor Borei	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
AKC03041	Angkor Borei	96.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	2.8%	0.0%	0.0%
AKC03042	Angkor Borei	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC03043	Angkor Borei	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC03044	Angkor Borei	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
AKC03045	Angkor Borei	99.6%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC03046	Angkor Borei	99.6%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC02060	Ban Non Wat	99.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%
AKC02061	Ban Non Wat	99.3%	0.0%	0.3%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
AKC02062	Ban Non Wat	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC02063	Ban Non Wat	99.6%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC02064	Ban Non Wat	99.6%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC02065	Ban Non Wat	99.4%	0.1%	0.0%	0.0%	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC02066	Ban Non Wat	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC02067	Ban Non Wat	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%
AKC02068	Ban Non Wat	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC02069	Ban Non Wat	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%
AKC02070	Ban Non Wat	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.1%	0.0%	0.0%

Database ID	Site	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO	MnO	Fe2O3	CuO	SnO2
AKC02071	Ban Non Wat	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%
AKC00730	Bit Meas	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AKC00732	Bit Meas	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AKC03500	Khao Sam Kao	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC03501	Khao Sam Kao	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC03503	Khao Sam Kao	99.6%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC03504	Khao Sam Kao	99.5%	0.0%	0.0%	0.1%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%
AKC03505	Khao Sam Kao	99.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
AKC03506	Khao Sam Kao	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC03507	Khao Sam Kao	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC03508	Khao Sam Kao	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
AKC03509	Khao Sam Kao	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
AKC03510	Khao Sam Kao	99.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC03511	Khao Sam Kao	99.4%	0.0%	0.0%	0.2%	0.0%	0.1%	0.2%	0.0%	0.1%	0.0%	0.0%
AKC03511	Khao Sam Kao	99.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.6%	0.0%	0.0%
AKC03512	Khao Sam Kao	99.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC03513	Khao Sam Kao	99.6%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC03514	Khao Sam Kao	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC03515	Khao Sam Kao	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC03516	Khao Sam Kao	99.6%	0.1%	0.0%	0.0%	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC03517	Khao Sam Kao	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC00647	Krek 52/62	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AKC01950	Phnom Borei	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
AKC01951	Phnom Borei	99.8%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
AKC00003	Phum Snay	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
AKC00016	Phum Snay	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%

Database ID	Site	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO	MnO	Fe2O3	CuO	SnO2
AKC00020	Phum Snay	99.8%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
AKC00025	Phum Snay	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AKC00026	Phum Snay	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
AKC00035	Phum Snay	99.8%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
AKC00044	Phum Snay	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AKC00053	Phum Snay	99.7%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%
AKC00056	Phum Snay	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AKC01721	Prei Khmeng	99.8%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AKC00643	Prohear	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%
AKC00644	Prohear	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
AKC00646	Prohear	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
AKC00902	Promtin Tai	99.5%	0.0%	0.0%	0.1%	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC00922	Promtin Tai	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
AKC00923	Promtin Tai	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC00932	Promtin Tai	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC00980	Promtin Tai	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
AKC00995	Promtin Tai	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC00999	Promtin Tai	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC01051	Promtin Tai	99.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC01061	Promtin Tai	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
AKC01062	Promtin Tai	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC01108	Promtin Tai	99.7%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
AKC01111	Promtin Tai	99.6%	0.0%	0.0%	0.0%	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%
AKC00303	Village 10.8	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AKC00308	Village 10.8	99.8%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
AKC00344	Village 10.8	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Database ID	Site	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO	MnO	Fe2O3	CuO	SnO2
AKC00348	Village 10.8	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
AKC00364	Village 10.8	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AKC00433	Village 10.8	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AKC00437	Village 10.8	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%

Database ID	Li	Be	B	Sc	Ti	V	Cr	Ni	Co	Zn	As
AKC03035	6.841	0.922	7.689	3.262	2.027	2.013	1.003	5.386	0.074	0.840	0.000
AKC03036	3.618	1.539	17.822	2.741	2.452	0.455	1.801	4.608	0.139	2.110	0.404
AKC03037	0.446	1.689	3.982	2.304	2.872	0.924	1.483	4.301	0.103	3.006	3.150
AKC03038	0.329	1.193	14.277	2.837	4.177	0.200	1.422	5.080	0.109	1.298	0.000
AKC03039	0.455	1.284	12.210	2.838	1.494	1.702	1.276	5.111	0.099	1.208	0.000
AKC03040	0.407	1.149	16.926	2.818	1.076	1.322	1.311	5.795	0.163	0.578	1.885
AKC03041	0.950	1.179	4.764	4.589	6.280	41.268	5.255	15.110	7.820	14.423	0.917
AKC03042	0.707	1.297	7.285	2.776	2.828	0.807	1.536	6.347	0.152	1.966	0.459
AKC03043	0.461	1.634	13.045	2.852	2.349	0.411	1.998	6.131	0.163	2.914	0.000
AKC03044	0.088	0.049	16.376	4.211	1.139	1.939	0.113	7.466	0.107	4.071	0.000
AKC03045	0.346	1.003	16.545	3.968	4.595	0.537	0.350	7.176	0.064	4.707	0.000
AKC03046	8.108	0.205	1.308	4.223	16.085	0.785	1.786	8.752	0.281	25.189	0.997
AKC02060	1.247	2.374	15.974	4.248	1.023	0.265	0.501	8.992	0.104	0.442	1.659
AKC02061	1.866	0.000	0.834	4.536	1.972	0.469	5.498	61.219	0.144	3.125	2.242
AKC02062	0.616	1.632	2.824	3.284	11.976	4.375	1.366	6.297	0.251	2.118	2.723
AKC02063	3.038	1.603	27.358	3.245	2.662	0.248	0.876	6.113	0.107	0.752	3.228
AKC02064	1.411	3.006	17.405	2.863	4.579	0.508	0.885	4.067	0.240	4.944	0.577
AKC02065	0.868	0.944	0.681	3.533	10.353	0.765	0.962	5.771	0.128	6.999	1.370
AKC02066	0.949	2.111	9.557	3.445	1.517	0.483	1.247	5.507	0.132	2.318	4.812
AKC02067	0.383	0.982	0.730	3.714	1.836	0.241	0.620	7.534	0.088	0.667	2.157
AKC02068	3.135	1.446	5.120	3.487	1.963	0.447	0.916	6.208	0.157	3.035	2.731
AKC02069	2.352	2.601	19.945	4.184	4.114	0.338	0.824	7.576	0.101	4.618	0.919
AKC02070	0.426	0.804	13.859	4.205	1.142	0.190	0.406	7.679	0.063	0.734	1.230
AKC02071	3.026	1.441	16.530	3.785	3.117	0.576	0.680	7.859	0.123	3.804	1.008
AKC00730	0.227	0.559	12.502	1.846	0.811	0.811	0.291	0.611	0.008	0.564	1.695
AKC00732	0.191	0.729	9.166	1.905	1.581	0.170	0.415	0.455	0.041	0.711	0.053

Database ID	Li	Be	B	Sc	Ti	V	Cr	Ni	Co	Zn	As
AKC03500	0.120	0.195	8.239	3.460	0.437	0.158	0.383	5.900	0.037	1.852	3.728
AKC03501	2.370	1.767	15.653	3.294	1.895	0.158	0.415	6.236	0.143	2.745	3.349
AKC03503	0.618	0.174	15.492	5.358	8.826	1.195	0.826	9.018	0.043	5.382	0.879
AKC03504	4.767	0.202	15.870	5.234	2.617	1.821	0.923	8.882	0.060	5.614	2.963
AKC03505	3.820	1.835	10.778	4.775	5.163	0.285	0.636	5.795	0.024	1.476	0.971
AKC03506	2.087	0.034	20.963	4.078	8.015	0.164	0.354	6.603	0.021	1.628	0.239
AKC03507	0.665	0.215	0.892	3.634	0.376	0.041	0.260	6.460	0.011	2.170	1.202
AKC03508	0.583	0.085	1.830	3.600	0.213	0.141	0.337	6.118	0.020	0.829	1.081
AKC03509	0.799	1.209	20.565	4.243	0.202	0.768	0.170	6.488	0.010	0.340	0.415
AKC03510	0.237	0.368	8.690	3.856	6.613	0.498	0.689	10.205	0.128	11.438	1.413
AKC03511	8.949	0.211	1.228	5.678	9.558	0.903	0.962	9.267	0.083	3.954	0.669
AKC03511	1.111	0.282	0.631	3.308	1.351	3.710	0.471	5.411	0.070	1.579	0.244
AKC03512	2.320	1.323	14.899	3.367	2.532	0.383	0.462	6.100	0.073	3.958	0.852
AKC03513	3.210	0.297	0.806	3.567	4.254	0.308	0.558	6.486	0.082	10.495	1.175
AKC03514	0.612	0.151	0.640	4.215	0.722	0.142	0.463	7.050	0.026	0.776	0.490
AKC03515	0.380	0.108	0.589	3.912	0.616	0.078	0.371	7.061	0.023	0.634	0.602
AKC03516	0.224	0.374	11.677	5.392	1.058	0.249	0.661	7.287	0.036	4.049	0.722
AKC03517	2.465	0.682	6.197	5.242	0.744	2.744	0.554	8.764	0.026	1.090	2.877
AKC00647	0.094	0.277	3.489	1.900	2.247	0.328	1.201	1.669	0.059	2.613	0.963
AKC01950	0.324	0.576	14.663	1.663	2.031	0.139	3.294	0.667	0.035	0.787	0.000
AKC01951	2.054	0.424	26.846	1.730	0.619	0.539	0.332	0.446	0.012	1.058	0.000
AKC00003	1.648	0.550	21.401	2.507	0.292	0.197	0.343	0.988	0.004	4.469	0.000
AKC00016	0.995	0.250	18.641	2.271	0.615	0.215	0.337	0.616	0.021	13.084	0.000
AKC00020	0.682	0.477	5.973	2.404	4.053	0.905	0.189	0.991	0.023	29.773	0.000
AKC00025	0.248	0.378	7.312	2.047	0.460	0.223	0.315	0.433	0.009	0.463	0.000
AKC00026	0.125	0.413	11.045	1.964	0.383	0.076	0.656	0.513	0.015	0.681	0.000

Database ID	Li	Be	B	Sc	Ti	V	Cr	Ni	Co	Zn	As
AKC00035	1.116	0.329	24.263	1.808	1.739	0.680	0.758	0.443	0.036	1.139	0.000
AKC00044	0.134	0.214	9.790	1.730	0.102	0.294	0.000	0.420	0.016	2.730	0.000
AKC00053	0.220	0.269	16.620	1.693	1.707	1.559	4.939	0.388	0.006	0.898	0.000
AKC00056	0.086	0.297	2.542	1.812	0.728	0.371	2.345	0.514	0.012	0.271	0.000
AKC01721	0.604	0.553	41.512	2.236	11.173	0.456	0.506	0.540	0.049	1.776	3.202
AKC00643	1.005	0.821	12.920	2.450	0.481	3.334	0.432	1.637	0.086	2.964	1.418
AKC00644	1.633	0.888	15.339	1.781	0.224	0.226	0.348	0.506	0.040	0.525	0.223
AKC00646	0.332	0.260	13.382	1.920	0.328	0.117	0.296	0.561	0.031	0.437	0.993
AKC00902	0.939	1.521	13.613	3.013	2.319	0.238	1.579	6.240	0.104	1.960	3.345
AKC00922	0.181	1.164	2.861	3.114	1.387	0.704	1.097	5.846	0.081	0.908	0.612
AKC00923	0.555	1.727	18.038	3.129	0.897	0.572	1.363	7.451	0.115	0.933	0.000
AKC00932	0.239	1.379	6.020	3.113	3.048	0.268	1.143	7.175	0.115	1.226	0.381
AKC00980	0.557	0.920	1.664	3.263	0.948	0.132	0.930	7.532	0.077	0.454	1.378
AKC00995	3.026	2.040	6.523	2.978	6.934	0.450	1.443	5.213	0.358	4.023	4.416
AKC00999	0.607	1.786	4.955	2.912	3.901	0.367	1.381	6.095	0.099	3.116	3.875
AKC01051	1.448	1.173	5.088	3.855	1.227	0.288	1.581	5.878	0.107	2.519	5.318
AKC01061	1.676	2.278	7.836	2.671	1.354	1.165	1.323	5.516	0.271	4.906	5.856
AKC01062	1.004	2.716	15.869	2.600	1.572	0.696	0.881	5.093	0.089	1.189	2.254
AKC01108	1.305	1.442	5.393	2.476	1.226	1.406	1.190	5.287	0.073	1.363	1.213
AKC01111	1.339	0.893	23.051	2.508	1.663	0.895	0.863	4.006	0.074	2.282	5.915
AKC00303	1.095	0.699	4.111	1.902	0.883	0.252	0.388	0.333	0.037	1.197	2.799
AKC00308	2.070	1.790	18.957	1.805	6.788	0.319	0.936	0.780	0.049	0.706	1.153
AKC00344	0.045	0.277	1.055	1.879	5.272	0.122	0.458	0.446	0.018	0.756	2.502
AKC00348	0.397	0.397	13.445	1.930	1.761	0.318	0.532	0.696	0.023	1.019	1.641
AKC00364	0.157	0.292	3.910	1.795	2.785	0.084	0.196	0.356	0.022	0.290	4.435
AKC00433	0.900	0.833	10.292	1.821	0.965	0.137	0.603	0.655	0.052	0.483	1.016

Database ID	Li	Be	B	Sc	Ti	V	Cr	Ni	Co	Zn	As
AKC00437	0.915	0.339	16.129	1.828	1.236	0.632	0.566	0.973	0.046	0.764	1.044

Database ID	Rb	Sr	Zr	Nb	Ag	In	Sb	Cs	Ba	La	Ce
AKC03035	2.029	1.952	0.241	0.039	0.133	0.078	0.516	0.029	9.731	0.058	0.025
AKC03036	0.367	1.512	0.098	0.063	0.170	0.035	0.854	0.035	1.031	0.065	0.063
AKC03037	0.119	0.231	0.159	0.067	0.306	0.038	0.330	0.017	0.374	0.048	0.051
AKC03038	0.116	0.552	0.174	0.069	0.137	0.027	0.667	0.021	1.423	0.033	0.045
AKC03039	0.223	0.584	0.089	0.051	0.098	0.031	0.540	0.029	0.552	0.055	0.054
AKC03040	0.429	0.464	0.068	0.048	0.069	0.019	0.478	0.019	1.458	0.045	0.053
AKC03041	0.462	2.826	0.956	0.032	0.084	0.045	0.614	0.019	6.532	0.557	2.050
AKC03042	0.387	0.779	0.126	0.084	0.208	0.028	0.671	0.038	1.798	0.044	0.073
AKC03043	0.357	1.040	0.118	0.089	0.274	0.036	0.658	0.023	0.676	0.069	0.127
AKC03044	0.222	0.460	0.109	0.009	0.016	0.006	0.627	0.010	0.842	0.019	0.051
AKC03045	1.002	0.832	0.583	0.034	0.412	0.019	0.940	0.042	1.062	0.093	0.178
AKC03046	1.291	1.648	0.759	0.217	1.037	0.130	1.155	0.145	4.519	0.196	0.590
AKC02060	0.342	1.098	0.065	0.040	0.077	0.044	1.458	0.013	2.691	0.027	0.035
AKC02061	0.830	0.359	0.143	0.037	0.192	0.020	0.123	0.199	1.568	0.022	0.037
AKC02062	0.369	0.357	0.214	0.108	0.153	0.028	0.340	0.068	1.436	0.188	0.220
AKC02063	0.610	1.034	0.104	0.090	0.103	0.036	1.436	0.036	2.240	0.064	0.083
AKC02064	0.635	1.262	0.201	0.075	0.398	0.065	1.075	0.082	4.062	0.112	0.263
AKC02065	1.868	2.738	0.195	0.080	0.079	0.016	0.325	0.028	13.209	0.064	0.178
AKC02066	1.965	0.768	0.174	0.070	0.102	0.047	0.655	0.136	2.713	0.034	0.102
AKC02067	0.506	0.860	0.099	0.049	0.100	0.023	0.093	0.038	4.206	0.075	0.060
AKC02068	0.093	0.769	0.084	0.045	0.141	0.029	0.298	0.041	4.149	0.036	0.043
AKC02069	0.362	0.640	0.102	0.075	0.268	0.054	0.652	0.065	1.274	0.082	0.083
AKC02070	0.113	1.087	0.113	0.035	0.048	0.021	0.376	0.023	7.008	0.085	0.596
AKC02071	0.478	0.670	0.109	0.079	0.124	0.024	0.405	0.041	5.342	0.179	0.450
AKC00730	0.172	0.636	0.068	0.101	7.839	0.002	0.454	0.006	9.579	0.019	0.033
AKC00732	0.232	0.910	0.062	0.004	0.050	0.005	0.183	0.010	1.939	0.016	0.066

Database ID	Rb	Sr	Zr	Nb	Ag	In	Sb	Cs	Ba	La	Ce
AKC03500	0.119	0.883	0.104	0.008	0.067	0.016	0.606	0.014	0.500	0.051	0.095
AKC03501	0.349	1.327	0.137	0.027	0.246	0.045	0.533	0.044	0.519	0.047	0.122
AKC03503	0.734	0.838	0.294	0.050	0.133	0.013	0.258	0.031	1.833	0.578	1.672
AKC03504	1.133	1.266	0.271	0.100	0.103	0.022	0.358	0.049	4.078	0.279	0.955
AKC03505	0.641	1.712	0.055	0.024	0.105	0.021	0.750	0.021	0.858	0.014	0.069
AKC03506	0.746	0.812	0.204	0.022	0.076	0.006	0.048	0.012	2.480	0.050	0.217
AKC03507	0.409	0.274	0.052	0.016	0.065	0.034	0.125	0.011	0.902	0.057	0.247
AKC03508	0.385	0.227	0.081	0.009	0.062	0.006	0.089	0.024	0.997	0.075	0.330
AKC03509	0.144	0.292	0.038	0.013	0.014	0.004	0.244	0.003	0.729	0.313	1.759
AKC03510	0.565	0.301	0.198	0.069	0.893	0.027	1.224	0.060	1.168	0.299	0.534
AKC03511	2.507	0.820	0.560	0.086	0.725	0.044	0.298	0.082	3.075	0.375	1.147
AKC03511	0.518	0.539	0.110	0.013	0.029	0.002	0.031	0.009	4.612	0.194	0.558
AKC03512	0.533	0.418	0.135	0.026	3.810	0.025	0.791	0.019	1.483	0.307	0.996
AKC03513	1.133	0.482	0.123	0.169	1.338	0.043	0.454	0.033	1.964	0.067	0.210
AKC03514	0.694	0.518	0.124	0.008	0.100	0.005	0.031	0.012	7.976	0.103	0.357
AKC03515	0.561	0.472	0.040	0.013	0.186	0.011	0.032	0.009	8.754	0.102	0.443
AKC03516	1.395	0.618	0.037	0.026	3.330	0.051	0.207	0.035	0.961	0.177	0.737
AKC03517	0.220	0.643	0.051	0.019	0.208	0.003	0.499	0.014	6.590	0.104	0.473
AKC00647	0.457	0.441	0.161	0.172	0.061	0.008	0.140	0.014	0.583	0.015	0.049
AKC01950	0.111	0.526	0.161	0.000	0.081	0.002	0.367	0.005	1.520	0.028	0.034
AKC01951	0.035	1.737	0.354	0.000	0.028	0.003	0.651	0.008	2.285	0.095	0.125
AKC00003	0.191	1.697	0.115	0.136	0.087	0.012	1.391	0.038	5.803	0.087	0.201
AKC00016	0.062	0.839	0.082	0.000	0.019	0.003	0.212	0.009	1.251	0.013	0.016
AKC00020	0.184	1.270	0.225	0.202	0.019	0.003	0.809	0.031	4.108	0.036	0.099
AKC00025	0.928	0.518	0.129	0.116	0.013	0.003	0.166	0.006	0.481	0.027	0.044
AKC00026	0.052	0.453	0.101	0.074	0.035	0.003	0.299	0.016	1.618	0.032	0.039

Database ID	Rb	Sr	Zr	Nb	Ag	In	Sb	Cs	Ba	La	Ce
AKC00035	0.073	1.489	0.181	0.027	0.078	0.003	1.028	0.010	7.646	0.086	0.119
AKC00044	0.033	0.633	0.030	0.000	0.019	0.002	0.091	0.005	11.709	0.143	0.056
AKC00053	1.982	1.208	0.028	1.332	0.024	0.002	0.356	0.006	1.581	0.012	0.011
AKC00056	0.000	0.166	0.024	0.000	0.014	0.003	0.350	0.005	0.344	0.009	0.008
AKC01721	1.079	0.457	0.816	0.036	0.059	0.001	2.172	0.042	2.505	0.077	0.211
AKC00643	2.398	0.887	0.042	0.185	0.961	0.002	0.163	0.032	2.716	0.097	0.067
AKC00644	1.578	1.054	0.066	0.007	111.217	0.005	0.761	0.012	2.320	0.050	0.083
AKC00646	0.223	1.521	0.072	0.086	0.588	0.004	0.261	0.006	2.214	0.015	0.016
AKC00902	3.085	1.972	0.316	0.047	0.136	0.061	1.036	0.088	5.105	0.049	0.087
AKC00922	0.286	0.802	0.080	0.043	0.133	0.020	0.447	0.009	2.731	0.041	0.052
AKC00923	0.371	2.424	0.129	0.045	0.072	0.061	0.848	0.006	2.689	0.022	0.081
AKC00932	0.663	1.123	0.108	0.039	0.095	0.061	0.158	0.023	3.399	0.043	0.049
AKC00980	0.654	0.392	0.073	0.024	0.095	0.013	0.077	0.013	3.602	0.053	0.168
AKC00995	0.258	1.402	0.168	0.075	0.295	0.041	0.391	0.031	7.711	0.043	0.107
AKC00999	0.192	0.362	0.121	0.074	0.187	0.052	0.713	0.056	0.643	0.033	0.071
AKC01051	0.339	1.281	0.090	0.083	0.144	0.040	0.217	0.014	1.341	0.029	0.052
AKC01061	0.390	0.921	0.099	0.124	0.304	0.105	1.489	0.035	0.901	0.058	0.105
AKC01062	0.413	0.704	0.102	0.050	0.121	0.053	0.908	0.020	0.737	0.037	0.053
AKC01108	1.378	4.014	0.105	0.067	0.439	0.025	2.115	0.031	14.898	0.038	0.037
AKC01111	1.506	2.206	0.111	0.044	0.189	0.017	0.593	0.030	2.592	0.039	0.059
AKC00303	0.205	0.344	0.074	0.010	0.023	0.003	0.533	0.008	0.728	0.048	0.125
AKC00308	0.465	3.681	0.220	0.263	0.043	0.002	0.622	0.014	1.219	0.091	0.219
AKC00344	0.199	0.935	7.250	0.250	0.027	0.002	0.188	0.014	1.630	0.021	0.055
AKC00348	0.071	0.582	0.085	0.063	0.034	0.003	0.417	0.004	0.778	0.009	0.024
AKC00364	0.125	0.298	0.064	0.063	0.022	0.002	0.215	0.004	1.014	0.008	0.023
AKC00433	0.218	0.551	0.048	0.161	0.045	0.005	0.974	0.008	0.404	0.008	0.021

Database ID	Rb	Sr	Zr	Nb	Ag	In	Sb	Cs	Ba	La	Ce
AKC00437	0.231	0.696	0.120	0.143	0.111	0.004	0.530	0.007	1.176	0.020	0.021

Database ID	Pr	Ta	Au	Y	Pb	Bi	U	W	Mo	Nd	Sm
AKC03035	0.024	0.049	0.198	0.382	1.522	0.065	0.037	0.092	0.148	0.141	0.116
AKC03036	0.033	0.068	0.577	0.086	0.391	0.054	0.034	0.124	0.238	0.132	0.159
AKC03037	0.036	0.074	1.013	0.058	1.419	0.066	0.051	0.154	0.206	0.148	0.000
AKC03038	0.025	0.084	0.743	0.097	0.523	0.055	0.722	1.248	0.163	0.179	0.184
AKC03039	0.049	0.033	0.614	0.105	0.570	0.040	0.048	0.096	0.306	0.193	0.167
AKC03040	0.017	0.107	0.206	0.078	0.322	0.069	0.034	0.107	0.156	0.099	0.123
AKC03041	0.445	0.000	0.070	4.614	0.692	0.026	0.048	0.087	0.177	2.621	1.267
AKC03042	0.021	0.074	0.438	0.090	0.634	0.077	0.085	0.138	0.226	0.107	0.199
AKC03043	0.038	0.082	0.696	0.150	1.319	0.141	0.051	0.127	0.293	0.114	0.192
AKC03044	0.005	0.005	0.123	0.032	0.411	0.008	0.035	0.020	0.011	0.019	0.012
AKC03045	0.035	0.011	0.707	0.657	2.593	0.116	0.031	0.029	0.070	0.083	0.050
AKC03046	0.087	0.065	7.018	0.131	6.758	0.415	0.202	0.107	0.184	0.223	0.125
AKC02060	0.018	0.025	0.282	0.262	0.116	0.028	0.029	0.071	0.077	0.080	0.277
AKC02061	0.019	0.045	0.248	0.040	0.466	0.029	0.022	2.563	0.133	0.349	0.000
AKC02062	0.068	0.066	0.311	0.388	0.645	0.099	4.253	0.164	0.225	0.229	0.272
AKC02063	0.023	0.320	0.857	0.072	0.211	0.048	0.144	3.344	0.200	0.106	1.320
AKC02064	0.063	0.068	0.947	1.563	1.993	0.082	0.104	0.771	0.152	0.195	0.196
AKC02065	0.032	0.188	0.720	0.109	0.564	0.028	0.046	0.100	0.115	0.099	0.100
AKC02066	0.027	0.194	0.208	1.391	0.299	0.046	0.071	0.853	0.214	0.145	0.205
AKC02067	0.026	0.028	0.203	0.173	0.188	0.055	0.032	0.093	2.113	0.111	0.113
AKC02068	0.026	0.278	0.318	0.048	0.800	0.051	0.043	0.117	0.240	0.114	0.122
AKC02069	0.031	0.074	0.673	1.085	1.329	0.050	0.095	0.362	0.195	0.133	0.232
AKC02070	0.056	0.028	0.174	0.088	0.686	0.025	0.023	0.045	0.107	0.238	0.107
AKC02071	0.048	0.258	0.448	0.162	0.804	0.038	0.412	1.360	0.130	0.162	0.204
AKC00730	0.007	0.006	0.025	0.080	0.463	0.016	0.021	0.015	0.012	0.016	0.018
AKC00732	0.011	0.010	0.029	0.142	0.222	0.015	0.018	0.021	0.013	0.040	0.035

Database ID	Pr	Ta	Au	Y	Pb	Bi	U	W	Mo	Nd	Sm
AKC03500	0.014	0.020	0.442	0.023	1.202	0.052	0.008	0.035	0.054	0.060	0.120
AKC03501	0.015	0.040	1.764	0.542	4.689	0.095	0.026	0.080	0.142	0.121	0.297
AKC03503	0.073	0.015	0.572	0.095	4.205	0.083	0.027	0.051	0.198	0.278	0.056
AKC03504	0.053	0.057	0.722	0.067	1.462	0.114	0.014	0.148	0.150	0.169	0.167
AKC03505	0.015	0.011	0.176	0.934	0.454	0.034	0.006	0.019	0.028	0.038	0.020
AKC03506	0.015	0.030	0.101	0.046	0.330	0.012	0.008	0.042	0.056	0.124	0.044
AKC03507	0.022	0.006	0.418	0.045	0.280	0.057	0.006	0.025	0.032	0.044	0.022
AKC03508	0.020	0.019	0.334	0.039	0.421	0.022	0.027	0.034	0.020	0.088	0.017
AKC03509	0.137	0.007	0.019	0.295	1.830	0.012	0.027	0.024	0.024	0.354	0.082
AKC03510	0.058	0.021	6.992	0.062	5.283	5.882	0.042	0.062	0.053	0.170	0.041
AKC03511	0.089	0.040	1.119	0.129	3.267	0.260	0.034	0.058	0.079	0.222	0.069
AKC03511	0.079	0.014	0.023	0.235	1.789	0.050	0.029	0.017	0.031	0.229	0.054
AKC03512	0.042	0.014	0.188	0.245	2.211	0.128	0.036	0.067	0.033	0.133	0.021
AKC03513	0.022	0.021	2.446	0.072	4.082	0.105	0.039	0.076	0.092	0.072	0.055
AKC03514	0.036	0.010	0.086	0.073	1.143	0.008	0.005	0.039	0.028	0.071	0.037
AKC03515	0.037	0.009	0.072	0.070	1.173	0.005	0.014	0.047	0.039	0.091	0.064
AKC03516	0.044	0.058	0.165	0.088	1.295	0.027	0.057	0.136	0.061	0.158	0.100
AKC03517	0.026	0.054	0.325	0.120	0.499	0.052	0.020	0.126	0.018	0.171	0.172
AKC00647	0.007	0.007	0.044	0.137	0.318	0.016	1.229	0.039	0.021	0.028	0.019
AKC01950	0.008	0.006	0.026	0.043	0.176	0.011	0.017	0.030	0.035	0.025	0.016
AKC01951	0.012	0.008	0.060	0.043	0.176	0.013	0.019	0.024	0.009	0.039	0.026
AKC00003	0.021	0.009	0.018	0.227	0.168	0.011	0.009	0.052	0.010	0.056	0.023
AKC00016	0.004	0.006	0.024	0.025	0.069	0.010	0.007	0.018	0.007	0.018	0.016
AKC00020	0.018	0.007	0.023	0.567	0.122	0.014	0.016	0.036	0.052	0.070	0.031
AKC00025	0.005	0.006	0.022	0.031	0.075	0.009	0.008	0.019	0.008	0.024	0.015
AKC00026	0.005	0.006	0.018	0.031	0.127	0.014	0.009	0.041	0.193	0.021	0.028

Database ID	Pr	Ta	Au	Y	Pb	Bi	U	W	Mo	Nd	Sm
AKC00035	0.016	0.007	0.022	0.099	0.251	0.011	0.257	0.027	0.016	0.061	0.028
AKC00044	0.036	0.013	0.023	0.100	0.360	0.006	0.091	0.015	0.010	0.149	0.031
AKC00053	0.004	0.039	0.024	0.037	0.031	0.011	0.014	0.033	0.035	0.014	0.014
AKC00056	0.008	0.005	0.019	0.151	0.031	0.009	0.009	0.033	0.010	0.035	0.026
AKC01721	0.010	0.005	0.012	0.034	0.152	0.007	0.021	0.012	0.024	0.070	0.013
AKC00643	0.056	0.004	0.029	0.310	0.447	0.009	0.019	0.055	0.044	0.250	0.079
AKC00644	0.010	0.008	0.031	0.325	2.724	0.012	0.007	0.020	0.017	0.036	0.030
AKC00646	0.004	0.004	0.028	0.008	0.175	0.010	0.005	0.027	0.018	0.015	0.021
AKC00902	0.031	0.109	0.967	0.237	1.005	0.227	0.000	3.063	0.151	0.125	0.155
AKC00922	0.024	0.031	0.181	0.173	0.250	0.035	0.127	0.100	0.136	0.146	0.109
AKC00923	0.019	0.033	0.270	1.791	0.250	0.030	0.044	0.000	0.127	0.102	0.138
AKC00932	0.028	0.045	0.424	0.095	0.397	0.046	0.026	0.107	0.315	0.111	0.170
AKC00980	0.031	0.028	0.079	0.114	0.428	0.029	0.028	0.056	0.110	0.138	0.167
AKC00995	0.041	0.085	1.125	0.065	1.277	0.202	1.019	0.252	0.184	0.165	0.163
AKC00999	0.035	0.048	1.474	0.120	1.164	0.358	0.000	0.156	0.174	0.165	0.129
AKC01051	0.023	0.032	0.245	0.084	1.153	0.039	0.167	0.067	0.197	0.090	0.135
AKC01061	0.046	0.074	1.430	0.101	1.664	0.262	0.000	0.177	0.355	0.175	0.193
AKC01062	0.020	0.133	0.561	0.920	0.706	0.301	0.000	0.492	0.220	0.119	0.119
AKC01108	0.034	0.024	0.166	0.330	0.371	0.030	0.154	0.000	0.134	0.084	0.099
AKC01111	0.016	0.033	0.144	0.067	0.087	0.037	0.153	0.079	0.201	0.109	0.109
AKC00303	0.020	0.005	0.016	0.238	0.109	0.006	0.006	0.016	0.010	0.111	0.026
AKC00308	0.034	0.008	0.024	0.816	0.194	0.013	0.011	0.292	0.023	0.103	0.041
AKC00344	0.009	0.006	0.052	0.050	0.501	0.015	0.100	0.020	0.008	0.017	0.019
AKC00348	0.004	0.006	0.031	0.030	0.089	0.008	0.007	0.017	0.009	0.023	0.017
AKC00364	0.003	0.005	0.039	0.028	0.085	0.008	0.009	0.016	0.010	0.014	0.018
AKC00433	0.005	0.006	0.038	0.054	0.068	0.017	0.022	0.031	0.017	0.025	0.023

Database ID	Pr	Ta	Au	Y	Pb	Bi	U	W	Mo	Nd	Sm
AKC00437	0.006	0.047	0.042	0.194	0.114	0.011	0.014	0.091	0.016	0.043	0.031

Database ID	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Th
AKC03035	0.028	0.123	0.017	0.086	0.026	0.092	0.043	0.122	0.052	0.093	1.111
AKC03036	0.039	0.252	0.032	0.138	0.041	0.111	0.057	0.233	0.032	0.169	8.638
AKC03037	0.053	0.151	0.044	0.150	0.041	0.122	0.052	0.183	0.049	0.122	8.907
AKC03038	0.040	0.000	0.029	0.150	0.048	0.092	0.046	0.192	0.040	0.393	6.997
AKC03039	0.051	0.137	0.027	0.157	0.056	0.097	0.044	0.201	0.046	0.126	7.451
AKC03040	0.031	0.182	0.020	0.114	0.026	0.083	0.034	0.136	0.024	0.092	0.030
AKC03041	0.318	1.120	0.197	1.289	0.187	0.574	0.063	0.575	0.058	0.150	0.031
AKC03042	0.049	0.183	0.026	0.106	0.043	0.092	0.080	0.192	0.035	0.164	9.580
AKC03043	0.077	0.188	0.030	0.146	0.061	0.132	0.047	0.209	0.043	0.222	15.951
AKC03044	0.004	0.016	0.003	0.012	0.003	0.008	0.003	0.025	0.008	0.008	0.093
AKC03045	0.015	0.034	0.017	0.057	0.027	0.064	0.017	0.082	0.009	0.032	17.189
AKC03046	0.059	0.095	0.040	0.093	0.063	0.061	0.075	0.052	0.085	0.099	210.633
AKC02060	0.019	0.091	0.020	0.083	0.025	0.070	0.026	0.117	0.029	0.081	0.022
AKC02061	0.033	0.097	0.228	0.074	0.023	0.068	0.028	0.074	0.024	0.094	4.461
AKC02062	0.043	0.254	0.049	0.227	0.048	0.124	0.041	0.226	0.173	0.117	1.750
AKC02063	0.160	0.138	0.023	2.609	0.342	0.000	0.038	0.156	0.119	0.209	2.029
AKC02064	0.045	0.199	0.051	0.164	0.068	0.144	0.048	0.170	0.049	0.159	0.119
AKC02065	0.021	0.091	0.018	0.263	0.194	0.118	0.046	0.097	0.338	0.194	0.039
AKC02066	0.047	0.171	0.029	0.161	0.055	0.155	0.045	0.200	0.045	0.136	1.291
AKC02067	0.032	0.137	0.025	0.090	0.023	0.079	0.026	0.000	0.031	0.000	1.140
AKC02068	0.027	0.162	0.023	0.124	0.191	0.106	0.038	0.142	0.054	0.143	1.074
AKC02069	0.044	0.182	0.028	0.220	0.045	0.169	0.063	0.340	0.049	0.315	5.405
AKC02070	0.020	0.108	0.016	0.055	0.014	0.050	0.022	0.141	0.015	0.063	0.024
AKC02071	0.023	0.118	0.018	0.541	0.114	0.105	0.102	1.869	0.125	0.266	0.967
AKC00730	0.003	0.018	0.003	0.018	0.004	0.013	0.004	0.015	0.005	0.016	0.011
AKC00732	0.006	0.032	0.005	0.025	0.005	0.014	0.003	0.021	0.006	0.021	0.010

Database ID	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Th
AKC03500	0.015	0.081	0.028	0.067	0.012	0.028	0.009	0.013	0.008	0.045	1.042
AKC03501	0.036	0.188	0.035	0.047	0.022	0.087	0.017	0.126	0.021	0.080	9.871
AKC03503	0.014	0.071	0.011	0.051	0.010	0.051	0.015	0.056	0.018	0.071	0.385
AKC03504	0.021	0.258	0.024	0.171	0.053	0.043	0.034	0.207	0.053	0.047	1.556
AKC03505	0.009	0.026	0.005	0.050	0.014	0.072	0.019	0.133	0.016	0.013	0.017
AKC03506	0.013	0.057	0.021	0.023	0.007	0.032	0.013	0.093	0.012	0.013	0.053
AKC03507	0.004	0.069	0.007	0.009	0.003	0.017	0.028	0.130	0.007	0.032	0.148
AKC03508	0.005	0.037	0.006	0.044	0.005	0.011	0.020	0.150	0.019	0.025	0.191
AKC03509	0.010	0.065	0.009	0.039	0.014	0.037	0.011	0.018	0.006	0.016	0.021
AKC03510	0.036	0.077	0.012	0.035	0.026	0.025	0.024	0.041	0.019	0.051	6.256
AKC03511	0.036	0.072	0.029	0.074	0.020	0.072	0.021	0.047	0.025	0.054	0.273
AKC03511	0.007	0.068	0.007	0.045	0.008	0.021	0.009	0.038	0.006	0.046	0.016
AKC03512	0.028	0.060	0.021	0.037	0.006	0.026	0.012	0.044	0.005	0.022	0.077
AKC03513	0.049	0.167	0.019	0.108	0.017	0.060	0.015	0.017	0.016	0.089	3.668
AKC03514	0.014	0.025	0.010	0.018	0.004	0.067	0.005	0.010	0.004	0.020	0.010
AKC03515	0.013	0.025	0.008	0.026	0.005	0.006	0.004	0.016	0.014	0.058	0.007
AKC03516	0.052	0.091	0.025	0.070	0.037	0.091	0.016	0.087	0.029	0.048	0.066
AKC03517	0.021	0.167	0.014	0.136	0.024	0.050	0.026	0.195	0.049	0.095	1.419
AKC00647	0.006	0.021	0.005	0.035	0.074	0.025	0.005	0.036	0.007	0.034	0.016
AKC01950	0.007	0.013	0.003	0.017	0.005	0.012	0.005	0.018	0.005	0.018	0.009
AKC01951	0.005	0.015	0.004	0.019	0.004	0.017	0.005	0.020	0.012	0.025	0.014
AKC00003	0.008	0.022	0.006	0.026	0.010	0.017	0.007	0.020	0.010	0.023	0.011
AKC00016	0.003	0.010	0.002	0.013	0.004	0.012	0.004	0.016	0.007	0.029	0.010
AKC00020	0.006	0.028	0.008	0.068	0.013	0.043	0.007	0.041	0.006	0.019	0.020
AKC00025	0.004	0.012	0.004	0.012	0.004	0.012	0.004	0.027	0.005	0.016	0.009
AKC00026	0.004	0.013	0.004	0.014	0.004	0.013	0.004	0.030	0.005	0.019	0.012

Database ID	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Th
AKC00035	0.005	0.025	0.004	0.024	0.009	0.013	0.004	0.029	0.006	0.019	0.015
AKC00044	0.010	0.020	0.007	0.024	0.005	0.011	0.003	0.016	0.004	0.011	0.006
AKC00053	0.004	0.014	0.003	0.015	0.004	0.013	0.004	0.025	0.007	0.044	0.009
AKC00056	0.007	0.019	0.005	0.032	0.008	0.022	0.005	0.034	0.005	0.020	0.010
AKC01721	0.002	0.010	0.002	0.017	0.003	0.009	0.002	0.018	0.003	0.023	0.021
AKC00643	0.023	0.059	0.018	0.102	0.006	0.027	0.006	0.052	0.006	0.023	0.009
AKC00644	0.007	0.041	0.005	0.040	0.006	0.015	0.004	0.020	0.005	0.017	0.012
AKC00646	0.004	0.016	0.003	0.015	0.000	0.009	0.006	0.022	0.005	0.018	0.013
AKC00902	0.043	0.257	0.026	0.141	0.000	0.081	0.041	0.170	0.057	0.093	0.470
AKC00922	0.031	0.139	0.020	0.112	0.030	0.075	0.032	0.135	0.029	0.083	2.775
AKC00923	0.027	0.170	0.031	0.208	0.040	0.179	0.035	0.230	0.030	0.170	4.019
AKC00932	0.031	0.146	0.031	0.095	0.031	0.110	0.044	0.000	0.030	0.106	5.950
AKC00980	0.030	0.091	0.019	0.107	0.027	0.066	0.018	0.084	0.099	0.053	0.354
AKC00995	0.055	0.225	0.024	0.119	0.000	0.089	0.046	0.728	0.079	0.483	8.341
AKC00999	0.034	0.150	0.034	0.118	0.000	0.077	0.043	0.139	0.053	0.000	9.016
AKC01051	0.030	0.105	0.016	0.112	0.034	0.088	0.024	0.111	0.043	0.122	1.013
AKC01061	0.081	0.214	0.035	0.170	0.172	0.130	0.054	0.197	0.048	0.000	5.368
AKC01062	0.122	0.181	0.024	0.124	0.000	0.160	0.039	0.189	0.043	0.000	9.245
AKC01108	0.039	0.099	0.022	0.093	0.027	0.149	0.028	0.137	0.030	0.000	1.303
AKC01111	0.033	0.119	0.016	0.117	0.021	0.087	0.019	0.109	0.000	0.080	0.019
AKC00303	0.005	0.036	0.004	0.039	0.006	0.022	0.003	0.021	0.005	0.015	0.008
AKC00308	0.015	0.050	0.007	0.071	0.014	0.055	0.011	0.123	0.012	0.027	0.018
AKC00344	0.002	0.013	0.003	0.018	0.004	0.011	0.004	0.028	0.004	0.022	0.008
AKC00348	0.001	0.017	0.004	0.023	0.004	0.009	0.002	0.017	0.005	0.021	0.009
AKC00364	0.001	0.012	0.002	0.017	0.003	0.010	0.003	0.015	0.004	0.015	0.010
AKC00433	0.007	0.018	0.003	0.023	0.000	0.016	0.005	0.025	0.006	0.021	0.059

Database ID	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Th
AKC00437	0.010	0.044	0.005	0.044	0.009	0.014	0.004	0.026	0.007	0.027	0.557

Database ID	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO	MnO	Fe2O3	CuO	SnO2
Kandek_1	99.6%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%
Kandek_2	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Kandek_3	99.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Kandek_4	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%
Kandek_5	99.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Kandek_6	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Kandek_7	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Kandek_8	99.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Kandek_9	99.8%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Kandek_10	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Kandek_11	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Kandek_12	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Kandek_13	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
Kandek_14	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%
Kandek_15	99.6%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
MardakBet_1	99.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
MardakBet_2	99.6%	0.1%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
MardakBet_3	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
MardakBet_4	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MardakBet_5	99.7%	0.1%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
MardakBet_6	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MardakBet_7	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MardakBet_8	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
MardakBet_9	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
MardakBet_10	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
MardakBet_11	99.5%	0.1%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%
MardakBet_12	99.7%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%

Database ID	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO	MnO	Fe2O3	CuO	SnO2
MardakBet_13	99.7%	0.1%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
MardakBet_14	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%
MardakBet_15	99.6%	0.1%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
Ratanpur_1	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Ratanpur_2	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Ratanpur_3	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Ratanpur_4	99.8%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Ratanpur_5	99.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Ratanpur_6	99.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Ratanpur_7	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Ratanpur_8	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Ratanpur_9	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Ratanpur_10	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%
Ratanpur_12	99.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Ratanpur_14	99.5%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
RTPUnheated	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RTPHeatedOnce	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
RTPHeated	99.8%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
Mahurjhari_1	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Mahurjhari_2	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Mahurjhari_3	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Mahurjhari_4	99.4%	0.0%	0.0%	0.2%	0.0%	0.0%	0.2%	0.0%	0.2%	0.0%	0.0%
Mahurjhari_5	98.6%	0.0%	0.1%	0.4%	0.0%	0.1%	0.3%	0.0%	0.4%	0.0%	0.0%
Mahurjhari_6	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Mahurjhari_7	99.2%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.5%	0.0%	0.0%
Mahurjhari_8	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Mahurjhari_9	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%

Database ID	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO	MnO	Fe2O3	CuO	SnO2
Mahurjhari_10	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Mahurjhari_12	99.6%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
Mahurjhari_13	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Mahurjhari_14	99.5%	0.1%	0.0%	0.1%	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%
Mahurjhari_15	98.7%	0.0%	0.0%	0.2%	0.0%	0.1%	0.3%	0.0%	0.2%	0.5%	0.0%
Mahurjhari_16	99.6%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
Mahurjhari_17	95.6%	0.1%	0.4%	0.6%	0.0%	0.6%	0.3%	0.0%	2.5%	0.0%	0.0%
Mahurjhari_18	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Mahurjhari_19	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Mahurjhari_20	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
Mahurjhari_21	99.6%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
Mahurjhari_22	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
Mahurjhari_23	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Mahurjhari_24	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Mahurjhari_25	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Mahurjhari_26	99.6%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Paithan_1	99.3%	0.1%	0.0%	0.3%	0.0%	0.1%	0.3%	0.0%	0.0%	0.0%	0.0%
Paithan_2	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%
Paithan_3	99.6%	0.0%	0.0%	0.1%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%
Paithan_4	99.2%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.7%	0.0%	0.0%
Paithan_5	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
Paithan_6	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Paithan_7	99.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Paithan_8	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Paithan_9	99.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%
Paithan_10	99.5%	0.0%	0.0%	0.1%	0.0%	0.0%	0.3%	0.0%	0.1%	0.0%	0.0%
Paithan_11	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%

Database ID	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO	MnO	Fe2O3	CuO	SnO2
Paithan_12	99.5%	0.1%	0.0%	0.2%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Paithan_13	99.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Paithan_14	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Paithan_15	99.5%	0.0%	0.0%	0.1%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%
Undari_1	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Undari_2	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%
Undari_3	99.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Undari_4	99.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Undari_5	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
Undari_6	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Undari_7	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Undari_8	99.5%	0.1%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Undari_9	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
Undari_10	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%
Undari_11	99.6%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Undari_12	99.5%	0.0%	0.0%	0.1%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%
Undhari_JMK1	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Undhari_JMK2	99.5%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
Shahr-i-Sokhta_1	99.8%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Shahr-i-Sokhta_2	99.7%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%
Shahr-i-Sokhta_3	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Shahr-i-Sokhta_4	99.6%	0.1%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%
Shahr-i-Sokhta_5	99.8%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Shahr-i-Sokhta_6	99.6%	0.1%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%
Shahr-i-Sokhta_7	99.6%	0.1%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Shahr-i-Sokhta_8	99.5%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%
Shahr-i-Sokhta_9	99.6%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%

Database ID	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO	MnO	Fe2O3	CuO	SnO2
Shahr-i-Sokhta_10	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Shahr-i-Sokhta_11	99.8%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Shahr-i-Sokhta_12	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Shahr-i-Sokhta_13	99.8%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
Shahr-i-Sokhta_14	99.8%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Shahr-i-Sokhta_15	99.7%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
Shahr-i-Sokhta_16	99.8%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Shahr-i-Sokhta_17	99.6%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%
BanKhaoMogul_1	98.6%	0.1%	0.1%	1.0%	0.0%	0.1%	0.1%	0.0%	0.1%	0.0%	0.0%
BanKhaoMogul_2	95.3%	0.1%	0.1%	2.6%	0.0%	1.1%	0.1%	0.0%	0.7%	0.0%	0.0%
BanKhaoMogul_4	96.4%	0.1%	0.1%	1.8%	0.0%	0.3%	0.1%	0.0%	1.2%	0.0%	0.0%
BanKhaoMogul_5	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BanKhaoMogul_6	96.4%	0.1%	0.1%	2.3%	0.0%	0.7%	0.1%	0.0%	0.2%	0.0%	0.0%
BanKhaoMogul_7	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BanKhaoMogul_9	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BanKhaoMogul_10	99.8%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BanKhaoMogul_11	99.0%	0.0%	0.0%	0.8%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
BanKhaoMogul_12	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BanKhaoMogul_13	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BanKhaoMogul_15	99.9%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BanKhaoMogul_16	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BanKhaoMogul_17	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BanKhaoMogul_18	99.8%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BanKhaoMogul_20	99.0%	0.0%	0.0%	0.7%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%
BanKhaoMogul_21	99.8%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
KonTum_1	99.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.3%	0.0%	0.0%
KonTum_2	99.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.3%	0.0%	0.0%

Database ID	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO	MnO	Fe2O3	CuO	SnO2
KonTum_3	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
KonTum_4	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
KonTum_5	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%
KonTum_6	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
KonTum_7	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.1%	0.0%	0.0%
KonTum_8	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
KonTum_9	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
GiaLai_1	98.5%	0.0%	0.2%	0.4%	0.0%	0.0%	0.1%	0.0%	0.7%	0.0%	0.0%
GiaLai_2	98.4%	0.0%	0.2%	0.5%	0.0%	0.0%	0.1%	0.0%	0.8%	0.0%	0.0%
GiaLai_3	98.4%	0.0%	0.1%	0.5%	0.0%	0.0%	0.3%	0.0%	0.7%	0.0%	0.0%
GiaLai_4	98.2%	0.0%	0.2%	0.5%	0.0%	0.0%	0.3%	0.0%	0.8%	0.0%	0.0%
DongNai_1	99.5%	0.0%	0.0%	0.1%	0.0%	0.0%	0.3%	0.0%	0.1%	0.0%	0.0%
DongNai_2	99.6%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
DongNai_3	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
DongNai_4	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
DongNai_5	99.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.4%	0.0%	0.0%
DongNai_6	99.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.3%	0.0%	0.0%
Pacitan_1	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.2%	0.0%	0.0%
Pacitan_2	99.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.3%	0.0%	0.0%
Pacitan_3	99.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.2%	0.0%	0.0%
Pacitan_4	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Pacitan_5	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%
Pacitan_6	99.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.2%	0.0%	0.0%
Pacitan_7	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Pacitan_8	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%
Pacitan_9	99.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.5%	0.0%	0.0%

Database ID	Li	Be	B	Sc	Ti	V	Cr	Ni	Co	Zn	As
Kandek_1	2.43	0.46	27.73	0.41	20.60	4.59	1.50	1.78	0.59	1.21	1.17
Kandek_2	0.91	0.73	9.27	3.62	0.56	0.26	0.17	6.61	0.01	0.64	0.00
Kandek_3	2.43	0.59	15.22	3.75	3.96	0.57	0.35	6.80	0.05	1.67	0.58
Kandek_4	0.28	0.76	5.81	4.66	1.28	0.10	1.21	8.35	0.08	0.87	1.99
Kandek_5	1.71	0.23	26.78	4.04	0.77	0.21	6.02	8.60	0.03	2.24	13.36
Kandek_6	2.19	0.88	18.75	4.43	1.30	0.77	0.15	8.22	0.09	1.47	0.39
Kandek_7	0.33	0.14	23.41	3.29	0.53	0.27	3.06	5.74	0.03	0.77	0.00
Kandek_8	0.89	0.30	27.74	3.32	6.99	0.97	1.02	6.05	0.17	3.12	0.93
Kandek_9	2.88	0.85	7.78	0.36	3.40	0.37	0.00	1.37	0.08	1.07	2.14
Kandek_10	0.12	0.27	7.56	3.05	5.56	1.14	0.21	5.41	0.11	0.73	0.00
Kandek_11	0.32	0.51	68.05	0.33	1.41	1.81	0.00	1.20	0.10	1.46	0.00
Kandek_12	0.67	0.21	10.90	3.99	1.01	1.72	0.32	7.23	0.10	1.40	0.00
Kandek_13	0.10	0.43	5.62	3.38	1.34	0.24	0.40	5.65	0.08	0.67	0.37
Kandek_14	1.14	0.90	13.93	4.54	1.23	0.29	0.92	7.82	0.08	0.56	2.03
Kandek_15	3.75	0.35	16.45	3.49	4.86	0.24	0.33	6.47	0.12	1.04	0.64
MardakBet_1	0.51	0.31	12.86	4.98	6.68	0.58	0.59	0.70	0.18	1.44	0.90
MardakBet_2	1.64	0.27	22.05	0.54	7.57	2.71	1.11	0.80	0.31	2.88	0.38
MardakBet_3	0.25	0.18	8.12	4.98	2.56	0.43	0.52	0.55	0.04	0.84	0.81
MardakBet_4	0.13	0.22	4.19	0.61	1.25	1.01	0.51	0.54	0.04	0.79	1.18
MardakBet_5	13.81	0.29	5.87	2.31	1.32	0.10	0.18	3.44	0.03	0.23	0.99
MardakBet_6	0.23	0.12	4.30	0.97	2.50	0.84	0.57	0.71	0.03	0.39	1.64
MardakBet_7	0.25	0.15	4.74	1.00	1.62	0.83	0.40	0.48	0.02	0.31	0.87
MardakBet_8	0.28	1.02	28.15	6.20	4.38	0.90	0.23	2.75	0.06	0.65	1.54
MardakBet_9	0.91	0.11	10.76	4.26	2.82	0.32	0.23	3.71	0.03	0.52	0.74
MardakBet_10	2.59	0.25	6.10	1.25	0.21	1.40	0.23	3.18	0.02	0.21	1.47
MardakBet_11	1.12	0.52	31.43	1.83	8.75	3.67	2.00	3.53	0.41	4.18	5.26
MardakBet_12	1.85	0.26	21.21	3.87	0.28	0.36	0.53	2.55	0.05	0.23	0.00

Database ID	Li	Be	B	Sc	Ti	V	Cr	Ni	Co	Zn	As
MardakBet_13	0.81	0.78	39.28	4.87	2.49	0.71	0.34	4.86	0.10	1.07	1.87
MardakBet_14	0.30	0.26	6.03	1.81	4.12	1.10	1.12	4.24	0.11	2.12	6.35
MardakBet_15	3.24	0.51	33.64	6.20	6.73	1.28	0.32	5.10	0.15	5.06	2.36
Ratanpur_1	0.22	0.29	2.41	2.20	1.49	0.95	0.29	3.89	0.06	1.25	15.89
Ratanpur_2	1.62	0.28	27.90	1.86	0.23	0.38	0.09	3.82	0.04	0.26	1.25
Ratanpur_3	1.48	0.23	32.98	1.76	1.03	0.47	0.12	4.22	0.02	0.65	0.00
Ratanpur_4	2.02	0.35	10.42	1.51	0.85	0.19	0.31	3.51	0.04	0.78	0.73
Ratanpur_5	9.21	0.33	2.76	1.42	1.59	0.59	0.28	2.83	0.04	0.50	2.19
Ratanpur_6	1.70	0.15	6.78	1.67	13.88	1.33	0.47	2.96	0.13	0.87	0.35
Ratanpur_7	1.32	0.28	9.16	1.54	7.63	1.24	0.60	3.71	0.06	0.54	0.00
Ratanpur_8	0.77	0.36	12.76	1.25	0.25	0.26	0.15	2.80	0.02	0.47	1.08
Ratanpur_9	0.70	0.39	13.89	1.61	3.95	0.71	0.46	4.35	0.10	1.31	4.23
Ratanpur_10	0.53	0.36	16.81	1.70	2.02	1.33	1.36	4.22	0.10	1.41	4.86
Ratanpur_12	0.55	0.48	22.95	2.64	35.79	2.43	1.19	7.27	0.17	4.53	3.07
Ratanpur_14	6.66	0.48	20.90	2.54	24.60	4.82	1.42	6.63	0.14	7.37	3.60
RTPUnheated	1.21	0.61	11.37	1.89	0.69	1.15	0.74	0.79	0.06	0.52	0.60
RTPHeatedOnce	0.84	0.69	9.62	1.84	0.20	1.42	0.60	0.94	0.09	0.32	0.93
RTPHeated	0.46	0.77	4.96	1.93	1.09	0.66	0.75	0.80	0.05	1.46	0.00
Mahurjhari_1	1.19	0.21	8.53	3.19	18.87	0.50	0.24	4.37	0.07	1.57	0.00
Mahurjhari_2	0.24	0.13	8.43	3.07	10.24	1.03	0.53	5.19	0.14	3.99	0.97
Mahurjhari_3	0.08	0.07	10.17	3.16	2.18	0.45	0.24	5.56	0.05	0.79	0.38
Mahurjhari_4	47.44	0.32	3.69	3.16	38.31	3.03	0.63	6.47	0.22	2.25	1.28
Mahurjhari_5	2.94	0.20	4.43	3.49	130.80	6.74	2.70	8.60	1.57	14.92	1.72
Mahurjhari_6	1.83	0.21	23.87	3.53	1.87	0.84	0.43	6.17	0.07	8.21	0.00
Mahurjhari_7	0.45	0.18	8.55	2.63	2.31	4.01	0.48	4.61	0.27	0.91	0.39
Mahurjhari_8	0.33	1.47	6.15	2.80	1.57	0.99	0.19	5.17	0.06	1.55	0.00
Mahurjhari_9	0.20	0.15	8.50	2.41	3.65	0.81	0.60	4.58	0.16	2.42	0.51

Database ID	Li	Be	B	Sc	Ti	V	Cr	Ni	Co	Zn	As
Mahurjhari_10	0.12	0.14	14.38	2.72	3.86	1.13	0.29	4.92	0.07	1.44	1.02
Mahurjhari_12	0.22	0.37	5.71	3.23	6.17	0.61	0.42	5.09	0.11	3.53	1.26
Mahurjhari_13	0.05	0.09	3.82	2.76	1.68	0.21	0.20	5.69	0.03	0.50	0.17
Mahurjhari_14	11.06	0.94	14.93	2.65	11.19	1.66	0.78	4.33	0.10	4.66	0.90
Mahurjhari_15	1.18	0.19	11.79	2.75	44.54	5.36	1.09	10.89	0.42	14.76	0.79
Mahurjhari_16	2.50	0.16	25.30	2.82	7.19	0.92	0.61	4.73	0.12	3.44	1.24
Mahurjhari_17	37.20	0.34	2.22	2.63	25.64	31.59	1.00	7.18	1.90	8.75	0.67
Mahurjhari_18	0.75	0.13	15.42	4.16	5.48	0.68	0.38	5.79	0.09	3.30	0.00
Mahurjhari_19	0.51	0.14	9.48	5.01	4.99	0.66	0.32	6.93	0.07	10.02	0.42
Mahurjhari_20	0.93	0.32	25.14	3.09	10.60	1.63	0.26	5.34	0.22	1.84	1.13
Mahurjhari_21	1.59	0.21	27.82	2.64	7.98	2.10	0.61	4.82	0.12	5.35	1.06
Mahurjhari_22	0.36	0.20	15.97	3.90	1.71	0.67	0.34	6.37	0.11	4.00	0.00
Mahurjhari_23	0.07	0.15	18.17	2.94	8.22	0.72	0.36	5.51	0.18	3.54	1.05
Mahurjhari_24	0.92	0.08	16.29	3.52	3.08	0.33	0.19	5.37	0.05	1.48	0.26
Mahurjhari_25	1.04	0.17	15.71	3.20	0.95	1.22	0.16	6.35	0.03	1.48	2.74
Mahurjhari_26	11.62	0.37	3.22	2.70	56.36	1.46	0.44	5.22	0.15	2.15	1.41
Paithan_1	14.75	1.33	5.37	4.35	1.49	0.62	1.49	8.23	0.11	3.48	3.16
Paithan_2	2.89	0.97	10.82	3.96	7.83	1.32	0.99	6.40	0.13	1.71	2.08
Paithan_3	2.82	1.34	11.62	4.19	2.61	0.33	1.51	7.97	0.15	3.76	1.45
Paithan_4	3.06	0.18	42.77	0.38	3.10	0.76	3.12	1.01	0.03	1.39	1.55
Paithan_5	3.07	0.11	4.48	3.30	2.22	6.04	0.19	5.36	0.06	0.82	0.00
Paithan_6	0.24	0.98	47.96	0.41	3.05	1.17	0.00	0.88	0.07	0.49	0.00
Paithan_7	2.53	0.17	11.81	3.92	0.79	0.23	0.35	5.70	0.03	0.80	0.00
Paithan_8	2.30	0.61	8.10	3.21	0.83	0.13	0.55	5.27	0.03	2.17	1.15
Paithan_9	1.91	1.23	27.13	0.37	4.40	2.32	2.03	1.44	0.15	0.46	0.92
Paithan_10	5.24	1.32	12.04	4.75	1.37	0.95	0.85	8.80	0.22	0.51	2.75
Paithan_11	0.16	0.36	2.57	3.52	1.72	0.65	0.28	6.14	0.03	0.74	0.46

Database ID	Li	Be	B	Sc	Ti	V	Cr	Ni	Co	Zn	As
Paithan_12	9.02	0.56	23.28	3.49	3.09	0.30	0.37	6.06	0.02	1.00	0.71
Paithan_13	2.04	0.29	14.07	4.29	1.75	0.84	0.65	8.10	0.06	3.22	0.00
Paithan_14	0.89	0.21	10.11	4.10	0.99	1.01	0.19	6.94	0.01	0.40	0.00
Paithan_15	5.26	1.79	20.45	5.10	3.31	0.98	0.88	9.27	0.09	1.01	3.73
Undari_1	1.43	0.61	23.65	0.31	4.52	0.30	0.00	1.03	0.12	0.57	1.04
Undari_2	0.33	0.75	10.35	4.98	1.29	2.10	0.97	9.02	0.08	0.54	2.02
Undari_3	4.67	0.22	4.38	3.50	7.80	0.86	0.43	5.48	0.08	5.74	1.63
Undari_4	10.37	0.30	5.04	0.33	0.60	0.80	0.08	0.60	0.07	0.23	2.74
Undari_5	0.15	0.16	20.26	4.72	4.88	1.36	0.37	8.71	0.14	0.93	0.00
Undari_6	0.05	0.12	23.50	4.38	1.53	0.27	0.31	8.04	0.04	0.91	0.13
Undari_7	0.51	0.95	4.82	4.03	2.13	3.65	0.86	7.00	0.11	0.33	3.68
Undari_8	17.92	0.33	4.02	4.19	2.73	1.46	0.43	8.34	0.30	4.55	0.00
Undari_9	1.18	0.55	16.07	3.21	1.04	0.85	1.05	6.23	0.12	1.04	0.00
Undari_10	2.78	0.35	4.53	0.38	1.21	1.08	0.79	0.87	0.15	0.36	0.00
Undari_11	4.16	0.69	8.93	4.69	0.68	1.10	0.16	8.54	0.03	1.00	0.00
Undari_12	2.04	0.21	18.06	5.20	12.51	1.08	0.64	9.47	0.12	3.43	0.41
Undhari_JMK1	0.08	0.33	14.78	2.36	0.67	0.87	0.34	4.15	0.03	0.84	0.71
Undhari_JMK2	0.32	0.22	5.72	2.45	5.85	0.45	0.57	5.05	0.31	1.01	0.45
Shahr-i-Sokhta_1	0.56	1.12	43.41	1.10	0.40	0.02	0.39	0.37	0.01	0.32	3.24
Shahr-i-Sokhta_2	0.51	2.22	90.94	1.11	5.04	1.23	0.63	0.61	0.06	2.08	9.21
Shahr-i-Sokhta_3	0.31	1.16	36.46	0.99	0.24	0.02	0.29	0.54	0.01	0.56	0.66
Shahr-i-Sokhta_4	1.32	1.63	69.38	0.65	8.93	0.56	0.74	1.04	0.09	3.33	0.79
Shahr-i-Sokhta_5	0.41	1.48	46.85	0.59	0.45	0.33	0.37	0.28	0.01	1.18	0.96
Shahr-i-Sokhta_6	0.73	2.90	96.23	0.69	8.06	0.74	0.94	0.71	0.06	3.98	8.63
Shahr-i-Sokhta_7	0.62	1.10	58.46	0.56	3.85	0.97	1.00	0.45	0.09	3.93	2.21
Shahr-i-Sokhta_8	0.56	1.48	39.32	0.51	3.99	1.00	1.11	0.66	0.11	1.84	2.66
Shahr-i-Sokhta_9	0.95	1.80	41.93	0.82	12.22	1.29	1.32	1.79	0.24	4.98	1.55

Database ID	Li	Be	B	Sc	Ti	V	Cr	Ni	Co	Zn	As
Shahr-i-Sokhta_10	0.51	1.19	34.57	0.92	0.23	0.04	0.43	0.50	0.01	0.58	1.02
Shahr-i-Sokhta_11	0.65	0.30	64.89	0.63	0.25	0.03	0.34	0.36	0.01	0.35	47.09
Shahr-i-Sokhta_12	0.85	2.17	39.34	0.69	3.49	0.44	0.59	1.11	0.10	5.99	1.69
Shahr-i-Sokhta_13	0.51	2.56	118.27	0.72	0.30	0.05	0.27	0.60	0.01	0.52	7.16
Shahr-i-Sokhta_14	0.95	1.34	34.71	0.61	0.33	0.02	0.25	0.55	0.02	0.58	0.36
Shahr-i-Sokhta_15	1.58	1.05	35.31	0.65	2.92	0.23	1.27	1.37	0.09	1.80	7.42
Shahr-i-Sokhta_16	0.19	0.74	21.44	0.59	1.30	0.07	0.49	0.64	0.04	1.82	0.74
Shahr-i-Sokhta_17	0.59	2.09	93.11	0.61	4.04	0.44	0.81	0.51	0.05	3.10	2.90
BanKhaoMogul_1	51.21	1.93	1.70	1.60	62.22	3.58	0.85	0.77	0.26	3.22	1.78
BanKhaoMogul_2	31.56	1.82	2.14	3.01	356.70	37.74	3.85	1.44	0.79	8.88	0.52
BanKhaoMogul_4	16.69	1.64	1.39	1.61	208.84	39.30	4.81	0.82	0.30	2.53	2.10
BanKhaoMogul_5	0.33	2.47	1.48	1.01	1.08	0.12	0.50	0.52	0.01	0.39	1.31
BanKhaoMogul_6	38.21	2.41	1.63	2.20	232.21	10.37	2.36	0.87	0.38	4.89	2.04
BanKhaoMogul_7	0.48	1.01	4.37	1.02	1.07	0.06	0.46	0.62	0.01	0.57	1.94
BanKhaoMogul_9	0.84	1.55	1.87	1.11	0.57	0.05	0.47	0.80	0.03	0.92	1.25
BanKhaoMogul_10	2.76	0.62	3.35	1.11	1.06	0.07	0.44	0.59	0.01	0.62	1.43
BanKhaoMogul_11	58.04	3.59	1.79	0.95	1.81	0.10	0.24	0.38	0.04	0.65	1.45
BanKhaoMogul_12	0.19	1.55	7.12	1.07	0.32	0.05	0.18	0.51	0.02	0.28	1.97
BanKhaoMogul_13	0.14	1.61	10.59	0.88	0.71	0.07	0.35	0.54	0.01	0.25	1.52
BanKhaoMogul_15	0.26	1.57	7.36	0.79	1.88	0.07	0.19	0.36	0.02	0.35	1.74
BanKhaoMogul_16	0.16	0.95	6.09	0.80	0.61	0.04	0.24	0.56	0.01	0.29	1.65
BanKhaoMogul_17	0.18	1.64	11.98	0.82	0.17	0.02	0.23	0.62	0.01	0.27	4.25
BanKhaoMogul_18	0.35	1.58	10.41	0.87	12.68	0.11	0.34	0.55	0.02	1.68	6.55
BanKhaoMogul_20	63.88	3.34	1.91	0.83	4.46	1.01	0.22	0.42	0.01	0.72	0.82
BanKhaoMogul_21	17.09	0.66	0.96	0.76	1.76	0.62	0.14	0.30	0.01	0.52	1.23
KonTum_1	0.21	0.57	3.42	4.71	1.35	0.96	0.39	8.26	0.14	2.93	1.66
KonTum_2	0.06	0.08	4.30	4.99	0.56	0.18	0.14	8.86	0.16	1.75	0.06

Database ID	Li	Be	B	Sc	Ti	V	Cr	Ni	Co	Zn	As
KonTum_3	0.09	0.18	1.94	0.34	0.99	0.04	0.00	0.82	0.06	1.43	0.00
KonTum_4	0.06	0.28	2.08	0.31	0.70	0.00	0.00	0.67	0.30	3.55	0.00
KonTum_5	0.59	1.53	2.45	4.54	2.84	0.36	1.49	13.80	9.49	15.10	5.12
KonTum_6	0.15	0.50	2.23	0.39	0.58	0.12	0.00	1.54	0.02	0.57	0.00
KonTum_7	0.34	0.55	2.64	5.38	1.64	0.15	0.39	9.92	0.07	0.81	2.15
KonTum_8	0.85	0.07	1.76	3.15	1.41	0.16	0.13	5.76	0.08	1.53	0.00
KonTum_9	0.05	0.21	2.72	4.22	0.86	0.11	0.28	7.41	0.20	1.33	0.00
GiaLai_1	0.16	0.52	1.10	0.52	26.17	9.04	0.28	20.71	5.08	6.53	1.31
GiaLai_2	0.16	0.51	0.76	0.59	26.95	9.55	0.70	23.89	5.63	4.97	0.00
GiaLai_3	0.09	0.30	0.67	4.83	9.48	12.45	0.65	16.04	0.87	1.75	0.48
GiaLai_4	0.12	0.24	0.30	5.26	10.27	24.94	0.75	18.36	1.08	2.40	0.62
DongNai_1	0.22	0.25	6.04	7.11	1.56	0.11	0.80	11.73	0.15	2.33	1.21
DongNai_2	0.10	0.41	3.49	5.91	0.78	0.15	1.35	10.25	0.10	1.52	0.59
DongNai_3	0.18	0.17	3.01	4.91	1.59	0.06	0.40	8.80	0.02	0.50	0.77
DongNai_4	0.09	0.18	2.07	3.77	1.13	0.04	0.59	6.69	0.17	1.58	0.75
DongNai_5	1.71	0.37	1.72	3.46	0.32	0.65	0.23	5.27	0.03	0.79	0.34
DongNai_6	0.03	0.09	2.54	3.41	0.33	0.06	0.42	5.38	0.07	0.93	0.65
Pacitan_1	0.18	0.27	27.81	1.44	0.22	0.18	1.76	2.44	0.21	3.06	0.00
Pacitan_2	0.11	0.17	26.55	1.42	0.15	0.23	1.86	2.62	0.17	2.16	0.00
Pacitan_3	0.08	0.13	25.81	1.31	0.30	0.18	1.64	2.47	0.12	2.06	0.00
Pacitan_4	1.03	0.30	28.39	1.17	0.75	0.08	0.41	2.49	0.06	2.30	1.71
Pacitan_5	0.99	0.14	28.11	1.23	0.62	0.29	0.36	2.82	0.05	1.65	0.50
Pacitan_6	0.27	0.35	31.31	1.24	0.60	0.09	0.74	2.76	0.13	2.65	2.96
Pacitan_7	0.35	0.29	27.20	1.16	0.17	0.07	0.22	2.06	0.09	1.05	0.00
Pacitan_8	0.17	0.18	25.52	1.11	0.05	0.13	0.42	1.75	0.03	0.46	0.00
Pacitan_9	0.60	0.20	27.91	1.27	8.66	2.24	0.58	1.38	0.77	2.48	0.00

Database ID	Rb	Sr	Zr	Nb	Ag	In	Sb	Cs	Ba	La	Ce
Kandek_1	0.38	0.96	0.87	0.11	0.02	0.02	0.24	0.05	2.71	0.27	0.48
Kandek_2	0.24	0.74	0.03	0.01	0.03	0.01	0.06	0.01	1.44	0.00	0.01
Kandek_3	0.27	0.97	0.23	0.02	0.12	0.02	0.21	0.02	2.15	0.06	0.12
Kandek_4	0.08	0.58	0.08	0.10	0.08	0.03	0.63	0.02	0.31	0.03	0.04
Kandek_5	0.62	0.61	0.07	0.02	0.42	0.03	1.28	0.03	1.23	0.02	0.05
Kandek_6	0.32	1.77	0.19	0.03	0.04	0.02	0.45	0.02	1.66	0.03	0.06
Kandek_7	0.07	0.27	0.03	0.01	0.01	0.00	0.11	0.01	0.51	0.01	0.03
Kandek_8	0.20	0.83	0.21	0.02	0.05	0.00	0.42	0.02	0.95	0.08	0.15
Kandek_9	0.90	1.42	0.03	0.03	0.03	0.01	0.18	0.01	3.79	0.01	0.03
Kandek_10	0.21	0.89	0.08	0.02	0.02	0.00	0.06	0.01	0.95	0.04	0.12
Kandek_11	0.36	0.42	0.09	0.03	0.02	0.01	0.79	0.02	0.60	0.13	0.21
Kandek_12	0.12	0.66	0.19	0.01	0.02	0.00	0.61	0.01	1.25	0.01	0.03
Kandek_13	0.07	0.58	0.18	0.01	0.04	0.01	0.54	0.00	0.30	0.06	0.15
Kandek_14	0.40	0.52	0.09	0.05	0.05	0.02	0.31	0.03	0.77	0.04	0.03
Kandek_15	0.71	1.92	0.56	0.04	0.03	0.01	0.36	0.02	1.41	0.03	0.07
MardakBet_1	0.26	1.18	0.17	0.03	0.01	0.01	0.61	0.02	1.80	0.09	0.14
MardakBet_2	1.20	3.06	0.60	0.03	0.05	0.01	0.10	0.06	8.99	0.13	0.44
MardakBet_3	0.13	1.67	0.07	0.01	0.01	0.00	0.09	0.01	0.98	0.02	0.08
MardakBet_4	0.12	0.49	0.04	0.02	0.03	0.01	0.07	0.02	0.54	0.02	0.05
MardakBet_5	0.48	1.04	1.08	0.03	0.11	0.03	0.34	0.03	4.62	0.04	0.07
MardakBet_6	0.17	0.54	0.04	0.02	0.03	0.01	0.07	0.02	0.87	0.02	0.10
MardakBet_7	0.15	0.57	0.03	0.03	0.01	0.01	0.07	0.02	1.12	0.03	0.04
MardakBet_8	0.18	0.62	0.13	0.02	0.05	0.01	0.97	0.01	0.66	0.05	0.15
MardakBet_9	0.32	8.06	0.93	0.02	0.05	0.01	0.15	0.04	144.63	0.04	0.06
MardakBet_10	0.18	0.93	0.03	0.02	0.05	0.01	0.23	0.01	0.20	0.02	0.04
MardakBet_11	0.67	1.40	0.69	0.06	0.38	0.01	0.41	0.02	2.24	0.12	0.32
MardakBet_12	0.15	0.76	0.05	0.01	0.05	0.01	0.19	0.01	32.31	0.02	0.04

Database ID	Rb	Sr	Zr	Nb	Ag	In	Sb	Cs	Ba	La	Ce
MardakBet_13	0.26	0.65	0.22	0.02	0.29	0.02	1.28	0.02	0.28	0.06	0.17
MardakBet_14	0.21	0.52	0.23	0.03	0.14	0.01	0.17	0.01	0.68	0.02	0.03
MardakBet_15	0.67	0.84	0.58	0.05	0.33	0.06	0.83	0.04	1.09	0.05	0.19
Ratanpur_1	0.08	0.30	0.16	0.01	0.03	0.01	0.18	0.01	0.37	0.02	0.05
Ratanpur_2	0.35	0.78	0.06	0.01	0.03	0.00	0.42	0.01	1.35	0.02	0.04
Ratanpur_3	0.34	0.71	0.07	0.01	0.05	0.00	0.41	0.01	1.54	0.02	0.04
Ratanpur_4	0.53	0.66	0.14	0.01	0.08	0.01	0.27	0.01	1.03	0.01	0.02
Ratanpur_5	0.84	1.35	0.03	0.01	0.02	0.00	0.17	0.02	2.52	0.01	0.05
Ratanpur_6	0.39	0.97	0.29	0.05	0.09	0.02	0.67	0.03	1.25	0.06	0.09
Ratanpur_7	0.18	0.65	0.06	0.03	0.09	0.01	0.50	0.02	0.60	0.01	0.04
Ratanpur_8	0.08	0.55	0.05	0.01	0.07	0.01	0.26	0.01	0.90	0.01	0.02
Ratanpur_9	0.23	0.59	0.10	0.03	0.13	0.02	0.44	0.01	1.70	0.03	0.04
Ratanpur_10	0.29	0.53	0.23	0.02	0.11	0.03	0.42	0.02	1.57	0.05	0.08
Ratanpur_12	0.30	1.05	0.27	0.07	0.45	0.02	0.87	0.03	2.13	0.06	0.15
Ratanpur_14	0.41	2.66	2.47	0.07	1.05	0.03	1.14	0.04	13.97	0.13	0.31
RTPUnheated	0.22	0.72	0.04	0.18	0.05	0.00	0.39	0.01	1.03	0.01	0.01
RTPHeatedOnce	0.24	0.59	0.14	0.08	0.02	0.00	0.17	0.00	0.69	0.09	0.06
RTPHeated	0.21	3.58	0.14	0.14	0.25	0.00	0.36	0.01	4.05	0.04	0.03
Mahurjhari_1	0.20	0.74	0.19	0.04	0.04	0.00	0.41	0.02	1.55	0.05	0.08
Mahurjhari_2	0.31	1.02	0.31	0.03	0.09	0.01	0.27	0.04	0.95	0.05	0.13
Mahurjhari_3	0.12	0.37	0.06	0.01	0.01	0.00	0.23	0.01	0.39	0.01	0.02
Mahurjhari_4	0.99	0.91	2.50	0.25	0.09	0.01	0.23	0.05	3.29	0.13	0.39
Mahurjhari_5	2.08	3.84	2.75	0.37	0.53	0.05	0.17	0.16	4.50	0.39	1.06
Mahurjhari_6	0.41	0.61	0.15	0.03	0.29	0.03	0.90	0.03	0.83	0.04	0.10
Mahurjhari_7	0.17	0.97	0.09	0.01	0.02	0.02	0.44	0.01	1.20	0.07	0.07
Mahurjhari_8	0.12	0.34	0.08	0.02	0.04	0.01	0.44	0.01	0.47	0.01	0.03
Mahurjhari_9	0.15	1.22	0.10	0.02	0.19	0.02	0.34	0.01	2.17	0.02	0.08

Database ID	Rb	Sr	Zr	Nb	Ag	In	Sb	Cs	Ba	La	Ce
Mahurjhari_10	0.11	0.33	0.08	0.01	0.06	0.03	0.37	0.01	0.56	0.02	0.02
Mahurjhari_12	0.21	0.98	0.18	0.02	0.06	0.02	0.48	0.02	0.73	0.09	0.17
Mahurjhari_13	0.08	0.49	0.08	0.01	0.02	0.00	0.18	0.01	1.32	0.01	0.03
Mahurjhari_14	1.12	1.24	0.23	0.06	0.46	0.02	0.41	0.06	2.39	0.06	0.15
Mahurjhari_15	1.29	1.81	1.99	0.12	0.10	0.00	0.37	0.03	2.52	0.40	0.63
Mahurjhari_16	0.34	0.87	0.25	0.02	0.15	0.03	1.18	0.03	1.42	0.02	0.08
Mahurjhari_17	25.61	4.35	3.01	0.29	0.03	0.06	0.04	0.12	14.27	0.16	0.42
Mahurjhari_18	0.19	0.57	0.23	0.03	0.08	0.01	0.90	0.02	1.27	0.03	0.09
Mahurjhari_19	0.21	0.82	0.16	0.01	0.20	0.00	0.50	0.01	0.67	0.03	0.08
Mahurjhari_20	0.17	0.57	0.23	0.02	0.08	0.03	0.58	0.02	1.49	0.04	0.12
Mahurjhari_21	0.37	0.92	0.18	0.03	0.14	0.02	0.82	0.04	2.59	0.04	0.09
Mahurjhari_22	0.24	0.63	0.08	0.02	0.15	0.01	0.77	0.02	0.49	0.04	0.07
Mahurjhari_23	0.24	0.39	0.14	0.07	0.08	0.02	0.10	0.01	1.01	0.04	0.08
Mahurjhari_24	0.11	0.63	0.16	0.01	0.05	0.01	0.43	0.01	0.80	0.02	0.04
Mahurjhari_25	0.09	0.43	0.06	0.01	0.08	0.01	0.53	0.01	0.80	0.02	0.05
Mahurjhari_26	0.80	0.76	0.99	0.14	0.10	0.00	0.25	0.04	1.70	0.07	0.31
Paithan_1	1.05	3.92	0.78	0.05	0.22	0.05	0.53	0.03	5.41	0.09	0.07
Paithan_2	0.17	1.50	0.12	0.05	0.08	0.02	0.28	0.11	1.50	0.05	0.14
Paithan_3	0.53	1.01	0.15	0.10	0.15	0.04	0.27	0.06	1.02	0.04	0.06
Paithan_4	0.14	3.52	0.31	0.01	0.05	0.01	0.54	0.01	3.10	0.05	0.05
Paithan_5	0.69	0.54	0.67	0.05	0.03	0.01	0.10	0.01	0.80	0.02	0.03
Paithan_6	0.12	0.89	0.10	0.02	0.04	0.01	0.83	0.02	1.53	0.06	0.16
Paithan_7	0.57	0.87	0.04	0.02	0.02	0.01	0.07	0.02	1.18	0.02	0.05
Paithan_8	0.17	0.65	0.04	0.05	0.10	0.03	0.71	0.02	1.40	0.02	0.06
Paithan_9	0.28	3.11	0.23	0.04	0.08	0.01	0.78	0.02	2.90	0.06	0.20
Paithan_10	0.22	4.35	0.19	0.06	0.05	0.02	0.31	0.01	8.84	0.05	0.08
Paithan_11	0.03	0.31	0.04	0.01	0.01	0.00	0.15	0.00	0.54	0.02	0.05

Database ID	Rb	Sr	Zr	Nb	Ag	In	Sb	Cs	Ba	La	Ce
Paithan_12	1.04	4.00	0.16	0.11	0.05	0.00	0.13	0.04	1.04	0.02	0.04
Paithan_13	0.20	1.45	0.06	0.03	0.04	0.01	0.28	0.01	2.80	0.03	0.13
Paithan_14	0.11	0.69	0.24	0.01	0.04	0.00	0.38	0.00	0.72	0.02	0.05
Paithan_15	0.37	1.49	0.16	0.09	0.11	0.04	1.24	0.03	1.08	0.10	0.23
Undari_1	0.13	0.85	0.09	0.02	0.04	0.01	0.81	0.03	0.85	0.07	0.17
Undari_2	0.07	0.51	0.08	0.05	0.05	0.02	0.57	0.02	0.65	0.02	0.02
Undari_3	0.36	0.78	0.23	0.02	0.06	0.01	0.08	0.02	0.83	0.04	0.08
Undari_4	0.29	0.79	0.09	0.02	0.03	0.00	0.25	0.01	0.87	0.02	0.03
Undari_5	0.11	0.65	0.12	0.02	0.02	0.01	0.50	0.01	0.41	0.04	0.09
Undari_6	0.07	0.28	0.07	0.01	0.03	0.01	0.43	0.01	0.30	0.03	0.05
Undari_7	0.06	0.50	0.10	0.05	0.06	0.02	0.30	0.02	0.47	0.03	0.03
Undari_8	0.51	1.80	0.81	0.06	0.24	0.02	0.53	0.04	3.37	0.07	0.22
Undari_9	0.12	0.52	0.07	0.03	0.05	0.02	1.13	0.01	0.91	0.01	0.02
Undari_10	0.68	0.78	0.46	0.02	0.01	0.00	0.06	0.02	1.16	0.01	0.01
Undari_11	0.39	0.90	0.05	0.02	0.09	0.01	0.37	0.01	2.72	0.02	0.04
Undari_12	0.37	0.83	0.34	0.06	0.12	0.03	0.55	0.04	2.90	0.08	0.15
Undhari_JMK1	0.29	0.95	0.05	0.01	0.02	0.02	0.06	0.01	0.35	0.02	0.03
Undhari_JMK2	0.73	2.09	0.25	0.03	0.02	0.00	0.13	0.04	1.30	0.07	0.23
Shahr-i-Sokhta_1	0.19	0.33	0.05	0.24	0.01	0.00	1.41	0.02	0.07	0.00	0.00
Shahr-i-Sokhta_2	0.28	4.56	0.23	0.15	0.02	0.00	2.70	0.02	0.73	0.06	0.11
Shahr-i-Sokhta_3	0.12	3.11	0.03	0.02	0.02	0.00	2.02	0.01	0.12	0.02	0.01
Shahr-i-Sokhta_4	0.75	5.55	0.63	0.65	0.03	0.00	1.51	0.05	3.63	0.07	0.31
Shahr-i-Sokhta_5	0.11	0.90	0.04	0.10	0.03	0.00	1.67	0.01	0.07	0.01	0.01
Shahr-i-Sokhta_6	0.31	7.60	0.40	0.10	0.06	0.01	1.63	0.04	2.35	0.06	0.17
Shahr-i-Sokhta_7	0.25	4.02	0.27	0.08	0.04	0.02	1.05	0.04	1.41	0.03	0.11
Shahr-i-Sokhta_8	0.40	3.03	0.15	0.11	0.05	0.03	1.30	0.07	0.63	0.05	0.10
Shahr-i-Sokhta_9	1.13	6.56	0.53	0.15	0.04	0.03	1.02	0.17	5.97	0.14	0.36

Database ID	Rb	Sr	Zr	Nb	Ag	In	Sb	Cs	Ba	La	Ce
Shahr-i-Sokhta_10	0.15	0.24	0.03	0.04	0.04	0.03	1.60	0.03	0.15	0.02	0.02
Shahr-i-Sokhta_11	0.21	0.28	88.40	0.03	0.03	0.01	0.40	0.02	1.09	0.01	0.01
Shahr-i-Sokhta_12	0.45	2.20	0.50	0.04	0.03	0.01	4.46	0.05	0.60	0.04	0.09
Shahr-i-Sokhta_13	0.07	0.41	0.11	0.08	0.05	0.01	2.28	0.02	0.12	0.01	0.02
Shahr-i-Sokhta_14	0.30	0.42	0.05	0.03	0.03	0.02	1.75	0.03	0.17	0.01	0.02
Shahr-i-Sokhta_15	0.36	8.07	0.18	0.10	0.04	0.03	1.83	0.07	17.40	0.06	0.09
Shahr-i-Sokhta_16	0.11	1.24	1.24	0.03	0.04	0.01	0.39	0.02	0.30	0.01	0.02
Shahr-i-Sokhta_17	0.21	20.22	0.25	0.16	0.03	0.02	2.31	0.04	3.28	0.12	0.26
BanKhaoMogul_1	3.57	53.60	21.54	0.98	0.09	0.02	0.87	0.35	176.82	0.94	1.61
BanKhaoMogul_2	19.62	40.33	29.76	2.30	0.07	0.01	0.52	0.42	110.27	9.70	20.27
BanKhaoMogul_4	14.93	36.62	24.38	3.36	0.06	0.01	1.81	0.82	235.23	3.34	4.56
BanKhaoMogul_5	0.10	0.75	0.66	0.22	0.07	0.01	15.16	0.02	0.56	0.02	0.07
BanKhaoMogul_6	11.80	41.97	50.11	2.99	0.06	0.01	0.58	0.58	106.41	5.16	10.61
BanKhaoMogul_7	0.36	0.60	0.98	0.11	0.03	0.01	2.26	0.02	1.54	0.02	0.02
BanKhaoMogul_9	0.31	1.33	0.84	0.15	0.03	0.01	1.94	0.01	3.63	0.01	0.02
BanKhaoMogul_10	0.67	1.39	1.81	0.13	0.03	0.01	1.86	0.03	4.74	0.01	0.02
BanKhaoMogul_11	2.51	13.58	0.33	0.03	0.03	0.01	5.99	0.26	81.59	0.02	0.10
BanKhaoMogul_12	0.06	0.99	2.81	0.13	0.03	0.01	1.90	0.01	1.34	0.01	0.01
BanKhaoMogul_13	0.03	0.47	1.18	0.10	0.07	0.01	5.00	0.01	0.87	0.00	0.01
BanKhaoMogul_15	0.14	2.38	1.46	1.25	0.02	0.00	3.17	0.01	4.89	0.02	0.02
BanKhaoMogul_16	0.15	0.86	1.20	0.09	0.03	0.00	2.12	0.01	3.05	0.02	0.04
BanKhaoMogul_17	0.10	0.78	0.44	0.02	0.02	0.01	3.15	0.01	1.03	0.03	0.02
BanKhaoMogul_18	0.44	9.02	0.79	0.11	0.02	0.00	2.27	0.02	93.61	0.11	0.18
BanKhaoMogul_20	2.11	12.82	0.40	0.09	0.03	0.00	6.41	0.24	84.00	0.13	0.21
BanKhaoMogul_21	0.33	2.29	0.21	0.09	0.02	0.01	1.61	0.03	11.05	0.02	0.04
KonTum_1	0.31	0.47	0.10	0.03	0.04	0.01	0.10	0.01	2.55	0.04	0.14
KonTum_2	0.35	0.44	0.03	0.01	0.02	0.00	0.05	0.01	1.32	0.02	0.06

Database ID	Rb	Sr	Zr	Nb	Ag	In	Sb	Cs	Ba	La	Ce
KonTum_3	0.18	0.53	0.03	0.01	0.03	0.00	0.08	0.01	0.74	0.01	0.02
KonTum_4	0.16	0.40	0.03	0.01	0.02	0.00	0.06	0.01	0.56	0.01	0.02
KonTum_5	0.29	0.48	0.15	0.08	0.18	0.20	0.42	0.04	1.45	0.06	0.06
KonTum_6	0.46	0.93	0.04	0.03	0.05	0.01	0.14	0.01	1.49	0.01	0.01
KonTum_7	0.25	0.38	0.07	0.03	0.04	0.01	0.10	0.01	1.72	0.02	0.02
KonTum_8	0.30	0.46	0.04	0.01	0.06	0.01	0.14	0.01	0.54	0.00	0.02
KonTum_9	0.24	0.32	0.05	0.01	0.01	0.00	0.04	0.00	0.82	0.01	0.01
GiaLai_1	0.55	7.17	20.35	1.05	0.05	0.01	0.17	0.10	6.76	0.52	0.18
GiaLai_2	0.64	7.53	22.56	1.31	0.02	0.00	0.06	0.11	4.48	0.13	0.03
GiaLai_3	0.90	4.85	3.33	0.58	0.01	0.00	0.02	0.11	3.36	0.14	0.27
GiaLai_4	1.15	7.62	4.13	0.69	0.01	0.01	0.07	0.12	11.05	0.26	0.53
DongNai_1	0.36	0.51	0.10	0.01	0.15	0.02	0.12	0.01	4.09	0.05	0.07
DongNai_2	0.28	0.36	0.05	0.03	0.03	0.02	0.09	0.01	1.83	0.01	0.03
DongNai_3	0.37	0.40	0.04	0.01	0.00	0.00	0.07	0.01	1.63	0.01	0.02
DongNai_4	0.33	0.37	0.09	0.02	0.05	0.00	0.12	0.01	3.79	0.01	0.02
DongNai_5	0.59	0.74	0.04	0.01	0.02	0.00	0.02	0.01	2.04	0.01	0.04
DongNai_6	0.29	0.53	0.03	0.00	0.01	0.00	0.01	0.01	10.24	0.02	0.04
Pacitan_1	0.25	0.57	0.02	0.05	0.05	0.01	2.54	0.01	0.15	0.04	0.05
Pacitan_2	0.18	0.62	0.01	0.00	0.03	0.00	2.48	0.01	0.17	0.04	0.06
Pacitan_3	0.12	0.46	0.05	0.01	0.03	0.00	2.05	0.00	0.13	0.03	0.03
Pacitan_4	0.20	0.57	0.22	0.01	0.18	0.00	1.49	0.01	0.33	0.03	0.09
Pacitan_5	0.23	0.58	0.16	0.04	0.14	0.01	1.43	0.01	0.63	0.03	0.10
Pacitan_6	0.18	0.29	0.05	0.03	0.07	0.01	1.41	0.01	0.33	0.03	0.10
Pacitan_7	0.27	0.37	0.03	0.04	0.16	0.04	1.76	0.02	0.42	0.04	0.11
Pacitan_8	0.04	0.68	0.04	0.06	0.07	0.02	2.84	0.01	0.21	0.05	0.07
Pacitan_9	0.15	8.23	0.54	0.05	0.41	0.01	2.70	0.07	109.32	0.16	0.30

Database ID	Pr	Ta	Au	Y	Pb	Bi	U	W	Mo	Nd	Sm
Kandek_1	0.07	0.01	0.02	0.40	1.42	0.02	0.12	0.03	0.02	0.31	0.11
Kandek_2	0.00	0.01	0.16	0.07	0.62	0.03	0.02	0.03	0.02	0.01	0.02
Kandek_3	0.03	0.01	0.25	0.14	0.41	0.03	0.01	0.05	0.04	0.10	0.04
Kandek_4	0.02	0.04	1.60	0.06	0.17	0.03	2.00	1.40	0.00	0.20	0.10
Kandek_5	0.02	0.02	2.23	0.02	1.31	0.11	0.03	0.03	0.04	0.02	0.03
Kandek_6	0.02	0.01	0.36	0.08	0.44	0.06	0.02	0.01	0.03	0.04	0.04
Kandek_7	0.00	0.00	0.05	0.02	0.17	0.00	0.01	0.01	0.01	0.01	0.01
Kandek_8	0.02	0.01	0.09	0.09	1.05	0.01	0.01	0.02	0.03	0.07	0.02
Kandek_9	0.01	0.01	0.04	0.07	0.10	0.03	0.02	0.04	0.04	0.02	0.05
Kandek_10	0.01	0.00	0.04	0.14	0.24	0.01	0.01	0.02	0.02	0.03	0.03
Kandek_11	0.02	0.01	0.10	0.04	0.36	0.01	0.00	0.03	0.01	0.07	0.02
Kandek_12	0.01	0.01	0.11	0.06	0.51	0.02	0.01	0.04	0.02	0.03	0.01
Kandek_13	0.02	0.01	0.09	0.14	0.29	0.01	0.00	0.01	0.02	0.09	0.02
Kandek_14	0.02	0.03	0.43	0.04	0.06	0.03	0.03	0.10	0.13	0.16	0.10
Kandek_15	0.01	0.01	0.13	0.05	0.33	0.01	0.00	0.06	0.03	0.04	0.04
MardakBet_1	0.04	0.06	0.13	0.10	0.51	0.03	0.03	0.11	0.03	0.15	0.17
MardakBet_2	0.08	0.01	0.06	0.17	0.72	0.02	0.37	0.04	0.03	0.19	0.06
MardakBet_3	0.01	0.05	0.06	0.05	0.16	0.03	0.03	0.04	0.02	0.09	0.13
MardakBet_4	0.01	0.04	0.08	0.03	0.35	0.01	0.11	0.26	0.03	0.05	0.14
MardakBet_5	0.02	0.01	0.03	0.07	0.17	0.01	0.01	0.04	0.05	0.05	0.04
MardakBet_6	0.01	0.01	0.12	0.03	0.32	0.03	0.13	0.03	0.02	0.04	0.03
MardakBet_7	0.03	0.02	0.17	0.02	0.24	0.04	0.20	0.14	0.01	0.06	0.12
MardakBet_8	0.03	0.00	0.04	0.14	0.26	0.01	0.19	0.04	0.06	0.06	0.04
MardakBet_9	0.01	0.01	0.02	0.06	0.33	0.01	0.02	0.01	0.04	0.06	0.06
MardakBet_10	0.00	0.00	0.06	0.03	0.09	0.01	0.01	0.01	0.08	0.03	0.02
MardakBet_11	0.04	0.02	0.15	0.18	1.00	0.04	0.32	0.04	0.06	0.13	0.04
MardakBet_12	0.00	0.00	0.02	0.05	0.36	0.00	0.25	0.02	0.05	0.03	0.01

Database ID	Pr	Ta	Au	Y	Pb	Bi	U	W	Mo	Nd	Sm
MardakBet_13	0.02	0.06	0.33	0.09	0.84	0.02	0.11	0.03	0.03	0.04	0.07
MardakBet_14	0.01	0.01	0.07	0.04	0.99	0.04	0.09	0.04	0.02	0.03	0.04
MardakBet_15	0.05	0.02	1.14	0.12	2.89	1.49	0.25	0.06	0.06	0.19	0.05
Ratanpur_1	0.02	0.01	0.02	0.12	0.12	0.01	0.01	0.01	0.02	0.05	0.02
Ratanpur_2	0.00	0.00	0.10	0.03	0.23	0.00	0.00	0.01	0.01	0.02	0.01
Ratanpur_3	0.01	0.00	0.06	0.03	0.37	0.01	0.01	0.01	0.01	0.02	0.01
Ratanpur_4	0.01	0.00	0.30	0.02	0.36	0.02	0.01	0.03	0.02	0.01	0.02
Ratanpur_5	0.01	0.00	0.09	0.39	0.11	0.01	0.01	0.02	0.02	0.04	0.05
Ratanpur_6	0.02	0.01	0.10	0.10	0.41	0.01	0.07	0.02	0.04	0.07	0.05
Ratanpur_7	0.01	0.00	0.40	0.03	0.34	0.01	0.02	0.02	0.01	0.04	0.01
Ratanpur_8	0.01	0.01	0.12	0.02	0.17	0.01	0.01	0.03	0.04	0.04	0.04
Ratanpur_9	0.01	0.01	0.22	0.11	0.38	0.01	0.01	0.04	0.08	0.06	0.05
Ratanpur_10	0.02	0.03	0.27	0.06	0.91	0.03	0.05	0.04	0.04	0.06	0.04
Ratanpur_12	0.03	0.02	0.58	0.13	3.57	0.12	0.02	0.07	0.07	0.10	0.05
Ratanpur_14	0.12	0.03	0.86	0.71	3.48	0.18	0.05	0.08	0.06	0.31	0.20
RTPUnheated	0.00	0.01	0.03	0.02	0.05	0.02	0.01	0.04	0.03	0.02	0.03
RTPHeatedOnce	0.04	0.01	0.02	0.11	0.08	0.02	0.03	0.03	0.02	0.14	0.04
RTPHeated	0.01	0.02	0.03	0.16	0.21	0.02	0.02	0.02	0.03	0.06	0.03
Mahurjhari_1	0.01	0.00	0.28	0.08	0.27	0.01	0.01	0.01	0.02	0.04	0.02
Mahurjhari_2	0.02	0.01	0.36	0.11	0.50	0.01	0.02	0.03	0.03	0.06	0.02
Mahurjhari_3	0.00	0.00	0.10	0.02	0.14	0.00	0.00	0.01	0.01	0.01	0.00
Mahurjhari_4	0.05	0.01	1.08	0.49	0.50	0.07	0.06	0.05	0.10	0.13	0.04
Mahurjhari_5	0.18	0.02	1.05	0.78	3.47	0.06	0.07	0.06	0.04	0.64	0.15
Mahurjhari_6	0.02	0.02	2.14	0.07	7.24	0.22	0.09	0.02	0.06	0.08	0.03
Mahurjhari_7	0.04	0.00	0.03	0.63	0.27	0.01	0.01	0.02	0.04	0.12	0.06
Mahurjhari_8	0.01	0.01	0.41	0.57	0.22	0.03	0.21	0.02	0.01	0.03	0.03
Mahurjhari_9	0.02	0.01	0.75	0.06	1.48	0.04	0.01	0.03	0.03	0.08	0.04

Database ID	Pr	Ta	Au	Y	Pb	Bi	U	W	Mo	Nd	Sm
Mahurjhari_10	0.01	0.01	0.86	0.03	0.80	0.03	0.01	0.06	0.01	0.01	0.02
Mahurjhari_12	0.02	0.01	0.82	0.10	1.43	0.07	0.01	0.07	0.02	0.05	0.02
Mahurjhari_13	0.01	0.00	0.13	0.02	0.20	0.02	0.01	0.02	0.04	0.02	0.02
Mahurjhari_14	0.03	0.01	0.96	0.55	1.98	0.05	0.02	0.04	0.17	0.08	0.04
Mahurjhari_15	0.12	0.01	0.14	0.64	8.38	0.02	0.02	0.06	0.03	0.44	0.12
Mahurjhari_16	0.06	0.01	1.01	0.09	1.40	0.03	0.02	0.02	0.07	0.07	0.14
Mahurjhari_17	0.05	0.00	0.50	0.44	0.57	0.01	0.01	0.01	0.02	0.19	0.07
Mahurjhari_18	0.01	0.01	0.74	0.07	1.26	0.04	0.01	0.02	0.02	0.04	0.01
Mahurjhari_19	0.01	0.01	0.10	0.06	0.33	0.00	0.02	0.01	0.01	0.03	0.01
Mahurjhari_20	0.02	0.01	0.20	0.10	0.87	0.04	0.08	0.10	0.10	0.06	0.01
Mahurjhari_21	0.02	0.01	0.43	0.08	1.07	0.04	0.02	0.04	0.04	0.03	0.06
Mahurjhari_22	0.02	0.02	0.56	0.17	0.69	0.11	0.03	0.02	0.05	0.06	0.02
Mahurjhari_23	0.01	0.01	1.10	0.06	0.88	0.05	0.01	0.03	0.04	0.03	0.03
Mahurjhari_24	0.01	0.00	0.26	0.04	0.35	0.03	0.01	0.01	0.02	0.02	0.01
Mahurjhari_25	0.01	0.00	0.66	0.06	0.62	0.04	0.03	0.01	0.04	0.03	0.02
Mahurjhari_26	0.02	0.01	0.80	0.15	0.70	0.02	0.07	0.02	0.03	0.05	0.04
Paithan_1	0.05	0.61	0.95	0.06	1.09	0.19	0.10	0.26	0.64	0.63	0.56
Paithan_2	0.03	0.27	0.16	0.10	0.42	0.73	0.02	3.02	0.13	0.11	0.12
Paithan_3	0.02	0.36	2.73	0.08	0.58	0.11	0.14	2.84	0.27	0.20	0.19
Paithan_4	0.01	0.01	0.05	0.09	0.17	0.02	0.10	0.02	0.02	0.03	0.02
Paithan_5	0.01	0.01	0.21	0.10	0.25	0.03	0.04	0.07	0.01	0.01	0.01
Paithan_6	0.02	0.01	0.30	0.31	0.63	0.01	0.20	0.03	0.03	0.07	0.03
Paithan_7	0.01	0.01	0.19	0.09	0.48	0.02	0.06	0.02	0.03	0.02	0.02
Paithan_8	0.01	0.03	1.10	0.06	1.45	0.04	0.01	0.02	0.11	0.03	0.01
Paithan_9	0.03	0.01	0.05	0.33	0.67	0.02	0.21	0.05	0.02	0.10	0.07
Paithan_10	0.02	0.03	0.22	0.06	0.13	0.03	0.04	0.05	0.00	0.09	0.13
Paithan_11	0.01	0.00	0.04	0.03	0.19	0.00	0.01	0.01	0.02	0.02	0.02

Database ID	Pr	Ta	Au	Y	Pb	Bi	U	W	Mo	Nd	Sm
Paithan_12	0.01	0.01	0.14	0.12	0.11	0.01	0.04	0.04	0.02	0.02	0.06
Paithan_13	0.02	0.01	0.22	0.07	0.72	0.03	0.09	0.01	0.01	0.04	0.02
Paithan_14	0.01	0.00	0.02	0.03	0.09	0.02	0.01	0.01	0.01	0.02	0.01
Paithan_15	0.04	0.05	0.23	0.11	0.45	0.05	0.05	0.11	0.14	0.13	0.16
Undari_1	0.03	0.02	0.03	0.17	0.24	0.01	0.35	0.09	0.03	0.07	0.03
Undari_2	0.04	0.03	0.10	0.06	0.06	0.06	0.03	0.06	0.14	0.10	0.09
Undari_3	0.01	0.01	0.19	0.05	0.59	0.02	0.01	0.02	0.03	0.04	0.02
Undari_4	0.00	0.01	0.02	0.05	0.08	0.02	0.05	0.04	0.01	0.02	0.02
Undari_5	0.02	0.01	0.10	0.05	0.16	0.01	0.02	0.01	0.02	0.04	0.02
Undari_6	0.01	0.01	0.50	0.02	0.70	0.03	0.01	0.01	0.02	0.02	0.02
Undari_7	0.02	0.04	0.18	0.12	0.07	0.23	0.03	0.09	0.15	0.12	0.13
Undari_8	0.04	0.02	0.80	0.15	2.33	0.10	0.06	0.07	0.04	0.07	0.03
Undari_9	0.01	0.01	0.19	0.07	0.76	0.03	0.02	0.06	0.03	0.03	0.02
Undari_10	0.00	0.01	0.01	0.08	0.08	0.01	0.14	0.03	0.01	0.02	0.01
Undari_11	0.01	0.01	0.31	0.07	0.56	0.02	0.02	0.02	0.04	0.02	0.01
Undari_12	0.03	0.02	1.21	0.14	2.76	0.10	0.05	0.04	0.03	0.07	0.03
Undhari_JMK1	0.00	0.01	0.12	0.19	0.24	0.01	0.12	0.02	0.04	0.02	0.03
Undhari_JMK2	0.02	0.00	0.02	0.11	0.86	0.00	0.00	0.01	0.02	0.07	0.02
Shahr-i-Sokhta_1	0.00	0.01	0.14	0.07	0.12	0.01	0.68	0.04	0.01	0.02	0.03
Shahr-i-Sokhta_2	0.01	0.01	0.15	0.15	1.35	0.03	34.09	0.19	0.08	0.06	0.03
Shahr-i-Sokhta_3	0.01	0.07	0.04	0.04	0.14	0.01	0.91	0.24	0.02	0.07	0.24
Shahr-i-Sokhta_4	0.02	0.03	0.29	0.19	1.19	0.03	6.86	0.11	0.07	0.07	0.02
Shahr-i-Sokhta_5	0.00	0.03	0.07	0.09	1.57	0.02	5.62	0.07	0.05	0.12	0.08
Shahr-i-Sokhta_6	0.03	0.03	0.14	0.12	5.04	0.04	18.54	0.13	0.12	0.14	0.12
Shahr-i-Sokhta_7	0.03	0.02	0.38	0.13	12.05	0.03	3.86	0.07	0.10	0.05	0.04
Shahr-i-Sokhta_8	0.04	0.04	0.19	0.11	3.47	0.06	14.69	0.11	0.10	0.08	0.05
Shahr-i-Sokhta_9	0.06	0.04	0.14	0.14	1.98	0.07	2.90	0.16	0.14	0.14	0.13

Database ID	Pr	Ta	Au	Y	Pb	Bi	U	W	Mo	Nd	Sm
Shahr-i-Sokhta_10	0.03	0.04	0.21	0.09	0.28	0.14	2.25	0.17	0.03	0.35	0.23
Shahr-i-Sokhta_11	0.01	0.02	0.11	0.00	0.18	0.07	2.48	0.11	0.03	0.08	0.10
Shahr-i-Sokhta_12	0.02	0.02	0.12	0.03	0.77	0.03	0.05	0.08	0.06	0.08	0.08
Shahr-i-Sokhta_13	0.01	0.04	0.13	0.10	0.62	0.07	27.63	0.13	0.05	0.07	0.12
Shahr-i-Sokhta_14	0.01	0.04	0.13	0.12	0.12	0.05	1.39	0.06	0.02	0.11	0.11
Shahr-i-Sokhta_15	0.04	0.04	0.14	0.12	0.71	0.04	2.62	0.08	0.21	0.08	0.12
Shahr-i-Sokhta_16	0.01	0.01	0.07	0.01	0.34	0.01	0.26	0.09	0.02	0.06	0.09
Shahr-i-Sokhta_17	0.05	0.03	0.11	0.41	0.96	0.04	13.58	0.22	0.13	0.26	0.21
BanKhaoMogul_1	0.19	0.12	1.81	2.60	1.78	0.08	0.45	1.78	0.16	0.61	0.16
BanKhaoMogul_2	2.89	0.14	0.45	17.93	1.52	0.14	4.35	0.34	0.15	9.84	2.24
BanKhaoMogul_4	0.74	0.13	2.07	9.57	3.19	0.08	1.09	0.09	0.39	2.40	0.55
BanKhaoMogul_5	0.01	0.16	0.69	0.01	0.22	0.15	0.05	1.77	0.03	0.18	0.20
BanKhaoMogul_6	1.19	0.13	0.12	50.62	2.07	0.07	3.59	0.15	0.21	3.90	1.11
BanKhaoMogul_7	0.01	1.65	2.70	0.01	0.55	1.21	0.26	1.85	0.08	0.26	0.08
BanKhaoMogul_9	0.03	0.04	0.26	0.03	0.18	0.04	0.07	0.21	0.03	0.09	0.13
BanKhaoMogul_10	0.02	0.29	0.48	0.01	0.32	0.45	0.04	0.00	0.06	0.16	0.06
BanKhaoMogul_11	0.01	0.02	0.19	0.03	0.45	0.03	0.04	0.05	0.02	0.06	0.07
BanKhaoMogul_12	0.01	0.05	0.19	0.01	0.16	0.02	0.15	0.08	0.02	0.07	0.17
BanKhaoMogul_13	0.01	0.03	0.22	0.01	0.16	0.03	0.16	0.10	0.04	0.05	0.09
BanKhaoMogul_15	0.01	0.10	0.14	0.02	0.43	0.01	0.46	0.27	0.01	0.02	0.03
BanKhaoMogul_16	0.01	0.10	0.40	0.01	0.21	0.05	0.22	0.73	0.03	0.09	0.12
BanKhaoMogul_17	0.01	0.01	0.11	0.01	0.14	0.03	0.05	0.17	0.03	0.05	0.07
BanKhaoMogul_18	0.02	0.03	0.13	0.06	0.51	0.12	0.15	0.06	0.05	0.15	0.16
BanKhaoMogul_20	0.03	0.04	0.26	0.12	0.67	0.02	0.07	0.09	0.01	0.11	0.04
BanKhaoMogul_21	0.01	0.01	0.23	0.07	0.23	0.03	0.11	0.07	0.02	0.13	0.13
KonTum_1	0.03	0.02	0.06	0.23	0.25	0.03	0.02	0.06	0.09	0.09	0.09
KonTum_2	0.01	0.02	0.01	0.16	0.25	0.01	0.04	0.02	0.01	0.05	0.02

Database ID	Pr	Ta	Au	Y	Pb	Bi	U	W	Mo	Nd	Sm
KonTum_3	0.01	0.02	0.10	0.31	0.39	0.02	0.07	0.04	0.01	0.02	0.03
KonTum_4	0.01	0.02	0.43	0.25	0.12	0.01	0.05	0.03	0.02	0.01	0.02
KonTum_5	0.06	0.59	2.83	0.19	2.08	0.24	0.06	0.18	0.41	0.29	0.22
KonTum_6	0.01	0.05	0.12	0.45	0.14	0.03	0.33	0.08	0.03	0.03	0.04
KonTum_7	0.01	0.00	0.10	0.28	0.12	0.02	0.02	0.05	0.52	0.08	0.08
KonTum_8	0.01	0.00	0.12	0.06	0.65	0.02	0.01	0.02	0.01	0.01	0.03
KonTum_9	0.00	0.01	0.01	0.19	0.14	0.01	0.00	0.01	0.01	0.01	0.01
GiaLai_1	0.06	0.01	0.02	0.20	0.06	0.01	0.07	0.02	0.02	0.20	0.04
GiaLai_2	0.02	0.01	0.02	0.13	0.03	0.01	0.09	0.04	0.01	0.08	0.02
GiaLai_3	0.04	0.00	0.01	0.05	0.01	0.00	0.10	0.01	0.02	0.16	0.04
GiaLai_4	0.08	0.01	0.01	0.14	0.02	0.01	0.07	0.03	0.02	0.24	0.07
DongNai_1	0.02	0.05	0.80	0.14	0.67	0.21	0.01	0.19	0.34	0.43	0.07
DongNai_2	0.01	0.05	0.11	1.11	0.12	0.02	0.01	0.05	0.09	0.09	0.10
DongNai_3	0.00	0.00	0.03	0.45	0.11	0.01	0.03	0.01	0.01	0.01	0.03
DongNai_4	0.01	0.01	0.28	0.22	0.22	0.03	0.02	0.07	0.04	0.02	0.02
DongNai_5	0.01	0.01	0.31	0.39	0.06	0.01	0.02	0.02	0.02	0.01	0.01
DongNai_6	0.01	0.01	0.02	0.11	0.26	0.01	0.00	0.02	0.02	0.02	0.02
Pacitan_1	0.01	0.01	0.08	0.04	0.42	0.04	0.59	0.03	0.02	0.03	0.02
Pacitan_2	0.01	0.01	0.07	0.05	0.23	0.02	0.06	0.02	0.01	0.04	0.02
Pacitan_3	0.01	0.01	0.04	0.04	0.38	0.01	0.01	0.02	0.01	0.02	0.01
Pacitan_4	0.01	0.02	0.08	0.39	1.04	0.03	0.12	0.03	0.03	0.05	0.03
Pacitan_5	0.01	0.01	0.26	0.52	0.22	0.03	0.02	0.27	0.02	0.04	0.03
Pacitan_6	0.01	0.01	0.26	0.43	2.07	0.02	0.10	0.04	0.07	0.04	0.03
Pacitan_7	0.02	0.05	0.47	0.54	0.91	0.05	0.15	0.14	0.16	0.13	0.04
Pacitan_8	0.01	0.03	0.05	0.08	0.23	0.02	0.10	0.14	0.07	0.05	0.03
Pacitan_9	0.06	0.01	0.06	0.43	0.58	0.01	0.07	0.05	0.02	0.19	0.07

Database ID	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Th
Kandek_1	0.03	0.09	0.02	0.09	0.02	0.04	0.01	0.04	0.01	0.03	0.10
Kandek_2	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.03	0.01	0.01	3.16
Kandek_3	0.01	0.04	0.01	0.03	0.01	0.03	0.01	0.03	0.01	0.03	0.54
Kandek_4	0.04	0.11	0.02	0.12	0.04	0.07	0.03	0.11	0.04	1.97	9.10
Kandek_5	0.01	0.03	0.01	0.03	0.01	0.02	0.01	0.03	0.02	0.03	4.60
Kandek_6	0.01	0.02	0.01	0.03	0.02	0.02	0.01	0.03	0.01	0.02	0.30
Kandek_7	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.02	0.01	0.01	0.07
Kandek_8	0.01	0.04	0.01	0.04	0.01	0.03	0.01	0.03	0.01	0.01	0.03
Kandek_9	0.00	0.02	0.00	0.04	0.01	0.04	0.00	0.06	0.01	0.02	0.02
Kandek_10	0.01	0.02	0.00	0.03	0.01	0.02	0.00	0.02	0.00	0.01	0.01
Kandek_11	0.01	0.04	0.01	0.03	0.01	0.01	0.01	0.04	0.00	0.02	0.02
Kandek_12	0.00	0.02	0.00	0.02	0.00	0.02	0.01	0.02	0.01	0.02	0.03
Kandek_13	0.01	0.04	0.01	0.06	0.01	0.03	0.00	0.03	0.00	0.03	0.00
Kandek_14	0.02	0.00	0.02	0.10	0.02	0.09	0.07	0.10	0.03	0.27	1.05
Kandek_15	0.04	0.04	0.01	0.03	0.01	0.03	0.00	0.06	0.00	0.02	0.19
MardakBet_1	0.05	0.10	0.02	0.06	0.03	0.05	0.02	0.08	0.02	0.05	0.05
MardakBet_2	0.03	0.06	0.01	0.04	0.01	0.03	0.01	0.03	0.01	0.02	0.05
MardakBet_3	0.07	0.13	0.02	0.02	0.02	0.05	0.01	0.07	0.00	0.18	0.03
MardakBet_4	0.05	0.12	0.02	0.15	0.02	0.04	0.02	0.13	0.01	0.05	0.03
MardakBet_5	0.01	0.05	0.01	0.04	0.01	0.03	0.01	0.03	0.01	0.05	0.02
MardakBet_6	0.01	0.04	0.01	0.02	0.01	0.02	0.01	0.03	0.01	0.03	0.02
MardakBet_7	0.02	0.15	0.02	0.16	0.04	0.09	0.04	0.20	0.03	0.37	0.08
MardakBet_8	0.01	0.05	0.01	0.03	0.01	0.02	0.01	0.02	0.01	0.01	0.01
MardakBet_9	0.03	0.02	0.01	0.04	0.01	0.02	0.01	0.04	0.01	0.03	0.05
MardakBet_10	0.01	0.01	0.00	0.03	0.00	0.01	0.00	0.01	0.00	0.02	0.13
MardakBet_11	0.01	0.05	0.01	0.04	0.01	0.03	0.01	0.04	0.01	0.03	0.04
MardakBet_12	0.01	0.04	0.01	0.02	0.00	0.01	0.00	0.01	0.00	0.01	0.19

Database ID	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Th
MardakBet_13	0.02	0.06	0.01	0.03	0.01	0.03	0.01	0.03	0.01	0.04	0.70
MardakBet_14	0.01	0.06	0.01	0.04	0.01	0.07	0.05	0.02	0.01	0.03	3.10
MardakBet_15	0.03	0.10	0.03	0.16	0.04	0.09	0.02	0.06	0.02	0.04	3.48
Ratanpur_1	0.01	0.03	0.01	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Ratanpur_2	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.28
Ratanpur_3	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.28
Ratanpur_4	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.27
Ratanpur_5	0.01	0.05	0.01	0.10	0.02	0.03	0.01	0.04	0.01	0.03	0.26
Ratanpur_6	0.02	0.04	0.00	0.02	0.00	0.01	0.00	0.03	0.01	0.03	0.04
Ratanpur_7	0.02	0.01	0.00	0.01	0.01	0.02	0.01	0.01	0.00	0.01	0.41
Ratanpur_8	0.01	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.17
Ratanpur_9	0.01	0.04	0.00	0.04	0.01	0.02	0.01	0.03	0.01	0.03	0.02
Ratanpur_10	0.07	0.04	0.05	0.07	0.06	0.16	0.01	0.25	0.01	0.05	8.44
Ratanpur_12	0.03	0.08	0.02	0.06	0.02	0.03	0.01	0.04	0.01	0.05	0.99
Ratanpur_14	0.05	0.15	0.04	0.22	0.03	0.07	0.03	0.11	0.02	0.07	0.40
RTPUnheated	0.02	0.03	0.01	0.02	0.01	0.02	0.01	0.03	0.01	0.03	0.01
RTPHeatedOnce	0.01	0.04	0.01	0.03	0.01	0.02	0.00	0.02	0.01	0.02	0.25
RTPHeated	0.01	0.03	0.01	0.03	0.01	0.02	0.00	0.03	0.01	0.02	0.01
Mahurjhari_1	0.01	0.02	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.54
Mahurjhari_2	0.02	0.05	0.01	0.03	0.01	0.04	0.01	0.02	0.01	0.02	0.69
Mahurjhari_3	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01
Mahurjhari_4	0.01	0.06	0.01	0.09	0.02	0.05	0.01	0.06	0.01	0.07	0.16
Mahurjhari_5	0.07	0.12	0.03	0.16	0.04	0.09	0.02	0.07	0.01	0.08	0.70
Mahurjhari_6	0.02	0.03	0.01	0.03	0.02	0.02	0.01	0.03	0.02	0.02	20.39
Mahurjhari_7	0.02	0.08	0.02	0.12	0.03	0.07	0.01	0.06	0.01	0.01	0.01
Mahurjhari_8	0.01	0.02	0.01	0.05	0.01	0.07	0.02	0.17	0.03	0.01	1.33
Mahurjhari_9	0.01	0.03	0.01	0.03	0.01	0.02	0.01	0.03	0.01	0.02	2.09

Database ID	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Th
Mahurjhari_10	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.03	0.01	0.01	0.69
Mahurjhari_12	0.01	0.02	0.01	0.02	0.01	0.02	0.00	0.02	0.01	0.01	0.51
Mahurjhari_13	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.01	0.05
Mahurjhari_14	0.02	0.05	0.01	0.05	0.03	0.04	0.01	0.04	0.01	0.02	1.98
Mahurjhari_15	0.03	0.06	0.02	0.13	0.03	0.07	0.01	0.08	0.01	0.05	0.06
Mahurjhari_16	0.01	0.06	0.02	0.06	0.01	0.01	0.01	0.03	0.03	0.02	2.08
Mahurjhari_17	0.02	0.06	0.01	0.06	0.02	0.04	0.01	0.06	0.01	0.03	0.12
Mahurjhari_18	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	1.52
Mahurjhari_19	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.01
Mahurjhari_20	0.01	0.06	li0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.04
Mahurjhari_21	0.01	0.02	0.01	0.03	0.02	0.02	0.01	0.03	0.01	0.02	1.34
Mahurjhari_22	0.01	0.03	0.01	0.02	0.01	0.02	0.00	0.02	0.01	0.01	1.43
Mahurjhari_23	0.01	0.03	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.62
Mahurjhari_24	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	1.79
Mahurjhari_25	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.13
Mahurjhari_26	0.01	0.03	0.01	0.03	0.01	0.02	0.01	0.02	0.00	0.03	2.06
Paithan_1	0.06	0.31	0.04	1.64	0.04	0.13	0.04	0.18	0.05	0.17	1.23
Paithan_2	0.04	0.28	0.05	0.22	0.21	0.09	0.22	1.26	0.03	1.27	0.66
Paithan_3	0.09	0.17	0.04	0.46	0.33	0.15	0.23	0.22	0.10	0.60	5.22
Paithan_4	0.01	0.01	0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.04
Paithan_5	0.00	0.02	0.00	0.01	0.01	0.01	0.00	0.02	0.01	0.01	0.14
Paithan_6	0.01	0.04	0.01	0.03	0.02	0.02	0.01	0.03	0.01	0.02	0.10
Paithan_7	0.01	0.02	0.00	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.39
Paithan_8	0.23	0.05	0.01	0.05	0.01	0.03	0.01	0.04	0.01	0.06	3.51
Paithan_9	0.02	0.07	0.01	0.06	0.02	0.03	0.01	0.03	0.01	0.02	0.02
Paithan_10	0.03	0.11	0.02	0.09	0.02	0.08	0.02	0.10	0.03	0.11	0.33
Paithan_11	0.01	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.08

Database ID	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Th
Paithan_12	0.00	0.01	0.00	0.02	0.00	0.02	0.00	0.03	0.01	0.01	0.01
Paithan_13	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.00	0.01	1.26
Paithan_14	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00
Paithan_15	0.05	0.13	0.03	0.14	0.03	0.09	0.03	0.14	0.05	1.19	0.06
Undari_1	0.02	0.04	0.01	0.03	0.01	0.02	0.01	0.03	0.01	0.02	1.65
Undari_2	0.03	0.12	0.02	1.17	0.02	0.08	0.02	1.70	0.03	0.00	0.17
Undari_3	0.01	0.02	0.00	0.02	0.01	0.01	0.01	0.01	0.00	0.02	0.30
Undari_4	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.02	0.00	0.02	0.03
Undari_5	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.02	0.01	1.39
Undari_6	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.27
Undari_7	0.03	0.14	0.02	0.16	0.03	0.08	0.03	0.15	0.04	3.35	0.98
Undari_8	0.01	0.04	0.02	0.04	0.03	0.03	0.01	0.03	0.01	0.04	1.50
Undari_9	0.01	0.02	0.01	0.02	0.00	0.01	0.00	0.02	0.01	0.01	0.23
Undari_10	0.01	0.01	0.00	0.01	0.00	0.02	0.00	0.02	0.00	0.01	0.02
Undari_11	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.01	1.00
Undari_12	0.02	0.05	0.01	0.03	0.02	0.02	0.01	0.03	0.01	0.02	1.29
Undhari_JMK1	0.01	0.02	0.00	0.02	0.01	0.02	0.00	0.07	0.01	0.02	0.34
Undhari_JMK2	0.00	0.02	0.00	0.02	0.01	0.01	0.00	0.02	0.00	0.01	0.04
Shahr-i-Sokhta_1	0.01	0.03	0.00	0.01	0.01	0.02	0.01	0.05	0.01	0.02	0.06
Shahr-i-Sokhta_2	0.01	0.26	0.05	0.02	0.03	0.03	0.01	0.34	0.09	0.18	0.04
Shahr-i-Sokhta_3	0.06	0.22	0.05	0.07	0.01	0.08	0.02	0.12	0.01	0.12	0.05
Shahr-i-Sokhta_4	0.01	0.06	0.01	0.07	0.02	0.05	0.01	0.11	0.02	0.08	0.07
Shahr-i-Sokhta_5	0.04	0.13	0.02	0.06	0.02	0.06	0.01	0.12	0.03	0.10	0.04
Shahr-i-Sokhta_6	0.05	0.12	0.03	0.07	0.02	0.06	0.02	0.12	0.02	0.09	0.05
Shahr-i-Sokhta_7	0.04	0.05	0.02	0.06	0.02	0.03	0.01	0.09	0.02	0.09	0.05
Shahr-i-Sokhta_8	0.04	0.06	0.03	0.09	0.04	0.08	0.04	0.12	0.05	0.05	0.06
Shahr-i-Sokhta_9	0.03	0.16	0.03	0.07	0.03	0.06	0.03	0.12	0.03	0.23	0.11

Database ID	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Th
Shahr-i-Sokhta_10	0.15	0.45	0.04	0.06	0.01	0.06	0.01	0.09	0.02	0.26	0.04
Shahr-i-Sokhta_11	0.03	0.06	0.02	0.10	0.02	0.04	0.02	0.24	0.01	0.61	0.03
Shahr-i-Sokhta_12	0.03	0.09	0.01	0.06	0.02	0.04	0.01	0.05	0.01	0.03	0.09
Shahr-i-Sokhta_13	0.03	0.08	0.02	0.04	0.01	0.03	0.01	0.11	0.02	0.06	0.04
Shahr-i-Sokhta_14	0.05	0.19	0.02	0.10	0.02	0.03	0.01	0.12	0.02	0.25	0.04
Shahr-i-Sokhta_15	0.05	0.09	0.04	0.08	0.07	0.09	0.04	0.08	0.03	0.15	0.09
Shahr-i-Sokhta_16	0.08	0.07	0.02	0.03	0.01	0.04	0.01	0.07	0.01	0.13	0.03
Shahr-i-Sokhta_17	0.06	0.31	0.07	0.41	0.04	0.10	0.03	0.59	0.07	0.14	0.05
BanKhaoMogul_1	0.05	0.19	0.05	0.36	0.10	0.61	0.05	0.37	0.06	0.56	0.68
BanKhaoMogul_2	0.44	2.28	0.35	2.23	0.49	1.56	0.24	1.89	0.32	0.66	1.26
BanKhaoMogul_4	0.12	0.76	0.16	1.14	0.29	0.72	0.15	1.03	0.11	0.42	1.36
BanKhaoMogul_5	0.03	0.28	0.03	0.10	0.02	0.08	0.08	0.65	0.22	0.19	0.05
BanKhaoMogul_6	0.25	1.62	0.47	3.59	1.40	4.78	0.79	6.23	1.03	0.58	0.93
BanKhaoMogul_7	0.06	0.72	0.09	0.21	0.03	0.23	0.04	0.20	0.23	0.37	0.10
BanKhaoMogul_9	0.02	0.16	0.02	0.12	0.04	0.06	0.04	0.14	0.03	0.04	0.03
BanKhaoMogul_10	0.02	0.29	0.10	0.04	0.11	0.00	0.11	0.18	0.11	0.47	2.53
BanKhaoMogul_11	0.01	0.06	0.01	0.03	0.01	0.07	0.02	0.04	0.03	0.03	0.02
BanKhaoMogul_12	0.02	0.07	0.03	0.21	0.02	0.05	0.03	0.18	0.03	0.05	0.40
BanKhaoMogul_13	0.03	0.06	0.01	0.09	0.02	0.08	0.03	0.07	0.05	0.08	0.06
BanKhaoMogul_15	0.01	0.13	0.01	0.03	0.01	0.04	0.03	0.08	0.02	0.04	0.02
BanKhaoMogul_16	0.09	0.24	0.05	0.18	0.06	0.31	0.09	0.12	0.06	0.41	0.09
BanKhaoMogul_17	0.02	0.06	0.01	0.09	0.01	0.03	0.02	0.04	0.02	0.07	0.04
BanKhaoMogul_18	0.02	0.05	0.02	0.06	0.02	0.11	0.05	0.04	0.03	0.06	0.03
BanKhaoMogul_20	0.02	0.05	0.01	0.04	0.03	0.03	0.01	0.15	0.02	0.04	0.08
BanKhaoMogul_21	0.05	0.14	0.01	0.06	0.04	0.03	0.01	0.06	0.02	0.05	0.03
KonTum_1	0.04	0.11	0.01	0.10	0.02	0.07	0.02	0.10	0.02	0.09	0.03
KonTum_2	0.01	0.01	0.00	0.03	0.00	0.02	0.00	0.02	0.02	0.04	0.10

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KonTum_3	0.00	0.02	0.00	0.03	0.01	0.02	0.00	0.02	0.00	0.02	0.03
KonTum_4	0.01	0.01	0.01	0.02	0.01	0.02	0.00	0.02	0.00	0.01	0.04
KonTum_5	0.08	0.39	0.05	0.20	0.10	0.21	0.06	0.26	0.06	1.10	8.11
KonTum_6	0.01	0.02	0.01	0.04	0.01	0.04	0.01	0.06	0.02	0.02	0.30
KonTum_7	0.03	0.08	0.01	0.08	0.02	0.07	0.02	0.10	0.02	0.00	0.02
KonTum_8	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.85
KonTum_9	0.00	0.01	0.00	0.02	0.01	0.01	0.00	0.03	0.00	0.01	0.00
GiaLai_1	0.02	0.05	0.01	0.05	0.01	0.02	0.01	0.02	0.00	0.15	0.01
GiaLai_2	0.01	0.02	0.00	0.04	0.01	0.02	0.01	0.04	0.01	0.16	0.02
GiaLai_3	0.01	0.03	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00
GiaLai_4	0.02	0.06	0.01	0.04	0.01	0.01	0.01	0.02	0.00	0.02	0.01
DongNai_1	0.05	0.15	0.08	0.17	0.07	0.04	0.05	0.20	0.06	0.15	1.12
DongNai_2	0.04	0.15	0.03	0.11	0.03	0.14	0.01	0.09	0.02	0.05	0.35
DongNai_3	0.00	0.02	0.00	0.06	0.01	0.06	0.01	0.11	0.02	0.01	0.01
DongNai_4	0.02	0.03	0.00	0.03	0.01	0.02	0.01	0.05	0.01	0.01	0.07
DongNai_5	0.00	0.02	0.00	0.04	0.01	0.05	0.01	0.09	0.01	0.01	0.88
DongNai_6	0.01	0.02	0.01	0.03	0.00	0.01	0.00	0.01	0.00	0.02	0.01
Pacitan_1	0.01	0.02	0.00	0.02	0.01	0.01	0.01	0.04	0.01	0.03	2.91
Pacitan_2	0.00	0.02	0.01	0.02	0.01	0.01	0.00	0.02	0.00	0.02	0.40
Pacitan_3	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.01	0.02	0.79
Pacitan_4	0.01	0.03	0.01	0.03	0.01	0.01	0.01	0.02	0.01	0.02	3.57
Pacitan_5	0.00	0.02	0.01	0.04	0.01	0.00	0.00	0.02	0.01	0.00	0.85
Pacitan_6	0.02	0.04	0.01	0.03	0.01	0.02	0.01	0.04	0.03	0.03	3.10
Pacitan_7	0.06	0.09	0.02	0.06	0.02	0.06	0.01	0.11	0.03	0.17	7.35
Pacitan_8	0.01	0.05	0.01	0.02	0.01	0.03	0.03	0.04	0.02	0.11	0.10
Pacitan_9	0.03	0.07	0.01	0.09	0.02	0.06	0.01	0.03	0.01	0.04	0.06

***Appendix 6.3: Standardized Canonical Discriminant Function
Coefficients for Scatterplots in Chapter 6 generated using Canonical
Discriminant Analysis***

Figure 6.19	<i>Function 1</i>	<i>Function 2</i>	<i>Function 3</i>
Ag	-0.718	0.145	-1.303
Al	-0.103	-1.058	-0.29
Ba	0.343	-0.145	-0.077
Be	-0.189	0.075	0.235
Bi	-0.641	0.161	0.364
Ce	0.7	-0.797	-0.675
Cs	-0.024	0.111	0.154
Cu	-0.142	-0.062	-0.851
La	-0.575	0.592	1.195
Li	0.197	0.106	0.652
Lu	0.229	-0.714	-0.599
Mg	-0.14	1.555	1.154
Na	-0.083	0.815	0.17
Ni	0.006	-1.077	1.577
Sb	0.006	-0.158	0.172
Sc	0.095	1.021	-0.799
Si	0.114	0.652	0.506
Sm	-0.086	0.327	-0.256
Sn	1.756	0.033	0.065
Ta	0.22	-0.472	0.999
Tb	-0.249	0.524	-0.187
Ti	-0.216	-0.623	-0.679
U	-0.232	0.386	0.351
V	0.139	-0.181	-0.162
W	0.23	-0.035	0.042
Yb	0.221	0.012	-0.234
Zr	-0.418	0.257	-0.274

Figure 6.20	<i>Function 1</i>	<i>Function 2</i>
Log Ag	0.37	0.585
Log Al	0.387	-0.561
Log Au	0.033	-0.393
Log B	0.055	0.132
Log Ba	-0.212	0.094
Log Bi	0.108	0.16
Log Co	0.065	0.858
Log Cs	0.032	-0.32
Log Dy	0.043	-0.205
Log Eu	-0.176	0.249
Log In	0.155	0.04
Log Li	-0.027	0.136
Log La	0.163	0.082
Log Mg	-0.239	0.614
Log Na	-0.145	0.748
Log Nd	0.033	-0.177
Log Ni	0.155	0.794
Log Pb	0.273	-0.416
Log Sb	0.049	-0.768
Log Sc	-0.181	-0.244
Log Si	0.017	0.597
Log Sn	-1.596	-0.086
Log Sr	-0.024	-0.503
Log Tb	-0.081	-0.204
Log Th	0.189	0.054
Log Ti	-0.062	0.196
Log Y	0.227	0.345
Log Zn	0.182	-0.18
Log Zr	0.221	-0.887

Figures 6.21 and 6.22	<i>Function 1</i>	<i>Function 2</i>
Log Ag	0.454	0.711
Log Al	0.328	-0.529
Log Au	-0.047	-0.334
Log B	0.044	0.148
Log Ba	-0.2	0.124
Log Bi	0.145	0.118
Log Co	0.031	0.863
Log Cs	-0.006	-0.405
Log Dy	0.083	-0.181
Log Eu	-0.072	0.282
Log In	0.153	-0.003
Log Li	-0.004	0.236
Log La	0.152	0.119
Log Mg	-0.101	0.387
Log Na	-0.098	0.658
Log Nd	-0.024	-0.173
Log Ni	0.004	0.845
Log Pb	0.285	-0.371
Log Sb	0.053	-0.813
Log Sc	-0.075	-0.248
Log Si	0.029	0.507
Log Sn	-1.557	-0.094
Log Sr	-0.016	-0.421
Log Tb	-0.131	-0.233
Log Th	0.189	0.01
Log Ti	-0.041	0.216
Log Y	0.163	0.36
Log Zn	0.116	-0.191
Log Zr	0.2	-0.903

Figure 6.23	<i>Function 1</i>	<i>Function 2</i>
Log Ag	-0.669	-0.113
Log Al	-0.578	-0.99
Log Au	-0.258	-0.814
Log B	-0.26	-0.016
Log Ba	0.365	0.034
Log Bi	-0.265	0.146
Log Ca	0.179	0.088
Log Co	0.246	-0.55
Log Cu	-0.104	0.135
Log Eu	0.152	0.318
Log In	0.046	0.55
Log La	0.025	-0.308
Log Li	0.482	-0.067
Log Mg	0.2	1.511
Log Na	0.101	1.098
Log Nd	-0.087	-0.095
Log Ni	-0.029	-0.788
Log Sc	0.17	0.592
Log Si	0.288	0.588
Log Sn	1.714	0.044
Log Sr	-0.127	-0.199
Log Th	-0.152	0.017
Log Tm	-0.178	0.099

Figure 6.26-6.28	<i>Function 1</i>	<i>Function 2</i>	<i>Function 3</i>
Log Ag	1.075	-0.648	0.149
Log Au	-0.03	0.178	-0.569
Log B	0.89	0.261	0.208
Log Ba	-1.386	-0.654	-2.06
Log Bi	-0.492	0.104	-0.594
Log Co	-0.239	-0.753	0.297
Log Mn	1.222	-0.441	-0.325
Log Mg	-1.953	-2.473	0.008
Log Pr	0.663	1.183	1.79
Log Rb	0.582	0.125	0.902
Log Si	0.678	0.076	1.329
Log Sr	1.336	2.476	1.522
Log Ti	-0.407	0.993	0.989
Log Tm	-0.458	0.178	-0.345
Log Y	1.156	-0.186	-1.335

Appendix 6.4: Determining elements to use in data analysis

As discussed in Chapter 4, each individual agate/carnelian sample was ablated at 10 different points on the sample and the results from these ablations were then averaged together to produce a single result. However, I discovered that many of the 55 elements were heterogeneously dispersed within the sample. This resulted in a high relative standard deviation (RSD) for the average of the ten ablations. Scholars have noted that the heterogeneous objects may be difficult to characterize using LA-ICP-MS (e.g. Roll et al. 2005:60). One way I hoped to overcome some of this difficulty was by analyzing numerous samples from a single source. This would allow for a better understanding of the variation within a single geological source.

Fortunately, it did not appear that the heterogeneity of agate and carnelian prevented me from obtaining meaningful results. Nevertheless, I did want a way to identify the elements that were less variable and which were more variable. For this reason, I selected four to five samples from each source, for a total of 62 samples, and looked more closely at the relative standard deviation produced during the ten point ablations. For each element I counted how many of the selected samples had an RSD between 0-10.99%, 11-20.99%, 21-30.99%, 31-40.99%, 41-50.99%, and over 50% (Table 6.4.1). Four elements B, Ca, Sc, and Ni, were the most homogeneously distributed, as at least 60% of the 62 geologic samples had an RSD of 10.5% or less for these elements. The elements Na, Sr, and Sb were also relatively homogeneous with over 60% of the geologic samples having an RSD of 20.5% or less. Lastly, I also included Be, Mg, K, Mn, Rb, Y, and Sn in the group of less variable elements, as over 60% of the geologic samples had an RSD of 30.5% or less. Other samples were more heterogeneously distributed, with the most variable elements being Au, Ta, Th, and W, which had over half of the geologic

samples with an RSD of 50.5% or more. Other elements that were commonly omitted due to a lack of data include Cl, As, Se, and P. These data is summarized in Table 6.4.2. While doing exploratory data analysis, I first focused on those elements I classified as being less variable. However, other more variable elements were also found to be important in distinguishing between sources and these were included in the statistical analyses discussed in Chapter 6 as well.

	0% or NA	0-10.5%	10.5- 20.5%	20.5- 30.5%	30.5- 40.5%	40.5- 50.5%	Over 50.5	Total
Ag	0	0	5	6	14	10	27	62
Al	0	9	11	10	14	6	12	62
As	20	1	4	3	5	8	21	62
Au	0	0	2	2	9	8	41	62
B	0	39	11	12	0	0	0	62
Ba	0	7	16	10	13	5	11	62
Be	0	10	24	18	8	1	1	62
Bi	0	0	5	17	11	8	21	62
Ca	0	38	17	5	2	0	0	62
Ce	0	7	10	15	3	13	14	62
Co	0	3	11	9	12	7	20	62
Cr	7	4	9	14	7	5	16	62
Cs	0	5	16	12	8	8	13	62
Cu	0	3	8	11	11	8	21	62
Dy	0	2	14	12	12	8	14	62
Er	2	3	11	16	11	7	12	62
Eu	0	0	9	12	11	9	21	62
Fe	6	9	12	10	5	5	15	62
Gd	0	0	8	14	17	6	17	62
Hf	0	0	7	8	12	6	29	62
Ho	0	2	12	12	9	10	17	62
In	0	0	1	9	14	9	29	62
K	0	14	19	8	9	5	7	62
La	0	5	12	13	10	11	11	62
Li	0	7	6	12	14	9	14	62
Lu	0	1	10	9	9	10	23	62
Mg	0	15	20	14	8	1	4	62
Mn	1	18	18	5	6	2	12	62
Mo	1	4	6	15	11	10	15	62
Na	0	26	22	7	2	4	1	62
Nb	3	5	10	12	9	5	18	62

	0% or NA	0-10.5%	10.5- 20.5%	20.5- 30.5%	30.5- 40.5%	40.5- 50.5%	Over 50.5	Total
Nd	0	4	12	13	12	9	12	62
Ni	0	41	14	4	3	0	0	62
P	18	3	5	8	6	1	21	62
Pb	0	1	6	14	15	11	15	62
Pr	0	3	8	15	14	8	14	62
Rb	0	13	17	15	6	4	7	62
Sb	0	21	18	14	5	2	2	62
Sc	0	53	5	3	1	0	0	62
Sm	0	1	10	13	11	9	18	62
Sn	0	11	24	13	8	3	3	62
Sr	0	18	20	11	5	2	6	62
Ta	2	2	0	4	10	5	39	62
Tb	0	0	12	16	6	10	18	62
Th	1	0	0	1	2	7	51	62
Ti	0	2	6	9	19	4	22	62
Tm	3	4	7	10	10	7	21	62
U	1	5	11	12	7	4	22	62
V	1	5	13	14	11	6	12	62
W	3	3	4	3	6	11	32	62
Y	0	11	19	11	8	1	12	62
Yb	0	4	11	15	10	5	17	62
Zn	0	4	9	17	10	9	13	62
Zr	0	4	10	14	11	8	15	62

Table 6.4.1: Number of geologic samples for which the RSD of each element was 0-10.99%, 11-20.99%, 21-30.99%, 31-40.99%, 41-50.99%, and over 50%.

Less Variable Elements			Variable Elements	Most Variable Elements
<i>60% of samples with an RSD under 10.5%</i>	<i>60% of samples with an RSD under 20.5%</i>	<i>60% of samples with an RSD under 30.5%</i>	<i>Samples with RSD between 30.5% and 50.5%</i>	<i>50% of samples with an RSD over 50.5%</i>
B, Ca, Ni, Sc	Na, Sb, Sr	Be, K, Mg, Mn, Rb, Sn, Y	Ag, Al, Ba, Bi, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Fe, Gd, Hf, Ho, In, La, Li, Lu, Mo, Nb, Nd, Pb, Pr, Sm, Tb, Ti, Tm, U, V, Yb, Zn, Zr	Au, Ta, Th, W

Table 6.4.2: A list of the less variable, variable, and most variable elements identified during LA-ICP-MS of agate and carnelian geologic samples. Based on the data in Table 6.4.1 above.

Appendix 6.5: Distinguishing between Agate and Carnelian Geologic Sources

Following LA-ICP-MS analysis, a series of bivariate plots and Canonical Discriminant Analyses (CDA) were used to identify elements that assisted in distinguishing between the various agate and carnelian geologic sources. Some sources were clearly distinct from the Deccan Trap agates and other geologic sources. For example, the Mahurjhari source samples were easily identifiable by the high levels of Sn (300-3400 ppm) (Figure 6.5.1). The Gia Lai samples were also notable for their high levels of Mg (approx 800-1200 ppm) and Ni (18-24ppm) (Figure 6.5.2). The Shahr-i-Sokhta samples had generally higher levels of U (0.2-34ppm) and B (21-118 ppm) but low Ni (0.38-1.37ppm) (Figure 6.5.3). Ban Khao Mogul is distinct from the other groups with slightly lower levels of B (.96-12ppm) and higher levels of Sb (0.5-15ppm) (Figure 6.5.4).

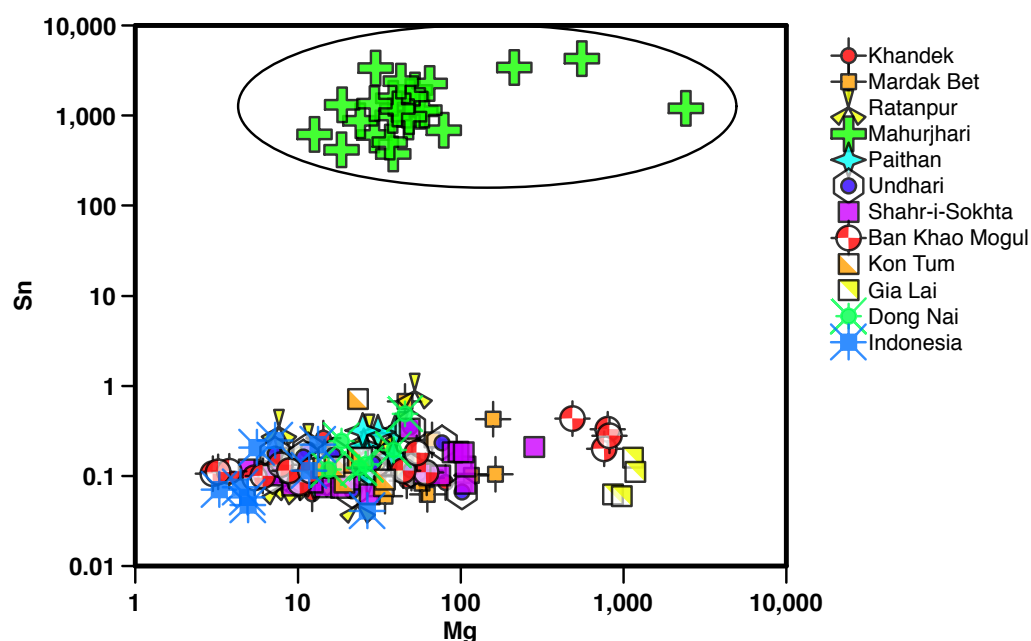


Figure 6.5.1: Bivariate scatterplot of Mg vs. Sn, showing the high levels of Sn in the Mahurjhari samples. Values in both axes have been $\log_{10}$ transformed.

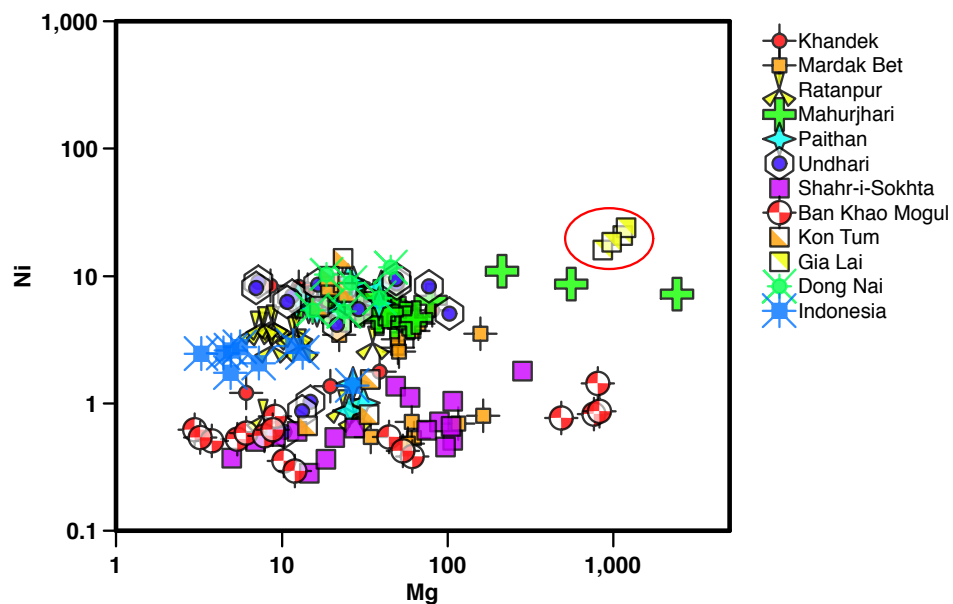


Figure 6.5.2: Bivariate scatterplot of Mg vs. Ni showing the high levels of both elements in the Gia Lai samples. Values in both axes have been $\log_{10}$ transformed.

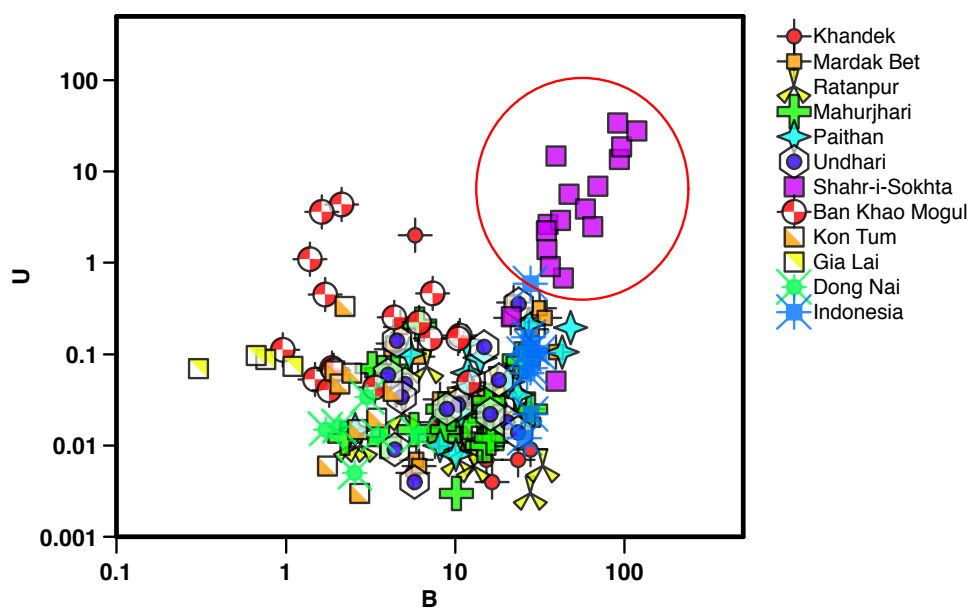


Figure 6.5.3: Bivariate scatterplot of B vs. U showing the high levels of both elements in the Shahr-i-Sokhta samples. Values in both axes have been $\log_{10}$ transformed.

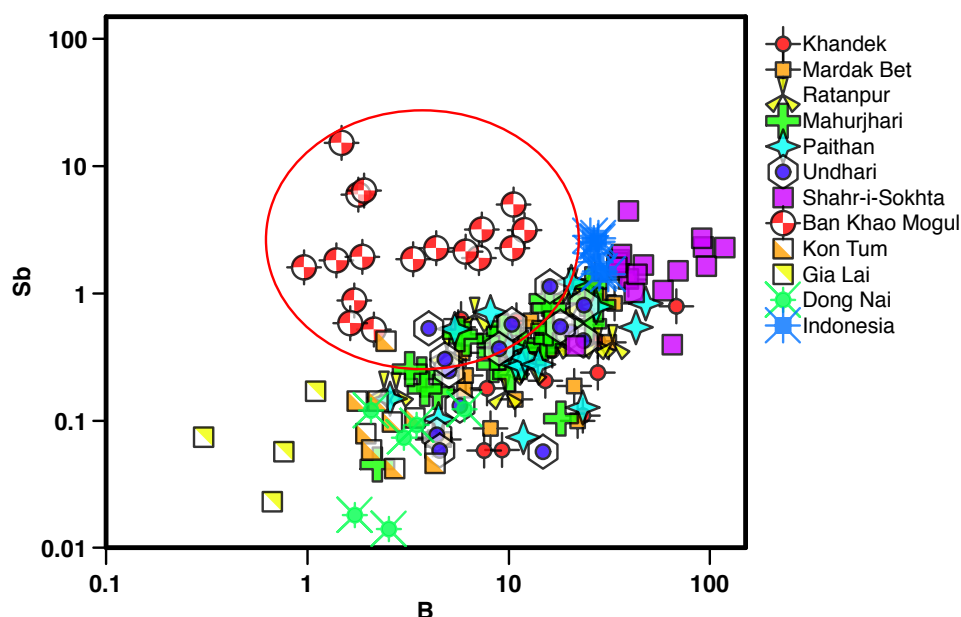


Figure 6.5.4: Bivariate scatterplot of B vs. Sb showing the high levels Sb and slightly lower levels of B in the Ban Khao Mogul samples. Values in both axes have been $\log_{10}$ transformed.

Although bivariate plotting was able to discriminate between some of the different geologic sources, there was also considerable overlap between the compositions of the different sources, especially those from the Deccan Traps. In order to better distinguish between these sources, a CDA was performed including all 12 of the geologic sources and using the elements: B, Be, Ca, Co, Cu, K, Mg, Mn, Na, Rb, Sb, Sc, Si, Sn, Sr, U, and Y. Figure 6.5.5 shows these sources plotted by their first and second discriminant function. Table 6.5.1 lists the standardized canonical discriminant function coefficients. The cross-validation rate for this analysis was 77.1%, a moderately good result as several of the Deccan Trap sources were misclassified with one another while the Kon Tum and Dong Nai sources were also misclassified with one another. However, the Gia Lai, Ban Khao Mogul, Shahr-i-Sokhta, Mahurjhari, and Indonesian sources appear to be compositionally distinct.

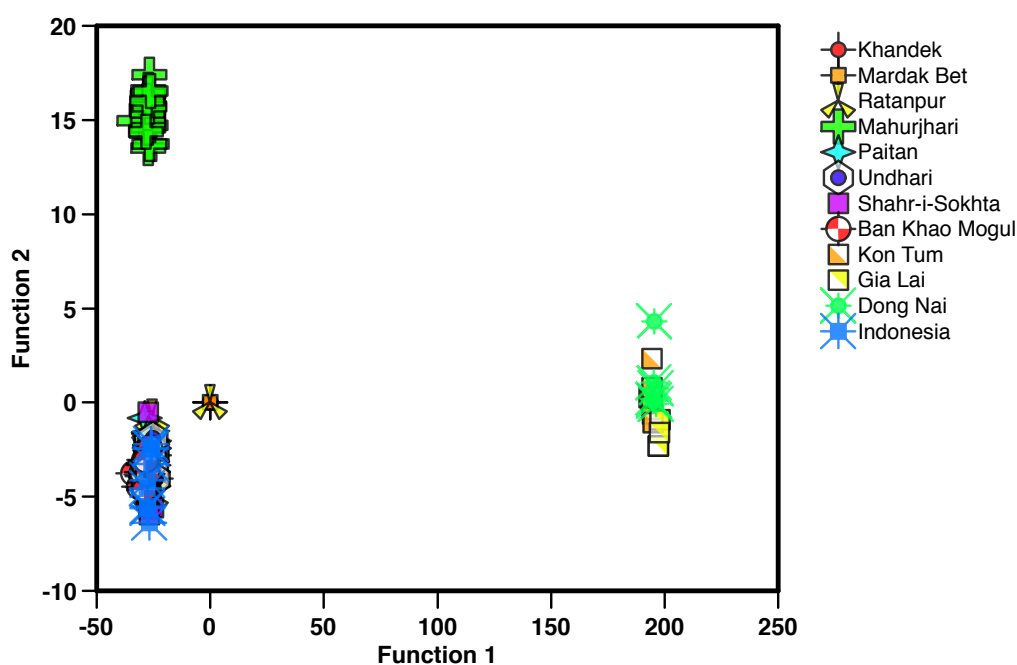


Figure 6.5.5: Geologic sources from South and Southeast Asia plotted by their first and second discriminant functions.

	Function 1	Function 2		Function 1	Function 2
Log B	-0.108	-0.032		Log Rb	0.277
Log Be	-0.102	-0.01		Log Sb	-0.218
Log Ca	0.256	0.027		Log Sc	0.057
Log Co	0.293	-0.269		Log Si	1.812
Log Cu	0.024	-0.139		Log Sn	-0.12
Log K	0.167	0.141		Log Sr	-0.268
Log Mg	0.497	-0.026		Log U	0.005
Log Mn	0.027	0.232		Log Y	0.525
Log Na	0.14	-0.163			

Table 6.5.1: Standardized canonical discriminant function coefficients generated using canonical discriminant analysis for Figure 6.5.5.

Due to the overlap between the Deccan Traps sources, a second CDA was performed in which all of the Deccan Trap agate sources with the exception of Mahurjhari were treated as a single source group. An excellent cross-validation rate of 96.2% was achieved (Figure 6.5.6 Table 6.5.2), confirming that the low cross-validation rate in the previous analysis was largely

due to overlap between the Deccan Trap sources. One Deccan Trap sample was classified as belonging to the Dong Nai source, four samples from Kon Tum were also misclassified as belonging to the Dong Nai sources as well as one additional sample that was classified with the Deccan Trap sources.

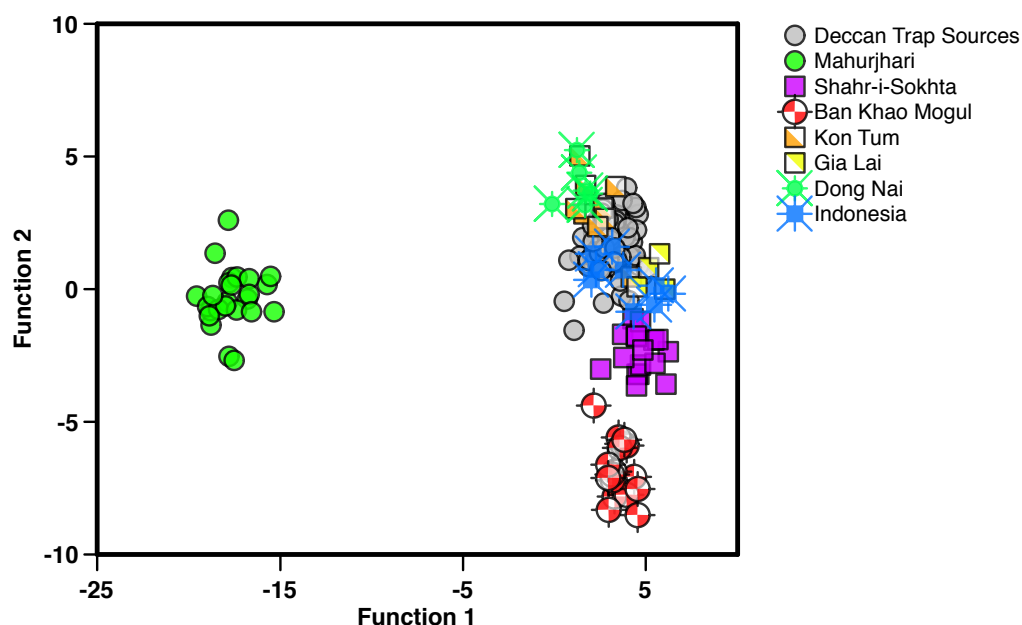


Figure 6.5.6: Results from a second CDA in which the Deccan Trap agate sources were treated as a single source. Sources are plotted by their first and second discriminant functions.

	Function 1	Function 2		Function 1	Function 2
Log Al	0.217	-0.094	Log Na	0.051	0.556
Log B	0.054	0.268	Log Rb	0.343	-0.061
Log Be	0.11	-0.156	Log Sb	0.233	-0.816
Log Ca	0.204	0.725	Log Sc	-0.014	-0.383
Log Co	0.254	0.374	Log Si	0.119	0.723
Log Cu	0.246	0.254	Log Sn	-1.317	-0.13
Log K	-0.242	-0.476	Log Sr	-0.139	-0.605
Log Mg	0.091	0.043	Log U	0.332	-0.421
Log Mn	-0.257	0.193	Log Y	0.034	0.67

Table 6.5.2: Standardized canonical discriminant function coefficients generated using canonical discriminant analysis for Figure 6.5.6

As noted above, the Dong Nai samples were purchased via an online gemstone dealer and I was told that the raw materials came from Dong Nai in southern Vietnam, but that they were worked in the city of Da Nang in central Vietnam. Although this may be true, the continued overlap between the Kon Tum and Dong Nai sources may indicate another story. Kon Tum province is geographically closer to Da Nang than Dong Nai and without further verification we must consider that the Dong Nai samples are not actually from this location and may in fact be from a source located in central Vietnam. However, this can only be demonstrated with further fieldwork, therefore I will continue to treat these two geologic sources as distinct from one another, despite their overlap.

It is not surprising that the agate and carnelian source samples from the Deccan Traps appear to be compositionally similar to one another. As noted in Chapter 6, the Deccan Traps are a massive geological formation and the sources sampled may belong to secondary deposits. Nevertheless, I was interested in determining if I could better differentiate between these sources and therefore focused my next phase of analysis on these samples alone. Three samples, Khandek 11, Khandek 14, and Mardak Bek¹² were removed due to missing values. CDA of the remaining source samples required a greater number of elements in order to achieve reasonable separation between the sources. The elements used in CDA were: Ag, Al, Au, B, Ba, Be, Bi, Ce, Co, Cu, Eu, Gd, In, La, Li, Lu, Mg, Mn, Na, Nb, Nd, Ni, Rb, Sc, Si, Sm, Sn, Sr, Ta, Tb, Th, Ti, U, V, W, Yb, Zn, and Zr. Despite this, the cross-validation rate between the sources was fairly low at 66.7% (Figure 6.5.7 and Table 6.5.3). With the exception of the Mahurjhari samples, all of the Deccan Trap agates overlapped (misclassified) with one another.

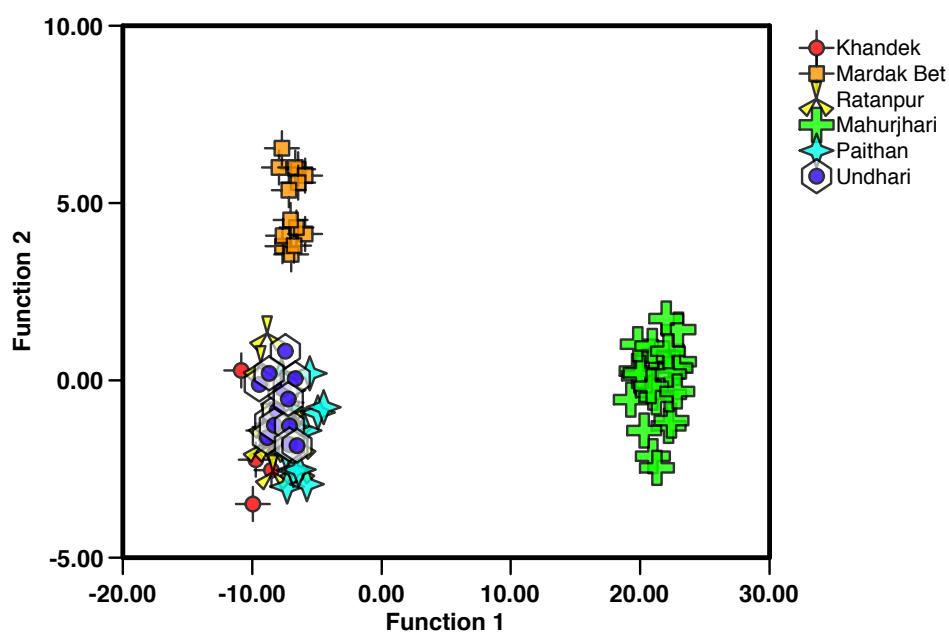


Figure 6.5.7: The Deccan Trap agate sources plotted by their first and second discriminant functions.

	Function 1	Function 2			Function 1	Function 2
Log Ag	-0.625	0.672		Log Nb	-0.127	-0.516
Log Al	-0.641	-0.903		Log Nd	0.167	-0.29
Log Au	-0.233	-0.893		Log Ni	-0.025	-0.998
Log B	0.009	-0.187		Log Rb	0.276	0.128
Log Ba	0.296	0.207		Log Sc	0.275	1.102
Log Be	-0.177	-0.196		Log Si	0.335	0.333
Log Bi	-0.307	0.453		Log Sm	-0.028	0.618
Log Ce	0.393	-0.04		Log Sn	1.954	0.021
Log Co	0.03	0.08		Log Sr	-0.221	-0.756
Log Cu	-0.291	0.322		Log Ta	0.218	-0.378
Log Eu	0.507	0.466		Log Tb	-0.457	-0.032
Log Gd	-0.185	0.033		Log Th	-0.31	-0.022
Log In	-0.035	0.371		Log Ti	-0.368	0.167
Log La	-0.323	-0.351		Log U	-0.137	0.597
Log Li	0.584	-0.027		Log V	-0.034	-0.336
Log Lu	0.154	-0.473		Log W	0.339	-0.145
Log Mg	0.315	1.547		Log Yb	-0.021	0.053
Log Mn	0.435	0.169		Log Zr	-0.465	0.054
Log Na	0.092	1.071		Log Zn	-0.325	-0.694

Table 6.5.3 Standardized canonical discriminant function coefficients generated using canonical discriminant analysis for Figure 6.5.7

I believe that overlap and misclassification of the Deccan Traps sources is not a limitation of LA-ICP-MS, but instead reflects the difficulty of distinguishing between the geochemically analogous Deccan Traps agate sources. I had hoped that the different sources would be compositionally distinct from one another, allowing for a more fine-grained analysis of agate exploitation over time and space. It is possible that analyses of additional samples from individual sources may increase the ability to distinguish between these sources. However for the remainder of this study I can only confidently determine if artifacts belonged or not to the broader Deccan Traps source group, and not the individual sources within this group.

Appendix 7.1: Glass bead data recorded as a part of this study

Glass beads were recorded in a FileMaker Pro database and are presented in table form here. Each site is reported in a separate table in order to accommodate the different context recording systems. In some cases, groups of glass beads were recorded individually. However, as the study progressed I found this was inefficient and began experimenting with the most efficient way to record groups of beads. I was prevented from recording the different glass bead types individually at Promptin Tai, due to time constraints. Therefore, some of the beads from this site within a single catalog number were recorded as a group, with measurements taken on certain beads as time allowed. The Ban Non Wat and Noen U-Loke beads make up several tables. One table includes beads from Noen U-Loke that are currently held in the Phimai museum, some of which no longer have contextual information. Beads from Ban Non Wat that are currently in storage with Dr. Rachanie Thosarat were also recorded quickly within a single afternoon. For this reason, only bead color, quantity, context, and shape were recorded and presented in a table here. Beads from Ban Non Wat and Noen U-Loke that were analyzed using LA-ICP-MS were recorded more carefully into a FileMaker Pro database and this information is presented in a separate table.

The glass bead recording system was recently updated in order to quickly and easily record glass beads from Angkor Borei. With the assistance from Juliana Johnson, a volunteer high-school student from Shabazz High School, Madison WI, beads were entered into the database by sorting them into general color and size categories. Roundness was not recorded, as this line of evidence did not appear to be significant, except when discussing beads that had unrounded edges (see Chapter 7). In the course of recording glass beads for this study, I

found that most Indo-Pacific beads had approximately the same length as width measurements, making them roughly spherical or oblate, or had a smaller (thinner) length than width. Beads that were longer, or barrel or tubular shaped were more unusual. For this reason size categories for the beads were determined by comparing the bead widths to a bead size chart that contained circles of different sizes (Figure 7.1.1). Measurements for tubular or barrel shaped beads were taken separately and noted in the “Notes” section of the FileMaker Pro database. This method has provided the quickest and most efficient way to record large groups of glass beads thus far, and will likely be used in future studies of glass beads. All measurements in the following tables are in millimeters.

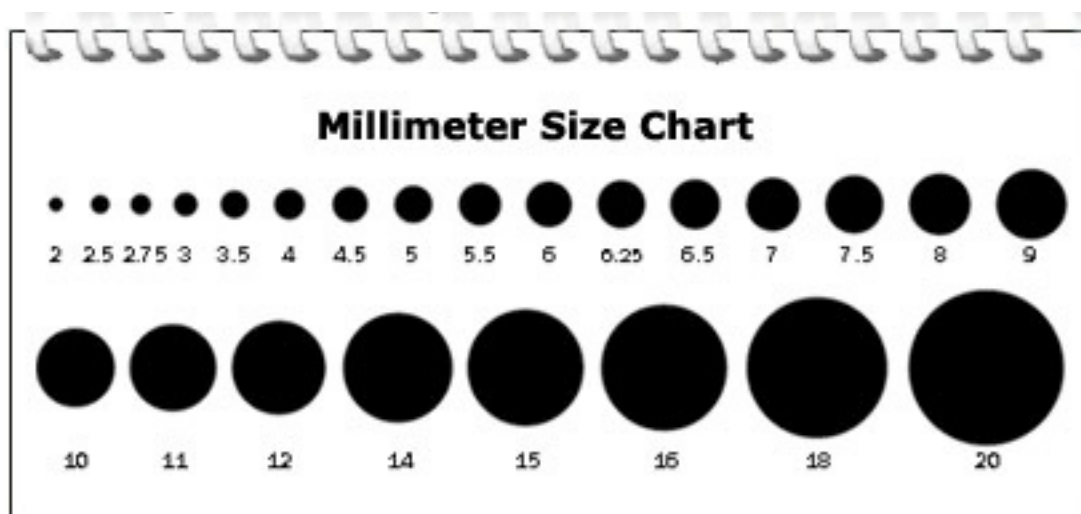


Figure 7.1.1: Millimeter size chart used to record Indo-Pacific beads of different sizes. Taken from <http://www.kmversteeg.com/edtec541/final/size.htm>

Appendix 7.1a: Glass Beads from Angkor Borei

Database ID	Site Name	Catalogue Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02501	Angkor Borei	1278	Indo-Pacific	11	AB7	2	5	11		1	Opaque Orange	3	With red stripes. Also found with stone bead (AKC03044)
AKC02501	Angkor Borei	1278	Indo-Pacific	11	AB7	2	5	11		1	Opaque Orange	3	
AKC02501	Angkor Borei	1278	Indo-Pacific	11	AB7	2	5	11		1	Opaque Red	4.5	
AKC02501	Angkor Borei	1278	Indo-Pacific	11	AB7	2	5	11		1	Opaque Red	2.5	
AKC02501	Angkor Borei	1278	Indo-Pacific	11	AB7	2	5	11		1	Opaque Red	3.5	
AKC02501	Angkor Borei	1278	Indo-Pacific	11	AB7	2	5	11		1	Opaque Red	2.5	6.46 mm long
AKC02501	Angkor Borei	1278	Indo-Pacific	11	AB7	2	5	11		1	Opaque Red	2.5	4.16mm long, with dark stripes
AKC02501	Angkor Borei	1278	Indo-Pacific	11	AB7	2	5	11		1	Opaque Light Blue	5	
AKC02501	Angkor Borei	1278	Indo-Pacific	11	AB7	2	5	11		1	Opaque Dark Green	6.5	
AKC02501	Angkor Borei	1278	Indo-Pacific	11	AB7	2	5	11		1	Opaque Dark Green	5.5	

Database ID	Site Name	Catalogue Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02501	Angkor Borei	1278	Indo-Pacific	11	AB7	2	5	11		1	Opaque Light Green	4.5	
AKC02502	Angkor Borei	2481	Indo-Pacific	9	AB7	2S	7	22		1	Opaque Yellow	4	
AKC02502	Angkor Borei	2481	Indo-Pacific	9	AB7	2S	7	22		1	Opaque Yellow	4	
AKC02502	Angkor Borei	2481	Indo-Pacific	9	AB7	2S	7	22		1	Opaque Yellow	3.5	
AKC02502	Angkor Borei	2481	Indo-Pacific	9	AB7	2S	7	22		5	Opaque Yellow	3	
AKC02502	Angkor Borei	2481	Indo-Pacific	9	AB7	2S	7	22		1	Opaque Yellow	2.5	2.93 mm long
AKC02504	Angkor Borei	2575	Indo-Pacific	2	AB7	2S	7	23		1	Opaque Dark Blue	5.5	see also: AKC03043 and AKC03042
AKC02504	Angkor Borei	2575	Indo-Pacific	2	AB7	2S	7	23		1	Opaque Dark Blue	5.5	
AKC02505	Angkor Borei	1675	Indo-Pacific	4	AB7	2N	7	20		1	Opaque Yellow	5.5	
AKC02505	Angkor Borei	1675	Indo-Pacific	4	AB7	2N	7	20		1	Opaque Yellow	4.5	
AKC02505	Angkor Borei	1675	Indo-Pacific	4	AB7	2N	7	20		1	Opaque Red	2	

Database ID	Site Name	Catalogue Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02505	Angkor Borei	1675	Indo-Pacific	4	AB7	2N	7	20		1	Opaque Dark Green	3	
AKC02506	Angkor Borei	1649	Indo-Pacific	10	Ab7	2S	7	20		1	Opaque Dark Blue	4.5	
AKC02506	Angkor Borei	1649	Indo-Pacific	10	Ab7	2S	7	20		1	Opaque Black	2	
AKC02506	Angkor Borei	1649	Indo-Pacific	10	Ab7	2S	7	20		1	Opaque Yellow	3	
AKC02506	Angkor Borei	1649	Indo-Pacific	10	Ab7	2S	7	20		1	Opaque Yellow	2.5	
AKC02506	Angkor Borei	1649	Indo-Pacific	10	Ab7	2S	7	20		1	Opaque Yellow	4	
AKC02506	Angkor Borei	1649	Indo-Pacific	10	Ab7	2S	7	20		1	Opaque Yellow	3.5	
AKC02507	Angkor Borei	1574	Indo-Pacific	8	AB7	2S	7	19		1	Opaque Light Green	2	
AKC02507	Angkor Borei	1574	Indo-Pacific	8	AB7	2S	7	19		1	Opaque Light Blue	3.5	
AKC02507	Angkor Borei	1574	Indo-Pacific	8	AB7	2S	7	19		1	Opaque Yellow	3.5	
AKC02507	Angkor Borei	1574	Indo-Pacific	8	AB7	2S	7	19		1	Opaque Red	2	
AKC02507	Angkor Borei	1574	Indo-Pacific	8	AB7	2S	7	19		1	Opaque Yellow	2.5	

Database ID	Site Name	Catalogue Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02507	Angkor Borei	1574	Indo-Pacific	8	AB7	2S	7	19		1	Opaque Yellow	3	
AKC02507	Angkor Borei	1574	Indo-Pacific	8	AB7	2S	7	19		1	Opaque Yellow	3.5	3.38 mm long
AKC02507	Angkor Borei	1574	Indo-Pacific	8	AB7	2S	7	19		1	Opaque Yellow	3.5	3.38 mm long
AKC02507	Angkor Borei	1574	Indo-Pacific	8	AB7	2S	7	19		1	Opaque Yellow	3.5	
AKC02510	Angkor Borei	2791	Indo-Pacific?	186	AB7	2N/3N	7	23	F36	9	Opaque Black	<2	
AKC02510	Angkor Borei	2791	Indo-Pacific?	186	AB7	2N/3N	7	23	F36	1	Purple	<2	
AKC02510	Angkor Borei	2791	Indo-Pacific?	186	AB7	2N/3N	7	23	F36	3	Purple	<2	Segmented beads
AKC02510	Angkor Borei	2791	Indo-Pacific?	186	AB7	2N/3N	7	23	F36	21	Opaque Light Green	<2	
AKC02510	Angkor Borei	2791	Indo-Pacific?	186	AB7	2N/3N	7	23	F36	115	Opaque Orange	<2	
AKC02510	Angkor Borei	2791	Indo-Pacific?	186	AB7	2N/3N	7	23	F36	9	Opaque Black	<2	
AKC02511	Angkor Borei	1242	Indo-Pacific	10	AB7	2	5	10		1	Opaque Yellow		Fragments
AKC02511	Angkor Borei	1242	Indo-Pacific	10	AB7	2	5	10		1	Opaque Light Green		Fragments

Database ID	Site Name	Catalogue Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02511	Angkor Borei	1242	Indo-Pacific	10	AB7	2	5	10		1	Opaque Light Green	4.5	
AKC02511	Angkor Borei	1242	Indo-Pacific	10	AB7	2	5	10		1	Opaque Dark Green	5	
AKC02511	Angkor Borei	1242	Indo-Pacific	10	AB7	2	5	10		1	Opaque Light Green	3	
AKC02511	Angkor Borei	1242	Indo-Pacific	10	AB7	2	5	10		1	Opaque Dark Green	6.5	Dark streaks in glass
AKC02511	Angkor Borei	1242	Indo-Pacific	10	AB7	2	5	10		1	Trans/Semi-Trans Light Blue	2	
AKC02511	Angkor Borei	1242	Indo-Pacific	10	AB7	2	5	10		1	Translucent Dark Blue	3	
AKC02511	Angkor Borei	1242	Indo-Pacific	10	AB7	2	5	10		1	Opaque Red	3	
AKC02513	Angkor Borei	1277	Indo-Pacific	2	AB7	2	5	11		1	Opaque Light Blue	4	
AKC02513	Angkor Borei	1277	Indo-Pacific	2	AB7	2	5	11		1	Opaque Dark Green	4.5	
AKC02514	Angkor Borei	1468	Indo-Pacific	2	AB7	2S	7	17		1	Trans/Semi-Trans Light Blue	3	4.44 mm long

Database ID	Site Name	Catalogue Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02514	Angkor Borei	1468	Indo-Pacific	2	AB7	2S	7	17		1	Opaque Yellow	3.5	
AKC02515	Angkor Borei	1375	Indo-Pacific	5	AB7	2	6	14		1	Translucent Dark Blue	4	2 additional pieces of stone/unknown material? not measured.
AKC02515	Angkor Borei	1375	Indo-Pacific	5	AB7	2	6	14		1	Opaque Red	2	
AKC02515	Angkor Borei	1375	Indo-Pacific	5	AB7	2	6	14		1	Trans/Semi-Trans Light Blue	2	
AKC02515	Angkor Borei	1375	Indo-Pacific	5	AB7	2	6	14		1	Opaque Light Green	3.5	
AKC02515	Angkor Borei	1375	Indo-Pacific	5	AB7	2	6	14		1	Opaque Red	5	6.90 mm long
AKC02516	Angkor Borei	2794	Indo-Pacific	23	AB7	2N/3N	7	23	F36	10	Opaque Light Green	2	Also included 3 tooth pendants
AKC02516	Angkor Borei	2794	Indo-Pacific	23	AB7	2N/3N	7	23	F36	2	Opaque Black	2	
AKC02516	Angkor Borei	2794	Indo-Pacific	23	AB7	2N/3N	7	23	F36	1	Opaque Orange	3	Dark streaks in orange bead
AKC02516	Angkor Borei	2794	Indo-Pacific	23	AB7	2N/3N	7	23	F36	3	Opaque Red	2	
AKC02516	Angkor Borei	2794	Indo-Pacific	23	AB7	2N/3N	7	23	F36	6	Opaque Orange	2	

Database ID	Site Name	Catalogue Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02516	Angkor Borei	2794	Indo-Pacific	23	AB7	2N/3N	7	23	F36	1	White/Cream	2	
AKC02517	Angkor Borei	1507	Indo-Pacific	1	AB7	2	7	17		1	Opaque Yellow	3	
AKC02518	Angkor Borei	1181	Indo-Pacific	7	AB7	2	5	8		1	Opaque Yellow	4	Also found with one copper bead
AKC02518	Angkor Borei	1181	Indo-Pacific	7	AB7	2	5	8		1	Opaque Dark Blue	3.5	
AKC02518	Angkor Borei	1181	Indo-Pacific	7	AB7	2	5	8		1	Opaque Light Green		Fragments
AKC02518	Angkor Borei	1181	Indo-Pacific	7	AB7	2	5	8		1	Opaque Red	2.5	
AKC02518	Angkor Borei	1181	Indo-Pacific	7	AB7	2	5	8		1	Opaque Red	3.5	
AKC02518	Angkor Borei	1181	Indo-Pacific	7	AB7	2	5	8		1	Opaque Light Blue	3.5	
AKC02518	Angkor Borei	1181	Indo-Pacific	7	AB7	2	5	8		1	Black w/ multiple stripes	5.5	Has both red and green stripes (Indo-Pacific bead). One copper bead not recorded
AKC02519	Angkor Borei	1255	Indo-Pacific?	1	AB7	3	5	10		1	Translucent Yellow	7	

Database ID	Site Name	Catalogue Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02520	Angkor Borei	1768	Indo-Pacific	5	AB7	2S	7	21		1	Opaque Dark Green	2.5	
AKC02520	Angkor Borei	1768	Indo-Pacific	5	AB7	2S	7	21		2	Opaque Yellow	3.5	
AKC02520	Angkor Borei	1768	Indo-Pacific	5	AB7	2S	7	21		1	Opaque Yellow	3	
AKC02520	Angkor Borei	1768	Indo-Pacific	5	AB7	2S	7	21		1	Opaque Yellow	3	3.41 mm long
AKC02521	Angkor Borei	2494	Indo-Pacific	7	AB7	2N	7	22		6	Opaque Yellow	<2	Brighter yellow color than other bead
AKC02521	Angkor Borei	2494	Indo-Pacific	7	AB7	2N	7	22		1	Opaque Yellow	3.5	
AKC02522	Angkor Borei	1346	Indo-Pacific	3	AB7	2	5	13		1	Opaque Yellow	3.5	
AKC02522	Angkor Borei	1346	Indo-Pacific	3	AB7	2	5	13		1	Opaque Red	3	
AKC02522	Angkor Borei	1346	Indo-Pacific	3	AB7	2	5	13		1	Opaque Light Green	3	

Database ID	Site Name	Catalogue Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02523	Angkor Borei	1635	Indo-Pacific	45	AB7	2N	7	19	F5	43	White/Cream	<2	
AKC02523	Angkor Borei	1635	Indo-Pacific	45	AB7	2N	7	19	F5	1	Opaque Red	<2	
AKC02523	Angkor Borei	1635	Indo-Pacific	45	AB7	2N	7	19	F5	1	Opaque Orange	<2	
AKC02524	Angkor Borei	2563	Indo-Pacific	16	AB7	2S	7	23		5	Opaque Yellow	3	
AKC02524	Angkor Borei	2563	Indo-Pacific	16	AB7	2S	7	23		3	Opaque Yellow	2.5	
AKC02524	Angkor Borei	2563	Indo-Pacific	16	AB7	2S	7	23		5	Opaque Red	<2	
AKC02524	Angkor Borei	2563	Indo-Pacific	16	AB7	2S	7	23		1	Opaque Orange	2	
AKC02524	Angkor Borei	2563	Indo-Pacific	16	AB7	2S	7	23		1	Opaque Light Green	2	
AKC02524	Angkor Borei	2563	Indo-Pacific	16	AB7	2S	7	23		1	Opaque Red	3	4.66 mm long
AKC02525	Angkor Borei	1541	Indo-Pacific	1	AB7	2N	7	18		1	Opaque Yellow	4	
AKC02526	Angkor Borei	1049	Indo-Pacific	1	AB7	2	2	4		1	Opaque Light Green	4.5	
AKC02527	Angkor Borei	2782		2	AB7	2n/3n	7	23	F36	1	Opaque Red	<2	

Database ID	Site Name	Catalogue Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02527	Angkor Borei	2782		2	AB7	2n/3n	7	23	F36	1	Opaque Light Green	2	
AKC02528	Angkor Borei	1770	Indo-Pacific	4	AB7	2S	7	21		1	Opaque Yellow	5	
AKC02528	Angkor Borei	1770	Indo-Pacific	4	AB7	2S	7	21		1	Opaque Yellow	3	
AKC02528	Angkor Borei	1770	Indo-Pacific	4	AB7	2S	7	21		1	Opaque Yellow	3.5	3.55 mm long
AKC02528	Angkor Borei	1770	Indo-Pacific	4	AB7	2S	7	21		1	Opaque Yellow	3.5	4.12 mm long
AKC02529	Angkor Borei	2634		6	AB7	2N	7	23	F22	1	Opaque Red	3	4.18 mm long
AKC02529	Angkor Borei	2634		6	AB7	2N	7	23	F22	5	Opaque Orange	2	
AKC02530	Angkor Borei	1205	Indo-Pacific	1	AB7	2	5	9		1	Trans/Semi-Trans Light Blue	3	
AKC02531	Angkor Borei	1152	Indo-Pacific	2	AB7	2	5	7		1	Opaque Orange	5	Dark streaks in glass
AKC02531	Angkor Borei	1152	Indo-Pacific	2	AB7	2	5	7		1	Opaque Orange	6	Dark streaks in glass
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		3	Translucent Dark Blue	4	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		2	Translucent Dark Blue	3.5	
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		1	Trans/Semi-Trans Light Blue	3	
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		5	Translucent Dark Blue	4	
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		1	Opaque Yellow	5	
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		3	Opaque Yellow	4	
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		14	Opaque Red	3.5	
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		1	Opaque Red	5	
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		3	Opaque Red	4.5	
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		2	Opaque Red	3.5	
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		1	Opaque Red	<2	
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		2	Opaque Light Green	3.5	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		3	Trans/Semi-Trans Light Blue	4	
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		1	Trans/Semi-Trans Light Blue	5	6.88 mm long
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		1	Trans/Semi-Trans Light Blue	3	
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		1	Trans/Semi-Trans Light Blue	5	
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		1	Translucent Dark Blue	2	
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		1	Opaque Red	2	10.09
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		2	Opaque Red	3.5	
AKC02533 AKC02534	Angkor Borei	1314	Indo-Pacific	49	AB7	2	5	12		1	Translucent Dark Blue	4.5	
AKC02535	Angkor Borei	1710	Indo-Pacific	1	AB7	2S	7	20	F1	1	Opaque Yellow	3	
AKC02536	Angkor Borei	1491	Indo-Pacific	1	AB7	2n	7	17	F1	1	Opaque Red	2	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02537	Angkor Borei	1545	Indo-Pacific	1	AB7	2S	7	18		1	Opaque Red		half fragment
AKC02538	Angkor Borei	1345	Indo-Pacific	1	AB7	2	5	13		1	Opaque Red	3.5	
AKC02539	Angkor Borei	1080	Indo-Pacific	2	AB7	1	3	5		1	Opaque Light Green	3	
AKC02539	Angkor Borei	1080	Indo-Pacific	2	AB7	1	3	5		1	Opaque Red	4	
AKC02540	Angkor Borei	1569	Indo-Pacific	2	AB7	2N	7	19		1	Opaque Yellow		fragments
AKC02540	Angkor Borei	1569	Indo-Pacific	2	AB7	2N	7	19		1	Opaque Red	4	
AKC02541	Angkor Borei	1523	Indo-Pacific	3	AB7	2n	7	17	F1	1	Opaque Yellow	4	1 small piece of clay also found with these beads.
AKC02541	Angkor Borei	1523	Indo-Pacific	3	AB7	2n	7	17	F1	1	Opaque Yellow	3	
AKC02541	Angkor Borei	1523	Indo-Pacific	3	AB7	2n	7	17	F1	1	Opaque Orange	<2	
AKC02542	Angkor Borei	2819	Fragments	0	AB7	2/3S	7	28	F37	N/A	N/A	N/A	Fragments
AKC02543	Angkor Borei	2766	Indo-Pacific	8	AB7	2S	7	23	F37	1	Opaque Black	5	Slag? L: 7.47 W:5.06 AB106N
AKC02543	Angkor Borei	2766	Indo-Pacific	8	AB7	2S	7	23	F37	1	Opaque Yellow	2	AB107J

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02543	Angkor Borei	2766	Indo-Pacific	8	AB7	2S	7	23	F37	1	Opaque Green-Yellow	3	AB108V
AKC02543	Angkor Borei	2766	Indo-Pacific	8	AB7	2S	7	23	F37	1	Opaque Red	<2	AB109R
AKC02543	Angkor Borei	2766	Indo-Pacific	8	AB7	2S	7	23	F37	2	Opaque Red	2	
AKC02543	Angkor Borei	2766	Indo-Pacific	8	AB7	2S	7	23	F37	2	Opaque Yellow	2	
AKC02545	Angkor Borei	2451	Indo-Pacific	1	AB7	1N			F31	1	Opaque Black	3	Found with bone tooth pendant
AKC02546	Angkor Borei	3151	Indo-Pacific	1	AB7	3/4			F43b	1	Opaque Light Green	3	
AKC02547	Angkor Borei	2880	Indo-Pacific	2	AB7	3S	7	24	F39	1	Opaque Orange		
AKC02547	Angkor Borei	2880	Indo-Pacific	2	AB7	3S	7	24	F39	1	Opaque Yellow	2	
AKC02548	Angkor Borei	2385	Indo-Pacific	1	AB7	3S	7	21	F26	1	Opaque Light Green	4	Large hole
AKC02549	Angkor Borei	3199	Spherical	81	AB7	5S/4S	8	28	F44	35	Opaque Black	2	a few are slightly less than 2mm
AKC02549	Angkor Borei	3199	Spherical	81	AB7	5S/4S	8	28	F44	46	Opaque Orange	<2	Also found with 10 gold beads (approx 2mm)

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02550	Angkor Borei	2913	Indo-Pacific	2	AB7	3S	7	24	F39	1	Trans/Semi-Trans Light Blue	4	
AKC02550	Angkor Borei	2913	Indo-Pacific	2	AB7	3S	7	24	F39	1	Opaque Light Green	2	
AKC02551	Angkor Borei	2731	Indo-Pacific	1	AB7	5S	5	23	F30	1	Opaque Yellow	3	AB099J
AKC02552	Angkor Borei	3391	Indo-Pacific	1	AB7	5N	5	26	F52	1	Opaque Light Green		Fragments
AKC02553	Angkor Borei	2753	Indo-Pacific	1	AB7	3N			F20	1	Opaque Yellow	2.5	
AKC02554	Angkor Borei	2414	Indo-Pacific	1	AB7	4N			F25	1	Opaque Orange	2	Unrounded edges
AKC02555	Angkor Borei	1863	Indo-Pacific	1	AB7	1	7	19	F17	1	Opaque Dark Blue	2	
AKC02556	Angkor Borei	1797	Indo-Pacific	2	AB7	1N	7	19	F3	1	Opaque Light Green	2.5	weathered, minty green
AKC02556	Angkor Borei	1797	Indo-Pacific	2	AB7	1N	7	19	F3	1	Opaque Orange	2	
AKC02557	Angkor Borei	1701	Indo-Pacific	3	AB7	3N	7	20	F8	1	Opaque Red	2	
AKC02557	Angkor Borei	1701	Indo-Pacific	3	AB7	3N	7	20	F8	1	Opaque Orange	2	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02557	Angkor Borei	1701	Indo-Pacific	3	AB7	3N	7	20	F8	1	Opaque Black	2	
AKC02558	Angkor Borei	2910	Indo-Pacific	1	AB7	3S			F39	1	Blue-Green	2	L: 8.11 (opaque)
AKC02559	Angkor Borei	3138	Short Barrel	1	AB7	5S/4S	5	24	F44	1	Opaque Dark Green	9	L: 6.95 W:9.35 AB118V
AKC02560	Angkor Borei	1552	Indo-Pacific	1	AB7	1S	7	17	F11	1	Opaque Red	3	AB079R
AKC02561	Angkor Borei	1807	Indo-Pacific	1	AB7	1N	7	19	F2	1	Opaque Yellow	2	
AKC02562	Angkor Borei	1606	Indo-Pacific	1	AB7	1S	7	18	F4	1	Opaque Orange	2	
AKC02563	Angkor Borei	3092	Indo-Pacific	1	AB7	3/4S	7	25	F43a	1	Opaque Orange	2	
AKC02564	Angkor Borei	3065	Indo-Pacific	1	AB7	4N	5	26	F42	1	Opaque Red	2	L:8.22
AKC02565	Angkor Borei	1677	Indo-Pacific	1	AB7	3N	7	20	F8	1	Trans/Semi-Trans Light Blue	<2	
AKC02566	Angkor Borei	2363	Indo-Pacific	4	AB7	4S	5	22	F10	2	Opaque Yellow	2	See also other beads from F10 in Tag 2373
AKC02566	Angkor Borei	2363	Indo-Pacific	4	AB7	4S	5	22	F10	2	2	Opaque Light Green	2

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02567	Angkor Borei	2373	Indo-Pacific	5	AB7				F10	3	Red/Orange	<2	Other beads from F10 in Tag 2363
AKC02567	Angkor Borei	2373	Indo-Pacific	5	AB7				F10	2	Opaque Yellow	2.5	
AKC02568	Angkor Borei	1872	Indo-Pacific	5	AB7	1S	7	19	F4	4	Opaque Light Green	2	
AKC02568	Angkor Borei	1872	Indo-Pacific	5	AB7	1S	7	19	F4	1	Opaque Light Green	<2	
AKC02569	Angkor Borei	1875	Indo-Pacific	2	AB7	1S	7	19	F4	1	Opaque Light Green	2	
AKC02569	Angkor Borei	1875	Indo-Pacific	2	AB7	1S	7	19	F4	1	White/Cream		slag? Opaque
AKC02570	Angkor Borei	1828	Indo-Pacific	4	AB7	3N	7	23	F20	4	Opaque Yellow	2.5	One bead broken
AKC02571	Angkor Borei	2920	Indo-Pacific	9	AB7	3S	7	24	F39	2	Red/Orange	<2	
AKC02571	Angkor Borei	2920	Indo-Pacific	9	AB7	3S	7	24	F39	4	Opaque Light Green	<2	
AKC02571	Angkor Borei	2920	Indo-Pacific	9	AB7	3S	7	24	F39	1	Opaque Light Green	2	Also found with 2 gold beads (<2mm)
AKC02572	Angkor Borei	2511	Indo-Pacific	32	AB7	4S	5	23	F27	24	Opaque Light Green	2	plus numerous broken frags

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02572	Angkor Borei	2511	Indo-Pacific	32	AB7	4S	5	23	F27	1	Opaque Yellow	5.5	L:3.33
AKC02572	Angkor Borei	2511	Indo-Pacific	32	AB7	4S	5	23	F27	1	Opaque Black	3	
AKC02572	Angkor Borei	2511	Indo-Pacific	32	AB7	4S	5	23	F27	1	Opaque Yellow	6	L:3.41 AB087J
AKC02572	Angkor Borei	2511	Indo-Pacific	32	AB7	4S	5	23	F27	1	Opaque Yellow	5	L: 4.07 AB088J
AKC02572	Angkor Borei	2511	Indo-Pacific	32	AB7	4S	5	23	F27	1	Opaque Orange	4.5	L: 4.71 AB089O
AKC02572	Angkor Borei	2511	Indo-Pacific	32	AB7	4S	5	23	F27	1	Opaque Orange	5	
AKC02572	Angkor Borei	2511	Indo-Pacific	32	AB7	4S	5	23	F27	1	Opaque Yellow	6	
AKC02572	Angkor Borei	2511	Indo-Pacific	32	AB7	4S	5	23	F27	1	Opaque Light Green	2	plus numerous broken frags
AKC02573	Angkor Borei	1700	Indo-Pacific	25	AB7	3N	7	20	F8	1	Opaque Black	2	
AKC02573	Angkor Borei	1700	Indo-Pacific	25	AB7	3N	7	20	F8	2	Opaque Light Green	2	
AKC02573	Angkor Borei	1700	Indo-Pacific	25	AB7	3N	7	20	F8	4	Opaque Light Green	<2	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02573	Angkor Borei	1700	Indo-Pacific	25	AB7	3N	7	20	F8	12	Opaque Orange	<2	
AKC02573	Angkor Borei	1700	Indo-Pacific	25	AB7	3N	7	20	F8	6	Opaque Red	<2	
AKC02574 AKC02575	Angkor Borei	2732	Indo-Pacific	213	AB7	4S	5	24	F35	1	Opaque Red	5	L: 4.42 AB103R
AKC02574 AKC02575	Angkor Borei	2732	Indo-Pacific	213	AB7	4S	5	24	F35	1	Opaque Light Green	2	AB101V
AKC02574 AKC02575	Angkor Borei	2732	Indo-Pacific	213	AB7	4S	5	24	F35	1	Opaque Light Green	2	AB100V
AKC02574 AKC02575	Angkor Borei	2732	Indo-Pacific	213	AB7	4S	5	24	F35	1	Opaque Orange	4	AB102O
AKC02574 AKC02575	Angkor Borei	2732	Indo-Pacific	213	AB7	4S	5	24	F35	1	Opaque Red		broken
AKC02574 AKC02575	Angkor Borei	2732	Indo-Pacific	213	AB7	4S	5	24	F35	1	Opaque Light Green		broken
AKC02574 AKC02575	Angkor Borei	2732	Indo-Pacific	213	AB7	4S	5	24	F35	2	Opaque Yellow	4.5	
AKC02574 AKC02575	Angkor Borei	2732	Indo-Pacific	213	AB7	4S	5	24	F35	1	Opaque Yellow	4	
AKC02574 AKC02575	Angkor Borei	2732	Indo-Pacific	213	AB7	4S	5	24	F35	16	Opaque Orange	3	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02574 AKC02575	Angkor Borei	2732	Indo-Pacific	213	AB7	4S	5	24	F35	5	Opaque Red	3.5	
AKC02574 AKC02575	Angkor Borei	2732	Indo-Pacific	213	AB7	4S	5	24	F35	1	Opaque Red	5.5	L: 3.21
AKC02574 AKC02575	Angkor Borei	2732	Indo-Pacific	213	AB7	4S	5	24	F35	7	Opaque Red	4.5	
AKC02574 AKC02575	Angkor Borei	2732	Indo-Pacific	213	AB7	4S	5	24	F35	129	Opaque Light Green	2	Many broken frags
AKC02574 AKC02575	Angkor Borei	2732	Indo-Pacific	213	AB7	4S	5	24	F35	42	Opaque Black	2	
AKC02574 AKC02575	Angkor Borei	2732	Indo-Pacific	213	AB7	4S	5	24	F35	2	Opaque Yellow	<2	
AKC02574 AKC02575	Angkor Borei	2732	Indo-Pacific	213	AB7	4S	5	24	F35	1	Opaque Orange	<2	
AKC02574 AKC02575	Angkor Borei	2732	Indo-Pacific	213	AB7	4S	5	24	F35	1	Opaque Orange	<2	L:3.23. Also found with 4 gold beads (<2mm)
AKC02576	Angkor Borei	3284	Indo-Pacific	56	AB7	5N	5	25	F48	14	Opaque Black	2	
AKC02576	Angkor Borei	3284	Indo-Pacific	56	AB7	5N	5	25	F48	42	Opaque Orange	2	off-white, dirty with black on surface
AKC02577	Angkor Borei	3278	Indo-Pacific	4	AB7	5N	5	25	F48	2	Opaque Black	2	
AKC02577	Angkor Borei	3278	Indo-Pacific	4	AB7	5N	5	25	F48	1	White/Cream	2	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02577	Angkor Borei	3278	Indo-Pacific	4	AB7	5N	5	25	F48	1	Opaque Orange	<2	
AKC02578	Angkor Borei	2792	Indo-Pacific	35	AB7	2N/3N	7	23	F26	7	Opaque Black	2	
AKC02578	Angkor Borei	2792	Indo-Pacific	35	AB7	2N/3N	7	23	F26	9	Opaque Orange	2	
AKC02578	Angkor Borei	2792	Indo-Pacific	35	AB7	2N/3N	7	23	F26	2	Opaque Red	<2	
AKC02578	Angkor Borei	2792	Indo-Pacific	35	AB7	2N/3N	7	23	F26	13	Opaque Light Green	2	
AKC02578	Angkor Borei	2792	Indo-Pacific	35	AB7	2N/3N	7	23	F26	1	Opaque Orange	2	AB1140
AKC02578	Angkor Borei	2792	Indo-Pacific	35	AB7	2N/3N	7	23	F26	1	Opaque Light Green	<2	AB116V
AKC02578	Angkor Borei	2792	Indo-Pacific	35	AB7	2N/3N	7	23	F26	1	Opaque Light Green	2	AB115V
AKC02578	Angkor Borei	2792	Indo-Pacific	35	AB7	2N/3N	7	23	F26	1	Opaque Orange	2	AB1170
AKC02580	Angkor Borei	1432	Hexagonal short barrel	1	AB7	2	7	16		1	White/Cream		Heavily weathered glass (?) hexagonal short barrel bead. L: 12.08 W: 13.12 IPA: 2:05 IPB: 2.43

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02581	Angkor Borei	2448	Indo-Pacific	11	AB7	1N	7	20	F31	1	Opaque Light Green	2	
AKC02581	Angkor Borei	2448	Indo-Pacific	11	AB7	1N	7	20	F31	1	Opaque Yellow	<2	
AKC02581	Angkor Borei	2448	Indo-Pacific	11	AB7	1N	7	20	F31	9	Opaque Yellow	2	
AKC02582	Angkor Borei	1827	Indo-Pacific	1	AB7	3N	7	21		1	White/Cream	2	Black marks on surface?
AKC02583	Angkor Borei	1313	Indo-Pacific	7	AB7	2	5	12		1	Opaque Red	2	
AKC02583	Angkor Borei	1313	Indo-Pacific	7	AB7	2	5	12		1	Opaque Red	4	
AKC02583	Angkor Borei	1313	Indo-Pacific	7	AB7	2	5	12		2	Opaque Red	5	
AKC02583	Angkor Borei	1313	Indo-Pacific	7	AB7	2	5	12		1	Trans/Semi-Trans Light Blue	5	
AKC02583	Angkor Borei	1313	Indo-Pacific	7	AB7	2	5	12		1	Opaque Yellow	4	
AKC02583	Angkor Borei	1313	Indo-Pacific	7	AB7	2	5	12		1	Opaque Dark Green	10	broken, weathered, spherical
AKC02584	Angkor Borei	1386	Indo-Pacific?	1						1	Purple Translucent		Broken. Believed to be garnet but was glass
AKC02585	Angkor Borei	1314	Indo-Pacific?	1						1	Purple Translucent		Broken. Believed to be garnet but was glass

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02586	Angkor Borei	1767	Indo-Pacific	8	AB7	2N	7	20	F16	1	Translucent Dark Blue	5	L: 6.74
AKC02586	Angkor Borei	1767	Indo-Pacific	8	AB7	2N	7	20	F16	1	Opaque Yellow	3.5	
AKC02586	Angkor Borei	1767	Indo-Pacific	8	AB7	2N	7	20	F16	3	Translucent Dark Blue	5.5	
AKC02586	Angkor Borei	1767	Indo-Pacific	8	AB7	2N	7	20	F16	3	Translucent Dark Blue	6.5	
AKC02587	Angkor Borei	1191	Indo-Pacific	3	AB7	3	5	8		1	Translucent Dark Blue	6.5	L: 3.02
AKC02587	Angkor Borei	1191	Indo-Pacific	3	AB7	3	5	8		1	Opaque Red	2.5	L: 5.55
AKC02587	Angkor Borei	1191	Indo-Pacific	3	AB7	3	5	8		1	Opaque Orange	3	L: 4.76
AKC02588	Angkor Borei	2066	Indo-Pacific	1	AB7	5	2	4		1	Translucent Dark Blue	6.5	L: 5.37
AKC02589	Angkor Borei	1326	Indo-Pacific	13	AB7	3	5	12		1	Translucent Dark Blue	8.5	L: 8.36 W: 8.45. Spherical shape, one end is slightly pointed. Not IP?
AKC02589	Angkor Borei	1326	Indo-Pacific	13	AB7	3	5	12		1	Opaque Yellow	4.5	
AKC02589	Angkor Borei	1326	Indo-Pacific	13	AB7	3	5	12		1	Opaque Yellow	3.5	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02589	Angkor Borei	1326	Indo-Pacific	13	AB7	3	5	12		1	Opaque Light Green	2.5	
AKC02589	Angkor Borei	1326	Indo-Pacific	13	AB7	3	5	12		1	Opaque Orange	2.5	
AKC02589	Angkor Borei	1326	Indo-Pacific	13	AB7	3	5	12		3	Opaque Red	2.5	
AKC02589	Angkor Borei	1326	Indo-Pacific	13	AB7	3	5	12		1	Opaque Red	3.5	
AKC02589	Angkor Borei	1326	Indo-Pacific	13	AB7	3	5	12		1	Opaque Red	5	
AKC02589	Angkor Borei	1326	Indo-Pacific	13	AB7	3	5	12		1	Opaque Red	5.5	
AKC02589	Angkor Borei	1326	Indo-Pacific	13	AB7	3	5	12		1	Trans/Semi-Trans Light Blue	4.5	
AKC02589	Angkor Borei	1326	Indo-Pacific	13	AB7	3	5	12		1	Trans/Semi-Trans Light Blue	6.5	
AKC02590	Angkor Borei	2111	Indo-Pacific	3	AB7	5	3	7		1	Purple	5.5	L: 2.6. Believed to be garnet but found was glass
AKC02590	Angkor Borei	2111	Indo-Pacific	3	AB7	5	3	7		1	Blue-Green	4	
AKC02590	Angkor Borei	2111	Indo-Pacific	3	AB7	5	3	7		1	Trans/Semi-Trans Light Blue	3	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02591	Angkor Borei	1467	Indo-Pacific	1	AB7	2N	7	17		1	Purple	4	L: 2.93. Believed to be garnet but found was glass
AKC02592	Angkor Borei	1402	Indo-Pacific?	3	AB7	2	6	15		1	Opaque Yellow		Broken. Measurements- L: 11.81 W:6.4 Thickness: 4.46 IP: 1.2
AKC02592	Angkor Borei	1402	Indo-Pacific?	3	AB7	2	6	15		1	Trans/Semi-Trans Light Blue	5	
AKC02592	Angkor Borei	1402	Indo-Pacific?	3	AB7	2	6	15		1	Translucent Dark Blue		Broken square barrel
AKC02593	Angkor Borei	2126	Wound faience?	1	AB7	5	3	8		1	Opaque Yellow		Measurements: L: 10.83 W: 14.29 IPA: 3.86 IPB: 4.02
AKC02594	Angkor Borei	1120	Indo-Pacific	4	AB7	2	3	6		1	Trans/Semi-Trans Light Blue		fragments
AKC02594	Angkor Borei	1120	Indo-Pacific	4	AB7	2	3	6		1	Opaque Dark Green	7	L: 5.10
AKC02594	Angkor Borei	1120	Indo-Pacific	4	AB7	2	3	6		1	Translucent Dark Blue	6.5	L: 5.46
AKC02594	Angkor Borei	1120	Indo-Pacific	4	AB7	2	3	6		1	Opaque Yellow	7.5	L: 6.23

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02595	Angkor Borei	1163	Indo-Pacific	1	AB7	3	5	7		1	Translucent Dark Blue	6.5	L: 5.42
AKC02596	Angkor Borei	1358	Indo-Pacific?	6	AB7	3	6	13		1	Trans/Semi-Trans Light Blue	N/A	broken fragments
AKC02596	Angkor Borei	1358	Indo-Pacific?	6	AB7	3	6	13		1	Opaque Black	2.5	
AKC02596	Angkor Borei	1358	Indo-Pacific?	6	AB7	3	6	13		1	Opaque Yellow	6.5	
AKC02596	Angkor Borei	1358	Indo-Pacific?	6	AB7	3	6	13		1	Opaque Yellow	4.5	
AKC02596	Angkor Borei	1358	Indo-Pacific?	6	AB7	3	6	13		1	Opaque Light Green		L: 20.07 W: 24.69
AKC02596	Angkor Borei	1358	Indo-Pacific?	6	AB7	3	6	13		1	Opaque Light Green	4	
AKC02597	Angkor Borei	1289	Indo-Pacific	1	AB7	3	5	11		1	Opaque Orange	3.5	Weathered
AKC02598	Angkor Borei	1292	Indo-Pacific	7	AB7	3	5	11		1	Opaque Yellow	5.5	
AKC02598	Angkor Borei	1292	Indo-Pacific	7	AB7	3	5	11		1	Opaque Light Green	2	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02598	Angkor Borei	1292	Indo-Pacific	7	AB7	3	5	11		1	Translucent Dark Blue	4	
AKC02598	Angkor Borei	1292	Indo-Pacific	7	AB7	3	5	11		1	Opaque Red	4.5	
AKC02598	Angkor Borei	1292	Indo-Pacific	7	AB7	3	5	11		1	Opaque Red	3.5	
AKC02598	Angkor Borei	1292	Indo-Pacific	7	AB7	3	5	11		1	Opaque Red	3	
AKC02598	Angkor Borei	1292	Indo-Pacific	7	AB7	3	5	11		1	Opaque Red	2	
AKC02599	Angkor Borei	1325	Indo-Pacific	1	AB7	3	5	12		1	Opaque Red	3.5	
AKC02600	Angkor Borei	1357	Indo-Pacific	1	AB7	3	6	13		1	Opaque Red	4	
AKC02601	Angkor Borei	1386	Indo-Pacific	8	AB7	3	6	11		1	Opaque Light Green	6	
AKC02601	Angkor Borei	1386	Indo-Pacific	8	AB7	3	6	11		1	Opaque Light Green	3.5	
AKC02601	Angkor Borei	1386	Indo-Pacific	8	AB7	3	6	11		1	Opaque Light Green	3	
AKC02601	Angkor Borei	1386	Indo-Pacific	8	AB7	3	6	11		1	Opaque Red	3	
AKC02601	Angkor Borei	1386	Indo-Pacific	8	AB7	3	6	11		1	Opaque Red	4	dark stripes
AKC02601	Angkor Borei	1386	Indo-Pacific	8	AB7	3	6	11		1	Opaque Yellow	4	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02601	Angkor Borei	1386	Indo-Pacific	8	AB7	3	6	11		1	Opaque Orange	3	6.27
AKC02601	Angkor Borei	1386	Indo-Pacific	8	AB7	3	6	11		1	Trans/Se mi-Trans Light Blue	4	
AKC02602	Angkor Borei	1397	Indo-Pacific	1	AB7	1	6	15		1	Opaque Light Green	<2	
AKC02604	Angkor Borei	1429	Indo-Pacific	1	AB7	3	7	16		1	Opaque Light Blue	4	5.67 mm
AKC02605	Angkor Borei	1428	Indo-Pacific	2	AB7	3	7	16		1	Opaque Red	5	
AKC02605	Angkor Borei	1428	Indo-Pacific	2	AB7	3	7	16		1	Opaque Yellow	3	
AKC02607	Angkor Borei	1451	Indo-Pacific	2	AB7	3	7	17		1	Opaque Yellow	2	
AKC02607	Angkor Borei	1451	Indo-Pacific	2	AB7	3	7	17		1	Opaque Red	3.5	
AKC02609	Angkor Borei	1478	Indo-Pacific	1	AB7	3	7	18		1	Opaque Yellow	4	
AKC02610	Angkor Borei	1506	Indo-Pacific	1	AB7	3n	7	19		1	Opaque Red	3	
AKC02611	Angkor Borei	1613	Indo-Pacific	3	AB7	35	7	20		1	Trans/Se mi-Trans Light Blue	4.5	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02611	Angkor Borei	1613	Indo-Pacific	3	AB7	35	7	20		1	Opaque Yellow	2	
AKC02611	Angkor Borei	1613	Indo-Pacific	3	AB7	35	7	20		1	Opaque Yellow	3.5	
AKC02612	Angkor Borei	2487	Indo-Pacific	7	AB7	35	7	22		1	Translucent Dark Blue	4.5	
AKC02612	Angkor Borei	2487	Indo-Pacific	7	AB7	35	7	22		1	Translucent Dark Blue	5	
AKC02612	Angkor Borei	2487	Indo-Pacific	7	AB7	35	7	22		1	Opaque Light Green	2	
AKC02612	Angkor Borei	2487	Indo-Pacific	7	AB7	35	7	22		1	Opaque Light Green	2.5	
AKC02612	Angkor Borei	2487	Indo-Pacific	7	AB7	35	7	22		1	White/Cream	<2	
AKC02612	Angkor Borei	2487	Indo-Pacific	7	AB7	35	7	22		1	Opaque Orange	3	
AKC02612	Angkor Borei	2487	Indo-Pacific	7	AB7	35	7	22		1	Opaque Yellow	2	
AKC02613	Angkor Borei	1255	Indo-Pacific	5	AB7	3	5	6	10	1	Opaque Red	3	
AKC02613	Angkor Borei	1255	Indo-Pacific	5	AB7	3	5	6	10	1	Opaque Red	3	
AKC02613	Angkor Borei	1255	Indo-Pacific	5	AB7	3	5	6	10	1	Opaque Red	3	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02613	Angkor Borei	1255	Indo-Pacific	5	AB7	3	5	6	10	1	Trans/Se mi-Trans Light Blue	3	
AKC02613	Angkor Borei	1255	Indo-Pacific	5	AB7	3	5	6	10	1	Opaque Light Green	2.5	
AKC02614	Angkor Borei	1732	Indo-Pacific	1	AB7	35	7	21		1	Opaque Light Green	2.5	
AKC02615	Angkor Borei	2635	Indo-Pacific	1	AB7	35	7	23		1	Opaque Yellow	2	
AKC02616	Angkor Borei	1223	Indo-Pacific	6	AB7	3	5	9		1	Opaque Dark Blue	5	
AKC02616	Angkor Borei	1223	Indo-Pacific	6	AB7	3	5	9		1	Opaque Light Green	3	
AKC02616	Angkor Borei	1223	Indo-Pacific	6	AB7	3	5	9		1	Opaque Dark Blue	5	
AKC02616	Angkor Borei	1223	Indo-Pacific	6	AB7	3	5	9		1	Opaque Red	4	
AKC02616	Angkor Borei	1223	Indo-Pacific	6	AB7	3	5	9		1	Opaque Yellow	3.5	
AKC02616	Angkor Borei	1223	Indo-Pacific	6	AB7	3	5	9		1	Opaque Yellow	2.5	8.22 mm long

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02618	Angkor Borei	1222	Indo-Pacific	1	AB7	3	5	9		1	Trans/Semi-Trans Light Blue	3.5	
AKC02619	Angkor Borei	1101	Indo-Pacific	1	AB7	3	4	5		1	Opaque dark blue	4	
AKC02620	Angkor Borei	1135	Indo-Pacific	2	AB7	3	4	6		1	Opaque Yellow	4.5	
AKC02620	Angkor Borei	1135	Indo-Pacific	2	AB7	3	4	6		1	Opaque Dark Blue	2	8.01 mm long
AKC02621	Angkor Borei	1066	Indo-Pacific	2	AB7	3	2	4		1	Opaque Red	2.5	
AKC02621	Angkor Borei	1066	Indo-Pacific	2	AB7	3	2	4		1	Opaque Orange	2	
AKC02622	Angkor Borei	2208	Indo-Pacific	18	AB7	6	4	16		3	Opaque Red	2	
AKC02622	Angkor Borei	2208	Indo-Pacific	18	AB7	6	4	16		2	Opaque Red	3	
AKC02622	Angkor Borei	2208	Indo-Pacific	18	AB7	6	4	16		2	Opaque Light Blue	4.5	
AKC02622	Angkor Borei	2208	Indo-Pacific	18	AB7	6	4	16		2	Opaque Light Blue	3	
AKC02622	Angkor Borei	2208	Indo-Pacific	18	AB7	6	4	16		2	Opaque Red	3.5	
AKC02622	Angkor Borei	2208	Indo-Pacific	18	AB7	6	4	16		1	Opaque Orange	4	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02622	Angkor Borei	2208	Indo-Pacific	18	AB7	6	4	16		1	Opaque Red	4.5	
AKC02622	Angkor Borei	2208	Indo-Pacific	18	AB7	6	4	16		1	Opaque Black	3.5	
AKC02622	Angkor Borei	2208	Indo-Pacific	18	AB7	6	4	16		1	Opaque Orange	3.5	6.75 mm long
AKC02622	Angkor Borei	2208	Indo-Pacific	18	AB7	6	4	16		1	blue w/ pinkish stripes	3.5	
AKC02622	Angkor Borei	2208	Indo-Pacific	18	AB7	6	4	16		1	Opaque Light Blue	3	5.23 mm long
AKC02622	Angkor Borei	2208	Indo-Pacific	18	AB7	6	4	16		1	Opaque Yellow	3	
AKC02623	Angkor Borei	3216	Indo-Pacific	1	AB7	5N	5	25		1	Opaque Yellow	4	orange stripes
AKC02624	Angkor Borei	2446	Indo-Pacific	1	AB7	5S	5	23		1	Opaque Orange	<2	
AKC02625	Angkor Borei	2326	Indo-Pacific	4	AB7	5	5	20		1	Opaque Yellow	3	
AKC02625	Angkor Borei	2326	Indo-Pacific	4	AB7	5	5	20		1	Opaque Light Green	2.5	
AKC02625	Angkor Borei	2326	Indo-Pacific	4	AB7	5	5	20		1	Opaque Yellow	2.5	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02625	Angkor Borei	2326	Indo-Pacific	4	AB7	5	5	20		1	Opaque Orange	2	Weathered
AKC02626	Angkor Borei	2306	Indo-Pacific	1	AB7	5	5	19		1	Opaque Red	3	
AKC02627	Angkor Borei	2292	Indo-Pacific	7	AB7	5	4	18		1	Opaque Light Green	2	
AKC02627	Angkor Borei	2292	Indo-Pacific	7	AB7	5	4	18		1	Opaque Black	2	
AKC02627	Angkor Borei	2292	Indo-Pacific	7	AB7	5	4	18		1	Opaque Light Green	3.5	
AKC02627	Angkor Borei	2292	Indo-Pacific	7	AB7	5	4	18		1	Opaque Light Green	<2	
AKC02627	Angkor Borei	2292	Indo-Pacific	7	AB7	5	4	18		1	Opaque Yellow	4	
AKC02627	Angkor Borei	2292	Indo-Pacific	7	AB7	5	4	18		1	Opaque Light Green	3	
AKC02627	Angkor Borei	2292	Indo-Pacific	7	AB7	5	4	18		1	Opaque Red	4	Also found with a slag piece
AKC02628	Angkor Borei	2251	Indo-Pacific	14	AB7	5	4	16		3	Opaque Red	3	
AKC02628	Angkor Borei	2251	Indo-Pacific	14	AB7	5	4	16		2	Opaque Yellow	4	
AKC02628	Angkor Borei	2251	Indo-Pacific	14	AB7	5	4	16		2	Translucent Dark Blue	4	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02628	Angkor Borei	2251	Indo-Pacific	14	AB7	5	4	16		1	Opaque Light Blue	5	
AKC02628	Angkor Borei	2251	Indo-Pacific	14	AB7	5	4	16		1	Opaque Light Blue	4.5	
AKC02628	Angkor Borei	2251	Indo-Pacific	14	AB7	5	4	16		1	Opaque Red	3.5	
AKC02628	Angkor Borei	2251	Indo-Pacific	14	AB7	5	4	16		1	Opaque Red	4	5.50 mm long
AKC02628	Angkor Borei	2251	Indo-Pacific	14	AB7	5	4	16		1	Translucent Dark Blue	3	
AKC02628	Angkor Borei	2251	Indo-Pacific	14	AB7	5	4	16		1	Opaque Light Green	3.5	
AKC02628	Angkor Borei	2251	Indo-Pacific	14	AB7	5	4	16		1	Opaque Yellow	3	
AKC02629	Angkor Borei	2237	Indo-Pacific	17	AB7	5	4	15		2	Opaque Red	3.5	
AKC02629	Angkor Borei	2237	Indo-Pacific	17	AB7	5	4	15		3	Translucent Light Blue	3	
AKC02629	Angkor Borei	2237	Indo-Pacific	17	AB7	5	4	15		2	Opaque Red	3	
AKC02629	Angkor Borei	2237	Indo-Pacific	17	AB7	5	4	15		2	Opaque Red	4	
AKC02629	Angkor Borei	2237	Indo-Pacific	17	AB7	5	4	15		1	Opaque Orange	4	7.57 mm long

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02629	Angkor Borei	2237	Indo-Pacific	17	AB7	5	4	15		1	Trans/Semi-Trans Light Blue	2.5	
AKC02629	Angkor Borei	2237	Indo-Pacific	17	AB7	5	4	15		1	Opaque Orange	3	
AKC02629	Angkor Borei	2237	Indo-Pacific	17	AB7	5	4	15		1	Opaque Red	2.5	
AKC02629	Angkor Borei	2237	Indo-Pacific	17	AB7	5	4	15		1	Opaque Red	4	L: 5.02
AKC02629	Angkor Borei	2237	Indo-Pacific	17	AB7	5	4	15		1	Opaque Yellow	3.5	
AKC02629	Angkor Borei	2237	Indo-Pacific	17	AB7	5	4	15		1	Opaque Red	3	
AKC02629	Angkor Borei	2237	Indo-Pacific	17	AB7	5	4	15		1	Opaque Light Green	4.5	
AKC02630	Angkor Borei	2222	Indo-Pacific	3	AB7	5	4	14		1	Trans/Semi-Trans Light Blue	6	broken
AKC02630	Angkor Borei	2222	Indo-Pacific	3	AB7	5	4	14		1	Opaque Red	3	
AKC02630	Angkor Borei	2222	Indo-Pacific	3	AB7	5	4	14		1	Opaque Red	2.5	
AKC02631	Angkor Borei	2190	Indo-Pacific	9	AB7	5	4	13		1	Opaque Red	<2	
AKC02631	Angkor Borei	2190	Indo-Pacific	9	AB7	5	4	13		1	Purple	3.5	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02631	Angkor Borei	2190	Indo-Pacific	9	AB7	5	4	13		1	Opaque Orange	4	
AKC02631	Angkor Borei	2190	Indo-Pacific	9	AB7	5	4	13		1	Opaque Orange	4.5	
AKC02631	Angkor Borei	2190	Indo-Pacific	9	AB7	5	4	13		1	Opaque Red	3.5	
AKC02631	Angkor Borei	2190	Indo-Pacific	9	AB7	5	4	13		1	Opaque Red	2.5	
AKC02631	Angkor Borei	2190	Indo-Pacific	9	AB7	5	4	13		1	Trans/Semi-Trans Light Blue	4	
AKC02631	Angkor Borei	2190	Indo-Pacific	9	AB7	5	4	13		1	Opaque Yellow	2	
AKC02631	Angkor Borei	2190	Indo-Pacific	9	AB7	5	4	13		1	Opaque Light Green	2.5	
AKC02632	Angkor Borei	2088	Indo-Pacific	1	AB7	5	3	5		1	Opaque Orange	3	
AKC02633	Angkor Borei	2159	Indo-Pacific	3	AB7	5	4	11		1	Opaque Red	4	
AKC02633	Angkor Borei	2159	Indo-Pacific	3	AB7	5	4	11		1	Opaque Light Green	4	
AKC02633	Angkor Borei	2159	Indo-Pacific	3	AB7	5	4	11		1	Opaque Light Green	3	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02636 AKC02637	Angkor Borei	2210	Indo-Pacific	36	AB7	5	10	4		4	Opaque Yellow	4.5	
AKC02636 AKC02637	Angkor Borei	2210	Indo-Pacific	36	AB7	5	10	4		3	Opaque Orange	4.5	
AKC02636 AKC02637	Angkor Borei	2210	Indo-Pacific	36	AB7	5	10	4		1	Opaque Red	4	
AKC02636 AKC02637	Angkor Borei	2210	Indo-Pacific	36	AB7	5	10	4		3	Opaque Light Blue	2.5	
AKC02636 AKC02637	Angkor Borei	2210	Indo-Pacific	36	AB7	5	10	4		9	Opaque Red	2.5	
AKC02636 AKC02637	Angkor Borei	2210	Indo-Pacific	36	AB7	5	10	4		3	Opaque Yellow	3	
AKC02636 AKC02637	Angkor Borei	2210	Indo-Pacific	36	AB7	5	10	4		3	Opaque Red	3.5	Dark streaks in glass
AKC02636 AKC02637	Angkor Borei	2210	Indo-Pacific	36	AB7	5	10	4		1	Opaque Yellow	2.5	
AKC02636 AKC02637	Angkor Borei	2210	Indo-Pacific	36	AB7	5	10	4		1	Opaque Red	3	
AKC02636 AKC02637	Angkor Borei	2210	Indo-Pacific	36	AB7	5	10	4		1	Opaque Light Green	3.5	
AKC02636 AKC02637	Angkor Borei	2210	Indo-Pacific	36	AB7	5	10	4		1	Opaque Light Green	3	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02636 AKC02637	Angkor Borei	2210	Indo-Pacific	36	AB7	5	10	4		1	Opaque Dark Blue	4.5	
AKC02636 AKC02637	Angkor Borei	2210	Indo-Pacific	36	AB7	5	10	4		1	Translucent Dark Blue	3	
AKC02636 AKC02637	Angkor Borei	2210	Indo-Pacific	36	AB7	5	10	4		1	Opaque Light Blue	3.5	
AKC02638	Angkor Borei	2984	Indo-Pacific	1	AB7	4S	5	27		1	Opaque Orange	<2	
AKC02639	Angkor Borei	2291	Indo-Pacific	2	AB7	4	4	20					
AKC02640	Angkor Borei	2291	Indo-Pacific	2	AB7	4	4	20		1	Translucent Dark Blue	3	
AKC02640	Angkor Borei	2291	Indo-Pacific	2	AB7	4	4	20		1	Opaque Light Blue	2	
AKC02641	Angkor Borei	3402	Indo-Pacific	1	AB7	4S	6	33		1	Opaque Yellow	2.5	
AKC02642	Angkor Borei	2123	Indo-Pacific		AB7	4	3	9					
AKC02643	Angkor Borei	2265	Indo-Pacific	2	AB7	4	4	19		1	Opaque Red	<2	
AKC02643	Angkor Borei	2265	Indo-Pacific	2	AB7	4	4	19		1	Opaque Yellow	3	
AKC02644	Angkor Borei	2342	Indo-Pacific	3	AB7	4	5	21		1	Trans/Semi-Trans Light Blue	2	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02644	Angkor Borei	2342	Indo-Pacific	3	AB7	4	5	21		1	Translucent Light Green	2	
AKC02644	Angkor Borei	2342	Indo-Pacific	3	AB7	4	5	21		1	Opaque Light Green	2	
AKC02646	Angkor Borei	2169	Indo-Pacific	2	AB7	4	4	14		1	Opaque Light Green	5.5	
AKC02646	Angkor Borei	2169	Indo-Pacific	2	AB7	4	4	14		1	Opaque Orange	2	
AKC02647	Angkor Borei	2500	Indo-Pacific	1	AB7	4S	5	24		1	Opaque Orange	<2	
AKC02648	Angkor Borei	2163	Indo-Pacific	1	AB7	4	4	13		1	Translucent Dark Blue	6	
AKC02649	Angkor Borei	2191	Indo-Pacific	2	AB7	4	4	15		1	Opaque Orange	3	
AKC02649	Angkor Borei	2191	Indo-Pacific	2	AB7	4	4	15		1	Opaque Dark Blue	3	
AKC02650	Angkor Borei	2231	Indo-Pacific	4	AB7	4	4	17		1	Opaque Dark Blue	4.5	
AKC02650	Angkor Borei	2231	Indo-Pacific	4	AB7	4	4	17		1	Opaque Red	3	
AKC02650	Angkor Borei	2231	Indo-Pacific	4	AB7	4	4	17		1	Opaque Light Green	3	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02650	Angkor Borei	2231	Indo-Pacific	4	AB7	4	4	17		1	Opaque Light Blue	3	
AKC02652	Angkor Borei	2302	Indo-Pacific	2	AB7	4	5	21		1	Opaque Light Green	3	
AKC02652	Angkor Borei	2302	Indo-Pacific	2	AB7	4	5	21		1	Opaque Light Blue	3	4.96 mm long
AKC02653	Angkor Borei	2380	Indo-Pacific	2	AB7	4N	5	22		1	Opaque Red	4.5	Dark streaks in glass
AKC02653	Angkor Borei	2380	Indo-Pacific	2	AB7	4N	5	22		1	Opaque Orange	2	
AKC02654	Angkor Borei	2232	Indo-Pacific	1	AB7	4	17	4		1	Opaque Light Green	4.5	
AKC02655	Angkor Borei	2252	Indo-Pacific	1	AB7	4	18	4		1	Opaque Light Green	2	
AKC02656	Angkor Borei	2217	Indo-Pacific	2	AB7	4	4	16		1	Translucent Dark Blue	4	
AKC02656	Angkor Borei	2217	Indo-Pacific	2	AB7	4	4	16		1	Trans/Semi-Trans Light Blue	3	
AKC02657	Angkor Borei	2198	Indo-Pacific	10	AB7	4	4	15		2	Opaque Red	3	
AKC02657	Angkor Borei	2198	Indo-Pacific	10	AB7	4	4	15		2	Opaque Light Green	3	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02657	Angkor Borei	2198	Indo-Pacific	10	AB7	4	4	15		2	Opaque Light Blue	3.5	
AKC02657	Angkor Borei	2198	Indo-Pacific	10	AB7	4	4	15		1	Opaque Light Blue	5.5	
AKC02657	Angkor Borei	2198	Indo-Pacific	10	AB7	4	4	15		1	Opaque Light Green	4	
AKC02657	Angkor Borei	2198	Indo-Pacific	10	AB7	4	4	15		1	Translucent Dark Blue	3.5	
AKC02657	Angkor Borei	2198	Indo-Pacific	10	AB7	4	4	15		1	Opaque Orange	4	
AKC02657	Angkor Borei	2198	Indo-Pacific	10	AB7	4	4	15		1	Opaque Red	3	
AKC02657	Angkor Borei	2198	Indo-Pacific	10	AB7	4	4	15		1	Opaque Red	2.5	3.56 mm long
AKC02657	Angkor Borei	2198	Indo-Pacific	10	AB7	4	4	15		1	Opaque Orange	2.5	
AKC02657	Angkor Borei	2198	Indo-Pacific	10	AB7	4	4	15		1	Opaque Yellow	3	
AKC02659	Angkor Borei	2549	Indo-Pacific	1	AB7	1S	8	25		1	Opaque Light Green	2	
AKC02660	Angkor Borei	3041	Indo-Pacific	1	AB7	1S	9	40		1	Opaque Red	3	
AKC02661	Angkor Borei	2452	Indo-Pacific	16	AB7	1N	7	23		5	Opaque Black	2.5	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02661	Angkor Borei	2452	Indo-Pacific	16	AB7	1N	7	23		11	Opaque Orange	2	
AKC02662	Angkor Borei	2439	Indo-Pacific	1	AB7	1S	7	22		1	Opaque Light Green	3.5	
AKC02663	Angkor Borei	2427	Indo-Pacific	3	AB7	1N	7	22		1	Opaque Orange	<2	
AKC02663	Angkor Borei	2427	Indo-Pacific	3	AB7	1N	7	22		1	Opaque Red	<2	
AKC02663	Angkor Borei	2427	Indo-Pacific	3	AB7	1N	7	22		1	Opaque Red	2.5	
AKC02664	Angkor Borei	2414	Indo-Pacific	2	AB7	1S	7	21		1	Opaque Light Green	2.5	
AKC02664	Angkor Borei	2414	Indo-Pacific	2	AB7	1S	7	21		1	Opaque Red	2	
AKC02666	Angkor Borei	2396	Indo-Pacific	1	AB7	1N	7	21		1	Opaque Yellow	<2	
AKC02667	Angkor Borei	1687	Indo-Pacific	1	AB7	1N	7	19		1	Opaque Light Green	2	
AKC02668	Angkor Borei	1559	Indo-Pacific	1	AB7	1N	7	18		1	Opaque Orange	<2	
AKC02669	Angkor Borei	1524	Indo-Pacific	1	AB7	1S	7	17		1	Opaque Yellow	3	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02670	Angkor Borei	1459	Indo-Pacific	13	AB7	1S	7	16		1	Trans/Semi-Trans Light Blue	2.5	
AKC02670	Angkor Borei	1459	Indo-Pacific	13	AB7	1S	7	16		2	Opaque Red	3.5	
AKC02670	Angkor Borei	1459	Indo-Pacific	13	AB7	1S	7	16		2	Opaque Red	2	
AKC02670	Angkor Borei	1459	Indo-Pacific	13	AB7	1S	7	16		1	Opaque Dark Green	3.5	
AKC02670	Angkor Borei	1459	Indo-Pacific	13	AB7	1S	7	16		1	Opaque Orange	4.5	
AKC02670	Angkor Borei	1459	Indo-Pacific	13	AB7	1S	7	16		1	Translucent Dark Blue	3	
AKC02670	Angkor Borei	1459	Indo-Pacific	13	AB7	1S	7	16		2	Opaque Yellow	2.5	
AKC02670	Angkor Borei	1459	Indo-Pacific	13	AB7	1S	7	16		1	Trans/Semi-Trans Light Blue	2.5	
AKC02670	Angkor Borei	1459	Indo-Pacific	13	AB7	1S	7	16		1	Opaque Orange	3.5	
AKC02671	Angkor Borei	1456	Indo-Pacific	3	AB7	1	7	16		3	Opaque Dark Green	3	
AKC02672	Angkor Borei	1337	Indo-Pacific	2	AB7	1	5	13		2	Opaque Red	3	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02673	Angkor Borei	1203	Indo-Pacific	1						1	Opaque Light Blue	7	
AKC02674	Angkor Borei	1020	Indo-Pacific	1	AB7	1	2	3		1	Opaque Red	5.5	
AKC02675	Angkor Borei	1145	Indo-Pacific	2	AB7	1	3	7		1	Translucent Dark Blue	4	AB011BT
AKC02675	Angkor Borei	1145	Indo-Pacific	2	AB7	1	3	7		1	Opaque Light Blue	4	AB010BT
AKC02676	Angkor Borei	1114	Indo-Pacific	1	AB7	1	3	6		1	Opaque Red	2.5	
AKC02679	Angkor Borei	1031	Indo-Pacific	6	AB7	1	2	4		2	Opaque Yellow	3	
AKC02679	Angkor Borei	1031	Indo-Pacific	6	AB7	1	2	4		1	Translucent Dark Blue	2	
AKC02679	Angkor Borei	1031	Indo-Pacific	6	AB7	1	2	4		1	Opaque Red	3	
AKC02679	Angkor Borei	1031	Indo-Pacific	6	AB7	1	2	4		1	Trans/Semi-Trans Light Blue	3	4.32 mm long
AKC02679	Angkor Borei	1031	Indo-Pacific	6	AB7	1	2	4		1	Opaque Yellow	2	
AKC02680	Angkor Borei	1120	Indo-Pacific	8	AB7	1	5	9		1	Black w/multiple stripes	3	AB006P

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02680	Angkor Borei	1120	Indo-Pacific	8	AB7	1	5	9		1	Translucent Dark Blue	4.5	AB002BT
AKC02680	Angkor Borei	1120	Indo-Pacific	8	AB7	1	5	9		1	Opaque Red	3.5	AB007R
AKC02680	Angkor Borei	1120	Indo-Pacific	8	AB7	1	5	9		1	Trans/Semi-Trans Light Blue	2.5	AB009BC
AKC02680	Angkor Borei	1120	Indo-Pacific	8	AB7	1	5	9		1	Trans/Semi-Trans Light Blue	2.5	AB003BT
AKC02680	Angkor Borei	1120	Indo-Pacific	8	AB7	1	5	9		1	Opaque Yellow	2	AB004J
AKC02680	Angkor Borei	1120	Indo-Pacific	8	AB7	1	5	9		1	Opaque Light Green	4	AB008V
AKC02680	Angkor Borei	1120	Indo-Pacific	8	AB7	1	5	9		1	Translucent Dark Blue	4	AB005BC
AKC02681	Angkor Borei	1302	Indo-Pacific	4	AB7	1	5	12		1	Trans/Semi-Trans Light Blue	2.5	AB056BT
AKC02681	Angkor Borei	1302	Indo-Pacific	4	AB7	1	5	12		1	Blue-Green	3	3.96 mm long; AB057BT
AKC02681	Angkor Borei	1302	Indo-Pacific	4	AB7	1	5	12		1	Opaque Dark Blue	4	AB055BT

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02681	Angkor Borei	1302	Indo-Pacific	4	AB7	1	5	12		1	Opaque Yellow	4	AB058J
AKC02684	Angkor Borei	2471	Indo-Pacific	3	AB7	1S	7	23		1	Opaque Light Green	<2	AB085V
AKC02684	Angkor Borei	2471	Indo-Pacific	3	AB7	1S	7	23		1	Opaque Red	2	AB084R
AKC02684	Angkor Borei	2471	Indo-Pacific	3	AB7	1S	7	23		1	Opaque Yellow	2	AB086J
AKC02685	Angkor Borei	2534	Indo-Pacific	4	AB7	1S	8	24		1	Opaque Light Green	2	AB09TV
AKC02685	Angkor Borei	2534	Indo-Pacific	4	AB7	1S	8	24		1	Opaque Light Blue	4	AB0963
AKC02685	Angkor Borei	2534	Indo-Pacific	4	AB7	1S	8	24		1	Opaque Yellow	3	AB098J
AKC02685	Angkor Borei	2534	Indo-Pacific	4	AB7	1S	8	24		1	Purple	3	AB095N
AKC02686	Angkor Borei	1571	Indo-Pacific	3	AB7	1S	7	18		1	Opaque Red	3.5	AB082R
AKC02686	Angkor Borei	1571	Indo-Pacific	3	AB7	1S	7	18		1	Opaque Light Green	<2	
AKC02686	Angkor Borei	1571	Indo-Pacific	3	AB7	1S	7	18		1	Opaque Light Green		AB083V
AKC02687	Angkor Borei	1335	Indo-Pacific	9	AB7	1	5	13		1	Opaque Dark Green	4	AB068B

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02687	Angkor Borei	1335	Indo-Pacific	9	AB7	1	5	13		1	Opaque Light Blue	4	AB065BT
AKC02687	Angkor Borei	1335	Indo-Pacific	9	AB7	1	5	13		1	Translucent Dark Blue	4	AB06UBT
AKC02687	Angkor Borei	1335	Indo-Pacific	9	AB7	1	5	13		1	Opaque Yellow	3	AB066J
AKC02687	Angkor Borei	1335	Indo-Pacific	9	AB7	1	5	13		1	Opaque Light Blue	2.5	
AKC02687	Angkor Borei	1335	Indo-Pacific	9	AB7	1	5	13		1	Opaque Red	4	AB060R
AKC02687	Angkor Borei	1335	Indo-Pacific	9	AB7	1	5	13		1	Opaque Red	3	AB061R
AKC02687	Angkor Borei	1335	Indo-Pacific	9	AB7	1	5	13		1	Opaque Light Green	3.5	AB062V
AKC02687	Angkor Borei	1335	Indo-Pacific	9	AB7	1	5	13		1	Unknown	N/A	AB063J
AKC02688	Angkor Borei	1232	Indo-Pacific	4	AB7	1	5	10		1	Opaque Orange	3.5	7.27 mm long AB027O
AKC02688	Angkor Borei	1232	Indo-Pacific	4	AB7	1	5	10		1	Blue-Green	4	AB026BT
AKC02688	Angkor Borei	1232	Indo-Pacific	4	AB7	1	5	10		1	Opaque Red	4	AB028R
AKC02688	Angkor Borei	1232	Indo-Pacific	4	AB7	1	5	10		1	Opaque Red	3	AB029R

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02689	Angkor Borei	1169	Indo-Pacific	14	AB7	1	5	8		1	Trans/Semi-Trans Light Blue	3.5	AB018BT
AKC02689	Angkor Borei	1169	Indo-Pacific	14	AB7	1	5	8		1	Opaque Yellow	3.5	AB020J
AKC02689	Angkor Borei	1169	Indo-Pacific	14	AB7	1	5	8		1	Opaque Light Green	3.5	AB017V
AKC02689	Angkor Borei	1169	Indo-Pacific	14	AB7	1	5	8		1	Opaque Light Green	4	AB021V
AKC02689	Angkor Borei	1169	Indo-Pacific	14	AB7	1	5	8		1	Opaque Black	6.5	AB012BC
AKC02689	Angkor Borei	1169	Indo-Pacific	14	AB7	1	5	8		1	Opaque Light Blue	5.5	AB013B
AKC02689	Angkor Borei	1169	Indo-Pacific	14	AB7	1	5	8		1	Translucent Dark Blue	3	AB025BC
AKC02689	Angkor Borei	1169	Indo-Pacific	14	AB7	1	5	8		1	Opaque Orange	2	AB024R
AKC02689	Angkor Borei	1169	Indo-Pacific	14	AB7	1	5	8		1	Opaque Dark Blue	4	AB0152BC
AKC02689	Angkor Borei	1169	Indo-Pacific	14	AB7	1	5	8		1	Opaque Orange	3	7.34 mm long; AB014O
AKC02689	Angkor Borei	1169	Indo-Pacific	14	AB7	1	5	8		1	Opaque Orange	2.5	AB019O

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02689	Angkor Borei	1169	Indo-Pacific	14	AB7	1	5	8		1	Opaque Red	2.5	AB022R
AKC02689	Angkor Borei	1169	Indo-Pacific	14	AB7	1	5	8		1	Opaque Red	4.5	AB016R
AKC02689	Angkor Borei	1169	Indo-Pacific	14	AB7	1	5	8		1	unknown	7	AB023BC
AKC02691	Angkor Borei	1366	Indo-Pacific	11	AB7	1	6	14		1	Opaque Red	3	7.30 mm long; AB069R
AKC02691	Angkor Borei	1366	Indo-Pacific	11	AB7	1	6	14		1	Opaque Light Blue	4	AB073BT
AKC02691	Angkor Borei	1366	Indo-Pacific	11	AB7	1	6	14		1	Opaque Red	4	AB07UR
AKC02691	Angkor Borei	1366	Indo-Pacific	11	AB7	1	6	14		1	Opaque Light Green	4	AB075V
AKC02691	Angkor Borei	1366	Indo-Pacific	11	AB7	1	6	14		1	Opaque Orange	4	AB071O
AKC02691	Angkor Borei	1366	Indo-Pacific	11	AB7	1	6	14		1	Opaque Yellow	4	AB076J
AKC02691	Angkor Borei	1366	Indo-Pacific	11	AB7	1	6	14		1	Opaque Light Green	4	AB072V
AKC02691	Angkor Borei	1366	Indo-Pacific	11	AB7	1	6	14		1	Opaque Light Blue	4	AB070BT
AKC02691	Angkor Borei	1366	Indo-Pacific	11	AB7	1	6	14		1	Opaque Light Green	3	AB078V

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02691	Angkor Borei	1366	Indo-Pacific	11	AB7	1	6	14		1	Opaque Light Green	N/A	AB077V; Fragments
AKC02692	Angkor Borei	1301	Indo-Pacific	10	AB7	1	5	12		1	Trans/Semi-Trans Light Blue	5	AB0UUBT
AKC02692	Angkor Borei	1301	Indo-Pacific	10	AB7	1	5	12		1	Opaque Orange	3.5	AB0500
AKC02692	Angkor Borei	1301	Indo-Pacific	10	AB7	1	5	12		1	Opaque Black	3	AB0U5N
AKC02692	Angkor Borei	1301	Indo-Pacific	10	AB7	1	5	12		1	Opaque Light Green	2.5	AB0U9V
AKC02692	Angkor Borei	1301	Indo-Pacific	10	AB7	1	5	12		1	Opaque Red	2.5	AB051R
AKC02692	Angkor Borei	1301	Indo-Pacific	10	AB7	1	5	12		1	Opaque Light Green	3.5	AB046V
AKC02692	Angkor Borei	1301	Indo-Pacific	10	AB7	1	5	12		1	Opaque Light Green	4.5	AB048V (broken)
AKC02692	Angkor Borei	1301	Indo-Pacific	10	AB7	1	5	12		1	Opaque Light Green	N/A	AB047V (fragments)
AKC02692	Angkor Borei	1301	Indo-Pacific	10	AB7	1	5	12		1	Opaque Orange	3	

Database ID	Site Name	Cat Number	Bead Shape	Quantity	Unit	Block	Layer	Level	Burial #	Glass Quantity	Glass Color	Glass Width Category (mm)	Notes
AKC02692	Angkor Borei	1301	Indo-Pacific	10	AB7	1	5	12		1	Trans/Semi-Trans Light Blue	3.5	
AKC02692	Angkor Borei	1301	Indo-Pacific	10	AB7	1	5	12		1	Trans/Semi-Trans Light Blue	4	One clay piece and one gold bead also found.

Appendix 7.1b: Glass beads from Phnom Borei

Database ID	Site Name	Catalogue Number	Bead Shape	Total # of beads	Glass Color	Glass Color Notes	Opacity
AKC01901	Phnom Borei	N/A	Indo-Pacific Bead	11	Red	Reddish-Brown	Opaque
AKC01902	Phnom Borei	N/A	Indo-Pacific Bead	11	Red	Reddish-Brown	Opaque
AKC01903	Phnom Borei	N/A	Indo-Pacific Bead	11	Red	Reddish-Brown	Opaque
AKC01904	Phnom Borei	N/A	Indo-Pacific Bead	11	Red	Reddish-Brown	Opaque
AKC01905	Phnom Borei	N/A	Indo-Pacific Bead	11	Red	Reddish-Brown	Opaque
AKC01906	Phnom Borei	N/A	Indo-Pacific Bead	11	Red	Reddish-Brown	Opaque
AKC01907	Phnom Borei	N/A	Indo-Pacific Bead	11	Yellow		Opaque
AKC01908	Phnom Borei	N/A	Indo-Pacific Bead	11	Yellow		Opaque
AKC01909	Phnom Borei	N/A	Indo-Pacific Bead	11	Dark Blue	Dark Turquoise	Semi-Translucent
AKC01910	Phnom Borei	N/A	Indo-Pacific Bead	11	Black/blue?	Corroded? Has a white coating	Opaque
AKC01912	Phnom Borei	N/A	Large Indo Pacific Bead	1	Dark Blue	Intense blue color	Translucent

Database ID	Site Name	Catalogue Number	Bead Shape	Total # of beads	Glass Color	Glass Color Notes	Opacity
AKC01913	Phnom Borei	N/A	Indo-Pacific Bead	1	Dark Blue	Dark Turquoise	Translucent
AKC01914	Phnom Borei	N/A	Indo-Pacific Bead	1	Red		Opaque
AKC01915	Phnom Borei	N/A	Indo-Pacific Bead	1	Red		Opaque
AKC01916	Phnom Borei	N/A	Indo-Pacific Bead	1	Red		Opaque
AKC01917	Phnom Borei	N/A	Indo-Pacific Bead	1	Light Blue	Light turquoise	Transparent
AKC01918	Phnom Borei	N/A	Indo-Pacific Micro Bead	1	Light Green		Opaque
AKC01919	Phnom Borei	N/A	Indo-Pacific Bead	7	Orange		Opaque
AKC01920	Phnom Borei	N/A	Indo-Pacific Bead	7	Yellow		Opaque
AKC01921	Phnom Borei	N/A	Indo-Pacific Bead	7	Red		Opaque
AKC01922	Phnom Borei	N/A	Indo-Pacific Bead	7	Red		Opaque
AKC01923	Phnom Borei	N/A	Indo-Pacific Bead	7	Red		Opaque
AKC01924	Phnom Borei	N/A	Indo-Pacific Bead	7	Red		Opaque
AKC01925	Phnom Borei	N/A	Indo-Pacific Bead	7	Red	Shiny surface	Opaque
AKC01926	Phnom Borei	N/A	Indo-Pacific Bead	9	Dark Blue	Dark Turquoise	Semi-Translucent
AKC01927	Phnom Borei	N/A	Indo-Pacific Bead	9	Yellow		Opaque
AKC01928	Phnom Borei	N/A	Indo-Pacific Bead	9	Yellow		Opaque
AKC01929	Phnom Borei	N/A	Indo-Pacific Bead	9	Red		Opaque
AKC01930	Phnom Borei	N/A	Indo-Pacific Bead	9	Red		Opaque
AKC01931	Phnom Borei	N/A	Indo-Pacific Bead	9	Red		Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Total # of beads	Glass Color	Glass Color Notes	Opacity
AKC01932	Phnom Borei	N/A	Indo-Pacific Bead	9	Red		Opaque
AKC01933	Phnom Borei	N/A	Indo-Pacific Bead	9	Red		Opaque
AKC01934	Phnom Borei	N/A	Unknown	9	White	Opaque in the middle with translucent edges	Opaque Translucent
AKC01935	Phnom Borei	N/A	Indo-Pacific Bead	15	Black		Opaque
AKC01936	Phnom Borei	N/A	Indo-Pacific Bead	15	Black		Opaque
AKC01937	Phnom Borei	N/A	Indo-Pacific Bead	15	Dark Blue	Dark Turquoise	Semi-Translucent
AKC01938	Phnom Borei	N/A	Indo-Pacific Bead	15	Light Green		Opaque
AKC01939	Phnom Borei	N/A	Indo-Pacific Bead	15	Orange		Opaque
AKC01940	Phnom Borei	N/A	Indo-Pacific Bead	15	Red		Opaque
AKC01941	Phnom Borei	N/A	Indo-Pacific Bead	15	Red		Opaque
AKC01942	Phnom Borei	N/A	Indo-Pacific Bead	15	Red		Opaque
AKC01943	Phnom Borei	N/A	Indo-Pacific Bead	15	Red		Opaque
AKC01944	Phnom Borei	N/A	Indo-Pacific Bead	15	Red		Opaque
AKC01945	Phnom Borei	N/A	Indo-Pacific Bead	15	Red		Opaque
AKC01946	Phnom Borei	N/A	Indo-Pacific Bead	15	Red		Opaque
AKC01947	Phnom Borei	N/A	Indo-Pacific Bead	15	Red	Shiny surface	Opaque
AKC01948	Phnom Borei	N/A	Indo-Pacific Bead	15	Red	Shiny surface	Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Total # of beads	Glass Color	Glass Color Notes	Opacity
AKC01949	Phnom Borei	N/A	Indo-Pacific Bead	15	Red	Shiny surface	Opaque

Database ID	Excavation Unit	Level	Depth	Roundness Factor	Interior Perforation A	Interior Perforation B	Max. Length	Max. Width	Notes
AKC01901	II (Speed 3)	150-160	30/40	R1	1.05		2.13	2.73	Group of 10 glass bead. Also found with these was one stone pebble (burnishing stone?)
AKC01902	II (Speed 3)	150-160	30/40	R1	0.73		1.84	2.54	Group of 10 glass bead. Also found with these was one stone pebble (burnishing stone?)
AKC01903	II (Speed 3)	150-160	30/40	R1	1.21		1.92	2.89	Group of 10 glass bead. Also found with these was one stone pebble (burnishing stone?)
AKC01904	II (Speed 3)	150-160	30/40	R1	1.06		2.02	2.68	Group of 10 glass bead. Also found with these was one stone pebble (burnishing stone?)
AKC01905	II (Speed 3)	150-160	30/40	R2	1.67		2.33	5.06	Group of 10 glass bead. Also found with these was one stone pebble (burnishing stone?)
AKC01906	II (Speed 3)	150-160	30/40	R2	1.27		2.04	3.93	Group of 10 glass bead. Also found with these was one stone pebble (burnishing stone?)
AKC01907	II (Speed 3)	150-160	30/40	R2	1.54		3.48	4.85	Group of 10 glass bead. Also found with these was one stone pebble (burnishing stone?)
AKC01908	II (Speed 3)	150-160	30/40	R2	1.53		2.51	4.96	Group of 10 glass bead. Also found with these was one stone pebble (burnishing stone?)

Database ID	Excavation Unit	Level	Depth	Roundness Factor	Interior Perforation A	Interior Perforation B	Max. Length	Max. Width	Notes
AKC01909	II (Speed 3)	150-160	30/40	R2	1.03		3.65	3.83	Group of 10 glass bead. Also found with these was one stone pebble (burnishing stone?)
AKC01910	II (Speed 3)	150-160	30/40	R2	1.81		2	4.47	Group of 10 glass bead. Also found with these was one stone pebble (burnishing stone?)
AKC01912	II	192		R2	1.8		6.03	6.26	In report called a "dark brown bead"
AKC01913	II	169.5 (-120)	40-50 cm	R2	0.96		3.3	3.78	
AKC01914	I	150-160	30-40	R1	0.87		2.21	2.85	
AKC01915	Surface Collection			R2	1.17		1.59	3.53	
AKC01916	I	180-190	60-70	R2	1.05		2.74	3.13	
AKC01917	Test Pit		90-100	R1	0.86		1.1	3	
AKC01918	Test Pit		70-80 cm	R1	0		1.48	1.53	
AKC01919	II	140-150		R2	1.32		4.79	3.92	Group of 7 glass beads
AKC01920	II	140-150		R2	1.46		3.6	4.67	Group of 7 glass beads
AKC01921	II	140-150		R2	1.74		2.74	5	Group of 7 glass beads
AKC01922	II	140-150		R2	1.21		2.63	4.38	Group of 7 glass beads
AKC01923	II	140-150		R2	1.42		2.54	3.4	Group of 7 glass beads
AKC01924	II	140-150		R2	0		1.91	2.43	Group of 7 glass beads
AKC01925	II	140-150		R1	0.77		1.14	2.47	Group of 7 glass beads

Database ID	Excavation Unit	Level	Depth	Roundness Factor	Interior Perforation A	Interior Perforation B	Max. Length	Max. Width	Notes
AKC01926	I		10-20 cm	R1	0.65		2.29	3.4	9 glass beads, found with a piece of bronze
AKC01927	I		10-20 cm	R1	0		2.23	2.27	9 glass beads, found with a piece of bronze
AKC01928	I		10-20 cm	R2	1.25		3.08	3.62	9 glass beads, found with a piece of bronze
AKC01929	I		10-20 cm	R1	1.34		2.49	3.53	9 glass beads, found with a piece of bronze
AKC01930	I		10-20 cm	R2	1.2		2.93	3.61	9 glass beads, found with a piece of bronze
AKC01931	I		10-20 cm	R1	1.09		2.15	3.13	9 glass beads, found with a piece of bronze

Database ID	Excavation Unit	Level	Depth	Roundness Factor	Interior Perforation A	Interior Perforation B	Max. Length	Max. Width	Notes
AKC01932	I		10-20 cm	R1	0.94		2.58	2.42	9 glass beads, found with a piece of bronze
AKC01933	I		10-20 cm	R2	0.68		2.51	2.82	9 glass beads, found with a piece of bronze
AKC01934	I		10-20 cm	NA			2.81	3.27	9 glass beads, found with a piece of bronze
AKC01935	I		20-30	R2	1.48		4.55	4.06	15 glass beads, found with a possible piece of charcoal and broken bone.
AKC01936	I		20-30	R2	1.36		2.71	4.5	15 glass beads, found with a possible piece of charcoal and broken bone.
AKC01937	I		20-30	R1	1.31		1.9	3.82	15 glass beads, found with a possible piece of charcoal and broken bone.
AKC01938	I		20-30	R1	1.67		3.07	5.3	15 glass beads, found with a possible piece of charcoal and broken bone.
AKC01939	I		20-30	R1	1.71		3.26	4.24	15 glass beads, found with a possible piece of charcoal and broken bone.
AKC01940	I		20-30	R2	1.05	0.93	4.86	3.48	15 glass beads, found with a possible piece of charcoal and broken bone. Two beads stuck together?

Database ID	Excavation Unit	Level	Depth	Roundness Factor	Interior Perforation A	Interior Perforation B	Max. Length	Max. Width	Notes
AKC01941	I		20-30	R1	1.8		4.38	4.11	15 glass beads, found with a possible piece of charcoal and broken bone.
AKC01942	I		20-30	R1	0.8		3.36	3.15	15 glass beads, found with a possible piece of charcoal and broken bone.
AKC01943	I		20-30	R1	1.23		2.48	3.08	15 glass beads, found with a possible piece of charcoal and broken bone.
AKC01944	I		20-30	R2	1.12		2.76	2.93	15 glass beads, found with a possible piece of charcoal and broken bone.
AKC01945	I		20-30	R1	1.01		1.85	3.04	15 glass beads, found with a possible piece of charcoal and broken bone.
AKC01946	I		20-30	R1	0.98		3.18	3.04	15 glass beads, found with a possible piece of charcoal and broken bone.
AKC01947	I		20-30	R1	1.06		2.52	3.96	15 glass beads, found with a possible piece of charcoal and broken bone.
AKC01948	I		20-30	R1	0.74		2.1	2.78	15 glass beads, found with a possible piece of charcoal and broken bone.
AKC01949	I		20-30	R1	0.64		2.42	2.51	15 glass beads, found with a possible piece of charcoal and broken bone.

Appendix 7.1c: Glass Beads from Prei Khmeng

Database ID	Site Name	Bead Shape	Total # of beads	Context Notes	Glass Colors	Glass Color Notes	Opacity
AKC01501	Prei Khmeng	Indo-Pacific Seed Bead	1	PKB4-100	Yellow	shiny	Transparent
AKC01502	Prei Khmeng	Indo-Pacific Seed Bead	1	PKB4-101	Dark Blue	matte	Translucent
AKC01503	Prei Khmeng	Indo-Pacific Micro Bead	1	PKB4-102	Orange	Light orange color	Opaque
AKC01504	Prei Khmeng	Indo-Pacific Seed Bead	1	PKB4-103	Dark Blue		Translucent Transparent
AKC01505	Prei Khmeng	Indo-Pacific Seed Bead	1	PKB4-104	Black	shiny	Opaque
AKC01506	Prei Khmeng	Indo-Pacific Seed Bead	1	PKB4-105	Yellow		Transparent
AKC01507	Prei Khmeng	Indo-Pacific Micro Bead	1	PKB4-106	Orange		Opaque
AKC01508	Prei Khmeng	Indo-Pacific Micro Bead	1	PKB4-107	Black		Opaque
AKC01509	Prei Khmeng	Indo-Pacific Seed Bead	1	PKB4-108	Dark Blue	matte	Translucent Transparent
AKC01510	Prei Khmeng	Indo-Pacific Micro Bead	1	PKB4-109	Orange		Opaque
AKC01511	Prei Khmeng	Indo-Pacific Micro Bead	1	PKB4-110	Orange		Opaque
AKC01512	Prei Khmeng	Indo-Pacific Micro Bead	1	PKB4-111	Black	shiny	Opaque
AKC01513	Prei Khmeng	Indo-Pacific Seed Bead	1	PKB4-112	Yellow		Transparent
AKC01514	Prei Khmeng	Indo-Pacific Micro Bead	1	PKB4-113	Black	shiny	Opaque
AKC01515	Prei Khmeng	Indo-Pacific Micro Bead	1	PKB4-114	Black	shiny	Opaque
AKC01516	Prei Khmeng	Indo-Pacific Micro Bead	1	PKB4-115	Orange		Opaque
AKC01517	Prei Khmeng	Indo-Pacific Seed Bead	1	PKB2BD01	Dark Blue		Translucent
AKC01518	Prei Khmeng	Indo-Pacific Seed Bead	1	PKB2BD02	Dark Blue		Translucent Transparent
AKC01519	Prei Khmeng	Indo-Pacific Seed Bead	1	PKB2BD03	Dark Blue		Translucent Transparent
AKC01520	Prei Khmeng	Indo-Pacific Seed Bead	1	PKB2BD05	Dark Blue		Translucent Transparent

Database ID	Site Name	Bead Shape	Total # of beads	Context Notes	Glass Colors	Glass Color Notes	Opacity
AKC01521	Prei Khmeng	Indo-Pacific Seed Bead	1	PKB2BD06	Dark Blue		Translucent Transparent
AKC01522	Prei Khmeng	Indo-Pacific Seed Bead	1	PKB2BD07	Dark Blue		Translucent Transparent
AKC01523	Prei Khmeng	Indo-Pacific Seed Bead	1	PKB2BD07	Dark Blue		Translucent Transparent
AKC01524	Prei Khmeng	Indo-Pacific Seed Bead?	1	PKB2BD07	Yellow		Unknown
AKC01643	Prei Khmeng	Larger Indo-Pacific Bead	4	PKM 03 24030 Perle PV 1	Orange	matte	Opaque
AKC01644	Prei Khmeng	Indo-Pacific Micro Bead	4	PKM 03 24030 Perle PV 1	Orange	matte	Opaque
AKC01645	Prei Khmeng	Indo-Pacific Seed Bead	4	PKM 03 24030 Perle PV 1	Yellow		Opaque
AKC01646	Prei Khmeng	Indo-Pacific Seed Bead	4	PKM 03 24030 Perle PV 1	Light Blue	Turquoise	Transparent
AKC01647	Prei Khmeng	Indo-Pacific Micro Bead	4	PKM 03 24013 Perle PV1	Orange	matte	Opaque
AKC01648	Prei Khmeng	Indo-Pacific Seed Bead	4	PKM 03 24013 Perle PV1	Red		Opaque
AKC01649	Prei Khmeng	Indo-Pacific Seed Bead	4	PKM 03 24013 Perle PV1	Dark Blue		Translucent
AKC01650	Prei Khmeng	Indo-Pacific Micro Bead	4	PKM 03 24013 Perle PV1	Light Green		Opaque
AKC01651	Prei Khmeng	Indo-Pacific Seed Bead	50	PKM 03 21025 object 2	Dark Blue	Navy, shiny	Opaque
AKC01652	Prei Khmeng	Indo-Pacific Seed Bead	50	PKM 03 21025 object 2	Yellow		Opaque
AKC01653	Prei Khmeng	Indo-Pacific Seed Bead	50	PKM 03 21025 object 2	Yellow		Opaque
AKC01654	Prei Khmeng	Indo-Pacific Seed Bead	50	PKM 03 21025 object 2	Yellow		Opaque
AKC01655	Prei Khmeng	Indo-Pacific Seed Bead	50	PKM 03 21025 object 2	Yellow		Opaque
AKC01656	Prei Khmeng	Indo-Pacific Seed Bead	50	PKM 03 21025 object 2	Yellow		Opaque
AKC01657	Prei Khmeng	Indo-Pacific Seed Bead	50	PKM 03 21025 object 2	Yellow		Opaque
AKC01658	Prei Khmeng	Indo-Pacific Seed Bead	50	PKM 03 21025 object 2	Dark blue		Semi-Translucent
AKC01659	Prei Khmeng	Indo-Pacific Seed Bead	50	PKM 03 21025 object 2	Dark blue		Semi-Translucent
AKC01660	Prei Khmeng	Indo-Pacific Seed Bead	50	PKM 03 21025 object 2	Dark blue		Semi-Translucent
AKC01661	Prei Khmeng	Indo-Pacific Seed Bead	50	PKM 03 21025 object 2	Dark blue		Semi-Translucent
AKC01662	Prei Khmeng	Indo-Pacific Seed Bead	50	PKM 03 21025 object 2	Dark blue		Semi-Translucent

Database ID	Site Name	Bead Shape	Total # of beads	Context Notes	Glass Colors	Glass Color Notes	Opacity
AKC01663	Prei Khmeng	Indo-Pacific Seed Bead	50	PKM 03 21025 object 2	Dark blue		Semi-Translucent
AKC01664	Prei Khmeng	Indo-Pacific Seed Bead	50	PKM 03 21025 object 2	Dark blue		Semi-Translucent
AKC01665	Prei Khmeng	Indo-Pacific Long Tube	1	PKM 03 22009 (2)	Red	Dark red	Opaque
AKC01666	Prei Khmeng	Indo-Pacific Micro Bead	1	PKM03 22026 (2) bead	Light Blue	Light Turquoise	Translucent Transparent
AKC01667	Prei Khmeng	Indo-Pacific Micro Bead	1	PKM03 22022 Bead 7	Dark Blue	Navy blue	Translucent Transparent
AKC01668	Prei Khmeng	Indo-Pacific Seed Bead	2	PKM 03 22018 (9)	Dark Green	shiny	Opaque
AKC01669	Prei Khmeng	Indo-Pacific Seed Bead	2	PKM 03 22018 (9)	Dark Blue	Dark Turquoise	Translucent Transparent
AKC01670	Prei Khmeng	Indo-Pacific Seed Bead	1	PKM 03 21010	Dark Blue	Navy blue	Transparent
AKC01671	Prei Khmeng	Indo-Pacific Seed Bead	1	PKM 03 21062	Orange	shiny	Opaque
AKC01672	Prei Khmeng	Indo-Pacific Seed Bead	2	PKM 03 21031 PV3	Yellow		Opaque
AKC01673	Prei Khmeng	Indo-Pacific Micro Bead	2	PKM 03 21031 PV3	Orange	shiny	Opaque
AKC01674	Prei Khmeng	Indo-Pacific Seed Bead	1	PKM 03 21039	Red		Opaque
AKC01675	Prei Khmeng	Indo-Pacific Micro Bead	1	PKM 0321060	Orange		Opaque
AKC01676	Prei Khmeng	Indo-Pacific Micro Bead	1	PKM 03 21030 PV 3	Light Blue	light turquoise	Transparent
AKC01677	Prei Khmeng	Indo-Pacific Long Tube	1	PKM 03 21044 PV1	Light Green		Opaque
AKC01678	Prei Khmeng	Indo-Pacific Seed Bead	1	PKM 03 21024 TAMIS	Orange		Opaque
AKC01679	Prei Khmeng	Indo-Pacific Bead	4	PKM 03 21052	Orange	matte	Opaque
AKC01680	Prei Khmeng	Indo-Pacific Micro Bead	4	PKM 03 21052	Orange	matte	Opaque
AKC01681	Prei Khmeng	Indo-Pacific Micro Bead	4	PKM 03 21052	Orange	matte	Opaque
AKC01682	Prei Khmeng	Indo-Pacific Micro Bead	4	PKM 03 21052	Orange	shiny	Opaque
AKC01683	Prei Khmeng	Indo-Pacific Bead	2	PKM 03 21038 PV. 1	Dark Blue		Transparent
AKC01684	Prei Khmeng	Indo-Pacific Seed Bead	2	PKM 03 21038 PV. 1	Dark Blue		Transparent
AKC01685	Prei Khmeng	Indo-Pacific Bead	1	PKM 03 21038	Orange	matte	Opaque
AKC01686	Prei Khmeng	Indo-Pacific Long Tube	1	PKM 03 21052	Red		Opaque

Database ID	Site Name	Bead Shape	Total # of beads	Context Notes	Glass Colors	Glass Color Notes	Opacity
AKC01687	Prei Khmeng	Larger Indo-Pacific Bead	1	PKM 03 21065	Orange		Opaque
AKC01688	Prei Khmeng	Indo-Pacific Bead	1	PKM 01 12102	Light Green		Opaque
AKC01689	Prei Khmeng	Indo-Pacific Bead?	1	PKM 01 16016	Yellow		Opaque
AKC01690	Prei Khmeng	Indo-Pacific Bead?	1	PKM 01 16016	Unknown		Opaque
AKC01691	Prei Khmeng	Indo-Pacific Seed Bead	1	PKM 01 15006	Red		Opaque
AKC01692	Prei Khmeng	Larger Indo-Pacific Bead	1	PKM 01 12087 mislabelled as "cornaline?"	Red		Opaque
AKC01693	Prei Khmeng	Indo-Pacific Bead	1	PKM 01 15062	Orange		Opaque
AKC01694	Prei Khmeng	Indo-Pacific Bead	1	PKM 01 12096	Dark Blue		Transparent
AKC01695	Prei Khmeng	Indo-Pacific Bead?	1	PKM 01 12067	Dark Blue	Difficult to determine color	Translucent
AKC01696	Prei Khmeng	Larger Indo-Pacific Bead	1	PKM 01 12085 mislabelled as "cornaline?"	Red	shiny	Opaque
AKC01697	Prei Khmeng	Indo-Pacific Bead	4	PKM 01 15021 beads on right hand	Yellow		Opaque
AKC01698	Prei Khmeng	Indo-Pacific Bead	4	PKM 01 15021 beads on right hand	Yellow		Opaque
AKC01699	Prei Khmeng	Indo-Pacific Long Tube	4	PKM 01 15021 beads on right hand	Dark Blue		Opaque Semi-Translucent
AKC01700	Prei Khmeng	JMK06- Short Bicone	4	PKM 01 15021 beads on right hand	Black/Red	with red trim	Opaque
AKC01701	Prei Khmeng	Indo-Pacific Long Tube	1	PKM01 16016 23.601 bead in burial	Yellow		Opaque

Database ID	Site Name	Bead Shape	Total # of beads	Context Notes	Glass Colors	Glass Color Notes	Opacity
AKC01702	Prei Khmeng	Indo-Pacific Seed Bead	11	PKM 01 16016 beads from shoulder of small skeleton	Dark Blue	Navy blue	Transparent
AKC01703	Prei Khmeng	Indo-Pacific Seed Bead	11	PKM 01 16016 beads from shoulder of small skeleton	Dark Blue	Navy blue	Transparent
AKC01704	Prei Khmeng	Indo-Pacific Seed Bead	11	PKM 01 16016 beads from shoulder of small skeleton	Dark Blue	Navy blue	Transparent
AKC01705	Prei Khmeng	Indo-Pacific Seed Bead	1	PKM 03 23097/98 -3- perde	Light Green		Opaque
AKC01706	Prei Khmeng	Indo-Pacific Seed Bead	2	PKM 03 23039/ 40-1 24102/03	Yellow		Opaque
AKC01707	Prei Khmeng	Indo-Pacific Micro Bead	2	PKM 03 23039/ 40-1 24102/03	Orange		Opaque
AKC01708	Prei Khmeng	Indo-Pacific Seed Bead	1	PKM 03 23031 - 1 Tamigant	Red	matte	Opaque
AKC01709	Prei Khmeng	Indo-Pacific Long Tube	1	PKM 03 22030	Orange		Opaque
AKC01710	Prei Khmeng	Unknown	2	PKM 03 23025-1	Light Green	green-yellow	Opaque
AKC01711	Prei Khmeng	Unknown	2	PKM 03 23025-1	Light Green	green-yellow	Opaque
AKC01712	Prei Khmeng	Indo-Pacific Seed Bead	1	PKM 2003 23037	Red		Opaque
AKC01713	Prei Khmeng	Indo-Pacific Long Tube	4	PKM 03 23037 -3	Orange		Opaque
AKC01714	Prei Khmeng	Larger Indo-Pacific Bead	4	PKM 03 23037 -3	Red		Opaque
AKC01717	Prei Khmeng	Indo-Pacific Seed Bead	4	PKM 03 23037	Dark Blue		Transparent
AKC01718	Prei Khmeng	Indo-Pacific Seed Bead	4	PKM 03 23037	Light Blue	Light Turquoise	Transparent

Database ID	Site Name	Bead Shape	Total # of beads	Context Notes	Glass Colors	Glass Color Notes	Opacity
AKC01719	Prei Khmeng	Indo-Pacific Bead	4	PKM 03 23037	Light Blue	Light Turquoise, shiny	Opaque
AKC01720	Prei Khmeng	Indo-Pacific Micro Bead	4	PKM 03 23037	Red		Opaque
AKC01722	Prei Khmeng	Indo-Pacific Seed Bead	4	PKM 03 21040	Dark Blue	Navy blue	Translucent Semi-Translucent
AKC01723	Prei Khmeng	Indo-Pacific Seed Bead	4	PKM 03 21040	Dark Blue	Navy blue	Translucent Semi-Translucent
AKC01724	Prei Khmeng	Indo-Pacific Seed Bead	4	PKM 03 21040	Light Blue	Light Turquoise	Semi-Translucent
AKC01725	Prei Khmeng	Indo-Pacific Seed Bead	4	PKM 03 21040 Associated with burial of BONY 3	Dark Blue?	Dark Blue- Green?	Semi-Translucent Opaque
AKC01726	Prei Khmeng	Indo-Pacific Seed Bead	3	PKM 03 21040 PV7	Red		Opaque
AKC01727	Prei Khmeng	Indo-Pacific Seed Bead	3	PKM 03 21040 PV7	Dark Blue		Semi-Translucent
AKC01728	Prei Khmeng	Indo-Pacific Seed Bead	3	PKM 03 21040 PV7	Dark Blue		Semi-Translucent
AKC01729	Prei Khmeng	Indo-Pacific Micro Bead	2	PKM03 21040 PV3 petit tas	Red		Opaque
AKC01730	Prei Khmeng	Indo-Pacific Micro Bead	2	PKM03 21040 PV3 petit tas	Red		Opaque
AKC01731	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Black	shiny	Opaque
AKC01732	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Black	shiny	Opaque
AKC01733	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Black	shiny	Opaque
AKC01734	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Brown		Semi-Translucent Translucent

Database ID	Site Name	Bead Shape	Total # of beads	Context Notes	Glass Colors	Glass Color Notes	Opacity
AKC01735	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Brown		Semi-Translucent Translucent
AKC01736	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Brown		Semi-Translucent Translucent
AKC01737	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Brown		Semi-Translucent Translucent
AKC01738	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Yellow		Opaque
AKC01739	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Yellow		Opaque
AKC01740	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Yellow		Opaque
AKC01741	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Yellow		Opaque
AKC01742	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Yellow		Translucent
AKC01743	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Yellow		Translucent
AKC01744	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Red		Opaque
AKC01745	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Red		Opaque

Database ID	Site Name	Bead Shape	Total # of beads	Context Notes	Glass Colors	Glass Color Notes	Opacity
AKC01746	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Dark Green		Opaque
AKC01747	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Dark Green		Opaque
AKC01748	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Light Blue	Light Turquoise	Semi-Translucent
AKC01749	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Light Blue	Light Turquoise	Semi-Translucent
AKC01750	Prei Khmeng	Indo-Pacific Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3			
AKC01751	Prei Khmeng	Indo-Pacific Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Light Blue	light blue-green turquoise	Semi-Translucent
AKC01752	Prei Khmeng	Larger Indo-Pacific Bead (JMK 04-Short Barrel)	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Light Blue	light blue-green turquoise	Semi-Translucent
AKC01753	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Dark Blue	Intense blue color	Translucent Transparent
AKC01754	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Dark Blue	Intense blue color	Translucent Transparent
AKC01755	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Dark Blue		Translucent Transparent
AKC01756	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Dark Blue		Translucent Transparent

Database ID	Site Name	Bead Shape	Total # of beads	Context Notes	Glass Colors	Glass Color Notes	Opacity
AKC01757	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Dark Blue	Navy blue	Translucent
AKC01758	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Dark Blue	Navy blue	Translucent
AKC01759	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Dark Blue	Navy blue	Translucent
AKC01760	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Dark Blue	Navy blue	Translucent
AKC01761	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Dark Blue	Navy blue	Translucent
AKC01762	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Dark Blue	Navy blue	Translucent
AKC01763	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Dark Blue	Navy blue	Translucent
AKC01764	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Black		Transparent Translucent
AKC01765	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Black		Transparent Translucent
AKC01766	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Black		Transparent Translucent
AKC01767	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Grey		Opaque

Database ID	Site Name	Bead Shape	Total # of beads	Context Notes	Glass Colors	Glass Color Notes	Opacity
AKC01768	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Black		Translucent Transparent
AKC01769	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Black		Translucent Semi-Translucent
AKC01770	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Black		Translucent Semi-Translucent
AKC01771	Prei Khmeng	Indo-Pacific Seed Bead	135	PKM03 21040 object No 9 Associated with Burial of BONY 3	Black		Translucent
AKC01772	Prei Khmeng	Indo-Pacific Seed Bead	23	PKM 03 21045	Brown	violet/brown?	Translucent
AKC01773	Prei Khmeng	Indo-Pacific Seed Bead	23	PKM 03 21045	Black		Opaque
AKC01774	Prei Khmeng	Indo-Pacific Seed Bead	23	PKM 03 21045	Dark Blue		Translucent Semi-Translucent
AKC01775	Prei Khmeng	Indo-Pacific Seed Bead	23	PKM 03 21045	Yellow		Translucent
AKC01776	Prei Khmeng	Indo-Pacific Seed Bead	23	PKM 03 21045	Yellow		Translucent
AKC01777	Prei Khmeng	Indo-Pacific Seed Bead	23	PKM 03 21045	Yellow		Translucent
AKC01778	Prei Khmeng	Indo-Pacific Seed Bead	23	PKM 03 21045	Yellow		Translucent
AKC01779	Prei Khmeng	Indo-Pacific Micro Bead	1078	PKM 03 21045 Object 1	Yellow		Opaque
AKC01780	Prei Khmeng	Indo-Pacific Micro Bead	1078	PKM 03 21045 Object 1	Orange		Opaque
AKC01781	Prei Khmeng	Indo-Pacific Micro Bead	1078	PKM 03 21045 Object 1	Orange		Opaque
AKC01782	Prei Khmeng	Indo-Pacific Micro Bead	1078	PKM 03 21045 Object 1	Orange	Dark orange	Opaque
AKC01783	Prei Khmeng	Indo-Pacific Micro Bead	1078	PKM 03 21045 Object 1	Orange	Dark orange	Opaque
AKC01784	Prei Khmeng	Indo-Pacific Micro Bead	1078	PKM 03 21045 Object 1	Orange		Opaque
AKC01785	Prei Khmeng	Indo-Pacific Micro Bead	1078	PKM 03 21045 Object 1	Orange		Opaque
AKC01786	Prei Khmeng	Indo-Pacific Micro Bead	1078	PKM 03 21045 Object 1	Orange		Opaque
AKC01787	Prei Khmeng	Indo-Pacific Micro Bead	1078	PKM 03 21045 Object 1	Orange		Opaque

Database ID	Site Name	Bead Shape	Total # of beads	Context Notes	Glass Colors	Glass Color Notes	Opacity
AKC01788	Prei Khmeng	Indo-Pacific Micro Bead	1078	PKM 03 21045 Object 1	Orange		Opaque
AKC01789	Prei Khmeng	Indo-Pacific Micro Bead	1078	PKM 03 21045 Object 1	Orange		Opaque
AKC01790	Prei Khmeng	Indo-Pacific Micro Bead	649	PKM 03 21045	Black		Opaque
AKC01791	Prei Khmeng	Indo-Pacific Micro Bead	649	PKM 03 21045	Black		Opaque
AKC01792	Prei Khmeng	Indo-Pacific Micro Bead	649	PKM 03 21045	Black		Opaque
AKC01793	Prei Khmeng	Indo-Pacific Micro Bead	649	PKM 03 21045	Black		Opaque
AKC01794	Prei Khmeng	Indo-Pacific Micro Bead	649	PKM 03 21045	Black		Opaque
AKC01795	Prei Khmeng	Indo-Pacific Micro Bead	649	PKM 03 21045	Black		Opaque
AKC01796	Prei Khmeng	Indo-Pacific Micro Bead	649	PKM 03 21045	Black		Opaque
AKC01797	Prei Khmeng	Indo-Pacific Micro Bead	649	PKM 03 21045	Black		Opaque
AKC01798	Prei Khmeng	Indo-Pacific Micro Bead	649	PKM 03 21045	Black		Opaque
AKC01799	Prei Khmeng	Indo-Pacific Micro Bead	649	PKM 03 21045	Black		Opaque
AKC01807	Prei Khmeng	Indo-Pacific Bead?	9	PKM Bony 2 burial	Multiple	Yellow, green, black, blue	
AKC01808	Prei Khmeng	Indo-Pacific Seed Bead	7	PKM Bony 2 burial	Dark Blue		Translucent Transparent
AKC01809	Prei Khmeng	Indo-Pacific Seed Bead	7	PKM Bony 2 burial	Dark Blue		Translucent Transparent

Database ID	Roundness Factor	Interior Perf.	Max. Length	Max. Width	Thickness	Notes
AKC01501	R1	0.99	2.74	2.75		From Latinis EDXRF Report Associated with B4 BonyIV burial
AKC01502	R2	0.86	2.09	3.22		
AKC01503	R2	0	1.58	1.83		
AKC01504	R1	1.13	1.41	3.13		
AKC01505	R1	0	1.73	1.84		
AKC01506	R1	1.04	1.7	3.15		
AKC01507	R1	0.76	1.54	1.81		
AKC01508	R1	0	1.34	1.71		
AKC01509	R2	0.85	1.69	2.86		
AKC01510	R1	0.81	1.41	2.04		
AKC01511	R2	0.72	1.86	1.91		
AKC01512	R1	0	1.13	1.67		
AKC01513	R1	0.58	1.81	2.95		
AKC01514	R1	0	1.5	1.45		
AKC01515	R1	0	1.31	1.71		
AKC01516	R1	0	1.37	1.81		
AKC01517	R2	0.92	1.54	2.83		From Latinis EDXRF Report Associated with B2 Bony II burial
AKC01518	R2	0.93	2.6	2.44		
AKC01519	R2	0.88	1.7	2.82		
AKC01520	R2	0.85	1.75	3.02		
AKC01521	R2	0.75	1.5	2.62		
AKC01522	R1	0.87	1.58	2.46		
AKC01523	R2	0.79	1.6	2.56		
AKC01524	N/A	0	0	0		
AKC01643	R2	0	4.66	0		
AKC01644	R1	0	1	1.47		

Database ID	Roundness Factor	Interior Perf.	Max. Length	Max. Width	Thickness	Notes
AKC01645	R2	0.9	2.06	3.16		
AKC01646	R2	1.11	2.01	3.23		
AKC01647	R2	0	1.65	1.42		Hole is too small to measure.
AKC01648	R2	0.78	1.59	2.67		
AKC01649	R2	0.88	1.78	2.89		
AKC01650	R2	0.67	1.3	2.34		
AKC01651	R2	1.17	2.23	3.66		Beads are associated with some sort of metal (?) object and several beads are embedded in it. Also present are few bronze pieces (ring or bracelet?)
						Measured 1 dark blue bead, 6 of 23 yellow beads, and 7 of 26 light blue beads.
AKC01652	R2	0	2.72	2.58		
AKC01653	R2	0.91	2.06	3.07		
AKC01654	R2	0.69	2.04	2.73		
AKC01655	R2	1.09	1.59	3.3		
AKC01656	R3	0	2.18	2.57		
AKC01657	R3	0.6	2.15	2.76		
AKC01658	R2	0.81	2.1	2.79		Beads are associated with some sort of metal (?) object and several beads are embedded in it. Also present are few bronze pieces (ring or bracelet?)
						Measured 1 dark blue bead, 6 of 23 yellow beads, and 7 of 26 light blue beads.
AKC01659	R2	0.96	1.72	2.71		
AKC01660	R2	1.2	1.82	3.64		
AKC01661	R2	0.9	1.37	2.86		
AKC01662	R2	0.92	1.58	3.08		
AKC01663	R2	0.8	1.99	3.05		
AKC01664	R2	0.91	1.62	3.02		

Database ID	Roundness Factor	Interior Perf.	Max. Length	Max. Width	Thickness	Notes
AKC01665	R2	0.97	5.61	2.89		
AKC01666	N/A	N/A	N/A	N/A		Fragment, unable to measure
AKC01667	R1	0.66	1.18	2.25		
AKC01668	R3	0.71	1.95	2.7		
AKC01669	R2	1.07	1.65	3.18		
AKC01670	R1	0.93	1.77	2.83		In layer associated with abandonment of domestic activities and accumulation of mound. Ceramics also found.
AKC01671	R1	0.58	1.1	2.38		Posthole/pit
AKC01672	R3	0.71	2.54	3.56		Large layer in which burials were found
AKC01673	R1	0.57	1.29	2.13		Large layer in which burials were found
AKC01674	R1	1.45	2.15	4.38		Posthole context
AKC01675	R1	N/A	1.85	1.58		Hole is too small to measure context: posthole
AKC01676	R1	0.81	0.88	2.19		Posthole context
AKC01677	R2	0.99	4.56	2.98		
AKC01678	R1	0.79	2.03	2.26		Posthole context
AKC01679	R1	1.1	2.41	3.36		"La Fosse" part of group of stratigraphic units associated with one another: 21052-21044-21038
AKC01680	R1	0.76	1.07	2.24		
AKC01681	R1	N/A	1	1.84		
AKC01682	R1	N/A	2.26	1.82		
AKC01683	R1	1.16	2.81	4.61		
AKC01684	N/A	0	0	0		
AKC01685	R2	1.17	2.78	3.94		
AKC01686	R1	0	5.42	2.65		
AKC01687	R2	1.85	4.16	6.65		Posthole context
AKC01688	R1	0	2.73	4.74		

Database ID	Roundness Factor	Interior Perf.	Max. Length	Max. Width	Thickness	Notes
AKC01689	N/A	N/A	N/A	N/A		Fragmented bead
AKC01690	N/A	N/A	N/A	N/A		Fragmented bead
AKC01691	R1	0.89	1.31	2.6		Area with 2 complete pots in a layer above a burial?
AKC01692	R2	1.29	4.53	6.29		Occupation phase, found with charcoal (?)
AKC01693	R2	1.01	2.5	4.14		Posthole context
AKC01694	R2	0.97	2.45	3.95		
AKC01695	N/A	N/A	N/A	N/A		Fragmented bead. Related to an occupation?
AKC01696	R2	1.39	4.64	6.32		May be associated with a brick hearth?
AKC01697	R2	0.9	3.44	4.31		4 beads associated with a burial
AKC01698	R2	0.83	2.84	4.35		4 beads associated with a burial
AKC01699	R1	0.65	2.52	2.25		4 beads associated with a burial
AKC01700	R1	1.18	2.59	6.46		4 beads associated with a burial
AKC01701	R2	N/A	9.47	5.95		Fragile bead, did not measure bead hole
AKC01702	R2	1.01	2.34	3.13		Measured 3 of 11 similar beads
AKC01703	R1	0.75	1.12	2.45		Measured 3 of 11 similar beads
AKC01704	R1	0.88	1.8	2.71		Measured 3 of 11 similar beads
AKC01705	R2	1.01	2.84	4.16		
AKC01706	R1	1.08	2.65	4.43		
AKC01707	R1	0.83	1.21	2.34		
AKC01708	R1	1.04	1.66	2.96		
AKC01709	R1	1.34	7.18	3.52		
AKC01710	N/A	N/A	5.56	4.86	2.18	No hole, glass?
AKC01711	N/A		8.87	3.81	4.41	Glass?
AKC01712	R1	1.02	1.56	2.91		
AKC01713	R1	1.04	6.55	3.32		

Database ID	Roundness Factor	Interior Perf.	Max. Length	Max. Width	Thickness	Notes
AKC01714	R2	1.27	7.78	6.9		
AKC01717	R1	0.8	1.13	2.61		
AKC01718	R1	0.78	1.2	2.67		
AKC01719	R1	1.15	2.86	4.11		
AKC01720	R1	0	1.15	1.67		
AKC01722	R2	1.05	1.81	3.04		Burial context
AKC01723	R1	1.01	1.83	2.99		Burial context
AKC01724	R1	0.8	1.13	2.26		Burial context
AKC01725	R1	0	1.45	0		Burial context
AKC01726	R1	0.82	1.26	2.22		Note on inventory says: 3 perles en verre dans le sediment proche du squelette From a burial context.
AKC01727	R1	0.78	1.53	2.49		
AKC01728	R1	N/A	1.49	0		
AKC01729	R1	N/A	1.19	1.48		
AKC01730	R1	N/A	1.24	1.6		
AKC01731	R1	0.91	1.19	2.15		From a group of 135 beads. Measured 3 of 9 black beads, 4 of 16 brown/violet beads, 5 of 16 opaque yellow beads, 2 translucent yellow beads, 2 of 5 opaque red beads, 2 of 7 light blue beads, 2 larger light bluebeads, 2 of 5 dark green beads, 2 of 6 blue-green beads, 2 of 5 dark blue beads, 7 of 28 dark (navy) blue beads, 8 of 33 grey beads. Not measured were fragments of blue glass beads.
AKC01732	R2	0.6	2.65	2.14		
AKC01733	R1	0.64	1.19	1.91		
AKC01734	R1	0.75	2.01	2.65		
AKC01735	R2	0.75	2.19	3.06		
AKC01736	R1	0.94	2.15	3.23		

Database ID	Roundness Factor	Interior Perf.	Max. Length	Max. Width	Thickness	Notes
AKC01737	R1	1.21	1.89	3.62		
AKC01738	R2	1.06	1.89	3.12		
AKC01739	R2	0.97	2.85	3.21		
AKC01740	R2	0.83	1.64	2.64		
AKC01741	R2	0.81	1.91	2.98		
AKC01742	R1	0.88	1.96	2.72		
AKC01743	R2	1.15	2.59	3.39		
AKC01744	R2	0.85	1.75	3		
AKC01745	R2	0.9	2.41	3.11		
AKC01746	R2	0	2.43	1.99		From a group of 135 beads. Measured 3 of 9 black beads, 4 of 16 brown/violet beads, 5 of 16 opaque yellow beads, 2 translucent yellow beads, 2 of 5 opaque red beads, 2 of 7 light blue beads, 2 larger light bluebeads, 2 of 5 dark green beads, 2 of 6 blue-green beads, 2 of 5 dark blue beads, 7 of 28 dark (navy) blue beads, 8 of 33 grey beads. Not measured were fragments of blue glass beads.
AKC01747	R1	0	1.78	2.78		
AKC01748	R1	0.77	1.21	2.36		
AKC01749	R1	0.72	1.71	2.56		
AKC01750		1.25	3.6	3.23		
AKC01751	R1	1.17	2.5	4.24		
AKC01752	R2	1.12	6.35	6.72		
AKC01753	R1	0.91	1.51	3.06		
AKC01754	R1	0.8	1.22	2.6		
AKC01755	R1	0.79	1.23	2.55		
AKC01756	R1	0.82	1.69	2.53		
AKC01757	R1	0.91	1.84	2.89		
AKC01758	R2	0	2.37	2.22		

Database ID	Roundness Factor	Interior Perf.	Max. Length	Max. Width	Thickness	Notes
AKC01759	R1	0.84	1.61	2.74		
AKC01760		0.78	1.63	2.73		
AKC01761	R1	0.83	1.83	3.04		
AKC01762	R1	0.92	1.68	2.89		From a group of 135 beads. Measured 3 of 9 black beads, 4 of 16 brown/violet beads, 5 of 16 opaque yellow beads, 2 translucent yellow beads, 2 of 5 opaque red beads, 2 of 7 light blue beads, 2 larger light bluebeads, 2 of 5 dark green beads, 2 of 6 blue-green beads, 2 of 5 dark blue beads, 7 of 28 dark (navy) blue beads, 8 of 33 grey beads. Not measured were fragments of blue glass beads.
AKC01763	R1	0.78	1.81	2.64		
AKC01764	R1	0.94	2.01	2.92		
AKC01765	R1	0.73	1.76	2.58		
AKC01766	R1	0.8	1.88	2.93		
AKC01767	R1	1.11	1.94	3.47		
AKC01768	R1	0.82	1.06	2.28		
AKC01769	R1	0.98	1.99	2.53		
AKC01770	R1	0.72	1.86	2.54		
AKC01771	R1	1.16	1.74	2.95		
AKC01772	R1	0.7	1.57	2.93		Group of 23 beads. Measured 1 of 3 black beads, 1 brown bead, 1 of 3 dark blue beads, 4 of 16 translucent yellow beads. Associated with burial context
AKC01773	R1	1.2	2.16	3.26		
AKC01774	R1	1.41	1.84	3.92		
AKC01775	R1	0.8	2.06	2.84		
AKC01776	R2	0	2.21	2.9		
AKC01777	R1	0	1.95	2.41		
AKC01778	R1	1.14	1.87	3.27		

Database ID	Roundness Factor	Interior Perf.	Max. Length	Max. Width	Thickness	Notes
AKC01779	R1	0	1.09	2.03		From a group of 1078 orange beads Burial Context
AKC01780	R1	0.72	1.84	2.22		
AKC01781	R1	0.62	1.37	2.07		
AKC01782	R1	1.04	1.66	2.7		
AKC01783	R1	1.12	1.67	2.16		
AKC01784	R1	0.83	1.96	2.4		
AKC01785	R1	0.73	2.07	1.87		
AKC01786	R1	0.96	1.41	2.56		
AKC01787	R1	0.72	1.85	1.89		
AKC01788	R1	0.68	1.11	1.96		
AKC01789	R1	0	1.21	1.81		
AKC01790	R0	0.73	1.44	1.83		Measured 10 of 649 black beads. Burial context
AKC01791	R1	0.93	1.3	2.83		
AKC01792	R1	0	1.91	1.86		
AKC01793	R1	0.71	1.75	2.06		
AKC01794	R1	0.67	2.64	1.94		
AKC01795	R1	0.84	1.13	1.77		
AKC01796	R1	N/A	1.11	1.28		
AKC01797	R1	N/A	1.77	1.7		
AKC01798	R1	N/A	1.79	1.51		
AKC01799	R1	N/A	1.26	1.5		

Database ID	Roundness Factor	Interior Perf.	Max. Length	Max. Width	Thickness	Notes
AKC01807	N/A	N/A	N/A	N/A		Group of disintegrated beads from Bony 2 burial at Prei Khmeng. Beads were from child skeleton that was analyzed in Singapore. All beads are destroyed and fragmented. Christophe Pottier said they were round IP beads 6 bags of yellow opaque bead fragments 1 bag with just a few black opaque bead fragments 2 bags of a blue or green bead fragments.
AKC01808	R1	0.89	1.39	2.86		Measured 2 of 7 blue beads from Bony 2 burial that were analyzed in Singapore. Not measured- a group of blue bead fragments.
AKC01809	R1	0.95	1.67	2.86		Measured 2 of 7 blue beads from Bony 2 burial that were analyzed in Singapore. Not measured- a group of blue bead fragments.

Appendix 7.1d: Glass beads from Prohear and Bit Meas

Database ID	Site Name	Catalogue Number	Unit	Square	Bead Shape	Total # of beads
AKC00441	Prohear	N/A			Ring	1
AKC00442	Prohear	6	A	I-K/116-117	Ring	1
AKC00443	Prohear	20	A	I-K/116-117	Indo-Pacific bead (tubular shape)	9
AKC00444	Prohear	20	A	I-K/116-117	Indo-Pacific bead (tubular shape)	9
AKC00445	Prohear	20	A	I-K/116-117	Indo-Pacific bead (tubular shape)	9
AKC00446	Prohear	20	A	I-K/116-117	Indo Pacific Bead	9
AKC00447	Prohear	20	A	I-K/116-117	Indo-Pacific bead (tubular shape)	9
AKC00448	Prohear	20	A	I-K/116-117	Indo-Pacific bead (tubular shape)	9
AKC00449	Prohear	20	A	I-K/116-117	Indo-Pacific bead (tubular shape)	9
AKC00450	Prohear	20	A	I-K/116-117	Indo Pacific Bead	9
AKC00451	Prohear	20	A	I-K/116-117	Indo Pacific Bead	9
AKC00452	Prohear	2	A	L-M/114-115	Indo-Pacific bead (tubular shape)	1
AKC00453	Prohear	5	A	I-K/112-113	Indo-Pacific bead (tubular shape)	3
AKC00454	Prohear	5	A	I-K/112-115	Indo-Pacific bead (tubular shape)	3
AKC00455	Prohear	5	A	I-K/112-115	Indo-Pacific bead (tubular shape)	3
AKC00456	Prohear	10	A	I-K/112-113	Indo-Pacific bead (tubular shape)	1
AKC00457	Prohear	6	A	L/114-115	Indo-Pacific bead (tubular shape)	5
AKC00458	Prohear	6	A	L/114-115	Indo-Pacific bead (tubular shape)	5
AKC00459	Prohear	6	A	L/114-115	Indo-Pacific bead (tubular shape)	5
AKC00460	Prohear	6	A	L/114-115	Indo-Pacific bead (tubular shape)	5
AKC00461	Prohear	6	A	L/114-115	Indo-Pacific bead (tubular shape)	5
AKC00462	Prohear	11	A	K/114	Indo-Pacific bead (tubular shape)	1
AKC00463	Prohear	10	A	L-M/116-117	Indo Pacific Bead	1
AKC00464	Prohear	6	A	I-K/114-115	Ring/Earring	2

Database ID	Site Name	Catalogue Number	Unit	Square	Bead Shape	Total # of beads
AKC00465	Prohear	6	A	I-K/114-115	Ring/Earring	2
AKC00466	Prohear	80	A	I-K/106-107	Indo-Pacific bead (tubular shape)	7
AKC00467	Prohear	80	A	I-K/106-107	Indo-Pacific bead (tubular shape)	7
AKC00468	Prohear	80	A	I-K/106-107	Indo-Pacific bead (tubular shape)	7
AKC00469	Prohear	80	A	I-K/106-107	Indo-Pacific bead (tubular shape)	7
AKC00470	Prohear	80	A	I-K/106-107	Indo-Pacific bead (tubular shape)	7
AKC00471	Prohear	80	A	I-K/106-107	Indo-Pacific bead (tubular shape)	7
AKC00472	Prohear	80	A	I-K/106-107	Indo-Pacific bead (tubular shape)	7
AKC00473	Prohear	41	A	I-K/112-113	Indo-Pacific bead	92
AKC00474	Prohear	41	A	I-K/112-113	Indo-Pacific bead	92
AKC00475	Prohear	41	A	I-K/112-113	Indo-Pacific bead	92
AKC00476	Prohear	41	A	I-K/112-113	Indo-Pacific bead	92
AKC00477	Prohear	41	A	I-K/112-113	Indo-Pacific bead	92
AKC00478	Prohear	41	A	I-K/112-113	Indo-Pacific bead	92
AKC00479	Prohear	41	A	I-K/112-113	Indo-Pacific bead	92
AKC00480	Prohear	41	A	I-K/112-113	Indo-Pacific bead	92
AKC00481	Prohear	41	A	I-K/112-113	Indo-Pacific bead	92
AKC00482	Prohear	41	A	I-K/112-113	Indo-Pacific bead	92
AKC00483	Prohear	8	A	I-K/112-113	Indo-Pacific Bead	2
AKC00484	Prohear	8	A	I-K/112-113	Indo-Pacific Bead	2
AKC00485	Prohear	54	A	IK/112-113	Indo-Pacific bead	44
AKC00486	Prohear	54	A	IK/112-113	Indo-Pacific bead	44
AKC00487	Prohear	54	A	IK/112-113	Indo-Pacific bead	44
AKC00488	Prohear	54	A	IK/112-113	Indo-Pacific bead	44
AKC00489	Prohear	54	A	IK/112-113	Indo-Pacific bead	44
AKC00490	Prohear	54	A	IK/112-113	Indo-Pacific bead	44
AKC00491	Prohear	54	A	IK/112-113	Indo-Pacific bead	44

Database ID	Site Name	Catalogue Number	Unit	Square	Bead Shape	Total # of beads
AKC00492	Prohear	54	A	IK/112-113	Indo-Pacific bead	44
AKC00493	Prohear	22	A	L/ 110-111	Indo Pacific Bead	1
AKC00494	Prohear	6	A	K/111	Indo-Pacific bead (tubular shape)	1
AKC00495	Prohear	7	A	I/ 110	Indo-Pacific bead (tubular shape)	1
AKC00496	Prohear	10	A	K109	Ring/Earring	1
AKC00497	Prohear	4	A	K/109	Indo-Pacific bead (tubular shape)	1
AKC00498	Prohear	5	A	L/110-111	Indo-Pacific bead (tubular shape)	5
AKC00499	Prohear	5	A	L/110-111	Indo-Pacific bead (tubular shape)	5
AKC00500	Prohear	5	A	L/110-111	Indo-Pacific bead (tubular shape)	5
AKC00501	Prohear	5	A	L/110-111	Indo-Pacific bead (tubular shape)	5
AKC00502	Prohear	5	A	L/110-111	Indo-Pacific bead (tubular shape)	5
AKC00503	Prohear	9	A	L/110-111	Indo-Pacific bead (tubular shape)	1
AKC00504	Prohear	16	A	K/108	Indo Pacific Bead	1
AKC00505	Prohear	11	A	L/108-109	Indo-Pacific bead (tubular shape)	1
AKC00506	Prohear	20	A	I-K/108-109	Indo-Pacific bead (tubular shape)	3
AKC00507	Prohear	20	A	I-K/108-109	Indo-Pacific bead (tubular shape)	3
AKC00508	Prohear	20	A	I-K/108-109	Indo-Pacific bead (tubular shape)	3
AKC00510	Prohear	12	A	L/107	Indo-Pacific bead (tubular shape)	1
AKC00511	Prohear	30	A	LM/112-113	Indo-Pacific bead?	1
AKC00512	Prohear	63	B	M/143	Indo-Pacific bead (tubular shape)	2
AKC00513	Prohear	63	B	M/143	Indo-Pacific bead (tubular shape)	2
AKC00514	Prohear	17	B	LM/ 143-144	Indo-Pacific bead (tubular shape)	1
AKC00515	Prohear	50	B	L7/ 143-144	Indo-Pacific bead (tubular shape)	34
AKC00516	Prohear	50	B	L7/ 143-144	Indo-Pacific bead (tubular shape)	34
AKC00517	Prohear	50	B	L7/ 143-144	Indo-Pacific bead (tubular shape)	34
AKC00518	Prohear	50	B	L7/ 143-144	Indo-Pacific bead (tubular shape)	34
AKC00519	Prohear	50	B	L7/ 143-144	Indo-Pacific bead (tubular shape)	34

Database ID	Site Name	Catalogue Number	Unit	Square	Bead Shape	Total # of beads
AKC00520	Prohear	43	B	LM/ 143-144	Indo-Pacific bead (tubular shape)	3
AKC00521	Prohear	43	B	LM/ 143-144	Indo-Pacific bead (tubular shape)	3
AKC00522	Prohear	43	B	LM/ 143-144	Indo-Pacific bead (tubular shape)	3
AKC00523	Prohear	49	B	LM/143-144	Indo-Pacific bead (tubular shape)	1
AKC00524	Prohear	35	B	LM/143-144	Indo-Pacific bead (tubular shape)	1
AKC00525	Prohear	46	B	LM/ 143-144	Indo-Pacific bead (tubular shape)	5
AKC00526	Prohear	46	B	LM/ 143-144	Indo-Pacific bead (tubular shape)	5
AKC00527	Prohear	46	B	LM/ 143-144	Indo-Pacific bead (tubular shape)	5
AKC00528	Prohear	46	B	LM/ 143-144	Indo-Pacific bead (tubular shape)	5
AKC00529	Prohear	46	B	LM/ 143-144	Indo-Pacific bead (tubular shape)	5
AKC00530	Prohear	41	B	LM/ 143-144	Indo-Pacific bead (tubular shape)	1
AKC00531	Prohear	39	B	LM/ 143-144	Indo-Pacific bead (tubular shape)	1
AKC00532	Prohear	34	B	L-M/143-144	Indo-Pacific bead (tubular shape)	1
AKC00533	Prohear	40	B	LM/143-144	Indo-Pacific bead (tubular shape)	1
AKC00534	Prohear	42	B	L-M/143-144	Indo-Pacific bead (tubular shape)	1
AKC00535	Prohear	44	B	LM/143-144	Indo-Pacific bead (tubular shape)	2
AKC00536	Prohear	44	B	LM/143-144	Indo-Pacific bead (tubular shape)	2
AKC00537	Prohear	33	B	LM/143-144	Indo-Pacific bead (tubular shape)	1
AKC00538	Prohear	3	B	M/144	Indo-Pacific bead (tubular shape)	1
AKC00539	Prohear	32	B	LM/143-144	Indo-Pacific bead (tubular shape)	1
AKC00540	Prohear	7	B	LM/143-144	Indo-Pacific bead (tubular shape)	1
AKC00541	Prohear	16	B	M/44	Indo-Pacific bead (tubular shape)	1
AKC00542	Prohear	37	B	LM/143-144	Indo-Pacific bead (tubular shape)	1
AKC00543	Prohear	38	B	LM/143-144	Indo-Pacific bead	1
AKC00544	Prohear	20	B	LM/143-144	Indo-Pacific bead	1
AKC00545	Prohear	15	B	M/144	Indo-Pacific bead (tubular shape)	1
AKC00546	Prohear	4	B	L/144	Indo-Pacific bead (tubular shape)	1

Database ID	Site Name	Catalogue Number	Unit	Square	Bead Shape	Total # of beads
AKC00547	Prohear	18	B	LM/143-144	Indo-Pacific bead (tubular shape)	1
AKC00548	Prohear	5	B	LM/143-144	Indo-Pacific bead (tubular shape)	1
AKC00549	Prohear	23	B	LM/143-144	Indo-Pacific bead (tubular shape)	1
AKC00550	Prohear	28	B	LM/143-144	Indo-Pacific Bead	8
AKC00551	Prohear	28	B	LM/143-144	Indo-Pacific Bead	8
AKC00552	Prohear	28	B	LM/143-144	Indo-Pacific Bead	8
AKC00553	Prohear	28	B	LM/143-144	Indo-Pacific Bead	8
AKC00554	Prohear	28	B	LM/143-144	Indo-Pacific Bead	8
AKC00555	Prohear	28	B	LM/143-144	Indo-Pacific Bead	8
AKC00556	Prohear	28	B	LM/143-144	Indo-Pacific Bead	8
AKC00557	Prohear	28	B	LM/143-144	Indo-Pacific Bead	8
AKC00558	Prohear	62	B	LM/143-144	Indo-Pacific bead (tubular shape)	9
AKC00559	Prohear	62	B	LM/143-144	Indo-Pacific bead (tubular shape)	9
AKC00560	Prohear	62	B	LM/143-144	Indo-Pacific bead (tubular shape)	9
AKC00561	Prohear	62	B	LM/143-144	Indo-Pacific Bead	9
AKC00562	Prohear	62	B	LM/143-144	Indo-Pacific Bead	9
AKC00563	Prohear	62	B	LM/143-144	Indo-Pacific Bead	9
AKC00564	Prohear	12	B	LM/143-144	Ring/Earring	1
AKC00565	Prohear	36	B	LM/143-144	Indo-Pacific bead	1
AKC00566	Prohear	19	B	LM/143-144	Indo-Pacific Bead	1
AKC00567	Prohear	45	B	L7/143-144	Indo-Pacific bead (tubular shape)	1
AKC00568	Prohear	11	B	LM/143-144	Indo-Pacific bead (tubular shape)	1
AKC00569	Prohear	5	A	I-K/114-115	Indo-Pacific bead (tubular shape)	1
AKC00570	Prohear	3	A	L/108-109	Indo-Pacific bead (tubular shape)	1
AKC00571	Prohear	3	A	L/108-109	Indo-Pacific bead	1
AKC00572	Prohear	13	A	IK/ 108-109	Indo-Pacific Bead	5
AKC00573	Prohear	13	A	IK/ 108-109	Indo-Pacific bead (tubular shape)	5

Database ID	Site Name	Catalogue Number	Unit	Square	Bead Shape	Total # of beads
AKC00574	Prohear	13	A	IK/108-109	Indo Pacific Bead	5
AKC00575	Prohear	13	A	IK/108-109	Indo Pacific Bead	5
AKC00576	Prohear	13	A	IK/108-109	Indo Pacific Bead	5
AKC00577	Prohear	1	A	L/108-109	Indo-Pacific bead (tubular shape)	1
AKC00578	Prohear	15	A	L/110-111	Indo-Pacific bead (tubular shape)	1
AKC00579	Prohear	5	A	K/109	Ring/Earring	1
AKC00580	Prohear	9	A	K/109	Indo-Pacific bead (tubular shape)	1
AKC00581	Prohear	2	A	L/110-111	Indo-Pacific bead (tubular shape)	1
AKC00582	Prohear	28	A	IK/110-111	Indo-Pacific bead (tubular shape)	1
AKC00583	Prohear	8	A	I/110	Indo-Pacific bead	1
AKC00584	Prohear	48	A	IK/110-111	Indo Pacific Bead	1
AKC00585	Prohear	13	A	I-110	Indo Pacific Bead	2
AKC00586	Prohear	13	A	I-110	Short Barrel	2
AKC00587	Prohear	22	A	LM/112-113	Indo-Pacific bead (tubular shape)	1
AKC00588	Prohear	14	A	IK/104-105	Indo Pacific Bead	1
AKC00589	Prohear	50	A	IK/110-111	Indo Pacific Bead	1
AKC00591	Prohear	12	C	IK/136-137	Indo-Pacific bead (tubular shape)	26
AKC00592	Prohear	12	C	IK/136-137	Indo-Pacific bead (tubular shape)	26
AKC00593	Prohear	12	C	IK/136-137	Indo Pacific Bead	26
AKC00594	Prohear	12	C	IK/136-137	Indo-Pacific bead (tubular shape)	26
AKC00595	Prohear	12	C	IK/136-137	Indo-Pacific bead (tubular shape)	26
AKC00596	Prohear	12	C	IK/136-137	Indo-Pacific bead (tubular shape)	26
AKC00597	Prohear	12	C	IK/136-137		26
AKC00598	Prohear	9	C	IK/136-137	Indo-Pacific bead (tubular shape)	1
AKC00599	Prohear	4	C	LM/136-137	Short Barrel (rough)	1
AKC00600	Prohear	3	C	LM/138-139	Indo-Pacific bead (tubular shape)	17
AKC00601	Prohear	3	C	LM/138-139	Indo-Pacific bead (tubular shape)	17

Database ID	Site Name	Catalogue Number	Unit	Square	Bead Shape	Total # of beads
AKC00602	Prohear	3	C	LM/138-139	Indo-Pacific bead (tubular shape)	17
AKC00603	Prohear	3	C	LM/138-139	Indo-Pacific bead (tubular shape)	17
AKC00604	Prohear	3	C	LM/138-139	Indo-Pacific bead (tubular shape)	17
AKC00605	Prohear	8	C	IK/136-137	Short Barrel	1
AKC00607	Prohear	12	A	IK/112-113	Indo-Pacific bead (tubular shape)	1
AKC00608	Prohear	28	A	LM/112-113	Indo-Pacific Bead	1
AKC00609	Prohear	7	A	LM/112-113	Indo-Pacific bead (tubular shape)	2
AKC00610	Prohear	7	A	LM/112-113	Indo-Pacific bead (tubular shape)	2
AKC00611	Prohear	3	A	IK/112-113	Indo-Pacific Bead	1
AKC00612	Prohear	11	A	LM/112-113	Indo-Pacific Bead	1
AKC00613	Prohear	3	A	LM/112-113	Indo-Pacific bead (tubular shape)	1
AKC00614	Prohear	19	A	LM/112-113	Indo-Pacific bead (tubular shape)	1
AKC00615	Prohear	18	A	LM/112-113	Indo-Pacific Bead	1
AKC00616	Prohear	13	A	IK/112-113	Short Barrel (rough)	1
AKC00617	Prohear	2	A	LM/112-113	Indo-Pacific bead (tubular shape)	1
AKC00618	Prohear	7	A	IK/112-113	Indo-Pacific bead (tubular shape)	2
AKC00619	Prohear	7	A	IK/112-113	Indo-Pacific bead (tubular shape)	2
AKC00620	Prohear	18	A	L/110-111	Indo-Pacific Bead	33
AKC00621	Prohear	18	A	L/110-111	Indo-Pacific Bead	33
AKC00622	Prohear	18	A	L/110-111	Indo-Pacific Bead	33
AKC00623	Prohear	18	A	L/110-111	Indo-Pacific Bead	33
AKC00624	Prohear	18	A	L/110-111	Indo-Pacific bead (tubular shape)	33
AKC00625	Prohear	39	A	L/104-105	Indo-Pacific bead (tubular shape)	1
AKC00626	Prohear	38		L/105	Ring/Earring	1
AKC00627	Prohear	12	A	LM/104-105	NA	1
AKC00628	Prohear	29	A	LM/104-105	Ring/Earring	1
AKC00629	Prohear	9	A	LM/104-105	Ring/Earring?	1

Database ID	Site Name	Catalogue Number	Unit	Square	Bead Shape	Total # of beads
AKC00630	Prohear	3	A	IK/104-105	Indo-Pacific bead (tubular shape)	1
AKC00631	Prohear	12	A	IK/104-105	Indo-Pacific bead (tubular shape)	1
AKC00632	Prohear	17/18	A	IK/104-105	Indo-Pacific bead (tubular shape)	1
AKC00633	Prohear	77	A		Indo-Pacific bead (tubular shape)	1
AKC00634	Prohear	26	A	I/107	Ring/Earring	1
AKC00635	Prohear	13	A	IK/106-107	Ring/Earring	1
AKC00636	Prohear	14	B	LM/145-156	Short Barrel	1
AKC00637	Prohear	17	B	LM/145-146	Indo-Pacific bead (tubular shape)	1
AKC00638	Prohear	11	B	LM/145-146	Indo-Pacific bead	1
AKC00639	Prohear	10	B	LM/145-146	Indo-Pacific bead (tubular shape)	1
AKC00640	Prohear	6	B	LM/145-146	Indo-Pacific bead (tubular shape)	1
AKC00641	Prohear	26	B	LM/145-146	Glass fragment	1
AKC00649	Bit Meas	71	III	K/83	Indo-Pacific bead (tubular shape)	1
AKC00650	Bit Meas	75	III	J/84	Indo Pacific Bead	1
AKC00655	Bit Meas				Indo-Pacific bead (tubular shape)	5
AKC00656	Prohear	11	A	IK/106-107	Indo Pacific Bead	1
AKC00657	Prohear	15	A	IK/106-107	Indo Pacific Bead	2
AKC00658	Prohear	15	A	IK/106-107	Indo Pacific Bead	2
AKC00659	Prohear	12	A	IK/106/107	Indo-Pacific bead (tubular shape)	1
AKC00660	Prohear	14	A	IK/106-107	Indo-Pacific bead (tubular shape)	1
AKC00661	Prohear	32	A	I/107	Indo-Pacific bead (tubular shape)	1
AKC00662	Prohear	103	A	K/107	Indo Pacific Bead	2
AKC00663	Prohear	103	A	K/107	Indo Pacific Bead	2
AKC00664	Prohear	25	A	I/107	Indo-Pacific bead (tubular shape)	1
AKC00665	Prohear	29	A	K/107	Indo-Pacific bead (tubular shape)	1
AKC00666	Prohear	30	A	K/107	Indo-Pacific bead (tubular shape)	1
AKC00667	Prohear	23	A	I/107	Indo-Pacific bead (tubular shape)	1

Database ID	Site Name	Catalogue Number	Unit	Square	Bead Shape	Total # of beads
AKC00668	Prohear	34	A	I/107	Indo-Pacific bead (tubular shape)	1
AKC00669	Prohear	24	A	I/107	Indo-Pacific Bead	1
AKC00670	Prohear	28	A	K/107	Indo-Pacific bead (tubular shape)	1
AKC00671	Prohear	35	A	I/107	Indo-Pacific bead (tubular shape)	1
AKC00672	Prohear	48	A	IK/107	Indo-Pacific Bead	5
AKC00673	Prohear	48	A	IK/107	Indo-Pacific Bead	5
AKC00674	Prohear	48	A	IK/107	Indo-Pacific bead (tubular shape)	5
AKC00675	Prohear	48	A	IK/107	Indo-Pacific bead (tubular shape)	5
AKC00676	Prohear	48	A	IK/107	Indo-Pacific bead (tubular shape)	5
AKC00677	Prohear	85	A	K/107	Indo-Pacific Bead	15
AKC00678	Prohear	85	A	K/107	Indo-Pacific Bead	15
AKC00679	Prohear	85	A	K/107	Indo-Pacific Bead	15
AKC00680	Prohear	85	A	K/107	Indo-Pacific Bead	15
AKC00681	Prohear	85	A	K/107	Indo-Pacific bead (tubular shape)	15
AKC00683	Prohear	104	A		Indo-Pacific Bead	49
AKC00684	Prohear	104	A		Indo-Pacific Bead	49
AKC00685	Prohear	104	A		Indo-Pacific Bead	49
AKC00686	Prohear	104	A		Indo-Pacific Bead	49
AKC00687	Prohear	104	A		Indo-Pacific Bead	49
AKC00688	Prohear	104	A		Indo-Pacific bead (tubular shape)	49
AKC00689	Prohear	104	A		Indo-Pacific bead (tubular shape)	49
AKC00717	Prohear	17	A	K/106	Indo-Pacific bead (tubular shape)	1
AKC00718	Prohear	21	A	L/106	Indo-Pacific bead (tubular shape)	1
AKC00719	Prohear	2	A	IK/111-110	Indo-Pacific bead (tubular shape)	1
AKC00720	Prohear	12	C	IK/136-137	Indo-Pacific bead (tubular shape)	25
AKC00721	Prohear	12	C	IK/136-137	Indo-Pacific bead (tubular shape)	25
AKC00722	Prohear	12	C	IK/136-137	Indo-Pacific bead (tubular shape)	25

Database ID	Site Name	Catalogue Number	Unit	Square	Bead Shape	Total # of beads
AKC00723	Prohear	12	C	IK/136-137	Indo-Pacific bead (tubular shape)	25
AKC00724	Prohear	12	C	IK/136-137	Indo-Pacific bead (tubular shape)	25
AKC00725	Prohear	12	C	IK/136-137	Indo-Pacific bead (tubular shape)	25
AKC00726	Prohear	104	A		Indo Pacific Bead	1
AKC00733	Prohear	13	A	L-M /106-107	Indo Pacific Bead	1
AKC00734	Prohear	80	A	I-K/106-107	Indo Pacific Bead	1
AKC00735	Prohear	85	A	I-K/106-107	Indo Pacific Bead	1
AKC00736	Prohear	38	A	L-M/104-105	Earring fragment	1
AKC00737	Prohear	10	A	I-K/108-109	Earring fragment	1
AKC00738	Prohear	18	A	L-M/110-111	Indo Pacific Bead	1
AKC00739	Prohear	30	A	L-M/112-113	Indo Pacific Bead?	1
AKC00740	Prohear	41	A	I-K/112-113	Indo-Pacific Bead?	1
AKC00741	Prohear	27	A	L-M/114-115	Earring fragment	1
AKC00742	Prohear	20	A	I-K/116-117	Indo-Pacific Bead?	1
AKC00743	Prohear	12	C	I-K/136-137	Indo-Pacific Bead?	1
AKC00744	Prohear	12	C	I-K/136-137	Indo-Pacific Bead?	1
AKC00745	Prohear	9	C	I-K/136-137	Indo-Pacific Bead?	1
AKC00746	Prohear	18	C	L-M/140-141	Indo Pacific Bead	1
AKC00747	Prohear	3	C	L-M/140-141	Bangle fragment	1
AKC00748	Prohear	45	B	L-M/143-144	Indo Pacific Bead	1
AKC00749	Prohear	62	B	L-M/143-144	Indo Pacific Bead	1
AKC00750	Prohear	11	A	L-M/114-115	Indo Pacific Bead	1
AKC00751	Prohear	7	D	L-M/120-121	Bangle fragment	1
AKC00752	Prohear	16	D	L-M/122-123	Earring fragment?	1
AKC00753	Prohear	65	D	L-M/126-127	Indo Pacific Bead?	1
AKC00754	Prohear	40	D	L-M/126-127	Indo Pacific Bead	1
AKC00755	Prohear	40	D	L-M/126-127	Indo Pacific Bead?	1

Database ID	Site Name	Catalogue Number	Unit	Square	Bead Shape	Total # of beads
AKC00756	Prohear	56	D	L-M/132-133	Indo Pacific Bead?	1
AKC00757	Prohear	39	D	L-M/132-133	Indo Pacific Bead	1
AKC00727	Bit Meas	N/A			Indo Pacific Bead	1
AKC00728	Bit Meas	N/A			Indo-Pacific bead (tubular shape)	1
AKC00729	Bit Meas	N/A			Large Indo Pacific Bead	1

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00441	Light Green	Light blue-green color	Transparent	NA					Ring is broken so measurements are incomplete
AKC00442	Black		Opaque	NA					Ring is broken so measurements are incomplete
AKC00443	Dark Blue		Translucent	R3	1.3		4.46	5.85	
AKC00444	Dark Blue		Translucent	R3	1.32		4.98	5.59	
AKC00445	Dark Blue		Translucent	R1	1.54		2.56	4.33	
AKC00446	Dark Blue		Translucent	R2	0		3.09	3.76	
AKC00447	Dark Blue		Translucent	R1	1.48		2.05	3.83	
AKC00448	Dark Blue		Translucent	R2	1.39		2.53	3.8	
AKC00449	Dark Blue	Slightly darker than other beads in this group	Translucent	R2	1.37		3.17	3.92	
AKC00450	Dark Blue		Translucent	R1	0		2.49	2.75	
AKC00451	Dark Blue		Translucent	R1	0		1.8	2.95	
AKC00452	Yellow		Opaque	R2	1.19		4.76	5.06	
AKC00453	Black		Opaque	R2	1.97		4	5.39	
AKC00454	Light Blue		Semi-Translucent	R3	1.36		6.09	6.23	
AKC00455	Cobalt	Dark cobalt	Semi-Translucent	R1	1.9		3	6.37	
AKC00456	Cobalt	Dark cobalt	Translucent	R2	1.23		3.47	5.02	

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00457	Light Blue		Translucent	R2	1.64		6.3	5.52	
AKC00458	Cobalt	Dark cobalt-almost black	Semi-Translucent	R1	1.7		3.16	6.86	
AKC00459	Cobalt	Intense blue color		R2	1.46		3.33	4.63	
AKC00460	Light Blue		Translucent	R2	1.65		3.85	5.35	
AKC00461	Black		Opaque	R1	1.6		4.11	4.74	
AKC00462	Cobalt	Intense blue color	Translucent	R1	1.89		4.22	5.37	
AKC00463	Cobalt	Dark cobalt	Semi-Translucent Opaque	R1	0		2.36	3.15	Hole is clogged making interior perforation and color determination difficult
AKC00464	Deep Purple		Semi-Translucent Opaque	NA					Piece is broken, no measurements
AKC00465	Deep Purple		Semi-Translucent Opaque	NA					Piece is broken, no measurements
AKC00466	Dark Blue	Not as dark blue as cobalt beads	Semi-Translucent	R0	N/A		2.18	2.73	
AKC00467	Dark Blue	Not as dark blue as cobalt beads	Semi-Translucent	R0	1.07		2.88	3.63	
AKC00468	Dark Blue	Not as dark blue as cobalt beads	Semi-Translucent	R0	1.04		2.15	3.01	
AKC00469	Dark Blue	Not as dark blue as cobalt beads	Semi-Translucent	R0	1.31		2.45	3.42	
AKC00470	Dark Blue	Not as dark blue as cobalt beads	Semi-Translucent	R0	1.03		2.22	3.28	
AKC00471	Dark Blue	Not as dark blue as cobalt beads	Semi-Translucent	R0	1.3		3	3.21	
AKC00472	Dark Blue	Not as dark blue as cobalt beads	Semi-Translucent	R0	N/A		3.53	3.43	

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00473	Cobalt	Dark blue cobalt/ matte finish	Semi-Translucent	R2	1.14		3.43	5.45	Measured 10 random beads from this group of 92
AKC00474	Cobalt	Dark blue cobalt/ matte finish	Semi-Translucent	R1	1.73		2.78	5.68	
AKC00475	Cobalt	Dark blue cobalt/ matte finish	Semi-Translucent	R1	1.44		2.97	6.04	
AKC00476	Cobalt	Dark blue cobalt/ matte finish	Semi-Translucent	R2	1.02		4.24	5.93	
AKC00477	Cobalt	Dark blue cobalt/ matte finish	Semi-Translucent	R1	1.57		3.55	6.23	
AKC00478	Cobalt	Dark blue cobalt/ matte finish	Semi-Translucent	R1	1.37		3.36	6.22	
AKC00479	Cobalt	Dark blue cobalt/ matte finish	Semi-Translucent	R1	1.73		3.08	5.8	
AKC00480	Cobalt	Dark blue cobalt/ matte finish	Semi-Translucent	R1	1.6		2.75	6.33	
AKC00481	Cobalt	Dark blue cobalt/ matte finish	Semi-Translucent	R1	1.26		3.42	5.42	
AKC00482	Cobalt	Dark blue cobalt/ matte finish	Semi-Translucent	R1	1.75		2.59	5.85	
AKC00483	Cobalt	Intense blue color	Semi-Translucent	R1	0.9		1.54	3.05	
AKC00484	Cobalt	Intense blue color	Semi-Translucent	R1	0.79		1.85	2.66	
AKC00485	Light Blue		Semi-Translucent	R2	1.29		4.01	5.01	Measured 8 beads from this group of 44. All but 3 beads were a matte cobalt blue color, 5 of these were measured. The three lighter blue beads were also measured.

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00486	Light Blue		Semi-Translucent	R2	1.6		2.84	5.34	
AKC00487	Cobalt		Semi-Translucent	R1	1.7		4.65	4.9	
AKC00488	Cobalt	Dark blue cobalt/ matte finish	Semi-Translucent	R1	2.4		2.6	6.66	
AKC00489	Cobalt	Dark blue cobalt/ matte finish	Semi-Translucent	R1	2.1		3.7	6.88	
AKC00490	Cobalt	Dark blue cobalt/ matte finish	Semi-Translucent	R2	1.56		4.35	4.79	
AKC00491	Cobalt	Dark blue cobalt/ matte finish	Semi-Translucent	R2	1.22		3.95	5.76	
AKC00492	Cobalt	Dark blue cobalt/ matte finish	Semi-Translucent	R1	2.31		2.92	6.38	
AKC00493	Cobalt	Dark cobalt		R1	1.14		1.46	3.84	
AKC00494	Cobalt	Intense blue color	Semi-Translucent	R2	0.96		4.25	4.68	Brighter blue color
AKC00495	Cobalt	Intense blue color	Semi-Translucent	R1	1.48		2.6	2.62	
AKC00496	Black		Opaque	NA					
AKC00497	Cobalt	Dark cobalt	Semi-Translucent	R1	1.82		3.23	6.27	
AKC00498	Cobalt	Intense blue color	Semi-Translucent	R2	1.32		4.45	4.92	
AKC00499	Cobalt	Intense blue color	Semi-Translucent	R2	1.57		5.01	4.8	
AKC00500	Cobalt	Intense blue color	Semi-Translucent	R2	1.23		4.32	5.2	
AKC00501	Cobalt	Intense blue color	Semi-Translucent	R2	1.28		6.24	5.14	barrel shaped
AKC00502	Cobalt	Intense blue color	Semi-Translucent	R2	1.26		5.61	4.55	barrel shaped
AKC00503	Cobalt	Intense blue color	Semi-Translucent	R1	2.02		5.18	6.83	Large size round bead
AKC00504	Dark Blue	Not as dark blue as cobalt beads	Semi-Translucent	R1	1.63		1.89	3.74	
AKC00505	Cobalt	Intense blue color	Semi-Translucent	R2	1.43		3.95	4.8	
AKC00506	Cobalt	Intense blue color, shiny surface	Semi-Translucent	R2	0.7		3.73	3.56	

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max.Width	Notes
AKC00507	Cobalt	Intense blue color	Semi-Translucent	R2	1.39		3.35	4.36	
AKC00508	Cobalt	Intense blue color	Semi-Translucent	R2	1.05		3.05	4.13	
AKC00510	Cobalt	Shiny surface	Semi-Translucent	R1	1.33		5.67	5.17	Not disc shaped like others in this color range and also more shiny than matte.
AKC00511	Red	NA		NA					Bead is fragmentary, difficult to measure
AKC00512	Cobalt	Intense blue color, shiny surface	Semi-Translucent	R1	1.95		4.88	6.99	
AKC00513	Cobalt	Intense blue color, shiny surface	Semi-Translucent	R1	1.14		4.86	6.78	
AKC00514	Cobalt	Intense blue color	Semi-Translucent	R2	2.05		4.99	6.11	
AKC00515	Cobalt	Dark blue cobalt/matte finish	Semi-Translucent	R1	2.1		4.6	5.76	Measured the only dark cobalt blue bead as well as the 4/33 of the group of more intense blue beads.
AKC00516	Cobalt	Intense blue color	Semi-Translucent	R1	1.79		4.39	4.66	
AKC00517	Cobalt	Intense blue color	Semi-Translucent	R1	2.38		6.52	6.58	
AKC00518	Cobalt	Intense blue color	Semi-Translucent	R1	90		4.39	5.74	
AKC00519	Cobalt	Intense blue color, shiny surface	Semi-Translucent	R2	0.93		4.91	4.75	
AKC00520	Cobalt	Intense blue color, shiny surface	Semi-Translucent	R2	1.9		4.56	5.97	

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00521	Cobalt	Intense blue color, shiny surface	Semi-Translucent	R1	2.06		4	5.78	
AKC00522	Cobalt	Intense blue color	Semi-Translucent	R2	1.19		4.07	5.01	
AKC00523	Cobalt		Semi-Translucent	R2		1.49	5.78	5.63	
AKC00524	Cobalt	Matte surface	Semi-Translucent	R2	1.49		5.05	5.35	
AKC00525	Cobalt	Intense blue color, shiny surface	Semi-Translucent	R2	1.07		4.18	5.27	
AKC00526	Cobalt	Intense blue color	Semi-Translucent	R2	1.49		5.85	5.35	
AKC00527	Cobalt	Intense blue color, shiny surface	Semi-Translucent	R2	1.96		5.78	5.39	
AKC00528	Cobalt	Intense blue color	Semi-Translucent	R2	0.97		5.2	5.91	
AKC00529	Cobalt	Intense blue color	Semi-Translucent	R1	1.73		3.97	5.14	
AKC00530	Cobalt	Intense blue color	Semi-Translucent	R1	1.9		5.46	4.9	
AKC00531	Cobalt	Intense blue color	Semi-Translucent	R2	1.58		5.18	6.37	
AKC00532	Cobalt	Intense blue color	Semi-Translucent	R1	1.27		3.36	5.14	Bead is chipped.
AKC00533	Black		Opaque	R2	1.15		4.89	4.63	
AKC00534	Cobalt	Intense blue color, shiny surface	Semi-Translucent	R2	2.02		4.82	5.89	
AKC00535	Cobalt	Intense blue color, shiny surface	Semi-Translucent	R2	1.3		3.75	5.32	
AKC00536	Cobalt	Intense blue color	Semi-Translucent	R3	1.21		5.13	5.39	
AKC00537	Cobalt	Shiny surface	Semi-Translucent	R2	1.22		4.83	5.63	
AKC00538	Cobalt	Intense blue color, shiny surface	Semi-Translucent	R2	1.42		4.68	5.05	
AKC00539	Cobalt	Intense blue color	Semi-Translucent	R2	0.88		5.96	5.7	

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00540	Cobalt	Intense blue color	Semi-Translucent	N/A	N/A	N/A	N/A	N/A	
AKC00541	Cobalt	Intense blue color	Semi-Translucent	R2	1.39		5.05	5.72	
AKC00542	Cobalt	Intense blue color, shiny surface	Semi-Translucent	R2	1.38		5.7	5.34	
AKC00543	Cobalt	Intense blue color	Semi-Translucent	R1	1.85		2.72	5.69	
AKC00544	Cobalt	Intense blue color	Semi-Translucent	R2	1.37		4.51	5.62	
AKC00545	Cobalt	Matte surface	Semi-Translucent	R2	1.31		5.92	6.29	
AKC00546	Cobalt	Intense blue color	Semi-Translucent	R1	1.91		4.77	5	
AKC00547	Cobalt	Intense blue color	Semi-Translucent	NA	1.71		0	0	Bead broken, measurements difficult
AKC00548	Cobalt	Intense blue color, shiny surface	Semi-Translucent	R1	1.77		4.72	5.47	
AKC00549	Cobalt	Intense blue color	Semi-Translucent	R2	1.74		6.09	0	
AKC00550	Red	Reddish-brown	Opaque	R1	1.21		2.46	3.69	
AKC00551	Red	Reddish-brown	Opaque	R1	1.36		2.15	3.81	
AKC00552	Red	Reddish-brown	Opaque	R1	1.38		2.8	3.66	
AKC00553	Red	Reddish-brown	Opaque	R1	1.51		1.85	3.8	
AKC00554	Red	Reddish-brown	Opaque	R1	1.31		1.95	3.81	
AKC00555	Red	Reddish-brown	Opaque	R1	0		2.67	0	
AKC00556	Red	Reddish-brown	Opaque		1.41		2.22	3.24	
AKC00557	Red	Reddish-brown	Opaque	R1	1.41		1.98	3.89	
AKC00558	Cobalt	Intense blue color	Semi-Translucent	R1	1.71		3.33	5.65	Measured and recorded all three of the blue beads and 3 of the red beads (n=6 total)
AKC00559	Cobalt	Intense blue color	Semi-Translucent	R2	1.07		4.84	5.79	

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00560	Cobalt	Intense blue color	Semi-Translucent	R1	1.25		3.81	4.87	
AKC00561	Red	Reddish-brown	Opaque	R1	0		2.41	3.77	
AKC00562	Red	Reddish-brown	Opaque	R1	1.63		2.47	4.25	
AKC00563	Red	Reddish-brown	Opaque	R2	0.68		3.49	3.43	
AKC00564	Black		Opaque	NA			0	0	
AKC00565	Cobalt	Dark cobalt	Semi-Translucent	R1	2.27		3.38	7.71	
AKC00566	Dark Blue	Not as dark blue as cobalt beads	Semi-Translucent	R1	0		1.68	2.6	Bead hole clogged, unable to measure
AKC00567	Black		Opaque	R1	0		3.84	0	
AKC00568	Dark Blue	Not as dark blue as cobalt beads	Semi-Translucent	R1	1.15		4.4	4.55	
AKC00569	Light Green	yellow-green	Translucent	R1	1.28		4.71	5.03	
AKC00570	Deep Purple		Semi-Translucent	R1	1.52		4.31	5.27	
AKC00571	Cobalt	Dark cobalt	Semi-Translucent	R1	2.23		3.02	6.45	
AKC00572	Black		Opaque	R1	0.96		1.41	2.71	
AKC00573	Cobalt	Intense blue color	Semi-Translucent	R2	1.63		5.72	6.68	
AKC00574	Black		Opaque	R1	1.13		2.65	3.57	
AKC00575	Black		Opaque	R1	0.9		1.16	2.52	
AKC00576	Black		Opaque	R1	0.8		1.77	2.39	
AKC00577	Light Green		Semi-Translucent Translucent	R2	1.42		4.94	5.58	
AKC00578	Cobalt	Intense blue color	Semi-Translucent	R2	1.11		5.12	5.72	
AKC00579	Black		Opaque	NA			0	0	
AKC00580	Cobalt	Intense blue color	Semi-Translucent	R2	0.98		4.61	4.69	
AKC00581	Cobalt	Intense blue color	Semi-Translucent	R2	0.65		6.12	6.93	
AKC00582	Cobalt	Intense blue color	Semi-Translucent	R1	2.12		5.69	6.03	
AKC00583	Cobalt	Dark cobalt	Semi-Translucent	R1	1.7		2.98	7.05	

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00584	Dark Blue		Semi-Translucent	R1	N/A		2.56	2.4	Perforation not measured as hole was clogged
AKC00585	Cobalt		Semi-Translucent	R1	N/A		1.41	3.55	Broken bead, unable to measure perforation
AKC00586	Cobalt	Dark cobalt	Semi-Translucent	R2	1.3		5	7.79	
AKC00587	Cobalt	Dark cobalt	Semi-Translucent	NA	0		0	0	Broken bead, unable to measure
AKC00588	Dark Blue	Not as dark blue as cobalt beads	Translucent	R1	0.84		1.23	2.84	
AKC00589	Cobalt	Dark cobalt	Semi-Translucent	R1	1.03		1.83	3.65	
AKC00591	Cobalt	Dark cobalt	Opaque	R2	1.24		5.37	5.62	26 total beads, measured 5 of 22 opaque cobalt beads, 1 light blue bead, and 1 of 3 sem-translucent dark blue beads.
AKC00592	Cobalt	Dark cobalt	Opaque	R2	1.63		4.42	5.75	
AKC00593	Cobalt	Dark cobalt	Semi-Translucent	R1	1.21		2.13	4.68	
AKC00594	Cobalt	Dark cobalt	Opaque	R2	0		4.2	4.33	
AKC00595	Cobalt	Dark cobalt	Opaque	R1	1.48		3.72	4.85	
AKC00596	Cobalt	Dark cobalt	Opaque	R2	1.57		6.22	5.7	
AKC00597	Dark Blue	Not as dark blue as cobalt beads	Translucent Transparent	R2	1.89		4.71	5.52	
AKC00598	Cobalt	Dark cobalt	Opaque	R2	N/A		N/A	N/A	Bead is broken so unable to measure
AKC00599	Cobalt	Dark cobalt	Semi-Translucent	R2	1.71		5.01	6.53	
AKC00600	Light Blue	sky blue	Translucent Transparent	R1	1.78		3.76	7.17	Measured one dark blue bead and 4 of 16 cobalt blue beads.

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00601	Cobalt	Dark cobalt	Semi-Translucent Opaque	R2	2.02		5.02	5.59	
AKC00602	Cobalt	Dark cobalt	Semi-Translucent Opaque	R2	1.97		4.04	5.55	
AKC00603	Cobalt	Dark cobalt	Semi-Translucent Opaque	R1	1.13		4	4.53	
AKC00604	Cobalt	Dark cobalt	Semi-Translucent Opaque	R2	1.4		4.62	5.46	
AKC00605	Cobalt	Dark cobalt	Semi-Translucent	R2	1.79		8.55	7.82	
AKC00607	Cobalt	Dark cobalt	Semi-Translucent	R2	1.5		5.31	5.45	
AKC00608	Black		Opaque	R1	0.72		2.18	3.29	
AKC00609	Cobalt	Dark cobalt	Semi-Translucent	R1	1.36		2.54	4.36	
AKC00610	Cobalt	Intense blue color	Semi-Translucent	R2	1.31		4.11	4.61	
AKC00611	Dark Blue	Not as dark blue as cobalt beads	Semi-Translucent Translucent	R1	0.97		2.44	3.54	
AKC00612	Cobalt	Intense blue color	Semi-Translucent	R1	1.03		1.5	3.43	
AKC00613	Cobalt	Dark cobalt	Opaque Semi-Translucent	NA	N/A		N/A	N/A	Bead is broken, unable to measure
AKC00614	Cobalt	Intense blue color	Opaque Semi-Translucent	R1	N/A		3.53	N/A	Bead is in poor condition, difficult to measure and determine color.
AKC00615	Dark Blue	Not as dark blue as cobalt beads	Semi-Translucent	R1	1.14		2.55	3.16	
AKC00616	Cobalt	Intense blue color	Opaque Semi-Translucent	R2	1.25		6.2	7.82	Slightly teardrop shaped?
AKC00617	Cobalt	Intense blue color	Semi-Translucent	R2	0.7		3.57	4.17	
AKC00618	Light Blue		Semi-Translucent Translucent	R2	1.71		3.88	5.33	
AKC00619	Cobalt	Intense blue color	Semi-Translucent Translucent	NA	N/A		N/A	N/A	Bead is broken, unable to measure

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00620	Cobalt	Intense blue color	Semi-Translucent Translucent	R1	1.35		1.51	3.52	32 of the beads are smaller in size and one is larger. Measured larger bead and 4 of the 32 smaller sized beads.
AKC00621	Cobalt	Intense blue color	Semi-Translucent Translucent		1.04		1.37	3.42	
AKC00622	Cobalt	Intense blue color	Semi-Translucent Translucent	R1	1.08		1.48	3.24	
AKC00623	Cobalt	Intense blue color	Semi-Translucent Translucent	R1	1.07		1.46	3.73	
AKC00624	Cobalt	Intense blue color	Semi-Translucent Translucent	R2	1.4		3.64	5.3	
AKC00625	Cobalt	Dark cobalt	Semi-Translucent Translucent	R2	1.88		3.8	5.11	
AKC00626	Blue-Green	with some yellow	Translucent	NA					
AKC00627	Unknown	Blue?		NA			0		Bead is fragmented.
AKC00628	Blue-Green		Translucent	NA					
AKC00629	Turquoise		Opaque	NA					Material?
AKC00630	Dark Blue?	Not as dark blue as cobalt beads	Semi-Translucent Opaque	R2	2.57		6.88	7.19	
AKC00631	Turquoise	Similar to Turq/Med Blue from Phum Snay?	Translucent	R2	1.95		5	6.49	
AKC00632	Deep Purple		Translucent Semi-Translucent	R1	1.12		4.22	4.62	
AKC00633	Black/Purple	Difficult to determine color	Opaque	R2	N/A		N/A	N/A	Bead is broken, unable to take measurements

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00634	Dark Blue		Semi-Translucent	NA	N/A		N/A	N/A	
AKC00635	Dark Blue		Semi-Translucent	NA	N/A		N/A	N/A	
AKC00636	Black		Opaque	R2	1.91		7.62	7.13	
AKC00637	Cobalt	Intense blue color	Semi-Translucent	R2	1.69		3.92	5.37	
AKC00638	Cobalt	Intense blue color	Semi-Translucent	R1	1.8		2.44	5.4	
AKC00639	Black/Purple		Opaque	R2	0.77		4.4	3.76	
AKC00640	Cobalt	Intense blue color	Semi-Translucent	R1	1.92		4.44	6.3	
AKC00641	Light Blue	Turquoise	Semi-Translucent	NA			12.66	10.59	Bracelet fragment?
AKC00649	Black	Purple/Black?	Opaque	R2					
AKC00650	Light Blue		Semi-Translucent	NA					
AKC00655	Black		Opaque	R1	1.64		3.48	3.95	
AKC00656	Violet?	Purple/Black?	Opaque Semi-Translucent	R0	1.08		1.08	3	
AKC00657	Black	Purple/Black?	Opaque	R1	0.78		2.58	3.76	
AKC00658	Black	Purple/Black?	Opaque	R1	N/A		N/A	N/A	Bead is broken, unable to take measurements.
AKC00659	Black	Purple/Black?	Opaque	R1	N/A		3.27	N/A	Bead is broken, unable to take measurements.
AKC00660	Black	Purple/Black?	Opaque	R1	N/A		3.18	N/A	
AKC00661	Black	Purple/Black?	Opaque	R1	1.3		2.42	3.93	
AKC00662	Dark Blue		Semi-Translucent	R0	0.9		1.2	2.25	
AKC00663	Dark Blue		Semi-Translucent	R0	1.08		1.59	2.57	

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00664	Black	Purple/Black?	Opaque	R2	0.95		2.56	3.89	
AKC00665	Black		Opaque	R1	1.51		2.47	4.13	
AKC00666	Black	Purple/Black?	Opaque	NA	N/A		N/A	N/A	Bead is broken, unable to take measurements.
AKC00667	Black	Purple/Black?	Opaque	R2	1.47		3.35	4.3	
AKC00668	Black	Purple/Black?	Opaque	R2	0.95		3.05	3.34	
AKC00669	Violet?	Purple/Black?	Semi-Translucent	R0	0.95		1.09	2.6	
AKC00670	Black	Purple/Black?	Opaque	R1	1.23		2.77	3.79	
AKC00671	Black	Purple/Black?	Opaque	R1	N/A		2.54	N/A	Bead is broken, unable to take measurements.
AKC00672	Violet?		Semi-Translucent	R0	0.94		1.24	2.71	2 broken black beads in this group were not measured/recorded.
AKC00673	Black	Purple/Black?	Opaque	R0	0.63		1.38	2.5	
AKC00674	Black	Purple/Black?	Opaque	R1	1.09		3.64	3.19	
AKC00675	Black	Purple/Black?	Opaque	R2	1.16		2.68	4.26	
AKC00676	Black	Purple/Black?	Opaque		0		2.48	3.58	
AKC00677	Dark Blue		Semi-Translucent	R0	0.97		1.14	2.62	Beads all the same color but there were more longer tubes. Measured 1 of 3 tubular beads and 4 of 12 disc/oblate shaped beads.
AKC00678	Dark Blue		Semi-Translucent	R0	1.04		1.23	2.57	
AKC00679	Dark Blue		Semi-Translucent	R0	0.82		1.18	2.18	

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00680	Dark Blue		Semi-Translucent	R0	1.05		1.54	2.4	
AKC00681	Dark Blue		Semi-Translucent	R0	1.23		2.03	3.25	
AKC00683	Dark Blue		Semi-Translucent	R0	0.75		1.76	2.31	Measured 3 of 23 dark blue beads, 2 of 14 Violet disc shaped beads, 2 of 12 violet tubular beads.
AKC00684	Dark Blue		Semi-Translucent	R0	0.86		1.47	2.27	
AKC00685	Dark Blue		Semi-Translucent	R0	0.85		1.26	2.22	
AKC00686	Violet		Semi-Translucent	R0	0.88		1.41	2.6	
AKC00687	Violet		Semi-Translucent	R0	0.8		1.25	2.77	
AKC00688	Violet		Semi-Translucent	R1	1.29		2.13	3.84	
AKC00689	Violet		Semi-Translucent	R1	1.3		2.09	4.27	
AKC00717	Cobalt	Dark cobalt	Semi-Translucent Opaque	R1	1.63		3.64	5.63	
AKC00718	Cobalt	Dark cobalt	Semi-Translucent	R1	1.9		7.16	7.79	
AKC00719	Cobalt	Intense blue color	Semi-Translucent	R3	1.09		7.71	5.86	
AKC00720	Dark Blue	Not as dark blue as cobalt beads	Translucent	R2	1.95		4.71	5.52	Measured 1 dark blue bead and 5 of 24 cobalt blue beads.
AKC00721	Cobalt	Dark cobalt	Semi-Translucent Opaque	R2	1.75		3.38	5.27	
AKC00722	Cobalt	Dark cobalt	Opaque Semi-Translucent	R2	N/A		4.32	5.65	

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00723	Cobalt	Dark cobalt	Opaque Semi-Translucent	R1	1.38		3.72	4.73	
AKC00724	Cobalt	Dark cobalt	Semi-Translucent Opaque	R2	0		3.85	4.98	
AKC00725	Cobalt	Dark cobalt	Semi-Translucent Opaque	R2	1.82		4.42	5.82	
AKC00726	White	With a rainbow coating on surface?	Opaque	R1	0.81		1.76	2.37	Could be modern?
AKC00733	Dark Blue		Semi-Translucent	R2	1.11		1.98	3.32	
AKC00734	Dark Blue		Opaque	R1	1.45		2.15	3.73	
AKC00735	Dark Blue		Opaque	R1	0.85		1.44	2.57	
AKC00736	Blue-green		Translucent	NA					
AKC00737	Black	Purple/Black?	Translucent						
AKC00738	Dark Blue		Semi-Translucent				1.63	3.25	
AKC00739	Black	Brown-Black	Translucent						
AKC00740	Dark Blue		Semi-Translucent						
AKC00741	Green	light green	Opaque						Heavily weathered
AKC00742	Cobalt		Semi-Translucent						
AKC00743	Dark Blue		Semi-Translucent				3.47		
AKC00744	Dark Blue		Semi-Translucent						
AKC00745	Dark Blue		Semi-Translucent						
AKC00746	Dark Blue		Semi-Translucent	R2	1.5		1.8	3.69	
AKC00747	Brown		Translucent						

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max.Width	Notes
AKC00748	Black		Opaque	R2			3.82		
AKC00749	Red	orange-red	Opaque				2.03		
AKC00750	Red		Opaque	R3	0.94		1.51	2.73	
AKC00751	Light Blue		Transparent						
AKC00752	Light Blue		Transparent						
AKC00753	Turquoise Blue		Opaque		0		4.49	5.96	
AKC00754	Black		Opaque	R1	0.98		1.8	3.62	
AKC00755	Dark Blue		Semi-Translucent	R2			2.89		
AKC00756	Dark Blue		Semi-Translucent				5.19		
AKC00757	Black		Opaque	R3	0.9		2.25	3.31	
AKC00727	Dark Blue	Not as dark blue as cobalt beads	Opaque	R2	1.09		1.91	3.26	
AKC00728	Blue-Green		Translucent		1.44		3.23	3.86	
AKC00729	Dark Blue		Semi-Translucent	R1	1.57		5.75	6.8	

Appendix 7.1e: Glass beads from Phum Snay

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00041	Phum Snay	359(p)	Indo-Pacific Bead	Burial 9 Bag 37 beads at waist	1	Light Blue		Semi-Translucent
AKC00057	Phum Snay	326	Ring fragment (earring?)	Unit A West 3:2 Bag 15 Cat 326	1	Light Blue	Turquoise blue/green with streaks of yellow.	Opaque
AKC00058	Phum Snay	327	Glass bangle/earring fragment	Unit A/West 3:2 Bag 15 Cat 327	1	Light Blue	Turquoise blue/green with streaks of yellow.	Opaque
AKC00059	Phum Snay	380	Earring/ring	Unit A/W 3:4 Feature 2 Burial 13 Bag 42	1	Dark Blue		Translucent
AKC00060	Phum Snay	232	Indo-Pacific Microbead	Unit A/E 1:1 Bag 1 Cat 232	1	Orange		Opaque
AKC00061	Phum Snay	243	Indo-Pacific Bead	Unit C/E 1:1 Bag 1 Cat 243	1	Yellow		Opaque
AKC00062	Phum Snay	236	Indo-Pacific Bead	Unit C/E 1:1 Bag 1 Cat 236	1	Yellow		Opaque
AKC00063	Phum Snay	253	Indo-Pacific Bead	Unit C/E 2:2 Bag 5 Cat 253	1	Yellow		Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00064	Phum Snay	24	Indo-Pacific Bead	Unit B 2:2 Bag 5 Cat 24	1	Yellow		Opaque
AKC00065	Phum Snay	148	Indo-Pacific Microbead	Unit B 3:5 Cat 148 Bag 26	1	Orange		Opaque
AKC00066	Phum Snay	122	Indo-Pacific Microbead	Unit B 3:5 Bag 26 Cat 122	1	Red		Opaque
AKC00067	Phum Snay	102	Indo-Pacific Microbead	Unit A 3:2 Feature 1 Bag 18 Cat 102	1	Orange		Opaque
AKC00068	Phum Snay	135	Indo-Pacific Microbead	Unit B 3:5 Bag 26 Cat 135	1	Red		Opaque
AKC00069	Phum Snay	73	Indo-Pacific Microbead	Unit C 3:2 Bag 17 Burial 1 Cat 73	1	Orange		Opaque
AKC00070	Phum Snay	151	Indo-Pacific Microbead	Unit B 3:3 Feature 1 Bag 20 Cat 151	1	Orange		Opaque
AKC00071	Phum Snay	13	Indo-Pacific Bead	Unit B 1:3 Bag 3 Cat 13	1	Red		Opaque
AKC00072	Phum Snay	302	Indo-Pacific Bead	Unit A West 3:2 Bag 15 Cat 302	1	Red		Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00073	Phum Snay	250	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 250	1	Orange		Opaque
AKC00074	Phum Snay	18	Indo-Pacific Bead	Unit B 2:1 Bag 4 Cat 18	1	Orange		Opaque
AKC00075	Phum Snay	761	Indo-Pacific Bead	Unit A/E 2:3 Bag 6 Cat 761	1	Red		Opaque
AKC00076	Phum Snay	255	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 255	1	Orange		Opaque
AKC00077	Phum Snay	50	Indo-Pacific Bead	Unit A 3:1 Feature 1 Bag 12 Cat 50	1	Red		Opaque
AKC00078	Phum Snay	26	Indo-Pacific Bead	Unit B 2:2 Bag 5 Cat 26	1	Orange		Opaque
AKC00079	Phum Snay	33	Indo-Pacific Bead	Unit A 2:3 Bag 6 Cat 33	1	Orange		Opaque
AKC00080	Phum Snay	25	Indo-Pacific Bead	Unit A 2:2 Bag 5 Cat 25	1	Light Green	green color similar to cat 234 but 234 has more yellow	Transparent Opaque
AKC00081	Phum Snay	234	Indo-Pacific Bead	Unit A/W 1:1 Bag 1 Cat 234	1	Yellow-Green		Translucent Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00082	Phum Snay	248	Indo-Pacific Bead	Unit C/E 2:1 Bag 4 Cat 248	1	Light Blue	Turquoise	Semi-Translucent
AKC00083	Phum Snay	349	Indo-Pacific Bead	Unit C/E Burial 9 at neck Bag 37 Cat 349	1	Light Blue	Turquoise	Semi-Translucent
AKC00084	Phum Snay	256	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 256	1	Light Blue	Turquoise	Semi-Translucent
AKC00085	Phum Snay	303	Indo-Pacific Bead	Unit C/E 2:4 Bag 7 Cat 303	1	Light Blue	Turquoise	Semi-Translucent
AKC00086	Phum Snay	252	Indo-Pacific Bead	Unit A/West 2:2 Bag 5 Cat 252	1	Light Blue	Turquoise	Semi-Translucent
AKC00087	Phum Snay	640	Indo-Pacific Bead	Unit C/E 2:2 Bag 5 Cat 640	1	Dark Green		Opaque
AKC00088	Phum Snay	246	Indo-Pacific Bead	Unit C/E 2:1 Bag 4 cat 246	1	Dark Blue		Semi-Translucent
AKC00089	Phum Snay	763	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 763	1	Dark Blue		Semi-Translucent
AKC00090	Phum Snay	29	Indo-Pacific Bead	Unit B 2:3 Bag 6 Cat 29	1	Dark Blue		Semi-Translucent

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00091	Phum Snay	12	Indo-Pacific Bead	Unit C 1:3 Bag 3 Cat 12	1	Dark Blue		Translucent Semi- Translucent
AKC00092	Phum Snay	42	Indo-Pacific Bead	Unit B 2:3 Bag 6 Cat 42	1	Dark Blue		Translucent
AKC00093	Phum Snay	271	Indo-Pacific Bead	Unit A/West 1:1 Bag 1 Cat 271	1	Dark Blue		Translucent
AKC00094	Phum Snay	45	Indo-Pacific Bead	Unit C Bag 9 Level 2:5 Cat 45	1	Dark Blue		Translucent
AKC00095	Phum Snay	348	Indo-Pacific Bead	Burial 9 (at head) Bag 37	1	Cobalt		Translucent
AKC00096	Phum Snay	65(a)	Indo-Pacific Microbead	Unit B 3:3 Bag 16 cat 65	4	Orange		Opaque
AKC00097	Phum Snay	65(b)	Indo-Pacific Microbead	Unit B 3:3 Bag 16 cat 65	4	Orange		Opaque
AKC00098	Phum Snay	65(c)	Indo-Pacific Microbead	Unit B 3:3 Bag 16 cat 65	4	Orange		Opaque
AKC00099	Phum Snay	65(d)	Indo-Pacific Microbead	Unit B 3:3 Bag 16 cat 65	4	Orange		Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00100	Phum Snay	100(a)	Indo-Pacific Microbead	Unit A/B 3: 2 Feature 2 Bag 19 Cat 100	3	Orange		Opaque
AKC00101	Phum Snay	100(b)	Indo-Pacific Microbead	Unit A/B 3: 2 Feature 2 Bag 19 Cat 100	3	Orange		Opaque
AKC00102	Phum Snay	100(c)	Indo-Pacific Microbead	Unit A/B 3: 2 Feature 2 Bag 19 Cat 100	3	Orange		Opaque
AKC00103	Phum Snay	402(a)	Indo-Pacific Bead	Burial 7 Bag 21 Cat 402	2	Dark Blue		Transparent
AKC00104	Phum Snay	402(b)	Indo-Pacific Bead	Burial 7 Bag 21 Cat 402	2	Dark Blue		Transparent
AKC00105	Phum Snay	352(a)	Indo-Pacific Bead	Burial 9 Bag 37 Cat 352	4	Red		Opaque
AKC00106	Phum Snay	352(b)	Indo-Pacific Bead	Burial 9 Bag 37 Cat 352	4	Light Blue	Turquoise	Semi-Translucent
AKC00107	Phum Snay	352(c)	Indo-Pacific Bead	Burial 9 Bag 37 Cat 352	4	Light Blue	Turquoise	Semi-Translucent
AKC00108	Phum Snay	352(d)	Indo-Pacific Bead	Burial 9 Bag 37 Cat 352	4	Light Blue	Turquoise	Semi-Translucent
AKC00109	Phum Snay	28(a)	Indo-Pacific Bead	Unit C 2:3 bag 6 cat 28	3	Dark Blue		Translucent
AKC00110	Phum Snay	28(b)	Indo-Pacific Bead	Unit C 2:3 bag 6 cat 28	3	Dark Blue		Translucent

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00111	Phum Snay	28(c)	Indo-Pacific Bead	Unit C 2:3 bag 6 cat 28	3	Dark Blue		Translucent
AKC00112	Phum Snay	229(a)	Indo-Pacific Bead	Burial 7 (beads at skull and neck) Bag 35	3	Dark Blue		Translucent
AKC00113	Phum Snay	229(b)	Indo-Pacific Bead	Burial 7 (beads at skull and neck) Bag 35	3	Dark Blue		Translucent
AKC00114	Phum Snay	229(c)	Indo-Pacific Bead	Burial 7 (beads at skull and neck) Bag 35	3	Dark Blue		Translucent
AKC00115	Phum Snay	292(a)	Indo-Pacific Bead	Unit C/E 2:1 Feature 1 Bag 37 Cat 292	2	Light Blue	Turquoise	Semi-Translucent
AKC00116	Phum Snay	292(b)	Indo-Pacific Bead	Unit C/E 2:1 Feature 1 Bag 37 Cat 292	2	Blue-Green		Translucent
AKC00117	Phum Snay	40(a)	Indo-Pacific Bead	Unit A 2:4 Bag 8 cat 40	2	Dark Blue	Navy blue?	Translucent
AKC00118	Phum Snay	40(b)	Indo-Pacific Bead	Unit A 2:4 Bag 8 cat 40	2	Dark Blue		Translucent
AKC00119	Phum Snay	258(a)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Dark Blue		Translucent

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00120	Phum Snay	258(b)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Dark Blue		Translucent
AKC00121	Phum Snay	258(c)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Orange		Opaque
AKC00122	Phum Snay	258(d)	Indo-Pacific Microbead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Red		Opaque
AKC00123	Phum Snay	258(e1)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00124	Phum Snay	258(e2)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00125	Phum Snay	258(e3)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00126	Phum Snay	258(e4)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00127	Phum Snay	258(e5)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00128	Phum Snay	258(e6)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00129	Phum Snay	258(e7)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00130	Phum Snay	258(e8)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00131	Phum Snay	258(e9)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00132	Phum Snay	258(e10)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00133	Phum Snay	258(e11)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00134	Phum Snay	258(e12)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00135	Phum Snay	258(e13)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00136	Phum Snay	258(e14)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00137	Phum Snay	258(e15)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00138	Phum Snay	258(e16)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00139	Phum Snay	258(e17)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00140	Phum Snay	258(e18)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00141	Phum Snay	258(e19)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00142	Phum Snay	258(e20)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00143	Phum Snay	258(e21)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00144	Phum Snay	258(e22)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00145	Phum Snay	258(e23)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00146	Phum Snay	258(e24)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00147	Phum Snay	258(e25)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00148	Phum Snay	258(e26)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00149	Phum Snay	258(e27)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00150	Phum Snay	258(e28)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00151	Phum Snay	258(e29)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00152	Phum Snay	258(e30)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00153	Phum Snay	258(e31)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00154	Phum Snay	258(e32)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00155	Phum Snay	258(e33)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00156	Phum Snay	258(e34)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00157	Phum Snay	258(e35)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00158	Phum Snay	258(e36)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00159	Phum Snay	258(e37)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00160	Phum Snay	258(e38)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00161	Phum Snay	258(e39)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00162	Phum Snay	258(e40)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00163	Phum Snay	258(e41)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00164	Phum Snay	258(e42)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00165	Phum Snay	258(e43)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00166	Phum Snay	258(e44)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque
AKC00167	Phum Snay	258(e45)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 258	49	Yellow		Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00168	Phum Snay	22(a)	Indo-Pacific Bead	Unit C 2:2 Bag 5 Cat 22	6	Yellow		Opaque
AKC00169	Phum Snay	22(b)	Indo-Pacific Bead	Unit C 2:2 Bag 5 Cat 22	6	Yellow		Opaque
AKC00170	Phum Snay	22(c)	Indo-Pacific Bead	Unit C 2:2 Bag 5 Cat 22	6	Yellow		Opaque
AKC00171	Phum Snay	22(d)	Indo-Pacific Bead	Unit C 2:2 Bag 5 Cat 22	6	Red		Opaque
AKC00172	Phum Snay	22(e)	Indo-Pacific Bead	Unit C 2:2 Bag 5 Cat 22	6	Dark Blue		Translucent
AKC00173	Phum Snay	22(f)	Indo-Pacific Bead	Unit C 2:2 Bag 5 Cat 22	6	Dark Blue		Translucent
AKC00174	Phum Snay	263(a1)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00175	Phum Snay	263(a2)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00176	Phum Snay	263(a3)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00177	Phum Snay	263(a4)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00178	Phum Snay	263(a5)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00179	Phum Snay	263(a6)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00180	Phum Snay	263(a7)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00181	Phum Snay	263(a8)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00182	Phum Snay	263(a9)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00183	Phum Snay	263(a10)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00184	Phum Snay	263(a11)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00185	Phum Snay	263(a12)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00186	Phum Snay	263(a13)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00187	Phum Snay	263(a14)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00188	Phum Snay	263(a15)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00189	Phum Snay	263(a16)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00190	Phum Snay	263(a17)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00191	Phum Snay	263(a18)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00192	Phum Snay	263(a19)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00193	Phum Snay	263(a20)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00194	Phum Snay	263(a21)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00195	Phum Snay	263(a22)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00196	Phum Snay	263(a23)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00197	Phum Snay	263(a24)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00198	Phum Snay	263(a25)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00199	Phum Snay	263(a26)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00200	Phum Snay	263(a27)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00201	Phum Snay	263(a28)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00202	Phum Snay	263(a29)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00203	Phum Snay	263(a30)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00204	Phum Snay	263(a31)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00205	Phum Snay	263(a32)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00206	Phum Snay	263(a33)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00207	Phum Snay	263(a34)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00208	Phum Snay	263(a35)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00209	Phum Snay	263(a36)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00210	Phum Snay	263(a37)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00211	Phum Snay	263(a38)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00212	Phum Snay	263(a39)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00213	Phum Snay	263(a40)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Light Blue	Turquoise	Semi-Translucent
AKC00214	Phum Snay	263(b1)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Red		Opaque
AKC00215	Phum Snay	263(b2)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Red		Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00216	Phum Snay	263(b3)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Red		Opaque
AKC00217	Phum Snay	263(b4)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Red		Opaque
AKC00218	Phum Snay	263(b5)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Red		Opaque
AKC00219	Phum Snay	263(b6)	Indo-Pacific Bead	Unit C/E 2:2 Feature 1 Bag 37 Cat 263	46	Red		Opaque
AKC00220	Phum Snay	243	Indo-Pacific Bead	Phum Snay 2001 S3E1 L3:1 Cat 243 Bag 19	1	Dark Blue		Transparent
AKC00221	Phum Snay	35	Indo-Pacific Bead	Phum Snay 2001 S3E1 Layer 1:4 Bag 7 Cat 35	1	Dark Blue	Matte finish	Transparent
AKC00222	Phum Snay	22	Indo-Pacific Bead		1	Dark Blue		Opaque Semi- Translucent
AKC00223	Phum Snay	119	Indo-Pacific Bead	Phum Snay 2001 S2E1 Layer 2:3 Bag 7 Cat 119	1	Dark Blue		Semi- Translucent

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00224	PHum Snay	41	Indo-Pacific Bead	Phum Snay 2001 S1E1 Level 1:4 Bag 5 Cat 41	1	Black		Opaque
AKC00226	Phum Snay	46	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 2:1 Bag 13 Cat 46	1	Yellow		Opaque
AKC00227	Phum Snay	126	Indo-Pacific Bead	S1E1 Layer 2:3 Bag 23 Cat 126	1	Yellow		Opaque
AKC00228	Phum Snay	259	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 3:2 Feature 3 Bag 36 Cat 259	1	Yellow		Opaque
AKC00229	PHum Snay	130	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 2:3 Bag 23 Cat 130	1	Yellow		Opaque
AKC00230	Phum Snay	17	Indo-Pacific Bead	Phum Snay 2001 S3E1 Bag 3 Test Probe Cat 17	1	Yellow		Opaque
AKC00231	Phum Snay	278	Indo-Pacific Bead	Phum Snay 2001 S2E1 Layer 3:2 Bag 16 Cat 278	1	Yellow		Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00232	Phum Snay	311	Bangle/earring fragment	S3E1 Layer 3:5/Natural Bag 35 Burial 6	1	Light Blue	Turquoise	Opaque
AKC00233	Phum Snay	193	Indo-Pacific Bead	Phum Snay 2001 S3E1 L 2:4 Bag 15 Cat 193	1	Red	Reddish-brown	Opaque
AKC00234	Phum Snay	113	Indo-Pacific Bead	Phum Snay 2001 Layer 2:3 Bag 23 Cat 113 SQUARE??	1	Red	Reddish-brown	Opaque
AKC00235	Phum Snay	293	Indo-Pacific Bead	S 1/2 E1 L 3:3 Feature 1 Bag 38 Cat 293	1	Red	Reddish-brown	Opaque
AKC00236	Phum Snay	85	Indo-Pacific bead (tubular)	Phum Snay 2001 S2E1 L 2:2 Cat 85 Bag 6	1	Red	Reddish-brown	Opaque
AKC00237	Phum Snay	131	Indo-Pacific bead (tubular)	S1E1 L 2:3 Bag 23 Cat 131	1	Red	Reddish-brown	Opaque
AKC00238	Phum Snay	107	Indo-Pacific bead (tubular)	S1E1 L 2:3 Bag 23 Cat 107	1	Red	Reddish-brown	Opaque
AKC00239	Phum Snay	262	Indo-Pacific bead (tubular)	Phum Snay 2001 L 3:1 Feature 1 Bag 33 Cat 262 SQUARE??	1	Red	Reddish-brown	Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00240	Phum Snay	186	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 2:5 Feature 3 Bag 31 Cat 186	1	Red	Reddish-brown	Opaque
AKC00241	Phum Snay	157	Indo-Pacific Bead	Phum Snay 2001 S1E1 L 2:4 Bag 27 Cat 157	1	Red	Reddish-brown	Opaque
AKC00242	Phum Snay	177	Indo-Pacific Bead	Phum Snay 2001 S1E1 L 2:5 Bag 30 Cat 177	1	Red	Reddish-brown	Opaque
AKC00243	Phum Snay	192	Indo-Pacific Bead	Phum Snay 2001 S3E1 L 2:5 Bag 17 Cat 192	1	Red	Reddish-brown	Opaque
AKC00244	Phum Snay	232	Indo-Pacific Bead	Phum Snay 2001 S2 E1 L 2:5 Feature 1 Bag 13 Cat 232	1	Red	Reddish-brown	Opaque
AKC00245	Phum Snay	245	Indo-Pacific Bead	Phum Snay 2001 S1E1 3:1 Feature 1 Bag 33 Cat 245	1	Red	Reddish-brown	Opaque
AKC00246	Phum Snay	64	Indo-Pacific Bead	Phum Snay 2001 S2E1 Layer 2:2 Bag 6 Cat 64	1	Red	Reddish-brown	Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00247	Phum Snay	48	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 2:1 Bag 13 Cat 48	1	Red	Darker reddish-brown	Opaque
AKC00248	Phum Snay	240	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 3:1 Feature 1 Bag 33 Cat 240	1	Red	Reddish-brown	Opaque
AKC00249	Phum Snay	274	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 3:2 Bag 34 Cat 274	1	Red	Darker reddish-brown	Opaque
AKC00250	Phum Snay	124	Indo-Pacific Bead	Phum Snay 2001 S2E1 Layer 2:2 Bag 5 Cat 124	1	Orange	Dark orange	Opaque
AKC00251	Phum Snay	210	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 3:1 Bag 32 Cat 210	1	Orange	Dark orange	Opaque
AKC00252	Phum Snay	241	Indo-Pacific Bead	Phum Snay 2001 S3E1 Layer 3:1 Bag 19 Cat 241	1	Orange	Dark orange	Opaque
AKC00253	Phum Snay	116	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 2:3 Bag 23 Cat 116	1	Orange		Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00254	Phum Snay	231	Indo-Pacific bead (tubular)	Phum Snay 2001 S2E1 Layer 3:1 Bag 14 Cat 231	1	Orange	Red-orange mix	Opaque
AKC00255	Phum Snay	107a	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 2:3 Bag 23 Cat 107	2	Orange		Opaque
AKC00256	Phum Snay	107b	Indo-Pacific bead (tubular)	Phum Snay 2001 S1E1 Layer 2:3 Bag 23 Cat 107	2	Orange		Opaque
AKC00257	Phum Snay	143	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 2:4 Bag 27 Cat 143	1	Orange	Shiny	Opaque
AKC00258	Phum Snay	197	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 2:4 Bag 27 Cat 197	1	Orange	Shiny and darker orange color	Opaque
AKC00259	Phum Snay	62	Indo-Pacific Bead	Phum Snay 2001 S2E1 Layer 2:2 Bag 6 Cat 62	1	Orange	Dark orange	Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00260	Phum Snay	188	Indo-Pacific bead (tubular)	Phum Snay 2001 S1E1 Layer 2:5 Bag 30 Cat 188	1	Orange	Shiny and darker orange color	Opaque
AKC00261	Phum Snay	307	Indo-Pacific Bead	Phum Snay 2001 S3E1 Layer 3:4 Bag 33 Cat 307	1	Orange	Shiny and darker orange color	Opaque
AKC00262	Phum Snay	66	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 2:1 Bag 13 Cat 66	1	Orange	Light orange color	Opaque
AKC00263	Phum Snay	59	Indo-Pacific Bead	Phum Snay 2001 S2E1 Layer 2:2 Bag 6 Cat 59	1	Orange	Light orange color	Opaque
AKC00264	Phum Snay	42	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 2:1 Bag 13 Cat 42	1	Orange	Light orange color	Opaque
AKC00265	Phum Snay	263	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 3:2 Feature 2 Bag 35 Cat 263	1	Orange	Light orange color	Opaque
AKC00266	Phum Snay	61	Indo-Pacific Bead	Phum Snay 2001 S2E1 Layer 2:2 Bag 6 Cat 61	1	Orange	Light orange color	Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00267	Phum Snay	10	Indo-Pacific bead (tubular)	Phum Snay 2001 S1E1 Layer 1:2 Bag 2 Cat 10	1	Orange	Light orange color	Opaque
AKC00268	Phum Snay	84	Indo-Pacific Bead	Phum Snay 2001 S2E1 Layer 2:2 Bag 6 Cat 84	1	Orange	Light orange color	Opaque
AKC00269	Phum Snay	129	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 2:3 Bag 23 Cat 129	1	Orange	Light orange color	Opaque
AKC00270	Phum Snay	73	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 2:2 Bag 21 Cat 73	1	Orange	Light orange color	Opaque
AKC00271	Phum Snay	15	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 1:2 Bag 2 Cat 15	1	Orange	Light orange color	Opaque
AKC00272	Phum Snay	179	Indo-Pacific Bead	Phum Snay 2001 S2E1 Layer 3:1 Bag 14 Cat 179	1	Orange	Area around bead hole is black	Opaque
AKC00273	Phum Snay	154	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 2:4 Bag 27 Cat 154	1	Orange	Dark orange	Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00274	Phum Snay	25	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 1:3 Bag 3 Cat 25	1	Orange	Dark orange	Opaque
AKC00275	Phum Snay	270	Indo-Pacific bead (tubular)	Phum Snay 2001 S1/2 E1 Layer 3:3 Feature 1 Bag 28 Cat 270	1	Orange	Dark orange	Opaque
AKC00276	Phum Snay	214	Indo-Pacific Bead	Phum Snay 2001 S2E1 Layer 2:5 Bag 12 Cat 214	1	Orange	Orange-red	Opaque
AKC00277	Phum Snay	273	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 3:2 Bag 34 Cat 273	1	Orange	Orange-red	Opaque
AKC00278	Phum Snay	93	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 2:3 Bag 21 Cat 93	1	Orange	Dark orange	Opaque
AKC00279	Phum Snay	98	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 2:2 Bag 21 Cat 98	1	Orange	Dark orange	Opaque
AKC00280	Phum Snay	147	Indo-Pacific Bead	Phum Snay 2001 S2E1 Layer 2:4 Bag 8 Cat 147	1	Orange	Dark orange, shiny	Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00281	Phum Snay	258	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 3:2 Feature 2 Bag 35 Cat 258	1	Orange	Dark orange	Opaque
AKC00282	Phum Snay	142	Indo-Pacific Bead	Phum Snay 2001 S1E1 Layer 2:4 Bag 27 Cat 142	1	Orange	Dark orange	Opaque
AKC00283	Phum Snay	176	Indo-Pacific Microbead	Phum Snay 2001 S3E1 Layer 3:1 Bag 19 Cat 176	1	Orange	Dark orange	Opaque
AKC00284	Phum Snay	214a	Indo-Pacific Microbead	Phum Snay 2001 S2E1 Burial 1 Bag 12 Cat 214 Layer 2:3?	58	Orange	Shiny	Opaque
AKC00285	Phum Snay	214b	Indo-Pacific Microbead	Phum Snay 2001 S2E1 Burial 1 Bag 12 Cat 214 Layer 2:3?	58	Orange	Shiny	Opaque
AKC00286	Phum Snay	214c	Indo-Pacific Microbead	Phum Snay 2001 S2E1 Burial 1 Bag 12 Cat 214 Layer 2:3?	58	Orange	Shiny	Opaque

Database ID	Site Name	Catalogue Number	Bead Shape	Context	Total # of beads	Glass Colors	Glass Color Notes	Opacity
AKC00287	Phum Snay	214e	Indo-Pacific Microbead	Phum Snay 2001 S2E1 Burial 1 Bag 12 Cat 214 Layer 2:3?	58	Orange	Shiny	Opaque
AKC00288	Phum Snay	214f	Indo-Pacific Microbead	Phum Snay 2001 S2E1 Burial 1 Bag 12 Cat 214 Layer 2:3?	58	Orange	Shiny	Opaque
AKC00289	Phum Snay	214g	Indo-Pacific Microbead	Phum Snay 2001 S2E1 Burial 1 Bag 12 Cat 214 Layer 2:3?	58	Orange	Shiny	Opaque

Database ID	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max.Width	Min. Width	Thickness	Notes
AKC00041	R1	0.9		2.56	4			Associated with 15 carnelian beads
AKC00057	N/A			34.23	N/A		5.04	
AKC00058	N/A			N/A	N/A		3.5	
AKC00059	N/A			22.45	N/A		4.12	
AKC00060	R1			1.43	1.5			
AKC00061	R1	1.28		2.3	3.25			
AKC00062	R2	1.23	1.3	4.43	5.04			
AKC00063	R1	1.29		2	3.82			
AKC00064	R1	0.7		2.1	2.91			
AKC00065	R1			0.74	1.2			
AKC00066	R1			1.34	1.63			
AKC00067	R1			0.93	1.27			
AKC00068	R1				1.05			
AKC00069	R1			0.95	1.41			
AKC00070	R1			0.49	1.26			
AKC00071	R1	1.17		3.14	3.51			
AKC00072	R1	1.87	1.7	2.8	4.24			
AKC00073	R1	0.9		2.26	2.44			
AKC00074	R2	1.33		2.9	3.72			
AKC00075	R1	1.71		3.01	4.01			
AKC00076	R1	1.75		2.2	4.53			
AKC00077	R1	1.43		2.61	3.23			
AKC00078	R1	1.65		2.47	4.51			
AKC00079	R1	0.73	0.29	5.27	2.82	2.56		
AKC00080	R1	0.79		2.71	3.56			
AKC00081	R1	1.21		2.32	4.12			
AKC00082	R1	1.22		2.67	4.49			

Database ID	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Min. Width	Thickness	Notes
AKC00083	R1	1.01	1.08	2.17	3.52			
AKC00084	R1	1.25	1.06	2.34	4.03			
AKC00085	R1	1.21	1.3	2.58	4.08			
AKC00086	R1	1.24	1.1	2.4	5			
AKC00087	R1	1.1	1.02	2.53	3.8			
AKC00088	R2	1.47		4	5.09			
AKC00089	R1	1.78		2.64	5.59			
AKC00090	R1	1.83		3.57	5.56			
AKC00091	R2	0.95		3.4	3.46			
AKC00092	R2	0.8		3.17	3.8			
AKC00093	R1	1.3		2.44	4.98			
AKC00094	R1	N/A	N/A	1.85	3.04			Broken bead, unable to measure
AKC00095	R1	0.63	0.73	1.36	2.66			
AKC00096	R1			0.71	1.1			
AKC00097	R1			0.8	1.07			
AKC00098	R1			0.88	1.24			
AKC00099	R1			0.72	1.11			
AKC00100	R1			0.56	1.3			
AKC00101	R1			0.7	1.21			
AKC00102				N/A	N/A			Broken bead, unable to measure
AKC00103	R1	1.01		3.43	4.13			
AKC00104	R2	1.56		2.93	4.29			
AKC00105	R1			0.98	2.28			
AKC00106	R1	0.98		1.52	3.3			
AKC00107	R1	1.23		2.84	4.9			
AKC00108	R1	0.93		2.3	4.11			
AKC00109	R1	1.19		3.03	4.65			

Database ID	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Min. Width	Thickness	Notes
AKC00110	R1	1.33		3.45	4.65			
AKC00111	R2	1.33		4.82	4.2			
AKC00112	R1	1.8	1.7	2.56	4.99			
AKC00113	R1	0.9		2.09	3.93			
AKC00114	R1	1.67		2.02	5			
AKC00115	R1	1.19		3.29	3.77			
AKC00116	R1	1.32	1.11	2.87	4.55			
AKC00117	R2	1.21		3.61	5.41			
AKC00118	R1	0.82		2.53	3.96			
AKC00119		N/A		N/A	N/A			Broken bead, unable to measure
AKC00120	R1	1.15		3.38	5			
AKC00121	R1	1.66	1.77	3.3	3.72			
AKC00122	R1	0.77		1.36	2.34			
AKC00123		0		0	0			
AKC00124	R1	1.04		1.73	3.72			
AKC00125	R1	1.53		4.14	5.45			
AKC00126	R2	1.17		3.49	4.6			
AKC00127	R2	1.01		3.36	4.29			
AKC00128	R1	1.05		3.64	4.09			
AKC00129	R1	1.47		3.14	6.12			
AKC00130	R1	1.08		3.4	4.24			
AKC00131	R1	1.44		4.31	5.1			
AKC00132	R1	1.41		2.59	6.15			
AKC00133	R1	1.26		3.4	5			
AKC00134	R1	1.26		3.4	5.17			
AKC00135	R1	1.3		3.6	5.07			
AKC00136	R1	1.21		3.17	4.68			

Database ID	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max.Width	Min. Width	Thickness	Notes
AKC00137	R1	1.19		3.95	4.41			
AKC00138	R1	1.42		3.88	4.9			
AKC00139	R1	1.82		3.74	5.87			
AKC00140	R1	1.14		4.27	5.88			
AKC00141	R1	1.18		3.1	5.47			
AKC00142	R1	1.29		3.62	5			
AKC00143	R1	1.82		2.81	5.72			
AKC00144	R1	1.72		2.53	5.36			
AKC00145	R1	1.72		2.47	5.36			
AKC00146	R1	1.71	1.54	3.53	6			
AKC00147	R1	1.52		2.95	5.63			
AKC00148	R1	1.54		3.32	5.85			
AKC00149	R1	2		3.28	5.67			
AKC00150	R1	1.16		3.42	4.82			
AKC00151	R1	1.32		3.16	4.82			
AKC00152	R0	1.19		3.62	5.11			
AKC00153	R1	1.62		3.2	5.09			
AKC00154	R1	1.2	1.3	3.63	5.28			
AKC00155	R1	1.47		3.17	5.03			
AKC00156	R0	1.01		3.86	4.89			
AKC00157	R1	1.6		3.62	5.79			
AKC00158	R1	1.07		3.89	4.83			
AKC00159	R1	1.3		3.24	5.27			
AKC00160	R1	1.39		3.54	5.69			
AKC00161	R1	2		3	5.18			
AKC00162	R1	1.4		3.67	5.61			
AKC00163	R1	0.98	0.88	2.96	4.26			

Database ID	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max.Width	Min. Width	Thickness	Notes
AKC00164	R1	1.22		3.68	4.53			
AKC00165	R1	1.26		3.12	4.95			
AKC00166	R1	1.2		2.83	4.6			
AKC00167	R1	1.34		2.95	5.55			
AKC00168	R1	1.48		2.8	4.83			
AKC00169	R1	1.05		2.06	3.15			
AKC00170	R1	0.88	1.15	1.87	3.64			
AKC00171	R2	0.88		3.2	3.66			
AKC00172	R1	0.98		2.04	3.14			
AKC00173	R1	0.85		2.72	4.7			
AKC00174		0		0	0			
AKC00175	R1	1.15		2.86	4.27			
AKC00176	R1	1.28		2.18	4.34			
AKC00177	R1	1.5		2.96	4.7			
AKC00178	R1	1.66		2.48	4.71			
AKC00179	R1	1.22		2.78	5.02			
AKC00180	R1	1.26		2.97	4.5			
AKC00181	R1	1.13		2.28	3.74			
AKC00182	R1	1.45		2.71	4.43			
AKC00183	R1	1.11		2.37	4.13			
AKC00184	R1	1.31		2.05	4.31			
AKC00185	R1	1.07		2.9	4.12			
AKC00186	R1	0.97		2.52	3.86			
AKC00187	R1	0.86		2.22	3.62			
AKC00188	R1	1.29		2.36	4.18			
AKC00189	R1	1.11	1.24	2.28	4.02			
AKC00190	R1	0.97		2.47	3.8			

Database ID	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max.Width	Min. Width	Thickness	Notes
AKC00191	R1	1.08		2.4	4.37			
AKC00192	R1	1.08		2.14	4.1			
AKC00193	R2	1.2		2.8	4.24			
AKC00194	R1	1.19		2.21	4.33			
AKC00195	R1	1.06		2.61	4.36			
AKC00196	R1	1.28		2.54	3.92			
AKC00197	R1	1.62		2.15	4.45			
AKC00198	R1	1.22		2.21	4.34			
AKC00199	R2	1.2		2.62	3.77			
AKC00200	R1	1.1		2.22	3.66			
AKC00201	R1	1	1.11	2.39	3.88			
AKC00202	R1	1.5		2.54	4.09			
AKC00203	R1	1.11		2.02	4.17			
AKC00204	R1	0.96		2.24	4.28			
AKC00205	R1	1.11		2.12	4.09			
AKC00206	R1	0		0	0			
AKC00207	R1	1.15		2.27	3.67			
AKC00208	R1	1.33		2.78	4.18			
AKC00209	R1	0.84		2.19	3.2			
AKC00210	R1	1.11		1.61	3.53			
AKC00211	R1	1.3		2.09	4.03			
AKC00212	R1	1.14		2.3	3.67			
AKC00213	R1	1.21		2.31	3.77			
AKC00214	R1	0.73		1.58	2.38			
AKC00215	R1	0.49		1.15	2.51			
AKC00216	R1	0.6		1.11	2.08			
AKC00217	R1	0.98	1.08	1.52	3.27			

Database ID	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max.Width	Min. Width	Thickness	Notes
AKC00218	R1	1		1.26	2.72			
AKC00219	R1	0.58		1.66	1.96			
AKC00220	R1	1.11		2.26	4.24			
AKC00221	R2			2.64	3.51			
AKC00222	R1	0.98		243	3.9			
AKC00223	R1	0.88		1.97	3.55			
AKC00224	R2	1.08		2.78	3.8			
AKC00226	R1	0.88		2.66	3.46			
AKC00227	R1	1.11		2.47	3.25			
AKC00228	R1	1.26		2.3	3.88			
AKC00229	R1	1.13		2.4	3.42			
AKC00230	R1	1.56		2.78	4.67			
AKC00231	R1	1.12		2.62	3.89			
AKC00232		N/A		N/A	N/A			Broken bead, unable to measure
AKC00233	R2	0.91		2.7	3.49			
AKC00234	R2	1.18		3.51	4.58			
AKC00235	R1	1.48		2.73	4.55			
AKC00236	R1	0.96		5.25	2.5			
AKC00237	R1	0.85		3.34	3.07			
AKC00238	R2	0.67		5.75	2.97			
AKC00239	R1	0.9		6.28	2.77			
AKC00240	R1	1.03		1.91	3.66			
AKC00241	R1	0.83		1.72	2.89			
AKC00242	R1	0.78		2.22	3.35			
AKC00243	R1	0.8		1.64	2.94			
AKC00244	R1	1.08		1.97	3.46			
AKC00245	R2	1.12		5.06	5.25			

Database ID	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Min. Width	Thickness	Notes
AKC00246	R1	1.17		2.71	4.95			
AKC00247	R1	1.29		4.37	4.17			
AKC00248	R2	1.28		5.27	6.78			
AKC00249	R1	1.64		5.35	8.05			
AKC00250	R1	1.95		2.72	4.06			
AKC00251	R1	1.06		2.51	5.58			
AKC00252	R1	1.18		2.09	4.06			
AKC00253	R1	N/A		1.61	1.78			Too small to measure bead hole
AKC00254	R1	1		5.63	2.49			
AKC00255	R1	1.14		3.25	2.74			
AKC00256	R1	0.72		3.78	2.03			
AKC00257	R2	1.22		2.25	3.33			
AKC00258	R1	1.25		3	4.45			
AKC00259	R1	1		3.43	3.87			
AKC00260	R1	0		6.41	1.95			Too small to measure bead hole
AKC00261	R1	2		3.25	5.25			Large orange bead
AKC00262	R1	0.98		2.4	3.38			
AKC00263	R1	1.02		2.16	3.88			
AKC00264	R3	1.03		2.82	3.78			
AKC00265	R2	1.25		2.83	3.81			
AKC00266	R1	0.95		2.8	3.31			
AKC00267	R1	0.78		5.19	2.18			
AKC00268	R1	1.21		2.46	3.32			
AKC00269	R2	0.86		2.79	3.01			
AKC00270	R1	0.83		1.67	2.86			
AKC00271	R1	1		1.67	2.81			
AKC00272	R1	0.89		3.13	3.27			

Database ID	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Min. Width	Thickness	Notes
AKC00273	R1	1.13		2.33	4.02			
AKC00274	R1	1.17		2.64	4.36			
AKC00275	R1	0.79		5.5	2.46			
AKC00276	R1	1.51		2.93	4.11			
AKC00277	R1	N/A		1.33	1.99			Too small to measure bead hole
AKC00278	R1	N/A		1.53	2.01			Too small to measure bead hole
AKC00279	R1	N/A		1.11	1.78			Too small to measure bead hole
AKC00280	R1	N/A		1.54	2.23			Too small to measure bead hole
AKC00281	R1	N/A		1.06	1.64			Too small to measure bead hole
AKC00282	R1	N/A		1.42	1.75			Too small to measure bead hole
AKC00283		N/A		0	0			Broken bead, unable to measure
AKC00284	R1	N/A		1.76	1.39			Choose 6 of 58 beads to measure, microbeads were too small to measure perforation size.
AKC00285	R1	N/A		2.12	1.37			
AKC00286	R1	N/A		0.99	1.36			
AKC00287	R1	N/A		0.82	1.53			
AKC00288	R1	N/A		1.38	1.5			
AKC00289	R1	N/A		1.08	1.47			

Appendix 7.1f: Glass beads from Village 10.8

Database ID	Site Name	Unit	Square	Catalogue Number	Bead Shape	Total # of beads
AKC00318	Village 10.8	EXXXVIII	AF-84	4	N/A	1
AKC00319	Village 10.8	XXXXIV	AG-84	2	NA	1
AKC00320	Village 10.8	EXVIII	N/85	47	Earring	1
AKC00321	Village 10.8	EXVIII	N/85	48	Earring	1
AKC00322	Village 10.8	EXXXVI	H/86		Earring	1
AKC00323	Village 10.8	EXVIII	N/85	18	Ring	1
AKC00324	Village 10.8	EXVIII	N/85	43	Ring	1
AKC00325	Village 10.8	EXVIII	N/85	42	Ring	1
AKC00326	Village 10.8	EXVIII	N/85	19	Ring	1
AKC00327	Village 10.8	E/I	U/91	6	Ring	1
AKC00328	Village 10.8	E	22/94	3	Indo-Pacific bead	1
AKC00329	Village 10.8	E	21/94	19	Indo-Pacific bead	1
AKC00330	Village 10.8	E/O	S/92, S/91	26	Indo-Pacific Bead	3
AKC00331	Village 10.8	E/O	S/92, 2/91	26	Indo-Pacific Bead	3
AKC00332	Village 10.8	E/O	S/92, 2/91	26	Indo-Pacific Bead	3
AKC00369	Village 10.8	EIX	Q 89,90	39	Indo-Pacific bead	1
AKC00370	Village 10.8	EVIII	R/89	45	Indo-Pacific bead	1
AKC00371	Village 10.8	EVIII	S/90	46	Indo-Pacific bead	1
AKC00372	Village 10.8	EIX	Q/90	14	Indo-Pacific bead	1
AKC00373	Village 10.8	EXVI	R/86	13	Indo-Pacific bead	1
AKC00374	Village 10.8	EIX	Q/89	38	Indo-Pacific bead	1
AKC00375	Village 10.8	EIX	Q/90	25	Indo-Pacific bead	1
AKC00376	Village 10.8	EXII	T/87	23	Indo-Pacific bead	1
AKC00377	Village 10.8	EIX	Q/90	17	Indo-Pacific bead	1
AKC00378	Village 10.8	EXII	T/87	43	Indo-Pacific bead	1

Database ID	Site Name	Unit	Square	Catalogue Number	Bead Shape	Total # of beads
AKC00379	Village 10.8	EI	T/92	39	Indo-Pacific bead	26
AKC00380	Village 10.8	EI	T/92	39	Indo-Pacific bead	26
AKC00381	Village 10.8	EXII	T/87	34	Indo-Pacific bead	11
AKC00382	Village 10.8	EXII	T/87	34	Indo-Pacific bead	11
AKC00383	Village 10.8	EXII	T/87	34	Indo-Pacific bead	11
AKC00384	Village 10.8	EIX	S/87	30	Indo-Pacific bead	4
AKC00385	Village 10.8	EIX	Q/89	20	Indo-Pacific bead	3
AKC00386	Village 10.8	EIX	Q/89	20	Indo-Pacific bead	3
AKC00387	Village 10.8	EIX	Q/89	20	Indo-Pacific bead	3
AKC00388	Village 10.8	EXII	T/87	34	Indo-Pacific bead	2
AKC00389	Village 10.8	EXII	T/87	34	Indo-Pacific bead	2
AKC00390	Village 10.8	EIX	Q/89	12	Indo-Pacific bead	26
AKC00391	Village 10.8	EIX	Q/89	12	Indo-Pacific bead	26
AKC00392	Village 10.8	EXII	T/87	34	Indo-Pacific bead	7
AKC00393	Village 10.8	EXII	T/87	34	Indo-Pacific bead	7
AKC00394	Village 10.8	EXII	T/87	34	Indo-Pacific bead	7
AKC00395	Village 10.8	EXII	T/87	34	Indo-Pacific bead	7
AKC00396	Village 10.8	EXII	T/87	34	Indo-Pacific bead	7
AKC00397	Village 10.8	EXII	T/87	34	Indo-Pacific bead	7
AKC00398	Village 10.8	EXII	T/87	34	Indo-Pacific bead	7
AKC00399	Village 10.8	EIX	Q/90	12	Indo-Pacific bead	43
AKC00400	Village 10.8	EIX	Q/90	12	Indo-Pacific bead	43
AKC00401	Village 10.8	EIX	Q/90	12	Indo-Pacific bead	43
AKC00402	Village 10.8	EIX	Q/90	12	Indo-Pacific bead	43
AKC00403	Village 10.8	EIX	Q/90	12	Indo-Pacific bead	43
AKC00404	Village 10.8	EIX	Q/90	12	Indo-Pacific bead	43
AKC00405	Village 10.8	EIX	Q/90	12	Indo-Pacific bead	43

Database ID	Site Name	Unit	Square	Catalogue Number	Bead Shape	Total # of beads
AKC00406	Village 10.8	EIX	Q/90	12	Indo-Pacific bead	43
AKC00407	Village 10.8	EIX	Q/90	12	Indo-Pacific bead	43
AKC00408	Village 10.8	EIX	Q/90	12	Indo-Pacific bead	43
AKC00409	Village 10.8	EIX	Q/90	12	Indo-Pacific bead	43
AKC00410	Village 10.8	EIX	Q/89	18	Indo-Pacific bead	69
AKC00411	Village 10.8	EIX	Q/89	18	Indo-Pacific bead	69
AKC00412	Village 10.8	EIX	Q/89	18	Indo-Pacific bead	69
AKC00413	Village 10.8	EIX	Q/89	18	Indo-Pacific bead	69
AKC00414	Village 10.8	EIX	Q/89	18	Indo-Pacific bead	69
AKC00415	Village 10.8	EIX	Q/89	18	Indo-Pacific bead	69
AKC00416	Village 10.8	EIX	Q/89	18	Indo-Pacific bead	69
AKC00417	Village 10.8	EIX	Q/89	18	Indo-Pacific bead	1269
AKC00418	Village 10.8	EIX	Q/89	18	Indo-Pacific bead	69
AKC00419	Village 10.8	EIX	Q/89	18	Indo-Pacific bead	69
AKC00420	Village 10.8	EIX	Q/89	18	Indo-Pacific bead	69
AKC00421	Village 10.8	EIX	Q/89	18	Indo-Pacific bead	69
AKC00422	Village 10.8	EIX	Q/90	to 18	Indo-Pacific bead	8
AKC00423	Village 10.8	EIX	Q/90	to 18	Indo-Pacific bead	8
AKC00424	Village 10.8	EXXVII	Ad/85	7	Short Barrel	1
AKC00425	Village 10.8	EXXXIX	Ad/87	7	Indo-Pacific bead	24
AKC00426	Village 10.8	EXXXIX	Ad/87	7	Indo-Pacific bead	24
AKC00427	Village 10.8	EXXXIX	Ad/87	7	Indo-Pacific bead	24
AKC00428	Village 10.8	EXXXIX	Ad/87	7	Indo-Pacific bead	24
AKC00429	Village 10.8	EXXXIX	Ad/87	7	Indo-Pacific bead	24
AKC00430	Village 10.8	EXXXIX	Ad/87	7	Indo-Pacific bead	24

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00318	Dark Green			NA	N/A	N/A	N/A	N/A	Weathering made bead fragile, unable to measure
AKC00319	Dark Green			NA	N/A	N/A	N/A	N/A	Fragmented beads due to weathering
AKC00320	Purple			NA	N/A	N/A	N/A	N/A	Fragmented beads due to weathering
AKC00321	Purple			NA	N/A	N/A	N/A	N/A	Fragmented beads due to weathering
AKC00322	Purple		Translucent	NA			N/A	N/A	Broken Earring fragment
AKC00323	Purple		Transparent	NA	19.76		24.46		Interior hole in ring is recorded as inside perforation A
AKC00324	Purple		Transparent	NA	19.6		24.63		Interior hole in ring is recorded as inside perforation A
AKC00325	Purple		Transparent	NA	19.74		24.96		Interior hole in ring is recorded as inside perforation A
AKC00326	Purple		Transparent	NA	20.33		25.32		Interior hole in ring is recorded as inside perforation A
AKC00327	Black		Opaque	NA	NA		NA	NA	Broken, unable to measure
AKC00328	Dark Blue	Navy blue	Translucent	R2	1.14		5.28	5.07	
AKC00329	Medium Blue		Transparent	NA	NA		NA	NA	Broken, unable to measure
AKC00330	Ivory		Opaque	R0	1.28		1.71	3.57	glass?
AKC00331	Ivory	Darker ivory color than AKC00330	Opaque	R0	1.44		1.56	3.62	
AKC00332	Ivory		Semi-Translucent	R0	1.52		0.76	3.45	

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00369	Cobalt	Dark cobalt	Translucent	R2	1.78		4.21	5.22	
AKC00370	Cobalt	Dark cobalt	Translucent	R2			5.35	5.04	Unable to measure hole
AKC00371	Cobalt	Dark cobalt	Translucent	R2	0.96		4.5	6.24	Shape of bead is uneven
AKC00372	Cobalt	Dark cobalt	Translucent	R1	1.29		3.01	5.62	
AKC00373	Cobalt	Dark cobalt	Translucent	R1	1.28		4.03	4.69	
AKC00374	Black	Or dark blue?	Opaque	R1	1.71		3.88	4.92	
AKC00375	Cobalt		Translucent	R1	1.5		3.21	5.05	
AKC00376	Dark Blue	Not as dark blue as cobalt beads	Translucent	R1	1.26		2.88	4.09	
AKC00377	Black		Opaque	R2	1.15		4.04	4.79	
AKC00378	Dark Green			NA					Fragmented beads due to weathering
AKC00379	Cobalt	Intense blue color	Translucent	R2	0		3.77	4.08	2 of 26 similar beads selected for measurement
AKC00380	Cobalt	Intense blue color	Translucent	R1	1.35		2.72	4.16	2 of 26 similar beads selected for measurement
AKC00381	Dark Green		Translucent	R1	1.5		2.61	3.95	Beads are heavily weathered. Measured 3 of 11 similar beads.
AKC00382	Dark Green		Translucent	R1	1.43		2.04	3.65	
AKC00383	Dark Green		Translucent	R1	1.25		2.61	3.9	
AKC00384	Dark Green		Translucent	R1			1.93	3.68	Beads were fragile due to weathering
AKC00385	Cobalt	Dark cobalt	Translucent	R2	1.05		3.72	5	
AKC00386	Blue-Green		Translucent	R2	0.87		3.66	4.64	
AKC00387	Cobalt	Dark cobalt	Translucent Semi-Translucent	R1	0		2.9	0	Broken bead, difficult to measure

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00388	Blue/Green	Weathering	Translucent	R2	0		2.88	3.83	Bead is too fragile to measure interior perforation
AKC00389	Blue/Green	Weathering	Translucent	R2	0		3.18	4.27	
AKC00390	Cobalt	Intense blue color	Transparent	R1	1.44		4.59	3.75	2 of 26 similar beads were measured
AKC00391	Cobalt	Intense blue color	Translucent	R2	0.75		4.24	4.47	
AKC00392	Dark Green	Weathering		R2	0		3.02	3.98	Only 7 complete beads in a group of fragmented and weathered samples.
AKC00393	Dark Green	Weathering		R2	0		2.53	3.73	
AKC00394	Dark Green	Weathering		R2	0		2.77	3.84	
AKC00395	Dark Green	Weathering		R2	0		2.68	3.88	
AKC00396	Dark Green	Weathering		R2	0		2.79	3.68	
AKC00397	Dark Green	Weathering		R0	0		1.51	3.6	
AKC00398	Dark Green	Weathering		R1	0		1.96	4.07	
AKC00399	Cobalt		Translucent	R2	1.3		4.53	4.84	11 of 43 similar beads were measured. All of the beads in this sample are a blue color however this is some variation in the intensity of the blue color and the transparency/translucency of the beads.
AKC00400	Cobalt		Translucent	R3	1.57		4.88	5.45	
AKC00401	Cobalt		Translucent	R1	1.42		3.71	4.34	
AKC00402	Cobalt		Translucent	R1	1.35		3.85	4.93	
AKC00403	Cobalt		Translucent	R1	1.12		3.71	4.91	
AKC00404	Cobalt		Translucent	R2	1.55		5.2	5.14	

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00405	Cobalt		Translucent	R2	2.12		2.96	6.13	
AKC00406	Cobalt		Translucent	R2	1.35		4.75	5.05	
AKC00407	Cobalt		Translucent	R2	1.18		4.33	4.82	11 of 43 similar beads were measured. All of the beads in this sample are a blue color however this is some variation in the intensity of the blue color and the transparency/translucency of the beads.
AKC00408	Cobalt		Translucent	R2	1.2		4.03	3.98	
AKC00409	Cobalt		Translucent	R2	1.08		4.16	5.52	
AKC00410	Cobalt		Translucent	R2	2.49		7.19	7.89	Measured 3 of 3 black beads, 1 dark blue bead, two larger cobalt beads, and 6 of 63 smaller sized cobalt beads.
AKC00411	Cobalt	Matte finish	Translucent	R2	2.06		6.01	7.78	
AKC00412	Dark Blue	Not as dark blue as cobalt beads	Translucent	R2	1.65		3.38	4.91	
AKC00413	Black		Opaque	R1	1.37		4.57	4.55	
AKC00414	Black		Opaque	R2	0.9		4.77	4.85	
AKC00415	Black		Opaque	R1	0.96		2.87	4.13	
AKC00416	Cobalt	Matte finish	Translucent	R2	0.96		4.91	5.62	
AKC00417	Cobalt	Matte finish	Translucent	R3	1.19		5.3	5.4	
AKC00418	Cobalt	Matte finish	Translucent	R1	1.1		2.96	4.45	
AKC00419	Cobalt	Matte finish	Translucent	R2	1.3		4.57	5.4	

Database ID	Glass Color	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00420	Cobalt	Matte finish	Translucent	R1	2.38		4.53	5.06	Measured 2 of 8 similar beads
AKC00421	Cobalt	Matte finish	Translucent	R1	1.76		3.76	5.45	
AKC00422	Cobalt		Translucent	R3	0.83		5.04	5.06	
AKC00423	Cobalt	Matte finish	Translucent	R1	1.44		3.83	5.75	Measured 6 of 24 similar beads in this group. This sample also includes a large number of unrecorded bead fragments.
AKC00424	Light Blue	Turquoise with white stripes	Semi-Translucent	R2	1.64		5.76	5.5	
AKC00425	Cobalt	Matte finish	Translucent	R2	1.02		4.52	5.71	
AKC00426	Cobalt	Matte finish	Translucent	R1	1.41		4.87	4.78	
AKC00427	Cobalt	Matte finish	Translucent	R2	0		5.81	6.7	
AKC00428	Cobalt	Matte finish	Translucent Semi-Translucent	R2	1.94		6.14	8.2	
AKC00429	Cobalt	Matte finish	Translucent	R2	0		5.63	6.78	
AKC00430	Cobalt	Matte finish	Translucent	R2	1.08		4.19	4.94	

Appendix 7.1g: Glass Beads from Promptin Tai

Database ID	Site Name	Trench	Layer	Bead Shape	Catalogue Number	Total # of beads
AKC00901	Promptin Tai	PTT S3/2 West Section	240-250 cm below datum (bd). (Burial #7)	Ring/Earring Fragment		1
AKC00903	Promptin Tai	PTT S3/2 West Section	250-260 cm bd. (Burial 18)	Indo-Pacific Bead		2
AKC00904	Promptin Tai	PTT S3/2 West Section	250-260 cm bd. (Burial 18)	Indo-Pacific Bead		2
AKC00906	Promptin Tai	PTT S3/2 West Section	240-250 cm bd (Burial #20)	Indo-Pacific Bead		2
AKC00907	Promptin Tai	PTT S3/2 West Section	240-250 cm bd (Burial #20)	Indo-Pacific Bead		2
AKC00908	Promptin Tai	PTT - S3 East Section	230-240 cm bd	Indo-Pacific Bead		1
AKC00909	Promptin Tai	PTT S3/2 West Section	240-250 cm bd (Burial 20)	Indo-Pacific Short Barrel		49
AKC00910	Promptin Tai	PTT S3/2 West Section	240-250 cm bd (Burial 20)	Indo-Pacific Short Barrel		49
AKC00911	Promptin Tai	PTT S3/2 West Section	240-250 cm bd (Burial 20)	Indo-Pacific Bead		49
AKC00912	Promptin Tai	PTT S3/2 West Section	240-250 cm bd (Burial 20)	Indo-Pacific Bead		49
AKC00913	Promptin Tai	PTT S3/2 West Section	240-250 cm bd (Burial 20)	Indo-Pacific Bead		49
AKC00914	Promptin Tai	PTT S3/2 West Section	240-250 cm bd (Burial 20)	Indo-Pacific Bead		49
AKC00915	Promptin Tai	PTT S3/2 West Section	240-250 cm bd (Burial 20)	Indo-Pacific Bead		49
AKC00916	Promptin Tai	PTT S3/2 West Section	240-250 cm bd (Burial 20)	Indo-Pacific Bead		49
AKC00917	Promptin Tai	PTT S3/2 West Section	240-250 cm bd (Burial 20)	Indo-Pacific Bead		49
AKC00938	Promptin Tai	PTT West Section	Burial 32	Unknown		33
AKC00939	Promptin Tai	PTT West Section	Burial 32	Indo-Pacific Bead		33
AKC00940	Promptin Tai	PTT West Section	Burial 32	Indo-Pacific Bead		33
AKC00941	Promptin Tai	PTT West Section	Burial 32	Indo-Pacific Bead		33
AKC00942	Promptin Tai	PTT West Section	Burial 32	Indo-Pacific Bead		33
AKC00943	Promptin Tai	PTT West Section	Burial 32	Indo-Pacific Bead		33
AKC00944	Promptin Tai	PTT S3/2 East Section	160-170 cm bd (S2L9)	Indo-Pacific Bead	040	3
AKC00945	Promptin Tai	PTT S3/2 East Section	160-170 cm bd (S2L9)	Indo-Pacific Bead	040	3

Database ID	Site Name	Trench	Layer	Bead Shape	Catalogue Number	Total # of beads
AKC00946	Promptin Tai	PTT S3/2 East Section	160-170 cm bd (S2L9)	Indo-Pacific Bead	040	3
AKC00947	Promptin Tai	PTT S3/2 East Section	170-180 cm bd (S3L2)	Indo-Pacific Bead	041	18
AKC00948	Promptin Tai	PTT S3/2 East Section	170-180 cm bd (S3L2)	Indo-Pacific Bead	041	18
AKC00949	Promptin Tai	PTT S3/2 East Section	170-180 cm bd (S3L2)	Indo-Pacific Bead	041	18
AKC00950	Promptin Tai	PTT S3/2 East Section	170-180 cm bd (S3L2)	Indo-Pacific Bead	041	18
AKC00951	Promptin Tai	PTT S3/2 East Section	170-180 cm bd (S3L2)	Indo-Pacific Bead	041	18
AKC00952	Promptin Tai	PTT S3/2 East Section	170-180 cm bd (S3L2)	Indo-Pacific Bead	041	18
AKC00953	Promptin Tai	PTT S3/2 East Section	170-180 cm bd (S3L2)	Indo-Pacific Bead	041	18
AKC00954	Promptin Tai	PTT S3/2 East Section	170-180 cm bd (S3L2)	Indo-Pacific Bead	041	18
AKC00955	Promptin Tai	PTT S3/2 East Section	170-180 cm bd (S3L2)	Indo-Pacific Micro Bead	041	18
AKC00956	Promptin Tai	PTT S3/2 East Section	170-180 cm bd (S3L2)	Indo-Pacific Micro Bead	041	18
AKC00957	Promptin Tai	PTT S3/2 East Section	170-180 cm bd (S3L2)	Indo-Pacific Bead	041	18
AKC00958	Promptin Tai	PTT S3/2 East Section	170-180 cm bd (S3L2)	Indo-Pacific Bead	041	18
AKC00959	Promptin Tai	PTT S3/2 East Section	180-190 cm bd (S3L3)	Indo-Pacific Bead	042	14
AKC00960	Promptin Tai	PTT S3/2 East Section	180-190 cm bd (S3L3)	Indo-Pacific Bead	042	14
AKC00961	Promptin Tai	PTT S3/2 East Section	180-190 cm bd (S3L3)	Indo-Pacific Bead	042	14
AKC00962	Promptin Tai	PTT S3/2 East Section	180-190 cm bd (S3L3)	Indo-Pacific Bead	042	14
AKC00963	Promptin Tai	PTT S3/2 East Section	180-190 cm bd (S3L3)	Indo-Pacific Bead	042	14
AKC00964	Promptin Tai	PTT S3/2 East Section	180-190 cm bd (S3L3)	Indo-Pacific Bead	042	14
AKC00965	Promptin Tai	PTT S3/2 East Section	180-190 cm bd (S3L3)	Indo-Pacific Bead	042	14
AKC00966	Promptin Tai	PTT S3/2 East Section	180-190 cm bd (S3L3)	Indo-Pacific Bead	042	14
AKC00967	Promptin Tai	PTT S3/2 East Section	180-190 cm bd (S3L3)	Indo-Pacific Bead	042	14
AKC00968	Promptin Tai	PTT S3/2 East Section	190-200 cm bd (S3L4)	Indo-Pacific Bead	043	18
AKC00969	Promptin Tai	PTT S3/2 East Section	190-200 cm bd (S3L4)	Indo-Pacific Bead	043	18
AKC00971	Promptin Tai	PTT S3/2 East Section	200-210 cm bd (S3L3)	Indo-Pacific Bead	044	8
AKC00972	Promptin Tai	PTT S3/2 East Section	200-210 cm bd (S3L3)	Indo-Pacific Bead	044	8
AKC00973	Promptin Tai	PTT S3/2 East Section	200-210 cm bd (S3L3)	Indo-Pacific Bead	044	8

Database ID	Site Name	Trench	Layer	Bead Shape	Catalogue Number	Total # of beads
AKC00974	Promptin Tai	PTT S3/2 East Section	200-210 cm bd (S3L3)	Indo-Pacific Bead	044	8
AKC00975	Promptin Tai	PTT S3/2 East Section	210-220 cm bd (S4L1)	Indo-Pacific Bead	045	11
AKC00976	Promptin Tai	PTT S3/2 East Section	210-220 cm bd (S4L1)	Indo-Pacific Bead	045	11
AKC00977	Promptin Tai	PTT S3/2 East Section	210-220 cm bd (S4L1)	Indo-Pacific Bead	045	15
AKC00978	Promptin Tai	PTT S3/2 East Section	210-220 cm bd (S4L1)	Indo-Pacific Bead	045	15
AKC00983	Promptin Tai	PTT S3/2 East Section	220-230 cm bd (S4L2)	Indo-Pacific Bead	046	2
AKC00984	Promptin Tai	PTT S3/2 East Section	220-230 cm bd (S4L2)	Indo-Pacific Bead	046	2
AKC00985	Promptin Tai	PTT S3/2 East Section	230-240 cm bd (S4L3)	Indo-Pacific Bead	047	3
AKC00986	Promptin Tai	PTT S3/2 East Section	230-240 cm bd (S4L3)	Unknown object	047	3
AKC01093	Promptin Tai	S3/2 West Section	220-230 cm bd (S4L2) Burial 18	Collar Bead	071	3
AKC01122	Promptin Tai	PTT S3/2 West Section	220-230 cm bd Burial #19	Indo-Pacific Bead	074	28
AKC01058	Promptin Tai	S3/2 West Section Burial 20	230-240 cm bd (S4L3)	Long Cylindrical	064	41
AKC01059	Promptin Tai	S3/2 West Section Burial 20	230-240 cm bd (S4L3)	Long Cylindrical	064	41
AKC01057	Promptin Tai	S3/2 West Section Burial 20	230-240 cm bd (S4L3)	Segmented beads?	064	41
AKC01043	Promptin Tai	PTT S3 West Section	150-160 cm bd	Short Bicone	024	14
AKC01015	Promptin Tai			Indo-Pacific Bead	008	1
AKC01018	Promptin Tai	S3 East Section	160-170 cm bd	Short Bicone	009	4
AKC01019	Promptin Tai	S3 East Section	170-180 cm bd	Indo-Pacific Bead	010	1
AKC01020	Promptin Tai	S3 East Section	180-190 cm bd	Indo-Pacific Bead	011	1
AKC01021	Promptin Tai	S3 East Section	180-190 cm bd	Indo-Pacific Bead	012	5
AKC01022	Promptin Tai	S3 East Section	BU#6 Grave Good	Short cylindrical beads?	014	13
AKC01023	Promptin Tai	S3 West Section	200-210 cm bd	Short Barrel	028	1
AKC01024	Promptin Tai	S3 West Section	210-220 cm bd	Indo-Pacific Bead	029	1
AKC01025	Promptin Tai	S3 West Section	220-230- cm bd	Indo-Pacific Bead	030	1

Database ID	Site Name	Trench	Layer	Bead Shape	Catalogue Number	Total # of beads
AKC01026	Promptin Tai	S3 West Section	220-230 cm bd	Indo-Pacific Bead	031	1
AKC01083	Promptin Tai	S3/2 West Section	220-230 cm bd (S4L2) Burial #19	Indo-Pacific Bead	072	1

Database ID	Glass Colors	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00901	Light Blue	Turquoise	Semi-Translucent	NA	0	0	10.12	4.61	
AKC00903	Dark Green	blue-green	Semi-Translucent	R3	1.67	1.8	5.13	5.92	
AKC00904	Dark Green	Blue-green	Semi-Translucent		1.4	1.43	5.76	6.35	
AKC00906	Dark Blue	Shiny surface	Translucent Transparent	R1	1.48		4.55	4.66	
AKC00907	Dark Blue	Shiny surface	Translucent Transparent	R1	1.29		4.67	4.44	
AKC00908	Dark Blue	Shiny surface	Translucent Transparent	R2	1.72		4.46	5.62	
AKC00909	Clear	Blue-greenish tint	Transparent	R2	2.25		6.86	7.16	Group of 35 glass beads. Measured 2 of 6 orange beads, 1 large clear bead, 1 large blue bead, and 5 of 27 dark blue beads. Associated with carnelian/agate/green stone beads.
AKC00910	Dark Blue		Translucent Semi-Translucent	R2	1.9		7.68	8.6	
AKC00911	Light Blue		Translucent	R1	1.46		2.82	4.06	
AKC00912	Dark Blue	Shiny surface	Translucent	R1	1.72		3.18	5.24	
AKC00913	Dark Blue	Shiny surface		R2	1.81		4.38	5.27	
AKC00914	Dark Blue	Shiny surface		R1	1.89		3.66	5.21	
AKC00915	Light Blue			R1	2.08		3.63	5.24	
AKC00916	Orange		Opaque	R1	0.63		1.36	2.78	
AKC00917	Orange		Opaque	R1	0.91		1.32	2.84	
AKC00938	Blue or Black?		Opaque	NA			8.14		Unknown glass object. Associated with Greenstone/carnelian and glass beads.

Database ID	Glass Colors	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00939	Dark Blue	Shiny surface	Semi-Translucent Opaque	R2	2.21		3.79	5.37	Measured 5 of 26 blue glass beads. Associated with greenstone/carnelian beads.
AKC00940	Dark Blue	Shiny surface	Translucent	R1	1.63		2.99	4.78	
AKC00941	Dark Blue	Shiny surface	Translucent	R2	2.07		4.44	4.69	
AKC00942	Dark Blue		Translucent	R1	1.43		3.04	4.74	
AKC00943	Dark Blue	Shiny surface	Translucent	R2	1.51		3.14	4.6	
AKC00944	Dark Blue		Translucent Transparent	R2	1.6		5.31	5.17	
AKC00945	Red	Shiny surface	Opaque	R1	0.68		1.12	2.41	
AKC00946	Orange		Opaque	R1	0.87		2.03	2.92	
AKC00947	Dark Blue		Translucent	R2	1.3		4.04	5.44	18 glass beads total. Measured 3 of 7 dark blue beads, 3 light blue beads, 2 large red beads, 1 red microbead, 2 green beads, and 1 yellow bead.
AKC00948	Dark Blue		Translucent	R2	1.76		6.13	5.46	
AKC00949	Dark Blue		Translucent	R1	1.73		4.12	4.93	18 glass beads total. Measured 3 of 7 dark blue beads, 3 light blue beads, 2 large red beads, 1 red microbead, 2 green beads, and 1 yellow bead.
AKC00950	Light Blue		Translucent	R1	1.48		2.25	4.2	

Database ID	Glass Colors	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00951	Light Blue	Turquoise	Translucent	R1	1.8		3.5	4.51	
AKC00952	Light Blue	Reddish-brown	Translucent	R1	1.1		2.46	3.37	
AKC00953	Red	Brick Red (mutisalah?)	Opaque	R1	1.38		8.35	4.62	
AKC00954	Red	Brick Red (mutisalah?)	Opaque	R1	1.17		2.23	3.77	
AKC00955	Yellow	bright yellow	Opaque	R3	0		1.43	1.69	
AKC00956	Orange	Shiny	Opaque	R1	0		1.55	1.5	
AKC00957	Light Green		Semi-Translucent	R1	0		1.06	1.71	
AKC00958	Light Green		Opaque	R0	0		2.16	2.53	
AKC00959	Red	Reddish-brown	Opaque	R0	1.69		8.22	5.8	
AKC00960	Red	Reddish-brown	Opaque	R1	0.8		1.04	4	Group of 14 complete beads. Measured 3 red beads, 2 of 5 light blue beads, 1 light green bead, 1 yellow bead, 1 orange bead, and 1 of 3 dark blue beads. Not recorded: fragments of blue glass beads.
AKC00961	Red	Reddish-brown	Opaque	R1	0.69		1.36	1.99	Group of 14 complete beads. Measured 3 red beads, 2 of 5 light blue beads, 1 light green bead, 1 yellow bead, 1 orange bead, and 1 of 3 dark blue beads. Not recorded: fragments of blue glass beads.

Database ID	Glass Colors	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC00962	Dark Blue		Translucent	R1	1.67		2.95	5.25	
AKC00963	Light Blue	Turquoise	Translucent	R1	0.84		2.01	3.81	
AKC00964	Light Blue	Turquoise	Translucent	R1	1.45		2.9	4.55	
AKC00965	Light Green		Semi-Translucent	R1	0		4.96	2.65	
AKC00966	Orange		Opaque	R2	1.64		4.29	3.72	
AKC00967	Yellow			R2	1.92		4.37	4.3	
AKC00968	Turquoise		Translucent	R2	1.12		3.25	4.13	Group of 14 complete beads. Measured 3 red beads, 2 of 5 light blue beads, 1 light green bead, 1 yellow bead, 1 orange bead, and 1 of 3 dark blue beads. Not recorded: fragments of blue glass beads.
AKC00969	Dark Blue		Translucent	R2	1.46		3.73	4.93	Measured 1 of 7 dark blue beads and 1 of 11 light blue beads. Also associated with a broken green stone bead.
AKC00971	Dark Blue		Translucent	R1	1.2		4.29	4.18	
AKC00972	Light Blue	Turquoise	Translucent	R2	1.9		3.01	4.57	8 glass beads: measured 1 red, 1 green, 1 of 2 light blue beads and 1 of 4 dark blue beads.
AKC00973	Red	Reddish-brown	Semi-Translucent	R1	1.02		5.76	3.16	

Database ID	Glass Colors	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf.B	Max. Length	Max. Width	Notes
AKC00974	Dark Green		Semi-Translucent	R1	0.84		1.98	2.42	
AKC00975	Orange		Opaque	R1	0.67		1.74	2.73	11 glass beads. Measured 1 of 2 small orange beads, 1 larger orange bead, 1 of 3 dark blue beads, and 1 of 3 light blue beads. Also associated with agate, carnelian, jade, shell, and fragments of light blue beads.
AKC00976	Orange		Opaque	R1	1.24		2.58	3.59	
AKC00977	Light Blue	Turquoise	Semi-Translucent Translucent	R1	1.63		2.34	3.8	
AKC00978	Dark Blue		Semi-Translucent Translucent	R2	0		5.09	4.95	11 glass beads. Measured 1 of 2 small orange beads, 1 larger orange bead, 1 of 3 dark blue beads, and 1 of 3 light blue beads. Also associated with agate, carnelian, jade, shell, and fragments of light blue beads.
AKC00983	Dark Blue		Translucent	R2	2.11		4.97	5.09	
AKC00984	Orange		Opaque	R1	1.18		2.6	3	
AKC00985	Light Blue	Turquoise	Semi-Translucent	R1	1.31		2.77	4.3	
AKC00986	Light Blue	Turquoise	Opaque	N/A			6.95	2.31	Unknown blue fragment associated with AKC00985.
AKC01093	White	Faience	Opaque	N/A	1.4	1.12	11.58	4.94	Found with an agate and greenstone bead.

Database ID	Glass Colors	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Notes
AKC01122	Dark Blue		Translucent	R2	2.11		3.17	5.28	
AKC01058	Black and White	Black opaque base with white opaque stripes	Opaque	N/A	1.6		14.68	4.9	Imitation agate glass bead
AKC01059	Black and White	Black opaque base with white opaque stripes	Opaque	N/A	N/A		N/A	3.97	Imitation agate glass bead (broken)
AKC01057	White/Clear	Gold foil	Semi-Translucent	N/A	See notes				Measurements of three beads: L 3.97 W 3.62 IP 0.87 L 2.98 W 2.96 IP 0.95 L 2.69 W 2.95 IP 0.96
AKC01043	Black and white	Black glass base with single white opaque stripe	Opaque	NA	2.25	2.41	7.16	6.73	
AKC01015	Light Green		Opaque	R1	1.3		1.83	3.6	
AKC01018	White	With a rainbow coating?	Opaque Semi-Translucent	N/A	2		6.17	6.98	
AKC01019	Light Blue		Transparent	R2	1.45		4.41	4.81	

Database ID	Glass Colors	Glass Color Notes	Opacity	Roundness Factor	Interior Perf. A	Interior Perf.B	Max. Length	Max. Width	Notes
AKC01020	Dark Turquoise		Translucent Transparent	R1	N/A		3.19	3.61	
AKC01021	Dark Blue	Shiny surface	Semi-Translucent		1.49		4.31	5.15	Measured 1 of 5 dark blue beads
AKC01022	Grey	Faience	Opaque		0		4.05	2.09	13 small black opaque tubular beads with weathered/corroded surface. Faience?
AKC01023	Light green		Opaque		1.04		4.71	3.33	
AKC01024	Red		Opaque		1.82		4.23	4.85	
AKC01025	Yellow		Opaque		1.58		4.16	5.52	
AKC01026	Dark Green		Opaque	R1			4.16	6.49	
AKC01083	Dark Blue	Shiny surface	Semi-Translucent	N/A	1.28		4.81	4.9	

Database ID	Site Name	Cat Number	Total # of beads	Trench	Layer	Notes	Notes (cont)
AKC00989	Promtin Tai	003	39	PTT S3 East Section	90-100 cm bd	Group of 39 glass beads divided into 4 groups. Group 1- Indo-Pacific beads approx 2-4 mm 1 dark blue cobalt- transparent 5 light blue semi-translucent 1 dark blue semi-translucent (slightly darker than dark blue turquoise) 1 light blue semi-translucent (L1.56 W2.68) 1 light blue opaque 1 light green opaque shiny Group 2 - Indo-Pacific beads approx 1.5-3mm 1 orange opaque 1 yellow opaque 1 dark blue 1 cobalt 3 dark blue translucent 1 light green opaque shiny 1 light green opaque 1 light blue turquoise	Group 3 - Small IP seed beads approx 2mm 1 orange opaque shiny 1 yellow opaque/semi trans? - shiny 1 red opaque shiny 3 light green opaque shiny 2 light yellow-green opaque shiny Group 4 - Larger Indo-Pacific beads 1 large orange opaque (L:5.24 W:5.96) 1 orange opaque tubular ead 1 long red tubular bead 1 dark blue cobalt matte 1 blue-black matte 1 light blue 1 light green-yellow opaque 2 light green opaque 1 dark blue cobalt translucent
AKC00991	Promtin Tai	004	24	PTT S3 East Section	100-110 cm bd	24 complete glass beads in two groups Group 1- Smaller Indo-Pacific Beads 3 orange opaque shiny (1 measured:L:1.55 W:2.49	Group 2- Larger Indo-Pacific beads (tubular shaped) 1 orange opaque shiny 1 yellow opaque shiny 1 red opaque shiny 2 light green (1 measured:L:3.58 W:4.66 IP:1.7)

						IP:0.83) 3 small red opaque beads beads (1 measured: L:1.21 W:2.20 IP:too small) 2 larger red opaque beads (1 measured:L:2.82 W:2.9) 1 yellow opaque bead: L:2.20 W:2.72 IP:1.29 1 dark blue translucent 1 red/orange bead	2 dark blue translucent 2 light blue beads, semi translucent. (1 measured: L: 3.37 W:2.75 IP:0.68) 3 dark blue beads (1 measured: L: 2.18 W:3.84 IP:1.15) 1 dark green opaque Fragments of red, orange, blue beads
AKC00992	Promtin Tai	005	20	PTT S3 East Section	110-120 cm bd	20 complete beads split into 2 groups Group 1 - Small Indo-Pacific Beads 3 orange opaque (1 measured: L:1.42 W:1.30 IP: too small) 3 red opaque beads (1 measured: L:1.88 W:3.83 IP:1.18) 1 dark blue semi-trans 1 light blue semi-trans: L:1.38 W:3.45 IP:1.14	Group 2- Indo-Pacific Beads 2 light green-yellow opaque shiny: (1 measured: L:2.39 W:3.67 IP:1.09) 1 red opaque: L:3.39 W:4.26 IP:1.43 1 light-green: L:2.60 W:4.00 IP:1.32 6 yellow opaque (1 measured:L: 2.30 W:4.03 IP:1.41) 1 dark blue-green transparent 1 black opaque
AKC00993	Promtin Tai	006	12	PTT S3 East Section	120-130 cm bd	12 complete Indo-Pacific Beads 6 red opaque beads, 3 are more tubular shaped. 1 tubular shaped bead measured (L:10.01 W:4.48 IP:1.31) 4 Blue-Green semi trans, (1 measured: L:3.99 W:4.29 IP:1.73) 1 dark blue:L: 4.15 W:5.22	

AKC00994	Promtin Tai	007	54	PTT S3 East Section	130-140 cm bd	IP:1.60 1 dark blue matte 54 glass beads in 3 groups Group 1- Small Indo-Pacific beads 1 yellow opaque 1 broken polychrome black with white and red stripes : L:2.36 W:3.26 IP: N/A 6 orange opaque (1 measured: L:2.46 W:3.39 IP:1.14) 2 red opaque shiny (1 measured: L:1.28 W:2.71 IP:0.62) Group 2 -Small Indo-Pacific beads 7 red opaque (1 measured: L:1.51 W:1.92 IP:0.74) 1 light green opaque microbead 1 yellow opaque 1 black opaque: L:3.58 W:2.73 IP:0.93	Group 3- IP Irregular Tubes etc 1 dark blue transparent 1 orange opaque 4 red opaque beads 7 red opaque tubular beads (1 measured: L:7.92 W:2.72 IP:0.94) 1 light blue short barrel L:10.05 W:5.83 IP:1.33. Coiled bead? 3 blue-green semi-translucent beads (1 measured: L:2.09 W:4.18 IP:1.32). 5 light blue opaque beads 2 dark blue matte bicones Darker blue: L:3.80 W:5.14 IP:1.68 Lighter blue: L:4.00 W:5.58 IP:1.24 4 yellow opaque (1 measured: L:3.83 W:4.88 IP:1.99 plus small fragments of red, yellow, dark blue, and green beads. Some yellow beads are melted together?	
AKC01001	Promtin Tai	050	11	PTT S3/2 West Section	80-90 cm bd (S2L1)	11 complete beads in two groups Group 1- Indo-Pacific beads approx 2.5-3mm 2 yellow opaque shiny 1 orange opaque shiny 1 light green opaque matte 2 light green shiny 2 light blue semi-trans	Group 2 1 large yellow opaque shiny: L:3.56 W:5.37 1 dark blue translucent 1 dark turquoise translucent	

AKC01002	Promtin Tai	051	14	PTT S3/2 West Section	90-100 cm bd (S2L2)	14 complete beads in two groups Group 1- Small Indo-Pacific Beads 2 orange opaque 2 red opaque 2 light green opaque shiny 1 dark turquoise transparent	14 complete beads in two groups Group 2-Indo-Pacific Beads 2 red opaque tubular beads (1 measured: L:6.26 W:4.50 IP:1.45) 1 dark blue transparent tube 1 dark blue turquoise opaque 1 blue-green opaque 1 dark blue bead with white coating- weathered 1 dark blue bead with white coating- weathered	
AKC01003	Promtin Tai	052	29	PTT S 3/2 West Section	100-110 cm bd (S2L3)	29 beads in 3 groups plus fragments of green, yellow, blue beads Group 1-Small Indo-Pacific beads 2 red opaque bead 4 orange opaque beads 1 yellow opaque bead 1 light green opaque shiny: L:1.09 W:1.71 1 dark turquoise Group 2- Small Indo-Pacific beads 4 orange opaque beads (1 measured: L:4.28 W:2.16 IP:N/A) 2 light green opaque shiny 1 light blue-green transparent	Group 3-Indo-Pacific beads 4 red opaque beads 4 opaque yellow (1 measured: L:2.84 W:5.56 IP:1.57) 2 opaque light blue 1 semi-trans dark blue-black 2 opaque orange	
AKC01004	Promtin Tai	053	22	PTT S3/2 West Section	110-120 cm bd (S2L4)	22 glass beads in 2 groups plus yellow, green, blue fragments	Group 2-Indo-Pacific beads 2 red opaque	

							Group 1- Small Indo-Pacific Beads 1 yellow opaque 1 orange opaque 2 red opaque 2 dark blue semi-transc 1 light blue opaque 2 light green opaque shiny .	1 dark blue cobalt semi-translucent (large) 2 dark blue translucent shiny 2 dark blue 2 dark blue-green shiny 1 yellow opaque 2 orange opaque 1 White translucent bicone shaped bead
AKC01005	Promtin Tai	054	18	S3/2 West Section	120-130 cm bd (S2L5)		18 glass beads in 2 groups Group 1- Small Indo-Pacific beads 1 yellow opaque 1 red opaque 1 orange opaque 1 dark blue-green transparent 2 light green opaque shiny	Group 2- Indo-Pacific Beads 1 yellow opaque 4 orange opaque 2 red opaque large (1 measured: L 4.80 W6.76) 1 light blue long tube transparent 1 dark blue with white corrosion 2 dark blue cobalt semi-trans 1 light green-yellow opaque matte
AKC01006	Promtin Tai	055	26	PTT S3/2 West Section	130-140 cm bd (S2L6)		26 glass beads in 2 groups Group 1- Indo-Pacific Beads 4 orange opaque beads 2 red opaque beads 1 light green opaque shiny 1 light blue sem-trans 1 black opaque shiny	Group 2- Indo-Pacific Beads 4 opaque orange beads 4 opaque red shiny 6 dark blue semi-trans 1 light green opaque shiny 1 light blue opaque shiny 1 dark turquoise semi-trans matte
AKC01007	Promtin Tai	056	14	PTT S3/2 West Section	140-150 cm bd (S2L7)		14 glass beads in 2 groups Group 1 - Small Indo-Pacific	Group 2: Small Indo-Pacific beads 3 orange opaque shiny

AKC01008	Promtin Tai	057	12	PTT S3/2 West Section	150-160 cm bd (S2L8)	Beads 2 orange opaque (1 measured: L2.20 W2.63)	3 red opaque beads 1 opaque yellow shiny 2 light blue opaque 1 light green opaque shiny 1 dark blue bicone- 1 dark blue seed bead Group 2- Indo-Pacific Beads 1 dark blue translucent 1 dark blue semi-trans opaque long tube/barrel with white corrosion 1 light blue opaque 1 dark turquoise opaque 1 dark blue-grey ceylon shiny opaque 3 red opaque (1 green-yellow opaque matte	Group 2 - Indo-Pacific Beads 1 dark blue-green transparent 1 red opaque matte 1 orange opaque 1 yellow opaque 1 cobalt translucent 1 dark blue translucent
AKC01009	Promtin Tai	058	12	PTT S3/2 West Section	170-180 cm bd (S3L2)	12 glass beads in 2 groups Group 1-Small Indo-Pacific beads 2 red opaque 1 orange opaque 1 yellow opaque 1 light blue transparent 1 light blue opaque	Group 2 - Indo-Pacific Beads 1 dark blue-green transparent 1 red opaque matte 1 orange opaque 1 yellow opaque 1 cobalt translucent 1 dark blue translucent	
AKC01011	Promtin Tai	059	6	PTT S3/2 West Section	180-190 cm bd (S3L3)	2 orange opaque 1 green transparent- 2 dark blue cobalt translucent 1 dark blue translucent		
AKC01012	Promtin Tai	001	4	PTT S3 East Section	30-40 cm bd	1 light green opaque 2 light blue opaque 1 dark blue larger IP bead (broken) semi-translucent		

Database ID	Site Name	Cat Number	Total # of beads	Trench	Layer	Notes	Notes (cont)
AKC01013	Promtin Tai	002	4	S3 East Section	40-60 cm bd	1 light blue opaque broken 1 yellow opaque seed bead	
AKC01027	Promtin Tai	032	12	PTT S3/2 East Section	80-90 cm bd (S2L1)	12 glass beads as well as fragments of yellow and dark blue beads 1 dark turquoise matte 1 yellow opaque 1 orange opaque 2 red opaque matte 2 dark blue transparent 1 dark blue matte translucent small seed bead size 1 black opaque 1 yellow opaque seed bead 1 light green opaque seed bead	
AKC01029	Promtin Tai	033	3	S 3/2 East Section	90-100 cm bd (S2L2)	1 red opaque tubular bead 1 yellow opaque 1 orange opaque	
AKC01030	Promtin Tai	034	20	PTT S3/2 East Section	100-110 cm bd (S2L3)	20 glass beads in 2 groups plus fragments of orange, green, and dark blue transparent beads Group 1- Small Indo-Pacific Beads 1 yellow opaque 1 orange opaque 2 red opaque beads (1 measured: L:1.03 W:1.70 IP: around 0.60) 1 light green-yellow opaque 2 light green opaque 1 dark blue-grey opaque L:1.78 W:2.83 IP:0.95	Group 2: 1 clear, white, red polychrome stripe: L6.31 W6.45 IP: 1.85) 1 dark blue-green transparent 1 light blue transparent 1 light blue opaque 1 dark blue semi-trans 1 light green-yellow opaque 2 yellow opaque (1 measured: 5.54 W:3.26 IP:0.70) 3 red opaque matte 1 dark blue opaque

Database ID	Site Name	Cat Number	Total # of beads	Trench	Layer	Notes	Notes (cont)
AKC01031	Promtin Tai	035	21	PTT S3/2 East Section	110-120 cm bd (S2L4)	20 glass beads plus fragments of blue and yellow beads Group 1: Small Indo-Pacific beads 1 yellow opaque: L:1.49 W:3.11 IP:0.83 3 red opaque microbeads 2 orange opaque microbeads	Group 2 IP Irregular Tubes etc 1 dark blue transparent 1 dark blue-grey tube (L:6.18 W:1.95 IP: 0.6) 3 light blue opaque shiny 3 red opaque 3 yellow opaque (1 measured: L:2.96 W:4.02) 2 orange opaque
AKC01032	Promtin Tai	036	3	PTT S3/2 East Section	120-130 cm bd (S2L5)	1 yellow opaque: L3.82 W4.09 IP:1.23 1 red-roange opaque: L1.74 W:3.15 IP:1.26 1 orange opaque bead: L: 1.30 W:2.14 IP: 0.60	
AKC01033	Promtin Tai	037	9	PTT S3/2 East Section	130-140 cm bd (S2L6)	9 glass beads plus fragments of yellow and blue beads 1 yellow opaque: L:3.59 W:5.04 IP:1.52 1 reddish-orange opaque: L:2.20 W:4.82 IP:2.00 1 dark blue cobalt semi-trans : L:7.85 W:7.24 IP:1.80 3 dark blue trans shiny 1 dark blue green translucent 1 red opaque microbead 1 light green opaque microbead	
AKC01034	Promtin Tai	038	11	PTT S3/2 East Section	140-150 cm bd (S2L7)	11 glass beads in two groups and fragments of blue glass beads Group 1-Small Indo-Pacific	Group 2: Indo-Pacific beads 3 red opaque 2 orange opaque 1 orange opaque tubular bead 1 red opaque

AKC01035	Promtin Tai	039	25	PTT S3/2 East Section	150-160 cm bd (S2L8)	beads 1 red opaque microbead 1 orange opaque microbead 1 orange opaque 1 Light blue semi-translucent 25 glass beads in two groups with fragments of orange and blue beads Group 1 : Small Indo-Pacific beads 1 dark blue bead 4 orange opaque microbeads (1 measured: L:1.20 W:2.07 IP:0.83) 2 red opaque microbeads 2 light green opaque beads (1 measured: L:1.80 W:2.95 IP:0.92)	1 red opaque microbead 1 orange opaque microbead 1 orange opaque 1 Light blue semi-translucent Group 2- IP Irregular Beads 3 red opaquetubular beads (1 measured: L:8.07 W:3.88 IP:0.72) 2 orange opaque 3 dark blue translucent (1 measured: L:4.15 W:5.45 0.99) 1 blue-green bicone: L:4.38 W:5.62 IP:1.88 1 dark green translucent 1 dark turquoise matte 3 light blue opaque shiny 1 yellow opaque shiny	
AKC01036	Promtin Tai	020	70	S3 West Section	120-130 cm bd	70 glass beads in 5 groups plus fragments of yellow, blue, green, and orange beads Group 1- Indo-Pacific Beads, approximately 2-4mm 5 yellow opaque beads 4 light blue opaque beads 1 dark blue translucent bead Group 2-Indo-Pacific beads, approximately 2-3mm	Group 4- Small Indo-Pacific beads 2 orange opaque 3 light green opaque microbeads 1 light blue opaque 1 dark blue-green transparent Group 5-Larger Indo-Pacific beads, approx 3-4mm 1 greenish-yellow opaque 1 dark green opaque 1 green-yellow opaque	

						4 red opaque beads 2 orange opaque beads shiny 2 light green opaque shiny 1 light green-yellow shiny Group 3- Indo-Pacific Microbeads 2 orange opaque 3 light green opaque 3 red opaque 2 light blue opaque	1 light green opaque 1 orange opaque tubular 13 orange opaque 3 dark blue 1 light blue opaque matte 1 dark blue shiny 2 dark blue opaque 2 red opaque long tube/barrel 3 red opaque 3 dark blue semi-translucent 1 blue-green 1 cobalt semi-trans
AKC01037	Promtin Tai	021	28	PTT S3/2 West Section	130-140 cm bd	Green and yellow fragments Group 1- seed beads 3 red opaque shiny (micro) 2 orange opaque 1 yellow opaque 2 light green opaque 1 white opaque Group 2- seed bead 2 yellow opaque 1 orange opaque 1 red opaque (micro?)	Group 3- larger IP beads 3 red opaque (1 shiny, 2 matte) 1 light blue opaque 1 blue-green transparent 1 dark green opaque 4 light green opaque (3 shiny, 1 larger matte) 1 dark blue-black transparent 2 yellow opaque 1 orange opaque 1 carnelian (AKC01038)
AKC01039	Promtin Tai	022	31	PTT S3 West Section	140-150 cm bd	31 glass beads in three groups plus orange and red fragments Group 1 - Small Indo-Pacific beads 4 orange opaque	Group 3- larger IP irregular beads 1 orange opaque tubular 1 orange opaque matte 1 yellow opaque 6 red opaque matte 3 blue-green transparent

						2 red opaque shiny 1 yellow opaque 1 light green opaque microbead 1 light green opaque 1 light yellow transparent Group 2 - sSmall Indo-Pacific beads 1 yellow opaque 1 orange opaque microbead 1 light blue opaque 1 dark blue transparent	1 light green opaque matte 2 light blue opaque 1 light blue/white opaque 1 dark blue translucent
AKC01040	Promtin Tai	023	20	PTT S3 East Section	140-150 cm bd	20 complete or mostly complete glass and many fragments (green, yellow, orange, red, blue) Group 1- IP seed beads 3 orange opaque (2 smaller micro, 1 seed) 3 red opaque (2 smaller micro, 1 seed) 1 yellow opaque 1 light blue opaque (micro) 2 light green opaque (1 micro, 1 seed)	Group 2- IP Irregular Beads 3 red opaque beads shiny (2 long tube/barrel, 1 is broken) 2 dark turquoise semi-trans 2 orange opaque 1 dark blue broken 1 transparent violet/amber- took image Plus one broken tip of a ring/earring light green - took image
AKC01041	Promtin Tai	024	14	PTT S3 West Section	150-160 cm bd	14 complete beads Group 1-Small Indo-Pacific beads 2 yellow opaque both measured: Large Yellow: L :2.22 W: 2.95	Group 2- larger irregular IP bead 2 yellow opaque beads, both measured: Bead 1: L: 1.82 W: 4.20 IP:1.66 Bead 2: L:2.93 W:4.37 IP:1.10 1 red opaque bead: L: 2.43 W:3.43 IP:1.48

						IP: 0.99 Small Yellow: L: 1.54 W:1.76 IP: 0.65 1 dark blue opaque: L:1.83 W:3.15 IP:0.80 1 light blue opaque: L:2.22 W:3.08 IP:0.84 1 orange opaque: L:2.49 W:2.91 IP:1.04 1 red opaque shiny: L:2.19 W:2.29 IP:0.87 1 dark blue translucent: L: 3.78 W: 2.43 IP:0.86	1 blue-green transparent: L: 2.14 W:4.03 IP:1.02 1 dark blue translucent shiny: L: 4.04 W:4.46 IP: 1.08
AKC01044	Promtin Tai	025	5	S3 West Section	160-170 cm bd	1 large orange opaque :L:3.36 W:4.82 IP:1.32 2 dark blue semi-translucent 1 blue-green seed bead:L:2.15 W:3.53 IP:1.18	
AKC01046	Promtin Tai	026	3	S3 West Section	170-180 cm bd	1 yellow opaque heavily corroded 1 dark turquoise opaque 1 light blue opaque	
AKC01047	Promtin Tai	027	4	PTT S3 West Section	170-180 cm bd	2 blue-green glass both are quite round. Bead 1: L: 4.89 W: 5.16 IP: 1.01 Bead 2: L: 5.67 W: 6.17 IPA: 1.65 IPB: 1.38 Not Indo-pacific beads?	
AKC01050	Promtin Tai	060	13	PTT S3/2 West Section	190-200 cm bd (S3L4)	11 glass beads in two groups Group 1: Small Indo-Pacific beads 3 orange opaque matte 1 red opaque matte	Group 2: Larger Indo-Pacific beads 3 dark blue cobalt translucent 1 Large dark blue cobalt: L:12.71 W:8.71- segmented?

AKC01052	Promtin Tai	061	13	PTT S3/2 West Section	200-210 cm bd (S3L3)	13 glass beads 2 orange opaque tubular beads 2 red opaque 1 yellow opaque 7 dark blue semi-translucent (1 measured: L:4.70 W:4.92) 1 blue-green translucent: L:2.89 W: 3.02	1 black opaque short barre:l L:5.66 W:3.40 1 orange opaque matte 1 light blue opaque
AKC01053	Promtin Tai	062	5	PTT S3/2 West Section	220-230 cm bd (S4L2)	8 glass beads 1 broken light blue bead 1 dark blue bead 1 broken black bead 1 yellow opaque: L: 1.71 W:2.96 IP:0.78 1 light blue opaque: L:2.45 W:3.45 IP:0.91 1 red opaque: L1.28 W:2.92 IP:1.07 1 dark blue cobalt translucent: L:3.69 W:5.36 IP:1.73 1 dark blue cobalt matte translucent: L2.47 W4.10 IP: 1.25	
AKC01054	Promtin Tai	063	6	PTT S3/2 West Section	230-240 cm bd (S4L3)	1 blue-green translucent 2 dark blue cobalt translucent shiny IP beads (1 measured:L:3.24 W:5.00 IP:1.95) 3 dark blue shiny semi-trans (1 measured:L:4.86 W:5.76 IP:1.34)	

Database ID	Site Name	Cat Number	Total # of beads	Trench	Layer	Notes	Notes (cont)
AKC01056	Promtin Tai	064	39	S3/2 West Section Burial 20	230-240 cm bd (S4L3)	39 glass beads in two groups Group 1: Small Indo-Pacific beads 8 orange opaque beads matte. 2 beads measured: Bead 1: L:1.40 W:2.63 IP:0.94 Bead 2: L: 1.05 W:2.84 IP:1.27 3 white semi-translucent beads in a spherical shape	Group 2: Indo-Pacific beads 3 dark blue semi-trans 21 dark blue cobalt translucent IP beads (1 measured: L:3.68 W:5.28 IP:2.02) 1 red opaque tubular bead 1 large clear glass bead: L8.04 W7.42 IP1.32 1 blue-green glass bead: L:5.29 W:6.99 IP:1.92 1 dark blue-green semi-trans bead
AKC01066	Promtin Tai	065	2	S3/2 West Section	240-250 cm bd (S4L4) Burial 9	2 dark blue shiny semi-trans, Bead 1: L:4.83 W:5.62 IP:1.48 Bead 2: L: 5.15 W: 4.63 IP: 161	
AKC01070	Promtin Tai	067	8	PTT S3/2 West Section	250-260 cm bd (S4L5) Burial 12	8 glass beads 2 dark blue shiny semi-trans (1 measured: L:4.64 W:5.32) 6 dark blue glass cobalt shiny (1 measured: L:2.33 W: 4.69)	
AKC01071	Promtin Tai	068	8	PTT S3/2 West Section	170-180 cm bd (S3L2)	8 pieces 1 small yellow opaque 2 dark blue shiny semi-trans 2 cobalt trans 1 large yellow opaque IP bead matte: L:3.70 W:4.51 IP:1.07 1 orange opaque bead matte: L:3.59 W:3.80 IP:1.21 1 light blue opaque bead matte: L: 1.99 W: 4.07 IP: 1.41	

Database ID	Site Name	Cat Number	Total # of beads	Trench	Layer	Notes	Notes (cont)
AKC01073	Promtin Tai	013	56	S3 East Section	190-200 cm bd Burial 20 (?)	56 glass beads plus several eark blue bead fragments 2 violet transparent beads (L1.60 W2.82) Bead 1: L: 1.60 W: 2.82 Bead 2: L: 1.65 W: 2.82 IP: 0.83 53 dark blue shiny semi-trans Bead 1: L: 4.84 W: 4.54 Bead 2: L: 4.12 W: 4.53 (broken) 1 light blue opaque	
AKC01076	Promtin Tai	015	3	S3 West Section	70-80 cm bd	2 red opaque (1 measured: L4.14 W4.36) 1 large opaque light blue: L3.81 W6.65	
AKC01077	Promtin Tai	016	53	S3 West Section	90-100 cm bd	53 glass beads in 4 groups plus fragments of yellow, green, and blue beads Group 1- Indo-Pacific beads approx 2-3.5 mm 2 yellow opaque shiny 7 light blue opaque shiny 1 light blue transparent Group 2- Small Indo-Pacific	Group 3- Small Indo-Pacific beads 1 white opaque shiny 2 orange opaque shiny 1 orange opaque with red core: L:1.28 W:2.86 IP:0.81 2 yellow opaque matte 1 long red tubular bead 1 light green opaque shiny 1 green opaque shiny Group 4- Larger Indo-Pacific Beads

						beads, approx 1-2mm 2 yellow opaque shiny 2 light green opaque shiny 4 red opaque shiny 2 orange opaque matte	1 light blue opaque 8 red opaque (1 measured: L:4.90 W:5.36 IP:1.47) 2 dark blue matte translucent 1 dark blue-green transparent 1 yellow opaque shiny 3 orange opaque 2 dark green opaque 1 turquoise opaque 1 light green opaque 1 polychrome black, red and white: L:3.78 W:3.80 IP:1.30 1 red opaque with heavy white corrosion? 2 light blue translucent
AKC01078	Promtin Tai	017	37	S3 West Section	100-110 cm bd	37 glass beads in three groups Group 1- Larger IP beads 1 brown short cylinder: L6.76 W6.37 IP2.62 3 red opaque 2 dark turquoise transparent 2 orange opaque 3 yellow opaque shiny (1 measured: L:3.01 W:4.36 IP:0.64ish 1 light blue opaque 1 dark green opaque 1 dark turquoise opaque	Group 2- Small Indo-Pacific beads 1 dark blue turquoise opaque 4 orange opaque matte 3 light green opaque 4 red opaque 1 yellow opaque: L:1.43 W:1.91 Group 3: Indo-Pacific beads 2 opaque yellow 1 dark blue semi-trans 1 light blue semi-trans 1 red opaque matte: L:2.32 W:3.48 4 red opaque shiny 1 light green opaque
AKC01079	Promtin Tai	018	26	S3 West Section	110-120 cm bd	26 glass beads plus fragments of red and blue beads Group 1- Indo-Pacific beads 1 yellow opaque 1 dark blue transparent	Group 2- Small Indo-Pacific beads 1 light green opaque: L:2.7 W:1.97 3 orange opaque 3 red opaque

						3 light blue opaque 1 dark turquoise semi-trans: L:2.13 W:3.25 IP:0.98 1 light green opaque shiny 1 green-yellow opaque 1 orange opaque	Group 3- Indo-Pacific beads 2 dark green opaque 2 orange opaque 1 yellow opaque IP bead: L:4.36 W:7.08 IP:2.06 1 yellow bicone 3 red opaque large short barrel (1 measured: L:7.72 W:8.46 IP:2.30) 1 light blue semi-trans
AKC01084	Promtin Tai	073	30	S3/2 West Section	230-240 cm bd (S4L3) Burial 9	30 glass dark cobalt shiny Indo- Pacific beads, 6 beads measured Bead 1: L: 2.86 W: 5.46 IP: 1.84? Bead 2: L: 3.01 W: 4.22 IP: 1.49 Bead 3: L: 2.52 W: 4.72 IP: 1.38 Bead 4: L: 3.50 W: 6.35 IP: 2.14 Bead 5: L: 3.39 W: 5.57 IP: 1.70 Bead 6: L: 3.39 W: 5.44 IP: 1.85	
AKC01016	Promtin Tai	009	2	S3 East Section	160-170 cm bd	1 orange opaque bead 1 opaque yellow microbead	

Appendix 7.1h: Glass beads from Noen U-Loke at the Phimai Museum

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
140/2547				orange	Indo-Pacific Microbead	54	
144/2547				orange	Indo-Pacific Microbead	19	
144/2547				orange	Wrapped glass bead/small tube	11	
144/2547				orange	Long wrapped beads	2	
144/2547				milky white semi-trans	Indo-Pacific Bead	3	
144/2547				red opaque	Indo-Pacific Bead	2	
144/2547				red opaque	Indo-Pacific Bead	6	
144/2547				weathered?	Indo-Pacific Bead	2	
144/2547				dark blue semi trans	Indo-Pacific Bead	7	
144/2547				dark turq trans	Indo-Pacific Bead	5	
144/2547				light turq	Indo-Pacific Bead	12	
144/2547				milky yellow	Indo-Pacific Bead	10	
144/2547				green opaque	Indo-Pacific Bead	82?	
136/2547				orange	Indo-Pacific Bead	3	

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
136/2547				yellow opaque	Indo-Pacific Bead	12	
137/2547				yellow opaque	Indo-Pacific Bead	22	
137/2547				orange	Wrapped glass bead	43	
137/2547				bright turq semi trans	Indo-Pacific Bead	5	plus broken frags
143/2547				green opaque	Indo-Pacific Bead	28	
143/2547				orange	Wrapped glass bead	3	
143/2547				red opaque	Indo-Pacific Bead	1	
143/2547				turquoise semi- trans	Indo-Pacific Bead	1	
134/2547				orange	Indo-Pacific Microbead	151 approx	Some red-orange glass
134/2547				yellow	Indo-Pacific Bead	1	
581/2547				orange beads	Long wrapped beads	2	
133/2547				orange	Wrapped glass bead	30	
142/2547				black opaque	Indo-Pacific Bead	31	
142/2547				yellow opaque	Indo-Pacific Bead	11	
142/2547				red opaque	Indo-Pacific Bead	7	
142/2547				milky white semi-trans	Indo-Pacific Bead	1	

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
142/2547				light turquoise trans	Indo-Pacific Bead	4	
142/2547				dark blue	Indo-Pacific Bead	2	Unrounded edges
142/2547				dark blue turq semi trans	Indo-Pacific Bead	2	
142/2547				orange	Wrapped glass bead	1	
142/2547				orange	Indo-Pacific Microbead	27	Some red-orange glass
142/2547				green opaque	Indo-Pacific Bead	27	
132/2547				orange	Wrapped glass beads	98	
132/2547				dark blue turq semi trans	Indo-Pacific Bead	6	Unrounded edges
132/2547				green opaque	Indo-Pacific Bead	1	
135/2547				orange	Indo-Pacific Microbead	116	Some red-orange glass
138/2547				orange	Indo-Pacific Microbead	408	
138/2547				light turquoise trans	Indo-Pacific Bead	2	
138/2547				black opaque	Indo-Pacific Bead	3	
138/2547				orange	Long wrapped beads	1	Some red-orange glass

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
145/2547				orange	Indo-Pacific Microbead	35?	
145/2547				orange	Wrapped glass bead	6	
145/2547				orange	Indo-Pacific Bead	1	
145/2547				black opaque	Indo-Pacific Bead	9	
145/2547				yellow opaque	Indo-Pacific Bead	18	
145/2547				red opaque	Indo-Pacific Bead	20	
145/2547				green opaque	Indo-Pacific Bead	43	
145/2547				light turquoise semi trans	Indo-Pacific Bead	13	
145/2547				med blue	Indo-Pacific Bead	5	
145/2547				dark blue	Indo-Pacific Bead	6	Unrounded edges
145/2547				blue	Indo-Pacific Bead	2	
145/2547				milky white semi-trans	Indo-Pacific Bead	1	
139/2547				green opaque	Indo-Pacific Bead	99	
139/2547				yellow opaque	Indo-Pacific Bead	1	
139/2547				yellow opaque	Indo-Pacific Bead	11	

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
139/2547				yellow opaque	Indo-Pacific Bead	1	
139/2547				red opaque	Indo-Pacific Bead	19	
139/2547				black opaque	Indo-Pacific Bead	1	
139/2547				light turq	Indo-Pacific Bead	24	
139/2547				light turq	Indo-Pacific Bead	1	
139/2547				dark blue	Indo-Pacific Bead	3	
139/2547				dark blue	Indo-Pacific Bead	5?	Dark turquoise
139/2547				orange	Indo-Pacific Bead	5	
139/2547				orange	Wrapped glass beads	6	
139/2547				orange	Indo-Pacific Bead	5	
139/2547				orange	Indo-Pacific Microbead	10	
141/2547				green opaque	Indo-Pacific Bead	23	sizes vary on most of the green opaque
141/2547				black	Indo-Pacific Bead	92	
141/2547				yellow opaque	Indo-Pacific Bead	3	
141/2547				dark blue	Indo-Pacific Bead	31	
141/2547				dark blue	Indo-Pacific Bead	20	Unrounded edges
61	730	NUL #43? BNB B2 4:12 feature 1	N/A	orange opaque	Long wrapped beads	41	
61	730	NUL #43? BNB B2 4:12 feature 1	N/A	blue semi trans	Indo-Pacific Bead	1	Unrounded edges
62	733	BNB B2:12 #412	N/A	orange	Wrapped glass bead?	1	

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
63	735	NUL #416 B2 4:13 BNB	N/A	orange	Long wrapped beads	1	
64	737	BNB B2 4-11 #410	N/A	orange	Long wrapped beads	10	
64	737	BNB B2 4-11 #410	N/A	orange	Wrapped glass bead?	2	
65	767	NUL #405 B2 4:11 BNB	N/A	orange	Wrapped glass bead? Broken	1	
66	773	NUL #81 A1 4:s1 feature 4 BNB	N/A	blue semi trans	broken	1	
67	783	NUL 252 B2 4:5 residue BNB	N/A	orange	Wrapped glass bead	11	
68	784	NUL #50 A2 3:2 Feature 2 BNB	N/A	orange	Indo-Pacific Bead	1	
69	791	NUL BNB A1 3 s5 lens	N/A	orange	Wrapped glass bead	1 complete, 1-2 broken	
70	774	NUL Cat 1196 B. 83 C1 4:s3	N/A	orange	Indo-Pacific Microbead	3	
70	774	NUL Cat 1196 B. 83 C1 4:s3	N/A	turquoise semi-trans	Indo-Pacific Bead	12 (8 complete)	
70	774	NUL Cat 1196 B. 83 C1 4:s3	N/A	turquoise semi-trans	Indo-Pacific Bead	2	with copper fragments
51	425	NUL#286 B2 4:s6 feature 10 BNB	N/A	orange	Wrapped glass bead	16	
52	444	NUL #228 A2 4:8 BNB	N/A	orange	Wrapped glass bead	1	
53	466	NUL #296 phase 3 B2 4:7 feature 1 "Scatter"	Burial 32	orange	Long wrapped beads	20 (1 incomplete)	

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
53	466	NUL #296 phase 3 B2 4:7 feature 1 "Scatter"	Burial 32	orange	Wrapped glass bead	5 (4 are more tubular than disc shaped)	
130/47	466	NUL #296 B2 4:s7 feature 1	Burial 32	orange	Long wrapped beads	55	plus some broken Wrapped glass bead glass bead fragments and one larger red opaque bead
54	496	NUL 320 A2 4:12 glass object	N/A	bright turquoise blue	broken/weathered	4 fragments of an object-ring/earring/bracelet?	
55	531	NUL 339 B2 4:s7 feature 3 BNB	N/A	orange	Wrapped glass bead	1	
56	643	NUL #375 B2 4:8 BNB	N/A	orange	Wrapped glass bead	4	
56	643	NUL #375 B2 4:8 BNB	N/A	orange	Long wrapped beads	6	
57	644	NUL #366 B2 4:7 BNB	N/A	orange	Wrapped glass bead?	4 (1 broken)	
59	711	B2 4:10 #405	N/A	orange	Wrapped glass bead	2	
59	711	B2 4:10 #405	N/A	orange	Long wrapped beads	6	
60	718	NUL #370 B1 4:11 glass bangle	N/A	light blue turquoise?	broken, weathered	4 fragments	
41	316	NUL #177 A2 4:s4 BNB	N/A	bright red	Indo-Pacific Bead	1	

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
42	337	NUL #225 B2 4:s3 feature 12 BNB	N/A	dark blue turq trans	Indo-Pacific Bead	1	Unrounded edges
43	339	B2 4:3 BNB	N/A	orange	Wrapped glass bead	11 (1 broken)	
44	368	B2 4:s2 feature 12 BNB	N/A	dark blue turq trans	Indo-Pacific Bead	1	Unrounded edges
45	385	NUL #242, B2 4:4 BNB	N/A	orange	Wrapped glass bead	1	
46	392	NUL #257 B2 4:5	N/A	orange	Wrapped glass bead	4	
46	392	NUL #257 B2 4:5	N/A	dark blue turq trans	Indo-Pacific Bead	1	Unrounded edges
47	414	NUL #25 B2 4:5 BNB	N/A	orange	Wrapped glass bead	8 (1 broken)	
47	414	NUL #25 B2 4:5 BNB	N/A	orange	Long wrapped beads	1	
47	414	NUL #25 B2 4:5 BNB	N/A	dark blue, semi-trans	tube, unrounded	2	
48	415	NUL #260 B2 4:s6 feature 1	N/A	orange	Long wrapped beads	2	
48	415	NUL #260 B2 4:s6 feature 1	N/A	dark blue turq trans	Indo-Pacific Bead	1	Unrounded edges
49	420	NUL #288 A2 4:s8 BNB	N/A	orange	long skinny tube	2	
50	421	NUL #291 B1 4:s3 BNB	N/A	light blue turquoise semi trans	Indo-Pacific Bead	1	

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
32	1456	NUL #930 B105 x/x1 3:s13 feature 2	Burial 105	orange	Indo-Pacific Microbead	24 plus a few tiny fragments	
32	1456	NUL #930 B105 x/x1 3:s13 feature 2	Burial 105	yellow opaque	Indo-Pacific Microbead	4	
32	1456	NUL #930 B105 x/x1 3:s13 feature 2	Burial 105	green opaque	Indo-Pacific Microbead	9 plus many broken frags	
32	1456	NUL #930 B105 x/x1 3:s13 feature 2	Burial 105	red opaque	Indo-Pacific Microbead	1	
31	1465	X1 3: s13 E of grave 105	Related to burial 105	dark blue almost opaque	Indo-Pacific Bead	3	
31	1465	X1 3: s13 E of grave 105	Related to burial 105	dark blue semi trans	Indo-Pacific Bead	1	
31	1465	X1 3: s13 E of grave 105	Related to burial 105	light green opaque	Indo-Pacific Bead	106	
31	1465	X1 3: s13 E of grave 105	Related to burial 105	yellow opaque	Indo-Pacific Bead	14	
31	1465	X1 3: s13 E of grave 105	Related to burial 105	black opaque	Indo-Pacific Bead	4	
31	1465	X1 3: s13 E of grave 105	Related to burial 105	orange	Indo-Pacific Microbead	6	

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
31	1465	X1 3: s13 E of grave 105	Related to burial 105	off white semi trans	Indo-Pacific Bead	2	
31	1465	X1 3: s13 E of grave 105	Related to burial 105	orange	Wrapped glass bead	11 with a few broken frags	
31	1465	X1 3: s13 E of grave 105	Related to burial 105	orange	Long wrapped bead	1	
31	1465	X1 3: s13 E of grave 105	Related to burial 105	dark red opaque	Indo-Pacific Bead	22	
31	1465	X1 3: s13 E of grave 105	Related to burial 105	light blue turq semi trans	Indo-Pacific Bead	22	
31	1465	X1 3: s13 E of grave 105	Related to burial 105	turquoise semitrans	Indo-Pacific Bead	a few fragments	Unrounded edges
33	none listed	Burial 113	Burial 113	orange	Wrapped glass bead	6	
33	none listed	Burial 113	Burial 113	orange	Indo-Pacific Bead	5	
33	none listed	Burial 113	Burial 113	dark blue (cobalt?) semi- trans	Indo-Pacific Bead	4	Unrounded edges
33	none listed	Burial 113	Burial 113	dark blue (cobalt?) semi- trans	Indo-Pacific Bead	2	
35	1741		Burial 121	orange	Indo-Pacific Microbead	11	
35	1741		Burial 121	red	Indo-Pacific Microbead	1	

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
35	1741		Burial 121	green	Indo-Pacific Microbead	18 plus some fragments	
35	1741		Burial 121	yellow	Indo-Pacific Microbead	3	
35	1741		Burial 121	black	Indo-Pacific Microbead	3	
36	1741	Burial 121 X1	Burial 121	orange	Indo-Pacific Microbead	16	
36	1741	Burial 121 X1	Burial 121	green	Indo-Pacific Microbead	4	
38	286	NUL #188 A2 4:s5 BNB	N/A	blue semi-trans turquoise	Indo-Pacific Bead	1	
39	299	NUL #188 A2 4:s5 BNB	N/A	orange	Wrapped glass bead	1	
40	306	NUL #127 B2 4:2 BNB	N/A	orange	Wrapped glass bead	12 plus one broken	
40	306	NUL #127 B2 4:2 BNB	N/A	dark blue semi trans	Indo-Pacific Bead	1	
20	683	NUL Phase 3, B2 4:8 #383 Burial 52 neck	Burial 52	orange	Long wrapped beads	18 plus some fragments	
20	683	NUL Phase 3, B2 4:8 #383 Burial 52 neck	Burial 52	orange	Wrapped glass bead	19 plus some fragments	
19	704	NUL #387 B2 4:8 Burial 50	Burial 50	orange	Wrapped glass bead	1 broken frag	

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
18	690	NUL Phase 3 4:9 Burial 49	Burial 49	orange	Wrapped glass bead	7 (1 broken)	
17	555	NUL #343 B1 4:s6 feature 6 Burial 47 residue	Burial 47	orange	Indo-Pacific Microbead	4	
17	555	NUL #343 B1 4:s6 feature 6 Burial 47 residue	Burial 47	orange	Wrapped glass bead	3	
17	555	NUL #343 B1 4:s6 feature 6 Burial 47 residue	Burial 47	green opaque	Indo-Pacific Bead	2	
17	555	NUL #343 B1 4:s6 feature 6 Burial 47 residue	Burial 47	yellow opaque	Indo-Pacific Bead	3	
17	555	NUL #343 B1 4:s6 feature 6 Burial 47 residue	Burial 47	black opaque	Indo-Pacific Bead	90 approx	
17	555	NUL #343 B1 4:s6 feature 6 Burial 47 residue	Burial 47	light blue turqu	Indo-Pacific Bead	5	
17	555	NUL #343 B1 4:s6 feature 6 Burial 47 residue	Burial 47	bright turq	Indo-Pacific Bead	2	Unrounded edges
17	555	NUL #343 B1 4:s6 feature 6 Burial 47 residue	Burial 47	orange	Indo-Pacific Bead	78	
17	555	NUL #343 B1 4:s6 feature 6 Burial 47 residue	Burial 47	dark brown	Indo-Pacific Bead	1	
16	533	B4:7 Burial 45 beads by skull	Burial 45	orange	Wrapped glass bead	2	

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
16	533	B4:7 Burial 45 beads by skull	Burial 45	orange	Indo-Pacific Bead	5	Unrounded edges
15	518	A2 4:12 phase 2 Burial 42 head area	Burial 42	turquoise semi-trans	Indo-Pacific Bead	1	
15	518	A2 4:12 phase 2 Burial 42 head area	Burial 42	orange	Wrapped glass bead	12	
15	518	A2 4:12 phase 2 Burial 42 head area	Burial 42	orange	Long wrapped beads	34 plus some fragments	
14	513	A2 4:12 burial 41 beads at skull	Burial 41	orange	Wrapped glass bead?	2	
14	513	A2 4:12 burial 41 beads at skull	Burial 41	orange	Long wrapped beads	2	
13	652	Phase 3 Burial 40 at feet	Burial 40	orange	Wrapped glass bead	1	
12	670	Phase 3 B2 4:9 #393 burial 39	Burial 39	orange	Wrapped glass bead	6	
12	670	Phase 3 B2 4:9 #393 burial 39	Burial 39	orange	Long wrapped beads	18	
11	492	Phase 2 NUL #319 A2 4:11 Burial 37 neck area	Burial 37	orange	Wrapped glass bead	115 plus many many broken fragments	
11	492	Phase 2 NUL #319 A2 4:11 Burial 37 neck area	Burial 37	bright blue semi trans	Indo-Pacific Bead	2 broken beads	

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
10	633	Nul #307 B2 4:7 feature 7 burial 33 (necklace)	Burial 33	orange	Wrapped glass bead	11	
9	294	NUL #294 Phase 3 B2 4:s8 feature 10 burial 29 residue	Burial 29	orange	Wrapped glass bead	32	outer bag says: phase 3 burial 29 residue cat 431
9	294	NUL #294 Phase 3 B2 4:s8 feature 10 burial 29	Burial 29	orange	Wrapped glass bead	62	outer bag says: phase 3 burial 29 residue cat 431
3	311	NUL #213 phase 4 A2 4:s4 area of burial 21	Burial 21	yellow opaque	Indo-Pacific Bead	8	
3	311	NUL #213 phase 4 A2 4:s4 area of burial 21	Burial 21	turquoise semi-trans	Indo-Pacific Bead	6	
7	541	NUL #330 Phase 3 B1/2 4:s5 Burial 25	Burial 25	orange	Wrapped glass bead	16	
7	541	NUL #330 Phase 3 B1/2 4:s5 Burial 25	Burial 25	orange-red mixed	Indo-Pacific Bead	29	
6	516	NUL #330 phase 3 B1/2 Burial 25	Burial 25	orange-red mixed	Indo-Pacific Bead	6	
6	516	NUL #330 phase 3 B1/2 Burial 25	Burial 25	orange	Wrapped glass bead	1	
6	516	NUL #330 phase 3 B1/2 Burial 25	Burial 25	blue turq trans	Indo-Pacific Bead	1	
5	504	NUL #330 phase 3 B/12 Burial 25	Burial 25	orange	Wrapped glass bead	3	
5	504	NUL #330 phase 3 B/12 Burial 25	Burial 25	orange-red mixed	Indo-Pacific Bead	7	

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
8	776	Phase 3 4:5 B12 Bag #? Burial 25	Burial 25	yellow opaque	Indo-Pacific Bead	2	
8	776	Phase 3 4:5 B12 Bag #? Burial 25	Burial 25	orange	Indo-Pacific Microbead	100	
8	776	Phase 3 4:5 B12 Bag #? Burial 25	Burial 25	orange	Wrapped glass bead	2	
8	776	Phase 3 4:5 B12 Bag #? Burial 25	Burial 25	orange	Indo-Pacific Bead	1	
8	776	Phase 3 4:5 B12 Bag #? Burial 25	Burial 25	light turquoise trans	Indo-Pacific Bead	36 plus many broken frags	
8	776	Phase 3 4:5 B12 Bag #? Burial 25	Burial 25	black opaque	Indo-Pacific Bead	24	
8	776	Phase 3 4:5 B12 Bag #? Burial 25	Burial 25	dark brown trans	Indo-Pacific Bead	1	
4	338?	NUL phase 3 possibly burial 23 B2 4:s6 feature 1 #260	Burial 23	orange	Wrapped glass bead?	1	
4	338?	NUL phase 3 possibly burial 23 B2 4:s6 feature 1 #260	Burial 23	dark turq trans	Indo-Pacific Bead	8 plus one fragment	Unrounded edges

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
2	178	NUL phase 4 Burial 14 glass beads found at foot area	Burial 14	yellow opaque	Indo-Pacific Bead	9 plus many broken frags	
2?	785	NUL phase 4 #132 A2 4:sl bead cat no. 785 or inside pot cat 217	Burial 14	orange	Wrapped glass bead	1	
2	178	NUL phase 4 Burial 14 glass beads found at foot area	Burial 14	green opaque	Indo-Pacific Bead	30 plus many broken frags	
2	178	NUL phase 4 Burial 14 glass beads found at foot area	Burial 14	light blue turq semi trans	Indo-Pacific Bead	212 plus many broken fragments	
2	178	NUL phase 4 Burial 14 glass beads found at foot area	Burial 14	dark turq trans, slightly darker than above or maybe less weathered?	Indo-Pacific Bead	136	
2	178	NUL phase 4 Burial 14 glass beads found at foot area	Burial 14	dark blue (cobalt?) semi-trans	Indo-Pacific Bead	2 broken beads	

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
2	178	NUL phase 4 Burial 14 glass beads found at foot area	Burial 14	dark turq- opaque	Indo-Pacific Bead	11	
2	178	NUL phase 4 Burial 14 glass beads found at foot area	Burial 14	light blue turq semi trans	Indo-Pacific Bead	1	
1	236	NUL phase 4#131 burial 13, A2 4:s1	Burial 13	blue turq semi- trans	Indo-Pacific Bead	265+500+7 00? So approx 1500 beads	
1	236	NUL phase 4#131 burial 13, A2 4:s1	Burial 13	turq opaque	Indo-Pacific Bead	11	
28	1254	NUL #829 C1/K1 Burial 95	Burial 95	orange	Wrapped glass bead	2	
28	1254	NUL #829 C1/K1 Burial 95	Burial 95	red opaque	Indo-Pacific Bead	1	
28	1254	NUL #829 C1/K1 Burial 95	Burial 95	green opaque	Indo-Pacific Bead	20	
28	1254	NUL #829 C1/K1 Burial 95	Burial 95	yellow opaque	Indo-Pacific Bead	1	
28	1254	NUL #829 C1/K1 Burial 95	Burial 95	light yellow opaque	Indo-Pacific Bead	1	
28	1254	NUL #829 C1/K1 Burial 95	Burial 95	milky white semi-trans	Indo-Pacific Bead	1	

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
28	1254	NUL #829 C1/K1 Burial 95	Burial 95	bright turq semi trans	Indo-Pacific Bead	2	
28	1254	NUL #829 C1/K1 Burial 95	Burial 95	bright turq semi trans	Indo-Pacific Bead	2 plus many fragments	Unrounded edges
28	1254	NUL #829 C1/K1 Burial 95	Burial 95	dark blue-cobalt?	Indo-Pacific Bead	1	
28	1254	NUL #829 C1/K1 Burial 95	Burial 95	blue?	weathered and broken beads		
27	1254	Burial 95	Burial 95	light blue?	weathered	several small fragments	
23	728	NUL #426 burial 54 phase 3 feet area	Burial 54	orange	Wrapped glass bead	1 broken frag	plus a weathered bead or copper bead Wrapped glass bead glass in tinfoil?
22	675	NUL #415 phase 3 410 burial 53 upper arm area	Burial 53	orange	Long wrapped beads	16	
21	673	burial 53	Burial 53	carnelian	small round faceted barrel	1	
25	1666	Burial 80	Burial 80	orange	Wrapped glass bead	1	
25	1666	Burial 80	Burial 80	orange	Indo-Pacific Bead	88	
25	1666	Burial 80	Burial 80	yellow	Indo-Pacific Bead	5 plus broken frags	

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
25	1666	Burial 80	Burial 80	black opaque	Indo-Pacific Bead	10	
26	1190	burial 94 beads around neck	Burial 94	orange	Wrapped glass bead	37 plus a few frags	
26	1190	burial 94 beads around neck	Burial 94	black and white/weathered	imitation agate beads?	4	
24	769	NUL #424 phase 3 B2 4:8 Burial 55	Burial 55	orange	Wrapped glass bead	1	
29	1275	NUL burial 96 X1/C1 4:s7	Burial 96	orange	Indo-Pacific Microbead	1	
30	1414	B102 X1 beads from baby skeleton in pot	Burial 102	orange	Wrapped glass bead	3	
30	1414	B102 X1 beads from baby skeleton in pot	Burial 102	green opaque	Indo-Pacific Bead	13	
30	1414	B102 X1 beads from baby skeleton in pot	Burial 102	yellow opaque	Indo-Pacific Bead	1	
30	1414	B102 X1 beads from baby skeleton in pot	Burial 102	black opaque	Indo-Pacific Bead	4	
30	1414	B102 X1 beads from baby skeleton in pot	Burial 102	turq trans	Indo-Pacific Bead	8?	Unrounded edges

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
30	1414	B102 X1 beads from baby skeleton in pot	Burial 102	dark blue/cobalt semi-trans	Indo-Pacific Bead	24? (some Wrapped glass bead glass in tin foil)	Unrounded edges
30	1414	B102 X1 beads from baby skeleton in pot	Burial 102	turq trans	Indo-Pacific Bead	43?	
30	1414	B102 X1 beads from baby skeleton in pot	Burial 102	light turq	Indo-Pacific Bead	2	
30	1414	B102 X1 beads from baby skeleton in pot	Burial 102	green opaque	Indo-Pacific Bead	1	
30	1414	B102 X1 beads from baby skeleton in pot	Burial 102	greenish yellow	Indo-Pacific Bead	2-Feb	
37	1204	C1 4:6 NUL 836 piece of blue glass pendant?	N/A	light blue turquoise	weathered	1 fragment	ring/earring?
130/47	466	NUL #296 B2 4:s7 feature 1	Burial 32	orange	Long wrapped beads	55	
541/2547	1628	Layer 3:10	Burial 116	orange	Wrapped glass bead	23	in bag that says: NUL Cat 1628 Burial 116 540-42/47 also written in red: 994
540/2547	1628		Burial 116	blue dark tur to dark blue	Indo-Pacific Bead	6	in bag that says: NUL Cat 1628 Burial 116 540-42/47 also written in red: 994

Number on Phimai Museum Chart	Cat No	Context Info	Burial Number	Bead color	Bead Shape	Number of beads	Notes
542/2547	1628		Burial 116	black opaque	Indo-Pacific Bead	84	in bag that says: NUL Cat 1628 Burial 116 540-42/47 also written in red: 994
542/2547	1628		Burial 116	orange	Indo-Pacific Bead	8	in bag that says: NUL Cat 1628 Burial 116 540-42/47 also written in red: 994
34	1628	Burial 116, glass bead necklace	Burial 116	black opaque	Indo-Pacific Bead	26	
34	1628	Burial 116, glass bead necklace	Burial 116	orange	Indo-Pacific Bead	6	

Appendix 7.1i: Glass beads from Ban Non Wat

Level:Layer	Burial #	Cat #	Beads	Description on bag	Total number of complete beads	Broken fragments	Notes
2:6	Burial 6	Cat 110	orange wrapped beads	orange bead belt, 200 complete- 5 broken	200	5	
2:2	Burial 36	Cat 2964	Orange opaque microbeads	orange glass beads from within jar burial. 85 beads	85		
2:2	Burial 36	3548	orange Indo-Pacific bead	1 small orange glass bead	1		
2:2	Burial 266	15506	Indo-Pacific glass beads: yellow (55), turquoise (14), dark blue(19), cobalt blue (7- these are not rounded but cut straight), red (9), orange (6), white (1) black (1)	necklace	112	0	beads are larger IP bead size, some tubes. Mostly rounded except cobalt blue
2:2	Burial 266	15506	broken frags of yellow and light blue glass.	necklace	0	several pieces	
3:1	Burial 203	11519	bright blue glass bead		1	0	
3:1	Burial 203	11528 and 11527	12 orange glass beads, 1 dark blue cobalt glass bead, 1 light blue Indo-Pacific beads		14	1	
3:1	Burial 203	11527	wrapped orange glass beads (90)	right wrist	90	0	
3:1	Burial 203	11536	orange wrapped and light blue bead Indo-Pacific bead	L wrist area, 10 orange 1/2 blue, 1/2 orange	10	2	

Level:Layer	Burial #	Cat #	Beads	Description on bag	Total number of complete beads	Broken fragments	Notes
3:1	Burial 203	11528	20 orange wrapped and 2 dark turq blue Indo-Pacific beads	neck area	22	0	
3:1	Burial 203	11521	4 wrapped orange glass beads		4	0	
1:5	non burial	8253	Light blue Indo-Pacific bead	glass bangle	1	0	
4:1	Burial 356	17155	blue/green glass bead fragments- weathered	glass beads? Chin area	0	several pieces	
	B108	cat 5136	broken orange Indo-Pacific bead		0	1	
	B101	5125	broken orange Indo-Pacific bead		0	1	
	B385	18110	broke weathered blue/green bead frags		0	several pieces	
		6028	Light blue Indo-Pacific bead		1	0	
5:3	B 304	17868	3 yellow beads, 1 orange bead, 1 light blue Indo-Pacific bead		5	0	
	B 343	19762	fragment of weathered glass beads		0	several pieces	
	B 357	19773	fragment of weathered glass beads		0	several pieces	
	B 36	3536	2 wrapped orange glass beads		2	0	
	B 36	3528	2 wrapped orange glass beads		2	0	
	38	4056	1 orange Indo-Pacific bead		1	0	

Level:Layer	Burial #	Cat #	Beads	Description on bag	Total number of complete beads	Broken fragments	Notes
	95	4528	4 orange Indo-Pacific beads		4	0	
	B 235	17656	4 orange and 1 black Indo-Pacific beads		5	0	
3:1	202	17873	15 orange beads (wrapped?) and Indo-Pacific beads: 2 cobalt blue tubes with sharp edges, 2 dark turq rounded IP beads		19	0	
3:1	202	17873	12 orange wrapped beads		12	0	
3:1	202	11524	1 orange wrapped tube		1	0	
2:5		18	fragment of earring or bangle blue		1	0	
3:2	gen spit	24517	orange wrapped bead		1	0	
3:2	gen spit	10024	Yellow Indo-Pacific bead		1	0	
1:6		7782	1 orange and 2 light blue Indo-Pacific beads		3	0	
1:2		393	large blue-green glass bead with large hole		1	0	
2:9		486 or 986	broken orange wrapped		0	1	
2:8		2982	Light blue Indo-Pacific bead		1	0	
2:4/5 Feature 1		6556	Light blue Indo-Pacific bead		1		
2:6		26006	orange wrapped bead		1		
3:1 Feature 3		4156	broken orang wrapped bead tube			1	

Level:Layer	Burial #	Cat #	Beads	Description on bag	Total number of complete beads	Broken fragments	Notes
2:1		17394	Light blue Indo-Pacific bead		1		
3:1		17390	orange Indo-Pacific bead		1		
2:8		17935	Cobalt Indo-Pacific bead		1		
2:8		17389	Light blue Indo-Pacific bead		1		
2 Feature 1		4351	Light blue Indo-Pacific bead		1		
2:4/5 Feature 1		6557	Yellow Indo-Pacific bead		1		
2:1		Bag # 4711	Light blue Indo-Pacific bead		0	1	
1:8		17861	Light blue Indo-Pacific bead		1		
		1	Large blue glass bead with large hole		1		
5:2		115	weathered and broken bead		1	0	
3:3		17882	orange wrapped tube and light-blue Indo-Pacific bead		1		
2:5		17883	Dark blue Indo-Pacific bead with sharp edges		1		
1:9	gen spit	9004	Broken Light blue Indo-Pacific bead		0	1	
2:5/6 Feature 2	Bag 11009	24505	Coiled blue glass beads?		16		
2:3 Feature 3		2016	Cobalt Indo-Pacific bead		1		
3:4		17877	Dark Blue Indo-Pacific bead		1		

Level:Layer	Burial #	Cat #	Beads	Description on bag	Total number of complete beads	Broken fragments	Notes
1:5		2693	orange wrapped bead		1		
2:5		17876	orange wrapped bead		1		
3:2 Feature 2		17865	2 orange wrapped beads?		2		
2:3 Feature 1		23452	2 blue coiled beads and one cobalt Indo-Pacific bead		3		
2:9		1784	Cobalt Indo-Pacific bead		1		unrounded edges
1:5		4	large clear/white bead with big hole		1		
topsoil			Light blue Indo-Pacific bead		1		
3:2 Feature 3		24512	Light blue Indo-Pacific bead		1		
2:4/5 Feature 1		6559	Light blue Indo-Pacific bead		1		
		8015	blue glass vessel frag? Light blue Indo-Pacific bead and cobalt Indo Pacific bead with unrounded edges		2		
2:5 Feature 6		6039	turq seed bead		1		
2:6 Feature 5		17863	Light Blue, 2 yellow and 1 white opaque Indo-Pacific bead. 4 orange wrapped tubes. \\		8		
3:4		515	broken weathered blue glass beads			several pieces	
1:4	gen spit	2974	Cobalt Indo-Pacific bead		1		

Level:Layer	Burial #	Cat #	Beads	Description on bag	Total number of complete beads	Broken fragments	Notes
2:4/5 Feature 1		6558	Light blue Indo-Pacific bead		1		
2:13	gen spit	5140	Light blue Indo-Pacific bead		1		
2:5		3351	Cobalt Indo-Pacific bead		1		
3:2		9690	Green opaque Indo-Pacific microbead		1		
		4381	Green Indo-Pacific bead		1		
3:4	gen spit	22529	blue glass earring frag		1		
2:6	gen spit	24509	broken weathered blue glass bead			1	
2:6		17888	Light blue Indo-Pacific bead		1		
2:8		17392	Light blue Indo-Pacific bead		1		
3:2		3571	weathred blue glass bead frag			1	
2:4/5	gen spit	22009	Cobalt Indo-Pacific bead		1		
1:4/5 Feature 1		7503	Yellow Indo-Pacific bead		1		
3:4		17875	2 orange wrapped beads		2		
2:6		5351	orange wrapped bead		1		
1:5		17881	Orange wrapped tube		2		
3:2	gen spit	24519	orange wrapped bead		1		
2:7		260	2 orange wrapped beads		2		
1:10		17878	orange Indo-Pacific bead		1		

Level:Layer	Burial #	Cat #	Beads	Description on bag	Total number of complete beads	Broken fragments	Notes
2:4/5 Feature 1		6556	orange wrapped bead		1		
4:3		4874	Orange wrapped tube and light blue Indo-Pacific bead		2		
2:3		25513	orange wrapped		1		
2:7		11516	orange micro bead		1		
2:9		210	orange wrapped bead		1		
3:3		17884	orange Indo-Pacific bead		1		
3:4		17880	Orange wrapped tube and light blue Indo-Pacific bead		1		
3:1		374	orange wrapped bead		1		
2:5/6 Feature 6		6040	orange wrapped bead		1		
2:5		123	3 orange wrapped tube beads		3		
2:6		25515	1 orange wrapped tube bead		1		
3:3		17867	orange wrapped small		1		
2:7		257	orange wrapped		1		
3:3		17885	2 orange wrapped beads?		2		
3:2		17872	orange wrapped tube bead		1		
4:10		17870	orange wrapped tube		1		
2:6		291	broken orange wrapped?			1	
3:2		23014	orange wrapped bead		1		
2:7		279	orange wrapped bead		1		

Level:Layer	Burial #	Cat #	Beads	Description on bag	Total number of complete beads	Broken fragments	Notes
2:6		193	orange wrapped small		1		
3:1 Feature 1		22923	orange wrapped small		1		
4:2	residue	8033	orange wrapped small		1		
4:1 Feature 1		1779	orange wrapped small		1		
2:4/5 Feature 1		6537	rounded orange tube		1		
2:7 Feature 15		233	orange wrapped bead		100		
2:10		5090	Dark blue glass chunk		1		
	burial 211	25424	blue glass bangle frags? Many		1		
1:4		1452	vessel glass- dark brown rainbow coating		1		
4:6	gen spit	3073	dark brown/black vessel glass		1		
2:3		2509	turq blue glass earring/ring/bangle frag		1		
5:2		4558	turq blue glass earring/ring/bangle frags		1		
4:1		5108 or 5168	weathred blue glass frags			several pieces	
3:1		27	weathred blue glass frag			several pieces	

Appendix 7.1j: Glass beads from Ban Non Wat and Noen U-Loke analyzed using LA-ICP-MS

Database ID	Site Name	Context Notes	Catalogue Number	Total # of beads	Bead Shape	Glass Colors	Glass Color Notes	Opacity
AKC02001	Noen U-Loke	NUL Cat 1465 X13 [13 E. Grave 105 T10 B8	1465/NUL-001	1	Indo-Pacific Bead	Dark Brown		Translucent
AKC02002	Noen U-Loke	3:6 Feature 1	141/NUL-002	1	Indo-Pacific Bead	Yellow		Opaque
AKC02003	Noen U-Loke	NUL #930 Cat No #1457 T9B3	1457/NUL-003	1	Indo-Pacific Bead	Blue		Translucent
AKC02004	Noen U-Loke	NUL 915 Cat 1417 T9B9	1417/NUL-004	1	Indo-Pacific Bead	Grey		Translucent
AKC02005	Noen U-Loke	Burial 102 Cat 1414 T9B2	1414/NUL-005	1	Indo-Pacific Bead	Dark Blue		Translucent
AKC02006	Noen U-Loke	B102 Cat #1414 T9B1	1414/NUL-006	1	Indo-Pacific Bead	Dark Blue		Translucent
AKC02007	Noen U-Loke	NUL 930 Cat #1457 T9B8	1457/NUL-007	1	Indo-Pacific Bead	Dark Blue		Translucent
AKC02008	Noen U-Loke	NUL #930 Cat #1457 T9B4	1457/NUL-008	1	Indo-Pacific Bead	Blue		Translucent

Database ID	Site Name	Context Notes	Catalogue Number	Total # of beads	Bead Shape	Glass Colors	Glass Color Notes	Opacity
AKC02009	Noen U-Loke	NUL #930 Cat 1457 T9 B7	1457/NUL-009	1	Indo-Pacific Bead	Dark Blue		Semi-Translucent
AKC02010	Noen U-Loke	NUL #96 Cat 207 Burial 8 B2 3:2 Residue Phase 5 T10 B2	207/NUL-010	1	Indo-Pacific Bead	Blue		Translucent
AKC02011	Noen U-Loke	NUL #915 Cat #1417 3:9 Feature 1 T9 B10	1417/NUL-011	1	Indo-Pacific Bead	Dark Blue	Corroded	
AKC02012	Noen U-Loke	NUL #915 Cat #1417 3:9 Feature 1 T9 B10	1502/NUL-012	1	Indo-Pacific Bead	White		Translucent
AKC02013	Noen U-Loke	NUL #915 Cat #1417 3:9 Feature 1 T9 B10	1417/NUL-013	2	Indo-Pacific Bead	Blue		Translucent
AKC02014	Noen U-Loke	NUL #915 Cat #1417 3:9 Feature 1 T9 B10	1417/NUL-014	2	Indo-Pacific Bead	Blue-Green		Translucent
AKC02015	Noen U-Loke	B102 Cat # 1414 T8B8 Royal Blue TP	1414/NUL-015	2	Indo-Pacific Bead	Dark Blue		Translucent
AKC02016	Noen U-Loke	B102 Cat # 1414 T8B8 Royal Blue TP	1414/NUL-016	2	Indo-Pacific Bead	Dark Blue	Almost purple	Semi-Translucent

Database ID	Site Name	Context Notes	Catalogue Number	Total # of beads	Bead Shape	Glass Colors	Glass Color Notes	Opacity
AKC02018	Noen U-Loke	NUL #115 Phase 5 Residue Burial 8 Cat 207 (A)	207/NUL-018	3	Indo-Pacific Bead	Yellow		Opaque
AKC02019	Noen U-Loke	NUL #115 Phase 5 Residue Burial 8 Cat 207 (A)	207/NUL-019	3	Indo-Pacific Microbead	Yellow		Opaque
AKC02020	Noen U-Loke	NUL #115 Phase 5 Residue Burial 8 Cat 207 (A)	207/NUL-020	1	Indo-Pacific Bead	Light Blue	Turquoise	Semi-Translucent
AKC02021	Noen U-Loke	NUL #115 Phase 5 Residue Burial 8 Cat 207 (A)	207/NUL-021	1	Indo-Pacific Bead	Dark Blue		Semi-Translucent
AKC02022	Noen U-Loke	NUL #115 Phase 5 Residue Burial 8 Cat 207 (A)	207/NUL-022	1	Indo-Pacific Bead	Dark Blue		Semi-Translucent
AKC02023	Noen U-Loke	NUL #115 Phase 5 Residue Burial 8 Cat 207 (A)	207/NUL-023	175	Indo-Pacific Microbead	Orange and Red	Red core with orange exterior	Opaque

Database ID	Site Name	Context Notes	Catalogue Number	Total # of beads	Bead Shape	Glass Colors	Glass Color Notes	Opacity
AKC02024	Noen U-Loke	NUL #115 Phase 5 Residue Burial 8 Cat 207 (A)	207/NUL-024	175	Indo-Pacific Microbead	Orange and Red	Red core with orange exterior	Opaque
AKC02025	Noen U-Loke	NUL #115 Phase 5 Residue Burial 8 Cat 207 (A)	207/NUL-025	175	Indo-Pacific Microbead	Orange and Red	Red core with orange exterior	Opaque
AKC02026	Noen U-Loke	NUL #115 Phase 5 Residue Burial 8 Cat 207 (A)	207/NUL-026	175	Indo-Pacific Microbead	Orange and Red	Red core with orange exterior	Opaque
AKC02027	Noen U-Loke	NUL #115 Phase 5 Residue Burial 8 Cat 207 (A)	207/NUL-027	175	Indo-Pacific Microbead	Orange and Red	Red core with orange exterior	Opaque
AKC02028	Noen U-Loke	NUL #319 A2 4:11 Burial 37 Phase 2	207/NUL-028	10	Wrapped tubular bead	Orange		Opaque
AKC02029	Noen U-Loke	NUL #319 A2 4:11 Burial 37 Phase 2	207/NUL-029	2	Large Indo-Pacific bead	Dark Blue		Semi-Translucent
AKC02030	Noen U-Loke	NUL #319 A2 4:11 Burial 37 Phase 2	207/NUL-030	6	Orange wrapped bead	Orange		Opaque

Database ID	Site Name	Context Notes	Catalogue Number	Total # of beads	Bead Shape	Glass Colors	Glass Color Notes	Opacity
AKC02031	Ban Non Wat	BNW 05/06 F7 #8903 2:1 Feature 12 Cat 19501 18.12.05	19501	1	Coiled bead	Blue	Corroded	
AKC02032	Ban Non Wat	BNW 05/06 13/12/05 G5 2:[2 Feature 6 Bag #9104 Cat: 20002	20002	1	Spherical	Yellow	Shiny surface	Opaque
AKC02033	Ban Non Wat	BNW 05/06 G5 #9104 2:[2 feature 6 17.12.05 Cat 20009	20009	1	Short bicone	Light Blue		Opaque
AKC02034	Ban Non Wat	G6 2:7 General Spit Cat 20523 Bag 9312 24/12/05	20523	1	Indo-Pacific Bead	Light Blue		Semi-Translucent
AKC02035	Ban Non Wat	BNW 05/06 G6 2:[5 Feature 5 Bag # 9507 Cat 20512 18.12.05	20512	1	Indo-Pacific Bead	Yellow		Opaque Semi-Translucent
AKC02036	Ban Non Wat	BNW 05/06 G6 Bag #9309 2:5 Cat 20514 2.12.05	20514	1	Wrapped bead	Orange		Opaque
AKC02037	Ban Non Wat	BNW 05/06 G6 2:5 Bag 9309 Cat 20519	20519	1	Indo-Pacific bead	Orange		Opaque

Database ID	Site Name	Context Notes	Catalogue Number	Total # of beads	Bead Shape	Glass Colors	Glass Color Notes	Opacity
AKC02038	Ban Non Wat	BNW 05/06 F6 2:6 Gen Spit Bag 8714 Cat 19013 22.12.05	19013	1	Earring fragment	Light Blue		Translucent
AKC02039	Ban Non Wat	BNW 05/06 E6 B. 235 4:[1 Cat 17673 Bag 8155	17673	1	Earring fragment	Light Blue	Corroded	Semi-Translucent
AKC02040	Ban Non Wat	BNW 05/06 E7 3:[3 B259 Cat 18066 Bag 8324	18066	1	Large Indo-Pacific Bead	Blue	Corroded	
AKC02041	Ban Non Wat	BNW 05/06 F7 4:3 B 357 Cat 19773 Bag 8953	19773	1	Earring fragment?	Blue	Corroded	
AKC02042	Ban Non Wat	BNW 05/06 F7 6:3 B 357 Cat 19780 Bag 8953	19780	1	Earring fragment?	Blue	Corroded	
AKC02043	Ban Non Wat	BNW 05/06 E6 4:[1 B 235 Cat 17671 Bag 8155	17671	1	Earring fragment?	Blue	Corroded	

Database ID	Site Name	Context Notes	Catalogue Number	Total # of beads	Bead Shape	Glass Colors	Glass Color Notes	Opacity
AKC02044	Ban Non Wat	BNW 05/06 E7 2:7 Bag #8316 Cat 18014	18014	1	Vessel fragment	Dark Blue-Green	Corroded, rainbow-coating?	Translucent
AKC02045	Ban Non Wat	BNW 04/05 AA2 2:S2 Bag 7304 Burial 266 Cat 15506 Necklace	15506	112	Indo-Pacific Bead	Red	Reddish-brown	Opaque
AKC02046	Ban Non Wat	BNW 04/05 AA2 2:S2 Bag 7304 Burial 266 Cat 15506 Necklace	15506	112	Indo-Pacific Bead	Orange	Light orange	Opaque
AKC02047	Ban Non Wat	BNW 04/05 AA2 2:S2 Bag 7304 Burial 266 Cat 15506 Necklace	15506	112	Indo-Pacific Bead	Yellow		Opaque
AKC02048	Ban Non Wat	BNW 04/05 AA2 2:S2 Bag 7304 Burial 266 Cat 15506 Necklace	15506	112	Indo-Pacific Bead	Dark Blue		Semi-Translucent

Database ID	Site Name	Context Notes	Catalogue Number	Total # of beads	Bead Shape	Glass Colors	Glass Color Notes	Opacity
AKC02049	Ban Non Wat	BNW 04/05 AA2 2:S2 Bag 7304 Burial 266 Cat 15506 Necklace	15506	112	Indo-Pacific Bead	Dark Blue		Translucent
AKC02050	Ban Non Wat	BNW 04/05 AA2 2:S2 Bag 7304 Burial 266 Cat 15506 Necklace	15506	112	Indo-Pacific Bead	Light Blue	Turquoise	Translucent
AKC02051	Ban Non Wat	BNW 04/05 AA2 2:S2 Bag 7304 Burial 266 Cat 15506 Necklace	15506	112	Indo-Pacific Bead	White	Milky-white	Semi-Translucent
AKC02052	Ban Non Wat	BNW 04/05 AA2 2:S2 Bag 7304 Burial 266 Cat 15506 Necklace	15506	112	Indo-Pacific Bead	Black		Opaque
AKC02053	Ban Non Wat	BNW 06/07 E4 2:5/6 feature 2 Bag 11009 Cat 24505	24505	16	Coiled bead	Turquoise		Opaque

Database ID	Site Name	Context Notes	Catalogue Number	Total # of beads	Bead Shape	Glass Colors	Glass Color Notes	Opacity
AKC02054	Ban Non Wat	BNW 02 Y1 Bag 34 Cat 18 4.2.02	18	1	Bangle fragment?	Light Blue	Weathering on surface	Semi-Translucent
AKC02055	Ban Non Wat	BNW 02 A4 1:2 Bag 2 Cat 393 4.1.02	393	1	Spherical	Blue-Green		Translucent
AKC02056	Ban Non Wat	BNW Y1 1:S5 Bag 18 Cat 4 1.2.02	4	1	Spherical	White	yellowish clear	Transparent
AKC02057	Ban Non Wat	BNW 02/03 X1 2:10 Bag 1979 Cat 5090 20.2.03	5090	1	Glass Fragment	Dark Blue		Transparent Translucent
AKC02058	Ban Non Wat	BNW 03/04 A3 1:5 Cat 8253	8253	1	Indo-Pacific Bead	Turquoise		Translucent
AKC02059	Ban Non Wat	BNW 02/03 B3 4:6 Bag 1166 Cat 3073 28.12.02	3073	1	Bangle fragment?	Dark Green		Semi-Translucent

Database ID	Site Name	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Thickness	Notes
AKC02001	Noen U-Loke	NA			0	0		Broken
AKC02002	Noen U-Loke	NA			0	0		Broken
AKC02003	Noen U-Loke	R0			1.86		0	
AKC02004	Noen U-Loke	NA			3.36		0	
AKC02005	Noen U-Loke	R0			3.4			
AKC02006	Noen U-Loke	R0			3			other half of AKC02005
AKC02007	Noen U-Loke	R0			2.9			
AKC02008	Noen U-Loke	R0			3.3			
AKC02009	Noen U-Loke	R1			3.52			
AKC02010	Noen U-Loke	NA						
AKC02011	Noen U-Loke	NA						
AKC02012	Noen U-Loke	R3			0	0	0	
AKC02013	Noen U-Loke	R2	1.19		2.32	4.11		
AKC02014	Noen U-Loke	R0	1.74		2.41	3.48		
AKC02015	Noen U-Loke	NA			0	0		
AKC02016	Noen U-Loke	R0			2.93			
AKC02018	Noen U-Loke	NA			0	0		
AKC02019	Noen U-Loke	R2	0		0.8	1.56		
AKC02020	Noen U-Loke	R2	1.27		2.4	4.33		
AKC02021	Noen U-Loke	R2	1.24		2.37	4.71		
AKC02022	Noen U-Loke	R1	0.98		1.98	3.96		
AKC02023	Noen U-Loke	R1	0		1.24	1.68		
AKC02024	Noen U-Loke	R1	0		1.23	1.36		
AKC02025	Noen U-Loke	R1	0		0.97	1.42		
AKC02026	Noen U-Loke	R1	0		0.74	1.6		
AKC02027	Noen U-Loke	R1	0		1.25	1.24		

Database ID	Site Name	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Thickness	Notes
AKC02028	Noen U-Loke	R1	1.15		4.27	2.33		
AKC02029	Noen U-Loke	R3	1.82		4.82	6.21		
AKC02030	Noen U-Loke	R0	2.42		1.89	5.11		
AKC02031	Ban Non Wat	NA	1.73		5.29	5.46		
AKC02032	Ban Non Wat	R3	1.05		5.91	6.66		
AKC02033	Ban Non Wat	NA	2.15		5	10.65		
AKC02034	Ban Non Wat	R2	1.17		2.46	3.71		
AKC02035	Ban Non Wat	R2	1.61		2.45	4.45		
AKC02036	Ban Non Wat	R0	0		1.02	4.5		
AKC02037	Ban Non Wat	R3	0.84		2.36	3.11		
AKC02038	Ban Non Wat	NA			15.55		3.73	
AKC02039	Ban Non Wat	NA					5.78	
AKC02040	Ban Non Wat	NA	0		6.92	8.55		Fragile bead, difficult to measure
AKC02041	Ban Non Wat	NA						Fragile bead, difficult to measure
AKC02042	Ban Non Wat	NA						Fragile bead, difficult to measure
AKC02043	Ban Non Wat	NA						Fragile bead, difficult to measure
AKC02044	Ban Non Wat	NA					3.71138	Fragile bead, difficult to measure
AKC02045	Ban Non Wat	R1	1.33	1.3	7.04	3.55		curved piece of vessel glass.
AKC02046	Ban Non Wat	R2	1.12	1.11	4.42	3.46		
AKC02047	Ban Non Wat	R1	1.42	1.38	4.92	5.09	4.48	
AKC02048	Ban Non Wat	R2	1.05	1.85	3.25	4.85		
AKC02049	Ban Non Wat	R0	1.93	1.96	4.66	4.61		
AKC02050	Ban Non Wat	R1	0.92	0.95	3.45	3.72		
AKC02051	Ban Non Wat	R1	1.72		2.39	4.95		

Database ID	Site Name	Roundness Factor	Interior Perf. A	Interior Perf. B	Max. Length	Max. Width	Thickness	Notes
AKC02052	Ban Non Wat	R1	1.82		2.37	4.73		
AKC02053	Ban Non Wat		1.72	1.76	5.25	5.97		
AKC02054	Ban Non Wat				12.98	8.53	6.16	
AKC02055	Ban Non Wat		3.63	3.77	7	8.6		
AKC02056	Ban Non Wat		2.87	2.87	10.11	11.7		
AKC02057	Ban Non Wat				19.52	16.54	6.25	
AKC02058	Ban Non Wat				22.61	8.31	5.27	
AKC02059	Ban Non Wat				23	12.93	3.65	

Appendix 7.2: LA-ICP-MS data for glass artifacts

Database ID	Site Name	Glass Type	Bead Description	SiO ₂	Na ₂ O	MgO	Al ₂ O ₃	P ₂ O ₃	K ₂ O	CaO
AKC02589	Angkor Borei	m-Na-Al Type 1	Dark blue-green Indo-Pacific bead	65.1%	18.0%	0.4%	9.2%	0.1%	2.8%	2.0%
AKC02519	Angkor Borei	m-Na-Al Type 1	Yellow Indo-Pacific Bead	67.3%	15.2%	0.3%	8.4%	0.1%	1.8%	2.5%
AKC02585	Angkor Borei	Unknown m-Na-Al?	Dark purple Indo-Pacific Bead	74.2%	13.4%	0.4%	5.4%	0.1%	2.5%	1.4%
AKC02584	Angkor Borei	Unknown m-Na-Al?	Dark purple Indo-Pacific Bead	75.0%	12.9%	0.4%	5.0%	0.0%	2.7%	1.4%
AKC02590	Angkor Borei	Unknown m-Na-Al?	Dark purple Indo-Pacific Bead	73.9%	15.6%	0.3%	5.1%	0.0%	1.4%	1.3%
AKC02591	Angkor Borei	Unknown m-Na-Al?	Dark purple Indo-Pacific Bead	71.8%	13.6%	0.3%	8.1%	0.0%	1.6%	1.6%
AKC02587	Angkor Borei	m-Na-Ca-Al	Dark blue Indo-Pacific bead	75.2%	12.0%	0.5%	3.5%	0.2%	1.3%	4.9%
AKC02588	Angkor Borei	m-Na-Ca-Al	Dark blue Indo-Pacific bead	72.8%	9.9%	0.6%	6.2%	0.1%	1.7%	5.7%
AKC02586	Angkor Borei	m-Na-Ca-Al	Dark blue Indo-Pacific bead	75.2%	10.0%	0.6%	4.5%	0.1%	1.4%	5.3%
AKC02594b	Angkor Borei	v-Na-Ca	Dark blue Indo-Pacific bead	68.1%	16.0%	2.5%	2.9%	0.2%	2.3%	6.0%
AKC02595	Angkor Borei	v-Na-Ca	Dark blue Indo-Pacific bead	67.8%	17.2%	2.6%	3.1%	0.1%	1.9%	5.4%
AKC02592	Angkor Borei	v-Na-Ca	Dark blue Indo-Pacific bead	64.3%	14.9%	3.0%	2.0%	0.2%	2.8%	8.2%
AKC02594y	Angkor Borei	Unknown	Cream Indo-Pacific bead	78.9%	0.1%	0.8%	7.8%	2.9%	1.7%	4.3%
AKC02593	Angkor Borei	Unknown/Weathered	Wound yellow faience bead?	56.9%	8.8%	0.1%	13.6%	0.2%	5.2%	2.3%
AKC02596	Angkor Borei	Unknown/Weathered	Weathered large green bead?	70.1%	9.6%	1.2%	4.7%	0.4%	1.7%	2.4%

Database ID	Site Name	Glass Type	Bead Description	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO
AKC02057	Ban Non Wat	m-K-Ca-Al	Blue glass fragment	75.2%	1.4%	0.5%	1.4%	0.3%	14.2%	4.2%
AKC02039	Ban Non Wat	m-K-Ca-Al	Blue earring fragment	82.2%	0.6%	0.3%	1.6%	0.2%	11.8%	1.7%
AKC02043	Ban Non Wat	m-K-Ca-Al	Blue earring fragment	89.2%	0.1%	0.5%	1.9%	0.2%	0.8%	5.4%
AKC02038	Ban Non Wat	m-K-Ca-Al	Blue earring fragment	77.2%	0.8%	0.3%	3.4%	0.2%	13.5%	3.0%
AKC02045	Ban Non Wat	m-Na-Al Type 1	Red Indo-Pacific bead	67.1%	13.0%	0.4%	9.3%	0.1%	2.1%	2.8%
AKC02046	Ban Non Wat	m-Na-Al Type 1	Orange Indo-Pacific bead	55.9%	12.6%	0.8%	12.6%	0.2%	1.9%	3.2%
AKC02047	Ban Non Wat	m-Na-Al Type 1	Yellow Indo-Pacific bead	65.3%	13.9%	0.3%	8.6%	0.0%	2.3%	1.7%
AKC02050	Ban Non Wat	m-Na-Al Type 1	Turquoise Indo-Pacific bead	68.6%	14.1%	0.4%	9.2%	0.0%	2.0%	2.8%
AKC02048	Ban Non Wat	m-Na-Al Type 1	Dark blue Indo-Pacific bead	67.8%	14.3%	0.3%	9.7%	0.0%	2.4%	1.8%
AKC02052	Ban Non Wat	m-Na-Al Type 1	Black Indo-Pacific bead	74.8%	12.0%	0.4%	6.8%	0.0%	1.7%	1.4%
AKC02051	Ban Non Wat	m-Na-Al Type 1	White Indo-Pacific bead	67.1%	14.6%	0.7%	9.6%	0.0%	1.8%	4.4%
AKC02032	Ban Non Wat	m-Na-Al Type 1	Yellow Indo-Pacific bead	63.6%	18.5%	0.3%	7.1%	0.0%	1.5%	2.7%
AKC02034	Ban Non Wat	m-Na-Al Type 1	Blue Indo-Pacific bead	66.9%	18.1%	0.3%	8.4%	0.0%	2.2%	1.8%
AKC02037	Ban Non Wat	m-Na-Al Type 1	Orange Indo-Pacific bead	56.3%	14.2%	1.1%	13.4%	0.2%	2.1%	4.5%
AKC02031	Ban Non Wat	lead glass	Blue coiled bead	54.8%	0.1%	0.1%	0.6%	0.2%	3.6%	4.4%
AKC02033	Ban Non Wat	lead glass	Blue flattened bicone bead	45.7%	1.9%	0.1%	0.2%	0.0%	9.6%	4.8%
AKC02035	Ban Non Wat	lead glass	Yellow Indo-Pacific bead	36.6%	0.2%	0.1%	0.6%	0.0%	8.6%	0.2%

Database ID	Site Name	Glass Type	Bead Description	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO
AKC02053	Ban Non Wat	lead glass	Blue coiled bead	40.0%	2.0%	0.2%	0.2%	0.0%	9.8%	4.2%
AKC02049	Ban Non Wat	m-Na-Ca-Al	Cobalt blue Indo-Pacific bead	72.3%	13.2%	0.4%	5.4%	0.1%	1.0%	4.1%
AKC02054	Ban Non Wat	v-Na-Ca	Blue bangle fragment?	67.0%	16.9%	2.7%	1.4%	0.2%	1.8%	8.4%
AKC02044	Ban Non Wat	v-Na-Ca	Transparent blue-green vessel glass	61.1%	16.8%	3.5%	2.3%	0.4%	2.8%	8.8%
AKC02036	Ban Non Wat	mixed alkali	Orange wrapped bead	56.0%	6.5%	1.9%	6.4%	1.5%	8.6%	2.9%
AKC02055	Ban Non Wat	unknown	Large green glass bead	57.7%	3.5%	5.3%	5.8%	0.1%	9.7%	15.9%
AKC02056	Ban Non Wat	unknown	Large clear glass bead	58.5%	3.9%	5.8%	5.3%	0.0%	6.0%	19.1%
AKC02059	Ban Non Wat	Weathered	Bangle?	87.3%	0.0%	0.4%	1.1%	0.9%	2.3%	3.4%
AKC02058	Ban Non Wat	Weathered	Bangle?	85.0%	0.2%	0.4%	3.8%	0.3%	4.5%	3.6%
AKC00727	Bit Meas	m-K-Ca-Al	Dark blue Indo-Pacific bead	72.5%	0.9%	0.4%	2.0%	0.1%	16.2%	1.9%
AKC00728	Bit Meas	m-K-Al Low C	Blue-Green Info-Pacific bead	73.6%	0.6%	0.3%	3.9%	0.2%	16.8%	0.6%
AKC00729	Bit Meas	m-K-Al Low C	Blue Indo-Pacific bead	76.8%	0.2%	0.3%	3.4%	0.1%	14.9%	0.9%
AKC00650	Bit Meas	m-K-Al Low C	Light Blue Indo-Pacific bead	76.2%	0.8%	0.1%	4.7%	0.1%	16.0%	0.4%
AKC00649	Bit Meas	m-K-Al Low C	Black/Purple Indo-Pacific bead	75.8%	1.0%	0.1%	4.2%	0.1%	15.9%	0.3%
AKC02001	Noen U-Loke	m-Na-Al Type 1	Brown/Black transparent broken bead	65.6%	14.5%	0.8%	9.6%	0.2%	2.0%	4.3%
AKC02002	Noen U-Loke	m-Na-Al Type 1	Yellow opaque broken bead	63.6%	13.5%	0.5%	9.9%	0.1%	1.9%	3.5%
AKC02003	Noen U-Loke	m-Na-Ca-Al	Blue trans broken	73.1%	14.6%	0.3%	3.9%	0.1%	0.8%	5.2%
AKC02004	Noen U-Loke	m-Na-Al Type 1	Transparent grey broken bead	63.5%	18.2%	0.3%	9.5%	0.0%	2.4%	2.4%

Database ID	Site Name	Glass Type	Bead Description	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO
AKC02005	Noen U-Loke	m-Na-Ca-Al	Dark Blue Trans Broken	66.5%	15.9%	0.3%	6.5%	0.0%	1.4%	2.3%
AKC02006	Noen U-Loke	m-K-Al, low CaO or m-K-Ca-Al	Dark blue broken bead	75.2%	0.9%	0.4%	4.4%	0.1%	14.6%	1.0%
AKC02007	Noen U-Loke	m-Na-Ca-Al	Dark Blue Trans Broken	65.7%	18.5%	0.3%	7.3%	0.0%	1.9%	2.5%
AKC02008	Noen U-Loke	m-Na-Al Type 1	Turquoise broken bead	68.1%	16.8%	0.3%	6.8%	0.0%	1.7%	2.1%
AKC02009	Noen U-Loke	m-Na-Al Type 1	Dark blue broken bead	60.5%	19.8%	0.3%	10.2%	0.1%	1.9%	2.4%
AKC02010	Noen U-Loke	m-K-Al, low CaO or m-K-Ca-Al	Dark blue broken bead	79.4%	0.5%	0.2%	3.3%	0.1%	13.3%	0.6%
AKC02012	Noen U-Loke	m-Na-Al Type 1	White trans broken	70.0%	14.2%	0.5%	8.5%	0.0%	2.1%	2.2%
AKC02013	Noen U-Loke	m-Na-Al Type 1	Turquoise bead	67.9%	16.3%	0.4%	7.2%	0.0%	2.4%	2.7%
AKC02014	Noen U-Loke	m-Na-Al Type 1	Transparent blue-green bead	66.5%	17.3%	0.3%	7.0%	0.1%	2.0%	2.3%
AKC02015	Noen U-Loke	m-Na-Ca-Al	Dark Blue Trans Broken	71.6%	11.7%	0.6%	5.0%	0.1%	1.3%	5.9%
AKC02016	Noen U-Loke	m-K-Ca-Al	Dark blue-purple broken bead	75.4%	1.4%	0.5%	1.9%	0.3%	13.8%	2.1%
AKC02019	Noen U-Loke	m-Na-Al Type 1	Opaque yellow bead	60.4%	15.0%	0.5%	11.3%	0.0%	2.0%	3.0%
AKC02020	Noen U-Loke	m-Na-Al Type 1	Turquoise bead	66.3%	15.2%	0.3%	10.3%	0.0%	3.4%	1.9%
AKC02021	Noen U-Loke	m-Na-Al Type 1	Turquoise bead	67.0%	18.3%	0.3%	7.1%	0.0%	1.7%	2.5%
AKC02022	Noen U-Loke	m-Na-Al Type 1	Turquoise bead	72.5%	15.3%	0.3%	6.3%	0.0%	1.3%	1.4%
AKC02023orange	Noen U-Loke	m-Na-Al Type 1	red/orange bead: orange glass	57.3%	12.5%	1.0%	12.6%	0.2%	1.9%	3.9%
AKC02023red	Noen U-Loke	m-Na-Al Type 1	red/orange bead: red glass	64.7%	12.8%	0.9%	12.2%	0.1%	1.9%	3.5%

Database ID	Site Name	Glass Type	Bead Description	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO
AKC020240	Noen U-Loke	m-Na-Al Type 1	red/orange bead: orange glass	56.8%	12.9%	1.0%	13.0%	0.2%	1.7%	4.0%
AKC02024red	Noen U-Loke	m-Na-Al Type 1	red/orange bead: red glass	69.0%	11.8%	0.8%	9.1%	0.1%	1.9%	2.7%
AKC020250	Noen U-Loke	m-Na-Al Type 1	red/orange bead: orange glass	57.6%	12.3%	1.0%	11.8%	0.2%	1.9%	4.0%
AKC02025red	Noen U-Loke	m-Na-Al Type 1	red/orange bead: red glass	64.1%	12.3%	0.9%	12.3%	0.1%	2.1%	3.4%
AKC020260	Noen U-Loke	m-Na-Al Type 1	red/orange bead: orange glass	57.8%	12.7%	0.9%	12.1%	0.2%	1.7%	3.8%
AKC02026red	Noen U-Loke	m-Na-Al Type 1	red/orange bead: red glass	65.7%	11.9%	0.8%	10.9%	0.1%	1.8%	3.9%
AKC020270	Noen U-Loke	m-Na-Al Type 1	red/orange bead: orange glass	57.3%	11.9%	1.0%	12.1%	0.2%	2.0%	4.1%
AKC02027red	Noen U-Loke	m-Na-Al Type 1	red/orange bead: red glass	63.0%	12.1%	0.9%	12.8%	0.1%	2.2%	3.6%
AKC02028	Noen U-Loke	mixed alkali	opaque orange tubular bead	61.7%	5.9%	2.2%	6.8%	1.6%	7.7%	2.5%
AKC02029	Noen U-Loke	m-K-Al, low CaO or m-K-Ca-Al	Dark blue bead	78.3%	0.8%	0.3%	2.8%	0.1%	13.9%	0.8%
AKC02030	Noen U-Loke	mixed alkali	opaque orange disc bead	59.4%	8.2%	2.0%	6.7%	1.6%	7.1%	2.8%
AKC01924	Phnom Borei	m-Na-Al Type 1	Red Indo-Pacific Bead	64.8%	13.8%	1.0%	9.4%	0.1%	2.7%	2.1%
AKC01922	Phnom Borei	m-Na-Al Type 1	Red Indo-Pacific Bead	62.6%	14.8%	0.4%	11.4%	0.1%	1.8%	2.8%
AKC01920	Phnom Borei	m-Na-Al Type 1	Yellow Indo-Pacific Bead	61.1%	16.6%	0.1%	10.8%	0.0%	3.2%	1.4%
AKC01912	Phnom Borei	m-K-Ca Low Al	Dark Blue Indo-Pacific Bead	70.9%	1.0%	0.1%	4.3%	0.2%	20.3%	0.4%
AKC01913	Phnom Borei	m-K-Ca-Al	Dark Blue Turquoise Indo-Pacific Bead	73.8%	0.9%	0.4%	3.2%	0.8%	16.1%	2.2%
AKC01919	Phnom Borei	m-Na-Al Type 1	Orange Indo-Pacific Bead	52.6%	11.1%	1.9%	10.0%	1.2%	3.9%	5.9%

Database ID	Site Name	Glass Type	Bead Description	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO
AKC00224	Phum Snay	m-Na-Al Type 1	Black Indo-Pacific Bead	68.1%	12.1%	0.5%	9.0%	0.1%	2.5%	3.7%
AKC00121	Phum Snay	m-Na-Al Type 1	Yellow Indo-Pacific Bead	64.0%	16.7%	0.3%	8.2%	0.0%	1.9%	2.3%
AKC00105	Phum Snay	m-Na-Al Type 1	Red Indo-Pacific Bead	67.0%	13.1%	0.4%	9.1%	0.1%	1.9%	2.9%
AKC00214	Phum Snay	m-Na-Al Type 1	Red Indo-Pacific Bead	66.8%	13.4%	0.4%	9.1%	0.1%	2.0%	2.9%
AKC00214b	Phum Snay	m-Na-Al Type 1	Light Blue Indo-Pacific bead	69.9%	13.2%	0.4%	8.9%	0.1%	2.2%	2.1%
AKC00090	Phum Snay	m-Na-Al Type 1	Dark Blue Indo-Pacific Bead	65.2%	16.4%	0.2%	10.1%	0.1%	2.6%	1.8%
AKC00080	Phum Snay	m-Na-Al Type 1	Light Green Indo-Pacific Bead	65.9%	15.3%	0.3%	7.0%	0.0%	1.8%	1.6%
AKC00069	Phum Snay	m-Na-Al Type 1	Orange Indo-Pacific Bead	58.0%	12.8%	0.4%	9.3%	0.1%	2.5%	2.3%
AKC00291	Phum Snay	m-Na-Al Type 1	Dark Blue Indo-Pacific Bead	66.2%	17.0%	0.3%	9.3%	0.0%	2.5%	1.7%
AKC00087	Phum Snay	m-Na-Al Type 1	Dark Green Indo-Pacific Bead	63.7%	16.2%	0.9%	8.9%	0.1%	1.6%	3.2%
AKC00081	Phum Snay	m-Na-Al Type 1	Light Green Indo-Pacific Bead	66.4%	13.5%	0.4%	10.5%	0.1%	1.7%	2.7%
AKC00116	Phum Snay	m-Na-Al Type 1	Blue-Green Indo-Pacific bead	67.9%	13.4%	0.5%	9.4%	0.1%	2.1%	2.6%
AKC00115	Phum Snay	m-Na-Al Type 1	Light Blue Indo-Pacific bead	70.0%	12.2%	0.4%	9.3%	0.1%	2.3%	2.1%
AKC00095	Phum Snay	m-Na-Al Type 1	Dark Blue Indo-Pacific Bead	65.1%	17.6%	0.2%	9.4%	0.0%	2.8%	1.8%
AKC00118	Phum Snay	m-Na-Al Type 1	Dark Blue Indo-Pacific Bead	68.9%	16.8%	0.3%	6.9%	0.1%	1.7%	2.2%
AKC00240	Phum Snay	m-Na-Al Type 1	Red Indo-Pacific Bead	61.0%	18.0%	0.5%	10.2%	0.1%	2.5%	3.4%
AKC00245	Phum Snay	m-Na-Al Type 1	Red Indo-Pacific Bead	60.5%	17.6%	0.5%	10.2%	0.1%	2.5%	4.1%
AKC00254red	Phum Snay	m-Na-Al Type 1	Red-orange Indo-Pacific Bead	56.0%	14.8%	0.9%	12.2%	0.2%	2.0%	3.6%
AKC00254orange	Phum Snay	m-Na-Al Type 1	Red-orange Indo-Pacific Bead	54.2%	13.9%	0.9%	12.4%	0.2%	2.0%	3.6%
AKC00284	Phum Snay	m-Na-Al Type 1	Orange Indo-Pacific Bead	56.4%	17.0%	0.8%	11.7%	0.1%	1.9%	3.8%

Database ID	Site Name	Glass Type	Bead Description	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO
AKC00223	Phum Snay	m-Na-Al Type 1	Dark Blue Indo-Pacific Bead	66.7%	14.4%	0.8%	9.3%	0.1%	2.4%	2.4%
AKC00221	Phum Snay	m-Na-Al Type 1	Dark Blue Indo-Pacific Bead	60.1%	22.2%	0.4%	8.2%	0.0%	2.1%	4.1%
AKC00220	Phum Snay	m-Na-Al Type 1	Dark Blue Indo-Pacific Bead	62.2%	20.6%	0.4%	7.8%	0.1%	2.0%	2.0%
AKC00122	Phum Snay	m-Na-Al Type 1	Red Indo-Pacific Bead	66.7%	15.0%	0.5%	9.2%	0.1%	2.7%	2.1%
AKC00278	Phum Snay	m-Na-Al Type 1	Orange Indo-Pacific Bead	53.0%	11.1%	2.0%	7.3%	1.9%	2.3%	7.9%
AKC00277	Phum Snay	m-Na-Al Type 1	Orange Indo-Pacific Bead	52.3%	11.3%	1.7%	7.3%	1.8%	2.2%	8.5%
AKC00057	Phum Snay	m-K-Ca-Al	Turquoise Ring/Earring	76.9%	0.6%	0.2%	4.0%	0.2%	13.3%	1.4%
AKC00058	Phum Snay	m-K-Ca-Al	Turquoise Ring/Earring	76.7%	0.6%	0.2%	4.0%	0.2%	13.5%	1.4%
AKC00059	Phum Snay	m-K-Ca-Al	Dark Blue Ring/Earring	76.8%	0.2%	0.4%	3.6%	0.2%	14.2%	1.3%
AKC00117	Phum Snay	v-Na-Ca	Dark Blue Indo-Pacific Bead	62.9%	18.4%	2.4%	3.9%	0.2%	1.8%	7.2%
AKC01651	Prei Khmeng	m-Na-Al Type 1	Dark blue Indo-Pacific bead	69.8%	17.2%	0.5%	5.2%	0.1%	1.0%	1.1%
AKC01652	Prei Khmeng	m-Na-Al Type 1	Yellow Indo-Pacific Bead	59.7%	15.6%	0.6%	11.3%	0.1%	2.2%	3.2%
AKC01658	Prei Khmeng	m-Na-Al Type 1	Dark blue Indo-Pacific bead	62.7%	18.0%	0.4%	9.4%	0.0%	2.0%	3.8%
AKC01677	Prei Khmeng	m-Na-Al Type 1	Light Green Indo-Pacific Bead	63.6%	14.2%	1.1%	8.6%	0.1%	1.6%	3.6%
AKC01679	Prei Khmeng	m-Na-Al Type 1	Orange Indo-Pacific Bead	55.1%	13.9%	0.9%	11.4%	0.1%	1.8%	3.4%
AKC01685	Prei Khmeng	m-Na-Al Type 1	Orange Indo-Pacific Bead	61.9%	14.8%	0.9%	14.5%	0.2%	3.0%	3.8%
AKC01683	Prei Khmeng	m-Na-Al Type 1	Dark blue Indo-Pacific bead	65.9%	20.2%	0.5%	5.3%	0.1%	1.1%	1.4%
AKC01686	Prei Khmeng	m-Na-Al Type 1	Red Indo-Pacific Bead	63.4%	13.0%	1.0%	15.5%	0.2%	2.3%	3.9%
AKC01688	Prei Khmeng	m-Na-Al Type 1	Light Green Indo-Pacific Bead	72.3%	16.0%	0.3%	7.3%	0.1%	1.6%	1.8%

Database ID	Site Name	Glass Type	Bead Description	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO
AKC01692	Prei Khmeng	m-Na-Al Type 1	Red Indo-Pacific Bead	67.6%	13.8%	0.6%	9.2%	0.1%	2.0%	2.1%
AKC01696	Prei Khmeng	m-Na-Al Type 1	Red Indo-Pacific Bead	67.8%	14.7%	0.7%	10.5%	0.1%	2.3%	3.0%
AKC01697	Prei Khmeng	m-Na-Al Type 1	Yellow Indo-Pacific Bead	59.4%	17.4%	1.0%	10.0%	0.1%	1.3%	2.9%
AKC01699	Prei Khmeng	m-Na-Al Type 1	Dark blue Indo-Pacific bead	64.2%	17.0%	0.4%	8.8%	0.1%	2.0%	3.0%
AKC01702	Prei Khmeng	m-Na-Al Type 1	Dark blue Indo-Pacific bead	64.7%	18.3%	0.5%	7.0%	0.1%	1.5%	4.6%
AKC01722	Prei Khmeng	m-Na-Al Type 1	Dark blue Indo-Pacific bead	61.3%	21.0%	0.4%	8.2%	0.1%	1.7%	4.0%
AKC01724	Prei Khmeng	m-Na-Al Type 1	Light Blue Indo-Pacific bead	63.6%	15.9%	0.5%	10.1%	0.1%	2.2%	4.3%
AKC01726	Prei Khmeng	m-Na-Al Type 1	Red Indo-Pacific Bead	61.6%	15.3%	0.6%	12.8%	0.0%	2.0%	3.5%
AKC01727	Prei Khmeng	m-Na-Al Type 1	Dark blue Indo-Pacific bead	63.2%	14.7%	0.6%	10.3%	0.1%	2.2%	5.0%
AKC01729	Prei Khmeng	m-Na-Al Type 1	Red Indo-Pacific Bead	63.9%	18.0%	0.4%	7.2%	0.0%	1.4%	2.9%
AKC01731	Prei Khmeng	m-Na-Al Type 1	Black Indo-Pacific Bead	61.8%	19.1%	0.8%	9.8%	0.0%	1.5%	2.9%
AKC01731b1a	Prei Khmeng	m-Na-Al Type 1	Blue Indo-Pacific bead	71.0%	12.2%	0.4%	7.0%	0.1%	2.8%	1.8%
AKC01731b1b	Prei Khmeng	m-Na-Al Type 1	Blue Indo-Pacific bead	64.6%	16.0%	0.5%	8.4%	0.1%	1.9%	4.1%
AKC01731b1c	Prei Khmeng	m-Na-Al Type 1	Blue Indo-Pacific bead	66.5%	14.9%	0.6%	11.7%	0.1%	2.0%	3.2%
AKC01731b1d	Prei Khmeng	m-Na-Al Type 1	Blue Indo-Pacific bead	65.7%	16.3%	0.5%	10.2%	0.1%	2.1%	4.3%
AKC01731b1e	Prei Khmeng	m-Na-Al Type 1	Blue Indo-Pacific bead	65.2%	19.4%	0.4%	8.4%	0.1%	1.9%	4.1%
AKC01731green	Prei Khmeng	m-Na-Al Type 1	Green Indo-Pacific bead	65.6%	14.8%	0.6%	12.5%	0.1%	1.9%	2.9%

Database ID	Site Name	Glass Type	Bead Description	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO
AKC01734	Prei Khmeng	m-Na-Al Type 1	Brown Indo-Pacific bead	61.0%	14.3%	0.7%	13.4%	0.1%	1.8%	5.1%
AKC01738	Prei Khmeng	m-Na-Al Type 1	Yellow Indo-Pacific Bead	63.7%	15.9%	0.3%	9.4%	0.0%	2.1%	2.4%
AKC01742	Prei Khmeng	m-Na-Al Type 1	Yellow Indo-Pacific Bead (transparent)	62.7%	14.1%	0.5%	9.8%	0.1%	2.2%	5.5%
AKC01744	Prei Khmeng	m-Na-Al Type 1	Red Indo-Pacific Bead	62.8%	16.4%	0.4%	10.6%	0.1%	2.5%	2.6%
AKC01752	Prei Khmeng	m-Na-Al Type 1	Light Blue-green Indo-Pacific bead	63.6%	17.0%	0.6%	9.2%	0.1%	1.9%	5.0%
AKC01773	Prei Khmeng	m-Na-Al Type 1	Black Indo-Pacific Bead	72.6%	13.6%	0.6%	7.2%	0.1%	1.2%	1.4%
AKC01774	Prei Khmeng	m-Na-Al Type 1	Dark Blue indo-Pacific bead	63.7%	18.9%	0.5%	9.0%	0.1%	1.5%	2.6%
AKC01775	Prei Khmeng	m-Na-Al Type 1	Yellow Indo-Pacific Bead	63.3%	13.6%	0.5%	10.1%	0.1%	2.1%	4.9%
AKC01779	Prei Khmeng	m-Na-Al Type 1	Orange Indo-Pacific Bead	54.6%	14.4%	1.0%	10.8%	0.1%	1.8%	4.0%
AKC01779y	Prei Khmeng	m-Na-Al Type 1	Yellow Indo-Pacific Bead	60.3%	14.0%	1.1%	10.4%	0.1%	1.7%	3.3%
AKC01780	Prei Khmeng	m-Na-Al Type 1	Orange Indo-Pacific Bead	58.9%	14.7%	1.1%	10.8%	0.1%	1.8%	3.4%
AKC01790	Prei Khmeng	m-Na-Al Type 1	Black Indo-Pacific Bead	58.6%	20.8%	0.9%	9.9%	0.0%	1.8%	4.0%
AKC01791	Prei Khmeng	m-Na-Al Type 1	Black Indo-Pacific Bead	66.4%	14.9%	0.5%	10.2%	0.0%	2.4%	2.3%
AKC01808	Prei Khmeng	m-Na-Al Type 1	Dark blue Indo-Pacific bead	65.9%	15.9%	0.3%	8.2%	0.1%	2.3%	3.7%
AKC01695	Prei Khmeng	v-Na-Ca	Dark blue broken bead	64.3%	18.4%	2.7%	2.9%	0.2%	2.1%	6.5%
AKC01700 black	Prei Khmeng	v-Na-Ca	Black flattened bicone with red trim	61.0%	16.1%	4.8%	3.8%	0.2%	3.2%	8.7%
AKC01700red trim	Prei Khmeng	v-Na-Ca	Black flattened bicone with red trim	60.7%	14.4%	4.8%	3.9%	0.2%	3.1%	9.1%

Database ID	Site Name	Glass Type	Bead Description	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO
AKC00443	Prohear	m-Na-Ca- Al	Dark Blue Indo-Pacific Bead	73.2%	11.9%	0.6%	4.8%	0.2%	1.6%	3.4%
AKC00452	Prohear	Lead Glass	Yellow Indo-Pacific Bead	46.8%	0.1%	0.1%	1.6%	0.1%	10.3%	0.2%
AKC00464	Prohear	m-K-Al Low C	Purple Ring/Earring	77.1%	0.3%	0.3%	2.5%	0.3%	13.2%	0.9%
AKC00466	Prohear	m-Na-Ca- Al	Dark Blue Indo-Pacific Bead	71.4%	14.7%	0.4%	5.6%	0.2%	1.7%	1.9%
AKC00473	Prohear	m-K-Ca-Al	Dark Blue Indo-Pacific Bead	72.7%	0.5%	0.3%	2.0%	0.1%	16.2%	1.5%
AKC00485	Prohear	m-K-Ca-Al	Light Blue Indo-Pacific bead	77.6%	0.9%	0.3%	2.2%	0.1%	14.2%	1.8%
AKC00487	Prohear	m-K-Ca-Al	Dark Blue Indo-Pacific Bead	73.2%	0.5%	0.3%	2.0%	0.1%	16.0%	1.5%
AKC00516	Prohear	m-K-Al Low C	Dark Blue Indo-Pacific Bead	78.1%	0.2%	0.1%	3.9%	0.1%	14.7%	0.4%
AKC00541	Prohear	m-K-Al Low C	Dark Blue Indo-Pacific Bead	78.0%	0.2%	0.1%	3.9%	0.1%	14.7%	0.4%
AKC00545	Prohear	m-K-Ca-Al	Dark Blue Indo-Pacific Bead	74.7%	0.2%	0.5%	3.4%	0.2%	15.5%	1.9%
AKC00550	Prohear	Arika Red	Red Indo-Pacific Bead	62.4%	17.6%	1.6%	5.6%	0.8%	1.7%	5.6%
AKC00564	Prohear	m-K-Al Low C	Black Ring Fragment	76.2%	0.3%	0.3%	3.2%	0.2%	14.1%	0.8%
AKC00569	Prohear	m-K-Al Low C	Light Green Indo-Pacific Bead	73.0%	0.7%	0.3%	4.6%	0.1%	16.4%	0.7%
AKC00572	Prohear	m-K-Al Low C	Black Indo-Pacific Bead	73.3%	0.5%	0.2%	3.2%	0.2%	17.5%	0.7%
AKC00573	Prohear	m-K-Al Low C	Dark Blue Indo-Pacific Bead	77.4%	0.4%	0.2%	2.7%	0.1%	15.1%	0.5%
AKC00579	Prohear	m-K-Ca Low Al	Black Ring/Earring	75.8%	1.1%	0.3%	0.9%	0.3%	16.2%	1.6%
AKC00596	Prohear	m-K-Ca-Al	Dark Blue Indo-Pacific Bead	77.4%	0.6%	0.3%	1.7%	0.1%	13.6%	1.2%
AKC00597	Prohear	m-K-Ca-Al	Dark Blue Indo-Pacific Bead	76.5%	0.3%	0.5%	3.0%	0.2%	15.6%	1.7%
AKC00605	Prohear	m-K-Ca-Al	Dark Blue Indo-Pacific Bead	77.7%	1.5%	0.3%	2.2%	0.2%	12.7%	1.8%

Database ID	Site Name	Glass Type	Bead Description	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO
AKC00624	Prohear	m-K-Ca-Al	Dark Blue Indo-Pacific Bead	72.4%	0.5%	0.3%	1.9%	0.1%	17.1%	1.7%
AKC00628	Prohear	Weathered	Blue-Green Ring/Earring	90.5%	0.0%	0.2%	2.2%	0.1%	3.2%	0.8%
AKC00630	Prohear	m-K-Ca-Al	Dark Blue Indo-Pacific Bead	72.3%	0.7%	0.6%	4.2%	0.2%	15.9%	1.6%
AKC00632	Prohear	m-K-Al Low C	Purple Indo-Pacific Bead	75.9%	1.1%	0.1%	4.1%	0.1%	15.8%	0.3%
AKC00633	Prohear	m-K-Al Low C	Purple Indo-Pacific Bead	74.9%	0.8%	0.2%	3.0%	0.2%	16.7%	0.4%
AKC00634	Prohear	m-K-Ca-Al	Dark Blue Ring/Earring	76.4%	0.4%	0.3%	1.5%	0.3%	13.7%	2.3%
AKC00641	Prohear	m-K-Ca-Al	Light Blue bracelet fragment	79.7%	0.8%	0.4%	3.4%	0.3%	9.6%	3.4%
AKC00662	Prohear	m-Na-Ca-Al	Dark Blue Indo-Pacific Bead	68.4%	15.3%	0.5%	6.8%	0.1%	1.3%	2.7%
AKC00672	Prohear	m-K-Al Low C	Purple Indo-Pacific Bead	74.9%	0.8%	0.2%	2.7%	0.2%	16.8%	0.5%
AKC00677	Prohear	m-Na-Ca-Al	Dark Blue Indo-Pacific Bead	68.0%	14.6%	0.4%	8.4%	0.3%	2.0%	2.2%
AKC00683	Prohear	m-Na-Ca-Al	Dark Blue Indo-Pacific Bead	66.8%	16.2%	0.5%	7.3%	0.1%	1.3%	2.8%
AKC00686	Prohear	m-K-Ca-Al	Purple Indo-Pacific Bead	72.5%	0.5%	0.3%	3.2%	0.3%	17.7%	1.0%
AKC00689	Prohear	m-K-Al Low C	Purple Indo-Pacific Bead	74.1%	0.8%	0.2%	2.8%	0.1%	17.0%	0.4%
AKC00726	Prohear	Modern?	White modern bead?	60.2%	17.9%	0.8%	8.6%	0.0%	4.9%	4.7%
AKC0733	Prohear	m-Na-Ca-Al	Dark Blue Indo-Pacific Bead	72.3%	14.6%	0.3%	5.7%	0.2%	1.5%	1.7%
AKC0734	Prohear	m-Na-Ca-Al	Dark Blue Indo-Pacific Bead	67.4%	16.4%	0.3%	7.7%	0.1%	2.1%	2.2%
AKC0735	Prohear	m-Na-Ca-Al	Dark Blue Indo-Pacific Bead	68.1%	14.7%	0.5%	7.6%	0.1%	1.5%	2.7%
AKC0736	Prohear	m-K-Al Low Ca	Green Earring Fragment	78.4%	0.1%	0.1%	2.1%	0.1%	15.6%	0.7%
AKC0737	Prohear	m-K-Al Low Ca	Blue Earring Fragment	69.7%	0.8%	0.2%	5.5%	0.3%	16.8%	0.8%
AKC0738	Prohear	m-K-Ca-Al	Dark Blue Indo-Pacific Bead	74.1%	0.3%	0.3%	1.8%	0.1%	15.6%	1.5%
AKC0739	Prohear	Weathered	Dark Blue Indo-Pacific Bead	89.4%	0.0%	0.6%	2.5%	0.3%	0.1%	1.7%

Database ID	Site Name	Glass Type	Bead Description	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO
AKC0740	Prohear	m-K-Ca-Al	Dark Blue Indo-Pacific Bead	71.4%	0.5%	0.3%	1.8%	0.1%	18.0%	1.3%
AKC0741	Prohear	Weathered	Green Earring Fragment	93.2%	0.0%	0.3%	1.5%	0.3%	0.2%	1.5%
AKC0742	Prohear	m-K-Ca-Al	Dark Blue Indo-Pacific Bead	71.4%	0.4%	0.5%	1.7%	0.2%	18.3%	2.4%
AKC0743	Prohear	m-K-Ca-Al	Dark Blue Indo-Pacific Bead	75.5%	0.5%	0.3%	1.6%	0.1%	15.5%	1.4%
AKC0744	Prohear	m-K-Ca-Al	Dark Blue Indo-Pacific Bead	78.4%	0.3%	0.3%	1.8%	0.1%	12.0%	1.4%
AKC0745	Prohear	m-K-Ca-Al	Dark Blue Indo-Pacific Bead	73.7%	0.5%	0.3%	1.7%	0.1%	17.1%	1.3%
AKC0746	Prohear	m-K-Ca-Al	Dark Blue Indo-Pacific Bead	77.8%	1.0%	0.2%	2.0%	0.1%	14.3%	1.4%
AKC0747	Prohear	Weathered	Brown Bangle Fragment	91.2%	0.0%	0.2%	0.9%	0.4%	0.4%	2.2%
AKC0748	Prohear	m-K-Al Low Ca	Dark blue Indo-Pacific bead	74.6%	0.1%	0.3%	2.9%	0.2%	15.0%	1.0%
AKC0749	Prohear	Arika Red?	Red Indo-Pacific Bead	65.2%	15.3%	1.5%	5.3%	0.8%	2.3%	5.3%
AKC0750	Prohear	Arika Red?	Red Indo-Pacific Bead	64.4%	15.0%	2.0%	3.5%	0.9%	4.7%	5.5%
AKC0751	Prohear	m-K-Ca-Al	Light Blue Bangle Fragment	81.7%	1.9%	0.4%	1.5%	0.3%	9.2%	2.2%
AKC0752	Prohear	m-K-Ca-Al	Green Earring Fragment	81.9%	0.8%	0.3%	3.3%	0.2%	9.5%	2.2%
AKC0753	Prohear	m-K-Al Low Ca	Green Indo-Pacific bead	72.0%	0.2%	0.2%	5.5%	0.1%	17.4%	0.4%
AKC0754	Prohear	Arika Black?	Black Indo-Pacific Bead	66.4%	5.6%	5.1%	4.1%	1.2%	8.2%	5.3%
AKC0755	Prohear	m-K-Ca-Al	Dark Blue Indo-Pacific Bead	71.4%	0.7%	0.3%	1.5%	0.1%	19.1%	1.2%
AKC0756	Prohear	m-K-Al Low Ca	Dark Blue Indo-Pacific Bead	77.7%	0.1%	0.2%	2.6%	0.3%	14.4%	0.6%
AKC0757	Prohear	m-K-Al Low Ca	Black Indo-Pacific Bead	72.3%	0.3%	0.3%	3.6%	0.2%	16.8%	0.8%
AKC0758	Prohear	Weathered	Green Earring Fragment	93.0%	0.0%	0.2%	1.4%	0.2%	1.0%	1.0%
AKC00939	Promtin Tai	m-Na-Ca-Al	Dark blue Indo-Pacific bead	74.1%	12.9%	0.4%	3.2%	0.1%	0.6%	4.7%
AKC01084	Promtin Tai	m-Na-Ca-Al	Dark blue Indo-Pacific bead	73.7%	12.5%	0.4%	3.3%	0.1%	0.6%	4.9%
AKC00912	Promtin Tai	m-Na-Ca-Al	Dark blue Indo-Pacific bead	72.3%	13.3%	0.4%	3.3%	0.1%	0.7%	5.0%

Database ID	Site Name	Glass Type	Bead Description	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO
AKC01073 violet	Promptin Tai	m-K-Al Low Ca	Purple Indo-Pacific Bead	78.4%	0.2%	0.2%	2.2%	0.0%	14.8%	0.4%
AKC01073 blue	Promptin Tai	m-K-Al Low Ca	Blue Indo-Pacific bead	78.3%	0.2%	0.3%	3.3%	0.1%	13.9%	0.9%
AKC01066	Promptin Tai	m-K-Al Low Ca	Dark blue Indo-Pacific bead	77.8%	0.3%	0.3%	3.5%	0.1%	14.3%	0.8%
AKC00909	Promptin Tai	m-K-Al Low Ca	Large clear Indo-Pacific Bead	79.9%	0.3%	0.4%	3.1%	0.2%	14.4%	0.9%
AKC00910	Promptin Tai	m-K-Ca-Al	Large Blue Indo-Pacific bead	79.3%	0.6%	0.3%	2.2%	0.1%	13.5%	1.1%
AKC00959_dkb lue	Promptin Tai	m-K-Ca-Al	Dark blue Indo-Pacific bead	74.2%	0.9%	0.3%	3.8%	0.2%	15.7%	1.1%
AKC00959_red	Promptin Tai	m-Na-Al Type 1	Red Indo-Pacific Bead	67.8%	12.7%	0.5%	8.7%	0.1%	2.7%	3.3%
AKC00959_yell ow	Promptin Tai	m-Na-Al Type 1	Yellow Indo-Pacific Bead	60.8%	14.7%	0.3%	11.9%	0.0%	3.7%	1.7%
AKC00959_turq	Promptin Tai	m-Na-Al Type 1	Light Blue Indo-Pacific bead	69.9%	15.8%	0.4%	7.2%	0.0%	1.7%	2.3%
AKC01071yello w	Promptin Tai	m-Na-Al Type 1	Yellow Indo-Pacific Bead	63.8%	14.5%	0.5%	9.2%	0.4%	2.8%	2.7%
AKC01071blue	Promptin Tai	m-Na-Al Type 1	Light Blue Indo-Pacific bead	63.3%	17.8%	0.2%	11.9%	0.1%	1.8%	2.3%
AKC00959_oran nge	Promptin Tai	m-Na-Al Type 1	Orange Indo-Pacific Bead	51.7%	10.4%	2.9%	8.1%	2.4%	4.3%	5.7%
AKC01057oran ge	Promptin Tai	m-Na-Al Type 1	Orange Indo-Pacific Bead	51.5%	12.6%	2.5%	7.8%	1.6%	3.5%	6.7%
AKC01071oran ge	Promptin Tai	m-Na-Al Type 1	Orange Indo-Pacific Bead	57.5%	9.4%	2.9%	6.3%	2.2%	4.2%	5.3%
AKC01043b	Promptin Tai	m-Na-Al Type 1?	Black and white glass bead- black section	61.9%	15.3%	2.7%	9.6%	0.6%	3.0%	2.8%
AKC01043w	Promptin Tai	Unknown	Black and white glass bead- white section	70.1%	3.7%	0.5%	2.4%	0.7%	1.2%	5.8%
AKC01059b	Promptin Tai	Unknown	Broken black and white bead. Black portion	69.1%	7.4%	1.6%	3.9%	0.5%	7.9%	2.9%
AKC01059w	Promptin Tai	Unknown	Broken black and white bead. White portion	62.5%	9.4%	0.7%	5.0%	0.5%	6.1%	5.1%

Database ID	Site Name	Glass Type	Bead Description	SiO2	Na2O	MgO	Al2O3	P2O3	K2O	CaO
AKC01057gold	Promtin Tai	Natron glass	Gold-in-Glass Bead	66.5%	17.4%	1.2%	2.9%	0.0%	0.6%	9.3%
AKC01093	Promtin Tai	Faience?	Collar Bead	96.1%	0.1%	0.1%	1.3%	0.1%	1.2%	0.5%
AKC00901	Promtin Tai	Weathered	Light Blue ring/earring fragment	91.0%	0.1%	0.4%	1.7%	0.1%	2.8%	2.4%
AKC01022	Promtin Tai	Weathered	Black Tubular Bead	70.0%	0.7%	2.9%	16.6%	0.3%	1.6%	2.3%
AKC00410	Village 10.8	m-K-Ca-Al	Dark blue Indo-Pacific bead	76.7%	0.2%	0.3%	2.7%	0.1%	15.4%	1.1%
AKC00413	Village 10.8	m-K-Ca-Al	Black Indo-Pacific Bead	76.3%	0.2%	0.3%	3.9%	0.2%	14.4%	1.1%
AKC00416	Village 10.8	m-K-Ca-Al	Dark blue Indo-Pacific bead	76.1%	0.1%	0.4%	4.4%	0.2%	12.6%	1.4%
AKC00327	Village 10.8	m-K-Ca-Al	Black Ring	69.4%	0.5%	0.8%	3.9%	0.5%	16.3%	2.3%
AKC00322	Village 10.8	m-K-Ca-Al	Purple Ring	79.7%	0.2%	0.3%	1.2%	0.2%	11.9%	2.3%
AKC00386	Village 10.8	m-K-Al Low Ca	Blue-Green Indo-Pacific bead	77.6%	0.3%	0.2%	1.9%	0.1%	15.5%	0.7%
AKC00412	Village 10.8	m-K-Al Low Ca	Dark Blue Indo-Pacific bead	74.0%	0.2%	0.3%	3.4%	0.2%	18.1%	0.9%
AKC00425a	Village 10.8	m-K-Al Low Ca	Dark Blue Indo-Pacific bead	71.2%	0.4%	0.3%	4.2%	0.2%	18.0%	1.0%
AKC00425b	Village 10.8	m-K-Al Low Ca	Dark Blue Indo-Pacific bead	75.9%	0.1%	0.2%	3.6%	0.2%	17.5%	0.7%
AKC00372	Village 10.8	m-K-Al Low Ca	Dark Blue Indo-Pacific bead	76.3%	0.2%	0.2%	5.6%	0.1%	14.3%	0.6%
AKC00381	Village 10.8	Weathered	Dark Green Indo-Pacific Bead	87.2%	0.0%	0.2%	4.9%	0.8%	0.1%	3.8%
AKC00389	Village 10.8	Weathered	Blue-Green Indo-Pacific bead	90.4%	0.0%	0.2%	0.6%	0.8%	1.0%	4.0%
AKC00376	Village 10.8	Weathered	Dark Blue Indo-Pacific Bead	84.6%	0.0%	0.3%	1.1%	0.6%	5.8%	3.7%
AKC00424g	Village 10.8	Weathered	Green with a White Stripe Bead-Green	85.8%	0.1%	0.4%	1.8%	0.2%	7.2%	1.4%
AKC00424w	Village 10.8	Weathered	White Stripe	88.7%	0.1%	0.4%	2.4%	0.2%	3.6%	1.4%

Database ID	MnO	Fe2O3	CuO	SnO2	PbO2	Li	Be	B	Sc	Ti	V	Cr	Ni	Co
AKC02589	0.1%	0.6%	1.0%	0.2%	0.2%	23.522	0.980	53.727	13.863	5136.438	60.573	89.510	43.255	17.004
AKC02519	0.1%	3.9%	0.0%	0.0%	0.1%	10.374	0.980	20.149	5.494	2504.790	63.485	20.618	8.916	4.272
AKC02585	0.6%	1.3%	0.1%	0.0%	0.0%	11.142	0.764	65.070	5.366	2686.396	49.126	47.492	10.872	5.594
AKC02584	0.7%	1.3%	0.0%	0.0%	0.0%	8.990	0.674	68.402	5.474	2696.570	49.043	54.370	10.156	5.648
AKC02590	0.6%	1.1%	0.0%	0.0%	0.0%	12.833	0.806	82.594	5.609	2010.565	44.695	47.188	9.187	5.398
AKC02591	0.9%	1.6%	0.0%	0.0%	0.0%	12.854	0.925	70.643	6.561	2572.664	56.666	44.380	11.760	7.615
AKC02587	1.1%	0.5%	0.0%	0.0%	0.0%	16.923	1.903	54.746	18.816	807.768	82.685	79.433	77.337	597.249
AKC02588	1.4%	0.5%	0.0%	0.0%	0.0%	16.851	1.600	60.442	16.438	1696.621	62.332	64.702	43.366	320.871
AKC02586	1.2%	0.9%	0.0%	0.0%	0.0%	14.278	1.691	48.900	20.285	1319.558	70.030	101.621	43.848	237.725
AKC02594b	0.1%	0.7%	0.1%	0.0%	0.1%	10.238	1.450	124.845	16.013	1657.522	36.165	116.244	45.355	404.052
AKC02595	0.1%	0.5%	0.2%	0.0%	0.1%	14.882	1.508	130.763	11.326	1783.333	33.114	85.910	41.685	403.790
AKC02592	1.0%	0.4%	1.9%	0.1%	0.2%	13.687	1.177	110.356	14.914	823.774	30.801	100.696	32.096	9.245
AKC02594y	0.2%	2.9%	0.0%	0.0%	0.1%	5.591	7.059	9.918	45.807	1925.449	59.166	394.569	69.010	61.275
AKC02593	0.1%	0.5%	0.0%	1.5%	9.2%	5.016	1.539	6.668	10.107	2168.914	58.177	45.262	13.894	6.811
AKC02596	0.1%	0.7%	0.3%	0.7%	7.0%	9.743	1.455	182.636	16.043	3405.624	144.054	118.389	38.545	13.400
AKC02057	0.0%	0.7%	1.6%	0.0%	0.1%	4.898	7.473	56.579	2.529	478.337	13.588	12.327	50.224	53.754
AKC02039	0.0%	0.5%	0.8%	0.0%	0.0%	3.368	0.321	78.429	1.764	447.078	10.559	6.635	53.037	66.064
AKC02043	0.0%	0.5%	1.1%	0.0%	0.0%	1.577	0.634	97.394	1.527	378.442	16.108	5.133	31.373	23.701
AKC02038	0.0%	0.3%	0.8%	0.0%	0.0%	7.344	0.809	54.953	1.770	360.539	9.887	4.172	21.961	11.167
AKC02045	0.1%	1.8%	2.2%	0.2%	0.4%	8.482	4.994	17.909	4.378	2709.231	69.476	24.541	62.362	18.853
AKC02046	0.1%	2.7%	7.8%	0.3%	1.7%	8.864	3.412	28.480	7.346	2454.196	97.153	52.098	103.456	24.968
AKC02047	0.0%	1.2%	0.1%	1.2%	4.6%	12.176	5.176	26.554	3.751	2437.772	63.486	20.889	9.651	4.636
AKC02050	0.1%	1.5%	0.6%	0.0%	0.1%	7.709	5.650	20.644	4.858	2644.167	61.189	24.759	28.675	7.660
AKC02048	0.0%	0.9%	1.6%	0.2%	0.3%	8.900	4.957	20.688	3.476	2083.178	70.180	20.380	38.242	12.277
AKC02052	0.1%	2.1%	0.0%	0.0%	0.0%	9.491	6.705	24.883	4.859	8276.726	65.065	44.364	9.622	8.499
AKC02051	0.1%	1.3%	0.0%	0.0%	0.0%	7.069	6.008	27.173	4.912	2531.752	79.106	20.837	7.698	3.754

Database ID	MnO	Fe2O3	CuO	SnO2	PbO2	Li	Be	B	Sc	Ti	V	Cr	Ni	Co
AKC02032	0.1%	2.6%	0.1%	0.3%	2.3%	8.545	0.643	34.873	6.755	1715.126	73.282	34.995	9.377	5.606
AKC02034	0.0%	1.1%	0.5%	0.0%	0.1%	12.415	0.829	34.356	3.036	2022.825	84.729	27.718	15.912	6.041
AKC02037	0.1%	3.8%	3.7%	0.0%	0.0%	14.469	1.071	46.160	8.542	2504.950	145.451	63.767	56.644	30.850
AKC02031	0.0%	0.6%	1.0%	0.1%	33.9%	4.463	0.310	5.330	0.849	125.972	12.799	7.481	33.612	2.043
AKC02033	0.0%	0.2%	0.9%	0.1%	35.9%	5.673	0.222	2.395	0.522	46.070	2.480	0.845	15.777	1.332
AKC02035	0.0%	0.3%	0.1%	3.5%	49.5%	27.189	0.488	1.767	0.420	34.295	3.897	0.545	10.105	1.399
AKC02053	0.0%	0.2%	0.8%	0.0%	42.1%	5.314	3.543	1.557	0.914	50.846	2.798	4.749	22.021	1.150
AKC02049	1.3%	1.4%	0.0%	0.0%	0.0%	13.350	12.645	74.951	6.037	1249.514	101.626	14.368	82.296	594.804
AKC02054	0.2%	0.5%	0.1%	0.0%	0.1%	11.673	8.034	98.993	2.815	307.895	9.680	27.700	29.477	129.308
AKC02044	3.0%	0.8%	0.0%	0.0%	0.0%	11.919	0.672	96.334	2.990	797.163	22.645	75.219	19.776	186.103
AKC02036	0.4%	4.7%	10.3%	0.1%	0.1%	24.312	1.364	37.981	5.573	1212.907	42.592	24.878	212.756	148.795
AKC02055	0.0%	0.6%	0.7%	0.1%	0.1%	23.026	6.829	17.889	3.170	1139.908	17.143	16.209	15.814	7.280
AKC02056	0.0%	0.4%	0.0%	0.0%	0.0%	15.160	7.281	13.578	3.133	1206.039	22.583	11.614	7.226	1.491
AKC02059	2.4%	1.0%	0.9%	0.0%	0.0%	2.786	5.729	39.500	3.821	704.867	55.036	10.115	63.738	107.143
AKC02058	0.0%	0.6%	1.1%	0.0%	0.0%	6.648	0.000	75.931	3.669	609.635	12.963	5.334	28.159	25.821
AKC00727	2.4%	2.4%	0.3%	0.0%	0.1%	22.308	0.877	85.626	9.194	737.218	114.600	24.264	121.188	891.083
AKC00728	0.1%	0.8%	2.2%	0.3%	0.4%	27.202	1.187	113.061	3.200	603.155	28.513	15.567	22.373	13.413
AKC00729	1.0%	1.5%	0.1%	0.0%	0.0%	22.342	0.869	89.182	4.113	551.525	44.771	11.125	55.515	358.797
AKC00650	0.8%	0.9%	0.0%	0.0%	0.0%	12.755	1.038	65.247	4.542	507.733	32.257	15.689	23.416	136.839
AKC00649	1.3%	1.0%	0.0%	0.0%	0.0%	12.624	1.110	60.602	4.549	520.724	36.367	12.269	27.830	191.931
AKC02001	0.1%	1.9%	0.1%	0.0%	0.1%	8.297	1.411	30.103	4.368	3057.818	67.422	31.146	13.399	5.969
AKC02002	0.1%	1.6%	0.0%	0.6%	4.1%	11.437	1.860	16.849	3.993	3026.789	63.043	24.354	8.209	4.732
AKC02003	0.4%	0.5%	0.0%	0.0%	0.0%	10.592	0.910	82.316	1.866	725.378	52.657	7.471	51.490	267.436
AKC02004	0.3%	1.5%	0.7%	0.0%	0.2%	11.168	1.268	21.808	2.865	3542.947	58.465	27.013	17.595	8.548
AKC02005	0.5%	1.2%	0.9%	0.7%	3.3%	11.945	1.317	15.582	3.182	2617.575	63.906	17.724	30.499	233.837

Database ID	MnO	Fe2O3	CuO	SnO2	PbO2	Li	Be	B	Sc	Ti	V	Cr	Ni	Co
AKC02006	1.4%	1.3%	0.1%	0.0%	0.2%	24.045	1.032	95.473	4.932	1058.621	45.121	15.114	46.920	275.250
AKC02007	0.7%	1.2%	0.8%	0.2%	0.5%	12.780	1.452	22.304	3.040	2603.980	68.630	17.933	24.437	157.112
AKC02008	0.1%	1.1%	1.9%	0.2%	0.5%	8.508	1.085	22.605	3.078	2493.334	63.341	18.542	10.153	6.279
AKC02009	0.1%	1.1%	1.6%	0.3%	0.6%	18.018	1.625	51.444	2.646	2649.856	77.311	13.085	20.892	10.518
AKC02010	1.1%	1.3%	0.1%	0.0%	0.0%	17.139	1.867	98.823	3.789	794.586	54.879	9.016	47.188	406.198
AKC02012	0.1%	1.8%	0.0%	0.0%	0.0%	9.247	1.177	20.866	3.686	6023.706	63.661	47.440	8.887	6.566
AKC02013	0.2%	1.4%	0.9%	0.1%	0.1%	11.581	2.707	23.369	4.840	2627.328	66.410	26.807	17.068	7.121
AKC02014	0.1%	1.3%	2.1%	0.3%	0.5%	9.153	1.930	17.613	3.745	2733.337	66.695	21.504	21.953	8.423
AKC02015	1.4%	1.2%	0.1%	0.0%	0.0%	25.897	2.508	75.074	5.777	1669.527	55.276	12.434	111.795	676.828
AKC02016	2.6%	1.6%	0.0%	0.0%	0.0%	12.859	4.338	127.889	9.004	714.109	79.651	14.406	108.324	641.699
AKC02019	0.0%	1.1%	0.0%	1.3%	4.9%	10.279	0.899	24.298	4.046	1544.013	89.727	11.520	7.800	3.270
AKC02020	0.0%	0.8%	0.9%	0.1%	0.1%	18.701	1.619	28.483	2.201	2003.515	67.546	10.560	11.056	3.723
AKC02021	0.2%	1.3%	0.9%	0.1%	0.1%	10.404	1.308	23.358	3.421	2449.403	62.329	12.809	16.291	5.827
AKC02022	0.3%	1.0%	1.0%	0.0%	0.0%	14.554	1.144	110.133	2.862	2482.368	45.098	24.997	10.516	4.792
AKC02023o	0.1%	2.8%	4.6%	0.5%	2.3%	10.622	1.316	44.483	7.156	2535.456	99.651	49.778	125.634	23.405
AKC02023re	0.1%	2.4%	0.8%	0.0%	0.2%	11.916	1.217	53.736	6.741	2630.081	90.083	46.176	20.065	9.331
AKC02024or	0.1%	2.9%	4.4%	0.7%	1.9%	12.501	1.280	44.632	7.606	2613.117	101.556	47.476	106.822	24.926
AKC02024r	0.1%	2.2%	1.3%	0.1%	0.4%	12.529	0.943	93.760	5.305	3269.308	81.376	45.842	37.686	12.861
AKC02025o	0.1%	2.8%	5.0%	0.5%	2.4%	12.182	1.156	43.159	7.216	2475.323	96.134	46.097	132.342	26.890
AKC02025r	0.1%	2.6%	1.6%	0.1%	0.2%	12.292	1.177	51.308	6.953	2614.377	96.610	47.928	39.317	10.968
AKC02026o	0.1%	2.7%	4.7%	0.7%	2.3%	11.704	1.068	35.994	7.398	2701.964	102.975	48.560	98.504	30.737
AKC02026r	0.1%	2.5%	1.6%	0.1%	0.2%	10.730	0.827	46.491	6.857	2830.547	120.616	51.510	39.636	11.281
AKC02027or	0.1%	2.7%	5.0%	0.6%	2.5%	12.326	1.273	42.108	7.382	2546.940	97.091	47.916	132.443	26.450
AKC02027re	0.1%	2.8%	1.7%	0.1%	0.2%	11.613	1.140	50.953	7.581	2794.005	101.112	50.205	40.430	11.636
AKC02028	0.4%	3.5%	7.2%	0.2%	0.1%	29.350	1.892	43.700	5.772	1370.701	42.549	16.469	183.371	87.367
AKC02029	1.3%	1.2%	0.2%	0.0%	0.1%	19.837	1.288	85.798	3.876	741.939	51.097	1.612	65.696	409.884

Database ID	MnO	Fe2O3	CuO	SnO2	PbO2	Li	Be	B	Sc	Ti	V	Cr	Ni	Co
AKC02030	0.5%	3.7%	7.2%	0.2%	0.1%	27.480	1.510	49.938	5.845	1409.911	44.336	18.066	157.224	84.809
AKC01924	0.2%	2.1%	1.8%	0.1%	0.1%	13.881	1.160	101.063	5.483	2739.587	54.528	58.563	54.856	26.963
AKC01922	0.1%	1.5%	1.6%	0.2%	0.5%	14.539	1.585	51.757	3.844	2028.454	57.145	17.909	28.388	9.572
AKC01920	0.0%	0.8%	0.0%	0.3%	2.5%	10.194	1.477	29.158	1.584	1354.887	43.221	6.182	3.961	1.748
AKC01912	0.0%	0.5%	1.7%	0.1%	0.3%	7.062	1.467	27.031	3.340	617.102	16.904	17.378	18.638	2.163
AKC01913	0.7%	1.3%	0.2%	0.0%	0.0%	19.929	1.261	27.824	4.535	1011.454	41.057	13.065	49.112	262.927
AKC01919	0.2%	2.9%	5.7%	0.9%	2.2%	12.879	1.786	54.457	5.274	1828.584	52.711	22.685	89.286	17.637
AKC00224	0.4%	2.2%	0.6%	0.1%	0.1%	11.069	1.043	24.863	5.301	2237.539	85.459	28.630	55.860	16.334
AKC00121	0.1%	1.8%	0.0%	0.6%	3.3%	9.243	0.999	21.855	3.765	1835.427	61.900	26.849	7.280	4.592
AKC00105	0.1%	2.3%	1.8%	0.3%	0.5%	9.160	1.198	18.282	4.765	1880.200	64.572	34.517	36.926	11.168
AKC00214	0.1%	2.2%	1.8%	0.3%	0.4%	8.808	1.252	20.196	4.656	1878.430	64.835	31.515	40.689	11.250
AKC00214b	0.1%	1.6%	0.7%	0.2%	0.1%	10.758	1.075	23.166	3.886	1986.813	65.658	27.376	35.118	7.653
AKC00090	0.0%	0.9%	1.3%	0.2%	0.1%	14.450	1.602	39.551	2.110	1395.366	75.698	16.704	20.338	6.958
AKC00080	0.1%	1.3%	0.9%	1.1%	4.0%	14.274	1.034	57.437	3.479	1752.610	45.474	45.942	24.051	7.522
AKC00069	0.1%	1.9%	11.1%	0.1%	0.7%	10.690	0.923	21.573	3.834	3545.176	52.871	41.109	142.748	17.013
AKC00291	0.2%	0.9%	0.9%	0.1%	0.1%	13.518	1.262	72.008	2.005	1121.218	41.358	35.753	13.664	4.743
AKC00087	0.1%	2.8%	0.7%	0.2%	0.8%	13.788	1.363	69.151	7.542	1918.292	113.767	61.480	48.855	22.619
AKC00081	0.1%	1.7%	0.6%	0.3%	1.2%	11.227	1.195	22.382	4.385	2412.220	63.553	33.631	15.918	6.122
AKC00116	0.1%	2.0%	1.0%	0.1%	0.2%	10.103	1.019	24.101	4.284	3406.878	71.809	41.613	23.961	9.661
AKC00115	0.1%	2.0%	0.7%	0.2%	0.3%	14.269	1.389	24.033	4.286	2176.762	67.619	30.968	45.004	8.581
AKC00095	0.3%	0.9%	1.0%	0.0%	0.0%	12.901	1.389	29.737	2.148	1340.178	82.086	21.969	6.887	3.709
AKC00118	0.5%	1.2%	0.8%	0.0%	0.0%	11.045	0.800	20.921	2.825	1526.005	67.029	18.367	36.898	16.921
AKC00240	0.1%	1.9%	1.3%	0.0%	0.0%	10.751	1.143	19.928	4.668	1912.703	90.375	27.796	15.649	9.052
AKC00245	0.1%	2.0%	1.3%	0.0%	0.1%	10.990	0.971	27.184	4.311	1887.891	95.474	31.805	13.628	9.001
AKC00254red	0.1%	3.2%	4.4%	0.3%	1.5%	9.677	1.035	48.409	7.613	1784.088	118.657	60.532	434.536	43.376
AKC00254orange	0.1%	3.3%	6.7%	0.4%	1.6%	8.078	1.317	42.286	7.838	1808.942	124.539	62.028	446.747	44.962

Database ID	MnO	Fe2O3	CuO	SnO2	PbO2	Li	Be	B	Sc	Ti	V	Cr	Ni	Co
AKC00284	0.1%	3.7%	3.6%	0.0%	0.0%	12.828	1.246	37.871	6.876	1511.330	182.449	47.972	133.484	39.267
AKC00223	0.1%	1.8%	0.9%	0.1%	0.2%	13.018	0.994	106.212	4.167	2694.654	74.344	19.078	32.038	8.040
AKC00221	0.1%	1.2%	0.9%	0.0%	0.0%	8.611	0.799	25.819	3.472	1772.897	103.581	26.371	9.862	3.513
AKC00220	0.3%	1.7%	1.7%	0.1%	0.1%	14.139	1.050	49.448	4.079	2809.382	58.908	44.831	22.091	9.721
AKC00122	0.1%	1.2%	1.5%	0.1%	0.3%	10.287	1.819	38.807	3.440	1636.425	61.671	30.032	19.239	5.107
AKC00278	0.3%	2.2%	8.0%	1.4%	1.5%	14.618	1.267	160.081	7.564	2125.838	64.846	65.327	134.277	33.291
AKC00277	0.3%	3.4%	7.2%	1.3%	1.9%	17.045	0.962	159.074	8.152	2142.095	61.385	69.386	258.797	33.503
AKC00057	0.2%	0.7%	2.3%	0.1%	0.0%	9.725	0.937	60.707	1.624	215.827	12.590	6.701	12.096	6.466
AKC00058	0.2%	0.7%	2.2%	0.1%	0.0%	9.349	1.114	59.900	1.468	245.501	12.426	6.053	11.373	6.227
AKC00059	1.3%	1.4%	0.1%	0.0%	0.0%	29.371	0.961	98.165	5.407	690.350	65.396	13.333	76.659	522.386
AKC00117	0.2%	2.0%	0.1%	0.0%	0.1%	19.138	0.729	100.808	3.249	987.303	32.383	54.343	62.679	399.098
AKC01651	0.6%	2.2%	1.1%	0.0%	0.1%	13.000	1.000	138.000	5.000	4136.000	76.000	36.000	44.000	22.210
AKC01652	0.1%	2.6%	0.0%	0.7%	3.5%	11.000	2.000	56.000	7.000	3810.000	193.000	44.000	18.000	7.940
AKC01658	0.1%	1.6%	1.3%	0.0%	0.0%	10.000	1.000	27.000	5.000	3182.000	99.000	30.000	16.000	8.740
AKC01677	0.1%	3.0%	0.9%	0.5%	2.0%	14.000	1.000	64.000	9.000	2755.000	138.000	40.000	67.000	24.450
AKC01679	0.1%	6.0%	6.5%	0.0%	0.0%	10.970	1.310	57.630	7.420	2931.560	87.580	58.530	530.770	483.790
AKC01685	0.1%	0.2%	0.0%	0.0%	0.0%	14.000	1.000	48.000	9.000	3281.000	169.000	57.000	93.000	26.900
AKC01683	0.6%	2.1%	1.4%	0.1%	0.4%	16.980	0.990	149.420	5.180	3319.320	99.160	66.390	47.610	29.830
AKC01686	0.1%	0.1%	0.0%	0.0%	0.0%	9.000	2.000	42.000	9.000	3479.000	108.000	70.000	501.000	25.940
AKC01688	0.0%	0.0%	0.0%	0.0%	0.0%	11.000	2.000	72.000	4.000	3785.000	50.000	45.000	19.000	5.460
AKC01692	0.1%	2.4%	0.9%	0.1%	0.4%	12.000	1.000	74.000	6.000	3207.000	79.000	57.000	113.000	35.460
AKC01696	0.0%	0.1%	0.0%	0.0%	0.0%	12.000	1.000	60.000	6.000	3287.000	89.000	43.000	72.000	10.250
AKC01697	0.1%	3.1%	0.0%	0.5%	3.3%	14.000	1.000	62.000	10.000	3521.000	107.000	48.000	28.000	11.540
AKC01699	0.6%	1.8%	1.5%	0.0%	0.1%	11.000	1.000	29.000	5.000	2718.000	80.000	30.000	19.000	11.570
AKC01702	0.4%	1.2%	1.3%	0.0%	0.0%	11.950	1.270	27.900	3.630	1651.840	128.380	27.400	16.760	11.020
AKC01722	0.4%	1.3%	1.0%	0.0%	0.0%	8.000	1.000	26.000	4.000	2230.000	133.000	36.000	16.000	10.590

Database ID	MnO	Fe2O3	CuO	SnO2	PbO2	Li	Be	B	Sc	Ti	V	Cr	Ni	Co
AKC01724	0.1%	1.9%	0.6%	0.0%	0.0%	11.000	1.000	30.000	5.000	3377.000	104.000	34.000	13.000	9.030
AKC01726	0.1%	2.0%	1.2%	0.0%	0.0%	13.000	1.000	19.000	4.000	3960.000	99.000	33.000	17.000	10.920
AKC01727	0.3%	1.5%	1.5%	0.0%	0.0%	15.000	1.000	33.000	5.000	2155.000	129.000	26.000	18.000	13.040
AKC01729	0.1%	2.5%	1.7%	0.4%	0.3%	8.290	0.770	53.600	10.920	1967.650	75.860	53.550	161.890	31.010
AKC01731	0.1%	2.5%	0.0%	0.0%	0.0%	14.000	1.000	55.000	8.000	2836.000	122.000	69.000	21.000	8.850
AKC01731bla	0.4%	2.0%	1.3%	0.0%	0.0%	14.000	2.000	53.000	4.000	4260.000	94.000	37.000	23.000	10.790
AKC01731blb	0.6%	2.0%	1.3%	0.0%	0.0%	12.000	1.000	34.000	6.000	2596.000	93.000	43.000	19.000	11.060
AKC01731blc	0.1%	0.1%	0.0%	0.0%	0.0%	13.000	1.000	27.000	7.000	3344.000	105.000	19.000	23.000	16.040
AKC01731blid	0.0%	0.1%	0.0%	0.0%	0.0%	11.000	1.000	25.000	5.000	3326.000	100.000	28.000	12.000	8.810
AKC01731ble	0.0%	0.1%	0.0%	0.0%	0.0%	8.000	1.000	27.000	4.000	2292.000	132.000	30.000	16.000	10.620
AKC01731green	0.1%	0.1%	0.0%	0.0%	0.0%	12.000	2.000	27.000	7.000	3464.000	105.000	30.000	23.000	16.310
AKC01734	0.5%	2.4%	0.1%	0.0%	0.1%	12.000	2.000	20.000	6.000	3080.000	109.000	34.000	15.000	8.470
AKC01738	0.1%	1.3%	0.0%	0.8%	3.2%	9.000	1.000	21.000	4.000	2889.000	63.000	24.000	6.000	3.440
AKC01742	0.1%	4.3%	0.0%	0.0%	0.0%	10.000	1.000	23.000	4.000	2920.000	85.000	36.000	9.000	5.310
AKC01744	0.1%	2.0%	1.5%	0.0%	0.0%	13.000	1.000	26.000	5.000	3417.000	68.000	35.000	13.000	7.060
AKC01752	0.1%	1.4%	0.3%	0.0%	0.0%	10.000	1.000	26.000	4.000	2945.000	103.000	26.000	9.000	5.460
AKC01773	0.1%	2.3%	0.0%	0.0%	0.0%	13.000	1.000	113.000	6.000	4136.000	69.000	68.000	23.000	12.370
AKC01774	0.3%	1.7%	1.1%	0.0%	0.0%	11.000	1.000	42.000	5.000	1820.000	197.000	34.000	62.000	16.570
AKC01775	0.1%	4.5%	0.0%	0.0%	0.0%	9.000	1.000	23.000	4.000	2968.000	86.000	24.000	10.000	5.450
AKC01779	0.1%	5.7%	6.8%	0.1%	0.0%	12.440	1.500	49.810	7.490	2911.600	124.900	57.880	132.560	182.120
AKC01779y	0.1%	3.8%	3.2%	0.2%	1.1%	14.310	0.970	64.490	8.940	3466.480	102.600	76.600	128.700	53.330
AKC01780	0.1%	4.1%	3.3%	0.1%	0.9%	13.690	1.720	61.920	9.280	3308.520	126.780	66.460	176.230	92.980
AKC01790	0.1%	2.4%	0.0%	0.0%	0.0%	19.670	1.670	55.690	8.840	2773.410	113.800	65.610	18.190	8.180
AKC01791	0.1%	2.3%	0.0%	0.0%	0.0%	12.960	1.530	32.180	5.660	6690.240	69.530	51.230	11.100	10.370
AKC01808	0.3%	1.4%	1.3%	0.0%	0.0%	7.510	1.210	24.650	3.850	2553.460	119.840	25.410	21.680	18.100
AKC01695	0.1%	1.6%	0.1%	0.0%	0.1%	7.515	1.046	145.909	3.791	2025.588	30.406	61.739	38.150	393.308
AKC01700black	0.0%	1.0%	0.3%	0.0%	0.0%	18.162	0.709	102.448	2.861	964.522	18.752	160.052	27.379	6.955

Database ID	MnO	Fe2O3	CuO	SnO2	PbO2	Li	Be	B	Sc	Ti	V	Cr	Ni	Co
AKC01700 red trim	0.0%	1.0%	2.0%	0.0%	0.0%	17.790	0.598	107.492	2.852	975.430	18.633	159.877	22.310	4.137
AKC00443	1.6%	1.7%	0.1%	0.0%	0.0%	16.862	1.305	46.002	5.472	549.252	288.163	31.011	57.041	496.815
AKC00452	0.1%	0.9%	0.0%	9.6%	30.0%	10.024	0.951	46.713	1.840	223.862	17.168	8.978	12.507	6.262
AKC00464	3.2%	1.2%	0.6%	0.0%	0.1%	31.724	0.764	77.642	2.912	360.285	24.503	12.043	31.948	91.682
AKC00466	1.3%	1.6%	0.1%	0.0%	0.0%	14.692	1.246	30.018	4.605	634.496	173.525	18.572	59.349	557.221
AKC00473	3.3%	2.7%	0.1%	0.0%	0.0%	20.626	1.314	87.057	12.683	831.437	160.157	31.714	131.929	1115.75 ₈
AKC00485	1.2%	1.4%	0.0%	0.0%	0.0%	13.572	0.910	70.513	4.342	358.272	81.819	15.646	74.299	547.931
AKC00487	3.1%	2.7%	0.1%	0.0%	0.0%	19.624	0.579	92.004	11.336	770.688	151.567	29.387	135.968	1119.59 ₅
AKC00516	1.2%	1.1%	0.1%	0.0%	0.0%	16.852	1.508	68.852	3.328	494.210	49.498	9.958	65.832	426.286
AKC00541	1.2%	1.1%	0.1%	0.0%	0.0%	14.957	1.235	71.148	3.287	493.868	50.283	10.722	68.261	441.695
AKC00545	1.3%	1.4%	0.6%	0.0%	0.0%	33.946	1.157	80.872	4.434	471.514	50.376	13.347	50.851	385.895
AKC00550	0.2%	1.4%	1.5%	0.0%	0.0%	6.237	0.584	46.402	3.869	684.442	151.255	31.293	31.311	36.079
AKC00564	3.3%	1.1%	0.2%	0.0%	0.1%	32.871	0.865	89.874	2.614	349.230	29.303	11.628	12.467	59.525
AKC00569	0.0%	2.0%	1.8%	0.0%	0.0%	24.992	1.111	91.690	4.023	729.563	30.432	20.046	21.457	8.515
AKC00572	3.2%	0.9%	0.0%	0.0%	0.1%	13.466	1.057	82.260	2.852	415.830	24.656	15.688	9.383	30.279
AKC00573	1.3%	2.0%	0.0%	0.0%	0.0%	50.213	1.142	102.446	5.633	446.767	64.463	15.737	64.081	486.775
AKC00579	2.4%	0.9%	0.0%	0.0%	0.0%	19.414	1.456	57.376	2.229	355.292	32.233	7.802	8.875	52.262
AKC00596	2.5%	2.0%	0.0%	0.0%	0.0%	15.820	1.440	83.854	7.414	463.848	117.977	19.016	126.123	970.605
AKC00597	0.7%	1.0%	0.2%	0.0%	0.0%	26.699	1.031	64.927	3.377	422.672	31.413	11.852	24.644	153.718
AKC00605	1.9%	1.6%	0.0%	0.0%	0.0%	12.899	1.140	84.113	6.410	448.138	83.286	15.809	92.093	656.986
AKC00624	2.9%	2.4%	0.1%	0.0%	0.0%	20.529	1.528	87.045	9.668	577.943	128.130	21.523	150.467	1157.72 ₁
AKC00628	0.0%	0.3%	2.4%	0.0%	0.0%	5.968	0.659	88.589	1.439	186.797	9.635	6.164	4.669	2.000
AKC00630	1.2%	1.5%	0.3%	0.3%	1.0%	26.721	1.294	85.491	5.776	755.729	52.784	22.319	40.146	247.921
AKC00632	1.3%	1.0%	0.0%	0.0%	0.0%	15.020	0.889	58.841	4.482	524.506	36.403	13.548	27.231	188.591
AKC00633	2.9%	0.9%	0.0%	0.0%	0.0%	36.657	0.716	121.497	2.118	361.574	20.834	9.598	7.284	24.267

Database ID	MnO	Fe2O3	CuO	SnO2	PbO2	Li	Be	B	Sc	Ti	V	Cr	Ni	Co
AKC00634	1.6%	0.8%	2.4%	0.0%	0.0%	3.747	1.070	31.141	2.671	152.349	13.041	5.296	26.737	62.066
AKC00641	0.1%	0.7%	1.1%	0.0%	0.0%	7.380	1.410	68.055	1.697	314.160	14.517	7.486	26.299	29.228
AKC00662	1.3%	2.3%	0.0%	0.0%	0.0%	11.176	1.001	28.711	7.599	827.126	138.807	23.492	64.506	543.478
AKC00672	2.9%	0.8%	0.0%	0.0%	0.0%	35.105	1.447	111.941	2.004	298.412	19.804	7.428	5.590	25.852
AKC00677	1.2%	1.7%	0.1%	0.0%	0.0%	13.321	1.028	26.833	6.503	633.755	157.886	25.406	55.905	478.970
AKC00683	1.3%	2.3%	0.0%	0.0%	0.0%	12.525	0.872	30.286	7.795	863.559	144.334	25.114	62.378	536.841
AKC00686	3.3%	0.8%	0.0%	0.0%	0.0%	12.652	0.725	81.202	2.765	424.569	24.350	13.231	10.423	29.312
AKC00689	3.0%	0.8%	0.0%	0.1%	0.4%	35.189	1.025	115.619	2.140	318.517	21.095	8.426	5.763	26.092
AKC00726	0.0%	0.1%	0.0%	0.0%	0.0%	9.999	0.514	5045.07 6	0.496	42.104	2.054	3.337	1.643	0.163
AKC0733	1.3%	1.5%	0.1%	0.0%	0.0%	12.307	1.317	23.004	5.186	824.228	169.186	18.370	55.818	542.226
AKC0734	1.4%	1.4%	0.0%	0.0%	0.0%	8.848	1.338	20.776	5.860	663.633	153.214	15.665	57.515	500.584
AKC0735	1.5%	2.2%	0.1%	0.0%	0.0%	11.000	1.000	28.000	8.000	1462.000	138.000	27.000	64.000	525.340
AKC0736	0.0%	0.3%	2.4%	0.0%	0.0%	6.000	0.000	88.000	3.000	149.000	7.000	5.000	4.000	0.800
AKC0737	4.2%	1.1%	0.1%	0.0%	0.0%	21.000	2.000	23.000	2.000	342.000	25.000	9.000	23.000	141.040
AKC0738	3.4%	2.4%	0.0%	0.0%	0.0%	11.000	2.000	100.000	9.000	907.000	130.000	21.000	163.000	1233.58 0
AKC0739	3.9%	0.9%	0.1%	0.0%	0.0%	2.000	1.000	103.000	3.000	627.000	21.000	31.000	19.000	33.900
AKC0740	3.7%	2.3%	0.1%	0.0%	0.0%	25.000	1.000	106.000	11.000	1172.000	141.000	24.000	142.000	1082.64 0
AKC0741	0.0%	0.6%	2.1%	0.0%	0.0%	2.000	1.000	135.000	2.000	486.000	19.000	9.000	37.000	11.830
AKC0742	2.2%	2.5%	0.1%	0.0%	0.0%	16.538	1.644	93.179	6.869	750.906	86.045	15.394	92.121	858.757
AKC0743	2.8%	1.8%	0.0%	0.0%	0.0%	13.051	1.797	100.747	7.100	715.352	117.550	19.096	144.794	1039.30 1
AKC0744	3.0%	2.2%	0.0%	0.0%	0.0%	12.426	1.510	114.261	7.937	875.229	124.265	20.614	149.410	1085.69 9
AKC0745	3.0%	1.9%	0.0%	0.0%	0.0%	16.485	2.416	95.498	7.638	771.759	117.215	17.481	146.245	1074.36 5
AKC0746	1.6%	1.3%	0.0%	0.0%	0.0%	7.079	2.001	62.489	4.910	539.144	72.328	14.595	61.646	440.037
AKC0747	3.5%	0.4%	0.0%	0.0%	0.0%	1.334	1.795	32.516	1.475	487.967	26.532	8.234	16.134	162.190

Database ID	MnO	Fe2O3	CuO	SnO2	PbO2	Li	Be	B	Sc	Ti	V	Cr	Ni	Co
AKC0748	4.0%	0.7%	0.1%	0.1%	0.6%	29.000	1.000	120.000	2.000	487.000	24.000	12.000	12.000	38.650
AKC0749	0.3%	1.4%	1.6%	0.0%	0.1%	6.156	0.980	48.139	3.497	1153.473	144.543	31.546	32.485	34.517
AKC0750	0.1%	1.2%	1.9%	0.0%	0.0%	4.967	1.250	95.506	2.642	615.975	300.241	29.375	99.338	81.750
AKC0751	0.0%	0.5%	1.0%	0.0%	0.0%	3.758	0.972	67.961	0.710	420.280	10.266	7.510	30.457	14.813
AKC0752	0.0%	0.4%	1.1%	0.0%	0.0%	5.754	7.399	52.390	2.324	257.970	10.461	4.341	20.389	11.401
AKC0753	0.1%	0.8%	1.9%	0.2%	0.9%	13.000	2.000	98.000	4.000	1013.000	33.000	19.000	17.000	10.630
AKC0754	0.8%	0.9%	0.1%	0.0%	0.0%	9.611	1.066	104.512	4.260	2076.174	36.368	49.790	34.950	32.554
AKC0755	2.7%	1.8%	0.1%	0.0%	0.0%	23.556	1.387	110.146	8.745	917.005	128.116	19.049	145.791	1139.29 ₉
AKC0756	1.9%	1.4%	0.0%	0.0%	0.0%	52.000	2.000	67.000	4.000	746.000	61.000	10.000	106.000	776.980
AKC0757	4.4%	0.6%	0.4%	0.0%	0.0%	22.000	2.000	93.000	2.000	667.000	26.000	9.000	11.000	50.960
AKC0758	0.3%	0.3%	2.1%	0.0%	0.0%	2.400	1.126	70.897	0.967	451.115	10.548	5.556	48.377	17.019
AKC00939	1.9%	1.0%	0.0%	0.0%	0.0%	20.272	1.386	79.292	4.852	943.785	77.524	14.774	181.984	962.644
AKC01084	2.1%	1.0%	0.0%	0.0%	0.0%	20.746	1.644	71.189	5.265	1001.210	83.743	15.004	200.151	1062.13 ₀
AKC00912	2.4%	1.1%	0.0%	0.0%	0.0%	23.098	2.232	71.659	5.872	1093.682	89.501	15.366	224.194	1198.19 ₉
AKC01073 violet	3.3%	0.4%	0.0%	0.0%	0.0%	24.307	0.683	112.279	1.340	381.572	20.085	7.528	6.769	30.406
AKC01073 blue	1.3%	1.6%	0.1%	0.0%	0.0%	19.874	0.706	85.299	3.300	678.530	44.055	12.247	53.232	372.681
AKC01066	1.4%	1.1%	0.1%	0.0%	0.0%	25.737	1.193	84.161	3.658	804.650	45.359	13.365	63.620	426.904
AKC00909	0.1%	0.5%	0.2%	0.0%	0.0%	17.835	1.545	84.180	1.725	436.298	15.650	13.480	6.258	6.843
AKC00910	1.3%	1.2%	0.0%	0.0%	0.0%	6.258	0.776	130.579	6.286	563.262	51.494	11.201	34.508	304.049
AKC00959dkblue	0.0%	0.9%	2.8%	0.1%	0.0%	17.939	1.068	56.647	1.524	347.903	15.617	7.096	11.325	2.830
AKC00959red	0.2%	1.8%	1.7%	0.1%	0.5%	12.136	0.912	29.053	4.300	2208.537	68.808	32.012	28.467	8.130
AKC00959yellow	0.1%	1.3%	0.0%	1.0%	4.3%	6.819	1.329	18.496	1.952	2695.867	43.049	11.053	5.748	3.045
AKC00959_turq	0.1%	1.5%	0.7%	0.1%	0.1%	6.196	1.262	19.316	4.015	2545.570	82.085	22.016	18.161	7.871
AKC01071yellow	0.1%	1.8%	0.3%	0.5%	3.4%	7.145	1.389	20.518	3.416	2042.732	73.479	21.251	20.703	7.454

Database ID	MnO	Fe2O3	CuO	SnO2	PbO2	Li	Be	B	Sc	Ti	V	Cr	Ni	Co
AKC01071blue	0.0%	0.9%	0.7%	0.1%	0.2%	16.744	2.113	65.277	6.511	932.185	54.685	13.502	14.036	5.122
AKC009590	0.2%	2.8%	5.8%	0.0%	5.4%	10.190	1.703	88.177	5.607	2139.352	68.463	28.863	86.487	10.227
AKC01057orange	0.2%	5.8%	7.0%	0.3%	0.4%	9.955	0.641	67.107	6.373	3791.884	89.997	29.498	639.151	640.674
AKC01071orange	0.2%	2.2%	7.3%	0.8%	1.6%	7.234	1.018	67.639	3.910	1749.994	54.053	17.314	401.173	90.088
AKC01043b	0.2%	2.7%	0.0%	0.0%	0.0%	28.871	1.878	107.536	8.004	3244.316	58.402	120.711	35.093	66.790
AKC01043w	0.1%	0.5%	0.0%	6.4%	6.9%	4.657	1.475	158.849	1.077	489.239	29.109	15.871	12.022	14.943
AKC01059b	2.4%	2.1%	1.0%	0.0%	0.7%	42.320	1.040	80.575	6.528	908.381	61.038	26.400	922.737	1663.5
AKC01059w	1.2%	1.4%	0.0%	4.1%	3.8%	24.688	0.778	48.795	2.571	1216.520	57.709	19.695	96.006	605.927
AKC01057gold	0.1%	1.0%	0.0%	0.0%	0.0%	5.062	0.276	239.820	1.756	731.969	14.340	15.245	8.281	3.350
AKC01093	0.0%	0.2%	0.3%	0.0%	0.0%	0.711	0.959	3.382	0.435	83.065	2.386	1.869	5.763	3.718
AKC00901	0.1%	0.4%	1.1%	0.0%	0.0%	1.200	0.312	65.660	0.585	359.598	12.897	5.038	30.878	33.418
AKC01022	0.1%	5.3%	0.1%	0.0%	0.0%	10.268	1.173	48.959	11.826	3750.508	106.544	220.669	63.517	24.817
AKC00410	1.5%	1.6%	0.1%	0.0%	0.0%	21.708	1.371	92.796	4.636	811.596	56.586	11.582	57.472	462.027
AKC00413	2.0%	1.3%	0.1%	0.0%	0.0%	93.108	1.753	116.909	6.150	1021.332	61.179	12.115	81.085	566.022
AKC00416	2.0%	1.6%	0.7%	0.0%	0.1%	23.497	1.150	134.938	5.372	1027.910	63.530	15.829	80.059	490.596
AKC00327	4.4%	1.5%	0.2%	0.0%	0.1%	26.267	1.516	96.752	3.841	1105.033	39.403	16.035	35.263	183.772
AKC00322	3.4%	0.5%	0.0%	0.0%	0.0%	7.826	1.126	69.515	1.672	421.575	9.775	6.207	15.470	44.156
AKC00386	0.0%	0.8%	2.3%	0.2%	0.1%	16.159	1.409	94.743	1.542	251.178	21.617	7.412	12.050	3.625
AKC00412	1.5%	1.1%	0.1%	0.0%	0.1%	21.388	1.393	130.092	4.665	940.605	71.720	11.942	72.876	537.533
AKC00425a	2.1%	2.0%	0.2%	0.0%	0.1%	33.526	2.002	79.572	6.751	1037.039	78.895	18.070	92.483	711.995
AKC00425b	0.9%	0.6%	0.0%	0.0%	0.1%	21.837	1.143	67.616	3.324	868.197	34.872	11.340	39.878	283.717
AKC00372	1.3%	1.2%	0.0%	0.0%	0.0%	16.697	1.340	66.538	6.308	1469.037	60.800	24.151	68.721	453.623
AKC00381	0.7%	0.3%	1.7%	0.0%	0.0%	31.646	1.211	50.610	1.484	469.358	16.403	8.525	19.157	97.988
AKC00389	0.7%	0.3%	1.9%	0.0%	0.0%	1.138	2.733	60.584	1.264	241.142	10.987	4.549	17.000	101.302
AKC00376	1.3%	0.5%	1.7%	0.0%	0.0%	2.111	1.128	65.255	1.693	560.285	12.243	9.867	28.768	124.170
AKC00424g	0.1%	0.5%	2.5%	0.0%	0.0%	10.882	0.837	82.389	1.813	568.566	14.016	9.761	12.192	11.739
AKC00424w	0.1%	0.8%	2.3%	0.0%	0.0%	7.232	1.138	83.024	2.602	1532.645	26.159	24.270	19.111	4.189

Database ID	Zn	As	Rb	Sr	Zr	Nb	Ag	In	Sb	Cs	Ba	La	Ce	Pr
AKC02589	76.772	0.000	78.825	288.377	1413.481	17.513	9.989	0.244	6.144	0.305	1162.263	90.647	143.022	14.652
AKC02519	18.256	1.187	49.695	246.792	456.225	7.165	0.418	0.019	0.127	0.570	629.339	24.008	40.424	5.029
AKC02585	29.505	2.229	65.514	183.739	716.317	10.252	0.580	0.008	0.435	0.590	671.876	30.035	48.500	5.700
AKC02584	21.111	1.159	76.801	175.542	770.425	10.327	0.446	0.022	0.190	0.489	640.243	28.853	48.029	5.434
AKC02590	16.326	1.740	41.874	170.191	684.014	9.025	0.430	0.008	0.307	0.487	593.135	26.667	42.344	5.110
AKC02591	24.758	3.241	47.641	245.557	482.664	13.089	0.206	0.020	0.194	0.582	711.319	40.946	64.849	7.218
AKC02587	69.106	0.000	30.962	344.147	139.824	1.607	0.217	0.145	0.203	0.217	1624.025	16.668	116.386	4.022
AKC02588	68.777	0.000	39.071	421.758	338.442	6.091	0.293	0.077	0.324	0.293	1784.270	20.005	106.674	4.649
AKC02586	67.266	0.000	33.855	414.075	249.635	3.397	1.155	0.278	2.722	0.469	1880.277	14.667	99.380	3.437
AKC02594b	69.981	0.000	37.790	444.652	162.546	3.416	0.216	0.399	0.969	0.250	150.288	7.560	14.819	2.069
AKC02595	58.732	5.005	21.749	402.481	217.790	4.990	1.070	0.495	1.418	0.263	202.190	11.239	20.749	2.968
AKC02592	70.734	0.000	18.238	645.492	80.205	1.372	9.870	0.208	35.348	0.332	472.172	6.639	12.845	1.529
AKC02594y	183.694	233.927	121.746	476.144	195.680	3.966	0.369	1.776	2.050	0.642	877.652	12.570	27.385	3.462
AKC02593	47.829	0.000	236.180	507.586	282.035	3.955	6.755	0.000	0.473	1.154	1195.624	11.396	31.953	2.995
AKC02596	76.683	5.621	50.952	315.670	712.438	9.367	6.344	0.380	1.895	0.797	264.867	31.049	43.696	6.926
AKC02057	25.945	97.948	117.303	155.632	72.122	2.463	1.478	0.208	1.656	0.619	255.277	9.406	19.683	2.241
AKC02039	15.073	171.616	130.737	34.033	102.699	2.211	0.842	0.147	1.166	0.698	140.418	9.801	18.829	2.235
AKC02043	19.382	47.354	19.336	98.344	67.345	1.478	0.900	0.107	1.056	0.616	104.979	10.292	20.769	2.316
AKC02038	14.301	35.469	120.887	88.123	71.887	1.953	0.674	0.054	0.800	1.191	226.873	9.669	17.878	2.293
AKC02045	57.847	52.698	46.418	329.904	414.755	6.585	16.776	0.361	14.696	0.525	604.112	20.788	38.903	4.483
AKC02046	160.741	190.225	46.488	425.852	287.088	6.955	58.571	0.688	70.999	0.358	512.889	23.534	48.694	5.539
AKC02047	16.956	22.677	39.569	298.033	565.511	8.402	3.294	0.000	1.635	0.255	1080.149	30.343	47.809	5.436
AKC02050	23.424	14.329	44.218	294.387	546.755	7.334	3.024	0.458	3.173	0.481	681.447	22.300	38.022	4.626
AKC02048	31.394	33.342	43.203	360.169	521.143	7.038	22.051	0.242	13.514	0.279	1348.387	30.781	48.887	5.471
AKC02052	32.195	4.499	35.902	179.784	949.053	23.184	0.315	0.167	0.624	0.222	443.305	42.395	78.923	9.449

Database ID	Zn	As	Rb	Sr	Zr	Nb	Ag	In	Sb	Cs	Ba	La	Ce	Pr
AKC02051	14.973	12.635	37.387	428.676	229.161	6.582	0.600	0.108	0.611	0.444	698.532	22.754	35.794	5.130
AKC02032	18.019	172.402	47.320	280.830	305.136	4.954	2.337	0.193	40.215	0.471	378.262	19.154	33.583	4.387
AKC02034	36.352	5.382	55.243	339.355	559.162	7.196	5.224	0.086	0.890	0.752	1294.839	30.193	50.250	5.365
AKC02037	52.988	7.521	71.271	524.664	192.736	7.314	1.168	0.605	6.305	0.959	664.383	33.992	60.325	7.576
AKC02031	87.780	475.625	10.150	34.924	9.806	0.678	42.003	0.108	666.917	0.459	29.678	2.567	4.600	0.632
AKC02033	81.516	305.824	6.186	30.738	4.051	0.213	37.055	0.035	309.201	0.151	16.825	1.323	2.693	0.314
AKC02035	50.090	3876.36	19.799	12.524	2.182	0.451	93.726	1.436	1075.55	0.237	25.411	1.553	6.351	0.331
AKC02053	391.718	222.919	8.297	27.258	3.976	0.305	24.499	0.227	504.487	0.146	17.460	1.613	2.605	0.373
AKC02049	48.155	14.128	20.470	319.302	186.464	3.478	0.575	0.095	0.637	0.239	1601.887	12.690	131.039	3.539
AKC02054	24.842	3.941	13.116	458.349	38.652	1.450	0.543	0.095	16.242	0.202	155.288	4.942	8.742	1.142
AKC02044	507.621	15.115	11.104	568.079	106.135	2.550	0.164	0.246	1.010	0.247	293.437	8.422	17.716	2.051
AKC02036	873.768	317.625	142.114	93.833	54.036	6.835	13.125	0.740	13.505	5.894	357.027	16.023	32.286	3.855
AKC02055	66.125	25.858	17.329	318.556	121.355	5.121	2.538	0.176	16.744	0.218	158.036	7.285	19.560	2.818
AKC02056	17.161	0.000	12.159	269.167	262.630	7.022	0.409	0.123	1.218	0.238	124.837	4.820	9.964	1.511
AKC02059	38.291	4.616	27.005	109.729	12.384	1.183	1.029	0.140	1.509	0.124	1586.410	11.418	81.825	2.504
AKC02058	30.637	30.950	129.391	126.417	85.158	2.690	0.724	0.145	1.493	1.162	279.846	12.010	23.402	2.622
AKC00727	50.123	15.772	186.312	102.533	35.889	2.438	2.724	0.092	1.820	0.674	2642.604	12.689	258.909	5.145
AKC00728	38.696	174.543	522.226	22.196	122.496	5.353	12.951	0.507	20.879	2.947	99.562	12.139	25.711	2.800
AKC00729	23.764	2.634	344.960	28.972	103.270	4.041	0.809	0.043	1.644	2.986	1077.282	13.589	120.450	3.533
AKC00650	19.997	0.000	513.833	17.644	117.795	5.599	0.266	0.040	1.910	2.326	907.775	13.326	51.295	3.122
AKC00649	27.330	0.000	439.624	20.180	149.305	5.128	0.444	0.048	0.408	2.253	1672.539	14.754	50.178	3.642
AKC02001	3.790	52.133	415.359	518.861	6.941	2.180	0.062	0.062	0.261	0.555	723.346	24.698	44.694	5.235
AKC02002	5.809	50.166	447.181	473.600	6.828	7.023	0.143	0.143	0.458	0.464	784.859	29.077	48.922	6.113
AKC02003	20.129	10.920	380.822	146.832	2.482	0.186	0.103	0.103	0.259	0.220	839.409	8.105	65.384	2.115
AKC02004	12.711	60.106	430.625	730.315	11.265	13.821	0.050	0.050	5.064	0.458	1718.829	48.436	74.012	7.480
AKC02005	23.203	28.980	267.999	520.869	6.360	30.812	0.468	0.468	7.666	0.337	834.132	19.165	59.026	4.298

Database ID	Zn	As	Rb	Sr	Zr	Nb	Ag	In	Sb	Cs	Ba	La	Ce	Pr
AKC02006	14.300	384.461	51.314	155.045	4.771	1.025	0.095	0.095	1.121	4.036	1840.400	15.561	66.955	3.717
AKC02007	22.489	44.284	318.020	461.675	6.113	48.976	0.262	0.262	9.319	0.582	1017.858	19.792	65.954	4.693
AKC02008	41.384	29.660	258.405	350.189	5.844	16.246	0.315	0.315	8.849	0.362	443.089	16.472	30.322	3.450
AKC02009	13.262	30.256	496.556	478.078	8.219	28.215	0.297	0.297	4.576	0.302	867.403	20.024	45.137	4.476
AKC02010	3.360	317.710	33.807	106.825	3.569	0.826	0.058	0.058	1.775	1.424	799.228	11.343	74.865	2.982
AKC02012	4.928	54.090	308.157	685.429	15.297	0.365	0.073	0.073	0.291	0.379	649.771	34.315	61.249	7.182
AKC02013	9.431	58.945	283.500	556.381	8.518	8.491	1.020	1.020	6.202	1.413	725.891	23.173	39.041	6.065
AKC02014	104.231	39.805	262.798	627.224	7.517	17.638	0.652	0.652	73.339	1.011	483.296	25.022	45.878	5.909
AKC02015	7.011	21.410	443.158	287.410	6.574	0.800	0.698	0.698	1.925	0.779	1563.852	19.428	139.859	5.069
AKC02016	2.692	113.818	126.897	31.453	2.790	2.842	4.097	4.097	3.751	3.599	3313.787	11.801	152.400	4.272
AKC02019	3.003	35.381	569.198	277.525	4.190	1.590	2.207	2.207	0.237	0.369	1033.491	22.883	37.100	5.339
AKC02020	8.312	77.771	381.951	392.411	6.353	3.999	0.078	0.078	1.256	0.313	1628.930	35.845	59.070	6.187
AKC02021	7.018	38.070	256.852	487.822	6.476	9.766	0.081	0.081	4.854	0.430	711.537	20.597	35.215	4.414
AKC02022	33.768	28.127	177.549	573.916	7.491	1.567	0.131	0.131	1.049	0.445	480.967	30.508	50.581	5.577
AKC02023o	327.784	49.045	473.341	333.405	6.777	33.331	0.127	0.127	93.645	0.656	635.034	31.283	60.412	7.142
AKC02023r	16.468	46.906	438.256	392.283	6.596	31.281	0.052	0.052	4.966	0.546	595.902	28.077	50.656	6.200
AKC02024o	250.373	40.091	514.604	371.208	7.198	40.605	0.232	0.232	184.487	0.513	683.236	34.476	65.241	7.988
AKC02024r	31.196	38.296	361.186	555.239	8.476	61.032	0.073	0.073	15.266	0.757	607.024	28.843	50.114	6.638
AKC02025o	295.153	54.332	489.118	343.353	6.622	42.778	0.717	0.717	123.717	0.532	636.646	30.451	56.943	7.075
AKC02025r	13.255	48.388	454.700	386.915	6.956	68.469	0.117	0.117	7.753	0.530	635.519	29.606	55.410	6.768
AKC02026o	226.777	41.202	476.879	415.536	7.017	63.668	2.287	2.287	94.420	0.516	661.375	33.167	63.853	7.626
AKC02026r	21.660	42.055	417.698	420.575	6.784	79.902	0.100	0.100	8.139	0.529	588.576	28.536	52.351	6.379
AKC02027o	282.214	60.639	507.511	371.368	6.811	39.378	0.237	0.237	131.166	0.731	680.174	32.529	61.441	7.535
AKC02027r	14.288	59.304	484.108	420.354	7.429	66.085	0.126	0.126	8.324	0.749	683.802	32.751	61.134	7.413
AKC02028	250.569	163.316	75.505	46.367	7.225	12.935	1.013	1.013	15.819	7.065	396.490	14.629	31.312	3.630
AKC02029	4.607	310.462	37.914	107.822	3.447	0.509	0.109	0.109	0.824	2.060	888.524	13.367	93.217	3.702

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AKC02030	237.686	157.243	89.540	58.414	7.502	13.042	0.568	0.568	11.618	6.883	407.728	16.654	37.794	3.963
AKC01924	62.041	36.995	54.420	277.305	355.046	9.818	18.866	0.283	4.223	0.797	812.586	28.281	47.832	6.022
AKC01922	73.459	5.915	32.833	357.307	414.060	8.522	8.072	0.137	8.587	0.464	841.265	24.733	50.914	5.240
AKC01920	34.053	0.000	72.029	248.194	246.428	13.546	16.857	1.521	0.542	0.560	984.405	10.543	37.338	2.467
AKC01912	15.605	127.876	409.478	9.940	122.923	5.407	12.347	0.598	20.752	1.681	53.565	8.270	16.955	2.018
AKC01913	42.823	17.513	120.091	140.025	99.619	4.285	1.004	0.093	1.595	0.759	754.453	8.814	60.879	2.429
AKC01919	369.402	79.459	84.980	409.651	529.807	14.076	63.158	0.820	72.283	0.789	1203.430	45.460	82.468	9.642
AKC00224	82.517	6.863	51.517	331.792	432.308	8.607	3.655	0.371	0.788	0.523	911.943	30.030	52.024	6.546
AKC00121	37.383	3.138	48.988	288.844	391.177	6.742	7.924	1.061	1.732	0.727	671.729	24.221	40.902	5.504
AKC00105	118.711	15.549	43.367	305.151	550.775	6.805	19.066	0.283	7.081	0.771	650.868	24.250	42.311	5.140
AKC00214	106.770	18.131	43.187	291.600	528.742	6.580	18.273	0.321	6.561	0.517	610.950	22.930	39.805	4.759
AKC00214b	82.331	1.710	60.760	300.005	377.754	7.356	7.249	0.257	1.150	0.897	628.054	23.729	40.724	5.108
AKC00090	57.454	9.562	57.991	360.929	355.433	8.398	3.155	0.129	5.858	1.600	926.262	12.360	27.720	2.618
AKC00080	55.728	12.668	42.541	234.697	598.336	9.097	22.517	1.004	4.780	0.797	982.288	33.510	55.499	6.566
AKC00069	84.439	264.909	54.002	267.437	574.782	13.463	141.297	0.352	78.429	0.278	640.035	44.982	80.428	9.409
AKC00291	25.541	33.731	48.191	377.981	419.679	5.448	4.042	0.093	7.893	0.405	1488.038	18.070	29.153	3.433
AKC00087	55.197	6.320	42.433	301.334	314.364	6.442	3.776	0.279	1.110	0.765	526.481	25.690	49.098	5.848
AKC00081	191.327	1.108	44.250	373.353	517.690	9.499	6.459	0.300	1.032	2.114	660.122	25.857	45.636	5.382
AKC00116	156.039	3.389	49.191	329.656	677.745	12.484	9.871	0.248	1.908	0.666	686.236	33.358	59.199	7.053
AKC00115	130.406	3.407	78.613	294.034	371.974	9.137	6.842	0.287	1.326	2.929	650.211	23.323	43.730	5.098
AKC00095	23.835	3.245	54.014	379.112	580.278	6.204	0.884	0.032	0.132	0.532	1709.173	29.037	46.997	4.938
AKC00118	89.747	5.918	37.949	277.141	470.376	6.706	6.783	0.084	2.615	0.949	650.379	15.911	29.398	3.319
AKC00240	24.488	0.000	62.773	404.728	442.605	6.700	2.268	0.070	0.301	0.505	773.110	26.672	46.299	5.538
AKC00245	22.059	1.261	61.061	377.416	400.065	6.617	4.923	0.103	2.446	0.564	740.542	27.637	48.428	5.865
AKC00254r	145.498	1734.23	44.198	459.345	354.029	7.011	25.231	0.352	284.561	0.524	606.708	30.065	57.535	6.848
AKC00254o	152.125	1775.15	48.461	473.073	372.505	7.284	31.774	0.529	344.099	0.552	622.557	32.499	61.031	7.554

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AKC00284	39.363	153.251	46.474	486.962	267.947	6.186	4.006	0.202	20.134	0.486	645.651	28.679	51.649	6.376
AKC00223	36.989	8.986	52.648	358.234	352.371	9.904	7.525	0.082	6.606	0.615	833.180	29.111	47.463	6.219
AKC00221	16.992	3.616	44.163	297.128	504.870	6.421	4.698	0.024	1.625	0.414	652.798	22.651	39.578	5.015
AKC00220	49.661	4.678	65.212	333.529	1111.140	13.429	7.300	0.093	3.874	0.530	916.863	56.677	86.468	8.988
AKC00122	39.116	20.333	60.203	338.840	551.244	7.067	6.234	0.112	3.547	0.505	1214.765	27.522	45.055	4.968
AKC00278	2346.79	99.872	77.367	284.209	511.024	11.044	114.273	2.852	77.803	1.259	580.298	53.969	72.306	12.889
AKC00277	188.920	478.500	75.025	284.014	483.141	11.364	44.039	5.459	96.105	1.549	514.915	51.295	72.260	12.230
AKC00057	23.126	9.606	331.995	45.953	36.713	2.947	2.351	0.115	7.735	2.512	169.515	4.571	8.747	0.953
AKC00058	20.022	12.359	356.214	43.279	37.521	3.108	2.267	0.122	8.469	2.603	176.606	4.603	8.826	1.052
AKC00059	35.027	1.920	408.663	56.307	122.860	4.623	0.424	0.091	1.197	1.745	1042.662	16.738	111.019	4.489
AKC00117	56.532	0.348	23.155	500.160	209.912	5.657	0.565	0.394	12.927	0.819	259.887	11.735	21.293	2.463
AKC01651	69.000	11.330	34.000	164.200	468.000	10.000	4.620	0.130	1.000	0.980	748.000	26.000	44.000	5.900
AKC01652	34.000	6.800	45.000	527.700	406.000	8.000	5.270	1.110	1.000	0.710	811.000	33.000	58.000	7.700
AKC01658	20.000	5.350	47.000	335.600	675.000	7.000	1.110	0.190	1.000	0.510	820.000	28.000	50.000	6.000
AKC01677	54.000	22.850	43.000	374.200	222.000	7.000	5.420	1.050	1.000	0.710	517.000	26.000	44.000	6.000
AKC01679	53.870	78.330	44.370	426.330	395.110	7.040	14.610	0.700	0.500	0.750	617.120	31.750	53.220	6.630
AKC01685	50.000	41.120	73.000	537.300	227.000	8.000	3.210	0.350	22.000	0.700	713.000	35.000	66.000	7.800
AKC01683	75.480	20.460	37.710	189.710	813.690	9.160	6.190	0.160	1.080	0.770	988.260	26.900	40.120	5.940
AKC01686	128.000	39.700	53.000	546.400	369.000	8.000	17.860	0.290	13.000	0.610	742.000	35.000	68.000	7.800
AKC01688	56.000	19.430	47.000	227.200	881.000	13.000	5.840	0.470	3.000	1.270	853.000	41.000	64.000	7.700
AKC01692	62.000	30.870	51.000	339.200	471.000	8.000	3.110	0.100	5.000	1.150	638.000	26.000	45.000	5.500
AKC01696	63.000	79.630	72.000	425.600	361.000	8.000	17.220	0.180	10.000	1.060	805.000	29.000	51.000	6.200
AKC01697	39.000	7.530	41.000	330.700	245.000	7.000	6.610	0.350	0.000	0.950	489.000	31.000	60.000	7.400
AKC01699	28.000	6.200	51.000	340.000	532.000	7.000	0.930	0.270	1.000	0.500	916.000	24.000	44.000	5.400
AKC01702	19.400	6.650	31.170	383.330	341.960	3.980	0.460	0.150	3.010	0.430	662.610	21.620	37.000	4.530
AKC01722	29.000	3.130	39.000	361.400	409.000	5.000	0.960	0.160	3.000	0.690	1377.000	21.000	39.000	4.500

Database ID	Zn	As	Rb	Sr	Zr	Nb	Ag	In	Sb	Cs	Ba	La	Ce	Pr
AKC01724	27.000	8.030	53.000	335.100	558.000	8.000	0.560	0.070	2.000	0.850	853.000	31.000	52.000	6.800
AKC01726	39.000	2.690	45.000	589.000	355.000	8.000	3.440	0.200	1.000	0.420	821.000	31.000	54.000	6.200
AKC01727	31.000	7.400	41.000	492.900	410.000	5.000	0.770	0.160	1.000	0.590	986.000	24.000	41.000	5.100
AKC01729	99.140	20.830	37.680	260.420	465.860	5.400	15.190	0.280	4.920	0.390	271.700	18.460	36.710	4.560
AKC01731	30.000	5.190	32.000	309.000	284.000	6.000	0.940	0.030	0.000	0.470	494.000	23.000	42.000	5.300
AKC01731 bla	37.000	26.320	145.000	176.300	870.000	12.000	14.090	0.100	28.000	0.560	1278.000	36.000	63.000	7.200
AKC01731 blb	29.000	10.610	44.000	319.900	523.000	6.000	1.540	0.250	11.000	0.490	751.000	24.000	43.000	5.300
AKC01731 blc	39.000	4.460	49.000	320.800	463.000	8.000	0.620	0.130	4.000	0.850	891.000	31.000	53.000	6.800
AKC01731 bld	23.000	10.060	50.000	330.400	542.000	8.000	0.690	0.060	5.000	0.660	835.000	30.000	51.000	6.500
AKC01731 ble	26.000	3.810	39.000	378.700	425.000	5.000	0.800	0.150	4.000	0.440	1394.000	22.000	39.000	4.600
AKC01731 green	34.000	14.240	48.000	322.200	404.000	8.000	0.540	0.170	1.000	0.800	889.000	32.000	54.000	7.200
AKC01734	41.000	6.500	38.000	614.000	456.000	6.000	0.590	0.060	0.000	0.390	849.000	30.000	52.000	6.500
AKC01738	21.000	4.880	46.000	332.500	405.000	6.000	7.300	0.240	0.000	0.450	776.000	23.000	40.000	4.900
AKC01742	27.000	3.360	53.000	391.800	452.000	7.000	0.490	0.040	0.000	0.480	863.000	27.000	48.000	6.000
AKC01744	27.000	9.700	62.000	328.100	459.000	8.000	0.880	0.110	0.000	0.750	847.000	29.000	43.000	5.900
AKC01752	22.000	4.950	44.000	435.000	235.000	6.000	0.280	0.050	0.000	0.260	622.000	27.000	45.000	5.800
AKC01773	30.000	8.060	30.000	200.800	744.000	10.000	0.310	0.030	0.000	1.000	348.000	26.000	44.000	5.700
AKC01774	100.000	25.190	47.000	342.000	411.000	4.000	3.610	0.200	1.000	0.650	719.000	16.000	28.000	3.500
AKC01775	25.000	4.930	51.000	381.200	468.000	7.000	0.470	0.030	0.000	0.530	838.000	26.000	44.000	5.500
AKC01779	56.970	31.630	45.910	464.290	380.510	7.000	4.240	1.190	1.030	0.560	662.600	30.950	53.820	6.490
AKC01779y	71.360	104.970	42.360	378.900	398.190	7.370	24.520	0.280	20.970	0.700	604.870	31.330	56.500	6.910
AKC01780	47.510	118.540	46.740	402.290	401.440	7.040	14.820	0.580	16.600	0.730	580.200	32.060	57.560	7.170
AKC01790	23.300	13.300	37.970	372.700	373.300	6.000	0.270	0.080	0.220	0.660	530.990	25.870	47.950	6.100

Database ID	Zn	As	Rb	Sr	Zr	Nb	Ag	In	Sb	Cs	Ba	La	Ce	Pr
AKC01791	38.450	4.400	54.980	259.630	579.350	16.530	0.290	0.060	0.160	0.350	693.170	46.030	81.460	9.570
AKC01808	23.330	7.420	87.240	303.620	572.430	6.060	2.070	0.240	0.720	0.450	1065.760	25.760	44.120	5.600
AKC01695	35.022	4.032	13.012	444.301	183.749	5.410	0.346	0.442	0.730	0.161	147.272	8.084	16.571	2.113
AKC01700 black	36.655	4.402	22.928	660.675	84.933	3.069	0.932	0.210	0.209	0.640	263.406	5.946	11.351	1.405
AKC01700 red trim	43.034	2.440	31.071	679.152	82.713	3.058	2.300	0.039	0.242	0.586	267.430	6.037	12.137	1.403
AKC00443	36.500	11.497	31.823	306.350	139.975	2.710	0.374	0.054	0.162	0.443	2107.270	11.991	95.690	3.124
AKC00452	20.290	0.000	160.479	12.063	62.859	2.720	58.842	0.272	3.678	1.405	93.996	8.248	20.326	1.939
AKC00464	57.261	4.337	346.065	55.756	71.824	3.609	0.451	0.070	0.739	1.763	1084.759	10.542	33.785	3.024
AKC00466	41.066	0.000	34.086	300.962	75.335	2.263	0.292	0.038	0.302	0.339	1706.508	12.280	83.521	2.787
AKC00473	41.635	0.000	224.506	89.274	29.034	2.398	0.508	0.038	0.102	0.922	3231.791	14.560	318.584	5.512
AKC00485	18.723	0.000	114.523	82.732	39.099	1.986	0.350	0.046	0.125	0.532	1378.694	11.182	218.499	3.237
AKC00487	43.842	0.000	218.566	88.477	29.197	2.366	0.504	0.033	0.261	0.838	2853.589	15.063	320.473	5.561
AKC00516	24.858	0.000	288.538	25.146	123.269	4.434	0.279	0.024	0.332	1.845	653.534	12.901	91.711	3.829
AKC00541	27.359	0.000	284.101	25.786	124.221	4.237	0.302	0.035	0.457	1.849	683.025	13.363	94.290	3.785
AKC00545	34.119	0.000	320.463	67.361	111.969	3.966	0.278	0.137	1.608	3.037	1011.107	12.203	94.070	3.263
AKC00550	62.395	0.000	34.335	632.926	187.344	2.779	2.473	0.077	8.868	0.425	654.255	15.261	42.251	3.189
AKC00564	48.247	0.000	314.536	51.362	82.311	3.772	0.180	0.059	0.540	2.415	1164.802	9.518	26.799	2.243
AKC00569	47.396	16.688	540.308	31.400	209.406	6.985	3.638	0.857	4.539	4.912	77.799	13.455	26.165	3.021
AKC00572	45.701	0.000	371.688	56.344	80.648	4.092	0.302	0.084	1.025	1.508	1000.129	10.663	21.942	2.543
AKC00573	101.997	0.000	316.988	33.450	103.991	3.921	0.346	0.048	1.044	1.708	1304.282	15.095	151.716	4.203
AKC00579	27.936	0.000	207.789	44.107	13.219	0.984	0.225	0.089	1.919	0.916	2336.463	2.995	8.634	0.891
AKC00596	52.748	0.000	200.386	81.146	21.609	1.907	0.762	0.036	0.438	0.829	1771.015	11.647	254.898	4.340
AKC00597	37.312	0.000	292.425	59.029	109.443	4.007	0.183	0.111	0.716	3.312	653.046	9.848	51.420	2.517
AKC00605	27.910	0.000	117.543	87.091	42.377	2.216	0.668	0.076	0.891	0.556	1549.172	11.585	193.952	3.755
AKC00624	37.671	0.000	219.486	85.680	28.898	2.096	0.443	0.035	0.161	0.779	3099.756	17.151	356.008	5.692

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AKC00628	22.033	0.000	269.364	21.906	51.559	2.072	0.810	0.036	0.612	2.429	20.965	7.115	15.348	1.547
AKC00630	46.270	4.885	413.988	66.760	188.696	7.173	2.117	0.291	2.506	4.491	803.547	15.627	94.633	4.052
AKC00632	25.509	0.000	446.842	20.820	151.765	5.109	0.309	0.041	0.345	2.224	1751.133	15.250	51.909	3.725
AKC00633	47.730	3.182	543.120	43.379	57.546	4.200	0.230	0.045	0.334	3.737	925.742	10.042	19.704	2.739
AKC00634	34.496	0.000	82.391	118.833	24.340	1.541	4.949	0.028	0.186	0.236	1824.729	6.212	20.422	1.518
AKC00641	26.292	14.065	147.057	112.959	82.633	2.929	0.966	0.072	0.974	2.583	286.265	11.137	23.204	2.578
AKC00662	31.706	0.000	22.700	345.953	123.965	3.838	0.813	0.144	0.308	0.134	1913.763	16.321	146.381	3.994
AKC00672	44.112	0.000	556.022	46.816	55.342	3.410	0.249	0.066	0.303	2.887	1013.058	9.717	19.654	2.278
AKC00677	49.885	0.000	52.426	345.332	58.378	3.244	95.578	0.061	0.404	3.150	1840.586	15.012	142.244	4.102
AKC00683	35.911	0.000	25.411	367.175	129.042	4.220	1.108	0.041	0.200	0.121	2052.256	17.276	158.599	4.296
AKC00686	73.733	0.000	381.870	66.442	79.067	4.381	0.264	0.041	0.795	1.674	1083.681	12.388	24.304	2.925
AKC00689	41.207	0.000	568.068	46.595	63.696	4.226	1.031	0.381	0.410	3.244	1125.399	11.725	24.671	2.896
AKC00726	9446.67	1.293	21.094	243.662	28.050	0.568	0.114	0.046	0.431	0.444	9862.367	2.639	5.019	0.618
AKC0733	39.859	4.662	26.665	286.393	64.013	2.892	408.485	0.535	1.031	0.878	1693.070	11.052	71.266	3.045
AKC0734	28.713	8.629	40.842	343.064	50.122	2.729	2.099	0.168	0.449	0.427	1923.084	13.021	132.183	3.316
AKC0735	43.000	4.630	28.000	337.800	125.000	4.000	6.500	0.150	1.000	0.530	2167.000	16.000	142.000	4.100
AKC0736	19.000	6.840	312.000	16.400	43.000	2.000	0.710	0.150	2.000	1.980	15.000	5.000	11.000	1.500
AKC0737	51.000	3.950	200.000	83.700	17.000	2.000	0.140	0.020	0.000	2.350	1513.000	7.000	31.000	2.000
AKC0738	44.000	16.190	181.000	72.900	24.000	2.000	0.470	0.030	1.000	0.560	2803.000	14.000	303.000	5.000
AKC0739	72.000	6.470	93.000	74.700	73.000	3.000	0.230	0.040	1.000	1.650	1828.000	6.000	12.000	1.600
AKC0740	47.000	6.350	200.000	82.000	23.000	2.000	0.670	0.040	0.000	0.820	3191.000	12.000	293.000	4.700
AKC0741	28.000	51.220	26.000	88.600	82.000	2.000	3.440	0.140	2.000	1.530	109.000	11.000	24.000	2.500
AKC0742	50.799	6.183	215.417	124.198	18.716	1.321	0.437	0.026	0.185	0.711	2229.493	11.283	147.018	3.938
AKC0743	42.428	5.382	187.223	88.439	20.723	1.716	0.501	0.055	0.401	0.522	1877.171	12.435	266.724	5.028
AKC0744	48.478	4.289	220.680	90.383	22.246	1.767	0.822	0.034	0.290	0.700	2058.634	12.296	265.150	4.912
AKC0745	42.400	9.855	198.399	88.033	20.078	2.297	0.712	0.041	0.320	0.754	1998.688	12.304	276.935	5.064

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AKC0746	26.149	2.242	117.872	73.191	30.218	1.855	0.326	0.018	0.219	0.625	1528.023	13.341	153.270	4.123
AKC0747	73.529	6.957	27.866	55.231	23.542	3.999	0.130	0.017	0.412	0.580	5332.095	5.295	18.689	1.729
AKC0748	58.000	9.960	391.000	63.000	68.000	3.000	0.760	0.240	1.000	3.200	1386.000	10.000	22.000	2.500
AKC0749	72.590	8.851	51.816	583.331	191.350	4.328	2.739	0.072	13.282	0.883	709.487	14.074	37.917	3.044
AKC0750	111.640	25.207	54.157	370.348	144.871	1.861	1.103	0.026	0.447	0.217	436.405	11.037	21.699	2.305
AKC0751	20.224	10.265	67.157	101.127	98.746	2.227	0.115	0.094	1.210	0.446	142.076	9.714	19.117	2.091
AKC0752	12.584	5.023	100.928	81.138	73.125	2.652	1.931	0.139	1.374	0.848	173.374	10.895	20.419	2.440
AKC0753	24.000	159.770	422.000	15.500	124.000	7.000	15.720	0.470	16.000	2.510	139.000	11.000	23.000	2.400
AKC0754	366.144	18.988	212.316	229.379	270.005	8.097	0.759	0.215	1.196	0.916	946.028	25.989	45.913	6.041
AKC0755	46.822	0.000	232.760	96.440	22.266	1.798	0.597	0.030	0.375	0.925	2375.314	13.621	311.314	5.584
AKC0756	44.000	0.000	440.000	40.700	89.000	4.000	0.180	0.050	1.000	2.250	1644.000	16.000	168.000	5.200
AKC0757	70.000	0.000	325.000	68.700	66.000	5.000	0.160	0.040	1.000	3.000	1462.000	12.000	26.000	3.000
AKC0758	22.052	37.257	29.107	53.699	90.548	2.589	3.059	0.113	2.536	0.841	104.461	10.950	21.878	2.457
AKC00939	39.278	10.715	10.088	455.790	133.319	2.832	0.562	0.029	0.115	0.184	2471.604	17.620	280.829	5.240
AKC01084	47.238	0.000	13.586	450.354	129.814	2.880	0.389	0.024	0.101	0.236	2770.028	19.273	312.497	5.494
AKC00912	40.197	0.000	12.322	483.791	148.944	3.298	0.554	0.029	0.161	0.199	3138.098	21.919	378.858	6.672
AKC01073_violet	39.437	0.000	310.727	43.144	76.321	2.876	0.106	0.013	0.459	2.348	1070.397	8.622	17.174	2.014
AKC01073_blue	47.236	5.723	296.115	36.282	98.036	3.913	0.615	0.026	1.173	2.399	998.424	11.288	95.136	3.071
AKC01066	37.327	0.000	308.282	36.543	103.349	3.793	0.925	0.035	0.804	2.797	987.372	13.464	107.621	3.858
AKC00909	24.333	0.000	429.649	30.348	64.832	2.391	0.390	0.045	1.811	12.510	95.989	7.026	15.606	1.566
AKC00910	23.983	14.800	149.948	97.746	32.091	2.015	0.253	0.024	0.359	0.554	1424.050	7.563	84.901	2.136
AKC00959_dkblue	28.043	1.985	352.539	37.403	45.747	3.925	1.778	0.032	11.776	3.183	94.065	4.630	8.609	0.989
AKC00959_red	63.485	9.567	79.474	288.557	474.343	6.111	32.490	0.028	12.591	0.475	640.992	19.783	33.605	4.111
AKC00959_yellow	36.400	0.000	75.001	368.924	257.279	18.585	6.929	0.165	0.509	0.467	1275.099	13.396	27.457	3.065

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AKC00959_turq	49.604	0.000	39.746	238.118	301.405	7.715	11.924	0.136	1.443	0.409	662.000	21.755	40.627	4.894
AKC01071_yellow	32.292	33.434	74.623	382.667	310.815	6.617	4.657	0.485	2.305	0.650	959.193	24.359	42.189	5.371
AKC01071_blue	55.702	6.797	30.420	444.246	252.368	7.204	13.021	0.070	3.970	0.291	641.921	17.879	43.613	4.026
AKC00959o	207.838	14.660	116.762	563.873	342.395	8.882	124.754	0.138	25.512	0.715	1309.493	29.760	58.714	6.388
AKC01057o	156.370	0.000	70.387	729.331	443.275	12.884	3.572	0.114	0.687	0.274	1411.053	23.052	53.222	5.100
AKC01071o	275.902	245.536	114.214	633.566	203.536	6.837	41.497	0.600	61.838	0.596	1183.656	23.443	48.578	4.936
AKC01043b	76.415	0.000	55.559	226.692	294.824	12.381	0.300	0.027	0.430	1.544	375.858	32.014	73.819	7.780
AKC0104w	64.850	6.268	28.112	415.534	75.303	2.195	1.694	0.429	3848.950	0.303	331.763	6.901	19.938	1.734
AKC01059b	86.186	0.000	200.581	274.323	53.570	4.195	88.318	0.105	61.184	1.853	3421.918	20.880	235.062	5.173
AKC0105w	88.921	4.340	140.716	469.746	276.287	5.298	0.879	0.104	2.074	1.249	1275.460	13.528	75.031	3.241
AKC01057_gold	34.034	17.418	5.463	632.121	104.560	4.102	782.061	0.008	5188.488	0.088	166.487	7.855	14.838	2.013
AKC01093	62.301	0.000	44.075	24.336	4.001	0.429	1.089	0.276	0.851	0.395	52.946	1.307	4.069	0.284
AKC00901	21.828	7.201	131.520	79.490	71.755	2.193	0.277	0.060	5.759	0.813	113.078	9.421	20.455	2.096
AKC01022	287.580	0.000	148.168	307.930	61.039	4.212	0.401	0.215	10.870	7.164	248.283	12.506	29.726	2.447
AKC00410	33.748	6.568	392.742	37.985	97.607	3.083	0.402	0.040	0.708	3.204	1320.426	12.757	138.545	3.674
AKC00413	44.237	6.817	315.241	57.363	96.127	4.340	0.437	0.043	0.773	3.462	1408.841	16.550	154.943	4.914
AKC00416	47.656	5.928	447.904	59.688	115.675	4.442	0.883	0.154	5.506	2.705	1022.924	16.213	134.628	4.687
AKC00327	101.893	3.031	350.462	112.835	105.599	5.180	0.854	0.077	2.222	2.843	1711.564	14.190	50.901	3.562
AKC00322	47.158	1.271	112.755	122.375	23.869	1.450	0.170	0.023	0.112	0.523	550.708	6.931	13.746	1.569
AKC00386	22.886	30.728	343.690	26.477	21.854	2.507	3.580	0.233	7.479	1.913	46.276	4.089	7.161	0.836
AKC00412	29.581	5.133	395.866	42.092	99.925	3.842	0.364	0.063	0.664	2.306	1003.080	13.656	116.034	3.778
AKC00425a	43.138	8.317	408.763	40.900	94.358	4.707	0.856	0.070	1.134	2.490	1855.237	16.766	180.262	5.180
AKC00425b	21.394	4.746	256.850	28.794	98.746	3.705	0.292	0.060	0.305	2.305	662.546	12.275	64.190	3.246

Database ID	Zn	As	Rb	Sr	Zr	Nb	Ag	In	Sb	Cs	Ba	La	Ce	Pr
AKC00372	55.415	2.667	281.705	32.953	129.307	5.562	0.296	0.024	0.463	1.506	958.145	16.079	115.599	4.317
AKC00381	19.012	20.894	29.812	101.021	22.799	1.958	0.588	0.337	0.209	0.330	1216.526	6.819	12.408	1.081
AKC00389	19.889	11.726	52.887	79.004	22.165	1.061	0.714	0.331	0.288	0.355	1275.996	3.762	9.154	0.793
AKC00376	37.981	13.909	77.891	67.887	28.449	2.633	1.549	0.609	0.169	0.406	2564.300	4.580	13.021	1.148
AKC00424g	33.644	4.702	415.899	39.048	28.678	2.857	4.965	0.088	0.396	6.057	58.131	2.803	8.352	0.687
AKC0042w	55.147	5.458	394.216	40.255	37.202	8.916	5.121	0.058	0.402	6.236	46.599	4.618	8.109	0.891

Database ID	Ta	Au	Y	Bi	U	W	Mo	Nd	Sm	Eu	Gd	Tb	Dy	Ho
AKC02589	1.134	1.044	16.992	2.998	6.263	0.515	1.789	46.471	7.574	1.374	5.273	0.561	2.858	0.707
AKC02519	0.439	0.009	16.523	0.048	4.735	0.267	0.949	17.014	3.101	0.794	2.692	0.413	2.602	0.591
AKC02585	0.530	0.046	11.743	0.119	14.156	0.300	1.372	18.164	3.133	0.702	2.531	0.350	1.953	0.415
AKC02584	0.542	0.023	11.680	0.069	16.035	0.310	1.439	17.482	3.014	0.691	2.412	0.339	1.834	0.418
AKC02590	0.470	0.019	10.748	0.090	15.730	0.290	1.323	16.299	2.895	0.659	2.300	0.324	1.740	0.401
AKC02591	0.608	0.010	13.395	0.093	8.102	0.265	1.075	22.470	3.757	0.880	2.946	0.419	2.104	0.489
AKC02587	0.246	0.678	12.983	0.881	22.780	0.731	4.912	14.649	3.382	0.622	3.357	0.435	2.922	0.572
AKC02588	0.460	1.335	15.108	1.342	11.552	0.304	2.414	17.685	3.806	0.781	2.966	0.501	3.182	0.683
AKC02586	0.344	1.972	11.281	0.576	11.522	1.156	3.332	12.462	2.682	0.686	2.402	0.511	2.170	0.536
AKC02594b	0.362	3.731	8.307	0.309	1.121	0.854	2.197	7.081	1.896	0.352	1.572	0.213	1.406	0.456
AKC02595	1.492	6.832	8.629	0.414	2.313	1.754	2.606	9.311	2.183	0.446	2.774	0.367	2.025	0.377
AKC02592	2.884	8.628	5.259	1.346	3.185	0.467	1.231	6.122	1.263	0.291	1.620	0.178	1.029	0.246
AKC02594y	13.526	83.769	9.264	4.093	2.868	126.714	3.673	14.289	5.979	1.039	3.571	3.218	6.146	2.042
AKC02593	0.361	0.240	11.681	0.299	23.189	0.819	0.430	11.652	2.407	0.770	1.967	0.259	1.721	0.497
AKC02596	0.672	0.710	15.518	0.422	11.157	0.427	0.775	23.962	4.812	0.899	3.538	0.431	3.116	0.624
AKC02057	0.341	0.577	5.793	2.324	0.743	1.180	40.130	8.199	1.741	0.286	1.395	0.282	1.532	0.249
AKC02039	0.190	0.092	6.972	0.809	0.763	0.714	33.747	8.002	1.600	0.264	1.269	0.194	1.216	0.244
AKC02043	0.222	0.185	6.993	1.240	1.052	1.204	46.678	7.904	1.670	0.275	1.435	0.193	1.246	0.268
AKC02038	0.216	0.072	7.658	0.871	0.911	1.980	73.822	7.911	1.519	0.341	1.469	0.213	1.393	0.286
AKC02045	0.382	0.331	13.408	2.616	6.534	0.435	1.093	15.385	3.329	0.918	2.561	0.357	2.111	0.384
AKC02046	0.488	0.247	10.572	11.701	5.193	0.314	4.746	19.213	3.294	0.950	2.464	0.360	1.823	0.351
AKC02047	0.607	0.000	9.654	0.225	4.439	0.439	1.518	18.645	2.993	0.754	2.495	0.266	1.685	0.411
AKC02050	0.504	0.378	14.908	0.355	10.557	0.773	1.446	16.689	3.347	0.912	2.356	0.412	1.997	0.524
AKC02048	0.649	0.616	8.611	2.727	5.091	0.420	0.947	17.561	2.871	0.791	2.119	0.265	1.631	0.332
AKC02052	1.268	0.442	12.035	0.159	8.619	0.650	1.770	30.505	5.315	0.776	3.864	0.485	2.607	0.401
AKC02051	0.361	0.383	17.750	0.149	3.452	0.810	0.832	19.179	3.485	0.921	2.460	0.455	3.313	0.632

Database ID	Ta	Au	Y	Bi	U	W	Mo	Nd	Sm	Eu	Gd	Tb	Dy	Ho
AKC02032	0.383	0.050	15.099	7.191	19.203	0.326	1.038	15.892	3.291	0.843	2.889	0.409	2.712	0.538
AKC02034	0.431	0.202	8.485	0.686	6.816	0.219	0.921	17.283	2.765	0.697	2.113	0.268	1.484	0.292
AKC02037	0.459	0.779	14.806	0.263	5.056	0.337	2.083	27.256	4.923	1.265	3.628	0.487	2.850	0.541
AKC02031	0.052	0.367	2.999	11.854	0.366	0.198	1.077	2.276	0.495	0.093	0.433	0.071	0.464	0.088
AKC02033	0.029	0.129	2.256	1.601	0.130	0.109	0.167	1.211	0.243	0.042	0.258	0.044	0.305	0.059
AKC02035	0.064	0.146	0.701	318.964	0.102	0.446	1.431	1.064	0.233	0.029	0.158	0.028	0.119	0.030
AKC02053	0.092	0.484	1.567	1.957	0.151	0.250	0.791	1.071	0.427	0.092	0.417	0.057	0.395	0.103
AKC02049	0.399	0.465	11.189	0.558	20.697	0.701	2.980	13.190	3.328	0.776	2.573	0.451	2.657	0.432
AKC02054	0.245	0.573	4.019	0.242	0.785	0.773	1.813	2.706	1.428	0.287	1.407	0.227	0.681	0.201
AKC02044	0.249	0.048	6.059	0.082	0.952	1.082	9.764	7.067	1.546	0.343	1.262	0.188	1.145	0.244
AKC02036	0.698	0.170	12.792	19.861	14.042	3.983	13.147	13.301	2.717	0.473	2.364	0.411	2.384	0.481
AKC02055	0.365	0.000	10.477	2.630	1.179	0.615	0.667	9.982	2.451	0.575	2.267	0.353	2.215	0.386
AKC02056	0.814	0.588	5.211	0.452	1.955	1.171	1.297	4.175	1.504	0.401	1.669	0.195	1.287	0.382
AKC02059	0.254	0.500	10.211	1.061	0.347	0.676	12.181	8.899	2.451	0.588	2.106	0.432	3.351	0.469
AKC02058	0.254	0.401	8.733	1.704	1.145	1.286	50.072	10.213	2.616	0.379	1.693	0.281	1.872	0.294
AKC00727	0.185	0.422	15.792	0.262	0.964	0.333	2.477	17.935	5.453	1.515	4.416	0.815	4.590	0.939
AKC00728	0.352	0.200	9.675	28.412	0.743	0.496	16.635	8.991	1.646	0.421	1.729	0.263	1.700	0.341
AKC00729	0.263	0.253	12.774	3.236	0.615	0.753	3.600	12.471	3.025	0.798	2.462	0.471	2.812	0.543
AKC00650	0.583	0.074	10.685	0.028	0.758	0.504	33.282	11.644	2.705	0.586	2.217	0.343	2.463	0.491
AKC00649	0.442	0.050	10.438	0.043	0.976	0.392	17.957	13.032	3.098	0.635	2.407	0.383	2.289	0.421
AKC02001	0.509	0.332	17.397	0.135	10.870	0.272	1.175	18.109	3.858	0.995	3.202	0.505	2.953	0.707
AKC02002	0.407	0.168	14.919	0.077	7.781	0.239	0.375	20.230	3.585	1.012	2.859	0.453	2.499	0.596
AKC02003	0.278	0.300	7.655	0.092	25.152	0.368	2.273	7.865	2.197	0.548	1.564	0.282	1.851	0.426
AKC02004	0.601	0.378	8.575	0.951	5.555	0.352	0.776	22.405	3.439	0.985	2.110	0.283	1.498	0.319
AKC02005	0.465	1.202	12.944	4.326	6.875	0.432	0.693	13.896	2.859	0.728	2.164	0.380	2.303	0.582
AKC02006	0.334	0.245	11.901	0.200	1.298	0.368	3.598	12.189	3.083	0.707	2.437	0.428	2.406	0.528

Database ID	Ta	Au	Y	Bi	U	W	Mo	Nd	Sm	Eu	Gd	Tb	Dy	Ho
AKC02007	0.363	2.004	11.293	2.607	6.242	0.280	1.034	15.772	2.924	0.871	2.814	0.387	2.442	0.542
AKC02008	0.383	0.244	10.609	1.950	21.679	0.205	1.343	11.737	2.323	0.654	1.817	0.303	1.834	0.373
AKC02009	0.599	1.264	9.374	0.536	13.769	0.146	0.588	15.071	3.089	0.942	2.256	0.289	1.522	0.409
AKC02010	0.238	0.380	10.018	0.052	0.848	0.317	0.783	10.275	2.781	0.716	2.071	0.392	2.065	0.439
AKC02012	0.802	0.236	11.170	0.117	5.698	0.374	0.492	25.649	4.629	0.940	2.787	0.402	1.989	0.409
AKC02013	1.596	0.518	17.545	6.361	7.608	1.729	1.907	17.872	4.886	1.894	3.643	1.623	4.133	1.926
AKC02014	1.199	0.483	12.623	14.903	7.165	1.121	2.025	17.486	3.886	1.367	3.086	1.070	2.690	1.284
AKC02015	1.095	0.120	15.119	0.911	12.899	0.978	3.873	16.557	4.721	1.645	4.197	1.380	3.859	1.470
AKC02016	1.460	0.526	10.459	1.092	1.651	1.365	42.558	13.343	4.663	2.045	3.471	1.659	3.529	1.816
AKC02019	0.556	0.149	8.634	0.155	10.250	0.358	0.408	19.186	3.494	0.813	2.507	0.374	2.216	0.407
AKC02020	0.390	0.250	8.782	0.440	6.161	0.118	0.847	20.128	3.270	0.733	2.241	0.271	1.535	0.265
AKC02021	0.389	0.279	15.688	5.596	6.229	0.298	0.992	15.653	3.042	0.680	2.719	0.356	2.707	0.552
AKC02022	0.446	0.446	9.790	0.753	9.766	0.257	0.660	18.361	3.301	0.743	2.273	0.312	1.797	0.381
AKC02023o	0.484	0.251	12.913	16.705	6.016	0.447	3.019	25.083	4.701	1.194	3.503	0.461	2.920	0.545
AKC02023r	0.452	0.029	12.698	0.485	7.166	0.279	1.966	22.380	4.171	1.012	2.841	0.422	2.273	0.406
AKC02024o	0.456	0.271	13.938	10.934	9.591	0.350	3.957	28.360	5.130	1.319	3.701	0.531	3.181	0.636
AKC02024r	0.525	0.381	14.878	1.066	5.846	0.390	2.219	23.036	4.112	1.088	3.213	0.468	2.567	0.582
AKC02025o	0.359	0.199	13.261	16.222	6.991	0.340	2.501	25.341	4.656	1.216	3.351	0.480	2.919	0.563
AKC02025r	0.482	0.190	13.438	0.884	6.497	0.349	2.495	24.567	4.633	1.203	3.204	0.425	2.664	0.525
AKC02026o	0.492	0.241	13.823	20.713	7.466	0.363	3.449	26.992	5.188	1.206	3.491	0.458	3.321	0.632
AKC02026r	0.419	0.141	14.128	0.835	6.401	0.334	1.787	22.634	4.272	0.971	3.017	0.456	2.539	0.505
AKC02027o	0.491	0.537	13.791	16.718	7.375	0.442	2.469	26.861	4.781	1.278	3.480	0.477	2.923	0.614
AKC02027r	0.489	0.247	14.525	0.828	7.507	0.408	2.598	26.132	5.207	1.274	3.701	0.513	3.046	0.644
AKC02028	0.818	0.220	12.554	22.013	16.744	4.156	10.415	12.934	2.517	0.424	2.190	0.348	2.187	0.431
AKC02029	0.264	0.166	10.821	0.994	0.955	0.482	1.020	14.124	3.426	0.785	3.023	0.426	2.989	0.555
AKC02030	0.823	0.408	14.741	16.333	20.574	3.921	9.944	14.662	3.227	0.557	2.994	0.410	2.973	0.551

Database ID	Ta	Au	Y	Bi	U	W	Mo	Nd	Sm	Eu	Gd	Tb	Dy	Ho
AKC01924	0.552	0.362	14.878	14.794	4.308	0.506	1.484	20.547	3.724	0.913	3.323	0.448	2.677	0.502
AKC01922	0.497	0.129	11.905	0.839	7.606	0.300	1.027	18.330	3.493	0.940	2.426	0.355	2.065	0.414
AKC01920	0.859	0.389	9.621	1.540	14.913	0.488	0.633	8.988	1.834	0.783	1.414	0.263	1.684	0.410
AKC01912	0.476	0.258	9.090	25.702	0.674	1.333	105.482	6.262	1.414	0.312	1.299	0.248	1.387	0.285
AKC01913	0.265	0.448	7.919	1.296	0.604	0.364	9.564	8.474	1.778	0.578	1.775	0.280	1.731	0.351
AKC01919	0.761	4.645	25.757	6.872	14.129	0.456	2.944	34.959	6.530	1.142	5.029	0.766	4.647	0.975
AKC00224	0.569	0.557	18.430	0.836	6.549	0.428	0.709	23.180	4.213	1.027	3.197	0.535	3.319	0.663
AKC00121	0.471	0.093	15.443	0.148	8.261	0.494	0.864	20.162	3.622	0.918	2.529	0.425	2.678	0.573
AKC00105	0.415	0.212	16.778	2.721	5.688	0.446	0.699	18.392	3.389	0.883	2.842	0.445	2.871	0.587
AKC00214	0.371	0.340	16.077	2.587	5.902	0.304	0.756	16.656	3.404	0.889	2.817	0.435	2.733	0.590
AKC00214b	0.550	0.378	15.265	1.081	6.983	0.352	0.635	17.752	3.179	0.786	2.762	0.396	2.649	0.562
AKC00090	0.453	0.226	6.940	0.778	22.779	0.304	0.326	9.741	1.582	0.777	1.261	0.181	1.201	0.233
AKC00080	0.527	0.216	10.427	3.394	10.869	0.370	1.492	21.970	3.600	0.761	2.586	0.345	1.967	0.386
AKC00069	0.766	0.312	9.731	23.613	6.709	0.709	1.278	32.493	5.146	1.035	3.231	0.373	1.976	0.369
AKC00291	0.291	0.150	6.722	3.379	3.769	0.306	1.193	11.111	1.746	0.612	1.653	0.187	1.140	0.245
AKC00087	0.484	0.172	18.485	0.316	13.440	0.294	1.536	21.060	3.983	0.862	3.792	0.521	3.044	0.720
AKC00081	0.547	0.266	13.784	0.585	10.737	0.683	0.523	18.445	3.060	0.931	2.522	0.358	2.379	0.511
AKC00116	0.673	0.315	13.870	1.305	7.684	0.395	0.854	23.858	3.875	1.064	2.721	0.374	2.445	0.508
AKC00115	0.603	0.201	14.582	0.972	6.893	1.021	0.833	17.456	2.867	0.855	2.728	0.417	2.460	0.493
AKC00095	0.439	0.155	7.910	0.163	7.108	0.281	0.938	17.286	2.499	0.752	2.250	0.228	1.388	0.335
AKC00118	0.314	0.172	11.647	0.915	8.660	0.320	1.261	11.345	2.188	0.683	1.847	0.300	1.798	0.404
AKC00240	0.437	0.327	18.589	0.094	9.110	0.365	0.446	19.184	3.629	1.017	3.097	0.460	3.118	0.726
AKC00245	0.391	0.206	18.178	0.068	7.581	0.265	0.697	21.251	3.846	0.978	3.139	0.486	3.053	0.611
AKC00254r	0.413	0.530	13.073	13.954	7.509	0.610	4.395	24.257	4.156	1.145	2.967	0.449	2.581	0.485
AKC00254o	0.396	0.247	14.108	14.930	8.505	0.472	4.782	26.620	4.725	1.205	3.583	0.454	2.477	0.546
AKC00284	0.370	0.319	13.982	1.588	9.859	0.225	7.876	23.908	4.088	1.166	3.224	0.452	2.538	0.509

Database ID	Ta	Au	Y	Bi	U	W	Mo	Nd	Sm	Eu	Gd	Tb	Dy	Ho
AKC00223	0.497	0.241	13.599	2.032	4.175	0.243	0.321	21.491	3.381	0.952	2.456	0.360	2.401	0.526
AKC00221	0.431	4.000	17.743	2.822	9.975	0.255	0.874	17.524	3.309	0.899	3.012	0.450	2.950	0.594
AKC00220	0.749	0.358	12.035	1.478	6.547	0.572	1.259	28.334	4.087	1.089	2.829	0.373	1.923	0.418
AKC00122	0.373	0.120	8.735	0.676	5.498	0.202	1.003	16.244	2.648	0.625	1.823	0.243	1.409	0.290
AKC00278	0.680	0.289	38.050	10.236	18.162	0.846	5.388	47.945	10.112	2.030	8.068	0.980	6.238	1.253
AKC00277	0.787	0.181	35.979	87.708	17.513	0.752	5.407	46.444	8.501	2.084	8.076	1.067	6.036	1.257
AKC00057	0.527	0.184	8.135	3.945	1.629	0.494	0.538	3.567	0.839	0.200	0.939	0.181	1.252	0.230
AKC00058	0.583	0.199	8.429	4.359	1.520	0.538	0.642	3.613	0.812	0.214	0.959	0.170	1.233	0.303
AKC00059	0.301	0.105	13.173	0.178	0.793	0.386	0.833	16.341	3.790	1.020	3.145	0.534	2.953	0.619
AKC00117	0.290	0.093	9.021	0.188	2.321	0.423	5.704	9.405	1.876	0.471	1.471	0.237	1.507	0.329
AKC01651	0.650	0.308	15.600	1.000	7.098	0.000	1.000	20.143	3.551	0.769	3.122	0.440	3.046	0.570
AKC01652	0.658	0.214	12.900	1.000	4.784	0.000	1.000	25.129	4.881	1.158	4.388	0.510	2.579	0.492
AKC01658	0.493	0.135	22.600	0.000	7.048	0.000	1.000	21.520	3.714	1.105	3.480	0.573	3.902	0.848
AKC01677	0.450	0.247	19.400	0.000	9.161	0.000	2.000	23.063	4.170	0.971	3.449	0.620	3.621	0.629
AKC01679	0.510	2.470	15.810	0.300	9.660	1.150	7.710	23.390	4.420	1.060	3.540	0.490	3.100	0.590
AKC01685	0.480	0.693	15.400	1.000	8.467	0.000	2.000	27.883	5.288	1.322	4.023	0.502	3.102	0.639
AKC01683	0.540	0.290	15.920	0.640	9.930	0.390	1.390	20.330	3.860	0.830	3.300	0.450	3.060	0.580
AKC01686	0.529	0.467	15.200	1.000	5.447	0.000	4.000	27.697	4.931	1.231	3.990	0.494	2.852	0.625
AKC01688	0.837	1.302	10.900	2.000	10.541	1.000	2.000	26.282	4.100	1.066	2.828	0.394	2.203	0.415
AKC01692	0.396	0.042	13.400	1.000	5.291	0.000	2.000	19.570	3.042	0.856	1.907	0.347	2.520	0.411
AKC01696	0.800	7.923	12.900	2.000	7.459	2.000	2.000	22.235	3.645	1.144	4.174	0.530	2.712	0.615
AKC01697	0.739	0.915	24.000	0.000	22.459	0.000	1.000	28.651	6.798	1.228	5.988	0.783	5.004	0.994
AKC01699	0.493	0.228	18.100	0.000	11.370	0.000	1.000	19.483	3.809	0.906	3.311	0.528	3.233	0.641
AKC01702	0.260	0.770	11.530	0.120	4.190	1.120	0.680	16.620	3.250	0.740	2.430	0.370	2.340	0.460
AKC01722	0.318	0.147	14.000	0.000	6.261	0.000	1.000	15.166	3.035	0.897	2.466	0.411	2.573	0.512
AKC01724	0.566	0.269	24.100	0.000	7.108	0.000	1.000	23.334	4.584	1.178	4.178	0.659	4.287	0.908

Database ID	Ta	Au	Y	Bi	U	W	Mo	Nd	Sm	Eu	Gd	Tb	Dy	Ho
AKC01726	0.441	0.884	12.600	0.000	7.358	0.000	0.000	20.895	3.326	0.998	3.292	0.424	2.222	0.514
AKC01727	0.281	0.563	14.600	0.000	5.896	0.000	1.000	18.691	3.652	1.043	3.139	0.407	2.604	0.500
AKC01729	0.450	0.550	20.650	2.360	34.160	0.480	1.520	16.850	3.870	0.960	3.430	0.540	3.970	0.750
AKC01731	0.523	2.072	20.200	0.000	22.369	0.000	1.000	19.136	3.930	0.892	3.957	0.556	3.657	0.747
AKC01731 bla	0.900	0.801	12.800	0.000	9.419	1.000	2.000	24.513	4.534	0.929	3.554	0.421	2.325	0.444
AKC01731 blb	0.452	0.415	19.500	1.000	10.532	0.000	1.000	18.913	3.877	0.981	3.946	0.551	3.701	0.773
AKC01731 blc	0.530	0.241	26.100	0.000	10.594	0.000	0.000	24.433	4.863	1.232	4.899	0.692	4.618	0.911
AKC01731 bld	0.440	0.328	24.800	0.000	7.345	0.000	1.000	23.707	4.633	1.214	4.808	0.659	4.433	0.948
AKC01731 ble	0.376	0.679	14.800	0.000	6.445	2.000	1.000	16.542	3.022	0.888	2.842	0.486	2.938	0.521
AKC01731 green	0.442	0.645	26.400	0.000	10.252	1.000	0.000	25.092	4.971	1.341	4.604	0.728	4.999	0.973
AKC01734	0.397	0.495	13.800	0.000	4.335	0.000	0.000	22.820	4.173	1.373	3.220	0.449	2.680	0.509
AKC01738	0.499	1.001	14.100	0.000	8.672	0.000	1.000	17.747	3.357	0.981	3.169	0.481	2.660	0.549
AKC01742	0.464	0.287	21.400	0.000	8.679	0.000	1.000	22.008	4.105	1.167	4.273	0.570	3.614	0.807
AKC01744	0.555	0.210	20.200	0.000	12.163	0.000	1.000	20.872	3.656	1.041	3.713	0.565	3.382	0.748
AKC01752	0.429	0.281	17.500	0.000	5.394	0.000	0.000	20.791	3.991	1.095	3.530	0.478	2.931	0.620
AKC01773	0.533	0.390	16.000	0.000	5.170	1.000	2.000	20.016	3.653	0.848	3.325	0.530	2.827	0.593
AKC01774	0.270	0.362	10.700	0.000	11.516	0.000	1.000	12.089	2.509	0.727	2.128	0.351	2.061	0.434
AKC01775	0.385	0.303	20.100	0.000	7.697	0.000	1.000	19.233	3.791	0.981	3.631	0.536	3.183	0.720
AKC01779	0.510	0.640	15.970	4.110	13.050	0.240	5.800	23.690	4.440	1.170	3.520	0.550	2.880	0.660
AKC01779y	0.660	0.660	22.170	22.230	21.400	0.380	3.880	26.930	5.280	1.120	4.740	0.650	4.050	0.880
AKC01780	0.620	0.550	22.410	9.790	24.100	0.280	15.060	25.570	5.510	1.210	4.410	0.680	4.150	0.870
AKC01790	0.530	2.610	20.990	0.160	24.460	0.540	1.920	23.060	5.310	1.000	4.900	0.860	4.290	0.860
AKC01791	1.070	0.460	16.990	0.130	14.410	0.960	0.780	34.810	6.120	1.320	4.750	0.630	3.470	0.730

Database ID	Ta	Au	Y	Bi	U	W	Mo	Nd	Sm	Eu	Gd	Tb	Dy	Ho
AKC01808	0.400	3.470	21.210	0.190	10.870	0.520	0.890	19.940	4.080	1.060	3.510	0.580	3.740	0.820
AKC01695	0.575	0.734	9.171	0.322	1.773	0.750	1.984	8.100	1.542	0.429	1.272	0.352	1.363	0.396
AKC01700 black	0.343	0.857	5.788	0.188	0.827	0.164	0.423	6.404	0.996	0.493	1.197	0.308	2.287	0.231
AKC01700 red trim	0.227	0.199	5.658	0.101	0.827	0.130	0.433	5.227	1.028	0.329	1.009	0.164	0.969	0.214
AKC00443	0.207	0.042	8.227	0.036	61.230	0.703	5.746	11.892	2.866	0.824	2.599	0.384	2.036	0.458
AKC00452	0.339	0.127	4.197	0.691	1.050	0.421	1.072	7.451	1.588	0.266	1.286	0.231	1.119	0.235
AKC00464	0.260	0.170	8.348	0.142	1.101	0.434	1.318	9.838	2.343	0.521	2.222	0.326	2.012	0.358
AKC00466	0.182	0.430	5.215	0.090	32.868	0.791	1.915	10.131	2.244	0.757	2.174	0.343	1.387	0.349
AKC00473	0.192	0.074	15.932	0.020	0.463	0.166	1.903	21.203	6.485	1.634	5.667	0.795	5.505	0.960
AKC00485	0.202	0.651	7.654	0.117	1.226	0.651	12.066	12.139	3.426	0.896	2.583	0.457	2.545	0.467
AKC00487	0.315	0.059	16.283	0.022	0.474	0.556	1.711	21.873	6.988	1.936	5.320	0.894	5.533	1.029
AKC00516	0.374	0.281	11.031	0.113	0.729	0.400	0.863	13.856	3.377	0.936	2.966	0.457	2.851	0.554
AKC00541	0.362	0.758	11.165	0.049	0.915	0.461	0.994	14.298	4.216	1.068	3.280	0.521	3.102	0.563
AKC00545	0.316	0.073	9.836	0.321	0.819	0.388	1.308	12.025	2.869	0.792	2.348	0.387	2.238	0.484
AKC00550	0.192	0.101	6.257	0.224	16.105	0.364	1.913	11.800	1.952	0.644	1.595	0.204	1.061	0.265
AKC00564	0.249	0.048	8.201	0.030	1.032	0.253	0.990	8.914	2.159	0.477	2.173	0.336	1.715	0.337
AKC00569	0.551	0.068	12.058	19.855	1.306	0.474	15.578	10.666	2.491	0.504	1.798	0.363	2.347	0.576
AKC00572	0.413	0.268	9.899	0.239	1.308	1.383	8.864	9.555	2.679	0.609	2.562	0.438	1.951	0.492
AKC00573	0.280	0.303	11.817	0.024	1.591	0.427	1.367	15.764	3.849	1.023	3.289	0.570	3.059	0.564
AKC00579	0.163	0.799	4.974	0.443	0.227	0.926	3.082	3.517	1.694	0.412	1.463	0.258	1.030	0.233
AKC00596	0.151	0.362	13.935	0.166	0.368	0.190	3.217	16.763	5.081	1.421	3.753	0.724	4.497	0.825
AKC00597	0.224	0.196	7.819	0.196	0.750	0.302	5.135	9.403	2.217	0.451	1.728	0.271	1.482	0.326
AKC00605	0.197	0.221	12.312	0.012	1.103	0.394	29.588	14.378	4.540	1.144	3.235	0.569	3.202	0.649
AKC00624	0.132	0.065	15.907	0.045	0.632	0.149	13.302	22.155	6.199	1.819	5.169	0.938	5.414	0.962
AKC00628	0.173	0.243	4.271	0.094	0.437	0.369	0.731	5.176	1.079	0.260	0.745	0.168	0.676	0.186

Database ID	Ta	Au	Y	Bi	U	W	Mo	Nd	Sm	Eu	Gd	Tb	Dy	Ho
AKC00630	0.576	0.074	13.832	0.733	1.801	0.718	17.449	14.271	3.245	0.759	3.077	0.501	3.530	0.683
AKC00632	0.392	0.082	10.499	0.264	0.923	0.459	18.202	12.529	2.716	0.640	2.116	0.389	2.249	0.435
AKC00633	0.325	0.165	7.670	0.129	0.908	0.517	18.109	9.167	1.930	0.404	2.014	0.263	1.452	0.276
AKC00634	0.225	1.064	5.847	0.303	0.634	0.627	3.138	5.427	1.546	0.366	1.074	0.193	1.237	0.237
AKC00641	0.305	0.089	8.907	1.327	1.105	1.090	42.084	9.140	2.003	0.381	1.589	0.275	1.570	0.338
AKC00662	0.404	0.347	12.484	0.212	52.488	0.661	0.980	13.269	3.048	1.178	2.884	0.596	3.049	0.750
AKC00672	0.229	0.208	7.558	0.170	0.804	0.426	18.235	8.381	2.589	0.443	1.928	0.265	1.749	0.316
AKC00677	0.332	0.369	7.287	0.231	16.530	1.188	1.733	13.984	3.572	1.038	2.596	0.487	2.559	0.462
AKC00683	0.278	0.264	12.374	0.037	58.461	0.436	1.015	15.881	3.997	1.351	2.937	0.535	3.365	0.651
AKC00686	0.468	0.159	10.326	0.090	1.216	0.776	7.474	10.885	2.625	0.558	2.616	0.357	1.788	0.413
AKC00689	0.369	0.076	8.098	0.136	1.068	0.360	19.283	11.225	2.487	0.510	2.458	0.382	1.794	0.379
AKC00726	0.126	0.035	3.612	0.163	0.339	0.387	0.679	2.269	0.595	0.177	0.381	0.114	0.441	0.150
AKC0733	0.821	0.152	5.035	0.441	35.246	0.614	1.953	8.452	2.879	1.023	1.961	0.926	1.504	0.684
AKC0734	0.224	0.338	6.465	0.154	14.272	0.315	1.583	12.236	2.772	1.046	2.139	0.538	2.040	0.512
AKC0735	0.403	0.054	12.300	1.000	51.424	0.000	1.000	14.107	3.507	1.248	2.901	0.584	3.068	0.634
AKC0736	0.286	6.163	3.400	0.000	1.264	1.000	1.000	5.214	1.049	0.230	0.956	0.116	0.769	0.223
AKC0737	0.387	0.064	9.500	0.000	1.186	0.000	1.000	7.791	2.083	0.621	2.052	0.340	2.017	0.374
AKC0738	0.141	0.066	14.200	0.000	0.582	0.000	10.000	18.799	5.307	1.513	4.427	0.753	5.137	0.798
AKC0739	0.260	0.217	9.300	0.000	0.965	1.000	4.000	6.029	2.093	0.497	2.464	0.353	1.940	0.386
AKC0740	0.116	0.076	14.100	0.000	0.323	0.000	1.000	18.628	5.217	1.583	4.245	0.770	4.075	0.743
AKC0741	0.178	0.458	7.100	2.000	0.934	4.000	166.000	8.197	1.814	0.318	1.756	0.246	1.369	0.280
AKC0742	0.105	0.056	14.628	0.045	0.283	0.117	2.461	15.256	4.311	1.267	3.556	0.614	3.763	0.762
AKC0743	0.114	0.068	15.040	0.189	0.330	0.154	2.746	19.002	5.441	1.615	4.634	0.786	5.072	0.905
AKC0744	0.117	0.071	15.082	0.087	0.323	0.106	2.648	19.009	5.609	1.556	4.357	0.804	4.609	0.883
AKC0745	0.114	0.102	14.570	0.103	0.335	0.141	2.715	19.238	5.560	1.533	4.320	0.766	4.855	0.860
AKC0746	0.180	0.083	7.965	0.037	0.904	0.250	21.439	14.864	3.788	1.015	2.895	0.511	2.828	0.498

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AKC0747	0.194	0.254	5.140	0.163	0.755	1.180	14.191	6.351	1.384	0.413	1.510	0.264	1.215	0.347
AKC0748	0.264	0.085	7.900	0.000	1.037	0.000	7.000	9.137	2.101	0.501	2.252	0.331	1.837	0.346
AKC0749	0.259	0.555	6.228	0.297	14.249	0.572	2.292	11.420	1.772	0.582	1.402	0.195	1.047	0.188
AKC0750	0.134	0.362	5.650	0.167	52.799	0.861	6.786	8.128	1.475	0.394	1.125	0.173	0.974	0.186
AKC0751	0.201	0.101	7.071	1.649	0.829	1.578	37.794	7.261	1.501	0.271	1.080	0.201	1.130	0.264
AKC0752	0.281	0.392	8.317	4.155	1.001	1.725	50.335	8.586	1.571	0.367	1.428	0.292	1.433	0.286
AKC0753	0.531	0.135	10.700	27.000	0.970	0.000	3.000	8.751	1.842	0.416	1.850	0.280	1.800	0.472
AKC0754	0.501	0.141	20.986	1.438	4.180	0.762	3.623	22.623	4.196	1.067	4.774	0.599	3.543	0.757
AKC0755	0.114	0.104	15.915	0.071	0.452	0.142	3.041	21.292	6.470	1.740	5.037	0.818	5.621	1.026
AKC0756	0.364	0.052	13.600	0.000	1.277	0.000	2.000	20.232	5.469	1.398	4.259	0.716	4.216	0.786
AKC0757	0.423	0.046	9.300	0.000	1.441	0.000	1.000	10.871	3.470	0.594	2.358	0.350	2.068	0.383
AKC0758	0.261	0.508	6.886	2.534	0.989	6.387	182.377	7.756	1.579	0.244	1.348	0.215	1.431	0.279
AKC00939	0.223	0.013	10.932	0.041	33.950	0.112	3.261	18.412	4.890	1.199	3.607	0.582	3.915	0.718
AKC01084	0.275	0.000	11.591	0.035	32.104	0.147	3.306	20.477	5.420	1.390	4.015	0.669	4.196	0.794
AKC00912	0.284	0.000	12.955	0.066	39.673	0.196	4.024	24.298	6.628	1.626	4.922	0.743	5.046	0.906
AKC01073 violet	0.168	0.007	6.393	0.046	0.778	0.127	1.031	7.267	1.474	0.317	1.606	0.212	1.285	0.244
AKC01073 blue	0.222	0.009	10.590	0.058	0.738	0.196	0.796	11.423	2.481	0.693	2.654	0.362	2.168	0.444
AKC01066	0.258	0.000	10.553	0.064	1.029	0.302	0.844	14.466	3.571	0.851	2.637	0.517	2.678	0.547
AKC00909	0.185	0.139	5.261	0.256	0.488	0.232	0.905	5.088	1.090	0.219	0.753	0.118	0.980	0.222
AKC00910	0.193	0.000	4.634	0.054	0.539	0.557	42.448	7.367	1.791	0.422	1.518	0.226	1.434	0.226
AKC00959_ dkblue	0.565	0.099	7.648	2.103	1.681	0.144	0.498	3.415	0.870	0.135	0.804	0.135	0.932	0.231
AKC00959_ red	0.286	0.127	14.466	2.000	4.638	0.165	0.915	14.546	2.592	0.709	2.403	0.325	1.970	0.455
AKC00959_ yellow	0.805	0.331	9.650	0.211	5.883	0.152	2.294	10.434	2.184	0.902	1.713	0.289	1.480	0.308

Database ID	Ta	Au	Y	Bi	U	W	Mo	Nd	Sm	Eu	Gd	Tb	Dy	Ho
AKC00959_turq	0.438	0.088	19.837	1.274	6.048	0.249	0.688	17.517	3.442	0.776	2.821	0.458	3.065	0.608
AKC01071_yellow	0.421	0.208	15.177	0.288	17.744	0.149	0.637	18.454	3.329	0.908	2.786	0.384	2.551	0.537
AKC01071_blue	0.569	0.428	8.909	0.635	10.690	0.100	0.462	15.159	2.938	1.009	2.380	0.283	1.601	0.363
AKC00959_orange	0.424	0.081	16.473	14.379	6.290	0.229	3.379	23.026	4.183	0.844	3.230	0.448	2.663	0.550
AKC01057o	0.604	2.390	14.840	0.082	6.807	0.151	3.144	18.705	3.432	0.892	3.007	0.398	2.627	0.510
AKC01071o	0.328	2.050	11.396	4.451	8.129	0.189	3.476	16.875	3.350	0.787	2.289	0.361	2.022	0.412
AKC01043b	1.139	0.019	24.386	0.041	3.255	0.651	0.379	28.566	5.667	1.070	5.111	0.730	4.714	1.032
AKC0104w	0.191	2.952	6.462	0.492	9.890	0.129	1.480	6.396	1.326	0.370	1.360	0.199	1.201	0.267
AKC01059b	0.284	52.252	12.071	0.895	2.565	0.473	16.200	18.452	4.863	1.195	3.644	0.566	3.730	0.667
AKC0105w	0.346	1.678	8.952	0.317	12.286	0.262	3.668	11.359	2.514	0.672	2.046	0.336	1.788	0.394
AKC01057_gold	0.253	18.969	8.461	0.094	1.383	0.132	0.519	7.413	1.728	0.365	1.299	0.239	1.379	0.299
AKC01093	0.139	0.570	1.076	9.994	0.127	0.274	0.140	0.885	0.310	0.054	0.273	0.019	0.126	0.031
AKC00901	0.219	0.854	6.971	0.781	0.878	0.480	19.258	7.079	1.403	0.275	1.307	0.197	1.103	0.227
AKC01022	0.339	0.219	6.252	0.192	0.794	0.826	0.726	15.282	2.006	0.559	1.503	0.212	1.399	0.287
AKC00410	0.200	0.220	21.921	0.041	0.677	0.239	1.041	13.559	3.969	1.032	4.147	0.762	4.916	0.908
AKC00413	0.284	0.106	13.872	0.106	0.766	0.192	0.467	18.415	4.389	1.213	4.199	0.683	4.440	0.704
AKC00416	0.318	0.076	15.124	0.304	0.855	0.223	0.736	17.383	4.133	1.213	3.587	0.646	3.704	0.708
AKC00327	0.347	2.852	11.896	0.218	1.225	0.342	1.365	12.811	3.421	0.826	3.133	0.482	2.714	0.537
AKC00322	0.145	0.242	5.143	0.057	1.094	0.186	3.400	5.462	1.171	0.310	1.265	0.170	1.033	0.203
AKC00386	0.603	0.240	3.379	4.935	0.694	0.401	1.519	3.118	0.751	0.118	0.495	0.101	0.597	0.103
AKC00412	0.242	0.167	11.630	0.090	0.577	0.505	0.686	14.004	3.356	0.917	2.799	0.493	2.973	0.540
AKC00425a	0.306	0.087	17.120	0.090	0.825	0.327	5.457	19.742	5.242	1.406	4.463	0.803	4.268	0.852
AKC00425b	0.290	0.081	11.024	0.092	0.854	0.531	1.360	12.874	2.866	0.664	2.274	0.343	2.095	0.416
AKC00372	0.474	0.322	13.060	0.115	0.910	0.396	0.502	15.335	3.920	0.915	3.031	0.508	3.046	0.587

Database ID	Ta	Au	Y	Bi	U	W	Mo	Nd	Sm	Eu	Gd	Tb	Dy	Ho
AKC00381	0.235	0.199	2.236	1.740	0.308	0.237	5.092	3.346	0.952	0.548	0.867	0.109	0.466	0.101
AKC00389	0.178	0.113	2.177	1.730	0.401	0.278	5.584	2.805	0.646	0.152	0.545	0.106	0.470	0.094
AKC00376	0.223	0.659	3.618	1.484	1.129	0.314	4.723	3.762	0.914	0.259	0.749	0.120	0.707	0.132
AKC00424g	0.450	0.082	2.934	0.334	0.624	0.245	0.508	2.197	0.483	0.127	0.468	0.090	0.413	0.093
AKC0042w	0.581	0.268	3.778	0.491	0.709	0.399	0.676	3.260	0.540	0.230	0.716	0.107	0.835	0.105

Database ID	Er	Tm	Yb	Lu	Hf	Th
AKC02589	2.001	0.300	1.698	0.333	40.679	48.194
AKC02519	1.668	0.259	1.775	0.291	11.895	8.196
AKC02585	1.106	0.175	1.179	0.202	17.042	16.487
AKC02584	1.075	0.158	1.151	0.197	18.293	15.871
AKC02590	1.038	0.162	1.099	0.191	16.527	20.598
AKC02591	1.227	0.185	1.192	0.210	10.462	25.283
AKC02587	1.541	0.255	1.871	0.314	4.069	5.664
AKC02588	1.901	0.312	1.951	0.320	9.354	6.866
AKC02586	1.363	0.189	1.410	0.323	6.382	5.974
AKC02594b	5.087	1.272	5.688	0.380	4.442	2.201
AKC02595	1.206	0.459	4.252	0.235	7.282	4.813
AKC02592	0.706	0.228	1.032	0.121	4.032	2.592
AKC02594y	2.307	2.581	28.930	8.553	58.890	13.277
AKC02593	1.247	0.276	1.179	0.233	8.416	4.039
AKC02596	1.617	0.209	1.756	0.363	19.148	9.490
AKC02057	0.872	0.208	1.395	0.204	2.120	3.009
AKC02039	0.660	0.089	0.763	0.108	3.148	4.683
AKC02043	0.763	0.098	0.738	0.111	2.102	4.405
AKC02038	0.808	0.116	0.877	0.134	2.124	3.825
AKC02045	1.232	0.188	1.586	0.317	10.113	5.318
AKC02046	1.358	0.170	1.196	0.167	7.612	5.675
AKC02047	0.792	0.192	0.941	0.235	14.260	13.607
AKC02050	1.724	0.230	1.550	0.279	13.606	6.291
AKC02048	0.831	0.182	1.278	0.184	13.076	13.754
AKC02052	1.587	0.217	1.514	0.334	24.963	20.402
AKC02051	1.575	0.263	1.850	0.354	4.909	5.305
AKC02032	1.569	0.221	1.681	0.244	8.844	8.217

Database ID	Er	Tm	Yb	Lu	Hf	Th
AKC02034	0.789	0.139	0.952	0.156	15.678	13.951
AKC02037	1.457	0.194	1.454	0.213	5.407	6.899
AKC02031	0.271	0.026	0.197	0.025	0.303	0.624
AKC02033	0.157	0.023	0.125	0.019	0.101	0.300
AKC02035	0.059	0.013	0.056	0.013	0.105	0.615
AKC02053	0.354	0.076	0.608	0.099	0.357	0.343
AKC02049	1.727	0.318	1.809	0.439	4.491	4.106
AKC02054	0.590	0.254	0.994	0.227	1.613	1.282
AKC02044	0.651	0.139	0.683	0.156	3.187	2.084
AKC02036	1.329	0.170	1.284	0.175	1.695	8.414
AKC02055	1.052	0.198	0.985	0.177	2.885	4.209
AKC02056	1.146	0.338	1.257	0.378	6.463	5.419
AKC02059	1.194	0.213	1.648	0.208	0.900	0.338
AKC02058	1.215	0.260	1.298	0.250	2.577	4.856
AKC00727	2.516	0.310	2.219	0.332	1.162	1.299
AKC00728	0.924	0.140	1.025	0.143	3.193	4.325
AKC00729	1.575	0.204	1.669	0.210	2.909	3.265
AKC00650	1.397	0.229	1.738	0.201	3.414	4.188
AKC00649	1.378	0.191	1.449	0.247	4.219	4.595
AKC02001	1.881	0.313	2.188	0.338	13.284	7.271
AKC02002	1.567	0.233	1.710	0.263	12.688	7.281
AKC02003	1.084	0.244	1.277	0.235	3.822	3.624
AKC02004	0.879	0.148	1.119	0.165	19.495	18.526
AKC02005	1.441	0.278	2.199	0.291	13.225	6.163
AKC02006	1.451	0.239	1.532	0.257	3.930	4.415
AKC02007	1.544	0.306	2.026	0.474	12.246	7.205
AKC02008	1.119	0.227	1.469	0.273	8.960	7.189

Database ID	Er	Tm	Yb	Lu	Hf	Th
AKC02009	1.179	0.164	1.408	0.238	11.932	8.536
AKC02010	1.337	0.213	1.253	0.183	2.493	2.976
AKC02012	1.165	0.162	1.360	0.244	17.398	15.657
AKC02013	2.957	1.812	3.608	1.889	16.949	8.775
AKC02014	2.050	1.049	2.383	1.007	16.761	14.247
AKC02015	2.707	0.975	2.724	1.006	8.203	5.974
AKC02016	2.523	1.141	2.928	1.278	1.675	3.321
AKC02019	1.046	0.209	1.157	0.133	8.903	8.221
AKC02020	0.834	0.122	0.807	0.121	10.718	19.798
AKC02021	1.619	0.215	1.619	0.230	12.721	7.416
AKC02022	1.032	0.161	1.085	0.248	13.647	18.402
AKC02023orange	1.536	0.232	1.335	0.215	9.821	8.774
AKC02023red	1.310	0.209	1.201	0.188	10.698	9.265
AKC02024orange	1.640	0.309	1.629	0.222	10.984	9.418
AKC02024red	1.687	0.258	1.568	0.222	15.712	9.203
AKC02025orange	1.616	0.219	1.586	0.231	10.301	9.734
AKC02025red	1.515	0.229	1.435	0.218	11.430	9.007
AKC02026orange	1.683	0.236	1.743	0.263	11.933	10.227
AKC02026red	1.451	0.208	1.287	0.184	11.475	10.305
AKC02027orange	1.471	0.267	1.636	0.200	11.103	9.877
AKC02027red	1.520	0.275	1.601	0.262	12.828	10.069
AKC02028	1.345	0.183	1.296	0.195	1.582	8.873
AKC02029	1.592	0.232	1.398	0.212	3.445	3.484
AKC02030	1.752	0.285	1.606	0.255	6.856	9.445
AKC01924	1.370	0.210	1.325	0.190	8.724	7.840
AKC01922	1.222	0.153	1.198	0.167	9.566	8.567
AKC01920	1.144	0.166	1.388	0.202	6.566	7.188

Database ID	Er	Tm	Yb	Lu	Hf	Th
AKC01912	0.895	0.172	1.156	0.168	3.255	2.993
AKC01913	0.880	0.141	0.992	0.100	2.416	2.301
AKC01919	2.754	0.379	2.563	0.430	13.598	9.053
AKC00224	1.956	0.263	1.887	0.341	11.910	9.569
AKC00121	1.733	0.289	1.822	0.305	11.500	7.685
AKC00105	1.759	0.252	1.889	0.283	15.180	7.414
AKC00214	1.649	0.247	1.722	0.349	14.081	7.212
AKC00214b	1.516	0.257	1.557	0.266	10.384	8.211
AKC00090	0.749	0.124	0.876	0.155	8.718	6.155
AKC00080	1.157	0.177	1.203	0.213	17.298	19.447
AKC00069	1.050	0.182	1.007	0.193	15.837	21.721
AKC00291	0.573	0.116	0.694	0.118	10.481	8.838
AKC00087	1.695	0.244	1.830	0.268	8.512	15.428
AKC00081	1.510	0.255	1.597	0.297	14.307	7.538
AKC00116	1.380	0.283	1.525	0.297	17.424	12.767
AKC00115	1.711	0.255	1.470	0.279	9.313	7.995
AKC00095	0.756	0.145	0.955	0.178	17.036	14.974
AKC00118	1.196	0.190	1.621	0.245	12.228	5.857
AKC00240	2.404	0.274	2.417	0.368	12.242	7.444
AKC00245	1.879	0.266	1.987	0.298	10.886	7.382
AKC00254red	1.403	0.197	1.188	0.265	9.995	8.544
AKC00254orange	1.559	0.210	1.468	0.208	9.986	9.005
AKC00284	1.399	0.251	1.234	0.176	7.168	9.013
AKC00223	1.506	0.224	1.620	0.257	9.423	7.576
AKC00221	1.790	0.257	2.237	0.310	13.276	7.435
AKC00220	1.246	0.157	1.466	0.236	28.388	21.280
AKC00122	0.840	0.100	0.937	0.137	13.350	12.119

Database ID	Er	Tm	Yb	Lu	Hf	Th
AKC00278	3.503	0.452	3.084	0.491	14.067	11.745
AKC00277	3.420	0.419	3.044	0.541	13.540	11.996
AKC00057	0.882	0.146	0.973	0.186	1.152	3.035
AKC00058	0.900	0.159	1.130	0.193	1.599	3.089
AKC00059	1.716	0.258	1.570	0.249	3.226	3.980
AKC00117	0.862	0.156	0.965	0.135	5.545	3.421
AKC01651	1.728	0.270	1.855	0.274	13.604	8.849
AKC01652	1.183	0.202	1.389	0.264	11.981	10.840
AKC01658	2.496	0.351	2.875	0.452	18.592	9.940
AKC01677	1.842	0.249	1.758	0.305	6.185	13.181
AKC01679	1.720	0.230	1.750	0.250	9.800	12.280
AKC01685	1.589	0.210	1.582	0.208	5.946	9.469
AKC01683	1.710	0.250	1.860	0.260	21.030	9.690
AKC01686	1.527	0.171	1.477	0.282	10.311	8.800
AKC01688	1.242	0.199	1.529	0.258	25.543	22.638
AKC01692	1.292	0.122	1.135	0.175	11.615	7.422
AKC01696	1.426	0.385	1.644	0.211	10.209	9.349
AKC01697	2.684	0.412	3.023	0.447	9.098	22.472
AKC01699	2.205	0.305	2.320	0.345	15.967	10.332
AKC01702	1.230	0.160	1.210	0.160	8.770	8.220
AKC01722	1.443	0.238	1.614	0.244	10.998	6.156
AKC01724	2.491	0.388	2.813	0.430	15.125	9.741
AKC01726	1.356	0.201	1.248	0.246	9.715	8.022
AKC01727	1.595	0.204	1.695	0.246	11.019	7.663
AKC01729	2.130	0.330	2.260	0.350	13.230	15.060
AKC01731	2.064	0.301	2.344	0.318	8.217	14.181
AKC01731bla	1.368	0.210	1.584	0.297	24.024	20.740

Database ID	Er	Tm	Yb	Lu	Hf	Th
AKC01731blb	2.116	0.272	2.298	0.457	15.202	9.340
AKC01731blc	2.885	0.447	2.549	0.411	13.235	8.714
AKC01731bld	2.790	0.505	2.832	0.482	14.762	9.853
AKC01731ble	1.544	0.205	1.723	0.274	12.222	6.359
AKC01731lgreen	3.004	0.441	2.636	0.502	11.216	8.350
AKC01734	1.557	0.190	1.347	0.311	12.094	5.796
AKC01738	1.558	0.315	1.860	0.284	12.425	7.644
AKC01742	2.379	0.372	2.484	0.367	13.867	8.512
AKC01744	2.146	0.297	2.527	0.334	12.813	8.224
AKC01752	1.665	0.326	2.133	0.264	5.846	5.912
AKC01773	1.734	0.222	1.904	0.338	19.183	8.686
AKC01774	1.076	0.164	1.252	0.169	10.642	8.841
AKC01775	2.228	0.270	2.044	0.349	13.530	8.607
AKC01779	1.580	0.210	1.620	0.300	10.730	13.480
AKC01779y	2.480	0.310	2.320	0.390	12.090	17.430
AKC01780	2.210	0.290	2.390	0.460	11.470	18.830
AKC01790	2.650	0.440	2.420	0.790	10.850	17.590
AKC01791	1.950	0.580	2.200	0.860	17.300	20.140
AKC01808	2.520	0.300	2.560	0.390	16.200	9.040
AKC01695	0.925	0.131	1.020	0.176	6.165	2.450
AKC01700black	0.895	0.099	0.696	0.116	2.734	2.027
AKC01700red trim	0.576	0.103	0.627	0.097	2.190	1.863
AKC00443	1.098	0.176	1.243	0.211	4.113	8.732
AKC00452	0.661	0.106	0.829	0.146	2.675	4.858
AKC00464	0.936	0.138	0.915	0.137	1.960	3.470
AKC00466	0.786	0.124	1.025	0.144	2.081	3.990
AKC00473	2.914	0.377	2.734	0.388	0.863	1.209

Database ID	Er	Tm	Yb	Lu	Hf	Th
AKC00485	1.267	0.183	1.472	0.166	1.142	4.812
AKC00487	2.733	0.385	2.897	0.395	0.986	1.360
AKC00516	1.478	0.201	1.537	0.249	3.905	3.851
AKC00541	1.498	0.282	1.771	0.248	3.566	3.863
AKC00545	1.286	0.209	1.409	0.193	3.119	3.364
AKC00550	0.806	0.104	0.722	0.107	5.854	4.976
AKC00564	0.877	0.135	0.838	0.166	2.234	3.407
AKC00569	1.292	0.289	1.639	0.428	6.564	6.134
AKC00572	1.187	0.117	1.401	0.218	2.528	5.137
AKC00573	1.625	0.271	1.724	0.326	2.915	4.097
AKC00579	0.643	0.095	0.661	0.139	0.411	0.788
AKC00596	2.353	0.354	2.440	0.329	0.464	0.941
AKC00597	0.937	0.151	0.984	0.129	2.932	3.691
AKC00605	1.762	0.299	1.901	0.249	1.316	4.497
AKC00624	2.669	0.393	2.886	0.382	0.869	1.625
AKC00628	0.487	0.088	0.725	0.156	1.826	2.179
AKC00630	2.104	0.314	1.922	0.344	5.482	6.326
AKC00632	1.197	0.184	1.430	0.180	4.726	4.696
AKC00633	0.827	0.126	1.105	0.121	1.584	4.718
AKC00634	0.632	0.127	1.126	0.141	0.717	1.983
AKC00641	0.809	0.137	0.823	0.153	2.272	4.418
AKC00662	1.684	0.349	1.998	0.371	3.599	5.112
AKC00672	0.732	0.125	0.745	0.127	1.556	3.930
AKC00677	1.315	0.216	1.652	0.243	1.734	6.421
AKC00683	2.396	0.283	2.195	0.239	3.653	5.859
AKC00686	1.046	0.149	1.222	0.242	2.585	5.847
AKC00689	1.005	0.111	1.005	0.161	2.149	5.182

Database ID	Er	Tm	Yb	Lu	Hf	Th
AKC00726	0.341	0.057	0.411	0.092	0.915	1.201
AKC00733	1.376	0.830	1.171	0.855	1.902	4.111
AKC00734	1.008	0.325	1.353	0.331	1.569	4.046
AKC00735	1.705	0.401	1.992	0.335	3.498	5.627
AKC00736	0.549	0.123	0.734	0.249	1.534	1.776
AKC00737	1.068	0.161	0.919	0.173	0.516	2.820
AKC00738	2.221	0.314	2.297	0.388	0.616	1.511
AKC00739	0.943	0.135	0.989	0.129	2.275	2.530
AKC00740	2.173	0.307	2.395	0.298	0.658	0.800
AKC00741	0.863	0.156	0.788	0.159	2.543	3.720
AKC00742	2.023	0.303	2.095	0.322	0.501	0.733
AKC00743	2.483	0.373	2.462	0.352	0.633	0.888
AKC00744	2.312	0.389	2.574	0.373	0.753	0.928
AKC00745	2.358	0.372	2.558	0.307	0.522	0.897
AKC00746	1.303	0.234	1.548	0.223	0.847	4.479
AKC00747	0.673	0.080	0.733	0.077	0.630	2.548
AKC00748	0.844	0.125	0.752	0.093	2.086	3.644
AKC00749	0.610	0.097	0.961	0.097	4.917	4.943
AKC00750	0.571	0.078	0.599	0.101	3.941	8.711
AKC00751	0.685	0.112	0.707	0.125	3.143	4.180
AKC00752	1.188	0.227	1.622	0.260	2.422	4.774
AKC00753	1.237	0.178	1.264	0.166	4.204	4.976
AKC00754	1.914	0.241	1.930	0.283	8.203	6.858
AKC00755	2.653	0.372	2.967	0.421	0.807	0.866
AKC00756	2.197	0.319	2.336	0.292	3.228	4.240
AKC00757	1.131	0.185	0.946	0.142	2.300	4.812
AKC00758	0.775	0.118	0.856	0.153	3.327	4.675

Database ID	Er	Tm	Yb	Lu	Hf	Th
AKC00939	2.058	0.303	2.490	0.281	3.714	5.788
AKC01084	2.207	0.379	2.518	0.392	3.635	5.352
AKC00912	2.578	0.360	2.516	0.394	4.799	7.411
AKC01073_violet	0.569	0.070	0.494	0.072	1.895	2.751
AKC01073_blue	1.265	0.169	1.180	0.181	2.567	3.335
AKC01066	1.665	0.221	1.685	0.181	3.374	3.945
AKC00909	0.689	0.105	0.821	0.103	2.027	2.801
AKC00910	0.703	0.123	0.660	0.107	1.011	4.569
AKC00959_dkblue	0.729	0.099	0.864	0.125	1.230	2.953
AKC00959_red	1.220	0.183	1.266	0.195	10.638	5.660
AKC00959_yellow	0.885	0.139	1.007	0.137	6.137	3.838
AKC00959_turq	2.066	0.274	1.980	0.294	7.321	7.249
AKC01071yellow	1.448	0.224	1.679	0.233	7.801	8.220
AKC01071blue	1.089	0.145	1.147	0.202	7.658	8.218
AKC00959_orange	1.404	0.204	1.295	0.208	7.854	7.223
AKC01057orange	1.598	0.218	1.515	0.287	11.467	6.979
AKC01071orange	0.997	0.139	0.988	0.161	4.866	6.706
AKC01043b	2.674	0.418	2.820	0.448	9.570	13.830
AKC01043w	0.867	0.106	0.849	0.112	2.539	3.143
AKC01059b	1.858	0.293	1.891	0.285	1.509	4.364
AKC01059w	1.414	0.150	1.124	0.169	7.095	5.791
AKC01057gold	0.780	0.112	0.894	0.111	2.526	1.815
AKC01093	0.087	0.045	0.103	0.047	0.129	0.797
AKC00901	0.668	0.092	0.722	0.104	2.047	4.416
AKC01022	0.869	0.146	0.989	0.207	2.271	1.798
AKC00410	2.649	0.410	2.583	0.354	2.693	3.045
AKC00413	1.980	0.287	2.030	0.311	2.218	3.676

Database ID	Er	Tm	Yb	Lu	Hf	Th
AKC00416	2.123	0.276	2.001	0.244	2.890	4.050
AKC00327	1.473	0.199	1.331	0.211	2.731	4.440
AKC00322	0.514	0.075	0.567	0.068	0.746	3.801
AKC00386	0.325	0.043	0.306	0.072	0.604	1.487
AKC00412	1.454	0.173	1.606	0.226	2.565	3.458
AKC00425a	2.250	0.318	2.301	0.357	2.533	3.348
AKC00425b	1.296	0.182	1.512	0.194	2.598	3.863
AKC00372	1.625	0.214	1.478	0.206	2.974	4.351
AKC00381	0.285	0.053	0.217	0.029	0.560	1.926
AKC00389	0.254	0.041	0.303	0.068	0.471	1.453
AKC00376	0.324	0.055	0.359	0.081	0.780	2.405
AKC00424g	0.317	0.045	0.328	0.048	0.869	1.537
AKC00424w	0.384	0.050	0.460	0.062	0.899	1.440

Not included due to weathering		
Ban Non Wat	AKC02040	Noen U-Loke
Ban Non Wat	AKC02041	
Ban Non Wat	AKC02042	

Appendix 7.3: PCA scores for Figure 7.30

Elements Used: Na, Ca, K, Mg, Al, Fe, Ti, Mn, Cu, Zn, Ba, Rb, Ce			
	PCA1	PCA2	PCA3
Ban Non Wat, Thailand	0.63113	1.12463	0.04073
Noen U-Loke, Thailand 1	-0.13101	0.52856	-0.7359
Noen U-Loke, Thailand 2	0.24695	0.38732	-0.08673
Phu Khao Thong, Thailand 1	-0.0544	1.03317	-0.72759
Phu Khao Thong, Thailand 2	-1.07042	-0.6463	0.11789
Phu Khao Thong, Thailand 3	-1.53603	-1.19173	0.54637
Dong Klang, Thailand	1.235	-0.56821	0.67211
Ta Chana, Thailand	1.29916	-0.18184	1.12688
Chombeung, Thailand 1	0.39991	-0.34212	-1.14704
Chombeung, Thailand 2	1.10851	0.89418	0.36821
Chombeung, Thailand 3	1.14134	0.55908	0.23163
Khao Sam Kaeo, Thailand 1	-1.73294	0.0946	-0.26354
Khao Sam Kaeo, Thailand 2	-1.75374	-0.28939	-0.29457
Khao Sam Kaeo, Thailand 3	0.95357	-1.937	1.53704
Kodumanal, India	-1.33821	1.42185	1.67097
Dhalbhum, India	0.95544	-0.20428	0.64671
Dulhikotta, India 1	0.26153	1.23006	-0.74477
Dulhikotta, India 2	0.36193	1.1673	-0.96578
Kalahandi, India	-0.12579	-0.17074	-2.02545
Kausambi, India 1	0.10402	-1.74098	-0.80629
Kausambi, India 2	0.12879	-1.65394	-1.0052
Giong Ca Vo, Vietnam	-1.08475	0.48581	1.84431

Appendix 8.1: Garnet Zoning and Heterogeneity

Although garnet is more geochemically homogeneous than agate and carnelian, there can still be heterogeneity within a garnet sample due to garnet zoning. As a garnet crystal grows, the distribution of elements can vary between the core and outer layers in a process called zoning. Identification of the zoning patterns of major elements (Fe, Ca, Mn, Mg) has assisted with understanding the temperature and pressure under which garnets were formed (Tracy et al. 1976). Trace element zoning of garnets has also been identified (see Hickmott et al. 1987; Hickmott 1988; Spear and Kohn 1996). In previous archaeological studies involving garnets, zoning has produced samples with a wide spread of values in certain elements, for example Y values ranging from 100 to 1000 ppm (Calligaro et al. 2002). Heterogeneity in garnet compositions was also identified in the current study and this became clear when looking at the relative standard deviation (%RSD) of various elements for the five point ablations performed on a single sample. Some elements had very high %RSD (50% or more), indicating a large variation in the concentration of elements within a single sample. The RSD of the point ablations for each sample were carefully examined and it was decided that the remaining statistical analyses would focus on elements with an RSD of ten percent or less. This number was chosen by the author in order to limit variation, while also acknowledging that a small amount of variation within the sample is unavoidable. Table 8.1.1 lists the thirteen elements with an RSD of ten percent or less in at least 75% of the 68 geologic samples (n=51). It should be noted that the Anthill source garnets were extremely heterogeneous, both within a single sample and when viewed as a group. This wide variation in element concentrations may be due to zoning; further analysis of additional samples from this source would clarify this issue. Heterogeneity was also identified in

the garnet artifacts. Table 5 lists the thirteen elements identified above and the proportion of artifacts that have a RSD above or below ten percent.

In addition to the thirteen elements discussed above, exploratory bivariate plotting identified additional elements that assisted with the discrimination of garnet source groups. Furthermore, previous research has identified elements such as Cr, Ti, and Y that are important in distinguishing between garnet types (Calligaro et al. 2002). These elements were heterogeneously distributed within the garnet samples, most likely as the result of zoning. Some of these important elements are discussed on a case-by-case basis below. However, this highlights an issue that must be considered when using LA-ICP-MS to analyze garnets, as one must carefully evaluate which elements are important for distinguishing a sample or group of samples, even if they are not distributed evenly. LA-ICP-MS has successfully measured heterogeneous materials such as ceramics (Dussubieux et al. 2007) and agate (Chapter 5). Therefore, the inclusion of some heterogeneously distributed elements was not expected to adversely affect results.

Element	Number of samples with 10% RSD or less	Number of samples with 10% RSD or more	Sample (%RSD)
Fe	68	0	N/A
Al	68	0	N/A
Mg	67	1	LamDong2 (11)
Mn	66	2	Anthill (16); SouthIndia4 (12)
Ca	65	3	PhuTho1 (22); Sri Lanka Group1_1 (19); Sri Lanka Group2_5 (33)
Co	63	5	LamDong1 (22); LamDong2 (11); SouthIndia1 (12); SouthIndia10 (15); SouthIndia7 (25)
Sc	62	6	Anthill3 (15); Anthill4 (11); LamDong2 (18); Mozambique6 (13); SouthIndia7 (21); SriLankaGroup1_1 (17)
V	62	6	LamDong2 (22); SouthIndia7 (17); Sri Lanka Group 2_2 (13); Sri Lanka Group2_4 (11); Sri Lanka Group1_1 (25); Sri Lanka Group 2_5 (12)
Zn	58	10	Anthill2 (18); Anthill3 (60); Anthill4 (14); Anthill5 (30); Anthill6 (14); Mozambique1 (11); Mozambique 6 (60); SouthIndia7 (19); SriLankaGroup1_7 (11); Sri Lanka Group2_5 (12)
Li	57	11	Anthill1 (73); Anthill2 (10); Anthill3 (19); Anthill4 (32); Anthill5 (111); Anthill6 (48); LamDong2 (17); Mozambique6 (13); Orissa3 (21); PhuTho8 (12); SouthIndia4 (12)
P	53	15	Anthill1 (14); Anthill2 (17); Anthill3 (19); Anthill4 (13); Anthill5 (38); LamDong1 (31); LamDong2 (11); PhuTho1 (16); PhuTho10 (14); SouthIndia1 (19); SouthIndia7 (15); SouthIndia8 (89); SouthIndia9 (12); SouthIndia10 (20)
Gd	52	16	Anthill2 (15); Anthill3 (16); Anthill 4 (26); Anthill5 (11); Anthill6 (28); India3 (11); India8 (20); LamDong2 (16); Mozambique5 (16); Mozambique6 (15); SouthIndia4 (11); SouthIndia5 (15); SouthIndia7 (17); SouthIndia9 (11); Sri Lanka Group1_1 (47); Sri Lanka Group1_7 (11)
Tb	52	16	Anthill3 (15); Anthill4 (33); Anthill6 (18); India1 (18); India8 (13); LamDong2 (25); Mozambique5 (25); PhuTho7 (14); PhuTho8 (18); PhuTho9 (17); SouthIndia4 (20); SouthIndia5 (20); SouthIndia7 (17); SouthIndia9 (13); SouthIndia10 (11)

Table 8.1.1: Thirteen elements with relative standard deviation (RSD) under ten percent in at least 75% of the geologic samples analyzed in this study. The column on the right lists the samples with RSD of 10% or higher

Appendix 8.2: Garnet beads recorded in this study

Database ID	Site Name	Context	Catalogue Number	Raw Material	Color(s)	Bead Shape
AKC03030	Angkor Borei	Unit AB7 Block 2N Layer 7 Level 20 Burial F16	1767	Garnet	Dark Purple	Spherical
AKC03031	Angkor Borei	Unit AB7 Block 5N Layer 5 Level 25 Burial F48	3284	Garnet	Dark Purple	Spherical
AKC03032	Angkor Borei	Unit AB7 Block 2N Layer 7 Level 21 Burial F21	1835	Garnet	Dark Purple	Spherical
AKC03033	Angkor Borei	Unit AB7 Block 4S Layer 5 Level 26	2801	Garnet	Dark Purple	Spherical
AKC03034	Angkor Borei	Unit AB7 Block 4N Layer 5 Level 30	3333	Garnet	Dark Purple	Spherical
AKC00310	Village 10.8	Unit EXVIII N/85 #46	N/A	Garnet	Dark Purple	Rough short barrel
AKC00311	Village 10.8	Unit EXXXII I/84 #32	N/A	Garnet	Dark Purple	Rough short barrel
AKC00333	Village 10.8	Unit E/1 T/92 #56	N/A	Garnet	Dark Purple	Rough long elliptical barrel
AKC00334	Village 10.8	Unit E 21/94 #37	N/A	Garnet	Dark Purple	Rough long elliptical barrel
AKC00335	Village 10.8	Unit E 21/94 #33	N/A	Garnet	Dark Purple	Rough short barrel
AKC00336	Village 10.8	Unit E/1 T/92 #30	N/A	Garnet	Dark Purple	Rough short barrel
AKC00337	Village 10.8	Unit E 21/94 #21	N/A	Garnet	Dark Purple	Rough short barrel
AKC00338	Village 10.8	Unit E 21/94 #32	N/A	Garnet	Dark Purple	Rough short barrel
AKC00339	Village 10.8	Unit E/1 T/92 #28	N/A	Garnet	Dark Purple	Rough long elliptical barrel
AKC00340	Village 10.8	Unit E 21/94 #20	N/A	Garnet	Dark Purple	Rough long elliptical barrel
AKC00341	Village 10.8	Unit E 21/94 #20	N/A	Garnet	Dark Purple	Rough short barrel

Database ID	Site Name	Context	Catalogue Number	Raw Material	Color(s)	Bead Shape
AKC00590	Prohear	Unit C LM/136-137 #16	N/A	Garnet	Dark Purple	Rough short barrel
AKC00606	Prohear	Unit C LM/112-113 #46	N/A	Garnet	Dark Purple	Rough short barrel
AKC00651	Bit Meas	N/A	N/A	Garnet	Dark Purple	Rough short barrel
AKC00652	Bit Meas	N/A	N/A	Garnet	Dark Purple	Rough short barrel
AKC00653	Bit Meas	N/A	N/A	Garnet	Dark Purple	Rough short barrel
AKC00654	Bit Meas	N/A	N/A	Garnet	Dark Purple	Rough short barrel
AKC00731	Bit Meas	N/A	N/A	Garnet	Dark Purple	Rough short barrel

Database ID	Drill Hole Type	Polish	Interior Perforation A	Interior Perforation B	Max. Length	Max. Width	Min. Width A	Min. Width B	Thickness
AKC03030	Type 3	Med-high	1.14	1.31	2.46	3.6			
AKC03031	Type 3	Med-high	1.52	1.33	3.7	4.69			
AKC03032	Type 2	Medium	0.9	1.27	3.74	4.97			
AKC03033	Type 3	Med-high	1.2	1.3	5.25	6.49			
AKC03034	Type 3	Med-high	1.4	1.34	3.46	4.58			
AKC00310	Type 4	No polish	1.18	1.16	5.66	5.61	4.39	4.25	
AKC00311	Type 4	No polish	1.47	1.58	9.62	8.4	5.57	5.41	6.57
AKC00333	Type 4	No polish	2.9	3.4	12.28	11.82			9.92
AKC00334	Type 4	No Polish	2.47	2.34	9.77	9.76			8.35
AKC00335	Type 4	No polish	2.15	1.85	9.55	7.86			7.75
AKC00336	Type 4	No polish	1.43	1.84	10.04	9.29			7.79
AKC00337	Type 4	No polish	2.76	2.31	8.87	8.81			7.91
AKC00338	Type 4	No polish	1.49	1.37	9.11	7.81			7.04
AKC00339	Type 4	No polish	2.74	2.64	10.45	9.45			8.14
AKC00340	Type 4	No polish	2.84	2.56	8.81	8.83			7.2
AKC00341	Type 4	No polish	1.55	1.93	7.25	7.76			
AKC00590	Type 4	No polish	1.32	1.4	5.45	5.78			4.63
AKC00606	Type 4	No polish	1.4	1.32	5.72	4.97			
AKC00651	Type 4	No polish	1.25	1.35	5.44	5.29			4.09
AKC00652	Type 4	No polish	1.35	1.3	5.22	4.81			4.23
AKC00653	Type 4	No polish	1.57	1.75	5.52	5.71			3.71
AKC00654	Type 4	No polish	1.32	1.24	5.09	5.1			4.54
AKC00731	Type 4	No polish	1.69	1.97	8.48	7.31			8.31

Appendix 8.3: LA-ICP-MS data for garnet geologic sources and artifacts

Database ID	SiO2	MgO	Al2O3	P2O3	CaO	MnO	Fe2O3	CuO	SnO2
Orissa1	41.6%	14.0%	22.0%	0.06%	1.5%	0.4%	20.3%	0.00%	0.00%
Orissa2	40.9%	10.9%	21.8%	0.03%	2.4%	0.7%	23.3%	0.00%	0.00%
Orissa3	41.0%	11.2%	21.5%	0.04%	2.5%	0.6%	23.1%	0.00%	0.00%
Orissa4	41.6%	13.4%	22.2%	0.08%	1.8%	0.3%	20.6%	0.00%	0.00%
Orissa5	41.4%	12.2%	22.1%	0.04%	3.1%	0.3%	20.8%	0.00%	0.00%
Orissa6	40.1%	10.3%	22.1%	0.02%	3.3%	1.2%	22.9%	0.00%	0.00%
Orissa7	41.3%	14.4%	22.2%	0.04%	1.6%	0.3%	20.2%	0.00%	0.00%
Orissa8	40.4%	9.5%	21.9%	0.08%	0.9%	0.7%	26.5%	0.00%	0.00%
Orissa9	40.6%	9.8%	21.9%	0.03%	2.2%	1.0%	24.5%	0.00%	0.00%
Orissa10	41.2%	12.3%	22.5%	0.03%	2.7%	0.3%	20.9%	0.00%	0.00%
SouthIndia1	39.5%	4.9%	21.1%	0.01%	1.5%	1.1%	31.8%	0.00%	0.00%
SouthIndia2	38.2%	3.9%	22.3%	0.01%	1.6%	2.3%	31.7%	0.00%	0.00%
SouthIndia3	38.9%	3.8%	21.5%	0.02%	1.5%	2.2%	31.9%	0.00%	0.00%
SouthIndia4	39.1%	4.2%	21.3%	0.02%	1.3%	1.4%	32.6%	0.00%	0.00%
SouthIndia5	38.6%	5.6%	21.7%	0.01%	1.9%	0.2%	31.9%	0.00%	0.00%
SouthIndia6	38.7%	4.2%	21.4%	0.02%	1.5%	2.4%	31.7%	0.00%	0.00%
SouthIndia7	39.7%	4.6%	20.8%	0.01%	1.5%	1.7%	31.7%	0.00%	0.00%
SouthIndia8	38.4%	4.5%	21.9%	0.04%	1.6%	1.5%	32.1%	0.00%	0.00%
SouthIndia9	39.0%	5.0%	21.5%	0.01%	1.9%	1.3%	31.3%	0.00%	0.00%
SouthIndia10	39.0%	4.5%	22.3%	0.01%	1.7%	1.0%	31.5%	0.00%	0.00%
IndiaGarnet1	38.5%	10.2%	22.7%	0.14%	0.5%	0.5%	27.3%	0.00%	0.00%
IndiaGarnet2	39.2%	10.8%	22.6%	0.05%	2.0%	0.2%	25.1%	0.00%	0.00%
IndiaGarnet3	38.5%	10.1%	22.7%	0.13%	0.5%	0.3%	27.6%	0.00%	0.00%

Database ID	SiO2	MgO	Al2O3	P2O3	CaO	MnO	Fe2O3	CuO	SnO2
IndiaGarnet4	38.6%	9.4%	22.3%	0.10%	0.5%	0.5%	28.5%	0.00%	0.00%
IndiaGarnet5	38.2%	9.6%	22.7%	0.11%	0.8%	0.3%	28.2%	0.00%	0.00%
IndiaGarnet6	38.3%	9.8%	22.2%	0.19%	0.5%	0.5%	28.5%	0.00%	0.00%
IndiaGarnet7	38.3%	9.5%	22.9%	0.14%	0.9%	0.5%	27.8%	0.00%	0.00%
IndiaGarnet8	38.1%	8.9%	22.6%	0.18%	0.5%	0.7%	28.9%	0.00%	0.00%
IndiaGarnet9	38.1%	8.7%	22.8%	0.13%	0.5%	0.7%	29.1%	0.00%	0.00%
SriLankaGroup1_1	39.3%	4.3%	21.2%	0.01%	2.1%	3.2%	29.9%	0.00%	0.00%
SriLankaGroup1_2	37.4%	4.0%	21.8%	0.02%	1.2%	6.3%	29.3%	0.00%	0.00%
SriLankaGroup1_3	37.3%	4.3%	22.1%	0.02%	1.5%	5.0%	29.7%	0.00%	0.00%
SriLankaGroup1_4	37.4%	4.6%	22.1%	0.03%	1.3%	3.9%	30.6%	0.00%	0.00%
SriLankaGroup1_5	37.1%	4.1%	21.6%	0.03%	1.1%	6.5%	29.6%	0.00%	0.00%
SriLankaGroup1_6	37.3%	5.0%	22.1%	0.01%	2.1%	1.6%	31.9%	0.00%	0.00%
SriLankaGroup1_7	36.6%	4.3%	22.0%	0.04%	1.0%	4.5%	31.4%	0.00%	0.00%
SriLankaGroup1_8	36.9%	4.5%	21.8%	0.03%	1.4%	5.0%	30.3%	0.00%	0.00%
SriLankaGroup1_9	36.8%	4.3%	21.9%	0.02%	1.6%	4.7%	30.6%	0.00%	0.00%
SriLankaGroup2_1	41.9%	4.1%	24.7%	0.09%	1.3%	0.7%	27.2%	0.00%	0.00%
SriLankaGroup2_2	41.5%	5.7%	25.1%	0.07%	1.1%	0.2%	26.4%	0.00%	0.00%
SriLankaGroup2_3	40.3%	4.7%	26.2%	0.04%	1.7%	0.2%	26.9%	0.00%	0.00%
SriLankaGroup2_4	40.3%	5.5%	25.7%	0.07%	0.8%	0.2%	27.5%	0.00%	0.00%
SriLankaGroup2_5	39.3%	4.4%	24.9%	0.07%	0.9%	0.1%	30.3%	0.00%	0.00%
SriLankaGroup2_6	39.0%	3.5%	24.1%	0.07%	1.6%	0.9%	30.8%	0.00%	0.00%
PhuThoGarnet1	39.9%	7.8%	23.5%	0.02%	1.8%	2.9%	23.9%	0.00%	0.00%
PhuThoGarnet2	40.8%	11.0%	24.0%	0.03%	2.6%	0.7%	20.7%	0.00%	0.00%
PhuThoGarnet3	41.1%	12.2%	23.6%	0.02%	3.8%	0.6%	18.5%	0.00%	0.00%
PhuThoGarnet4	41.4%	13.1%	23.8%	0.03%	3.7%	0.4%	17.5%	0.00%	0.00%
PhuThoGarnet5	41.7%	13.9%	24.0%	0.04%	2.5%	0.4%	17.5%	0.00%	0.00%

Database ID	SiO2	MgO	Al2O3	P2O3	CaO	MnO	Fe2O3	CuO	SnO2
PhuThoGarnet6	41.4%	12.8%	23.9%	0.04%	1.9%	0.5%	19.5%	0.00%	0.00%
PhuThoGarnet7	40.8%	12.7%	24.1%	0.03%	3.0%	0.5%	18.9%	0.00%	0.00%
PhuThoGarnet8	40.9%	13.1%	24.1%	0.03%	2.8%	0.4%	18.8%	0.00%	0.00%
PhuThoGarnet9	41.3%	12.6%	24.1%	0.04%	2.6%	0.5%	18.8%	0.00%	0.00%
PhuThoGarnet10	41.1%	12.2%	24.2%	0.03%	2.1%	0.9%	19.3%	0.00%	0.00%
LamDong1	36.7%	0.1%	20.6%	0.00%	0.5%	35.4%	6.7%	0.00%	0.08%
LamDong2	36.9%	0.0%	20.6%	0.01%	0.6%	37.0%	4.7%	0.00%	0.20%
Anthill1	40.1%	9.4%	22.5%	0.07%	8.0%	0.4%	19.5%	0.00%	0.00%
Anthill2	44.0%	18.7%	21.8%	0.01%	4.8%	0.5%	10.2%	0.00%	0.00%
Anthill3	39.7%	8.4%	22.5%	0.01%	12.7%	0.3%	16.4%	0.00%	0.00%
Anthill4	43.4%	18.8%	22.1%	0.00%	4.7%	0.5%	10.4%	0.00%	0.00%
Anthill5	44.2%	19.1%	22.0%	0.02%	4.4%	0.4%	9.8%	0.00%	0.00%
Anthill6	40.8%	11.7%	22.1%	0.01%	7.8%	0.3%	17.2%	0.00%	0.00%
Mozambique1	41.3%	11.9%	21.9%	0.04%	4.1%	0.6%	20.1%	0.00%	0.00%
Mozambique2	40.4%	12.0%	22.8%	0.05%	3.6%	0.8%	20.3%	0.00%	0.00%
Mozambique3	39.9%	12.6%	23.2%	0.04%	4.4%	0.7%	19.1%	0.00%	0.00%
Mozambique4	40.5%	12.3%	22.4%	0.04%	3.8%	0.8%	20.2%	0.00%	0.00%
Mozambique5	40.3%	13.4%	23.2%	0.04%	4.1%	0.5%	18.5%	0.00%	0.00%
Mozambique6	40.4%	13.6%	23.2%	0.04%	3.7%	0.5%	18.6%	0.00%	0.00%
AKC00590	41.8%	14.2%	22.3%	0.02%	6.4%	0.5%	14.7%	0.00%	0.00%
AKC00606	42.0%	14.0%	22.8%	0.03%	6.2%	0.5%	14.5%	0.00%	0.00%
AKC00651	41.8%	16.1%	23.2%	0.02%	6.0%	0.4%	12.4%	0.00%	0.00%
AKC00311	40.0%	15.8%	22.8%	0.02%	7.0%	0.5%	13.9%	0.00%	0.00%
AKC00310	39.9%	16.6%	23.4%	0.02%	6.9%	0.4%	12.7%	0.00%	0.00%
AKC00338	40.1%	17.0%	23.3%	0.02%	6.5%	0.4%	12.6%	0.00%	0.00%
AKC00339	40.5%	17.4%	23.6%	0.02%	6.3%	0.4%	11.8%	0.00%	0.00%

Database ID	SiO2	MgO	Al2O3	P2O3	CaO	MnO	Fe2O3	CuO	SnO2
AKC00731	40.0%	15.9%	23.4%	0.02%	6.6%	0.5%	13.6%	0.00%	0.00%
AKC03030	35.9%	2.7%	23.4%	0.08%	0.7%	2.0%	35.2%	0.00%	0.00%
AKC03031	35.8%	3.0%	24.0%	0.06%	0.7%	0.9%	35.4%	0.00%	0.00%
AKC03032	36.0%	2.7%	22.8%	0.04%	0.7%	1.0%	36.7%	0.00%	0.00%
AKC03033	36.5%	3.0%	23.2%	0.05%	0.6%	1.3%	35.2%	0.00%	0.00%
AKC03034	36.4%	2.7%	23.5%	0.03%	0.8%	0.9%	35.7%	0.00%	0.00%
PorunthalGarnet	37.6%	2.5%	21.6%	0.05%	0.6%	1.2%	36.4%	0.00%	0.00%
PKTgarnet	39.3%	12.0%	23.2%	0.03%	5.1%	0.9%	19.5%	0.00%	0.00%

Database ID	Li	Be	B	Sc	Ti	V	Cr	Co	Zn	Rb	Sr
Orissa1	7.39	0.25	0.57	75.63	140.65	99.35	563.54	67.73	101.67	0.04	0.07
Orissa2	1.62	0.22	0.41	120.94	132.12	156.76	331.71	46.16	35.99	0.04	0.03
Orissa3	0.48	0.22	0.37	32.93	188.31	56.86	12.85	37.99	59.38	0.04	0.07
Orissa4	8.26	0.16	0.44	80.56	296.07	28.32	197.94	56.09	38.18	0.03	0.30
Orissa5	1.39	0.30	0.53	74.93	183.41	56.37	61.61	31.03	19.31	0.03	0.03
Orissa6	2.18	0.26	0.39	126.93	163.60	141.01	246.32	39.97	57.80	0.04	0.11
Orissa7	4.03	0.27	0.47	59.28	166.87	32.32	161.43	59.71	54.94	0.03	0.06
Orissa8	2.41	0.51	0.54	73.70	65.43	23.53	20.52	15.78	64.37	0.03	0.04
Orissa9	4.43	0.18	0.65	118.46	50.12	54.54	126.87	32.22	44.94	0.02	0.03
Orissa10	4.42	0.14	0.48	82.08	280.12	60.88	44.08	51.50	53.14	0.02	0.04
SouthIndia1	2.29	0.28	0.57	110.00	8.47	18.06	52.47	6.31	28.24	0.02	0.02
SouthIndia2	3.38	0.15	0.55	123.97	6.60	15.12	69.23	6.98	22.19	0.05	0.07
SouthIndia3	2.57	0.16	0.70	94.55	6.19	17.55	56.96	7.17	25.28	0.03	0.02
SouthIndia4	2.67	0.14	0.57	88.50	4.72	15.19	60.64	7.02	25.22	0.03	0.02
SouthIndia5	1.62	0.20	0.46	48.60	7.12	10.70	61.39	5.89	29.07	0.03	0.02
SouthIndia6	2.90	0.34	0.91	95.26	5.95	15.22	57.58	7.44	28.93	0.02	0.22
SouthIndia7	1.66	0.25	1.53	60.88	31.72	27.60	63.34	5.02	25.86	0.03	0.06
SouthIndia8	2.51	0.26	0.73	85.60	4.72	10.89	59.09	6.86	24.26	0.05	0.40
SouthIndia9	1.68	0.27	0.56	34.78	6.05	10.16	44.40	6.23	28.72	0.03	0.03
SouthIndia10	2.07	0.23	0.48	73.01	15.97	26.73	70.89	6.77	26.51	0.02	0.02
IndiaGarnet1	9.10	0.35	0.71	65.35	17.36	25.45	75.87	66.15	68.85	0.09	0.07
IndiaGarnet2	3.01	0.36	1.06	44.66	26.68	60.10	66.57	22.67	57.08	0.07	0.03
IndiaGarnet3	11.29	0.51	1.04	47.54	12.42	27.62	70.17	33.09	83.54	0.06	0.13
IndiaGarnet4	7.99	0.49	1.01	75.49	14.85	27.54	60.74	59.52	79.10	0.05	0.33
IndiaGarnet5	8.91	0.45	0.88	63.65	21.81	25.03	42.37	49.64	60.06	0.05	0.12
IndiaGarnet6	14.23	0.86	1.46	51.69	16.34	35.55	60.59	80.41	56.85	0.09	0.02

Database ID	Li	Be	B	Sc	Ti	V	Cr	Co	Zn	Rb	Sr
IndiaGarnet7	9.02	0.35	0.79	64.96	18.96	25.93	65.60	45.24	80.59	0.06	0.04
IndiaGarnet8	13.41	0.51	0.77	52.24	27.00	42.97	73.49	66.31	59.48	0.06	0.02
IndiaGarnet9	9.27	0.31	0.67	83.03	22.33	41.40	72.85	46.70	66.46	0.04	0.02
SriLankaGroup1_1	10.36	0.40	0.89	150.41	27.79	37.65	64.46	18.16	9.19	0.21	0.13
SriLankaGroup1_2	18.17	0.23	0.74	152.78	57.22	31.35	54.70	18.15	18.32	0.09	0.03
SriLankaGroup1_3	19.21	0.33	1.05	183.05	48.97	34.04	85.52	19.24	19.71	0.14	0.05
SriLankaGroup1_4	9.02	0.28	0.74	150.44	39.65	39.43	84.19	20.24	28.17	0.07	0.02
SriLankaGroup1_5	14.66	0.36	1.26	147.71	83.34	35.57	261.34	17.56	20.96	0.06	0.04
SriLankaGroup1_6	11.35	0.40	0.85	263.73	38.44	46.01	92.53	21.94	15.46	0.03	0.01
SriLankaGroup1_7	13.04	0.31	0.62	175.99	37.20	32.76	130.61	17.75	27.12	0.06	0.02
SriLankaGroup1_8	12.15	0.25	0.59	154.05	71.80	44.86	31.90	20.58	14.72	0.05	0.02
SriLankaGroup1_9	12.51	0.30	0.82	153.94	285.73	46.44	301.34	18.84	20.49	0.06	0.02
SriLankaGroup2_1	30.79	0.13	0.35	16.20	63.92	5.32	38.96	3.61	4.01	0.05	0.03
SriLankaGroup2_2	30.43	0.29	0.31	2.90	17.06	0.31	43.85	2.91	13.04	0.08	0.03
SriLankaGroup2_3	29.98	0.11	0.62	21.45	69.15	3.08	7.06	4.68	5.31	0.04	0.02
SriLankaGroup2_4	30.69	0.12	0.55	21.89	19.64	1.55	2.61	3.54	8.21	0.06	0.01
SriLankaGroup2_5	37.28	0.20	0.35	15.53	55.88	1.52	17.19	4.18	8.74	0.08	0.03
SriLankaGroup2_6	16.53	0.18	0.27	6.00	79.51	1.16	15.25	3.45	5.40	0.10	0.02
PhuThoGarnet1	8.84	0.67	1.88	212.07	64.44	42.70	74.93	32.78	129.56	0.29	0.63
PhuThoGarnet2	9.29	0.70	1.39	106.42	103.72	34.72	283.89	19.81	42.03	0.29	0.39
PhuThoGarnet3	4.74	0.67	1.68	69.62	148.18	31.86	291.05	19.63	37.83	0.09	0.13
PhuThoGarnet4	5.77	0.63	1.00	80.50	110.50	29.05	511.84	34.13	36.35	0.10	0.17
PhuThoGarnet5	5.77	0.74	1.05	79.52	51.35	11.58	117.49	20.54	36.66	0.16	0.19
PhuThoGarnet6	7.46	0.39	1.07	104.35	54.54	20.22	103.25	25.80	45.07	0.06	0.06
PhuThoGarnet7	7.98	0.62	1.54	80.27	156.00	19.42	37.51	34.25	39.31	0.11	0.05
PhuThoGarnet8	5.36	0.67	1.42	77.23	82.91	38.35	92.73	39.96	68.66	0.16	0.29

Database ID	Li	Be	B	Sc	Ti	V	Cr	Co	Zn	Rb	Sr
PhuThoGarnet9	9.12	0.32	1.24	109.98	70.24	51.10	1213.43	25.85	54.98	0.10	0.11
PhuThoGarnet10	21.81	0.44	0.77	264.86	63.91	80.15	711.28	30.03	132.18	0.12	0.14
LamDong1	83.27	0.49	2.55	760.06	801.63	2.11	0.70	0.07	260.09	0.11	0.16
LamDong2	41.44	1.64	8.85	982.57	1021.62	1.40	0.46	0.05	186.71	1.08	0.10
Anthill1	0.93	0.34	1.43	40.29	178.37	94.66	262.32	51.57	76.44	0.09	2.79
Anthill2	0.83	0.39	1.84	93.92	314.58	171.21	14897.54	40.13	18.79	0.54	0.65
Anthill3	0.45	0.35	0.59	35.84	219.31	199.12	315.52	46.22	25.74	0.02	0.81
Anthill4	0.33	0.88	0.60	105.34	157.89	123.21	12875.00	38.77	12.22	0.09	0.06
Anthill5	0.76	0.37	0.98	112.69	235.49	109.65	10726.24	41.85	15.76	0.05	0.10
Anthill6	1.15	0.50	1.02	32.69	198.71	156.17	293.05	62.78	30.97	0.05	0.64
Mozambique1	12.54	0.28	0.66	41.63	184.12	61.31	128.15	60.95	49.90	0.03	0.04
Mozambique2	12.64	0.19	0.64	46.09	195.83	54.95	110.78	63.24	38.80	0.03	0.05
Mozambique3	13.38	0.29	0.30	49.51	143.33	48.77	123.89	56.64	41.43	0.04	0.02
Mozambique4	11.13	0.38	0.47	42.99	154.46	44.28	175.79	49.27	36.17	0.03	0.01
Mozambique5	14.35	0.31	0.93	47.29	143.91	53.31	139.94	59.77	54.13	0.05	0.07
Mozambique6	16.19	0.23	0.92	46.83	166.76	57.39	198.60	62.00	102.83	0.04	0.09
AKC00590	0.48	0.42	0.91	63.96	2077.33	144.48	8.11	68.49	43.07	0.52	0.43
AKC00606	0.43	0.37	1.14	71.65	2442.75	162.19	5.68	65.44	44.04	0.92	0.64
AKC00651	0.23	0.31	1.11	95.52	1882.44	166.64	15.04	61.47	34.12	0.03	0.25
AKC00311	0.24	0.48	1.15	111.36	2401.70	190.15	46.14	66.80	41.56	0.21	0.37
AKC00310	0.15	0.38	0.91	131.67	2216.39	163.95	18.30	64.50	36.84	0.10	0.33
AKC00338	0.36	0.45	1.22	132.49	2233.04	168.18	23.28	63.79	36.04	0.06	0.34
AKC00339	0.22	0.35	0.49	82.83	2121.10	158.92	55.97	62.90	34.79	0.17	0.40
AKC00731	0.20	0.45	1.37	99.51	2131.90	159.31	39.16	66.37	42.26	0.09	0.34
AKC03030	20.12	0.13	0.97	92.31	32.26	23.21	21.98	37.41	125.72	0.92	5.29
AKC03031	21.10	0.07	0.54	163.70	35.79	36.72	18.40	29.18	126.37	0.11	0.17

Database ID	Li	Be	B	Sc	Ti	V	Cr	Co	Zn	Rb	Sr
AKC03032	21.41	0.11	0.31	98.72	21.00	27.26	49.42	39.96	134.44	0.32	0.15
AKC03033	19.29	0.11	0.57	111.20	24.00	32.98	42.17	42.98	140.76	0.40	0.22
AKC03034	15.12	0.09	0.65	108.65	12.41	19.09	38.52	25.34	115.68	0.20	0.35
PorunthalGarnet	20.54	0.14	0.52	112.51	23.56	23.15	24.65	24.69	82.77	0.26	0.46
PKTgarnet	2.79	0.88	0.85	32.59	138.65	20.81	173.99	62.19	27.24	0.04	0.03

Database ID	Zr	Nb	Ag	Cs	Ce	Pr	Y	Bi	U	Mo	Nd
Orissa1	28.04	0.01	0.02	0.01	0.02	0.04	47.93	0.01	0.00	0.05	0.70
Orissa2	15.38	0.01	0.01	0.00	0.08	0.06	257.88	0.01	0.01	0.08	1.05
Orissa3	31.81	0.03	0.02	0.01	0.40	0.24	223.78	0.01	0.05	0.08	3.28
Orissa4	81.62	0.01	0.03	0.01	0.05	0.09	81.14	0.01	0.01	0.06	1.72
Orissa5	25.13	0.01	0.01	0.01	0.07	0.04	63.64	0.01	0.03	0.07	0.48
Orissa6	20.29	0.02	0.02	0.00	0.12	0.09	207.80	0.01	0.03	0.06	1.55
Orissa7	45.28	0.02	0.02	0.00	0.14	0.15	31.38	0.01	0.01	0.07	2.56
Orissa8	10.15	0.01	0.02	0.01	0.04	0.03	273.33	0.01	0.01	0.06	0.47
Orissa9	11.66	0.00	0.06	0.02	0.01	0.01	81.57	0.01	0.01	0.08	0.47
Orissa10	54.34	0.00	0.01	0.01	0.15	0.15	41.37	0.00	0.00	0.05	2.71
SouthIndia1	17.30	0.02	0.03	0.00	0.02	0.02	24.89	0.01	0.08	0.11	0.09
SouthIndia2	4.99	0.06	0.02	0.04	0.07	0.03	162.37	0.02	0.06	0.08	0.07
SouthIndia3	10.02	0.02	0.01	0.01	0.01	0.01	60.80	0.01	0.04	0.10	0.07
SouthIndia4	13.87	0.01	0.02	0.00	0.00	0.00	61.64	0.01	0.07	0.09	0.04
SouthIndia5	6.86	0.01	0.03	0.01	0.01	0.01	3.35	0.01	0.02	0.08	0.11
SouthIndia6	12.51	0.01	0.14	0.01	0.29	0.03	85.45	0.03	0.28	0.06	0.07
SouthIndia7	20.25	0.19	0.06	0.02	0.02	0.03	70.51	0.00	0.56	0.08	0.18
SouthIndia8	4.85	0.02	0.03	0.01	0.23	0.04	20.65	0.01	0.02	0.08	0.23
SouthIndia9	3.23	0.03	0.02	0.01	0.01	0.01	4.34	0.01	0.01	0.11	0.08
SouthIndia10	4.01	0.02	0.07	0.01	0.01	0.01	26.53	0.01	0.00	0.09	0.10
IndiaGarnet1	6.24	0.06	0.03	0.03	0.03	0.02	123.25	0.05	0.06	0.06	0.06
IndiaGarnet2	14.69	0.04	0.03	0.01	0.07	0.04	116.77	0.04	0.11	0.03	0.48
IndiaGarnet3	5.67	0.05	0.05	0.02	0.02	0.01	110.79	0.02	0.02	0.03	0.04
IndiaGarnet4	4.26	0.05	0.05	0.01	0.01	0.01	85.28	0.02	0.01	0.03	0.04
IndiaGarnet5	54.79	0.04	0.04	0.00	0.01	0.01	143.32	0.01	0.04	0.02	0.10
IndiaGarnet6	13.51	0.08	0.04	0.01	0.02	0.04	108.73	0.04	0.02	0.05	0.06

Database ID	Zr	Nb	Ag	Cs	Ce	Pr	Y	Bi	U	Mo	Nd
IndiaGarnet7	31.24	0.03	0.05	0.00	0.02	0.02	282.41	0.02	0.01	0.03	0.05
IndiaGarnet8	11.22	0.03	0.06	0.01	0.01	0.01	133.38	0.01	0.03	0.02	0.02
IndiaGarnet9	5.77	0.04	0.04	0.00	0.01	0.01	82.54	0.01	0.01	0.03	0.03
SriLankaGroup1_1	50.03	0.23	0.04	0.02	0.18	0.05	1175.10	0.06	0.85	0.03	0.13
SriLankaGroup1_2	4.06	0.03	0.02	0.01	0.00	0.00	621.49	0.02	0.01	0.03	0.06
SriLankaGroup1_3	4.19	0.03	0.05	0.00	0.01	0.00	998.34	0.01	0.02	0.02	0.05
SriLankaGroup1_4	5.26	0.02	0.02	0.00	0.00	0.00	528.41	0.01	0.01	0.03	0.04
SriLankaGroup1_5	6.61	0.01	0.04	0.02	0.01	0.00	637.23	0.03	0.02	0.03	0.06
SriLankaGroup1_6	5.07	0.02	0.01	0.00	0.01	0.00	340.71	0.01	0.01	0.03	0.07
SriLankaGroup1_7	5.84	0.01	0.02	0.00	0.01	0.00	430.46	0.02	0.03	0.03	0.03
SriLankaGroup1_8	7.28	0.02	0.06	0.00	0.01	0.00	596.70	0.05	0.04	0.02	0.06
SriLankaGroup1_9	16.66	0.62	0.04	0.01	0.01	0.00	704.61	0.02	0.14	0.02	0.08
SriLankaGroup2_1	5.34	0.02	0.07	0.00	0.01	0.01	73.22	0.02	0.13	0.02	0.17
SriLankaGroup2_2	8.09	0.01	0.12	0.00	0.00	0.01	21.16	0.02	0.25	0.02	0.10
SriLankaGroup2_3	8.02	0.01	0.04	0.00	0.01	0.01	118.44	0.01	0.03	0.04	0.21
SriLankaGroup2_4	5.40	0.00	0.07	0.00	0.00	0.00	179.88	0.02	0.02	0.03	0.05
SriLankaGroup2_5	7.13	0.08	0.11	0.00	0.01	0.00	111.49	0.03	0.02	0.03	0.05
SriLankaGroup2_6	6.46	0.02	0.07	0.01	0.01	0.01	73.52	0.02	0.25	0.05	0.32
PhuThoGarnet1	5.33	0.17	0.03	0.07	0.79	0.05	513.58	0.06	0.06	0.05	0.81
PhuThoGarnet2	7.04	0.29	0.21	0.17	0.61	0.29	712.67	0.13	0.32	0.19	0.59
PhuThoGarnet3	8.26	0.46	0.06	0.04	0.16	0.05	39.56	0.13	0.06	0.05	0.70
PhuThoGarnet4	17.60	0.29	0.06	0.02	0.25	0.04	60.45	0.06	0.04	0.04	0.51
PhuThoGarnet5	5.87	0.17	0.05	0.02	0.25	0.04	15.08	0.04	0.02	0.04	0.34
PhuThoGarnet6	4.08	0.09	0.04	0.01	0.04	0.02	71.06	0.03	0.03	0.05	0.22
PhuThoGarnet7	9.42	0.14	0.03	0.01	0.08	0.03	393.09	0.04	0.02	0.04	0.54
PhuThoGarnet8	10.66	0.14	0.04	0.03	0.23	0.05	2.51	0.04	0.04	0.07	0.48

Database ID	Zr	Nb	Ag	Cs	Ce	Pr	Y	Bi	U	Mo	Nd
PhuThoGarnet9	7.54	0.08	0.04	0.03	0.09	0.03	97.60	0.06	0.03	0.03	0.33
PhuThoGarnet10	5.69	0.11	0.05	0.03	0.16	0.02	164.62	0.04	0.02	0.04	0.31
LamDong1	4.93	7.35	0.46	0.01	0.50	0.10	507.46	0.04	0.12	0.03	1.41
LamDong2	21.30	102.96	0.10	0.29	0.64	0.50	694.85	0.04	0.75	0.16	5.66
Anthill1	4.11	0.06	0.05	0.06	0.61	0.26	28.59	0.03	0.01	0.08	2.08
Anthill2	2.96	0.25	0.09	0.05	0.33	0.03	12.87	0.01	0.01	0.08	0.15
Anthill3	8.32	0.02	0.02	0.02	0.34	0.29	13.19	0.02	0.02	0.06	3.35
Anthill4	0.70	0.16	0.04	0.01	0.05	0.05	6.37	0.01	0.00	0.08	0.12
Anthill5	4.02	0.23	0.04	0.01	0.16	0.06	33.08	0.01	0.01	0.06	0.38
Anthill6	7.13	0.05	0.06	0.02	2.42	0.44	6.96	0.04	0.01	0.07	2.32
Mozambique1	22.02	0.05	0.03	0.01	0.06	0.03	20.86	0.03	0.03	0.07	0.30
Mozambique2	41.19	0.01	0.03	0.01	0.04	0.02	23.80	0.01	0.00	0.07	0.24
Mozambique3	30.32	0.04	0.03	0.03	0.05	0.03	28.79	0.02	0.01	0.08	0.34
Mozambique4	28.32	0.02	0.03	0.02	0.03	0.02	22.35	0.01	0.01	0.06	0.18
Mozambique5	29.06	0.02	0.03	0.01	0.06	0.03	19.78	0.02	0.01	0.09	0.26
Mozambique6	32.29	0.03	0.04	0.01	0.09	0.02	21.98	0.02	0.01	0.06	0.25
AKC00590	38.71	0.16	0.09	0.05	0.46	0.14	94.02	0.05	0.04	0.05	1.10
AKC00606	50.63	0.11	0.09	0.07	0.46	0.14	99.01	0.02	0.03	0.03	1.13
AKC00651	45.05	0.05	0.11	0.01	0.27	0.09	86.76	0.01	0.01	0.02	0.94
AKC00311	51.02	0.19	0.04	0.01	0.26	0.11	101.14	0.01	0.02	0.04	1.14
AKC00310	51.85	0.16	0.04	0.01	0.40	0.15	89.76	0.02	0.02	0.02	1.24
AKC00338	54.31	0.05	0.04	0.01	0.31	0.12	86.54	0.02	0.02	0.03	1.20
AKC00339	56.39	0.19	0.09	0.02	0.42	0.09	62.07	0.04	0.07	0.03	1.15
AKC00731	41.52	0.03	0.05	0.01	0.25	0.08	96.17	0.04	0.02	0.03	1.01
AKC03030	3.01	0.02	0.01	0.04	0.28	0.03	187.20	0.01	0.06	0.09	0.15
AKC03031	6.64	0.03	0.01	0.01	0.08	0.01	236.57	0.01	0.05	0.05	0.05

Database ID	Zr	Nb	Ag	Cs	Ce	Pr	Y	Bi	U	Mo	Nd
AKC03032	3.49	0.05	0.02	0.02	0.04	0.01	289.16	0.02	0.01	0.07	0.03
AKC03033	5.11	0.07	0.03	0.07	0.04	0.02	263.07	0.04	0.04	0.11	0.11
AKC03034	2.00	0.03	0.01	0.02	0.10	0.01	323.66	0.05	0.04	0.06	0.04
PorunthalGarnet	3.21	0.02	0.03	0.01	0.16	0.02	269.22	0.02	0.01	0.05	0.03
PKTgarnet	18.72	0.11	0.03	0.01	0.03	0.01	16.05	0.01	0.17	0.03	0.08

Database ID	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf
Orissa1	2.34	1.13	7.59	1.48	9.54	1.90	4.97	0.71	4.87	0.71	0.53
Orissa2	2.89	0.59	11.98	3.98	38.14	10.21	30.92	4.47	30.76	4.28	0.29
Orissa3	6.30	1.37	17.31	4.70	38.87	9.18	27.36	3.99	27.08	3.64	0.63
Orissa4	4.17	1.96	9.61	1.87	13.24	2.77	7.39	0.98	6.51	0.96	1.44
Orissa5	0.68	0.47	2.85	0.89	8.41	2.34	7.57	1.22	9.12	1.51	0.48
Orissa6	3.97	1.08	15.77	4.45	36.31	8.48	25.15	3.81	27.53	4.12	0.41
Orissa7	3.58	1.50	4.97	0.92	6.03	1.24	3.42	0.46	3.11	0.47	1.05
Orissa8	1.50	0.33	8.46	3.54	35.16	9.19	30.40	5.06	38.05	5.90	0.21
Orissa9	1.97	0.56	10.20	2.62	16.80	3.13	8.39	1.27	8.97	1.30	0.20
Orissa10	4.16	1.90	5.68	1.07	7.97	1.73	5.24	0.80	6.06	0.93	0.97
SouthIndia1	0.36	0.27	1.98	0.65	5.16	0.96	3.11	0.42	2.73	0.46	0.58
SouthIndia2	0.27	0.26	2.86	1.58	20.60	7.09	29.38	5.44	43.82	7.50	0.13
SouthIndia3	0.39	0.28	3.13	1.35	12.64	2.49	6.32	0.65	4.06	0.63	0.27
SouthIndia4	0.21	0.20	2.36	1.01	9.82	2.39	6.56	0.85	5.21	0.80	1.45
SouthIndia5	0.58	0.55	3.17	0.49	1.44	0.17	0.33	0.04	0.35	0.07	0.15
SouthIndia6	0.45	0.33	4.55	1.83	15.82	3.40	9.74	1.56	11.96	1.89	0.34
SouthIndia7	1.07	0.51	5.66	1.68	13.53	2.82	7.42	1.05	7.41	1.06	1.31
SouthIndia8	0.47	0.31	2.98	0.88	5.39	0.91	1.99	0.28	1.85	0.31	0.14
SouthIndia9	0.65	0.62	3.08	0.55	1.75	0.16	0.32	0.05	0.39	0.08	0.09
SouthIndia10	0.59	0.51	3.80	0.89	5.29	0.95	2.33	0.39	2.60	0.28	0.07
IndiaGarnet1	0.09	0.11	1.34	0.86	13.01	4.75	13.03	2.27	14.19	2.04	0.18
IndiaGarnet2	2.08	0.49	11.32	2.77	19.07	4.19	11.23	1.56	10.50	1.36	0.37
IndiaGarnet3	0.11	0.05	1.07	0.71	10.93	3.58	10.79	1.49	9.22	1.54	0.15
IndiaGarnet4	0.08	0.04	0.88	0.55	8.01	2.57	8.92	1.40	10.18	1.59	0.08
IndiaGarnet5	0.66	0.19	7.29	2.67	22.80	5.10	13.83	2.07	13.93	2.01	0.67
IndiaGarnet6	0.16	0.09	2.36	1.24	14.24	3.77	11.00	1.68	11.00	1.66	0.29

Database ID	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf
IndiaGarnet7	0.54	0.31	8.59	3.96	39.94	8.96	22.79	3.04	18.74	2.27	0.59
IndiaGarnet8	0.09	0.06	1.80	1.00	14.75	5.36	18.91	3.13	22.12	3.46	0.25
IndiaGarnet9	0.07	0.05	0.91	0.58	8.87	3.10	10.75	1.76	12.08	1.68	0.11
SriLankaGroup1_1	0.46	0.27	11.00	9.16	151.17	52.79	185.33	27.36	166.92	20.60	1.38
SriLankaGroup1_2	0.58	0.31	8.42	4.90	68.62	21.76	74.15	12.27	89.51	12.11	0.07
SriLankaGroup1_3	0.50	0.26	8.96	6.00	103.56	42.22	172.71	30.62	230.52	34.30	0.08
SriLankaGroup1_4	0.43	0.19	7.95	4.94	67.81	19.21	53.57	7.29	43.70	4.82	0.10
SriLankaGroup1_5	0.50	0.31	9.22	5.64	78.69	21.92	60.60	8.03	45.61	4.48	0.11
SriLankaGroup1_6	0.62	0.27	10.58	5.67	59.21	12.39	27.10	3.40	21.24	3.19	0.09
SriLankaGroup1_7	0.25	0.15	4.38	2.92	48.54	19.27	72.61	12.44	86.79	13.30	0.09
SriLankaGroup1_8	0.81	0.42	12.94	6.76	80.59	22.48	68.80	10.45	67.11	8.84	0.18
SriLankaGroup1_9	0.73	0.36	13.46	7.43	96.14	23.80	59.55	7.92	45.62	4.92	0.49
SriLankaGroup2_1	0.99	0.87	4.48	1.29	9.37	1.96	5.16	0.79	5.37	0.70	0.13
SriLankaGroup2_2	0.90	0.46	3.19	0.66	3.40	0.50	1.03	0.16	1.08	0.14	0.24
SriLankaGroup2_3	1.11	0.68	4.01	1.56	15.48	4.26	13.70	2.37	18.52	2.65	0.19
SriLankaGroup2_4	0.46	0.21	3.72	1.66	17.05	4.83	16.89	3.30	27.32	4.07	0.15
SriLankaGroup2_5	0.38	0.23	3.49	1.33	11.43	2.82	9.05	1.55	11.52	1.73	0.17
SriLankaGroup2_6	2.51	1.77	7.47	1.71	10.41	1.87	4.41	0.69	4.65	0.62	0.17
PhuThoGarnet1	1.24	0.22	4.13	2.58	47.47	19.66	93.45	23.22	213.56	39.95	0.10
PhuThoGarnet2	2.23	0.88	17.62	8.05	89.85	23.64	66.62	8.98	52.48	5.58	0.27
PhuThoGarnet3	3.61	1.31	9.03	1.46	7.69	1.22	2.49	0.28	1.68	0.25	0.26
PhuThoGarnet4	1.43	0.69	6.40	1.55	11.13	2.06	4.71	0.53	3.02	0.33	0.41
PhuThoGarnet5	0.97	0.58	3.88	0.79	3.73	0.53	1.09	0.13	1.14	0.25	0.17
PhuThoGarnet6	1.47	0.58	7.92	2.02	13.13	2.21	4.46	0.47	2.63	0.29	0.13
PhuThoGarnet7	2.40	1.26	11.90	3.67	41.74	15.10	66.29	13.35	112.20	16.44	0.18
PhuThoGarnet8	1.16	0.41	1.29	0.12	0.51	0.11	0.35	0.06	0.45	0.12	0.37

Database ID	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf
PhuThoGarnet9	1.20	0.76	2.77	0.92	10.60	3.43	12.04	1.94	11.36	1.90	0.20
PhuThoGarnet10	1.05	0.16	7.27	3.19	27.41	5.12	10.78	1.20	6.87	0.94	0.19
LamDong1	6.06	0.00	19.68	7.32	58.17	12.87	40.76	8.24	72.86	11.11	0.51
LamDong2	15.88	0.00	39.70	12.64	89.97	13.63	41.49	8.37	79.28	13.05	4.77
Anthill1	2.10	1.23	3.55	0.68	5.04	1.10	3.23	0.48	3.66	0.56	0.07
Anthill2	0.14	0.11	0.68	0.18	1.66	0.44	1.62	0.25	2.04	0.30	0.10
Anthill3	2.38	1.14	2.33	0.35	2.55	0.47	1.43	0.20	1.34	0.22	0.11
Anthill4	0.20	0.09	0.46	0.14	1.38	0.22	1.04	0.16	0.81	0.21	0.05
Anthill5	0.31	0.15	0.93	0.34	3.63	1.19	4.29	0.79	6.55	1.10	0.11
Anthill6	1.32	0.87	1.59	0.24	1.42	0.26	0.75	0.11	0.79	0.09	0.14
Mozambique1	0.36	0.27	1.19	0.35	3.08	0.76	2.42	0.36	3.01	0.45	0.34
Mozambique2	0.35	0.25	1.27	0.36	3.33	0.87	2.83	0.46	3.51	0.59	0.53
Mozambique3	0.61	0.32	1.59	0.45	4.28	1.09	3.49	0.56	4.26	0.67	0.45
Mozambique4	0.29	0.29	1.09	0.31	2.92	0.81	2.78	0.42	3.39	0.53	0.38
Mozambique5	0.33	0.24	1.10	0.32	2.98	0.75	2.42	0.35	2.66	0.45	0.47
Mozambique6	0.28	0.19	1.33	0.35	3.32	0.79	2.41	0.33	2.38	0.36	0.49
AKC00590	1.32	0.81	4.16	1.23	11.17	2.94	9.30	1.39	9.06	1.32	0.78
AKC00606	1.43	0.85	4.76	1.29	11.74	3.06	9.72	1.45	9.73	1.36	1.00
AKC00651	1.10	0.66	3.61	1.03	9.64	2.73	8.88	1.37	9.83	1.48	0.86
AKC00311	1.42	0.78	4.44	1.24	11.65	3.27	10.64	1.68	12.23	1.89	1.00
AKC00310	1.50	0.78	4.04	1.09	10.26	2.80	9.52	1.53	11.58	1.91	1.08
AKC00338	1.37	0.76	4.00	1.02	9.69	2.79	9.26	1.50	11.48	1.85	1.09
AKC00339	1.25	0.69	3.59	0.91	8.08	2.04	6.30	0.96	6.71	0.95	1.25
AKC00731	1.30	0.74	4.21	1.16	11.38	3.14	10.58	1.70	12.39	1.88	0.89
AKC03030	0.12	0.11	1.75	1.22	18.18	7.05	25.89	5.18	39.23	5.56	0.07
AKC03031	0.20	0.14	3.41	2.09	28.04	9.33	30.97	5.80	43.20	6.80	0.11

Database ID	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf
AKC03032	0.11	0.09	2.02	1.90	31.45	12.52	34.34	4.75	26.39	3.41	0.06
AKC03033	0.11	0.14	1.95	1.58	24.77	10.88	37.07	6.30	40.88	6.32	0.10
AKC03034	0.14	0.12	2.55	2.04	30.91	10.95	29.20	4.17	23.04	2.73	0.04
PorunthalGarnet	0.13	0.13	2.47	1.82	29.60	10.83	32.52	5.43	32.35	4.49	0.05
PKTgarnet	0.14	0.24	0.64	0.18	1.80	0.50	1.70	0.28	2.39	0.46	0.16

Appendix 8.4: Differentiating between garnet sources

In order to better distinguish between the garnet sources, I used Principal Components Analysis (PCA) and bivariate plotting to highlight geochemical differences between these different sources. I began with the almandine-rich sources. Figure 8.4.1 presents these groups plotted by their first and second components using the elements Co, Tb, V, and Zn. Table 8.4.1 lists the PCA scores used in this scatterplot. The Sri Lanka Group 1 garnets are differentiated from the other two sources by their higher levels of Co and Tb. Sri Lanka Group 2 has lower concentrations V and Zn, while the South India source had moderate amounts of all four elements. Bivariate plotting of these sources also identified that the South India source is notable for low concentrations of Cu (approximately 1 ppm), while Sri Lanka Group 1 has high levels of Dy (48-151 ppm) in comparison to the other source groups (Figure 8.4.2).

Garnet Source	Principal Component Score 1	Principal Component Score 2
SriLankaGroup1_1	0.52756	2.00465
SriLankaGroup1_2	0.58962	1.06061
SriLankaGroup1_3	0.70709	1.19293
SriLankaGroup1_4	0.8586	0.83624
SriLankaGroup1_5	0.68416	1.11391
SriLankaGroup1_6	0.76171	1.31738
SriLankaGroup1_7	0.62348	0.4068
SriLankaGroup1_8	0.74092	1.48991
SriLankaGroup1_9	0.84103	1.3788
SouthIndia1	-0.3384	-0.91313
SouthIndia2	-0.24537	-0.04955
SouthIndia3	-0.17535	-0.24089
SouthIndia4	-0.28462	-0.49049
SouthIndia5	-0.56606	-1.21249
SouthIndia6	-0.09186	-0.07922
SouthIndia7	-0.1703	-0.01988
SouthIndia8	-0.4324	-0.61848
SouthIndia9	-0.53175	-1.10507
SouthIndia10	-0.15022	-0.56833
SriLankaGroup2_1	-1.49496	0.70091
SriLankaGroup2_2	-2.13144	-0.82718
SriLankaGroup2_3	-1.38988	0.63103
SriLankaGroup2_4	-1.55732	0.36732
SriLankaGroup2_5	-1.50339	0.14073
SriLankaGroup2_6	-1.79084	0.61025
AB1767	0.88853	-1.38051
AB3284	1.42773	-1.15107
AB2801	1.6087	-1.15762
AB3333	0.69625	-1.37355
AB1835lg	0.92246	-1.38174
PorunthalGarnet	0.9763	-0.68227

Table 8.4.1: PCA scores for the almandine-rich sources and artifacts.

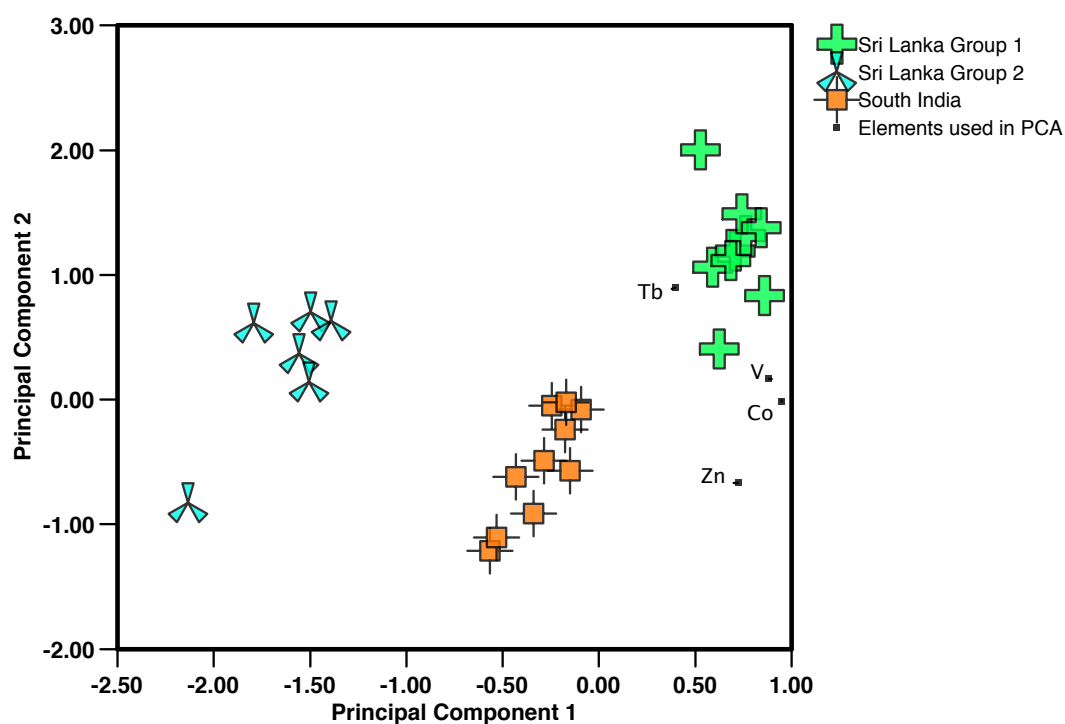


Figure 8.4.1: Principal component analysis of the Group 1 almandine garnets. The first component summarizes 59% of the variance and the second component accounts for 32%.

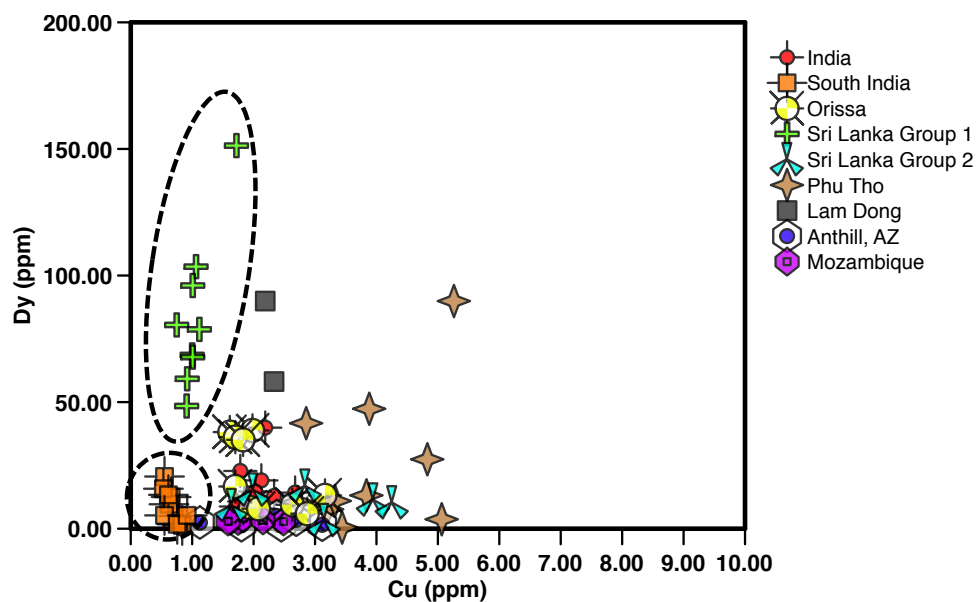


Figure 8.4.2: A bivariate plot of Cu vs. Dy highlighting the high concentration of Dy in the Sri Lanka Group 1 garnet group and the low concentration of Cu in the South India garnet group

A similar analysis was done on the almandine-pyrope source groups. PCA was performed using the elements Al, Ca, Co, Cu, Fe, Li, Sc, Tb and V (Figure 8.4.3). The table of the PCA scores is listed in Table 8.4.2 and a table for the PCA scores for the almandine-pyrope artifacts discussed in Chapter 8 is in Table 8.4.3. The element Cu was added to better distinguish the Orissa source from the other sources in the group. Cu was distributed relatively evenly within this source group, with only two samples containing an RSD above 10%. The Anthill source is clearly separated from the other groups by the higher levels of Ca, however three samples from this source (Anthill2, Anthill4, and Anthill5) had lower levels of iron than magnesium. The Phu Tho source is notable for higher concentrations of Cu (3-5 ppm) and Sc (70-265). Conversely, the Mozambique source group had lower levels of Sc than the Phu Tho source, but generally higher concentrations of Li (11-16 ppm). The India source had higher concentrations of Fe (68-77%), although one sample (India 2) consistently plotted with the Orissa source. The Orissa source was perhaps the most problematic source group to evaluate, as the samples were not tightly clustered and overlapped with the Phu Tho source. This highlights a drawback of not personally collecting geologic samples directly from a source, as the variation may be the result of garnets from multiple distinct sources. It is hoped that this problem will be corrected in future studies.

	PCA1	PCA2			PCA1	PCA2
PhuTho1	0.83841	1.81762		Mozambique6	0.18117	-1.14029
PhuTho2	1.03073	2.2892		Orissa1	0.1017	-0.15563
PhuTho3	0.63578	0.94673		Orissa2	-0.07795	0.34271
PhuTho4	0.50713	0.75848		Orissa3	0.09501	-0.38537
PhuTho5	0.94668	1.33368		Orissa4	0.53903	0.27446
PhuTho6	0.98618	1.33581		Orissa5	0.08542	-0.00157
PhuTho7	0.8863	0.78325		Orissa6	-0.00036	0.58505
PhuTho8	0.28864	-0.13724		Orissa7	0.3375	-0.32005
PhuTho9	0.61945	0.81618		Orissa8	1.15561	0.60434
PhuTho10	0.69924	2.4496		Orissa9	0.50806	0.41409
Anthill1	-0.48394	-0.67561		Orissa10	0.17453	-0.20581
Anthill2	-1.22471	0.39788		India1	1.0293	-0.75459
Anthill3	-1.03123	-1.58572		India2	0.70494	0.06312
Anthill4	-1.23018	0.22378		India3	1.25238	-0.87257
Anthill5	-1.06626	0.56721		India4	0.95895	-0.7954
Anthill6	-0.86294	-1.58128		India5	1.14778	-0.52327
Mozambique1	0.02447	-1.49193		India6	0.94628	-0.8792
Mozambique2	0.19147	-1.49031		India7	1.18665	-0.0882
Mozambique3	0.23115	-1.12933		India8	0.98573	-1.09782
Mozambique4	0.23656	-1.45333		India9	1.03736	-0.76137
Mozambique5	0.15478	-0.95799				

Table 8.4.2: PCA scores for the almandine-pyrope garnet sources and artifacts.

	PCA1	PCA2
AKC00590	-1.62482	0.77633
AKC00606	-1.64772	0.57773
AKC00651	-1.74228	0.27444
AKC00311	-1.79034	0.492
AKC00310	-1.82342	0.63429
AKC00338	-1.70533	0.70244
AKC00339	-1.74937	0.28334
AKC00731	-1.77421	0.56347
PKTgarnet	-0.86932	-1.82335

Table 8.4.3: PCA scores for the almandine-pyrope artifacts discussed in Chapter 8.

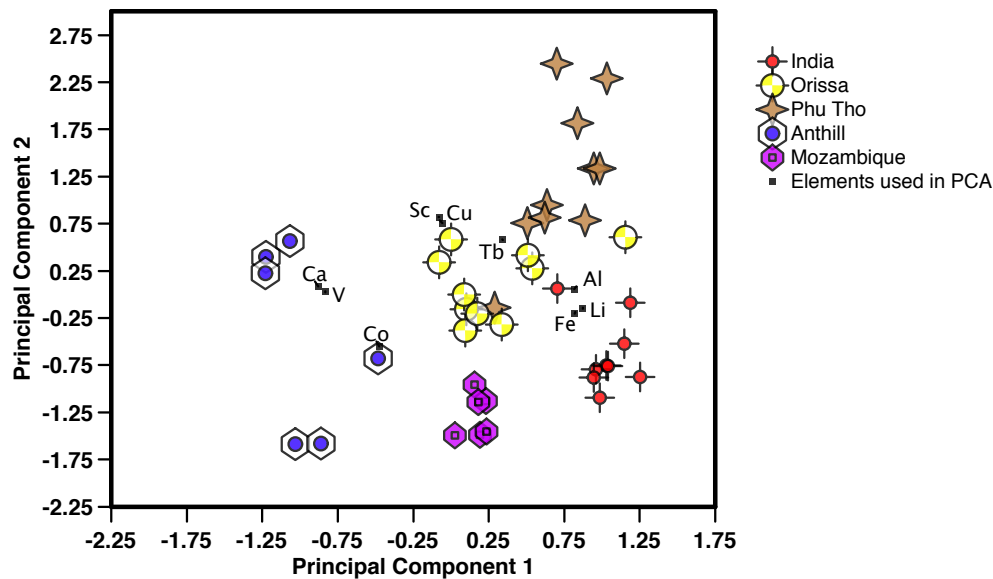


Figure 8.4.3: Principal component analysis of the group 2 almandine-pyrope garnets. The first component summarizes 44% of the variance and the second component accounts for 22%.

Lastly, the Lam Dong garnets were clearly different from the other two groups, being primarily spessartine garnets. A 3D scatterplot also shows that these samples have high concentrations of In (1-8ppm), Ti (802-1022 ppm) and Zn (187-260 ppm), the highest concentration of these elements of all the sources. (Figure 8.4.4).

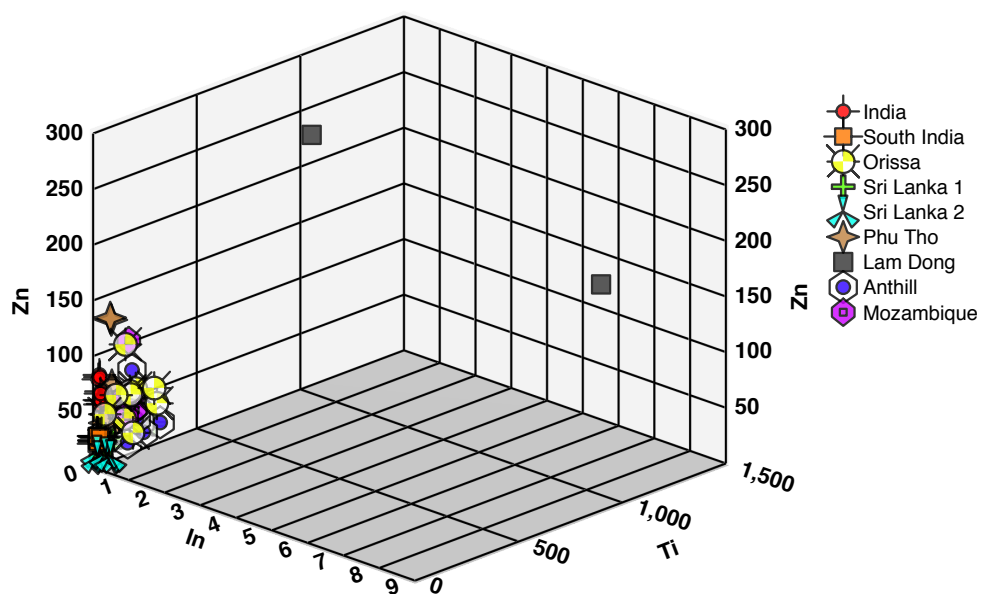


Figure 8.4.4:A 3D scatterplot showing the high levels of In, Ti, and Zn (all PPM) in the Lam Dong garnets as compared to the other garnet sources.