The Trade, Exchange and Manufacture of Stone Ornaments in Korea and Japan ca. 250-700CE

By

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Abstract

From the 3rd century CE to the 7th century CE, the peoples of the Korean peninsula and the Japanese archipelago were engaged in economic, political, and technological exchanges. Stone beads were used by elites in both areas as a means of displaying their wealth, social status, power and were used as part of ritual life. These beads are important because they are still considered an important symbol in modern day Korea and Japan, and this research revealed new trade connections across Asia. The stone beads were analyzed by documenting overall morphology, along with details of manufacturing technology and use wear. Scanning Electron Microscope analysis of silicone impressions of drill holes helped to determine specific aspects of drilling manufacture and signs of use wear. K-Means cluster analysis, means Anova and pairwise t-tests were used to determine if the results were statistically significant. Various factors in the qualities of the stone beads from color, shape to type of material influenced how a stone bead was manufactured, used and deposited.

In the Korean peninsula, overall patterns of distribution include a shift from locally made stone beads and shapes to imported beads of exotic materials in the 3rd century CE. Carnelian beads made with the South Asian perforation style of diamond-drilling were imported in great numbers to the peninsula. Statistical cluster analysis of bead drill holes and shapes has been used to define the presence of multiple workshops supplying the carnelian beads to the peninsula. It also appears that some polities shared similar sources and trade routes, while others obtained their beads from other distinct sources. Faceted carnelian beads of types found in South, Western and Central Asia were found in great numbers in the Silla and Gaya polities, but not the Baekje polity. Multiple trade routes, both overland and maritime may have been used to acquire these carnelian beads. This is in addition to jadeite and nephrite *gogok* from either the Japanese archipelago or Mongolia being used by Three Kingdoms Period elites in rituals and displays of their wealth and power.

In the Japanese archipelago, a local bead manufacturing tradition was present beginning in the Jomon Period. Many of the beads reveal heavy string wear and abrasion indicating long periods of use before final deposition. The jadeite *magatama* raw material and manufacture seem to have come under elite control at the beginning of the Kofun period (250CE – 400CE). Shimane prefecture became a center of bead manufacture and had access to local raw materials such as jasper, chalcedony and carnelian. My research suggests that while carnelian beads were plentiful within the Shimane area, these beads were rare and prized outside of the region. The isolated area of Miyazaki prefecture also seems to have developed some independent bead making traditions using narrow tapered metal drills. However, many beads continued to be passed down for generations before final deposition as indicated by the presence of older manufacturing styles and use wear.

Through this dissertation I have been able to demonstrate that ritual stone ornaments *(gogok/magatama)* found in elite burials and ritual deposits in both Japan and Korea, share many stylistic and technological features that were not known before. There are also important patterns of local production and use that provide insight into the nature of local and regional ritual traditions as well as economic and political organization.

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Chapter 1

Introduction

My research has revealed that patterns of stone ornament production, trade and use in Korea and Japan from 200-700CE reflect a complex series of interactions related to the economic, political and ideological interests of the peoples and polities of the Korean peninsula and the Japanese archipelago. There are differences over time and space in trade networks between major regions and also within specific regions. Raw material and bead shape played a significant role in where and how these beads were manufactured and exchanged. This study is important because it examined multiple regions within Korea and Japan which represents not just the centers of various polities, but also more independent and distant regions. As a result, I was able to map out both interregional exchange, trade and manufacture within regions, as well as inter-polity and overseas exchange, trade and manufacture of stone ornaments. This study can serve as an example for how to examine a wide, multi-faceted exchange network across intersecting and competing regions utilizing non-destructive methods, statistical analysis and theoretical discussions of value and symbolism in the past.

Stone beads were an essential part of the tool kit for elites in the Korean peninsula and the Japanese archipelago from 200-700CE. These beads were visual reminders of their wearer's status, wealth, power and ideological beliefs. They were deposited in elite tombs and ritual deposits. Non-elite burials and *haniwa* funerary figurines of non-elites, along with workshop's contained specifically within palaces show that elites were controlling manufacture and access to stone ornaments. The importance of jade and stone beads to the elites of ancient China, Korea and Japan cannot be underestimated. The character for 'king' (王) is thought to actually be derived from the word for 'jade' or 'bead' (玉) and the earlier character for 'precious' depicted jade/beads and cowrie shells in a house (Dubin 1987:166). Stone beads were utilized in different ways in these regions, but were essential for elites to establish their political, economic and ideological power.

This study examines the provenance, manufacture, trade, use and final deposition of stone beads during the period from 200-700CE in the Korean peninsula and on the Japanese archipelago. These regions were involved in a complex system of trade and exchange of not just material goods, but of ideas, skilled and unskilled workers, political and martial support (Barnes 2007:1-3; Farris 1995:3; Kwon 2008:80, 97-101; Rhee et al. 2007:404). It was during this period that many of the traditions and symbols of the later Korean and Japanese states were established (Pearson 1992b:121-123). One of those symbols was stone beads. My research strategy was to examine each bead's raw material and to a certain extent, type, especially in the case of the *gogok/magatama* bead, separately to see which properties it was valued for in the past.

This dissertation's underlying research question was to ask why stone beads? By around 200CE glass beads were freely available to elites in the Korean peninsula and the Japanese archipelago. These beads were either made locally or were Indo-Pacific imports (Lankton and Dussubieux 2006: 137; Pak 2016:172). Glass comes in a variety of colors and was made locally, so why did both regions continue to import and export stone beads, and in the case of Japan, manufacture them? Why did stone beads continue to be extensively used by elites as significant trade items, objects of political and economic power, and as consistent inclusions in elite burials?

On the question of terminology, in this dissertation I have decided to take an emic perspective on utilizing the term 'bead' and utilize it to refer to any stone ornament with a perforation since this has been the traditional use of the term in East Asia for thousands of years.

Most scholars follow Beck and define beads and pendants separately though they are both perforated ornaments (Beck 1928:11). Although there are multiple exceptions, beads tend to have a hole on the longitudinal axis and be relatively symmetrical in shape. For Beck (1928:11) and other scholars the only difference between a bead and a pendant is the location of the perforation either in the center for it to become a bead or on the edge to make it a pendant. By this definition, the *gogok/magatama* beads would be classified as pendants. In this study, they are referred to as beads. This is partially done to avoid confusion since Korean and Japanese literature (and English language literature about these artifacts) always refers to the *gogok/magatama* as beads and not as pendants (and in fact, the words themselves contain the word 'bead 玉' when written with Chinese characters). There are also *gogok/magatama* which have been drilled closer to the center of the bead and would therefore be called beads while all the others are called pendants even though their overall form points to them being *gogok/magatama*. And it is also because the *gogok/magatama* were not measured the same way as the other beads and the pendants in this study due to innate issues. Neither the perforation nor the shape of the bead need to be done by humans in order to make an object a bead. Although most beads are small enough to be worn, larger beads do exist and were created for varied reasons such as displays of religious piety, shows of great wealth or displays of technical prowess (Kenoyer 2000: 99, 104-105). Some of these larger beads were examined in this study.

Throughout the text, the area currently occupied by the nation states of South Korea and Japan are mostly going to be referred to as the Korean peninsula and the Japanese archipelago. I have chosen to use this terminology to avoid the implications of referring to ancient polities by modern designations which did not apply at the time. However, in some places it was more expedient to refer to these regions as Japanese or Korean, generally when discussing locations as they relate to modern day South Korea and Japan. There is a certain amount of debate regarding when the kingdoms of the Three Kingdoms Period and the people of the Kofun period (sometimes referred to as the Wa) became full-fledged states (Barnes 2001:4-7). This debate often relies heavily on historical documents written centuries after the fact and differing definitions of ‘state’. Since it is likely that all five of these developing polities became states at different times (Barnes 2001:3, 2007:53), they are simply referred to as polities within the text in order to prevent confusion.

The term ‘elites’ will be used to refer to individuals in society who hold a higher status than an average person. This category includes kings and queens, nobles and religious figures, but does not always necessarily refer to these categories; an individual considered to be elite in the region they control might be considered of a lower class when they approach the central areas of power, for example. Therefore, elite status is somewhat relative, but can be defined in the periods under study by being buried in elaborate tombs, living in high status residences or being buried with high status objects. This definition is based on those by cultural anthropologists who research modern elites, but modified by chronological and regional distinctions which I applied based on archaeological criteria (Salveda and Abbink 2013:1; Schif 2013:29).

The nature of archaeological data in Korea and Japan during these time periods is often excellent and comprehensive. Excavations occurring in the past few decades tend to practice total site excavation with whole landscapes and cemeteries being excavated at the same time or tombs from specific sites excavated in their totality. Site reports of these excavations are extremely detailed and record artifacts (in particular debitage on workshop sites) on the microscale. Earlier excavations, especially in the Korean peninsula, have been subject to looting and less precise recording (Kwon 2008:65-68). As a result, some of the earlier excavated royal

Silla and Gaya site reports I have are not as detailed or missing. When a site has been radiocarbon or typologically dated to an exact date, I use exact dates within this text. If there is no exact date or there is a range of dates on offer, then I use ranges instead.

Chapter 2 examines my research questions in detail, followed by a discussion of my methodology and then theoretical issues in bead analysis followed by bead theory and studies. My first research questions involved asking why certain raw materials such as jadeite are only used to make *gogok/magatama*? Were the beads being made specifically as burial goods or were they being used before deposition? Were beads being heirloomed over time? Were they only worn and utilized by elites? All of these questions could be answered to some extent by statistical and interpretive analysis of the stone beads. These answers came from quantitative analysis of the bead dimensions and drill hole size along with silicone impressions of the interior of drill holes and analysis of those impressions by a scanning electron microscope (SEM). String wear on the inside of drill holes was visible under a scanning electron microscope as well as end wear from bead ends rubbing against other beads. This allowed me to answer questions about heirlooming and whether the beads were made specifically for funerary practices. Surveys of the available literature supported the idea that only elites had access to certain materials and bead shapes. And multiple lines of evidence including art from the time period, clay figures (*haniwa*), mythology, Korean shamanism, Shintō religion, and historic and proto-historic texts were combined with the archaeological evidence to discuss why different raw materials were used specifically as well as the significance of certain bead types such as *gogok/magatama*.

The methodology section is divided into several parts. The sampling methods section explains how sites were chosen and how beads were chosen to study. I was limited in my time and access to stone beads so sites and samples were often selected due to their accessibility and availability. In the bead measurements section, I specifically define how I measured and recorded all the stone beads. This includes measurements of length and drill hole diameter, image recording through cameras, digital microscopes and a flatbed scanner and specific gravity measurements. The process for mounting silicone drill hole impressions and preparing them for analysis under the scanning electron microscope is also detailed. In addition, there is a protocol for consistently measuring the taper of the drill hole impressions using a Dinolite™ digital microscope.

My theoretical research related to bead studies first focused on how we determine value in the past and specifically in the early polities of Korea and Japan. In order to investigate these proto-historic periods, I have undertaken a broad and multifaceted analysis of the presence and absence of beads in the archaeological record and attempted to interpret their value on the basis of local texts, tomb art, figurines, and texts from China. How these beads have been used in the past and are viewed in the present, especially in local religion such as the shamanism in Korea and the Shinto religion in Japan was also incorporated into my interpretive analysis. In addition, theoretical discussions of how archaeologists interpret wealth, power, status and ideology in the past have also been examined and incorporated into my interpretations. Because of the unique, curved, bulbous "claw" or "crescent" shape of the *gogok/magatama* stone beads, I also examine the possible source for this form and the possible meaning of the shape as a symbol and how this might have changed over time.

This theoretical discussion is followed by a discussion of theoretical and practical examples of bead studies either in regions of the world that are relevant to my own research (South and Southeast Asia) or because they present precedents in methodology or bead studies as it relates to archaeology. This includes the methods utilized in my research to analyze beads via silicone drill hole impressions and the use of a scanning electron microscope for analysis (Kenoyer 2017b). Also of note is Ludvik's (2018: 42-47) recent work which statistically confirms that stone beads made in the same workshop tradition can be identified through analysis of their dimensions and manufacturing methods.

Chapter 3 provides background information on the regions under study: the Korean peninsula and the Japanese archipelago. I define which chronological frameworks and periodizations I am using for each major region as well as discuss different lines of evidence available for studying these time periods. This is followed by a general overview of what was happening on a political, economic, social and ideological level at various points in time. The next section of the chapter specifically discusses stone bead studies that have already been published in Korea and Japan with a particular focus on the studies which look at stone beads from the same time periods as I examined. Finally, the chapter ends with an overview of the geological resources available in these regions as well as a closer look at the raw materials used to make the beads in this study.

Chapter 4 is divided into two parts discussing the major sites where stone beads have been found in Korea and Japan as well as associated finds and some regional trends. All sites are discussed geographically. In the Korean section, I present the beads according to the sites associated with the three southern polities they belong to: Silla, Baekje, Gaya - which also conforms to different geographical areas of the peninsula (Figure 3.7). In Japan, I have presented the beads according to the prefecture where the sites are located (Figure 3.1), beginning with the centrally located Nara prefecture that was the core region for the Kofun period elite, and moving further away to discuss more isolated, distant regions such as Shimane prefecture and Miyazaki prefecture. The Shimane prefecture sites are also further sub-divided into categories of stone beads found in tombs, those found at workshop sites and a few from the end of the Kofun period which were found at settlement sites.

Chapter 5 contains the results of my statistical and quantitative analysis of 371 stone beads from sites in Korea and Japan. 137 stone beads were from Korean sites while 234 were from Japanese sites. Analysis of the scanning electron microscope photos of the drill hole impressions was used to identify the different types of manufacturing present, use wear and any unusual occurrences during manufacturing. For the statistical analysis, bead size (length/width) was compared to maximum drill hole diameter in order to identify potential workshop traditions as well as trends and changes over time and geographically. Because bead size is a standardized measurement, it could be tested to see if it were normally distributed. When it was, K-Means cluster analysis, a form of multivariate statistical analysis, was performed using the program JMP in order to determine if these patterns in distribution and potential workshop traditions were statistically significant. These results were further confirmed with means Anova analysis and multiple pairwise t-tests. This chapter is divided into separate, raw material and shape related sub headings since different raw materials were treated, manufactured and distributed differently during these periods.

For carnelian beads, 87% of the Korean carnelian beads studied and 70% of the Japanese carnelian beads were manufactured in distinctive shapes and perforated with diamond drills, both of which can be related to beads made in South Asia or possibly Southeast Asia. Moreover, my survey of site reports and museums revealed that there are thousands of these diamond drilled carnelian beads present in elite burials on the Korean peninsula. Other carnelian beads were made in shapes that are less diagnostic, but they too were drilled with a metal drill with fine abrasive which is not a method used in previous Korean peninsular workshops (Glover and

Kenoyer 2019:190-191). This suggests a thriving trade in imported stone beads which appears to have begun in the Late Proto Three Kingdoms Period (1CE – 300CE) and continued until the end of the Three Kingdoms Period. Prior to this period, there were stone workshops in Korea and stone beads being produced of local materials, but the workshops disappear from the archaeological record at the beginning of the Three Kingdoms Period (300CE – 668CE) (Heo 2018: 138-139).

The diamond drilled carnelian beads show a couple of trends over time. Beads made with smaller drill hole sizes are found in the earlier period and beads with larger drill holes are found by the end of the period. Earlier beads appear to have been made more rapidly with less finishing, resulting in irregular shapes and drilling from one side with large spalls where the drill popped out the opposite surface (Glover and Kenoyer 2019:190). The most likely source for these beads is South Asia, but it is also possible that some beads were being made by South Asian trained craftspeople located in workshops in Southeast Asia (Carter 2015:738-739). It is interesting to note that although the same trend of increasingly larger drill holes is seen in beads from Southeast Asia, the bead shapes in Southeast Asia start out with finely shaped beads and in the later periods they become less regular and mass produced (Bellina 2003:291, 2014; Carter 2015:739). The diamond drilled beads found in Korea and Japan resemble carnelian found at the sources in India in terms of composition and color. They do not resemble carnelian found in Japan or the more translucent carnelian that makes up the cylindrical beads found in the Korean peninsula. This suggests they were made of South Asian materials by craftspeople utilizing South Asian drilling techniques. Eleven of the diamond drilled carnelian beads are even made in the pattern of bead making amongst the Khambhat and Nagara bead drillers (which I will provisionally refer to as the Khambhat style for this dissertation), with a larger single diamond drilled bead using a technique still seen in the modern bead making city of Khambhat, India, where a larger single diamond drilled bead is used to start the drill hole and a second double diamond drill used to finish the drilling (Kenoyer and Vidale 1992:514–515, fig. 14). Since this is a technique that can be clearly linked to South Asian workshops, it is highly likely that the beads were made in South Asia and transported across various trade routes to end up in the Korean peninsula and the Japanese archipelago. Multivariate cluster analysis and pairwise t-tests of the dimensions of the diamond drilled carnelian beads points to several workshop traditions supplying carnelian to the Korean peninsula and the Japanese archipelago. In particular, the Silla polity shares a source with the Gaya polity and the archipelago, but not with the Baekje polity and the Baekje polity shares a source with Gaya and the archipelago but not with Silla. Based on the patterns found in the bead shapes and drill hole diameters, it appears that the faceted and spherical beads found in the Gaya and the Silla polities were being produced in the same workshops or sources or that they were acquiring beads from similar workshop traditions. This result also suggests that Silla, at the least, may have been utilizing different sources and workshop traditions for their carnelian. The different sources for different polities are also suggested by the well-crafted faceted hexagonal biconical carnelian beads with diamond drilling which are found in Silla and Gaya during the Three Kingdoms period. This particular shape is not popular in Southeast Asia and does not seem to have been used in the Baekje polity. The faceted carnelian bead shapes are popular in South and Central Asia as well as Western Asia (Kenoyer Pers. communication; Reinjang et al. 2017), but more investigation of Western and South Asian beads is required to discover the source of these faceted hexagonal biconical beads and how they got to the Korean peninsula and Japanese archipelago.

Non-diamond drilled carnelian in Japan is rare outside of Shimane prefecture. Since there is a source of carnelian within the prefecture, it seems to have been common in both the workshops and tombs of the region. However outside of Shimane, the few carnelian beads were all heavily worn and even used after breaking before finally being deposited in tombs. A single stone drilled carnelian bead must have been heirloomed for centuries before deposition. I hypothesize that the deep red color of the bead and the rarity of the material outside of the Shimane area, made beads of this particular raw material more valuable than those of more common materials such as rock crystal.

There is little distinction made between jasper and green tuff in the literature and site reports discussing these beads so they were discussed together (Warashina 1992:358). Jasper is found in several sources across Japan, but the most prominent and well-used in the past was Mt. Kazen in Shimane (Warashina 1992:358). Statistical comparison of maximum drill hole diameter of these beads to their max length reveals some trends over time. Beads from Japan from 200-100BCE and 200-500CE and Korea in 200-400CE were often similar in dimension and drill hole sizes suggesting similar workshop traditions and variation for the 500-700CE range in Japan. However, K-means cluster analysis was not appropriate since the data is not evenly distributed (which it needs to be for this analysis to work) and that there are just not enough samples in this study of this very common bead which was produced for long periods of time. The unfinished cylindrical beads from workshops were also not useful since their length could often only be estimated due to being unfinished. However, the data was evenly distributed for jadeite, carnelian, and rock crystal analysis so K-means cluster analysis was performed.

Rock crystal was available in both Korea and Japan to such an extent that it was even used to make drills in the Korean peninsula in earlier time periods (Bokcheon Museum

2013b:64). In the Proto-Three Kingdoms Period, it was a common material for stone beads and there was a unique drilling technique used which involved an extremely narrow, tapered metal drill. My research found two workshops sites on Iki Island between Japan and Korea and on the northern coast of Kyushū with partially drilled beads with these narrow drill holes. This technique was also used on faceted square biconical rock crystal beads which are unique to Miyazaki prefecture in southern Kyushū. However, more samples from the area are needed to draw any conclusions about continuation of this tradition. Otherwise, these rock crystal beads were drilled with metal drills and abrasive. They fell out of favor on the peninsula during the Three Kingdoms Period, but remained popular in the archipelago and seem to be regularly and locally produced in workshops there.

Steatite beads are relatively rare on the Korean peninsula but common in the Japanese archipelago. This may be because there are several native sources of steatite in Japan. All steatite beads from all regions were consistently well worn, to the point where often their manufacturing methods were worn away due to string and end wear. This includes the *moja gogok/komochi magatama* a uniquely large version of the *gogok/magatama* with many smaller versions of the beads carved on the body of the larger bead.

Of the thirty-seven jade artifacts examined in this study, all were *gogok/magatama* and one was made of nephrite and the rest were made of jadeite. Jadeite seems to exclusively be used to make *gogok/magatama* and nothing else. The placement of these beads in royal and high level elite tombs suggests that jadeite was considered a high status material. Since the sources in Myanmar were not discovered at this point in time, it is likely that the raw material for these beads either came from the source in Itoigawa, Japan or from sources in Mongolia. Jadeite is a difficult material to work and I believe that the opaque white beads of lesser hardness or different materials (such as alabaster *gogok*) were substituted for jadeite/nephrite either by the workshops themselves or the elites who were obtaining them in order to save on time/cost. I concluded this based on the presence of opaque white beads of hydrogrossular and alabaster which are found in the same contexts as jadeite/nephrite *gogok/magatama* and worked in similar ways. Visually, these non-jadeite beads are indistinguishable from the jadeite, but there was only a small sampling of opaque white *gogok/magatama* so more research is needed to see if this continues to be the case in larger samples.

The jadeite/nephrite *gogok/magatama* were analyzed by comparing drill hole diameter, overall bead length divided by width and the taper of the drill hole to each other. The taper was included because it represents another variable for analyzing different drilling styles. This stylistic variable can potentially be used to determine if there were different workshop traditions producing these ornaments. These three variables were then utilized for K-Means cluster analysis. A 3D plot of this analysis suggests there are at least five workshop traditions present among these beads. Two beads which I had identified as being from the same workshop traditions, despite one being from the archipelago and one from the Gaya polity, did fall into the same group. Stone beads from multiple time periods fall into the same groups as well which suggests my hypothesis of heirlooming them over time is accurate. This is confirmed by use wear visible under SEM analysis.

Chapter 6 includes interpretive analysis of the data. In particular, there is a discussion of the potential origins of the diamond drilled and metal with fine abrasive drilled carnelian beads. However, primarily the chapter discusses the potential meaning of the *gogok/magatama.* Based on the results of my research, evidence from historical texts, art, figurines, mythology, modern day analogy, ethnography and other archaeological research, I developed a hypothesis about the meaning of *gogok/magatama*; the *gogok/magatama* can be interpreted as being vehicles that were used for transport or other uses by different gods/spirits. This hypothesis is based on multiple lines of evidence. First, my own research revealed that many of these beads were well used in life before their deposition via use wear. Some were even heirloomed such as the jadeite *magatama* in Miyazaki which were stone drilled centuries after stone drills had fallen out of use, but continued being used until final deposition in tombs. Jadeite was rare except in known royal tombs and in the case of carnelian, rare outside of Shimane prefecture. Jasper, chalcedony and rock crystal are relatively common in elite tombs across Japan during the Kofun period while rock crystal completely falls out of favor for *gogok* in Korea during the Three Kingdoms period and jasper/chalcedony *gogok* rarely show up in the elite tombs. Instead, it seems Korean peninsular elites who could not get ahold of jadeite (or the various imitations of jadeite) or carnelian would instead use the glass *gogok* which were being produced in the peninsula during the Three Kingdoms Period. Production of jadeite beads was also highly controlled by the state with raw material only being found on workshop sites in Itoigawa (the source of the jadeite in Japan) and in Soga workshop located in the Kofun period palace. This suggests a hierarchy of value for the *gogok/magatama* with jadeite and carnelian at the very top. My research also showed that the lines on the *gogok/magatama* were being deliberately made through metal tools or abrasives and not through use wear as was previously thought. I believe that the lines around the heads of the *gogok/magatama* are indicators of rank, both for the person wearing them who is able to shelter multiple gods/spirits and for the gods/spirits themselves to indicate which particular vehicle they should occupy as befitting their rank/powers. In the 6th century, the Silla polity officially implemented a complicated bone rank system which placed the elites of Silla and the conquered Gaya polity into a rigid hierarchy based on their blood relatedness to the Silla rulers (Kim S. 2008:6-7). The lines around the head of *gogok/magatama* are much more prevalent in the Korean peninsula compared to the Japanese archipelago and I believe this is because the peninsular elites are imposing their own hierarchical status system on the stone beads to denote which god/spirit should go in each stone bead. Of course, the royal Kofun period tombs in Japan have never been excavated so it is possible they were utilizing this system themselves at the higher levels since there are at least two high ranking tombs which have *magatama* with lines around their heads in the Nara plain, which I have observed in the Kashihara Archaeological Museum.

Other lines of evidence also point to the *gogok/magatama* being used as vehicles for various gods. First, popular perception almost always has these beads being viewed in profile so that modern viewers can see the unique, curved shape. However, this is not how the *gogok/magatama* were often worn or utilized. There are only a handful of cases where the *gogok/magatama* are depicted in profile; on staves/banners where they sit on the edge and top of long poles or on the outer edge of a single bronze mirror. *Haniwa* funeral figurines from the Kofun period tombs show them being worn on necklaces with the tails facing up and the same is true of the *gogok* on crowns. Historical and proto-historic texts consistently mention them being mounted on trees/poles and this is reflected on the elaborate crowns shaped like tree branches (although it has been argued they represent antlers, they have golden leaves attached and one even has a bird perched at the top of a branch) as well as the poles/staves which have been found. We have archaeological evidence of specific sacred trees (still used today in Shinto) being prepared during the Kofun period as well as ritual offerings at the bases of trees across the Japanese archipelago (Ishino 1992:204,211). Studies of folklore in Korea suggest that the depictions of birds on the end of long poles placed outside of villages were considered messengers of the gods (Choi 2005:111-112). There are two bronze banners from the Three Kingdoms period which appear to merge the imagery of birds and *gogok*. The belief that gods/spirits can be raised or lowered from the heavens through sacred poles also appears in Japanese texts and mythology (Holtom 1928:46). There are also the holes piercing the talc (steatite) ornaments of the Middle Kofun period so they could be hung on trees.

There are multiple theories as the meaning of the *gogok*, many of which have to do with the shape of the bead. However, as I mentioned above, the shape of the bead has usually been interpreted based on the modern side view, which is not how these beads were traditionally worn. Japanese texts mention the *magatama* being hung from a sacred tree from a mountain in the territory of a female chieftain/shamaness and it being surrendered to the emperor as a sign of fealty (Barnes 2007:170; Hosoi 1976:114). Another discusses how a *magatama* was used to control the tides (Holtom 1928:40). The Shinto religion considers these beads to be the dwelling place of the gods (Blacker 1975:40; Underwood 1934:52; Yamaguchi 2016: 22), but I consider the term ‘vehicle’ to be a more appropriate translation since these are not permanent resting places for the gods/spirits, but vehicles which they can inhabit, imbue with their specific powers (hence the multiple uses for them) and can be used to transport the gods/spirits. I believe that the mass production of tens of thousands steatite *magatama* in the elite controlled palace workshop, Soga, in Nara prefecture, was actually used as a way to distribute godly power or blessings to any elites who visited the capital. Defining the provenience of steatite found in both Soga workshop and elite tombs in other prefectures would allow this to be investigated.

Elites in both the Korean peninsula and the Japanese archipelago maintained exclusive access to stone beads, and in particular jadeite stone beads from 200-700CE. Excavations of local preserved villages in Japan revealed that villagers would have had access to steatite stone beads which have been found in ritual deposits, however, none of these deposits included *magatama* (Ishino 1992:201;Tsude 1992:223-225). Common burials during this period also lack any types of stone beads or adornment (Pearson 1992:201). Therefore, the appearance of *gogok/magatama* only in elite tombs or ritual deposits suggests this was a controlled form of stone bead. In fact, my research revealed that *magatama* are only found on settlement sites at the end of the Kofun period in small amounts. This corresponds with the decline in use of the *gogok/magatama* in general since they are taken out of circulation and use by being deposited in elite tombs and underneath Shintō and Buddhist temples. It is possible that the rise in prevalence of Buddhism meant that these *gogok/magatama* and their association with the gods were no longer needed for maintaining elite power and control.

Elites in the Korean peninsula in the Late Proto Three Kingdoms Period (100-300CE) changed from utilizing local materials in local workshops to importing stone beads from potentially as far away as over 4000 km in South Asia. These stone beads were only found in elite tombs and even among the elite tombs, jadeite *gogok* are limited to only the highest levels while irregular shaped carnelian is common enough to be found in lower elite tombs. However, finely made carnelian beads are rarer and belong exclusively to high level elites. Jadeite and carnelian are also restricted to high level elites in the Japanese archipelago. The exception is Shimane prefecture which held very little jadeite and large amounts of carnelian due to the proximity of a source for the red-orange raw material. Jasper, rock crystal, steatite and other less commonly used materials were all mass produced in Japan during the Kofun period. Beads of all these raw materials are once again found in elite tombs and ritual deposits. Steatite seems to be the only accessible stone to non-elites with deposits of steatite beads found in ritual spaces

(Ishino 1992:202) – but not the *magatama* which was reserved only for elites and in myths, the gods.

Chapter 7 is an overview of all the above discussions on the statistical and interpretive analysis of stone beads in the Korean peninsula and the Japanese archipelago. Overall, my conclusion was that the reasons for the importance and long term use of these unique ornaments lies in the properties of the stone beads: color, ease/difficulty of obtaining the raw material, durability, ease of manufacture and potentially the ideological implications of material choice. Not all of these categories apply to each type of bead or raw material. I argue that jadeite beads are valued for their color, toughness, rareness and, potentially, their ideological significance (as discussed in chapter 6) whereas green jasper may have been valued somewhat for its color but also for its′ local availability in Japan and being easier to work with than jadeite. Steatite stone beads were mass produced and by the middle to late Kofun period were often distributed under the control of the central political authority in Nara prefecture. The relative ease of drilling and carving steatite is potentially the reason why this material was used to craft the complicated and large shapes of the *moja gogok/komochi magatama*, however it is also possible that steatite had its′ own potential significance as a raw material. With this general framework for my dissertation outlined, it is possible now to move into my research questions and how my methodology has been developed.

1. A note on transliteration: This thesis follows the Revised Korean Romanization method since that is the Romanization method currently utilized in South Korea. However, out of respect for the many institutions and people who I worked with or plan to work with in the future, their preferred Romanization, as shown in their published works or on their websites, was used within the text. Japanese Modified Hepburn Romanization is used throughout the text with the exception of personal names and institutions that have preferred different or modified Romanization.

Chapter 2

Research Questions, Methods, Theory, and Bead Theory/Research

2.1 Research Questions

Although it has always been acknowledged that beads were a key ornament in the lifestyle of Korean and Japanese elites (Kim, W 1986; Barnes 1999), a large scale analysis of the beads across these regions has never been completed and the meaning behind these symbols of authority, wealth and ideology is uncertain. My research questions are focused on manufacture, trade, and the use and meaning of these stone beads. Although glass beads are introduced to both regions by 100CE (Bokcheon Museum 2013b:94-95; Pak J. 2016: 172; Mizoguchi 2014:846; Pearson 1992:135), elites continued to procure and use stone beads. Therefore, the stone beads continued to hold a value that could only partially be replaced by glass beads. In fact, some shapes such as the *gogok/magatama* were seen as so important that they were reproduced in glass through special molds found at the Korean site of Sonamdong (Pak J. 2016:140) and they were also reproduced in metal such as the golden *gogok* on the belts found in Hwangnam Daechong tomb in the Silla polity c. CE (Lee, H. 2006:122). Another shift in this time period was the move from producing stone beads in the Korean peninsula made of locally available materials such as amazonite and rock crystal (Bokcheon Museum 2013b:66), and instead shifting over to material obtained from further afield. My hypothesis is that this shift was seen as necessary (consciously or unconsciously) by elites in the Korean peninsula to consolidate their power through overt displays of their wealth and trade connections which were demonstrated by displaying these valuable stone goods on their persons. These elites abandon local sources of aquamarine stone and all local stone bead workshops shut down by the beginning of the Three Kingdoms Period in 300CE (Bokcheon Museum 2013b:93, 157). It is of course possible they forgot or lost access to the local stone, but stone bead workshops could have continued with imported stone. If they did, there is no archaeological evidence of the tradition continuing though a single Baekje grinding stone could indicate that they left the option open to finish the beads themselves (Seoul National University Museum 1997:186). This hypothesis was tested by seeing if there was any continuity in manufacturing methods from the Proto Three Kingdoms Period into the Three Kingdoms Period, determining the sources for the raw materials used to make the stone beads and identifying foreign, non-peninsular manufacturing methods and processes on stone beads.

Near the end of the Yayoi period, there was also a shift in how stone beads were utilized in the Japanese archipelago. The people of the Japanese archipelago move from utilizing beads relatively rarely to stone beads becoming a necessary tool of power and control for Japanese elites. People of importance, who were buried in mounded tombs which would have required command of local manpower to build, were all buried with at least one stone bead, if not more; in addition to the several other valuable artifacts such as fine pottery, weapons, and armor which often accompanied them. Art of the period such as *haniwa* depicts elites and shamans wearing these beads (Pearson 1992:204). From ~400-500CE there are rough stone bead replicas, made of cheaper and easier to shape steatite, which made it as far as the southern coast of the Korean peninsula. They were deposited in large numbers in water-related deposits (lakes, rivers, springs etc.) and some seem to have been suspended from trees or other objects (Ishino 1992:211). Even after this practice disappears, stone beads continue to be produced and worn into the Nara period. A stone jewel/bead is still considered one of the three sacred artifacts of the Japanese imperial regalia (Holtom 1928:34). My hypothesis is that raw material was intrinsically related to these beads in terms of their value and their purpose in both Japan and Korea during this time period.

This hypothesis was tested by determining distributions of raw material locally and regionally as well as if certain raw materials are only used to make certain types of beads.

My research questions can be divided into three sections: general, encompassing research questions, questions which compare/contrast the two regions and questions which developed during the course of my research.

My first research questions relate to how beads were being treated, traded and used in both Korea and Japan.

1) Why were some bead styles chosen over others for certain materials? Jadeite, for example, is only used for *gogok/magatama* in this period. This could be tested by determining the sources and distribution of raw materials, studying the raw material characteristics (such as steatite being easier to work), and utilizing art and ethnographic analogy about the meanings of the bead shapes.

2) Were these beads being worn by the living before their deposition in tombs and in ritual deposits? Are beads only acting as burial goods? This can be determined by examining signs of use wear on the beads and art and figurines from the time period to see if beads are being worn.

3) Were the beads being heirloomed over long periods of time or being deposited soon after creation? This can be determined utilizing a scanning electron microscope or microscope for visible indications of heavy use wear on the inside of the bead drill hole and outside of the beads, particularly the bead ends. Another indication would be beads that have been shortened and/or broken and transformed.

4) Were they only being worn by elite members of society? Were these beads being found anywhere besides elite tombs and bead workshops? If these beads are only being found in

elite tombs and only depicted as being worn by elite members of society, then this would be true. Examination of site reports and discussions of stone beads from this period does reveal there this a third class of deposition; ritual deposits in sacred spaces.

5) Why continue to utilize stone beads when glass beads were available? Why spend so much time and effort to import stone beads? Although a definitive answer to this question can never be provided, the properties of the stone beads such as durability and unique coloration can be examined to determine what advantages they give over glass beads.

There were also research questions in relation to comparing the people of the Korean peninsula and the Japanese archipelago.

1) What was the significance of the unique *gogok*/*magatama* bead found in both study areas during this period? The long prevalence of this shape and its continued use by elites has made this one of the most intriguing questions regarding stone ornaments from the Three Kingdoms/Kofun period (250CE-668CE). The significance will be investigated by examining the context these beads are found in and comparing it to the multiple modern theories on the meaning and significance of the *gogok/magatama* in order to determine which, if any, best fits the evidence.

2) Are *gogok/magatama* being worn and utilized different in Korea and Japan and if so, why? Why are *gogok* commonly found on crowns and on royal belts and earrings in Korea? Why are they usually found on necklaces in Japan? These questions will be answered by examining the context of how the beads were worn and utilizing historical and ethnographic sources to develop a hypothesis for why they are being utilized differently (if they are).

3) Are there stylistic/size/decoration differences between Korea and Japan? For example, markings on the heads of *gogok/magatama* seemed to be common. This can be determined by systematically recording quantitative data on measurements, size and features of the stone beads.

As I did my research, more questions were revealed.

1) Where were the jadeite beads being manufactured during the Kofun period in Japan since there was no sign of them being manufactured at any of the workshops in Izumo which I examined and there was only small scale manufacture at the jadeite source in Itoigawa? Extensive survey of potential jadeite workshops during the time period did turn up manufacture in the Early to Middle Kofun period (250CE-500CE).

2) Where is the diamond-drilled carnelian, found in great abundance in the Korean peninsula and in small amounts in the Japanese archipelago, coming from? The location of the raw material may be different than the place of manufacture. In addition, how is this carnelian reaching Korea and Japan? Although sourcing of the carnelian raw materials from Japan has been done, there are no available archaeological samples yet to compare to the raw materials. Until that is possible, determinations were made based on the carnelian's visual properties and manufacturing methods.

3) Where were the extremely narrow, low taper drilled rock crystal beads prominent during the Proto-Three Kingdoms period (300BCE-300CE) coming from? Where were they manufactured? A survey of rock crystal bead manufacturing sites from near the end of the Yayoi Period (100CE-250CE) found two workshops on an island north of Japan's Kyushu and on Kyushu's northern shore which had partially finished, narrowly drilled beads.

2.2 Methods

2.2a Sampling Methods

Sites were chosen by 1) availability and access 2) relevant stone artifacts and 3) association with elite contexts and/or stone ornament production. This research is as comprehensive as possible given the time available for study and the accessibility of collections. I tried to get access to samples from each major region where excavations have been carried out in Korea and Japan, in order to examine a broad range of sites geographically and regionally so as to provide a proper inter-regional analysis and comparison between the Korean peninsula and the Japanese archipelago. Beads were examined from the following sites in Korea and Japan.

Table 2.1		
Kingdom	**Korean Site Names**	**Type of Site**
Baekje	Songnam~Yoju Subway Area 9, Seoul	Mortuary
	Unyang Dong, Seoul	Mortuary
	Sucheong Dong, Osan	Mortuary
	Kwoltong, Osan	Mortuary
	Cheonghak Dong, Osan	Mortuary
Silla	Deokcheon-ri, north of Gyeongju	Mortuary
	Hwangnam-Dong, Gyeongju	Mortuary
	Hwango-ri, Gyeongju	Mortuary
	King Michu's area tombs, Gyeongju	Mortuary
	Hwango-ri Tomb 1, Gyeongju	Mortuary
Gaya	Bokcheon Dong, Busan	Mortuary
	Nopoh-Dong, Busan	Mortuary
	Yeongsan Dong, Busan	Mortuary
	DaeKaya Tombs, Daegu	Mortuary
Region	**Japanese Sites Names**	**Type of Site**

Nara	Kamonokuba Otani East Kofun	Mortuary
	Ushirode Kofun	Mortuary
	Kitahara West Kofun	Mortuary
	Noyama Site	Mortuary/ditch
	Takada Gaito Kofun	Mortuary
	Matobaike Kofun	Mortuary
	Mitsuzuka Kofun	Mortuary
	Mida Oosawa Kofun	Mortuary
	Horinowo Kofun	Mortuary
	Ishigami North	Mortuary
	Ikenoichi Kofun	Mortuary
	Ishihousan	Mortuary
	Akaokumagatani Kofun	Mortuary
North Kyushu	Amakubo Dolmen Burial	Mortuary
	Ushirode Site	Mortuary
	Banzuka Kofun	Mortuary
Miyazaki	Saitobaru Kofun	Mortuary
	Mutsunobaru	Mortuary
	Ko-onji	Mortuary
	Kusaba (Reikyo-Duka)	Mortuary
	Tachigiri	Mortuary
	Iimori	Mortuary
	Nagayama	Mortuary
	Ikeuchi	Mortuary
	Sakamoto no Ue	Mortuary
	Kitsunetsuka Kofun	Mortuary
Saga	Tsubuteishi	Mortuary
	Daimonishi	Mortuary
	Kouda	Mortuary
	Nagata Kofun	Mortuary
	Tofukuji Kofun	Mortuary
	Tsuzumi	Mortuary
	Miyakodani	Mortuary
	Nishibara	Mortuary
Shimane	Hayashi Tomb	Mortuary
	Komosawa Site, Matsue City	Mortuary
	Matsumoto Kofun	Mortuary
	Gotanda I Kofun	Mortuary
	Shimada Ike Site	Mortuary
	Shirokokuri	Mortuary
	Kamienyatsu	Mortuary

	Iwayaguchi South	Mortuary
	Kitsune Zako Site	Workshop
	Dotoko Site	Workshop
	Fukutomi I Site	Workshop
	Ohara Site	Workshop
	Osumiyama Site	Workshop
	Hiratoko II Site	Workshop
	Omojirodani	Workshop
	Yotsuzako	Workshop
	Nunoden Site	Village
	Komesaka Site	Village
	Komuta II Site, Matsue City	Village

Before beginning my research, I developed a sampling method. For sampling within a site; if the stone beads were less than 10, then all artifacts would be sampled. If the stone artifacts were greater than 10 and less than 200, then artifact #/10 = number of artifacts to be sampled. If the stone artifacts on a site were greater than 200, then 25 artifacts would be sampled. These sampling sizes were used due to time constraints: it takes approximately 30 minutes to fully process a single artifact so allowing for time to set up and breaks for meetings and food, twelve artifacts was a reasonable amount to study in a single day and that was only if I was able to work from 9am to 5pm which was sometimes not the case. I was also often only allowed access to a site or artifacts for a single day so reducing a large amount of artifacts to a manageable sample was considered key. The study would practice stratified sampling in order to isolate particular types of stone ornaments. Within the stratified sample, simple random sampling would be practiced using a random number generator (Price and Knudson 2018:140).

In practice, simple random sampling within the stratified sample was not possible. Stone beads were often strung together in necklaces and bracelets. As a result, it was difficult to gain access to specific beads, especially when I was only permitted to examine beads near the knot of the string or only allowed to look at beads to either side of a single spot. Another case I had (especially with the softer stone beads) is that some were not suited to being studied since they were too fragile or too caked with hardened dirt to clean without damaging the bead. A final issue was that all the beads from a single site are not always stored in one place and generally, once divided into stratified samples, there was never enough in one place to need to practice simple random sampling.

I was also limited in time for some of my analysis; I might have only one or two days at an archaeological center to analyze the beads. It took approximately a half hour to fully record, analyze and take impressions from a single bead. In order to survey the largest sample of bead types possible, I would prioritize the more unusual bead types and materials before addressing as many of the more common bead types as possible before I ran out of time.

2.2b Measurements

All beads had a standard set of measurements taken utilizing a Mitutoyo digital caliper (CD-6"CSX) in person and a Dinolite™ portable microscope (AM413TA) for later digital measurements and for measuring silicon impressions. These measurements were used to calculate the average drill hole sizes, size of the beads, and shape of the drill hole. Once these measurements were standardized, they could be used in statistical analysis. For my measurements, it was necessary to define exactly what was meant by length, width, maximum etc. See Figure 2.1. There is also some specific terminology I implemented for the unique shape of the *gogok/magatama* bead. Measurements of length follow Beck (1928:3) in measuring length along the length of the drill hole (with some exceptions discussed below). Max length was the longest length available on the bead along the drill hole while minimum was the minimum length that could be measured on the bead along the drill hole. When the max length equaled the minimum length, then the minimum length was not recorded since it was identical to the max length. The areas of the beads on either end of the length measurement are referred to as the ends - this is where you will find the drill holes. My procedure was to refer to the end with the larger hole as end 1 and the one with the smaller hole as end 2. When the drill holes were the same size, I simply chose which sides to designated end 1 and 2. Maximum width measured the widest area of the bead perpendicular to the drill hole. The minimum width was the shortest area of the bead perpendicular to the drill hole. On beads which were not cylindrical or spherical, the width of the ends (or diameter) was also measured. The maximum and minimum measurements could vary greatly, especially on the faceted beads since the end measurements are determined by the manufacturer. Drill holes were measured on both ends, referred to as drill hole 1 and drill hole 2 (corresponding with end 1 and end 2), and measurements were taken from the maximum diameter of the hole, excluding non-drill hole areas such as depressions caused by popping one end of the bead out with the drill or gouges caused by manufacture.

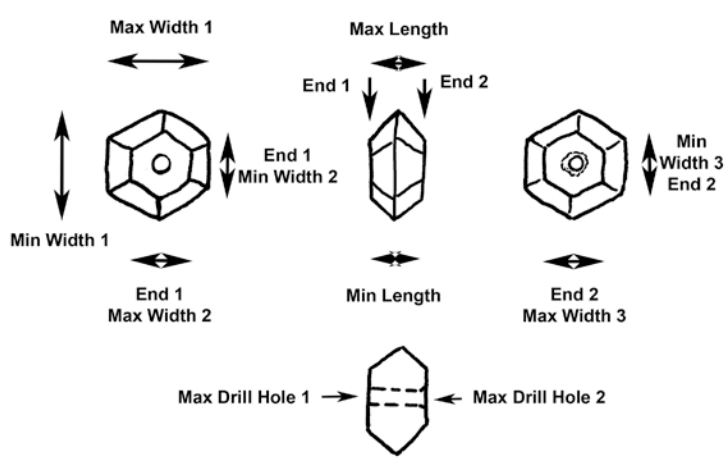


Figure 2.1 Standard bead measurements. Drawn by Dr. J. M. Kenoyer 2016.

Gogok/magatama, pendants and incompletely drilled beads were measured in different ways than in the majority of the analyzed beads (Figure 2.4). Beck (1928:2) measures length as the distance between the two ends of the bead but I believe measuring this way is not wholly appropriate for pendants since the length is not always representative of the length of the drill hole. For *gogok/magatama* often there is a narrowing at the head of the *magatama* making the head around the hole, not the longest measurement of length; this would mean that the maximum length and occasionally even the minimum length would not indicate the length of the drill hole (Figure 2.2). As a result, I have measured *gogok/magatama* and pendants in the following way (Figure 2.4). Namely, *maximum bead length* for the gogok/magatama is the longest distance that can be measured from the head to tail of the bead while *length* measures the drill hole length.

Figure 2.2 A steatite *magatama* from Shimane, Japan with a constricted head due to wear

Due to its unique shape, I have defined new terms for referring to parts of the *gogok/magatama* (Figure 2.3). The area at the top of the bead where the hole is drilled is called the head. The area in the lower half of the bead I have referred to as the tail. Although these terms are somewhat zoomorphizing, I have chosen them because top/bottom and upper/lower end of the bead and not always descriptive enough to account for the more unusual *gogok/magatama*. I have referred to the outer, curved edge of the bead as the back and the inner curved area as the front. End 1 is always defined as the left side of the head when viewed with the bead’s head and tail facing to the left. End 2 is always the right side of the head. The front of the bead was chosen to be placed where it is due to evidence from *haniwa* figures and extant crowns that these beads were not mounted sideways with the hole visible, though this is often how they are displayed in the modern day. Although this anatomical method was finalized before its' publication, this is relatively the same system used by Choi, H. (2018: 145), although she goes even further in assigning parts of the body to the bead such as neck and stomach.

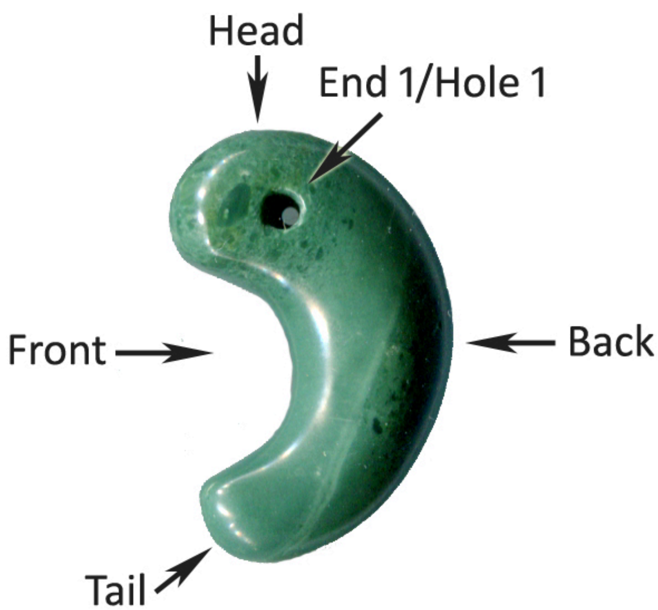


Figure 2.3 The 'anatomy' of a *gogok/magatama* *not to scale

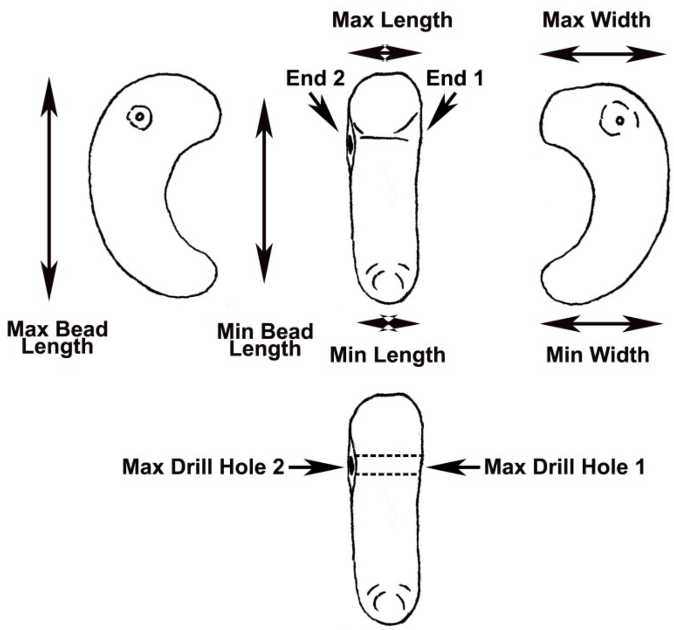


Figure 2.4 How measurements were standardized on the *gogok/magatama*. Drawn by Lauren Glover 2018.

Maximum bead length is from the top of the head to the furthest end of the tail area. (Figure 2.4) This was not necessarily the tip of the tail since the shape of the *gogok/magatama* often meant that the tail curved upwards in a somewhat "C" shape. Therefore, the tip of the tail to the slope of the head was often measured as the minimum length but there was variation in the shape of both the bead as a whole and the head and tails of these beads. As a result, there is less standardization in the measurement of the minimum length. Maximum width was measured from the most curved area of the back to the front of the head of the bead. Minimum width was from the most curved area of the back to the tip of the tail except for on those rare beads where the tail extends further than the head of the bead and therefore the max would measure from the back to the tail on those beads. Length (different from bead length) is measured from end 1 to end 2. The maximum length was usually taken from the head of the bead, but some beads had a thicker middle and this was noted when it happened. Minimum length was invariably measured on the tail of the bead. Some *gogok/magatama*'s holes are pinched at the top of the head and therefore the length was only measuring the bottom of the drill hole's length and not the top. When needed, the top of the drill hole could be measured from the impression.

All of these measurements of bead length, width, diameters and drill hole size can be standardized and compared to other beads of the same type in order to perform statistical analysis in the hopes of finding similar workshop traditions or styles.

I had planned to record the angle of the top of the head to the center of the tail on the *magatama*. Due to the variations in shape for *gogok/magatama*, this proved a difficult task since the slightest change in orientation of the head could change the angle of the tail and the 'top' of the head varied quite widely. My solution was to photograph each bead through the protractor as I took the measurement (Figure 2.5). This way, I could standardize or retake my measurements as needed.

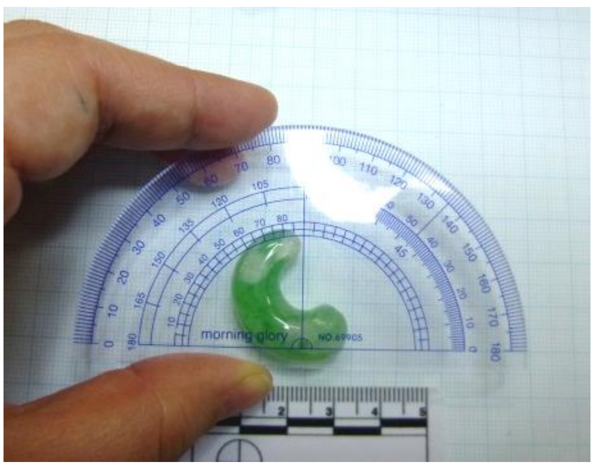


Figure 2.5 Protractor measurement of a *gogok*

Incomplete beads were also measured in a similar way to the *gogok*/pendants. Their length was the longest available side of the artifact. Width was the second longest available side and thickness was the smallest available side (assuming a third side was present). All these measurements were taken from the maximum extension of the bead and the minimum. When possible, such as when it was a clear, rock crystal bead or when the bead was broken, the hole length was also measured. Many of the incomplete beads were not fully drilled through so there was only end 1 to the bead and only one hole diameter measurement.

2.2c Photographic Recording

After recording their measurements, several methods were used to take images of the beads. First, pictures were taken using a Sony Cyber-shot™ DSC-F707 in Korea and a Canon Rebel XT™ DS126071 in Japan. There was not always adequate lighting available or the flash produced a glare on the bead, so this was not relied upon as the only method of recording. Beads were also scanned on multiple sides using an EPSON™ Perfection V37/V370 flatbed scanner which I carried with me. These scans tend to produce more color true images of the beads then those in poor lighting. Finally, I took multiple images of the beads using a Dinolite™ portable microscope (AM413TA). Although the lighting occasionally produced a glare on the bead, the majority of the bead surface was usually visible. All sides of the bead were photographed under the microscope, sometimes utilizing sticky tac or erasers as props to position the bead. Then close up images of the surface of the bead and the drill holes were taken along with any other features of interest. In general, about 5-10 microscopic photos were taken of each bead. These microscopic photos had the advantage of having a built in scale, and allowed for more detailed analysis of the artifacts through photos after there was no longer access to the artifacts.

2.2d Specific Gravity

Specific gravity is a constant, testable way to determine what type of mineral is under analysis. It can be extremely helpful for telling apart minerals that superficially resemble each other but have different specific gravity. This is especially the case for the two forms of jade: jadeite and nephrite. Specific gravity is calculated as follows:

Specific gravity = Weight of mineral in air/ (Weight of mineral in air - Weight of mineral in water)

Each bead was measured three separate times in order to maximize accuracy. They were weighed in air and in water three times and the average of all those measurements, after applying the specific gravity equation, was taken as the specific gravity. The weight in water was often subject to change due to small variations such as the suspension plate touching the side of the box or due to bubbles caught in the drill hole so it might be measured more than three times in order to produce semi-consistent results.

My portable specific gravity kit (from PrettyRock.com) was accurate up to 0.001grams but could only handle small beads up to 20grams which could fit within the small box filled with water for weighing the weight within water (Figure 2.6). The smallest of my beads were also too small for the scale to register when weighed in water or produced a heavy amount of inaccuracy between measurements. Due to the limitations on size and shape of the bead as well as time requirements, not all beads had specific gravity tested. In general, beads which were suspected to be made of jadeite, nephrite, chalcedony, rock crystal, jasper, steatite and green tuff were tested whenever possible.

At some archaeological centers or museums, larger scientific scales with enough accuracy were available for use, so when possible, I would create a DIY larger version of the test kit where the water measurement would be taken with the bead suspended by a thin thread inside a beaker or clear container (modified from the method accounted in Betts 2014:1). The calculation for this type of DIY test then becomes

Specific gravity = Weight of mineral in air/Volume of mineral in water.

I had tested this method on known minerals beforehand and found it to sometimes produce either an exact measurement or a measurement which was 0.01-0.04 points off the actual measurement. This introduced a measure of human error to the specific gravity measurement which would have made it difficult to discern the difference between minerals which are close on the specific gravity scale. However, most of the larger beads tested this way were jade and the measurements of jadeite and nephrite are far enough away from each other on the scale to not make a difference.

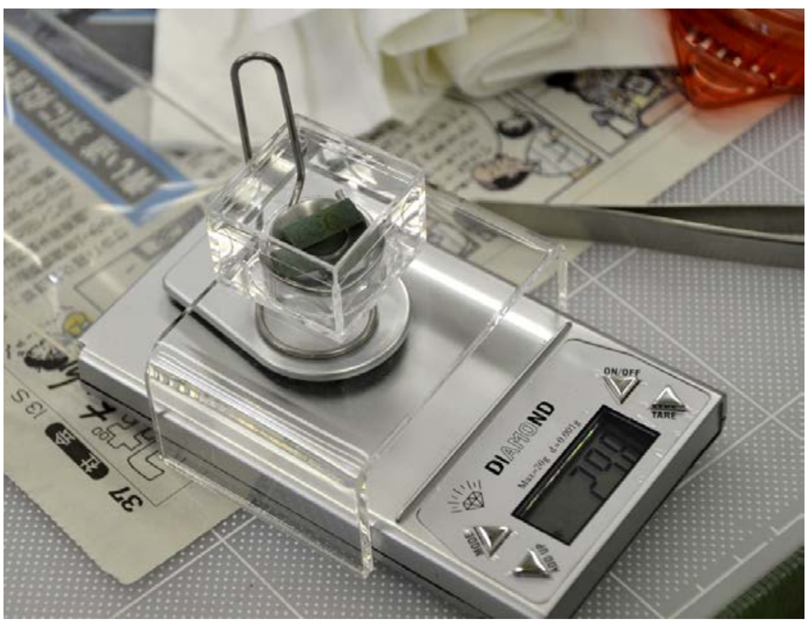


Figure 2.6 My specific gravity scale taking the water weight of a cylindrical jasper bead.

2.2e Impressions

Bead drill holes were all cleaned with the use of cotton and water. Impressions were taken utilizing vinyl polysiloxane. It is dispensed by an automix system produced by 3M ESPE (Express ™ VPS Impression Material). Three sets of impressions were taken. The first set were given to the hosting institution. The second set were for examination and measurement under a Dinolite™ microscope. The third set were taken while wearing gloves and kept very clean. This was so they were as pristine as possible in preparation for being viewed under the scanning electron microscope.

Certain types of stone are more porous than others, and the more porous they are, the more susceptible they are to absorbing some of the impression material permanently which slightly stains the surface of the bead. As a result, if during cleaning the bead seemed to soak up the water, I would coat the area around the drill hole with a mixture of B-72 (10%) and acetone (90%). This mixture left a thin, clear layer on the bead and protected it from absorbing the silicone. After impressions were done, I used acetone to dissolve the mixture and remove it from the bead. Steatite was the most likely stone to need coating but sometimes jadeite required it as well.

After taking pictures of the second set of impressions under a Dinolite™, I was able to determine which beads and features I wanted to examine. The third set of impressions were handled with tweezers only in a clean workspace which was free of dust. They were carefully cut so they would show the features I wished to examine and then carefully, but securely mounted on small metal plates. Double sided tape and colloidal silver were used to secure the impressions to the plate (Figure 2.7). This plate was then stored in a dust free, clear sample box and brought to be sputter coated with a conductive material (a 60/40 gold/palladium alloy in this case, courtesy of the SeeVac Auto conductavac IV sputter coater BBPIC™ at the University of

Wisconsin-Madison). Once sputter coated, the samples were again stored in a sample box to keep them dust free.

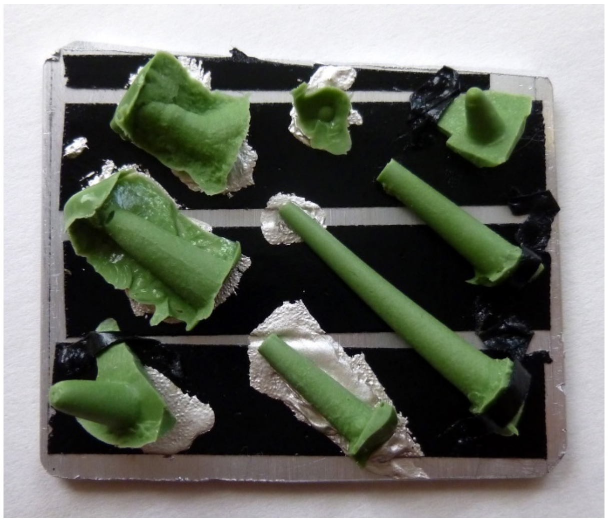


Figure 2.7 SEM samples mounted and ready for coating.*not to scale

2.2f Scanning Electron Microscope

The coated samples were then placed into a Scanning Electron Microscope (Hitachi 570S™ – UW Madison Laboratory for Experimental Archaeology and IIT™ Gandhinagar, India). Each impression was photographed at different points of interest along the bead; most often near the tip, base and at any visible signs of manufacture. These impressions were recorded flat for measurement purposes and at a tilt which allowed for better viewing of manufacturing marks. The flat view of the impression was always done at 20X magnification but the tilted views at points along the impression were done at 20X, 50X, 100X and 300X. The lower magnifications allowed me to see overall drilling features while higher magnifications often revealed the type of drill used and abrasions from long periods of string wear. Figure 2.8 is a typical example of how the SEM images were recorded for each impression.

Figure 2.8 A coated and labelled SEM sample after SEM analysis. *not to scale

2.2g Impression Taper

The taper of the beads was measured utilizing a Dinolite™ on a straight stand at 20x magnification. This was utilized for all impressions in order to standardize the data as much as possible. (Figure 2.9). Below is my bead taper measurement protocol. This is similar to Ludvik (2018:824)'s bead taper protocol, but with more detail. Taper is measured in order to understand the shape and angle of the drill. However, drills do deform as they are used so there is potential variation in drills even within a workshop.

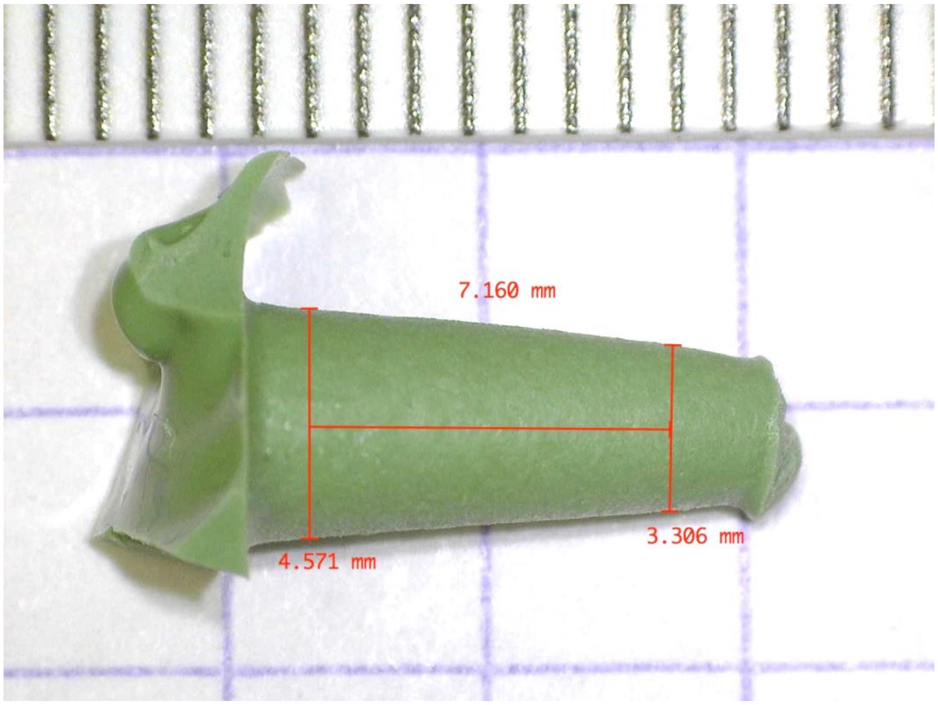


Figure 2.9 A typical bead drill hole taper measurement on K0153

Bead Taper Measurement Protocol

1. Set up a 20x calibration profile.

2. Set the microscope at 20x exactly and move the microscope up and down to focus it.

3. Take the impression, cut the excess and arrange it so there is no distortion of the impression shape when viewed from the top (there should be no curve if at all possible). If the bead has a high taper, it may be necessary to cut it in half to prevent distortion.

4. Focus on the top edge of the bead.

5. Take a photo with the ruler and impression visibly centered. The impression's tip should be on the right side. If there are two impressions (drilled from 2 sides), it is acceptable to place the second impression with the tip on the left.

6. If there are multiple drilling incidents on the impression, it should be rotated so that all of the incidents are visible with the least amount of distortion then each taper calculated using the appropriate image.

7. Select the photo with the straightest top edge of the bead.

8. Chose line measurement and 20x calibration.

9. The first measurement is the max distance from the top edge to the bottom edge perpendicular to an imaginary line drawn down the center of the length of the impression.

    a. There can often be string wear, wearing down the end of the bead at the end of the bead so the max measurement can be taken further down the line towards the point – wherever it can be measured to avoid the string wear or distortion.

    b. Be aware: in high taper impressions, the perpendicular line can extend into the distortion on the bottom. If necessary, move the top point further down to avoid this.

10. The second measurement is the minimum distance from the top edge near the tip to the bottom edge, perpendicular to the center line.

    a. There can be an inflection curve on either the top or bottom edge of the bead near the tip caused by either a different drill being used or string wear. As a result, the minimum distance should be measured at a point before any distortions occur.

11. The length measurement should be done from the center of the maximum measurement and run straight to the minimum measurement line. It does not matter where it falls on the

minimum measurement line however there should be a right angle formed by the max/min measurements and the length measurement.

12. If the impression is concave or convex, the bead should be divided into sections with straight edges and measured as separate sections.

13. Record all measurements. Slope is calculated by Max –Min/Length = Slope. Calculate to 0.00 decimal places.

14. Save both the non-measurement images and the measurement images.

2.3 Theoretical Issues in Bead Analysis

Now that I have discussed my research questions and methodology, I will examine some of the theoretical background which intersects with my research. This will begin with discussing broad issues of value, wealth and ideology in the past, and how symbols are interpreted. These issues relate to stone beads because these are objects which are deliberately made of valuable materials, utilizing skilled manufacturing methods, and in the Korean peninsula and the Japanese archipelago, are solely associated with elites and religious contexts. Although many of these more abstract, theoretical concepts are difficult to approach solely utilizing archaeology, the proto-historic nature of the time periods in this study means there are textual primary and secondary sources available as well as art which can be used to support archaeological evidence. In addition, although their meaning has almost certainly changed over time, these stone beads and their raw materials still hold value and symbolism in modern day Korea and Japan which may be useful for interpreting these stone beads use in the past.

Over time archaeologists have had to develop clear assumptions which pertain to the value of artifacts in the past. To Appadurai (1986:6) “value is situationally mediated” and archaeologists must take this into account even more when studying value in the past. There are four assumptions of ranked value: rare/exotic materials have more value, the wealth of an object increases with the amount of labor invested, the more technical skill, time, or specialized knowledge invested in an object increases its value, and once an item is an accepted symbol of wealth, elites will attempt to control either the raw materials or its production (Kenoyer 1995:217, 2000:91). Helms (1993: 5) touches on this in her own work with her emphasis on how acquiring long-distance trade goods and artifacts crafted by skilled craftspeople adds value to the goods both physically and intangibly through what the goods symbolically represent. And sometimes elites will become involved in the crafting themselves in order to increase their prestige or control over the process (Costin 1991:11; Helms 1993:70). In the Korean peninsula and the Japanese archipelago, we have evidence of stone beads being valuable due to them only being found in elite and ritual contexts. They are also often made of materials which were difficult to obtain either through long distance trade or due to scarcity. In the Japanese archipelago, the elites at the center of the Wa polity in Nara brought together craftspeople from across the archipelago to produce stone beads in a central workshop located in their palace so they could control the manufacture and distribution of the stone beads (Barnes 1987:98).

Another aspect of value in addition to the four factors above is that of ‘age/newness’. Just as people collect antiques today, there could be value to collecting, utilizing or displaying older objects in the past. For example, the successive use of ancient forms and imitations of Shang dynasty bronzes in later time periods suggests there was value in obtaining these particular bronze vessels (Barnes 1999:125; Sun 2003:763-764). Or how in Fijian culture, their whale tooth necklaces darken over time from handling and show that the owner has an object with a long history (Gosden and Marshall 1999: 171). There is also value to be found in obtaining something new or unique. This can be evident by lack of wear on a single artifact before final deposition. For example, a stone axe made out of rare, non-local material with no evidence of use could have been a new object meant to demonstrate its owner's skill in obtaining valuable items. However, it should be kept in mind that just because an artifact is well used, does not always mean it was considered more valuable when it was new. For stone beads, we can use the use wear evidence from within the drill hole and on the outside of the bead to determine if a bead is new or well used. If an earlier drilling technique is present on a bead which has been deposited centuries later than when that drilling technique stopped being used, then we can conclude that that stone bead was heirloomed or at least in circulation for a very long period of time.

Another aspect of value that should be considered is the 'perception of value'. An artifact does not necessarily need to be made of a valuable material to be considered valuable but rather if those viewing it *perceive* it to be made of that valuable material, it will hold the same value in their eyes. This was done by bead workers in the Harappan Period of the Indus who produced terracotta and steatite imitations of other beads made from different raw materials (Kenoyer 2003b:164). In the Yayoi period, the mainland of the Japanese archipelago imported shell from the Okinawan islands for elite bracelets, but when that source became unavailable or rare, switched to making imitations of the shell ornaments with bronze and jasper (Hudson 1999: 189). If the differences between the original goods and their imitations are perceptible or the imitations proliferate beyond strict control of elites, then value may once again be decreased. However, sometimes differences that archaeologists find easy to determine would not have been readily visible to your average person, so the expert bias of the archaeologist should be kept in mind.

This is evident in my own research with jadeite stone beads and other beads made of easier to work and obtain materials which seem to have been made as imitations of jadeite.

The idea of value intersects with how elites govern and maintain their power and authority (Costin 1998:5). Overt displays of wealth could act as a way to legitimate a person's place in society, but so could controlling the circumstances of when others could hold and display indicators of wealth (Baines and Yoffee 2000: 15). Beads in the Kofun period (250CE-645CE) of Japan, for example, were expensive products which were limited to being worn by elites and held specific political connotations (Barnes 1987:100). Although my research is concerned with overt displays of wealth through ornaments, wealth does not have to be demonstrated in such a way. A person who can store and distribute grain in a time of famine is also using their wealth to control other people's perceptions about them. Mann (1986:11) would call this economic power. A way to expand on this is to think of power as something elites obtain by controlling and mobilizing resources from the tangible items such as gold to intangibles such as important rituals (Blanton et al. 1996:2, 24).The distribution and limitation of stone beads only to elites during the Three Kingdoms/Kofun period (250CE-668CE) served as a visual and economic reminder of elite power and control.

Ideology and religion are often intricately related to elite strategies for maintaining the power and control (Costin 1998:5; DeMarrais et al. 1996:15; Mann 1986:21-22). "Because multiple ideas and beliefs exist in a given society, a ruling segment must control the ideology – shared ideas, beliefs, and their representations – that legitimates its position and authority" (DeMarris et al. 1996:31). When elites are in charge of ideological rituals and religion, they can use it to manipulate other elites and common people. They exploit a shared belief system in order to affirm their place in the social order and often the belief system reflects aspects of their own society (Renfrew 1994:49-50). Examining ideology is seeing how symbolic meaning is mobilized to legitimize groups (Hodder and Hutson 1986:85). Yet ideology is difficult for archaeologists to perceive in the past since we are limited to interpreting them through only the material aspects of what is found in the archaeological record (Hodder and Hutson 1986:82). As will be discussed in more detail in chapter 3, elites in the Korean peninsula and the Japanese archipelago maintained not just political but ideological power by performing rituals, many of which involved the use of stone beads.

There are several ways to approach studying ideology and religion in the past. One is “symbolically oriented” i.e. focused on what rituals and artifacts stand for, while another is to view religion and ritual functionally i.e. what purpose or advantage (usually to power and prestige) does the ritual or artifacts provide (Fogelin 2007:2). During the course of this study, stone beads will be examined in both ways in the hopes of exploring new interpretations of their use in the past. In particular, Shintō and other folk traditions in Japan are thought to retain some elements of the religious beliefs and rituals from before Buddhism was introduced to the country in the 6th century CE. Although there is the potential that many ideological aspects and symbols have changed over time, it has been shown that rituals and folklore can sometimes retain their forms and symbolic meanings over centuries (Fogelin 2007: 57). An example of this from Japan is the continued offering of miniature ceramic vessels as a ritual practice which continues from the Jomon period, through the Yayoi (400BCE-250CE) and Kofun period (250CE-645CE) and is still practiced in the modern day (Hudson 1992: 176). This does not necessarily mean that the *meaning* of this symbolic practice remained the same over this long period of time, but the form has retained a surprising continuity over thousands of years.

Early ideological systems were not irrational to the people producing or involved in them, even if they are often perceived that way. Actions and rituals take place in order to achieve a concrete goal, though those goals can vary greatly (Walraven 2002:86). Rulers in Han China would legitimize their power by publicly performing ceremonies and divination rituals (Bronson 2000:120). However, the goals of a ritual can be different for those performing the ritual versus those observing, sponsoring or participating in the ritual. For example, rituals are often thought to be performed by elites to legitimate their power and authority (Blanton 2016:24; Baines and Yoffee 2000), but they also serve a purpose for those observing the rituals. This can be tangible outcomes such as weather changes, wealth acquisition, or good health. Rituals can even act as a way of teaching the observers about society, life and religion (Blanton et al. 1996:24). But there are also intangible goals such as receiving messages from spirits or gods or obtaining good fortune. Shamanic practices in Korea today have changed with the modern times, but still reflect how shamanism was practiced in the past (Kendall 2009: 142). Shamans were consulted in the past for issues regarding health and people's spiritual status while in modern day society they are consulted for rituals involving wealth and good fortune. It should also be noted that rituals did not necessarily have to be successful to achieve their purpose. However, elites had to at least give the illusion that they were investing their power, control and wealth into these rituals (Bronson 2000:127). One of the ways they did this was subscribe heavily to the use of symbolic representations of rituals and meaning (Renfew 1994:53). One of those symbols was stone beads, and in particular those of jadeite and those in the curved, comma shape of the *gogok/magatama*.

Everything in the world can be conceived of, on some level, as being symbolic (Robb 1998:331). Geertz (1973:91) defines symbol to mean "any object, act, event, quality or relation which serves as a vehicle for a conception - the conception is the vehicle's 'meaning'." Symbols, in their most basic sense, act as a form of visual communication (Hegmon 2003:221-222). The meaning of these symbols can fluctuate and change on both a microscopic and macroscopic scale. One aspect of symbols for Robb (1998:338) is explained as fragments which are put together temporarily and experienced by people. However, people do often develop similar symbols across time and space due to shared experiences such as natural phenomenon like volcanic eruptions or the change of seasons (Arnheim 1961:390).“Material correlates for the same behavior (for example, social mobility) may vary according to the different ways symbols are negotiated within different frameworks of meaning and within different ideologies” (Hodder 1982: 190-191). In the case of the Korean archipelago and the Japanese archipelago, the symbol I am most interested in investigating is the *gogok/magatama* bead. There are several theories about what the bead and its’ unique shape meant in the past, and I will combine archaeological, historical, and ethnographic evidence to discuss which of those theories, if any, has potential. This broadly follows the methodology outlined by Robb (1998:341) for studying symbols utilizing multiple lines of evidence to get at various aspects of symbol studies.

Ingold (2007:10) believes that a material or object is intricately related to the objects past or history and not with the physical attributes of an object. However, it is limiting to not take the physical attributes of an object into consideration and Miller (1997:9) suggests looking at the mundane and physical attributes is essential to understanding what an object is doing. For Hodder (1982), objects have both a functional value and a symbolic value. Symbols can have different meanings in different contexts and although those meanings are often disregarded in studies of exchange, they absolutely should be considered since they can change the value and power of the object at the beginning or end of the exchange (Hodder 1982: 202-203). Craft production and exchange of material goods has its own symbolic meanings (Helms 1993: 4).

Hodder (1982:202) suggests instead that archaeologists must look at local meaning of the symbols which are being exchanged so you can understand the larger context. To Hays (1993:82), the more important aspect to focus on is the roles and functions of the symbols themselves. Both of these aspects were considered in my work.

One aspect of local meaning is style. “Style is that which has social and ideological functions as opposed to utilitarian functions” (Hodder 1982: 204). The way people design and make objects is neither for just functional tools, but nor is it also to follow a strict set of rules of design. Instead, the chosen style of an artifact is both informed by those creating it and also transforms the larger society (Hodder 1982: 206-207; Shanks and Tilley 1992:137). It is connected to socio-economic factors and ideology (Hays 1993:83). Style does not exist as a static isolated variable and this should be kept in mind while considering how style is analyzed archaeologically. For my research, style was defined as stone beads which share a range of similar measurements, shapes, and sometimes manufacturing methods. Statistical cluster analysis of those features were used to group beads into workshop traditions (as defined by Ludvik (2018:42-47) and based on work by Kenoyer and Vidale (1992), Jamison (2017) and Kenoyer (2017b)), however, the presence of beads with similar measurements and shapes, but not the same manufacturing methods can also reflect a style which is being copied or spread.

Ian Hodder’s (1982) study examined multiple ethnoarchaeological case studies in order to answer questions about material culture and how it should be interpreted. What he found was that material culture similarity is determined by how different groups in society (for example, young women) manipulate and negotiate utilizing that material culture to achieve their goals (Hodder 1982: 185). This can be happening simultaneously with other more homogeneous forms of material culture. Material culture discard follows rules which are understood by the group perpetuating them so in order for an archaeologist to interpret them, they must arrive at an implicit or explicit understanding of those rules (Hodder 1982: 192).

In 1974, Fleming suggested a proposed model of artefactual study for historians to use to incorporate artifacts into their studies. While it is overly complicated and not fully applicable to archaeology, the key aspect of this model is “The Artifact: History, Material, Construction, Design, and Function” (Fleming 1974:154). In other words, what is the artifact constructed of, how was it made, how was it used and how did it end up in the historical record. Archaeologists (Shott 1996; Tringham 1994) utilizing this concept of the ‘life’ of the artifact first called it the “use-life” of an artifact studying how an artifact was changed and used over time until deposition. However, this concept of “use-life” does not take into account the human factor involved in the artifacts production and use and it also does not consider that the period of use for an artifact may not be perceptible to an archaeologist. A broken tool may be discarded, but it could also be kept in someone’s pocket for sentimental or ideological reasons long past its’ apparent ‘usefulness’. Another factor ‘use-life’ does not take into account are the numerous objects which were recycled back into the archaeological record when metal was melted down or pottery was used as grog.

A more appropriate term might be “life-history” which incorporates the creation of the artifact, its duration of use, its associations with both other artifacts and human actors and final deposition or use (Tringham 1995: 98). Tringham summarizes this with the term “biography” but uses the term more literally than interpreted by Gosden and Marshall (1999) in their discussion of the biography of objects. They discuss how artifacts develop and change over time and how these changes are intimately related to how humans interact with them (1999: 169). Those interactions cause the artifact to go through multiple, potentially changing meanings throughout its' lifetime. There is also a distinction made between artifacts which "accumulate biographies" and those which instead inform the performance of rituals or knowledge of culture or history (Gosden and Marshall 1999: 176). In other words, sometimes artifacts do not have meaning in and of themselves, but do when they are used in the proper context.

The research I described recording in the earlier methodology section as well as samples of raw materials gathered from Korea and Japan are key to understanding the "life history" or biography of these stone beads. It begins with the raw material from which the bead is made of. That raw material is then transported or traded until it arrives at a stone bead workshop. The stone bead is then created (or someone fails at creating it and it is discarded). The stone bead then is traded or given to the elite who utilizes it either as a display of their wealth, power or status, or as part of the performance of an ideological ritual. Once a bead has outlived its' usefulness (and my research shows this is not necessarily when it breaks), elites in both regions either discard the stone beads in tombs or in ritual contexts. My research shows large amounts of use wear on the majority of beads suggesting they were not made solely for deposition in burials or ritual sites and were instead used in life. There are also famous stone beads in Japanese history and the Shintō religion suggesting that although those beads do have a particular meaning or symbolism (and in the past may have had the same or completely different meaning/symbolism), these famous stone beads have accumulated multiple biographies and associations. Most notable of these are the sacred stone beads (jewels) as one of the three main symbols Shintoism and of the Imperial family of Japan (Pearson 1992:197).

2.4 Bead Theory and Studies

The study of stone beads has been addressed in a wide variety of ways across the world. Stone beads are commonly assessed as only an aspect of a site or feature such as a burial or a cache. However, there are also specific studies which focus only on stone beads. This section will first look at studies which are relevant either through their discussion of manufacturing techniques, bead research methodology and the history of said research, or which are from related time periods or localities. Studies focusing particularly on Korean and Japanese stone beads will be addressed in chapter 3.

One of the pioneers of bead studies in archaeology is Dr. Kenoyer. His work is well known for his multiple studies on bead sourcing, manufacture, use and deposition in South Asia (Kenoyer 1992a, 1992b, 1992c, 1994, 1995, 2003a, 2003b, 2004, 2005, 2017a, 2017b, 2017c). Kenoyer (2003a) discusses how various materials are made into stone beads and pendants. Quartz is one of the most popular bead making materials, while nephrite and jadeite are harder to work due to their material qualities which means they need to be sawed or ground into smaller pieces and processed by hand (2003a:15-16). As a result, working with nephrite and jadeite are very time consuming. For all beads, perforation is often the most difficult part. Beads can either be pecked using a stone of similar or greater hardness or drilled (2003a:16). Because of its hardness, carnelian was originally perforated by pecking out the hole using a pointed stone flake or burin (Kenoyer 2003a:15). In order to drill longer beads, tapered cylindrical stone drills made from more resilient materials such as chert and jasper were used to drill carnelian. In the Indus region of modern Pakistan and western India a unique stone material called “Ernestite” (comprised of sillimanite and other minerals) was discovered and used to made a distinctive form of constricted cylindrical drill. These “Ernestite” drills made it possible to perforate long biconical beads that are characteristic of the Indus urban centers (Kenoyer 2003a:17). Harappan beads have been examined in detail and show both continuity over time but also changing patterns of production and distribution during the site occupation (Kenoyer 2003b:158).

There have been several studies of the ethnoarchaeological and historical history of bead manufacture in Gujarat. Around the 6th century BCE, hard stone beads were being drilled using a new form of drill made of iron and tipped with tiny diamond chips (Kenoyer 2017*a*:138-140). Single diamond drills have a large diamond chip crimped into the tip and double diamond drills have two tiny chips crimped into the edges of the drill tip. The use of single and double diamond drills is well documented in many regions of South Asia during the period between 600 BCE and 300 CE. These drills are still used today in India and this method of drilling slowly may have spread into Western and Southeast Asia by the 3rd century BCE to 3rd century CE, but did not reach East Asia. There is a specific drilling method used in modern day Khambhat, India which involves using a single diamond drill to start the hole, then finishing the perforation with a double diamond drill (Kenoyer, Vidale, Bhan 1991:53). This information is extremely relevant to my research since I found these same manufacturing methods appearing on carnelian beads in Korea and Japan.

The study by Roux (2000) looked at the manufacture of carnelian beads in Khambhat, India through ethnographic, experimental and observational studies. She focuses on the different stages of the chaîne opératoire which were observed with bead workers in Khambhat (Roux 2000: 39). This book is an excellent source of diagrams and discussions of 1990s carnelian bead manufacture in Khambhat, but her results utilizing digital monitoring and recording of such things as hammer strike speed are difficult to extrapolate into the past.

Of particular relevance to my research is Ludvik's (2018) dissertation examining stone beads from the Southern Levant in 2500-2000BCE. These beads were arriving in the Southern Levant through movement of individuals from the Northern Levant and Mesopotamia (Ludvik 2018:738). Ludvik utilized SEM analysis of stone bead impressions in order to determine manufacturing methods and use-wear in similar ways to my own research. Of great interest is Ludvik's (2018: 42-47) experimental ethnoarchaeological work which analyzed modern and archaeological beads with Elliptical Fourier transforms and was able to assign these beads clearly to specific workshop traditions. This supports the idea that a single craftsperson producing beads will produce similar and statistically recognizable bead shapes over time which can be designated to a workshop tradition. This work is based on earlier work by Kenoyer and Vidale (1992), Kenoyer (2017b) and Jamison (2017). Ludvik's (2012:4) earlier work on stone beads of Afghanistan also looked at SEM analysis of various beads to determine manufacturing methods in the past.

Another example of the use of silicone impressions in stone artefact studies is the examination of nephrite artifacts from various time periods across Chinese history from the Bronze Age to the 20th century (Sax and Ji 2013; Sax et al. 2004). These works took impressions of drill holes and the external surfaces of these artifacts to determine which methods of manufacturing were being used in the past. The impressions from the Bronze Age nephrite were analyzed under a scanning electron microscope to reveal that saws, files and pointed incising tools were used to shape the stone, though they do not always identify the materials of the tools themselves (Sax and Ji 2013:1078). It is thought that Bronze Age nephrite workers in China used bronze tools and quartz abrasive (Dubin 1987:166).

In regards to the southern India, Kelly (2013) examined south Indian Iron Age beads from roughly the same time period as this dissertation. Bead production was not being controlled by elites in the region and instead was an ad-hoc process involving the opportunistic acquisition of non-local resources (Kelly 2013:1). Different regions had different funerary traditions involving beads. One group were rarely depositing a certain type of bead in their burials while another region had complex rituals happening in or near the megalithic tombs which led to the placement of multiple beads of varying types (Kelly 2013:11). Beads, therefore, could not necessarily be an indicator of social status when examining the burials due to these differing funerary practices and rituals.

Over the course of my research, it became apparent that some of the carnelian beads in Korea and Japan may have been manufactured in Southeast Asia. As a result, it is relevant to my research to discuss studies on carnelian in Southeast Asia. Bellina's (2003, 2007, 2014) studies of stone beads in Southeast Asia looked at results from several sites across the region. She found there were multiple bead manufacturing sites present crafting agate and carnelian beads. Beads from the last century BCE were made by Indian craftspeople in the local style, suggesting they were being made for the Southeast Asian market (2003:291). In the first millennium CE, although Indian made beads are still present, it is mostly locally manufactured mid to low level beads which are making their way through Southeast Asia (2003: 294). Bellina (2014:350) was particularly interested in the grinding/polishing stage of the chaîne opératoire of Southeast Asian bead production and identifies three separate methods being utilized either individually or concurrently: a bead polisher, a rotary grinding stone, or a leather bag with abrasive. She assigned the corpus of stone ornaments at the Thai site of Khao Sam Kaeo into four technological groups based on a qualitative comparison of bead attributes (Bellina 2014:354-355).

Carter (2010, 2015) studies glass and stone bead exchange in Cambodia and Thailand. From 200BCE - 1CE, well-made, high quality (Type 1) carnelian and agate beads are found on coastal, and some inland, sites (Carter 2015:752). From 1CE-300CE, the quality of these materials changed. The carnelian and agate beads become low-quality with signs of mass production leading to poorly finished beads (Carter 2015:741). The distribution of beads also moves further inland and outside of the usual coastal trade routes.

The final research that must be examined is Francis's (2002) book on Asia's maritime bead trade which looks at glass and stone bead manufacture and trade across Asia. The book covers a wide variety of regions, sites and time periods, though it seems to be more focused on glass beads than stone. Unfortunately, very little attention is paid to East Asia in the study with only a few pages on China and nothing about Korea or Japan. Only half a page is devoted to discussing jade, despite its importance to bead studies across Southeast and East Asia (Francis 2002: 150). Carter (2016) has analyzed Francis's theories in regards to bead production and exchange in Southeast Asia and found that recent work in Southeast Asia supports a much more complex period of trade, exchange and manufacture than the direct distribution from India model proposed by Francis.

This chapter has reviewed my research questions and how I will address them. This was followed by my sampling methods and research methodology. The theory section addressed issues of value, power and control, wealth, ideology and the use of symbols in the past. In the bead studies section, I looked at relevant past studies and studies from across Asia. Next chapter will provide a background on Korean and Japanese archaeological research, a geological background for the Korean peninsula and the Japanese archipelago and look in detail at Korean and Japanese bead studies.

Chapter 3

Korea and Japan's Socio-political, Bead Studies and Geological Background

The purpose of this chapter is to illustrate the socio-political, economic, geologic and ideological context of my research. This will be accomplished first by giving a general background on archaeological research in the regions of Korea and Japan, including establishing a chronology and illustrating various aspects of life in the region, which have been investigated archaeologically. Stone beads were in use and being manufactured all through these regions during this period, but the specific bead studies will be introduced in the final section of the chapter. This section is followed by a geological background of the Korean peninsula and the Japanese archipelago so that readers may understand the raw materials, which were available locally. The Japanese archipelago in particular has a vast and varied supply of raw materials. Finally, the last section of this chapter specifically examines bead studies done in Korea and Japan with an emphasis on those which deal with artifacts from the time period under consideration.

3.1 Korea and Japan

The peoples of East Asia have been involved in trade and exchange of natural resources, and manufactured goods for the past 25,000 years (Barnes 1999:62; Imamura 1996:37; Kuzmin 2008:7). Finds of Jomon style sherds alongside Korean peninsular material culture, at sites in Korea like Tongsamdong from 4000-1000BCE, show that this trade and exchange continued over time (Nelson, 1993:107). From 500BCE-500CE, the eastern coastal areas of East Asia were involved in the Yellow Sea Interaction Sphere (Barnes, 1999:208) which not only involved the exchange of goods, but also of ideology and technology. Although there was undoubtedly exchange before 500BCE, Barnes (1999:208) notes that there was an upswing in interaction during this period. Figure 3.1 is a map which designates prefectures and regions mentioned in the text. Figure 3.2 shows specific sites mentioned in this chapter.

The study of the Three Kingdoms (300-668CE) and the Kofun period (250-645(700)CE) is the study of emerging complexity and the development of early states. Many scholars are preoccupied with the question of when the Koguryo, Silla, Paekche, Kaya, and Wa polities can be considered states because statehood is often conflated with the present day concept of a homogeneous nation (Hudson 2006; Ikawa-Smith 1990; Mizoguchi 2006; Nelson 2006; Pai 2000). The historical documents written about these periods place the beginning of these states much earlier than the archaeological evidence supports (Barnes, 1999:222; Noh 2004; Piggot 1997). The majority of scholars have been highly critical of the mythical elements in historical texts such as early foundation dates, but historical data are still privileged over the archaeological. While the Western 'state' model is being challenged in how it applies to Asia (Honeychurch & Amartuvshin 2006; Liu & Chen 2006), scholars in both countries have been debating how it applies to the “kingdoms” of the Three Kingdoms/Kofun period. Although most debates on statehood have been confined to the earlier Samhan/proto-Three Kingdoms period in regards to Korea, there is no agreement on terminology for ‘states’ in the Three Kingdoms period or in the Kofun period, so I have chosen to follow the example of other scholars and refer to these "kingdoms" as polities (Allen 2002; Barnes 1999; Kim, K. 1995; Park 2008).

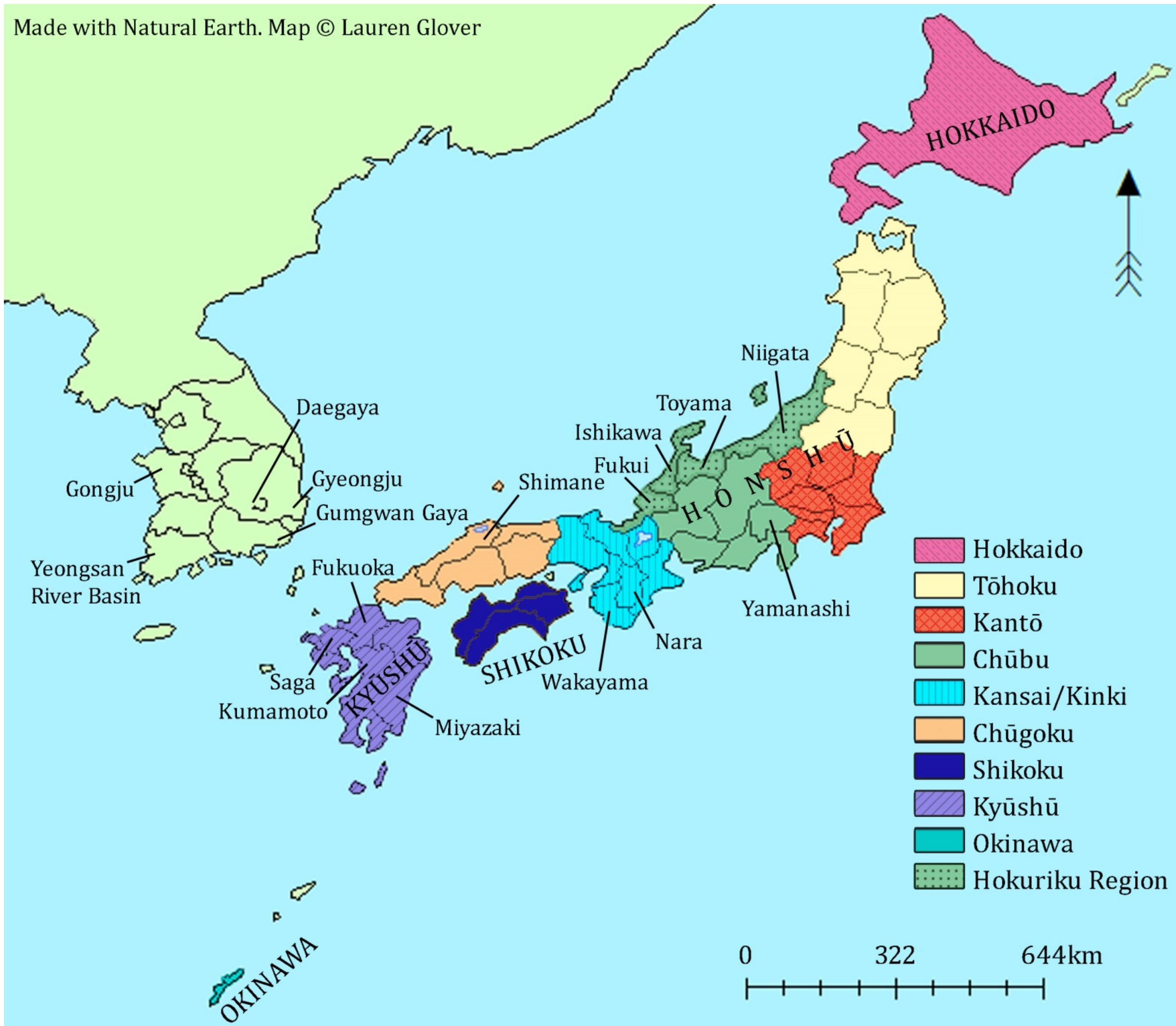


Figure 3.1 Map of regions and prefectures mentioned in the text.

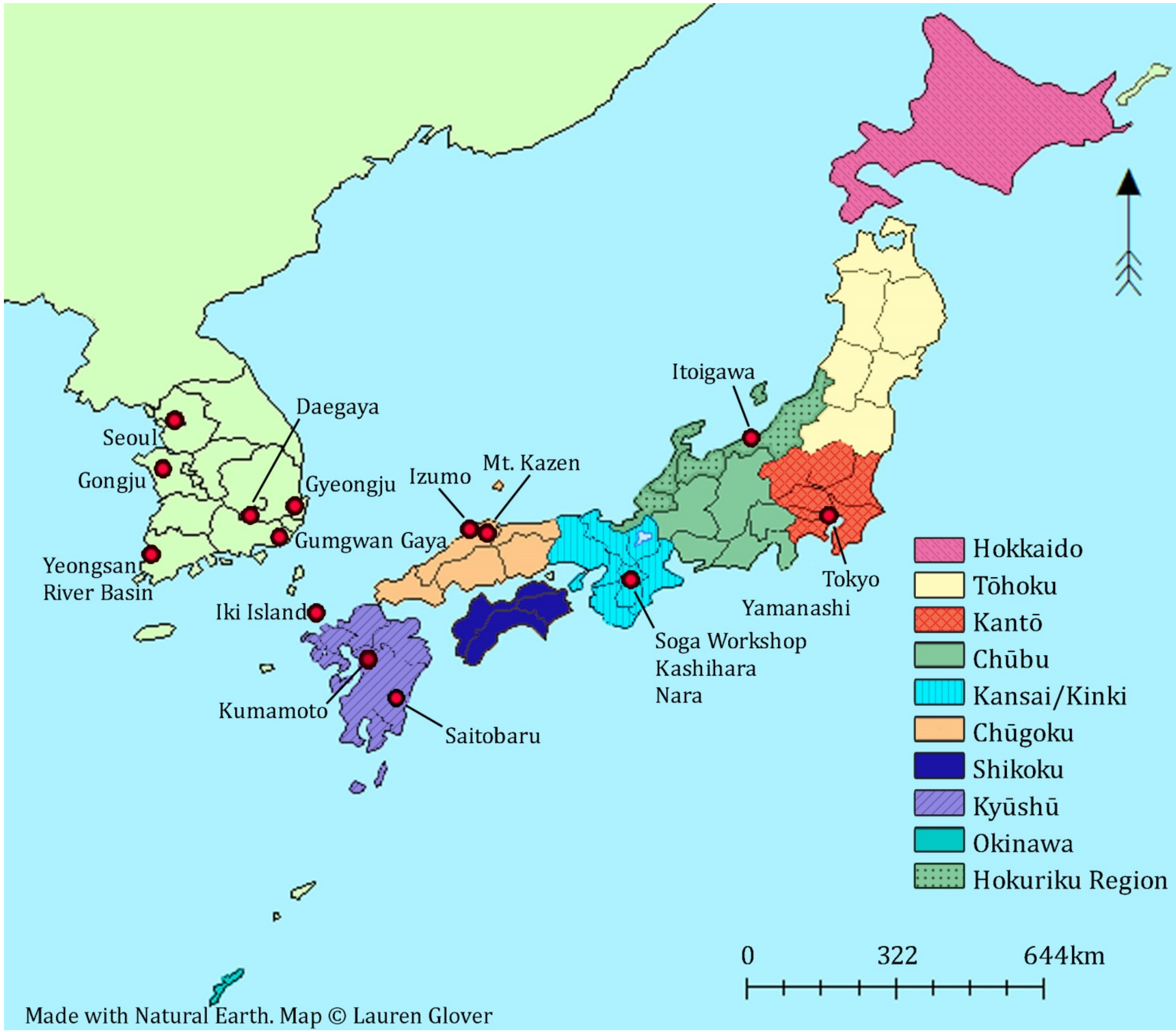


Figure 3.2 Map of sites mentioned in this chapter.

There are various lines of evidence for the study of the Three Kingdoms and Kofun Periods which need to be evaluated and considered. Although some might refer to the Three Kingdoms and Kofun Periods as historic periods, they are more properly referred to as proto-historic periods since the historical texts for the Three Kingdoms period were actually recorded in the 10th century by commission of a Goryo ruler who wished to trace his lineage back through time to the beginning of the Silla dynasty and in the early 8th century CE for the Kofun period (Barnes 2001: 3, 2007:20-21). The 10th century Korean source only exists in fragments and the full versions were written down in the 12th and 13th centuries (Obayashi 1991: 68). Best (2002:166) also rightfully points out that the Korean accounts depict a very static view of history with the Baekje polity's politics remaining unchanging for hundreds of years. The author of the *Samguk Sagi*, Kim Pusik, also admits in the introduction that his purpose was to present a study of Confucian political values (Best 2002: 166). Some sections of the Korean texts have been confirmed archaeologically such as the date of the conquest of the Baekje polity around modern day Seoul and the burial practices of one of the Baekje Kings (Muryeong and his Queen) (Kwon 2008:68, 86).

It is thought that the Baekje scribes provided some of the basis for the historical text, the *Nihon Shoki* written in 720CE, in Nara, Japan (Barnes 1999:243), but the *Nihon Shoki* was compiled to aggrandize the Japanese Emperor and was still written down 75 years after the Kofun period ended and 52 years after the end of the Three Kingdoms Period. It is best to collaborate the text with archaeology whenever possible, especially for the earlier parts of the chronicle. In 711-712, the *Kojiki*, a compilation of myths relating to the Japanese archipelago was written down. Since it deals with mythology, this document is rarely used by archaeologists, but there has been some intriguing analysis by historians; each region of Japan had its own mythology which was combined to form the official *Kojiki*, but it is obvious from the text that the region of Izumo had its own mythological influence (which still exists today in the form of the Great Izumo Shrine, one of the oldest and most important shrines in Japan, the first of which was constructed at the tail end of the Kofun period (Carlqvist 2010:186; Shimane Museum of Ancient Izumo and Kyoto National Museum 2012:333; Takioto 2010:103). This mythological influence may have translated to economic/political power or a level of independence from the main Kofun polity (Carlqvist 2010: 186, 196). In practice, while these historical texts can be a guide to what was happening in the past, it is best not to take everything in them at face value until it can be collaborated either archaeologically or by other historical texts since both the Korean and Japanese texts have their own issues. These texts do mention beads however and will be referenced in Chapter 6 when discussing interpretive analysis.

In addition to these historical texts written in later periods, there are also mentions and depictions of the peoples of the Three Kingdoms and Kofun period in Chinese texts. The polities in these regions were involving themselves in the tributary system of the Chinese dynasties in return for titles and valuable prestige goods (Barnes 2007:41-43,70; Park 2008:122). Both regions sent missions with tribute to the Chinese court and returned with titles and valuable gifts, though their value and meanings varied on a case by case basis (Lim 2007: 31). For example, Daegaya sent tribute from their king to the Southern Qi dynasty in 479CE and was granted a honorary Chinese title as a reward (Tikhonov 1998:66). There are depictions of envoys from the Three Kingdoms painted on the walls of a tomb in old Samarkand and the tomb of Li Xian, the Prince Zhanghuai who died in 684CE (Figure 3.3)(Pak, Y. 1984:16).

Fig. 3.3 Replica of a Tang dynasty text depicting foreign envoys including Silla (left) and Goguryeo (right), Courtesy of the Seoul Baekje Museum. Photo by Lauren Glover.

There are many studies of Korea and Japan which view the Korean Peninsula as an area through which Chinese culture simply passed to influence the Japanese archipelago (Barnes 2007, 3; Best 1982:447). This traditional view is often embraced by historians since it privileges the early Chinese historical sources, and because after the Kofun period, the Japanese state was greatly influenced by China (Barnes 1999; Kito 1990). While some still embrace this traditional view (Chun 2004:74; Hong 2010), many scholars have been acknowledging both the regional variation within the Korean Peninsula during the Three Kingdoms period (Kim, W. 1972; Park, C. 2008) and also that the peninsula and the Japanese archipelago were involved in periods of heavy exchange (Barnes 2007; Farris 1995: 2-3; Kang 2008: 53; Rhee et al. 2007: 404). The nature of this exchange and how it influenced and altered the lives of elites, the workmen producing the goods, and the average person has not been adequately explored.

There are multiple periodization methods for the Korean peninsula (Bale and Ko 2006: 160). This dissertation will follow some of the more recent ones. The Mumun period began circa 1500BCE and ended around 300BCE. The Early Mumun is from 1500BCE - 700BCE and the Late Mumun is from 700BCE - 300BCE. The Proto-historic period can be divided into early 300BCE-1CE and late 1CE-300CE with the late period being referred to as the Proto-Three Kingdoms Period. The Three Kingdoms Period begins at 300CE and continues until 668CE when Silla conquers the last of the other polities.

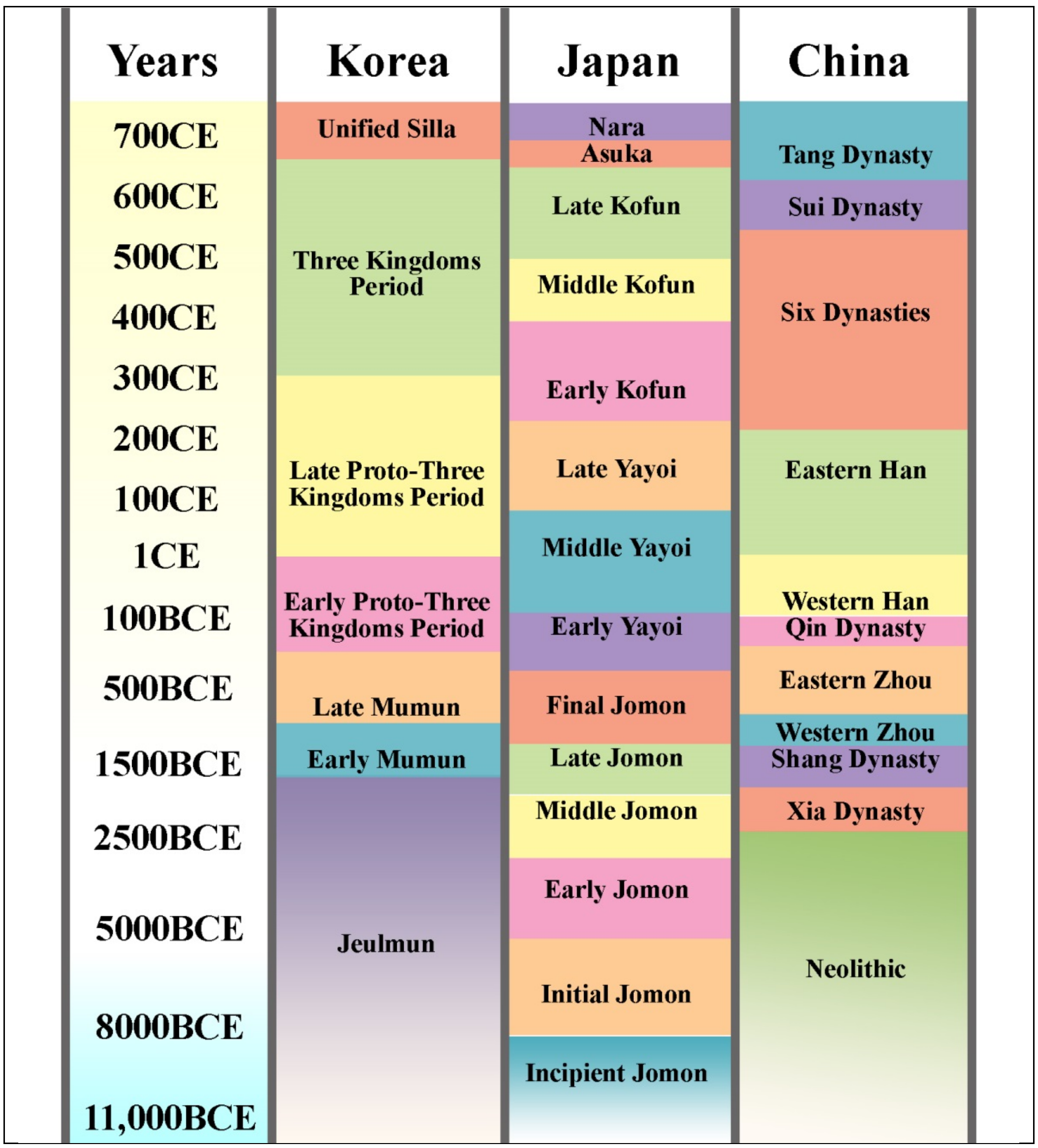


Figure 3.4 A comparative timeline

The Proto-Three Kingdoms period is a time of consolidation. Multiple chiefdoms across the peninsula began to consolidate their power and resources in order to develop into the four main polities of the Three Kingdoms Period. Historical texts date Silla, Goguryeo, Baekje and Gaya as beginning during this period, but although they may have existed, they cannot be considered consolidated states (Barnes 1999:222; Park, C. 2008:123). Trade routes were shifting during this time period as the Proto Three Kingdoms Period moated settlements gave way to walled fortresses, capital cities and mounded tombs (Kwon 2008:71-73; Park, C. 2008:113, 116, 123). The southeastern coastal region begins to develop after the second century CE due to the development of iron technology and mining (Lee, J. 2009:84). The Silla and (multiple) Gaya polities would all be centered around this area.

The three kingdoms of the Three Kingdoms period actually consist of four polities: Silla, Gaya, Baekje, and Goguryeo. Goguryeo was located in the north of the peninsula in present day southern Manchuria and North Korea. Goguryeo is named after walled towns and sites have been found half way into Manchuria to the north (Kang 2008:13,16). Baekje was originally located in the middle of the peninsula in the area occupied by present day Seoul and to the south of Seoul. In 475CE, the area around Seoul was conquered by Goguryeo and the Baekje polity retreated to the southwestern area of the peninsula replacing the local elite burial system by 538CE (Best 2007: 191; Kwon 2008: 70; Lee, D. 2014:174). Gaya was centered around the Han River valley in the center and central southern coast of the peninsula. It consisted of multiple chiefdoms which existed at various, often consecutive, times. Their location was first centered on the coastal area of Gimhae and was known as Gumgwan Gaya in the 3rd and 4th century CE (Kim,

T. 2005: 186; Park, C. 2008: 113). By the 5th century, Gaya's location had shifted north to the center of the peninsula (Kim, T. 2005: 187; Park, C. 2008: 135) and lasted into the 6th century CE as the Daegaya polity. Silla is located in the southeast area of the peninsula though its' actual borders fluctuated throughout the period.

Each polity on the Korean Peninsula had its own preferred style of tomb building, though styles changed over time and could be regionally distinct within a polity. Goguryeo and Baekje favored stone corridor or chambered tombs, for example (Farris, 1995, 21). Gaya and Silla were building large scale wood chamber tombs in the beginning with human sacrifices in the royal tombs (Park 2008:116). Of interest are the keyhole shaped tombs which appear on the peninsula in the late 5th/early 6th century CE in the Yeongsan River Basin area (SW) (Park 2008:144; Saka 2016:96). Recent work suggests that these tombs were built due to increased interactions of the region with people from Kyushū, Japan in order to strengthen the political and economic standing of both regions (Lee, D. 2014:174-175; Park, C. 2008:144-145). They also appear in small numbers on the border between the Dae and So Gaya polities which is thought to be because people from the archipelago were being hired or invited into the area by Daegaya to defend the border against Baekje (Park, C. 2008:144; Tikhonov 1998:66). If true, this presents a separate route for stone beads and other goods, people and ideas to be traded between the peninsula and the different groups in Kyushu, distinct from the main Kofun period polity.

According to historical texts, inscriptions and archaeological artifacts, the Three Kingdoms periods was a time of bustling trade, diplomatic exchanges and warfare (Best 2007; Barnes 2007; Farris 1995; Rhee et al 2007). All four polities along with various Chinese dynasties and the peoples of Japan (called Wa) were involved in these conflicts at various times (Best 2007: 191). Kofun period goods are found in tombs in the south of the peninsula, while iron goods made their way to Japan in exchange (Kim, T. 2005: 190; Park C. 2008:116). Of particular note is the Gwanggaeto stele which was erected by a Goguryeo king to celebrate his victory against Baekje, Wa and Silla forces in 396CE (Best 2007:191). Farris (1995: 8) believes that the Wa became involved in battles on the peninsula due to a need for iron and better technology for armor and, eventually, horseback riding. The *Nihon Shoki* also speaks of Wa forces being active on the peninsula during this time (Farris 1995:24-25). Iron ingots from the iron rich Gaya regions are found centered around the Kinai/Kinki region in Japan but also in northern Kyushū, coastal Shikoku and as far north as the Chibu region around Tokyo (Kim, T. 2014: 294).

In 520CE, Silla codified into a law a complicated status system called the bone-rank system which divided the entire polity into various classes from royalty on downwards (Kim S. 2008:6-7). A restructuring of ranking within the elites/government also occurred in Baekje in the early sixth century (Best 2002:169). In 562CE, Silla conquered Gaya and embarked on an effort to conquer the rest of the kingdoms (Park, C. 2008: 145). Silla successfully claimed the Han River valley - the original Baekje territory; this eventually caused Baekje and Goguryeo to put aside their own animosities and work against Silla (Best 2007: 192-193; Lim 2007:30). Silla conquered Baekje in 660CE with the help of the Tang Dynasty, and the Baekje elites fled to the Japanese archipelago while their king fled to Goguryeo (Best 2007: 194). Refugees from both the Gaya and Baekje, due to war and conquest by Silla, seem to have immigrated to the archipelago (Tikhonov 1998:64). There were Korean immigrants in the archipelago before then as evident by their distinctive cooking tools appearing in various regions (Rhee et al.2007:433), but in this period, the Baekje elite seem to have integrated themselves into the court life of the Kofun period polity (Barnes 1986:87). These second and third generation Korean immigrants worked as craftspeople, but also became powerful political and martial leaders in the emerging Japanese state (Hideo 2007:58; Rhee et al. 2007: 405). With Baekje gone, Silla once again allied itself with the Tang Dynasty to conquer Goguryeo in 668CE, thus beginning the Unified Silla period (Lim 2007:35; Yihong 1997:223).

There is considerable debate on when various periods in Japanese protohistory began. As a result, the beginning and end dates of various time periods are continuously being shifted. For example, the Yayoi period used to be thought to end in 300CE but the discovery of older keyhole shaped tombs pushed the end of the period back to 250CE (Pearson 1992:188). The dates I provide here are general dates which may not necessarily apply to certain regions of Japan. When that is the case, it will be noted in the text, but otherwise references to the various time periods agree with the following periodization.

The Jomon period spans the period of time from to 400 BCE, so it is generally divided into six sub sections as follows: Incipient ~11,000BCE - 8000BCE, Initial 8000BCE - 5000BCE, Early 5000BCE - 2500BCE, Middle 2500BCE - 1500BCE, Late 1500BCE - 1000BCE and Final Jomon 1000BCE - 400BCE (Habu 2004: 39-41). The Yayoi period begins in 400BCE and continues until 250CE (Mizoguchi 2013: 34). The Early Yayoi is from 400BCE - 100BCE, Middle Yayoi is 100BCE - 100CE and the Late Yayoi is 100CE - 250CE. The Kofun period begins in 250CE. From 250CE - 400CE is the Early Kofun period. The Middle Kofun period is 400 - 500CE and the Late Kofun period is until 645CE (Mizoguchi 2013:34). The Asuka period begins in 645CE and is marked by the appearance of elaborate palace complexes near Nara, the full adoption of Buddhism and a change in tomb styles (Mizoguchi 2002:218-223). However, the Kofun period does extend to 700CE in certain regions in Japan such as the edges of the Kantō plain (Pearson 1992:188).

From 500BC-500AD, the eastern coastal regions of East Asia were involved in the Yellow Sea Interaction Sphere (Barnes 1999: 208) which not only involved the exchange of goods, but also of ideology and technology. By the Middle Yayoi, burial mounds begin to appear, but not in the distinct shapes of the Kofun period (Imamura 1996:182). Notably, Yayoi period elites, often called 'kings and queens', were not only in contact with the Korean peninsula but also with various Chinese dynasties. A gold seal was found in northern Kyushū, Japan which was recorded in the late Han dynasty chronicles as being gifted to a king of Wa (Imamura 1996:185). And notably, Queen Himiko, a Late Yayoi ruler, whose designated tomb in Nara prefecture is one of the largest keyhole shaped tombs, is recorded as having received hundreds of Han dynasty mirrors; versions of which have been found in early Kofun period tombs (Aoki 1991:17;Ishino 1992:193) (for further discussion of whether these were the exact same mirrors see Barnes 2007:99-101, 150). Mizoguchi (2008:25) believes these solid contacts with the Chinese dynasties were the extra boost elites in the Kinki region needed to solidify their domination in the Kofun period.

In the Japanese archipelago, tombs known as 'kofun' (古墳) in Japanese are found in round, and square shapes similar to those of the Korean Peninsula, but the most prominent shape was the keyhole shaped mounded tomb (Figure 3.5). These keyhole shaped tombs appear a little before 250CE and continue throughout the period, though the inner chamber styles change over time (Barnes, 2007:10). The extent of the keyhole shaped tombs is often used to judge the extent of the Wa kingdom since their unique form is seen as a sign of Wa ideological/political influence. The keyhole tombs from 250-400CE extended across the southern half of Honshū and the northern part of Kyushū (Barnes 2007:121). From 500-600CE they are found across the length of the archipelago excluding Hokkaido (Figure 3.6) (Mizoguchi 2013:298). People of low status could not afford the time, expense and labor of building kofun tombs and were buried without grave goods in irregular, unmarked pits (Pearson 1992:201).

Figure 3.5 Shima no Yama Kofun, Nara. The classic keyhole-shaped tomb. Courtesy of Google Earth.

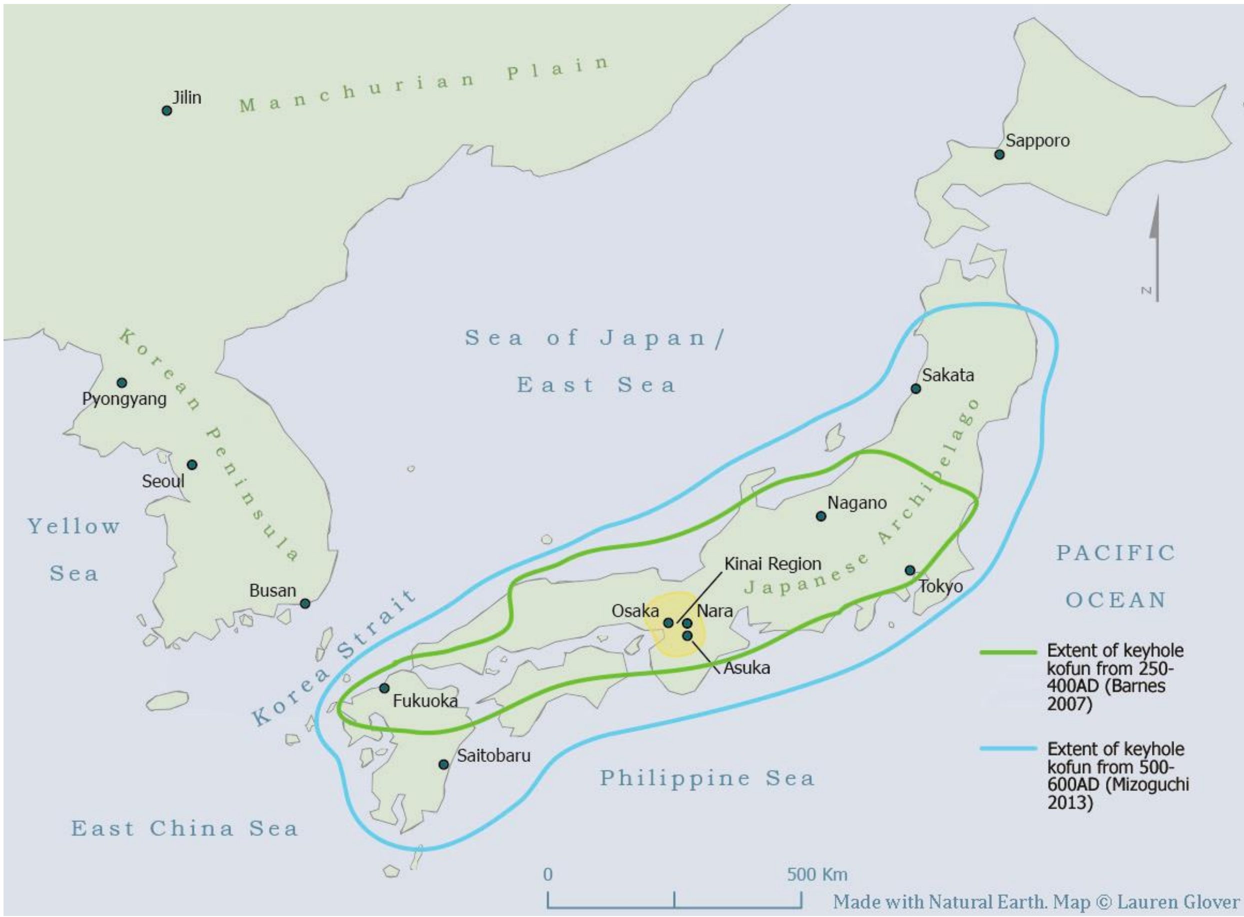


Figure 3.6 The extent of keyhole shaped tombs during the Early and Late Kofun period.

With the exception of royal tombs which tend to be grouped close together, these mounded tombs are often found in association with nearby settlements and territory which the occupants of the tomb are considered to have administered (Pearson 1992:197). Many of these tombs demonstrate local control of resources and a large number of people would have been involved in their construction. The largest of these tombs is 486 meters long and is from the fifth century, but there are at least forty other tombs which are larger than 200 meters (Tsude 1987: 55). By the late Kofun period, kofun changed to horizontal style chambers which allowed multiple entries and burials over time (Pearson 1992: 198).

The outside of the tomb mounds were carefully constructed and then often decorated along the edges and top with figurines known as *haniwa* (Figure 3.7). Although they are most often found to be made of clay, they have also been found in wood and in stone (Pearson 1992:206). Plain, cylindrical *haniwa* with ridges along the side are most common, followed by animals and people, then individual objects such as houses, shields and parasols (Miki 1958:24-37; Pearson 1992:203-205). Animals tend to fall into two categories: domesticated animals such as horses, dogs and cows, and animals that can be hunted such as birds and deer (Pearson 1992:237). The people depicted show a wide swath of society from naked men and women to musicians, warriors, elites and priestesses/priests (Chikatsuasuka 2008:63-66; Miki 1958:38). In the second half of the Kofun period, these *haniwa* were manufactured under the direct control of occupational groups (known as *be*) who were in turn under Kofun elite’s control (Pearson 1992: 192).

*not to scale

Figure 3.7 Various *haniwa*. Courtesy of the Tokyo National Museum. Photo by Lauren Glover.

Inside these tombs were burials of 1-4 people, with 1-2 being more common in general while larger tombs were more likely to have multiple burials (Makabe 1991:12). The inside walls of these tombs were often left bare but there are multiple examples of elaborately painted and decorated tombs as well (Figure 3.8). Pottery, jewelry (almost always including beads), weapons (mostly swords and arrowheads) and bronze mirrors are the most common grave goods (Pearson 1992:188). By the mid to late Kofun period, iron armor and horse riding gear join the list (Pearson 1992:187,200). The bronze mirrors appear in the late Yayoi period and were mostly imported from China with a few being from Korea and many being made in Japan (Tanaka

1992:216). These mirrors were important ritual and political tools. Outside of graves, we see them hanging from the belts of *haniwa* shamans and are told that they were hung from trees in the Japanese historical texts (Barnes 2007:170). In the 6th century, *sue*-ware, a luxury type of pottery, and gilt bronze items become common (Pearson 1992: 201). By the end of the Kofun period and into the Asuka period, tomb styles have changed to include Chinese iconography, and Buddhist ideas and artifacts have been incorporated into tombs (Kaner 2011: 466; Tsude 1987:69-71).

Figure 3.8 Replica of the tomb decorations inside Chibusan Tomb, Kumamoto Prefecture, Kyushū. Photo by Lauren Glover.

The horserider theory states that invaders on horseback came to Japan from either north Asia or Korea and conquered the indigenous people of Japan, forming the Japanese state in the late 5th-early 6th century (Edwards 1983). The theory is not supported by the archaeological evidence, but it is also the result of the traditional view of Japanese culture coming solely from outside of the archipelago (Barnes 2007: 18; Edwards 1983; Egami 1964; Farris 1995; Ikawa-Smith 2002: 326). In truth, horse riding gear is found in Japan before the 5th century and it takes until the 6th century for it to catch on (Pearson 1992: 193). This theory still retains a certain amount of popularity in non-archaeological circles in Korea, but has been largely dismissed by archaeologists.

By the late 5th century, the main Kofun polity had been established in the Nara basin (Pearson 1992: 187). This polity controlled outer regions through the exchange of raw materials and prestige goods. Mizoguchi (2008:14) argues that this central area's location constrained and controlled how they were connected to other regions. Barnes (2007:173-177) calls this "stratified peer polities" with one of those peer polities eventually gaining supremacy over the other polities. Grayson (2002: 466-68) suggests that Izumo in modern day Shimane prefecture was the center of a rival polity to the central Kofun polity since Izumo has its' own set of myths which seem to have been incorporated prominently into the *Nihon Shoki* and *Kojiki* as a form of compromise after the central polity won them over. The myth of the god Susano coming from Silla along with Korean place names in the region suggests that the region had close ties with the Korean peninsula (Grayson 2002: 469, 480). In both Korea and Japan, swords were seen as political gifts. The most famous of these swords is the seven-branched sword of the Isonokami Shrine which is inscribed with the date 369CE and that it was a gift for the King of Wa (Kofun period central authority) from the Baekje king (Pearson 1992: 210). Other swords seem to have been made or gifted from a central authority to subordinates to show their appreciation. There was also extensive trading and interactions overseas with a large port in modern day Osaka and other warehouses/naval bases elsewhere in the archipelago (Pearson 1992: 190). Elites lived in private residences, separate, but associated with non-elite villages (Pearson 1992: 194).

In the early 5th century CE, immigrants from the Baekje polity brought scribes, horse breeding, brocade weaving, gold working and the fine pottery (*sue* ware) making to central Japan (Barnes 1987: 87; Hideo 2007:50). Buddhism was introduced from Baekje in the mid sixth century (Kaner 2011:465). Agricultural advanced due to tools obtained from the peninsula and changes in how rice paddies were laid out (Pearson 1992:190). This stimulation of better agriculture and new craft technologies spurred the Kofun central authority to control the production and distribution of luxury goods. However, they were not always successful since the archipelago is very accessible by sea (Pearson 1992: 213).

A semi-complete image of the ritual and religion of the Three Kingdoms Period and Kofun period has been formed by combining archaeological research, historical sources, mythological sources and parallels to modern practices. One comprehensive analysis of the rituals of the Kofun period is by Ishino (1992). Ishino (1992:192) believes that in the late Yayoi period, inhabitants of Japan rejected the Yayoi religious artifacts (bronze bells known as *dotaku*) and rituals because a Little Ice Age was causing famine and unrest. Himiko, the queen who is thought to be the ruler mentioned in the Chinese chronicles for this time period, then used the 100 Chinese bronze mirrors obtained from a diplomatic mission as replacement locations or objects of worship for the gods (Ishino 1992:193). In the early Kofun period most archaeological evidence of ritual were through votive deposits in rivers and on mountains (Ishino 1992:203). Barnes (2014:3) discusses the five different landscape features which would attract ritual behavior and deposition during the Kofun period. These are: conical mountains, plains facing those mountains, beaches/underwater locations, mountain passes, and sea passages. To that, Pearson adds islands (1992:196). The Makimuku river has evidence of cooking utensils, rice, weaving implements, a bird shaped boat and a ceremonial staff which Ishino (1992:205-206) believes are evidence of the start of a harvest festival celebration.

From 450-550CE, talc (steatite) replica objects (Figure 3.9) of swords, mirrors, mortar shaped beads and *magatama* became popular (Ishino 1992:212). Many of them have small holes in them which may have allowed them to be hung on trees. These beads are also sometimes found on sites along the southern coast of the Korean peninsula (Park, C. 2007:139). During the 5th century, talc imitation artifacts and small pots were deposited in all the above mentioned ritual locations. Yamanokami is a site at the base of Mt. Miwa where 10,000 ritual artifact deposits were found with depositions extending into the Nara period (Barnes 2014:4). The mountain is still considered sacred today and has a famous Shinto shrine at its base (Figure 3.10).

*Not to scale

Figure 3.9 Talc replica objects, Courtesy of the Kashihara Archaeological Museum. Photo by Lauren Glover

Figure 3.10 Mt. Miwa Shrine. Nara Prefecture, Japan. Photo by Lauren Glover.

From the mid-4th to 9th century, Okinoshima, an island off the coast of Kyushū held a shrine dedicated to the safety of sea travelers (Pearson 1992:196). Offerings of mirrors, horse gear, talc effigies of horses, humans and boats were all found on the island. Some of the artifacts are from the main Kofun region around Nara according to their similarity to objects found in the large kofun in the region. This suggests that the central authority around Nara was administering these ceremonies from afar (Pearson 1992:197).

3.2 Bead Studies in Korea and Japan

Bead studies are relatively rare in Korea and Japan and become even more limited when focused on the period from 250CE to 700CE. When glass beads are excavated, they are systematically chemically analyzed, but stone beads are often neglected in site reports, especially older reports. There are only a handful of Korean studies on stone beads. In Japan, stone beads have frequently been a subject of interest in discussion of elites of the Kofun period, but they are often mentioned in passing in relation to other prestige objects. Most articles on Japanese stone beads have focused on the Yayoi period, but there are several sources specifically discussing the stone beads and their workshops in the Kofun period.

The origins of the *gogok/magatama* are an issue of contention in Korea and Japan with both regions claiming to have the form first (Dubin 1987:167). They appear in Korea during the Early Bronze Age ie Early Mumun 1500BCE - 700BCE (Noh 2009:93). They appear in Japan during the Middle Jomon 2500BCE - 1500BCE (Habu 2004: 225). Both regions have potential proto-*gogok/magatama* appearing before those dates which take the form of either modified half-moon shaped blades or modified jade earrings which are cut in half and then a hole is drilled near the bottom to make them *gogok/magatama* (Figure 3.11).

*Not to scale

Figure 3.11 Initial and Early Jomon (8000BCE-2500BCE) beads. Courtesy of the Chojagahara Archaeological Museum, Photo by Lauren Glover - most appear to be versions of the earring in the center bottom which have been cut in half.

Nephrite from the Korean peninsula was used in making neolithic tools, such as blades of white nephrite; pale green nephrite from the south of Gyeongju, was also being worked (Dubin 1987:167; Chihara 1999: 9). However, in the middle of the Mumun period (c. 850BCE), people began to use stone beads (generally in a green or blue color) as ornaments and deposits in burials (Bale and Ko 2006: 175-176). These beads consisted of *gogok*, cylindrical and spherical beads and were made of materials such as amazonite, jasper and nephrite. Earlier beads have been found but are thought to have been discards of Middle Mumun period refuse in early Mumun contexts. Since roughly half of the deposits of Middle to Late Mumun beads were from high status contexts, these stone beads may not have been 100% prestige goods but it is clear that some members of society did not have equal access to these beads.

Evidence from the Middle Mumun pit houses in Daepyeong points to household level bead production with a small amount of raw material, stone drills, partial beads and grinding stones found in household contexts (Bale and Ko 2006: 178; Shoda 2009: 188-189). By 700BCE, production had shifted to a group of pit houses protected by a palisade and ditch which contained grinding stones, debitage and partially finished beads. However, there is less debitage and partially finished beads on this site than in the earlier household production. Bale and Ko (2006: 179) theorize that this means the bead workers are only producing small amounts for themselves and locals. However, if this is the case, the high amounts of stone beads found across the south of the Korean peninsula by this time period - 513 stone beads - points to an intensification of production elsewhere than Daepyeong. 56% of the burials after 700BCE contain stone beads. Bale and Ko (2006: 182) conclude that this period is when long distance exchange of groundstone daggers and stone beads begins to be used as networking strategy by high status individuals.

Beads from the Middle Mumun into the early Proto-Historic period were examined by Shoda (2008, 2009). Studies have suggested that there are many similarities between the jasper cylindrical beads of the Korean peninsula and those from the Yayoi period in Japan (Shoda 2008: 9). These consist of short (often about 1cm long) cylindrical beads of small width and drilled from both sides. By the Proto-Historic period, bead workshops begin to decline (Shoda 2009:237).

In the Proto-Three Kingdoms period, bead production was still done within settlements and mostly seems to have focused on rock crystal beads (Heo 2018:138-139). A good example of this is the site of Seokpyeong (Mahan Cultural Research Center 2011). This rock crystal bead workshop has partially manufactured hexagonal biconical beads and *gogok* along with a single iron drill. Although the site continues into the early Three Kingdoms Period, the bead manufacturing areas which have dates are not from Three Kingdoms Period (Mahan Cultural Research Center 2011: 345). Heo's (2018) examination of stone and glass beads from this period found that stone bead distribution expanded widely, appearing beyond the coastal regions after 200CE and seems to have been part of an elite effort to expand their political power and status inland.

In the Three Kingdoms Period, there are no known production centers for stone beads (Park, C. 2008: 131). There is one potential bead grinding stone from an early Paekche tomb so it is possible that beads were being finished but not worked or drilled (Seoul National University Museum 1997: 186). The hundreds of jadeite *gogok* found in the Korean peninsula follow the same progression as Japan from earlier translucent green jadeite with varying sizes and shapes to more opaque white jadeites (Park 2008: 132). A study of the measurement of jadeite beads from a tomb in Korea matched with jadeite *magatama* produced in Itoigawa, Japan (Saotome and Hayakawa 1997:21-23). Warashina's (2014:255) XRF examination of two jadeite *gogok* from Bokcheon tombs in Busan revealed they had the same composition as Itoigawa jadeite.

According to accounts recorded in the Chosun dynasty "Sejeong shilrok chirichi" and "Cheongbodongkuk yochi sengram" agate/carnelian can be found on mountains in Gyeongju, Ulsan, Youngil, Anju and Gangwon Sambo (Bokcheon Museum 2013a:140). It is thought that there was no mountain in the southwest of the peninsula and the excavated agate from the central area of peninsula is very refined while those of the southwest are characterized by being irregularly shaped, roughly faced and concave on one side (Bokcheon Museum 2013a:140). Rather than there being a source in the Korean peninsula (which does not exist (Heo 2018:141)), this seems to be an explanation on observations of types of carnelian making their way to various regions. My research does support that in the Three Kingdoms Period; the Gaya and Silla carnelian is often well finished while the Baekje carnelian does tend to be roughly finished and have the depression where the spall was popped out during diamond drilling. While it is certainly possible that those areas listed by the Chosun dynasty do have agate or carnelian available, the diamond drill manufacturing methods and lack of workshops does not support their conclusion that these beads came solely from, and were manufactured in, the Korean peninsula.

Choi (2018) recently published a study on the distribution of jadeite *gogok* during the Three Kingdoms period, focusing on the Yeongnam region which is the location of the Gaya and Silla polities in that period. She discusses how they were traded for political purposes between regions with the Silla region around Gyeongju dominating the trade and having the largest sized beads (Choi 2018: 143). There is a peak in the trade in the late 5th century as Silla expands its' influence. Choi (2018: 170) thinks that it is highly likely all the jadeite beads come from Japan, though not just the Kinai region, but also Fukuoka and the Hokuriku region. She defines 10 different types of jadeite *gogok* and an attempt is made to track their changes over time with the majority found in the 4th to 5th centuries (Choi 2018: 148-150). Issues with this study are that no specific gravity analysis was performed on the beads, and it is possible that some may not be jadeite. Beads were also typed based on their shape, sometimes taking into account their drill hole, and sometimes them having lines around the head. Nothing was defined based on manufacturing method, nor does it take into account heirlooming and the fact that these beads may have been in use long before final deposition which could completely negate the dating in this study. Another issue is that none of the measurements or sketches seem to have been done by the author. This means that there was no standardization in either measurements or how they were sketched which brings into question the study results which are based entirely on these features. She states at one point that drill hole sizes were disregarded because all they did was increase with bead size (Choi 2018: 146), but there are a lot of exceptions in her diagrams to this and more in my own studies .

Another source analyzed the regional distribution of jadeite *gogok* during the Three Kingdoms Period (Bokcheon Museum 2013b). They found that they were largely confined to the south of the peninsula, but seem to have been heavily involved in diplomatic exchanges between Silla and other kingdoms (Bokcheon Museum 2013b:273). They estimate 700+ jadeite *gogok* are found on the peninsula at this time (Bokcheon Museum 2013b:256).

In Japan there have been many regional studies of various bead types and several of the studies address bead production from a broad perspective. Some of the earliest Japanese and English language books on ancient Japan include stone beads as part of their discussions of ancient culture (Hamada et al. 1927; Kanda 1884; Milne 1881; Takahashi 1911). However, they are only discussed in broad terms and well before the dating was developed which makes them difficult to use in modern day studies. An early study in English (Holtom 1928:33-34) discusses the importance of beads in the past as they were mentioned in ancient texts, in archaeological evidence, and their current importance in Shintō traditions. One of the more recent non-regional studies is Takahashi (2005:8-11) which discusses the distribution of jadeite artifacts across the Japanese archipelago from the Jomon period to the Kofun period. In the Jomon period, jadeite is found in the north of Japan only but begins to migrate south at the end of the period. During the

Yayoi period, jadeite artifacts are spread via coastal routes, including the southern shores of Japan which are quite a long distance nautically from Itoigawa in Niigata prefecture. In the Kofun period, these routes continue to be used but there is also more penetration inland and possibly some use of transport overland.

Chihara (1999: 8) discusses the evolution of jadeite working in Japan over time starting the Middle Jomon period. The earliest jadeite bead is a large pendant from Itoigawa, Niigata prefecture which is the source for the jadeite found in Japan from the Jomon to Kofun period. The earliest jadeite artifacts were large, but by the end of the Jomon period, there was a transition to smaller beads like *magatama*, spherical and irregular shaped beads. By the Yayoi period, only jadeite *magatama* were being produced. There is little evidence of jadeite production in the Kofun period beyond some workshops in Toyama prefecture to the south of Itoigawa and Soga Workshop in Nara. (This is contradicted by Takahashi 2012b: 6). Jadeite carving disappears completely from Japan in the 7th century CE. The Itoigawa jadeite sources were not rediscovered until 1939.

Warashina (1978, 1992a, 1992b, 2009, 2010, 2014) has multiple articles and discussions of the distribution of stone materials across Japan as determined by XRF (X-Ray Fluorescence) analysis. He has developed a truly detailed distribution and origin map for multiple types of raw materials, though not all of them were used for making stone beads. For jasper, there are eleven known sites where jasper is found geologically in Japan. XRF analysis of samples gathered from those sites (particularly 1-5 which are well known) revealed that the majority of jasper beads found in Kofun period Japan are from jasper source 2: Mt. Kazen in the Izumo bead making area of Shimane prefecture (Warashina 1992a:358). Three beads were found to be from other available jasper sources (1 and 11) so there was some utilization of other sources, but Mt. Kazen jasper dominated the market.

Barnes (1987:98-101) discusses the changes in distribution and location of bead making throughout the Kofun period. In the early Kofun period, bead workshops have been found in the Chūbu and Kantō regions utilizing both local and long-distance raw materials pointing to long distance trade outside of the main kofun regions. By the middle Kofun period, there are still sites in the Chūbu and Kantō regions along with the Chūgoku and Kansai regions. Beads made of semi-precious or precious stones were then often replaced with steatite imitations. Sites such as the Soga workshop in Nara, begin to appear in association with elite spaces. In the case of the Soga workshop, it was founded, then a palace was built in the area and the bead manufacture continued under elite control. While most workshops of the Late Kofun period are in the Chūgoku region, there still remain others in the Kansai region located at the site of 5th century palaces despite the palaces themselves being relocated. Barnes (2014:2) mentions that the nature of the workshop sites in the early Kofun period were all household level, but that by the Middle and Late Kofun period there were established workshops.

The Shimane Museum of Ancient Izumo (2009) produced a comprehensive but brief overview of bead working in Japan. This focused mostly on the Yayoi and Kofun period due to the 40 bead workshops present in the Izumo area during the Kofun period. The site distribution during the Kofun period discussed by Barnes (1987: 98-101) has been refined. There are sites in the Chūgoku region throughout the Kofun period (Shimane Museum of Ancient Izumo 2009: 60). In the early Kofun period, the Chūbu region has the majority of the workshops with around half as many in the Kantō region - this is a continuation of the distribution during the Late Yayoi period (Kawamura 2004:57; Shimane Museum of Ancient Izumo 2009: 60). There are isolated workshops sites in the Kyūshū, Kansai and Chūgoku regions during this period (Shimane Museum of Ancient Izumo 2009: 60). By the middle Kofun period, there is a much small number of workshops in all these areas except for Kyūshū where they have disappeared. In the Late Kofun period, only the Chūgoku and Kansai regions are producing beads.

In addition to discussing distribution of beads, The Shimane Museum of Ancient Izumo (2009) presents an overview of the raw materials used to make beads in Japan and outlines the beads most common shapes as well as provides a time line from 500BCE onwards. The book then focuses on bead workshops in Shimane in the Yayoi and Kofun period providing pictures of artifacts from workshops and some of the workshops themselves. It delves into the chaîne opératoire of bead production, addressing each material that was produced in the region.

Miyada (2014:14) discusses three chaîne opératoire found for cylindrical beads in Japan during the Yayoi period: one involves dividing the stone into rectangular blocks then grinding the edges of that block into a rough with multiple faces around its length before finishing. A second method involves cutting long strips of rectangular stone off a larger block, then cutting that strip down to the length of a cylindrical bead before grinding down the faces and finishing the bead, and a third method involves cutting the block into rectangles, then roughly chipping off the edges of the rectangle before finishing the bead (Shimane Museum of Ancient Izumo 2009: 29-32). This third method of creating a rough out is typical to the Shimane bead workshops into the Kofun period.

In 1987, the Shimane Board of Education published an overview of each bead workshop found in Shimane prefecture at the time. It showed the location of each workshop, year, a comprehensive summary and photos/sketches of a selection of artifacts from the sites. The workshops ranged from the Yayoi period to the end of the Kofun period. Some workshop sites were small, household style production centers while others were much larger. They invariably had the local dark green jasper from Mt. Kasen on their workshop sites and some had rock crystal or red agate. My personal observations of the Shimane collections showed that commonly this red agate was actually a pale orange. A small number, and generally the larger workshops, had a dark red agate which I would classify as carnelian.

Takahashi's monograph (2012a) focuses specifically on jadeite *magatama* of the Kofun period (250CE-645CE) with articles by him and several others included. Takahashi (2012b) looked at the chaîne opératoire of jadeite *magatama* production at 12 workshop sites from the north west coast of Japan in and below Itoigawa (the source of the jadeite). These workshops dated from the Yayoi period into the early Kofun period and Takahashi (2012b: 6) cannot find evidence of jadeite working continuing into the Kofun period so he concludes that the jadeite *magatama* are being manufactured during the Yayoi period. In the Jomon period, the jadeite workers used direct percussion methods to simply block out pieces of jadeite, regardless of color, but in the Yayoi period they figured out how to extract the clear green and green with cloudy pieces from the jadeite. By the late Yayoi in the Hokuriku region, they were utilizing iron tools to work the jadeite (2012b: 14). Takahashi's (2012c) second article in the monograph discusses when the manufacturing of jadeite *magatama* began in the Hokuriku area. He concludes it did not take off truly until the late Yayoi period but acknowledges this does not explain jadeite *magatama* being found in northern Kyushū.

Kishima (2012: 37-43) looks at the history of jadeite manufacture in and around the Itoigawa area. He identifies fourteen workshops from the Yayoi and Kofun period. There are eleven workshops from the Kofun period and three from the Yayoi period. All three of the Yayoi workshops had jadeite present. Ten of the eleven Kofun period workshops had jadeite present, either in raw form or as partially complete *magatama*. After analyzing them all together, he suggests that the jadeite *magatama* have a larger range of size in the Kofun period (2012: 45). Yamagishi (2012) looks specifically at the late Kofun to early Kofun period site of Fuesuita and the bead manufacture there. The site reports show more detailed images (Itoigawa City Board of Education 1983a, 1984), but it is a useful overview. Yamagishi (2012: 64) makes the point that there are signs of connections in Itoigawa with the Kofun period elites through the large supply of dark green jasper and the lighter green tuff which is found in Itoigawa.

Ohga (2012: 50) divides the *magatama* into three types in the Kofun period: O type which is nicely rounded C shape across the whole bead and has marks around the hole, type Nn which is thickly shaped, has smaller holes and is often made out of a more opaque jadeite and type Nw which is C shaped with a low polish but still can have marks around the hole. Type O and Nn are common while type Nw is rare. There were also several other *magatama* which were not used in typologies since he was uncertain if they were from the Kofun period. It is quite difficult looking only at the sketches of the beads provided on page 51 to determine how these three types apply to the actual beads so these typologies were not applied in my research.

Kawamura (2004) discusses the distribution of stone beads and ornaments during the first half of the Kofun period with a focus on jasper and steatite beads and ornaments. These stone implements are discussed and analyzed purely in terms of funeral implements and their distribution in tombs.

One of the most researched regions for bead studies in Japan is that of Shimane Prefecture. This is no doubt because numerous bead workshops and raw materials are found in the region. There have been several collected volumes on bead research which have emerged about Shimane in the past few decades. Of note are the three series of collected studies on bead making in the region of ancient Izumo (Center for Studies of the Ancient Culture and The Buried Cultural Properties Center, Shimane Prefecture, Japan, 2004, 2005, 2009). The first two of these studies is an extremely detailed list of stone beads, the sites where they are found and images and trends in the different prefectures in the Chūgoku region. The third study (2009) is a collection of articles analyzing various aspects of bead studies from trends over time, to manufacture and the sources of the raw material. Some of them reference stone beads outside of the Chūgoku region, but are often only focused on the beads from a single prefecture.

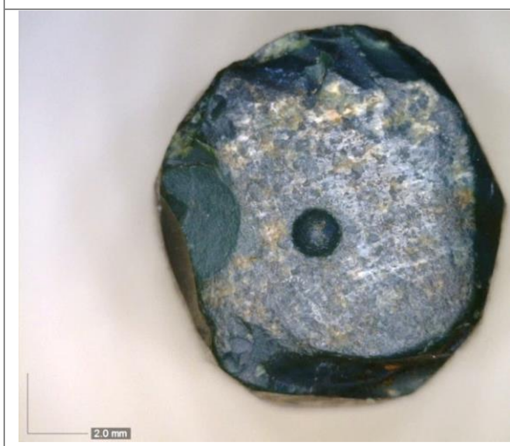
It is only in the 6th century with the decline of the central production at the Soga workshop in Nara that bead production begins to decline everywhere except for Shimane prefecture, which produces the majority of the beads of the late Kofun period (Yoneda 2008:23). The beads continued to be used by shamanesses/priestesses, shrines, and the royal family. Beads still remain important for their being part of the three imperial regalia (mirrors, swords and beads) up to this day, but after the Kofun and Asuka periods, they were no longer required elites outside of the royal family to legitimize their positions and instead fulfilled a decorative function (Dubin 1987:175).

My dissertation research spans across multiple time periods and regions in Korea and Japan. I was even able to examine stone beads from the Jomon and Yayoi periods (the equivalent of the Mumun period in Korea) so some of these earlier studies became relevant over the course of my research. I was able to analyze beads from a wide range of workshop, tomb and settlement sites in Shimane prefecture, so all the earlier bead research done there has been of great help to my own work. Since I was not able to analyze any workshop sites outside of Shimane prefecture, these other studies of workshops, especially along the northern coast of the main island of Japan, allowed me to broaden my knowledge of workshops during the Kofun period. The studies on *gogok/magatama* will be addressed again in the interpretive analysis chapters when discussing changes in style and materials as well as the potential meaning behind this uniquely shaped bead type. But first we must discuss the geological backgrounds of the Korean peninsula and the Japanese archipelago.

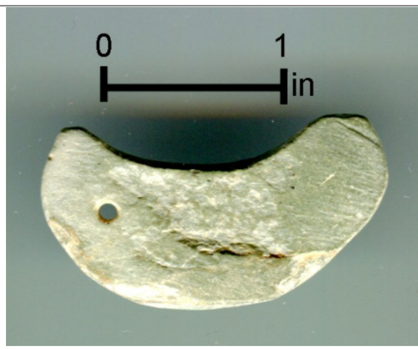
3.3 Geological Background

The raw materials used to make soft and hard stone beads come from a wide variety of contexts. Over the course of my research in Korea and Japan, stone beads made of rock crystal (mostly quartz), chalcedony (including agate, carnelian, and jasper), jadeite, nephrite, steatite, jet, alabaster, tuff, amblygonite, gypsum, amber, schist, serpentine and hydrogrossular were all examined**.** What follows will therefore be a brief introduction to each raw material with some of their specific properties as it applies to stone beads. Included in this will be color, the mineral's Mohs' hardness which is the measurement of how hard the mineral typically is, and its specific gravity which is the density of the stone (Marshak and Repcheck 2009:77). Specific gravity was used to determine which stone was being analyzed whenever possible. Mohs' hardness testing was only done on raw materials since it would have scratched any beads which were analyzed. Many other aspects of identifying minerals such as streak, crystal habit, luster and fracture and cleavage will not be addressed because testing the majority of them would damage the artifacts or are not visible due to how the beads were manufactured.

Table 3.1 Raw material characteristics **Photographic example**	**Mohs' #** **Specific Gravity**	**Description**
	Mohs' # 6.5-7 Specific Gravity 3.30-3.38	**Jadeite** Characteristics: A tough, difficult to work stone due to it being composed of well interlocked, tiny grains (Schumann 2011: 170). Colors: Jadeite is often thought to consist only of green stones, but it actually comes in a variety of colors and its base color is white (Abduriyim et al. 2017: 48). Location: Jadeite is extremely rare and is only found in gem quality deposits in a few places in the world. These places are Myanmar, Guatemala, Japan, and Siberia (Chihara 1999: 5). Itoigawa, Niigata prefecture in Japan is the known source of jadeite beads in Japan from the Jomon period through the Kofun period, though there are other sources in Japan that either had no bead suitable stones or were not utilized in the past (Abduriyim et al. 2017: 49; Chihara 1999: 15).
 *Not to scale	Mohs' # 6-6.5 Specific Gravity 2.9-3.03	**Nephrite**: Characteristics: A tough stone. It is actually nephrite which was worked as jade in China until the 1700s when they began to get jadeite from sources in Myanmar (Schumann 2011: 170). Colors: Appears mostly as a tough, white to green stone but other colors are possible (Schumann 2011: 172). Its' appearance can vary greatly by region. For example, nephrite from Australia is a very dark black-green (top left corner). Location: Nephrite is present in both the Korean peninsula and the

		Japanese archipelago. Nephrite from the center of the peninsula is white while southern nephrite is light green (Chihara 1999: 9). Nephrite gathered from Itoigawa, Japan is an opaque green-blue.
	Mohs' # 6.5-7 Specific Gravity 2.58-2.64	**Chalcedony**: <u>Characteristics</u>: The species name for all cryptocrystalline quartzes such as jasper, carnelian, bloodstone, agate etc. <u>Colors</u>: Often white, gray, or bluish (Schumann 2011: 142). Chalcedony in Japan is often an opaque white to yellow or light orange color. <u>Location</u>: Shimane and Ibaraki prefectures, Japan.
	Mohs' # 6.5-7 Specific Gravity 2.58-2.91	**Jasper**: <u>Characteristics</u>: A variety of chalcedony which is opaque and finely grained. <u>Colors</u>: Of varying colors and often with inclusions of different materials (Schumann 2011: 162). The jasper of Korea and Japan analyzed in this study is usually an opaque light green to dark green color, often with swirls or inclusions of different shades of green. <u>Location</u>: Jasper is found in eleven localities across Japan (Warashina 1992:359). The most plentiful being the mine on Mt. Kazen in Izumo, Shimane prefecture.
	Mohs' # 6.5-7 Specific Gravity 2.58-2.64	**Carnelian**: <u>Characteristics</u>: A variety of chalcedony characterized by its distinctive color. The rock usually needs to be heated to create the deep red color (Kenoyer 2003:15). <u>Colors</u>: A deep red to orange color and of varying translucency (Schumann 2011: 142). <u>Location</u>: Deposits of carnelian are found around the world. Locations with large amounts of gem quality

		stone have been worked for millennia and acted as suppliers of the stone to other areas of the world (Kenoyer 1991:44). There is carnelian available in Japan in small amounts.
	Mohs' # 6.5-7 Specific Gravity 2.6-2.64	**Agate**: Characteristics: A variety of chalcedony formed into concentric rings inside absences in the rock, though there are other theories for their formation (Marshak and Repcheck 2009: 158-159; Schumann 2011: 148). Colors: Can be found in a variety of colors though white, brown, gray and black are common band colors. Location: Found along the northwest coast of Japan. Ibaraki, Toyama and Ishikawa prefecture.
	Mohs' # 7 Specific Gravity 2.65	**Massive Crystalline Quartz (Rock Crystal):** Characteristics: Conchoidally fractures (Schumann 2011:132) Colors: Transparent and colorless. Location: This stone can be found around the world. It is common to refer to any transparent gem as rock crystal until proven otherwise. There are multiple sources of rock crystal available in both Korea and Japan, but Yamanashi prefecture in Japan is famous for producing rock crystal in later centuries (Sunagawa 2009: 30).
	Mohs' # 7 Specific Gravity 2.65	**Quartz:** Characteristics: Microcrystalline quartz Colors: Can range from transparent to opaque and comes in a variety of colors (Schumann 2011: 132). Location: Toyama prefecture.
	Mohs' #	**Steatite**:

	1 Specific Gravity 2.55-2.8	Characteristics: A dense but soft stone sometimes known as talc or soapstone. Colors: Gray-green is a common color along with white, yellowish or blue green (Schumann 2011: 226).The majority of the steatite examined from Korea and Japan ranges from black to gray in color. Location: Wakayama, Shiga and Hyogo prefectures, northern Kyushū (especially Nagasaki and Fukuoka) and near Tokyo in Gunma, Saitama and Ibaraki prefectures (Sakurai City Cultural Resource Center 2010:2,5).
	N/A	**Schist**: Characteristics: A somewhat coarse grained metamorphic rock containing mica flakes and formed at a high temperature (Marshak and Repcheck 2009: 181). Schist is often used to make the grinding stones of the Kofun and Yayoi period in Japan (Museum of Ancient Izumo 2009:6). Colors: Gray Location: Widely found in layers across the world. A deep belt of it runs along the Sanbagawa belt in Wakayama prefecture to half way through the island of Shikoku (Sakurai City Cultural Resource Center 2010:3)
	N/A	**Tuff**: Characteristics: A common pyroclastic, igneous rock made of volcanic ash (Marshak and Repcheck 2009: 108). Because tuff is a light weight stone, often with inclusions of pumice, it does not seem to do well in the geothermal earth of the Korean peninsula and the Japanese archipelago, but it would have been easy to work. Colors: A light green tuff is commonly used to make stone beads in East Asia.

		<u>Location</u>: Tuff is common wherever there has been current or prior volcanic activity. In Japan it is found across the northern coast of the main island, in parts of Hokkaido and Kyushū and in other smaller deposits on the main island (Huzioka 1963:57).
	Mohs' # 2 Specific Gravity 2.3-2.33	**Alabaster**: <u>Characteristics</u>: A porous form of gypsum (Schumann 2011: 248). The low Mohs' hardness made this bead easy to work. <u>Colors</u>: White, brown or pink <u>Location</u>: Often found in massive deposits in sedentary rocks.
	Mohs' # 2 Specific Gravity 2.2-2.4	**Gypsum**: <u>Characteristics</u>: a soft white stone which can range from transparent to opaque (Schumann 2011: 226). Similar to alabaster, this bead would have been easy to shape and drill. <u>Colors</u>: White <u>Location</u>: Often found in massive deposits in sedentary rocks.
	Mohs' # 6 Specific Gravity 3.01-3.11	**Amblygonite**: <u>Characteristics</u>: Gem quality stones are usually transparent, but opaque versions are possible. <u>Colors</u>: A golden yellow to colorless stone (Schulmann 2011: 208). <u>Location</u>: Often found in occurrence with quartz and feldspar (Pough 1996:243)
	Mohs' # 6-7 Specific Gravity 3.25-3.5	**Hydroglossular**: <u>Characteristics</u>: Also known as katoite and is a form of garnet (Schulmann 2011: 280). <u>Colors</u>: It can be pink, green, white or colorless and range from transparent to opaque. <u>Location</u>: Found in similar locations

		as nephrite and jadeite.
	Mohs' # 2-2.5 Specific Gravity 1.05-1.09	**Amber**: Characteristics: Consists of fossilized tree sap and is not considered a mineral because it is made of organic material (Marshak and Repcheck 2009: 82). Colors: Usually yellow to red to brown. Location: Although much is made of Baltic and Russian amber, amber can also be found washed up on beaches in East Asia so it is difficult to determine where the amber from this period came from (Schumann 2011: 254).
	Mohs' # 2.5-4 Specific Gravity 1.19-1.35	**Jet**: Characteristics: black coal, very soft. It is almost exclusively used to make biconic or rounded oval shaped beads known as jujube beads in Japan during the Kofun period (Museum of Ancient Izumo 2009: 6) Colors: Usually a deep black or a dark brown (Schumann 2011: 252) Location: Found in natural deposits around the world.

(Mohs' Hardness numbers and specific gravity are all from Schumann 2011 except schist and tuff whose hardness and specific gravity vary depending on which inclusions are in the stone.)

The Korean Peninsula is made up of the volcanic Gyeongsang basin, two Phanerozoic belts; the Imjingang belt, and the Ogcheon fold belt, and the Nangrim, Gyeonggi, and Yeongnam Massifs which are Precambrian basement terrains (Cho et al., 2017:847). The south of the peninsula divides into four distinct areas in relation to these geologic features with corresponding lead isotope ratios (Jeong et al., 2012:4). Copper, tin, gold-silver, and zinc are all available geologically (Jeong et al., 2012:3) though direct evidence of bronze production during the Three Kingdoms period has only been supported indirectly by lead isotope data, and it is likely that most tin was being imported (Lee, J. 2009: 73; Mabuchi et al. 1985:151). There are large nephrite deposits across the entire peninsula and into Manchuria, but no natural jadeite (Chihara

1999:9; Yui and Kwon 2002:593). River valleys provided a natural means of transport and access to inland resources, with the river mouths and coast allowing for access to maritime trade (Park 2008:137). The location of a polity could therefore determine what resources and trade routes it could utilize. For example, Paekche, in the southwest of the peninsula, was able to keep close ties with both southern China, and the Japanese archipelago (Chen 1991: 84). Trade was not just happening around the Yellow Sea region, but there were also trade routes along the eastern coast of the peninsula (Lee, J. 2009: 88).

The Japanese archipelago is made up of four main islands and many smaller islands. Kyushū, the southern island, and Honshū, the main island are both close enough to the Korean peninsula to be reached by sea, though there are also numerous islands in between, some of which were used as stopping points or even trade centers (Miyamoto 2008:13). The Japanese archipelago is divided into twenty-five tectonic belts which can be further divided into four major areas (Wakita 2013:75-76). There are several metamorphic belts which run across Japan and provide access to various metamorphic stones. These include the jadeite bearing Omi-Renge belt which is located on the northeast of the Sangun metamorphic belt (Chihara 1999: 11). These two belts on the lower western coast of the islands of Honshū and Kyushū were often a source of semi-precious stones in ancient times. The Omi-Renge belt is a serpentine melange zone consisting of four different types of tectonic units separated by the serpentine melange (Chihara 1999: 12). There is a huge variety of stones available in these serpentine melange areas including jadeite, garnet, rock crystal, schist, serpentine and crystalline schist (Chihara 1999: 12). Jadeite can actually be found in nine locations across Japan, but only the Itoigawa locality has gem quality stone (Abduriyim et al. 2017: 49). Another belt which provides jadeite and serpentine is the Sanbagawa belts which run parallel to the Renge-Sangun belts but further south in a line that almost directly bisects the island of Shikoku (Abduriyim et al. 2017: 49). Serpentine can be found in the same locations as jadeite including a source running from the northern most tip of Hokkaido towards the south and an additional line of serpentine bisecting the northern and southern halves of Kyushū (Abduriyim et al. 2017: 49). Jadeite from Itoigawa comes in multiple colors. Opaque white and green are common, along with opaque purple, blue and black, though more translucent green with white clouds has also been found (Figure 3.12). Yellow jadeite is present in Itoigawa but yellow and red jadeite is much more commonly from Myanmar (Fossa Magna Museum 2016:87).

Figure 3.12 Common types of Itoigawa jadeite seen in the Magna Fossa Museum 2016. Photo by Lauren Glover. *not to scale

Volcanic tuff is a common stone found in volcanic deposits across the country (Wada 1904:1). It is most often found along the western coast of Japan and as far north as eastern Hokkaido (Sakurai City Cultural Resource Center 2010: 4). Rock crystal is common enough in Japan that it was once suggested that it become the national gemstone of Japan before jadeite was re-discovered (Tsujimori and Harlow 2017:185). It can essentially be found either as rock crystal or quartz across Japan (Wada 1904: 38). In the historical period, Yamanashi prefecture was well known as a locality for rock crystal mining and manufacture but there is no evidence it was being utilized much during the Kofun period (Sunagawa 2009:30). Jasper, agate, carnelian and rock-crystal can all be found in the vicinity of Mt. Kazen, Izumo in Shimane Prefecture and this explains the confluence of bead workshops in the area (Hamada et al. 1927: 19; Sakurai City Cultural Resource Center 2010:3). Ibaraki prefecture north of Chiba prefecture has red agate which can be found in rivers there (Itagaki 2008:23). There are 11 sites where jasper can be found in Japan though only a handful of those were used during the Yayoi and Kofun periods (Warashina 1992:359).Chalcedony found in Ibaraki prefecture tends to be transparent or a grayish color (Wada 1904:47). In Toyama prefecture on the NW coast, chalcedony is found with jasper and quartz while deposits further south in Ishikawa prefecture are found with volcanic tuff (Wada 1904:47).

Steatite (talc) is found in multiple deposits across Japan. It ranges from a light gray to a gray-blue to black with small, lighter flecks in color. There are potential deposits in the Wakayama, Shiga and Hyogo prefectures which are in and around the main Kinki region where one of the main centers of Kofun period culture was located (Sakurai City Cultural Resource Center 2010:2). There also was a source in northern Kyushū (especially Nagasaki and Fukuoka) and near Tokyo in Gunma, Saitama and Ibaraki prefectures (Sakurai City Cultural Resource Center 2010:2,5). This abundance of resources means that while archaeologists mostly consider steatite beads from the central area to be from the closer prefectures, it is possible they were from much further away (Sakurai City Cultural Resource Center 2010:5).

Gypsum is not found in large deposits in Japan, but in small, individual deposits which are either white or colorless and often have a rough surface (Wada 1904: 78-79). Amber is mostly confined to coastal deposits in Japan. It is available along the middle stretch of the northwest coast of the main island and on the southeast coast above Tokyo and near the northern most tip of Honshū (Sakurai City Cultural Resource Center 2010:4). Crystalline schist is available in multiple locations, but a deep belt of it runs along the Sanbagawa belt in Wakayama prefecture to half way through the island of Shikoku (Sakurai City Cultural Resource Center 2010:3).

Now that we have examined the historical, socio-political and ideological background of the Korean peninsula and the Japanese archipelago, as well as looked at specific, relevant bead studies in both regions and been introduced to the geology of the two regions, it is time to examine the data and context of said data which was gathered from South Korea and Japan.

Chapter 4

Stone Bead Assemblages from Korea and Japan

This chapter discusses the context of the data that was analyzed over the course of my research. It has been organized by overlying region i.e. Korea and Japan, and then sub-regions of polity areas (i.e. Baekje, Gaya and Silla) in the case of the Korean peninsula or prefectures/regions within the Japanese archipelago (See Figure 3.1). Shimane prefecture in Japan has been further subdivided by types of sites: tombs, workshops and settlements since this was the only region where there were multiple site types present. This is intended to show the wide range of available beads and types of tombs from multiple polities in the Korean peninsula. In the archipelago, some of these current prefectures represent regions which were either isolated or semi-independent of the main Kofun period polity so it is useful to compare them to the stone beads found in the central area of the Nara basin. Despite their geographic locations, it should be kept in mind that all these regions were involved, to some extent, in both inter and extra regional trade and exchange, as well as trade overseas.

4.1 Scope of Bead Research

One hundred thirty-seven beads were analyzed in South Korea from August 2014 to July 2015 with the help of a Fulbright IIE grant. These beads were all from tombs on cemetery sites in regions belonging to three of the four ancient Korean kingdoms: Silla, Baekje and Gaya. (See Table 4.1) Two hundred thirty-four beads were analyzed in Japan from January 2016 to July 2016 supported by a Fulbright DDRA grant. This included sites in and around Nara prefecture, Miyazaki prefecture, Saga prefecture and the majority of bead workshops in Izumo in Shimane prefecture along with stone beads from local Shimane tombs and settlements. (See Table 4.2) There were multiple shapes and styles of beads found, some of which were common to both areas such as the *gogok/magatama* while other styles were unique to their regions. Many bead styles were limited to only being made out of certain materials. *Gogok* in the Korean peninsula were made out of jadeite, rock crystal, jasper or a few other isolated materials like alabaster. Faceted hexagonal beads were found in rock crystal and carnelian only. While this may have been a choice due to aesthetics, it is likely the natural hexagonal shape that rock crystal is often found in played a factor in this choice since the natural faceting demonstrated what the final beads would look like once faceted. The rock crystal *gogok/magatama* are often narrower so as to accommodate this shape as well.

Since the types of beads present in the past and available to be examined were different in the Korean peninsula versus the Japanese archipelago, I discussed two different bead typologies for these regions though all are present on the below figure 4.1. Korean beads fall into the following bead types: *gogok*, cylindrical, spherical, faceted hexagonal biconical, irregular, semi-irregular, faceted pentagonal biconical, biconical, *moja* 모자 *gogok*, and pendants. Japanese beads fall into the following beads types: cylindrical, spherical, *magatama*, faceted hexagonal biconical, irregular, semi-irregular, flat circular, biconical, short cylindrical, square biconical, hexagonal cylindrical, ovoid, pendant, *komochi magatama*, and flat spherical.

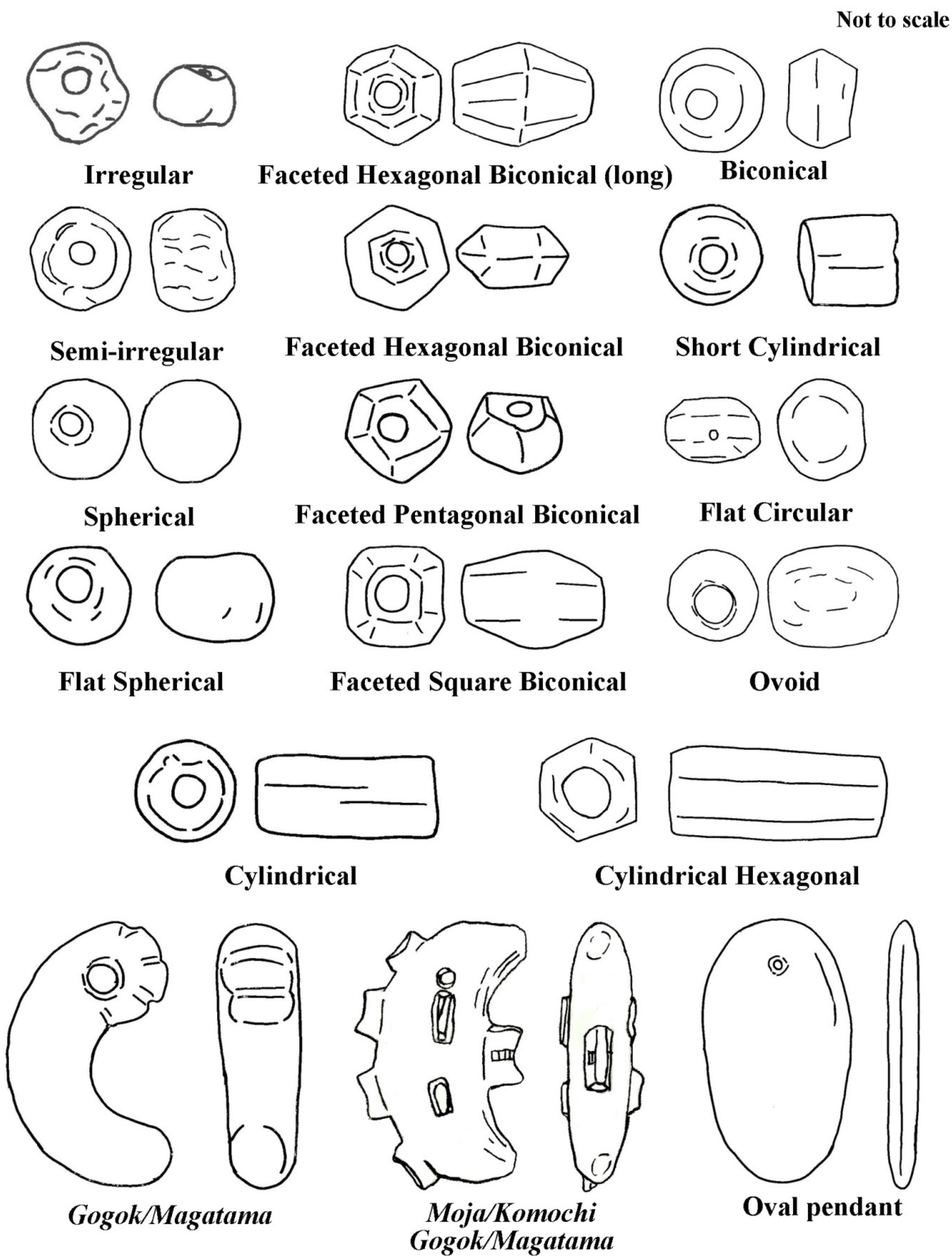


Figure 4.1 Beads types in Korea and Japan

4.2 Beads from Korean Sites

Figure 4.2: A map of sites examined during this study (Glover and Kenoyer 2019).

Korean Bead Chart								
	Carne-lian	Jasper/ Green Tuff	Jadeite	Rock Crystal/ Quartz	Steatite	Chalcedony	Misc.	Total

Baekje								
Songnam~Yoju Subway Area 9, Seoul	23			1				24
Unyang Dong, Seoul		4					2	6
Sucheong Dong, Osan	14	2		3			1	19
Kwoltong, Osan	11							11
Cheonghak Dong, Osan	11							11
Silla								
Deokcheon-ri, north of Gyeongju	1		1		1			3
Hwangnam-Dong, Gyeongju	1						1	2
Hwango-ri, Gyeongju			3					3
King Michu's area tombs, Gyeongju		1	4					5
Hwango-ri Tomb 1, Gyeongju			3					3
Gaya								
Bokcheon Dong, Busan	2		8			1	5	16
Nopoh-Dong, Busan	6			4				10
Yeongsan Dong, Busan					1			1
DaeKaya Tombs, Daegu			5				1	6
Total	69	7	24	8	2	1	10	120

Table 4.1 Table of Korean Sites by Region and Raw Material

4.2a Baekje Polity sites

Seongnam~Yeoju Subway Area 9 dates to the 3rd-4th century CE (Kukpang Cultural Heritage Institute 2014). The majority of the beads examined from this site were carnelian. This included irregular, semi-irregular, hexagonal biconical and spherical diamond drilled beads and cylindrical beads drilled with metal drills and fine abrasive (Figures 4.3 and 4.4). K0189 was a hexagonal bicone of rock crystal.

Figure 4.3 K0191 cylindrical carnelian bead which is broken and heavily worn from use

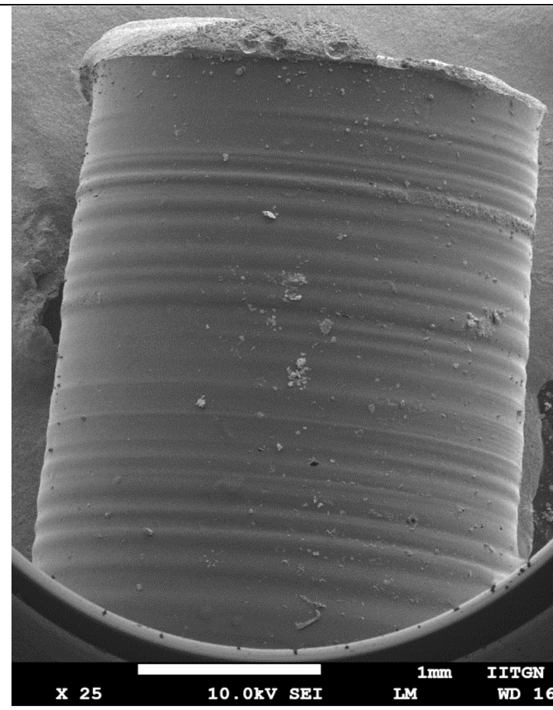


Figure 4.4 K0190 SEM x25 carnelian cylindrical bead drilled with a cylindrical metal drill and fine abrasive

Unyang-dong in Gimpo City is a Proto-Three Kingdoms Period/Three Kingdoms Period tomb cluster of 28 tombs (Hangang Cultural Heritage Institute 2011:178). Common grave goods were iron weapons and armor, gold earrings, glass and stone beads. Unfortunately, the impression materials were not available when this site was examined and it was archived before it could be revisited. Spherical beige quartz beads and cylindrical green tuff beads were present (Figure 4.5 and 4.6). The green tuff beads were in poor condition and would most likely not have had impressions taken even if it were possible.

 *not to scale	 *not to scale
Figure 4.5 Quartz spherical beads	Figure 4.6 Green tuff cylindrical beads

Sucheong-dong is a large cemetery complex containing 300+ tombs located on several hills and ridges in Osan to the south of Seoul (Kyŏnggi Research Institute of Cultural Heritage 2012). It dates to the early Three Kingdoms period (4th to 5th century CE) and would have belonged to the Paekche polity. The undisturbed graves revealed large amounts of complete pottery vessels, thousands of glass and stone beads, iron tools/weapons/ornaments and a small amount of bronze ornaments. There were approximately 4000 stone beads found on the site and the majority of them were carnelian (Kyŏnggi Research Institute of Cultural Heritage 2012 Vol 5:59). I was unable to take impressions of any of the beads from this site (some were not even allowed to be taken off their strings), but there are some beads of note which should be discussed.

Figure 4.7 K0122 – carnelian cylindrical bead, length view with string

Figure 4.8 K0122 – the inside of the drill hole was visible on several of these broken beads

Figure 4.9 Several of the carnelian beads from Sucheong-dong

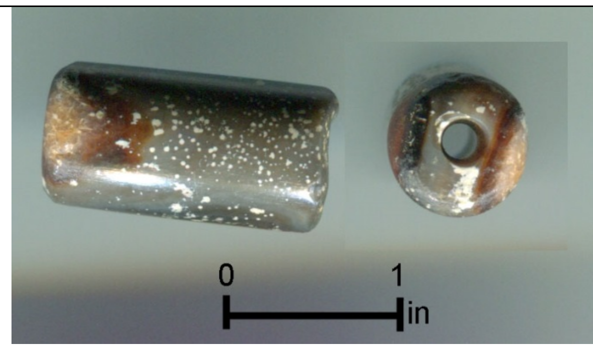


Figure 4.10 K0133 banded agate cylindrical bead, length and side view

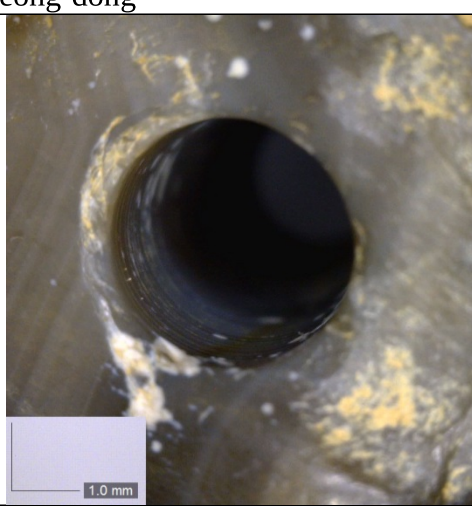


Figure 4.11 K0133 – close up on the parallel drilling striae

K0122 (Figure 4.7) is a broken cylindrical carnelian bead. Because it was broken, it is possible to examine the inside of the drill hole (Figure 4.8) and see that this bead was drilled in a way consistent with the SEM analysis of other cylindrical carnelian beads from the period. The heavy wear, even on the broken end, suggests this bead was in use for a long period of time and that it was still considered worth wearing despite the brokenness. All the cylindrical beads that were examined from this site showed heavy wear, though it was only the carnelian beads which were often broken and foreshortened (Figure 4.9 - note the varying sizes of cylindrical beads). Another interesting bead is the only banded agate (Figure 4.10) I have encountered in South Korea. This is a typical stone used in South and Southeast Asia to make beads. Like the other cylindrical beads, it was also broken yet continued to be used and shows signs of heavy wear. Microscopic examination of the drill hole shows regular parallel drilling striae consistent with diamond drilling (Figure 4.11), but since no impressions could be taken, it cannot be confirmed via SEM.

The Gwoldong site in Osan city to the south of Seoul involved multiple trenches placed at regular intervals across five main site areas which included settlement sites and tombs (Central Institute of Cultural Heritage 2013). All beads examined were from tombs which dated to the 2nd century CE which is the end of the Proto-Three Kingdoms Period. All beads examined from this site were diamond-drilled carnelian of the irregular or semi-irregular type (Figure 4.12).

Figure 4.12 Diamond-drilled carnelian from the Gwoldong site.*not to scale

Cheonghak-dong is a Proto Three Kingdoms Period/Three Kingdoms Period Baekje cemetery and Mumun settlement site in Osan city (Gyeore Institute of Cultural Heritage 2013). Tombs 15 and 16 yielded carnelian beads and are estimated to date from the late Proto-Three Kingdoms period into the Three Kingdoms period. A radiocarbon date from tomb 15 is 180CE, however the only other radiocarbon date from a tomb is 380CE so a more exact date is not possible (Gyeore Institute of Cultural Heritage 2013:759-60).

4.2b Gaya Polity Sites

The Bokcheon Tombs are located on a high ridge above the modern day city of Busan. They look out over the southern coast of South Korea. 130 of the nearly 200 tombs there have been excavated over the past several decades by a variety of excavators. Unfortunately, there are no records of some of those early excavations so some of the beads I examined from this site lack context beyond them being from a particular Bokcheon tomb. They are all from one of the successive Gaya kingdoms - Geumgwan Gaya who controlled the land around the modern day city of Busan from the 2nd to 7th century CE although they peaked in the 5th century CE (Bokcheon Museum 2018). The beads I examined came from tombs 15, 35, 38, 51, 54, 73, 80, 304 and one was from an unknown tomb. The majority of these beads were well formed *gogok* which were part of larger necklaces of glass beads with the *gogok* at their center. Some *gogok* were also found without any other beads near them. The majority of the *gogok* were jadeite but there were also *gogok* of alabaster, hydrogrossular, amber, amethyst and steatite. The amethyst *gogok* was not examined, but amethyst is available as a raw material in both Korea and Japan so it is not necessarily an imported bead.

Two of the jadeite *gogok* (K0105 and K0106) from Bokcheon tombs were excavated and published recently (Pusan National University Museum 2014:40-41). These tombs contained fine pottery, iron ingots and weapons and date to the 4th century CE. K0105 (Figure 4.13) was highly polished and drilled from two sides with tapered conical drills. On side 2 (the shorter drill section) the drill's orientation was adjusted several times before joining the other drilling section causing the two to not fully meet in the middle. K0106 is not entirely smoothed down around the edges, presenting a flatter, boxier shape. It was drilled from one side with a long tapered cylindrical drill. There are still visible grinding marks at the end of the tail (Figure 4.14).

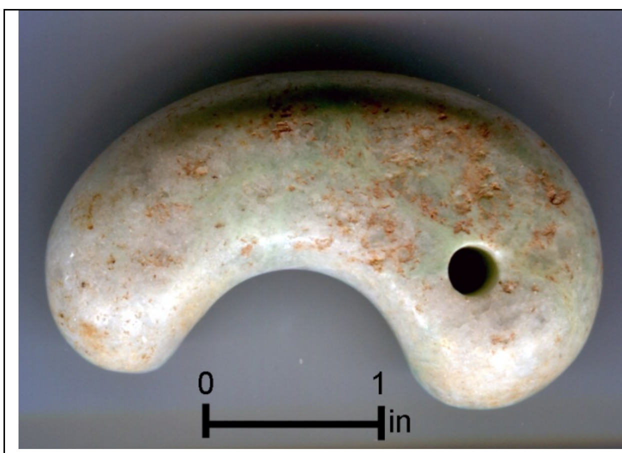


Figure 4.13 K0105 – jadeite gogok, white with a faint green marbling and heavy pitting

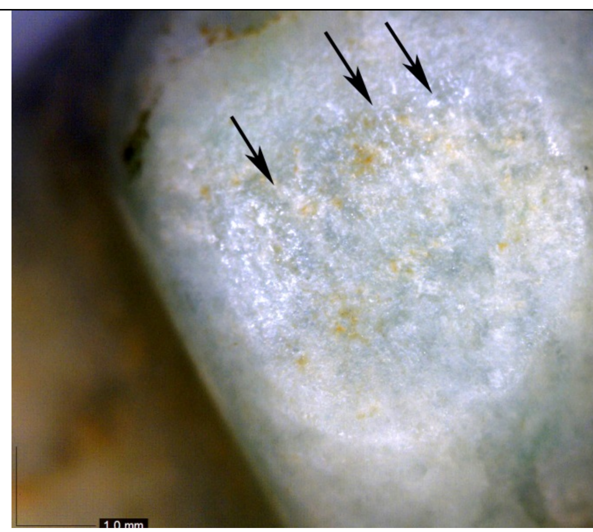


Figure 4.14 K0106 – close up of the tail end which has faint remnants of grinding

K0004 is one of the larger jadeite *gogok* which was examined in this study (Figure 4.15). It was drilled from two sides with a wide, tapered conical drill. The two drill holes are not aligned which allowed the tip of the drills to be examined. SEM analysis revealed that it was drilled with a tapered metal drill with abrasive but also shows heavy signs of wear inside the drill hole (Figure 4.16 and 4.17). Impressions of the grooves on the outside of the bead were also taken. SEM analysis of those impressions reveals that the grooves were not worn into the beads as has been theorized, but were deliberately made with the aid of a metal tool (Figure 4.18).

Figure 4.15 K0004 jadeite *gogok* with two grooves on the head

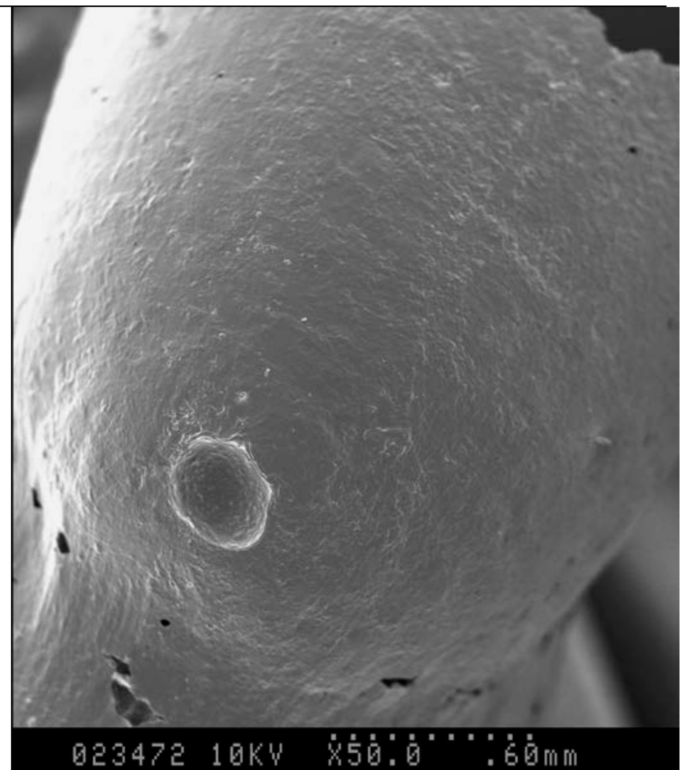


Figure 4.16 K0004 SEM 50x of drill tip

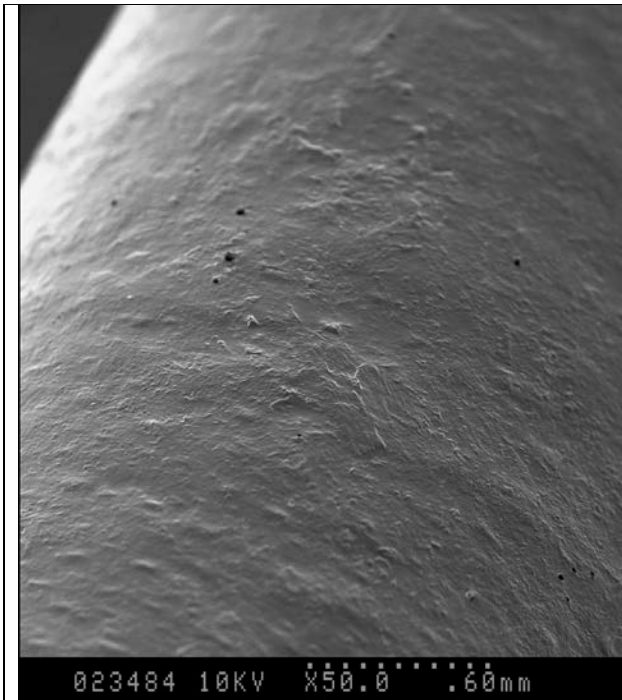


Figure 4.17 K0004 SEM 50x focused on one of the drill impressions

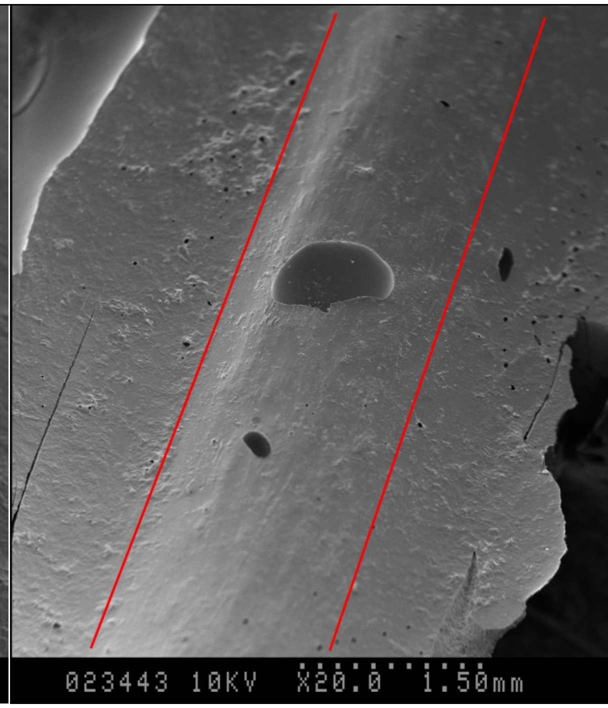


Figure 4.18 K0004 SEM 20x one of the grooves across the bead's head

In addition to the *gogok* and glass necklaces there were two glass, faceted hexagonal carnelian and green jasper and carnelian cylindrical beads. K0091 and K0092 were both well-made faceted hexagonal beads with a consistent red-orange color. K0091 has a chip off one corner and some faint bands are visible on one side (Figure 4.19). Both beads were drilled from one side and a spall was popped out. They were then ground so that most evidence of that spall was removed but a close examination of the holes shows chipping from drilling and the remains of the spall depression.

Figure 4.19 K0091 – carnelian faceted hexagonal

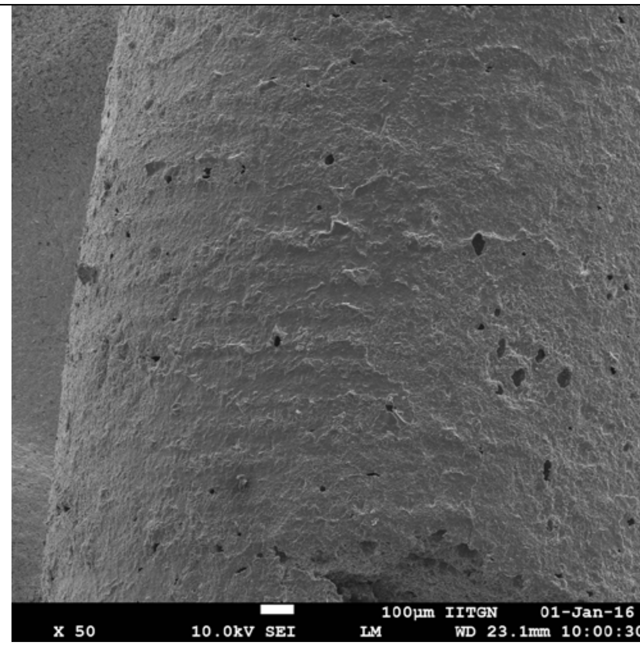


Figure 4.20 K0091 SEM x50 – extremely heavily worn but the regular, parallel striations are still visible

Nopo-dong tombs are a proto-Three Kingdoms period tomb group located in Busan (Busan Museum 1988:94). The graves there yielded numerous beads, pottery, weapons, and iron tools. Several carnelian and rock crystal beads were examined from tombs 4, 8, 10, 21, 24 and jar burial C.

Yeonsan-dong Tomb Group is a Three Kingdoms period site located on a series of hills (Busan Museum 2012). Tomb goods included pottery, iron armor, weapons, metal ornaments, and beads. Tomb 1 contained one heavily worn, black steatite cylindrical bead (Figure 4.21).

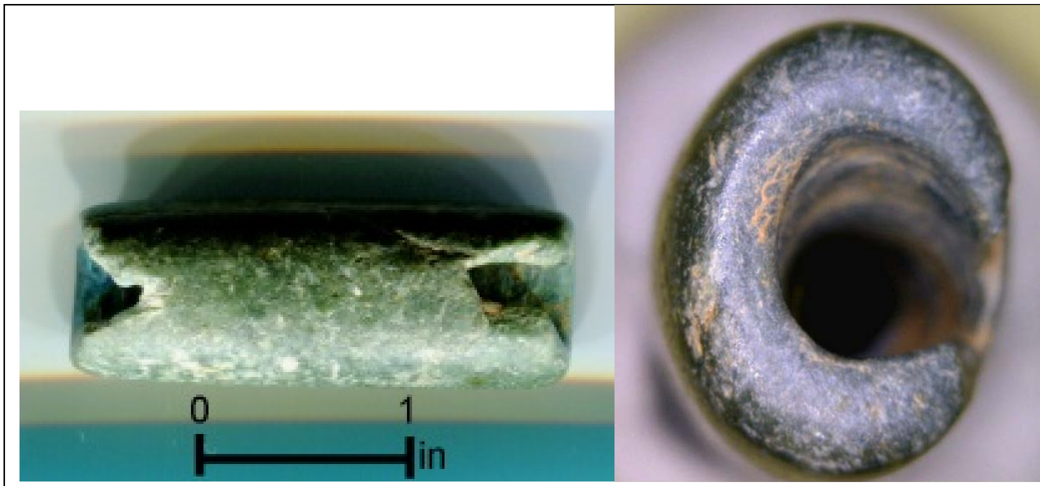


Figure 4.21 K0096 cylindrical steatite bead showing heavy string and end wear

Daegaya tombs are a large tomb complex located on a series of hills in the southern, central area of South Korea, north of Busan and southwest of the city of Daegu (Figure 4.22). This was where the Daegaya Gaya kingdom was located from the 4th century CE to the 6th century CE (Daegaya Museum 2013: 13, 22, 46). There are 700 tombs located on the hills with the oldest containing human sacrifices to accompany the dead (Daegaya Museum 2013: 46-47). The burials there contained shell ladles from Okinawa, pointing to an extensive trade network (Daegaya Museum 2006:189; Park 2008:136). Park (2008: 136) believes that during this period, the Kofun elites became trading partners with Daegaya since Silla goods are replaced with Daegaya goods in 5th century kofun tombs. Jisan-dong 73, 75 tombs are from the 5th to 6th century and contained several burials with jade beads, bronze mirrors, gold and silver, iron, pottery and a gilt-bronze crown (Figure 4.23) (Daegaya Museum 2013: 46-49). Tomb 73, where the *gogok* came from, is considered the earliest royal tomb in the area. Five jadeite and one nephrite *gogok* were examined (Figure 4.24).

Figure 4.22 Daegaya tomb complex covering several hills

Figure 4.23 Daegaya tombs 73 and 75

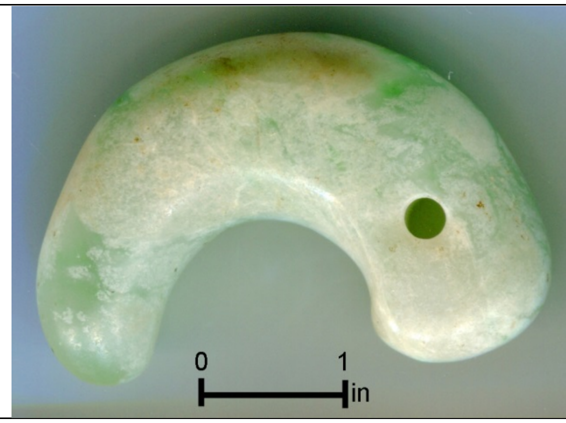


Figure 4.24 K0153 *gogok* jadeite

4.2c Silla Polity Sites

Deokcheon-ri is a 5th to 7th century CE Silla cemetery site located on the coast of the northern edge of what is usually considered the Silla cultural region (Sunglim Institute of Cultural Properties 2014). 263 tombs from the 5th to 7th century were excavated total (Ryu 2013:160). The tombs held pottery, iron weapons, beads, gold earrings, a gilt bronze crown, and gilt bronze accessories and horse gear. Three beads were examined from these a single tomb – a *moja gogok*, a spherical carnelian bead and a jadeite *gogok* (Figure 4.25a-3) (Sunglim Institute of Cultural Properties 2014:289). These three beads represent a range of materials and shapes. The *moja gogok* is thought to be a sign of political power and foreign trade exchanges with the Japanese archipelago (Ryu 2013:160).

Figure 4.25 Beads and measurements from Deokcheon-ri

Figure 4.25a K0116 spherical carnelian

Figure 4.25b K0117 jadeite *gogok*

Figure 4.25c K0118 *moja gogok*

Figure 4.25d K0118 impression showing heavy wear and scratches inside the drill hole

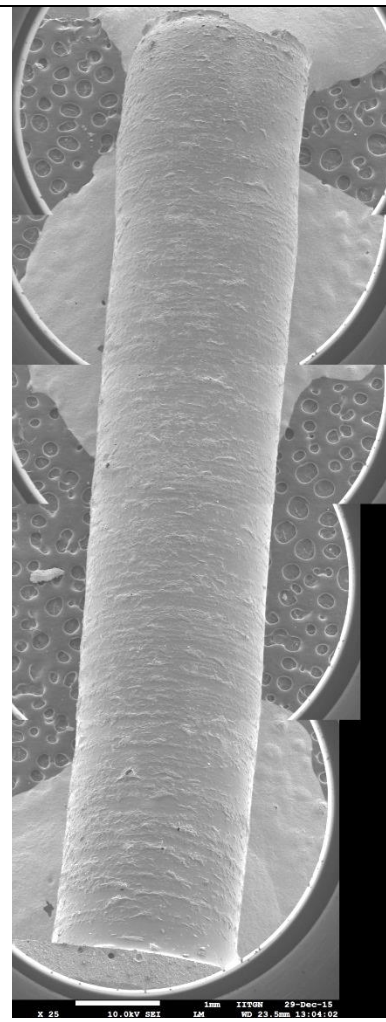


Figure 4.25e K0116 20x SEM

The other Silla beads which were examined were all from royal tombs in Gyeongju which is the heart of the Silla region. Hwango-ri Tomb 1 (Fig 4.26) is part of a tomb complex in central Gyeongju dating to the 4th to 5th century CE and is thought to have belonged to one of the Silla elites from this period (National Research Institute of Cultural Heritage 1969). Three jadeite *gogok* from the tomb were examined (National Research Institute of Cultural Heritage 1969: 100). SEM analysis of K0080 showed string wear where the two drill holes meet and was drilled with a metal drill and abrasive (Fig 4.27). The Southern Tomb of Hwangnam is a royal tomb which yielded a crown, gold/silver jewelry, bronze ornaments, horse gear, a bronze mirror, jadeite *gogok*, swords, 1,332 iron ingots and multiple rich and unique grave goods (National Research Institute of Cultural Heritage 1993; Park 2008:128). One carnelian hexagonal bead and one alabaster *gogok* were examined from the tomb (National Research Institute of Cultural Heritage 1993:Figure 33:11, 35:1). From King Michu's tomb area in the south of the tomb group (Figure 4.28), several jadeite and one dark green jasper *gogok* were examined. This area was excavated in 1973 due to construction and found several burials accompanied by fine pottery, gogok and iron (Kyungpook National University Museum 2000:35). The tombs in this group have yielded multiple artifacts from roman style glass and gilt bronze saddle frames which show contact with the north through Goguryeo, with China and with the Nara region of Japan (Park 2008:126-129).

Hwango-dong 34 was excavated in 1965 and dates to the 5th century CE (Kyungpook National University Museum 2000:16). The tomb held large amounts of pottery, horse equipment, gold earrings, bronze bells and dishes, a tall, golden crown and three jadeite *gogok*.

Figure 4.26 Hwango-ri Tomb 1

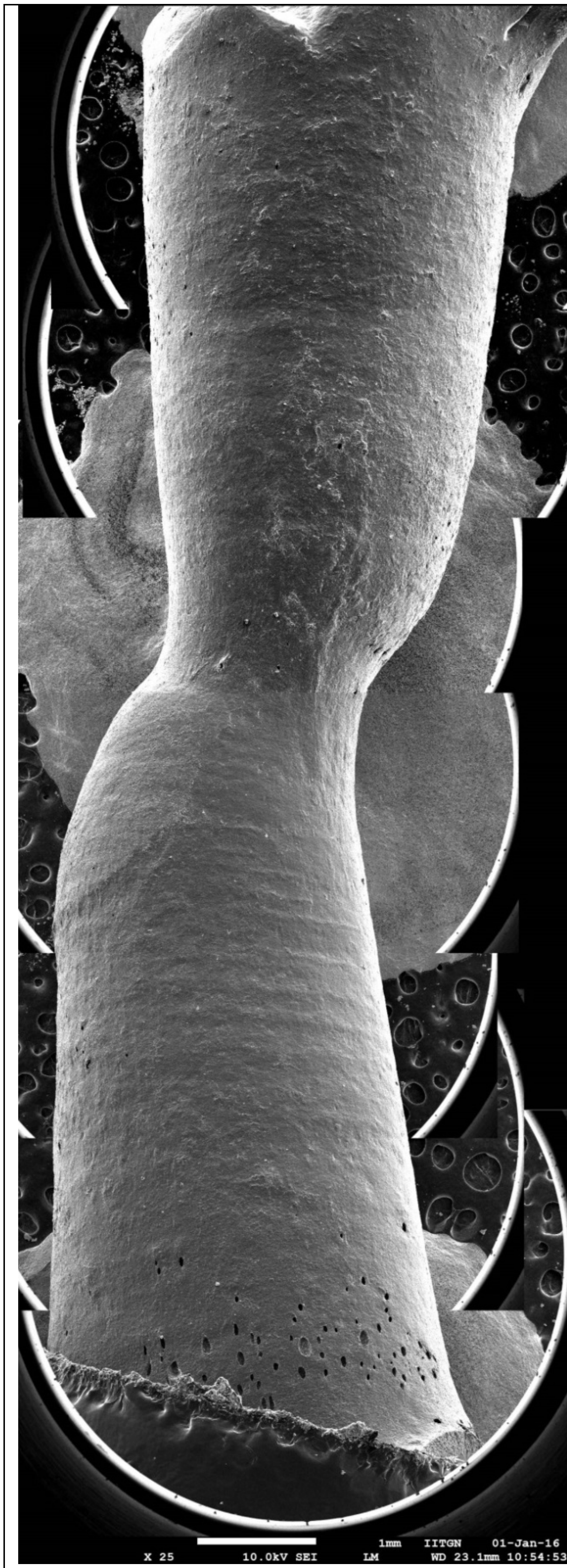


Figure 4.27 SEM x 25 of jadeite gogok K0080 from Hwango-ri Tomb 1

Figure 4.28 Jadeite/jasper *gogok* from King Michu's tomb area

4.3 Beads from Japanese Sites

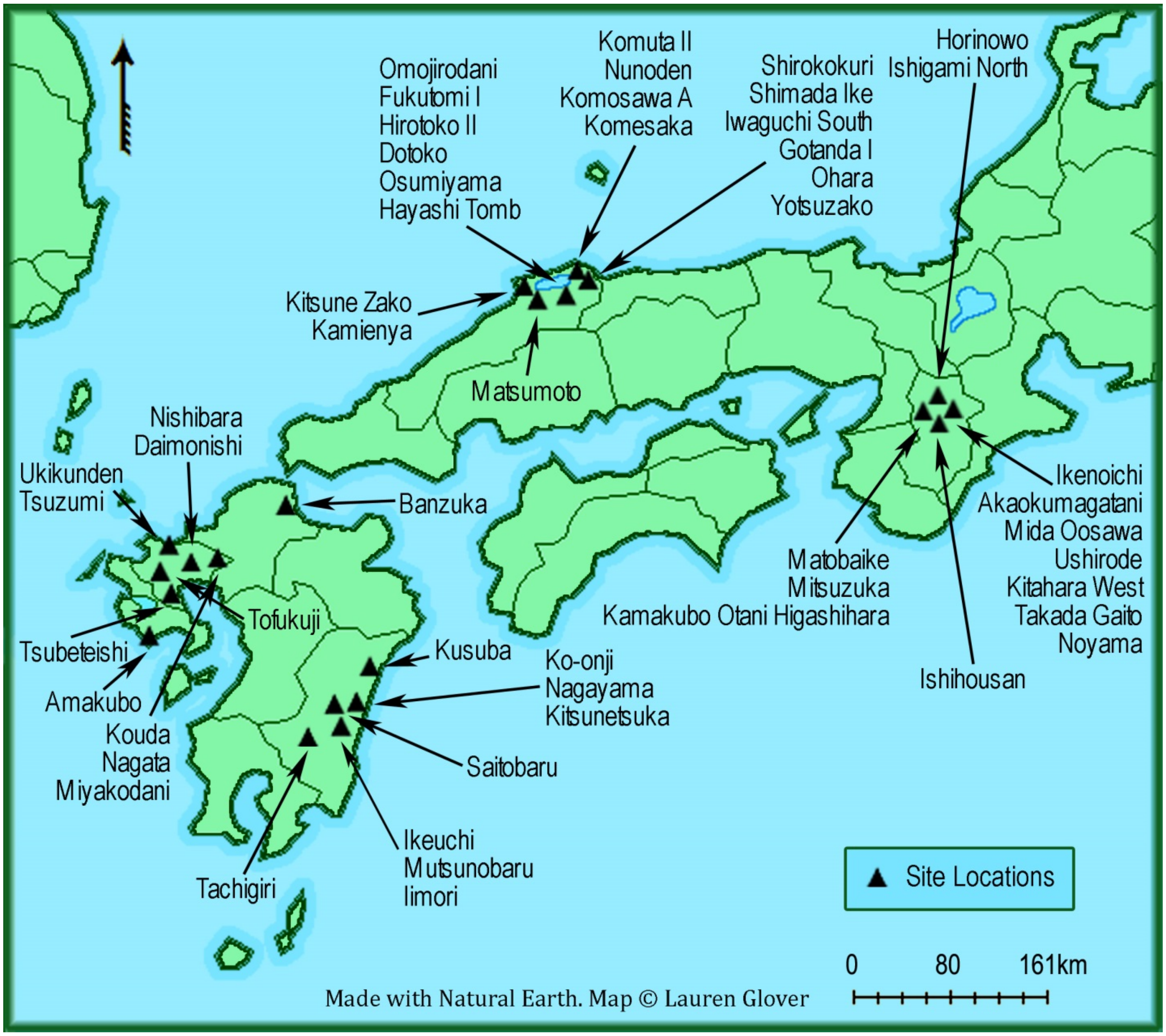


Figure 4.29 A map of sites (51 total) examined in Japan from six different prefectures (Map made by Lauren Glover 2018).

Japanese Bead Chart								
	Carnelian	Jasper/Green Tuff	Jadeite	Rock Crystal/ Quartz	Steatite	Chalcedony	Misc.	Total
Nara								
Kamonokuba Otani East Kofun		9		2				11

Ushirode Kofun							2	2
Kitahara West Kofun	1				1		1	3
Noyama Site		1			2	1		4
Takada Gaito Kofun				4			1	5
Matobaike Kofun		1	1	2	2			6
Mitsuzuka Kofun				1	1			2
Mida Oosawa Kofun			1					1
Horinowo Kofun				4				4
Ishigami North		1		2				3
Ikenoichi Kofun		6	2		2	1		11
Ishihousan		2						2
Akaokumagatani Kofun	10	1						11
Shimane								
Hayashi Tomb				4			1	5
Komosawa Site, Matsue City		1						1
Matsumoto Kofun		1						1
Gotanda I Kofun			2					2
Shimada Ike Site	1	2		7		3		13
Shirokokuri		1		6	1	3		11
Kamienyatsu	1					1		2
Iwayaguchi South	1	3		2	1	1		8
Kitsune Zako Site				1		1		2
Dotoko Site		6		2		2		10
Fukutomi I Site	1	6		1	2	4		14
Ohara Site		6						6
Osumiyama Site		5				1		6
Hiratoko II Site		3		2		1		6
Omojirodani		1		1				2
Yotsuzako					1			1
Nunoden Site						1		1
Komesaka Site						1		1
Komuta II Site, Matsue City						1		1
Miyazaki								
Saitobaru Kofun	1	1				1		3
Mutsunobaru		1	2					3

Ko-onji		1		3		2		6
Kusaba (Reikyo-Duka)		1	1					2
Tachigiri					1			1
Iimori		2						2
Nagayama		2		2				4
Ikeuchi						1		1
Sakamoto no Ue			1					1
Kitsunetsuka Kofun	1		1	3				5
Saga								
Tsubuteishi	2							2
Daimonishi						1		1
Kouda	2							2
Nagata Kofun	6					2		8
Tofukuji Kofun	5					1		6
Tsuzumi	1							1
Miyakodani	3		1	2				6
Nishibara						1		1
North Kyushū								
Amakubo Dolmen Burial		3						3
Ushirode Site		6						6
Banzuka Kofun		9						9
Total	36	82	12	51	14	31	5	231

Table 4.2 Table of Japanese Sites by Region and Raw Material

4.3a Nara, Japan

The following is a detailed description of analyzed beads found in the Nara region of Japan from the Kofun period. This region is largely agreed to have been a center of Kofun period authority which developed in the Asuka and Nara periods into the center of the nascent government (Barnes 2007:15). As a result, it is an area rich in archaeological sites including large numbers of monumental tombs i.e. kofun. All of the analyzed beads from Nara came from tombs or the ditches around tombs. I attempted to gain formal access to the Soga bead workshop site, a late 5th-early 6th century bead making site which appears to have been an attempt at elite control of bead working by placing workers in an area associated with their palace complexes (Barnes 1987: 98-101), but the partially manufactured rock crystal and agate beads were on display in the Kashihara Archaeological Museum and I was only able to informally examine some of the jasper cylindrical beads. There is, unfortunately, only a partial excavation report for the site which only includes raw data on how many beads and bead types were found in each area of the site along with some context (Kashihara Archaeological Center 1989). My understanding is that there is a complex issue of permissions relating to formally studying the artifacts from Soga which precludes anyone performing additional analysis. Therefore, I was unable to analyze any bead workshops from Nara in order to compare to the Shimane bead workshop sites. However, the site will be discussed based on my informal observations within the museum and the Kashihara Archaeological Center. It is one of the largest workshop sites in Japan with 300,000 artifacts found on site which are thought to have been supplied to various other regions (Ishino 1992: 212; Kashihara Archaeological Center 1989).

Soga workshop was working with a wide variety of materials. Although steatite was most prevalent with thousands of bead blanks and completed *magatama* found, there was also jasper, green tuff, rock crystal, jadeite and carnelian being worked (Figure 4.31) (Shimane Museum of Ancient Izumo 2009: 17). Some of the debitage is visible in the site report and shows there were distinct areas designated for bead working with steatite and jasper being worked together (and carnelian when present) (Kashihara Archaeological Center 1989:43,69,90). Examination of the Soga workshop beads in the museum reveals that they are using at least two different chaîne opératoire methods on the cylindrical jasper/green tuff beads (Figure 4.30). Some of the blanks are being pecked roughly into shape and some are being split into bead blanks and then being ground down. This suggests there were craftspeople from more than one region at the workshop working on the beads and utilizing their own workshop traditions. Since this site was within one of the palace complexes, there seems to have been a concerted effort to bring in a variety of materials and craftspeople to exclusively manufacture beads for Kofun period elites. Carnelian is rare outside of Shimane prefecture/Izumo but seems to have been worked exclusively (instead of agate or chalcedony) in the Soga workshop. On the other hand, the size of the debitage is quite small compared to the jasper and rock crystal from the site (Figures 4.31 – 4.32) suggesting they were either not getting it in large quantities and/or they were being very economical with the material. The jadeite raw material is not on display in the museum, but can be glimpsed at the center of one of the published photos of the workshop beads and raw material (Shimane Museum of Ancient Izumo 2009: 17); it shows two 3-6cm pieces of unshaped jadeite. The site report mentions jadeite being found in small quantities on site with 133 pieces total weighing 151.4grams (Kashihara Archaeological Center 1989: Summary pages before page 1 of bead context distribution charts). I am hesitant to trust this estimation however since they also list only 139 pieces of agate/carnelian when there are obviously many more than that in photos from the site (Shimane Museum of Ancient Izumo 2009:17). The tens of thousands of steatite *magatama* suggests production on a mass scale to meet a need for *magatama*. It is likely that all the steatite beads I examined from Nara were made in Soga workshop, and with the scale of production, likely many of those from beyond Nara prefecture as well. The site report states that there were 5,791,793 pieces of steatite found on the site which makes up 70% of the sites beads and raw material (Kashihara Archaeological Center 1989: Summary pages before page 1 of bead context distribution charts).

*not to scale

Figure 4.30 Jasper raw material and bead blanks from Soga workshop in the Kashihara Archaeological Museum. Courtesy of the Kashihara Archaeological Museum. Photo by Lauren Glover.

Figure 4.31 Hundreds of steatite *magatama* bead blanks, semi completed flat circular steatite beads, jasper/green tuff raw material and bead blanks and carnelian debitage from Soga Site. Courtesy of the Kashihara Archaeological Museum. Photo by Lauren Glover. *not to scale

Figure 4.32 Rock crystal remains from Soga workshop. Courtesy of the Kashihara Archaeological Museum. Photo by Lauren Glover. *not to scale

Kamakubo Otani Higashihara Kofun (Kashihara Archaeological Center and Yoshimura 2009:32-32) is a mid-sixth century tomb. All stone beads from this site were jasper, rock crystal and green tuff which were found in a concentration near the center of the tomb. There is some indication of how this particular set of beads were worn with the *magatama* near the center and some of the cylindrical beads were laid in articulation with each other. It seems likely that the beads were being worn by the deceased, with the body and thread holding them together being dissolved by the acidic soil. J0001 (Figure 4.34), the jasper *magatama*, was drilled first, then the bead was shifted, probably due to remounting and drilled all the way through, popping out a spall. The metal drill with abrasive had a taper of 0.21 which is consistent with other Japanese *magatama*. The bead shows signs of heavy wear from use around the edges of the drill hole and signs of bead end wear (of a cylindrical bead) on the hole on one side (Figure 4.35). Although the bead is a homogeneous dark green at first glance, under a microscope there are marbled inclusions of lighter and darker green.

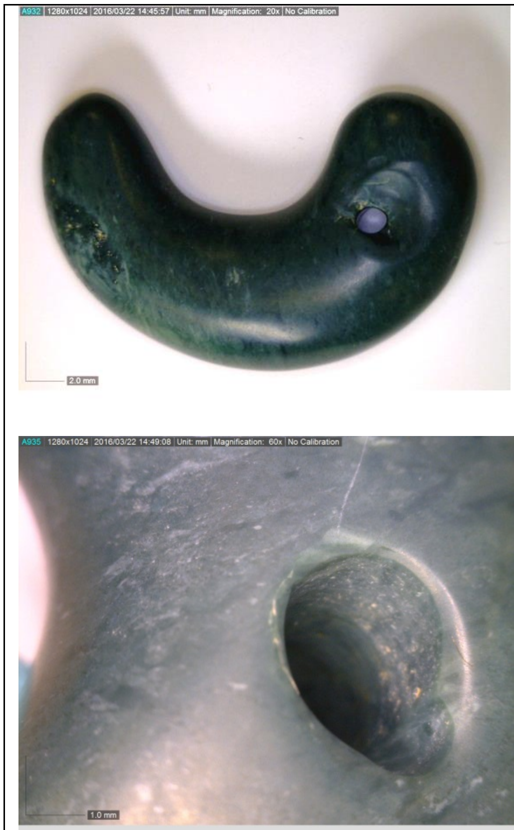


Figure 4.34 J0001 whole bead (top) and closeup showing heavy string wear around the edge of the bead's hole (bottom)

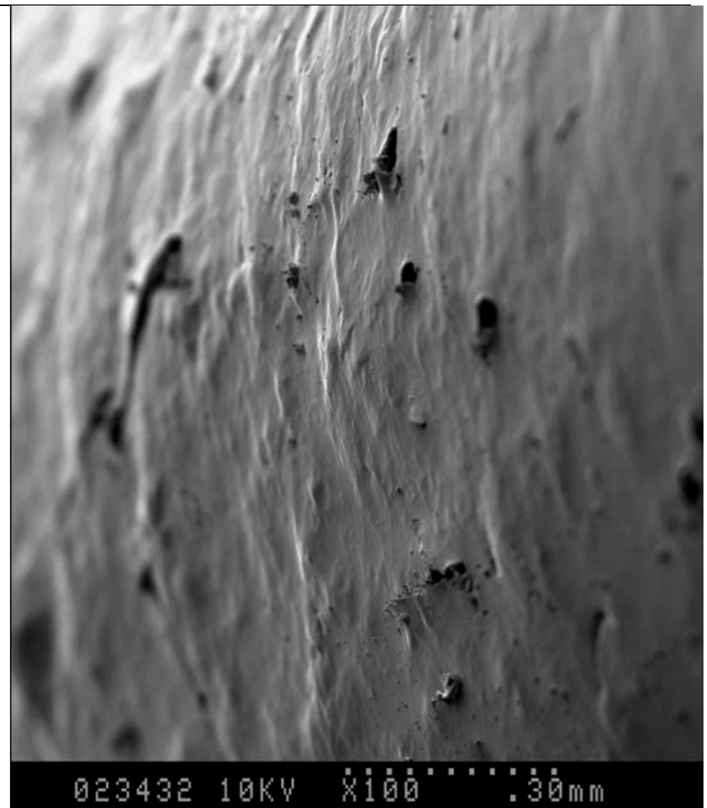


Figure 4.35 J0001 SEM x100 abrasive with a metal drill on an unworn area of the drill hole

Ushirode Kofun (Kashihara Archaeological Center 2003) is a fifth century tomb group. The two *magatama* examined from the site were amber and schist so neither of them had impressions taken. This was a rich set of tombs which yielded a set of iron armor and bronze mirrors in addition to the stone beads (Kashihara Archaeological Center 2003:22-23, 118).

Kitahara West Kofun (Uda Kofun Culture Research Center 1986) is dated to the 3rd to 5th century CE. It held a large, dark red carnelian *magatama* with a broken tail (Figure 4.35), one gypsum *magatama* and one steatite *magatama*. The holes on the carnelian *magatama* were extremely misaligned (Figure 4.36), but this did allow for an examination of one of the tips of the tapered drills. Although extremely worn in places, the drill tip has been polished due to abrasive and under high power, some parts of the drill hole show signs of an abrasive being used with a metal drill (Figure 4.37 and 4.48).

	
Figure 4.35 J0014 carnelian *magatama*	Figure 4.36 J0014 impressions of drill holes with misalignment

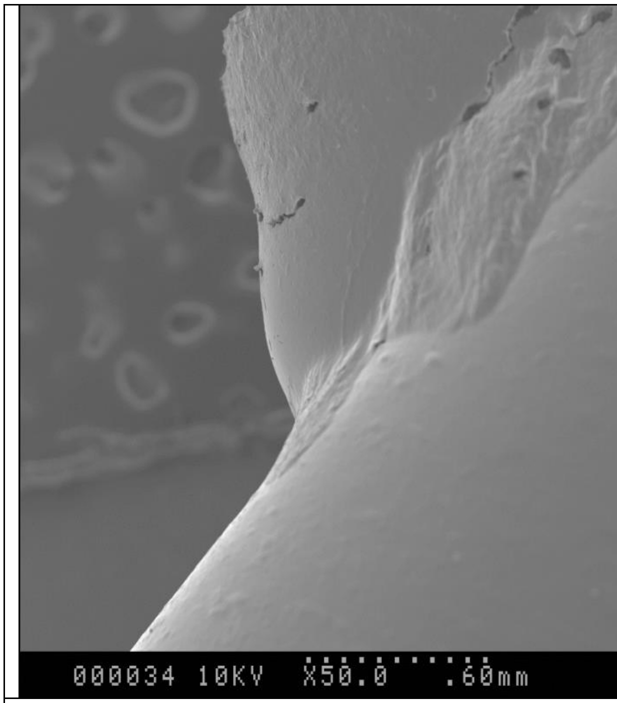


Figure 4.37 J0014 SEM x50 showing polish on the drill tip

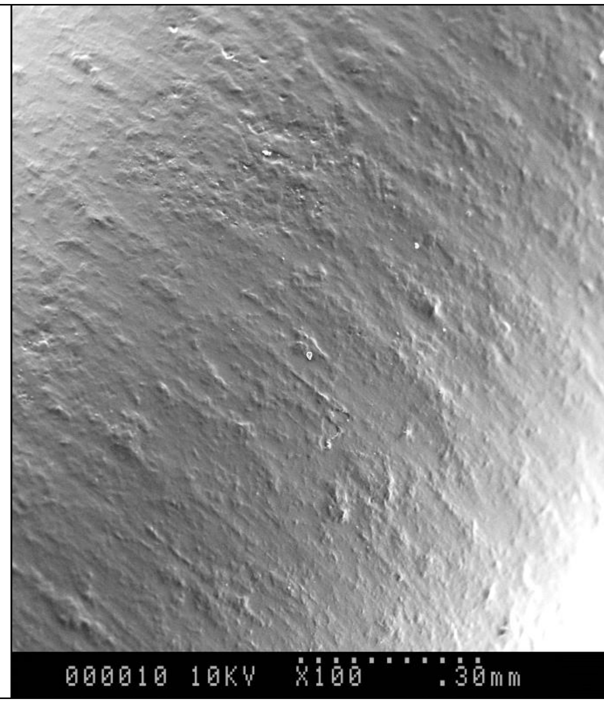


Figure 4.38 J0014 SEM x100 showing use of an abrasive

Noyama site (Kashihara Archaeological Center, Ito and Inoue 1989) dates from the 5th-6th century CE. Tombs on this site held fine pottery, *magatama* and other stone and glass beads, iron weapons and a bronze mirror (Kashihara Archaeological Center 1988: Fig 47,62). Three *magatama*, one chalcedony and two steatite along with a jasper cylindrical bead were examined from the site.

Takada Gaito Kofun tomb #4 (Kashihara Archaeological Center 1991: 89) dates to the first half of the 6th century CE. One rock crystal hexagonal biconical, three rock crystal biconical beads and one jet biconical were examined. The jet bead had no impressions taken. This particular burial had stone beads, the remains of iron arrows and some pottery inside (Kashihara Archaeological Center 1991:88-89).

Matobaike Kofun, and especially tomb #8 (Toma Board of Education 1982) is a burial site from the 5th century CE. Six *magatama* made of jasper, steatite, quartz, and jadeite were examined (Toma Board of Education 1982: 30, 52). The quartz *magatama* was drilled with a tapered metal drill and abrasive. It was popped on one end then ground to some extent to remove the depression. The outside of the bead is highly polished but it has not been rounded at the front of the head as is typical of most *magatama* (Figure 4.39).

Figure 4.39 J0032 quartz *magatama*

Two beads were examined from Mitsuzuka Kofun (Kashihara Archaeological Center 2002:199). One is from a mid-7th to 9th century (but probably Nara period) cremation burial while the other is from the kofun itself and dates to the 7th century CE (Kashihara Archaeological Center 2002:141). The spherical rock crystal bead from the cremation burial had no impressions taken since it was covered in multiple tiny fractures. The short cylindrical steatite bead was drilled with a cylindrical drill which left heavy striations despite the wear inside the hole and showed grooves from string wear on one side (Figure 4.40 – 4.41). Impressions were poor quality but showed the same heavy striations (Figure 4.42 – 4.43).

Figure 4.40 J0028 short cylindrical steatite bead

Figure 4.41 Close up on the string wear from J0028

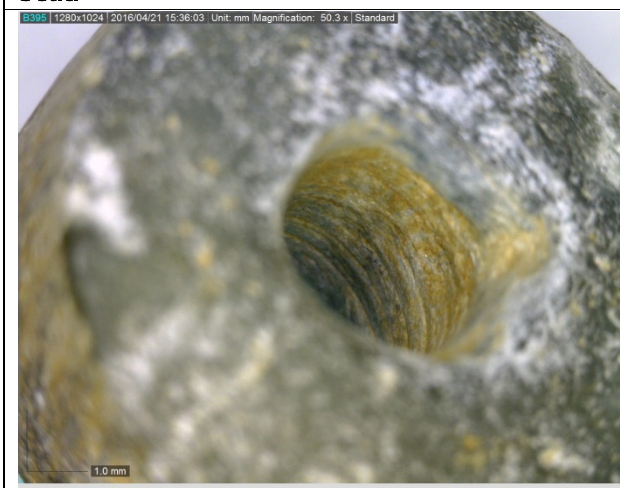


Figure 4.42 Close up of drilling striations on J0028

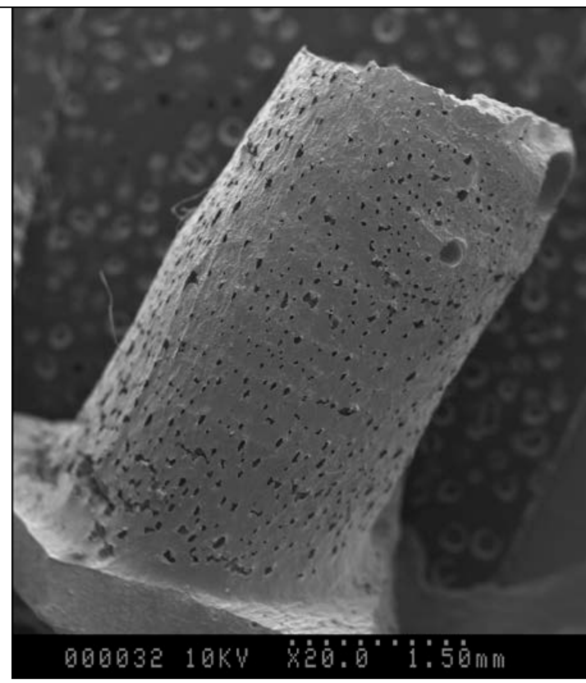


Figure 4.43 J0028 SEM x20 heavy striations visible but the quality of impression is poor with lots of air bubbles

Horinowo Kofun (Kashihara Archaeological Center 1975) is a 3rd to 4th century CE tomb group which is part of the larger Toyota Kofun group. Four beads from tombs 2 and 4 were examined which were all faceted hexagonal biconical rock crystal beads of varying lengths (Kashihara Archaeological Center 1975: 34,44,49).

Three beads were examined from Ishigami North Tomb (Kashihara Archaeological Center 1976) which dates to the 5th to 7th century CE. These beads were two faceted hexagonal rock crystal beads and one cylindrical jasper bead (Kashihara Archaeological Center 1976: 44).

Ikenoichi Kofun (Kashihara Archaeological Center 1973) is a group of tombs and burials dating from the 4th-5th century. Tomb No. 1 dates to the 4th century whereas Tomb No. 5 dates to the 4th-5th century. Eleven beads were examined from these two tombs including jadeite, chalcedony and steatite *magatama* and cylindrical jasper beads (Kashihara Archaeological Center 1973: 71, 74, 76). X-rays were taken of the beads by the Kashihara Archaeological Institute to insure there were no obstructions inside of their drill holes before impressions were taken (Figure 4.44 – 4.45).

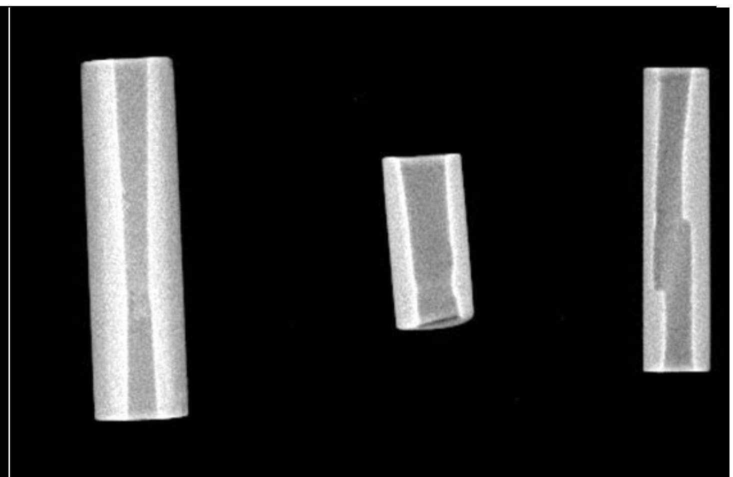
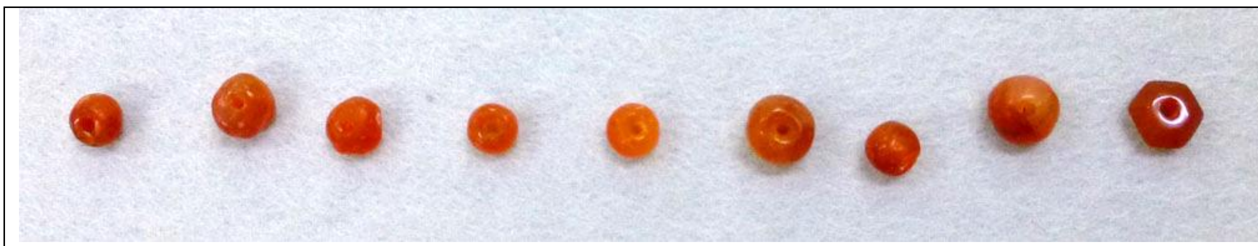


Figure 4.44 X-rays of *magatama* from Ikenoichi Kofun	Figure 4.45 X-rays of cylindrical beads from Ikenoichi Kofun

One jadeite *magatama* was examined from the Mida Oosawa tomb group and dates to the 4th-5th century CE (Kashihara Archaeological Center 1982: 63). It was found scattered in a tomb with cylindrical green tuff beads and a single bronze mirror (Kashihara Archaeological Center 1982: 61).

Ishihousan Tomb No. 6 (Kashihara Archaeological Center 1976:453) dated to the 5th to 6th century. The tombs in this group yielded large amounts of fine pottery, iron implements, along with glass and stone beads. Two of the jasper cylindrical beads from the tomb were examined.

Akaokumagatani Kofun group (Sakurai City Cultural Report 2002) dates to the early to middle Kofun period. 11 beads total were examined of carnelian, agate and jasper (Sakurai City Cultural Report 2002: 54-55). I was particularly interested in examining the carnelian since it appeared to be straight drilled and some were popped, suggesting the beads were diamond drilled. This turned out to be the case (Figure 4.46). The two *magatama* were made of agate and jasper while the faceted hexagonal and semi-irregular/irregular beads were all diamond drilled (Figure 4.47 and 4.58).



*not to scale

Fig. 4.46 Akaokumagatani carnelian diamond drilled beads

*not to scale

Figure 4.47 Carnelian and jasper *magatama*

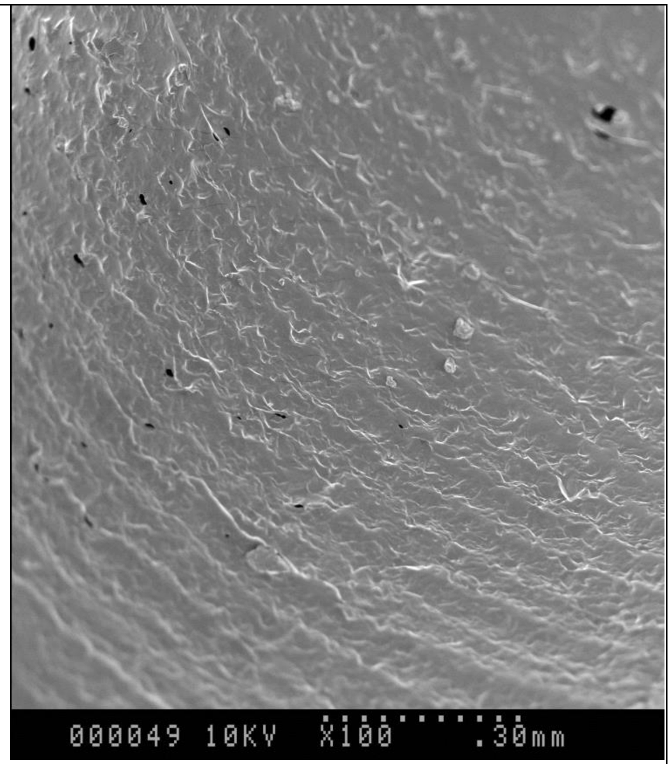


Figure 4.48 J0100 SEM x100 faceted hexagonal biconical, diamond drilling

Despite not performing any analysis of the beads, Soga workshop (late 5th- early 6th century CE) should still be discussed due to the fact that it was established before a palace complex was built around it and remained after the palace was moved elsewhere (Barnes 1987: 98, Kashiwara 1983). Thousands of beads were found on the site and it was interestingly, a place for large scale manufacture of steatite beads. There are hundreds of rough steatite *magatama* blanks without holes drilled in them which are 1-2cm in bead length and both rough and mostly finished 1-2cm short cylindrical beads. Green tuff, dark green jasper, agate, carnelian and rock crystal were all present in forms from raw material to the final or nearly final bead. The green tuff and dark green jasper seem to have only been used to make cylindrical beads. My own visual examination of the non-displayed jasper debris in the Kashihara Archaeological Center storage showed beads drilled from one side with the discarded ones having fractured during or after the drilling during final polish. In general, rough blanks were chipped out in a rectangular shape before the hole was drilled. There was also a large number of polishing stones with heavy grooves on the site from shaping the beads.

4.3b Shimane, Japan

Shimane prefecture, and in particular the region known as Izumo which surrounds Lake Shinji is rife with ideological and historical significance. The *Izumo fudoki* was written in 733CE, just 13 years after the official Japanese history was written in the *Nihon shoki* (Carlqvist 2010: 186). In it are unique myths which either have key differences from those in *Kojiki/Nihon shoki* or directly contradict those myths. Izumo and surrounding coastal areas also had distinctly different archaeological culture from the Yayoi period to the Nara period (Figure 4.49) (Carlqvist 2010: 186, 196). Of particular interest is the land pulling myth which suggests that a god created Izumo by pulling land from Silla and surrounding coastal regions along the west coast of the main island of Honshu. Carlqvist (2010:200) believes that this myth details the regions which Izumo/Shimane had specific ties with during the late Yayoi period.

Figure 4.49 Unique square burial mounds with protruding corners (Nishitani tombs) from the late Yayoi in Shimane prefecture. Courtesy of the Izumo Yayoi no Mori Museum. Photo by Lauren Glover.

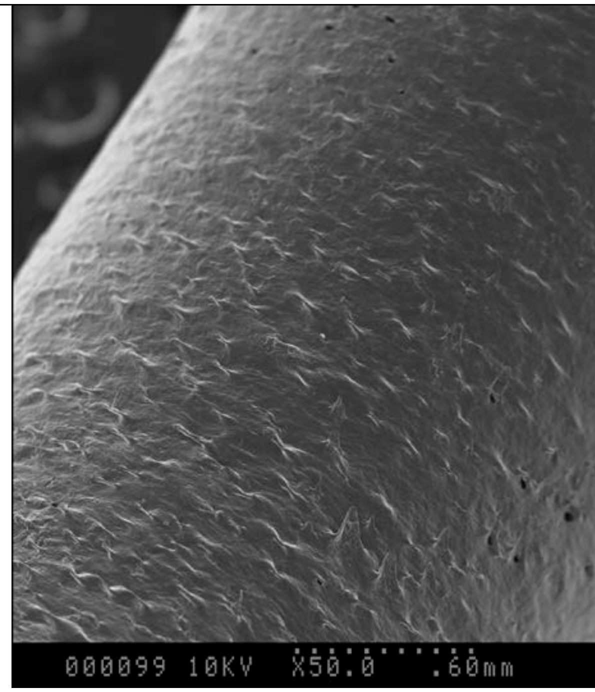
Shimane contains the site of the Izumo shrine, one of the most famous Shintō shrines in Japan where the gods are supposed to visit once a year (Shimane Museum of Ancient Izumo 2007:13). The Izumo shrine is regularly rebuilt following the ancient style in use since the Kofun period (Figure 4.50). This is known because recent excavations of the temple complex found the three wooden pillars which supported the shrine in the past which are still used today (Shimane Museum of Ancient Izumo 2007:12). They also found a cache of beads deposited during construction which seems to have been for ideological reasons (Shimane Museum of Ancient Izumo 2009:71). These beads included a large carnelian *magatama* as well as a steatite *magatama* and smaller, disc shaped steatite beads.

Figure 4.50 The current inner sanctuary of the main Izumo shrine. Photo by Lauren Glover.

Beads from this region can be divided roughly into 3 groups based on the type of site they were found at: workshop sites, burial sites and three from village sites, though one village had a bead workshop within it as well. This section is divided into these groups because it is the only region I investigated which had non-burial stone bead deposits. I addressed the workshops first, then the tombs and the village sites. There were many more workshops present in Shimane but workshops were only examined if they had beads with signs of drilling. Workshop sites with just un-drilled raw material were not included in the study both due to time restraints and because without drill holes, I would have been unable to take any impressions of drill hole interiors.

4.3b-1 Workshops

Ohara bead workshop site is one of the largest bead workshops in the region operating during the Middle Kofun period (Komeda 2002:27; Matsue National Highway Construction Firm and Shimane Prefectural School Board 1994:261). The large amounts of debitage from the site revealed they were working primarily with green jasper and carnelian/agate on the site along with rock crystal, though steatite is also present. All partially completed beads examined from this site were dark green jasper. Five jasper *magatama* and one cylindrical bead were examined. Because the beads were never used, it is possible to see the remains from manufacture very clearly on the SEM images. Figures 4.51 and 4.52 show one of the incomplete beads and the SEM results which show it was drilled with a metal drill and abrasive. At Ohara workshop, the chaîne opératoire involved chipping and grinding out an appropriate size section of stone, then roughly chipping the sides into the appropriate shape before drilling (Komeda 2002:57). After drilling, the bead would sometimes be chipped more, then ground and polished. They seem to have drilled early in order to save time from finishing the bead if things went wrong; J0131 was discarded because a large flake came off on side 2 where the drill hole emerged making it impossible to finish the head of the bead.

	
Figure 4.51 J0131 jasper incomplete *magatama*	Figure 4.52 J0131 SEM x50

The Kitsune Zako site is both the location of a workshop and kofun tombs from the second half of the Kofun period near the town of Izumo (Morioka 1998:12). Two beads were examined from the site: a hexagonal biconical rock crystal bead and a chalcedony *magatama*.

Several beads were examined from the Dotoko bead workshop site which dates to the middle Kofun period (Matsue National Highway Construction Firm and Shimane Prefecture Research Center 1998; 2001). These beads range from rough outs with the beginnings of drill holes in them to beads which were in the process of being ground down to a smooth surface in order to complete them.

Osumiyama site is a workshop which dates to the middle Kofun period (Shimane Prefectural School Board 1988). Three *magatama*: one carnelian (Figure 4.53), one chalcedony and one made of jasper/green tuff were examined along with three unfinished jasper/green tuff beads. This workshop utilizes roughly the same chaîne opératoire pattern as that of Ohara (Shimane Prefectural School Board 1988:46).

Figure 4.53 J0139 incomplete carnelian *magatama*

Fukutomi I is a workshop site from the 5th-6th century CE (Shimane Research Center 1997). There were several designated areas within buildings where rock crystal, jasper, agate and steatite were being worked. Multiple incomplete or broken beads made of these materials were examined. Of interest is the steatite pendant from this site since pendants are fairly rare (Figure 4.54) and the half drilled rock crystal bead (Figure 4.55) (Shimane Research Center 1997:321,351). The steatite pendant was drilled from two sides and is a dark black with white flecks. The rock crystal bead fractured in half which allowed for easy examination of the drill hole. It was drilled with a tapered metal drill and abrasive.

Figure 4.54 J0189 steatite pendant

Figure 4.55 J0192 partial rock crystal bead

Hirotoko II is a 6th century CE workshop site (Shimane Ancient Cultural Center 2005). They worked jasper, green tuff, chalcedony and rock crystal on site. One incomplete bead of green tuff/jasper, two partial short cylindrical pieces of rock crystal which were broken, one partial green tuff/jasper *magatama*, one partial chalcedony *magatama*, one incomplete carnelian *magatama* which had red sections (Figure 4.56) and one green tuff or jasper ovoid bead (Figure 4.57) which are often called jujube beads in Japan and Korea due to their shape.

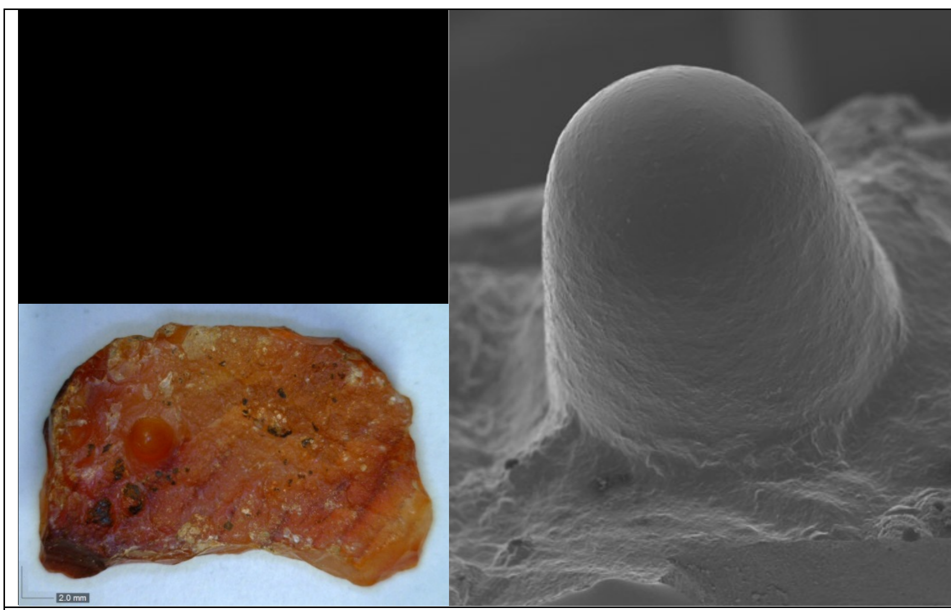


Figure 4.56 Unfinished carnelian *magatama* and drill hole SEM showing use of an abrasive and a metal drill

Figure 4.57 J0183 ovoid green tuff/jasper showing heavy string wear

Omojirodani is a workshop site dating to the Kofun period (Shimane Ancient Cultural Center 2005). The popped spall of a rock crystal bead and a jasper *magatama* with a deep gouge in one side were examined from the site.

Yotsuzako is a small, early to middle Kofun period workshop site (Matsue National Highway Construction Firm and Shimane Prefectural School Board 1996:51). Only one partially completed steatite bead which was either planned to become a pendant or *magatama* was examined. Due to the fragility of the material, no impressions were taken.

4.3b – 2 Tombs

Komesaka site is a cemetery dating from the mid to late Kofun period (Egawa 1999: 138). A single chalcedony *magatama* was examined from this site.

Hayashi Tomb 43 dates to the Late Kofun period, but rock crystal seems to have been a popular material in tombs on the site. The three cylindrical rock crystal beads all come from tombs on this site (Shimane Ancient Cultural Center 2005). Two were simple cylindrical beads while a third was hexagonal cylindrical (Figure 4.58). All were drilled with a large, long conical drill from one side and popped.

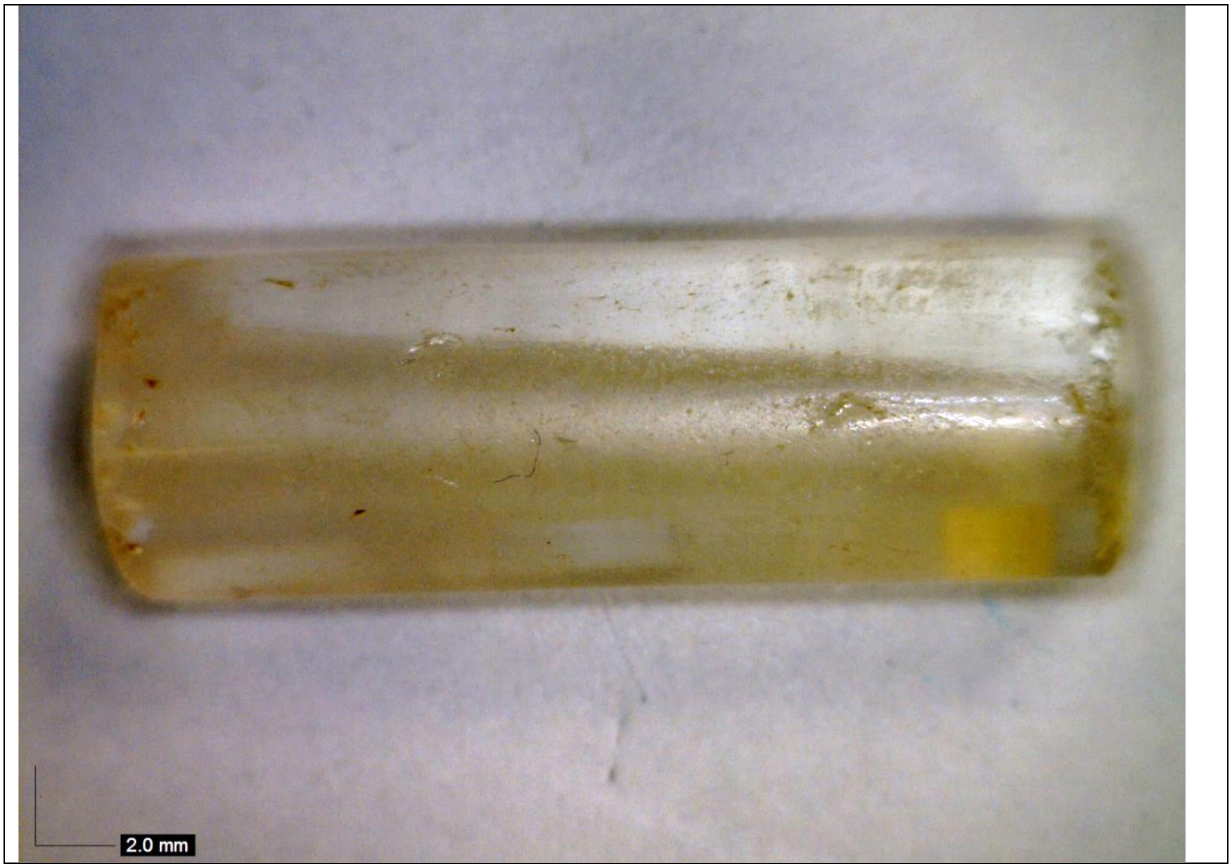


Figure 4.58 Cylindrical and hexagonal cylindrical beads J0113 and J0115

Matsumoto Kofun group is an early Kofun period large square keyhole tomb group in the Mitoya area of Eastern Izumo (Carlqvist 2010: 202). A single jasper cylindrical bead was examined from the site.

Gotanda I kofun dates to the first half of the Kofun period and held two jadeite *magatama* (Shimane Ancient Cultural Center 2005:161). Both were drilled with short, conical drills and showed heavy wear on both bead ends.

The Shimada Ike site was occupied from the late Yayoi into the middle Kofun period (Harada and Yui 1997). Several of the tombs held rock crystal and chalcedony beads but the dating on some of the tombs is unclear so it is uncertain if all of the beads came from the Kofun period.

Shirokokuri (Usukokuri) is a tomb complex which dates to the second half of the Kofun period around the 6th century CE (Matsue National Highway Construction Firm and Shimane Prefectural School Board 1994:192, 1997:189). Several hexagonal biconical rock crystal beads and rock crystal, jasper, steatite and chalcedony *magatama* were examined from four different tombs. The chalcedony *magatama* on this site were not finished as well as those from other sites with truncated heads and tails or pitting and chunks left unpolished (Figure 4.59).

Figure 4.59 J0166 chalcedony *magatama*

Kamienya horizontal hole tomb group is located near modern day Izumo town and dates to the second half of the Kofun period (Masaoka 1998:5-6). Two beads were examined from the site: a carnelian bead which was mistaken for glass in the site report and a chalcedony magatama (though an argument for carnelian could be made for parts of the bead) (Masaoka 1998: 32, 171).

Iwaguchi South dates to the second half of the Kofun period. Beads from the tombs which were examined involved agate and carnelian *magatama*, cylindrical green tuff/jasper, and two faceted biconical hexagonal beads. One tomb held the head of a steatite *komochi magatama* (Figure 4.60). Notably, the tomb ditch held two broken cylindrical jasper beads (Figure 4.61). It is possible that these beads were placed in the tomb ditch instead of the tomb itself due to their broken state.

	
Figure 4.60 J0202 *komochi magatama* head	Figure 4.61 J0205 jasper cylindrical broken

4.3b – 3 Settlements

Nunoden site (Shimane 1991) is a village site with a bead workshop from the middle Kofun period. A single partial chalcedony *magatama* (J0163) was examined from the site (Shimane 1991: Figure 134).

Komosawa A site, Matsue City (Okazaki 1988: 55) is a settlement site from the late 6th to early 7th century. One of two *magatama* found on the site was examined (Figure 4.62). This jasper *magatama* showed heavy end wear which shows it was mounted with two cylindrical beads abutting the drill holes. It was drilled from one side with a short tapered drill and the outside of the bead was ground and semi-polished.

Figure 4.62 J0120 jasper *magatama*

Komuta II site, Matsue City is a small settlement site from the early 7th century (Riko, Shigeto and Nari 1997: 8, 31). One chalcedony *magatama* was examined. It was drilled with a conical drill from one side and popped.

4.3c Miyazaki

Miyazaki prefecture is separated from the rest of the southern island of Kyushū by mountains, but was still accessible by sea. Because of their semi-isolation, there exists interesting variations in Kofun period culture such as unusually shaped mounded tombs. This pattern continues to some extent in their stone beads.

Figure 4.63 A view of some of the Saitobaru tomb group.

Saitobaru mounds is a large mounded tomb complex containing three-hundred nineteen tombs located on a raised plain which looks out over the sea (Figure 4.63) (Hongo 2005:42). Tomb 202 (otherwise known as Himezuka) is from the mid-6th century AD and contained a chalcedony *magatama* along with glass and rock crystal beads (Miyazaki Prefecture School Board 2013:45). The keyhole shaped burial mound had swords, fine Sue ware pottery, iron arrowheads and jewelry including the beads. The *magatama* was ground and polished into a rounded, thicker shape. It was drilled from one side with a metal drill and abrasive and shows some string wear from use (Figure 4.64). There is a flaw inside the bead head which has caused an unusual ring to appear on the bead impression (Figure 4.65).

	
Figure 4.64 J0074 chalcedony *magatama*	Figure 4.65 J0074 a visible flaw inside the impression

Saitobaru Tomb 13 (Figure 4.66a) is from the 4th century CE (Hongo 2005:47). It is a keyhole shaped tomb with a single burial placed on a long, narrow clay bed along with beads, swords and a bronze mirror (Figure 4.66b) (Hongo 2005:47-50). J0070 is a small cylindrical jasper bead (Figure 4.67). With a length of 11.5mm and lots of visible lips along the bead impression, this bead most resembled the jasper cylindrical beads I examined from the Jomon and Yayoi period in northern Kyushu. The Jomon period beads were stone drilled and examination of the SEM images of J0070's impression reveals that it was stone drilled as well (Figure 5.69 – 4.70).

Figure 4.66a and b (top and bottom) Saitobaru Kofun No. 13 (reconstructed) along with the replicated interior.

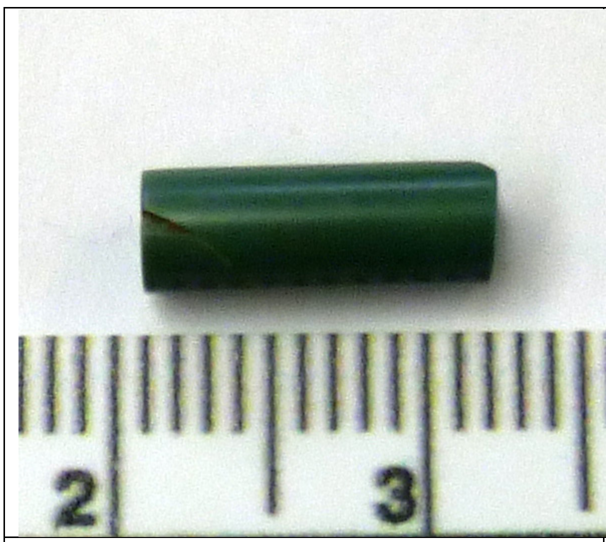


Figure 4.67 J0070 jasper cylindrical	Figure 4.68 J0070 impression

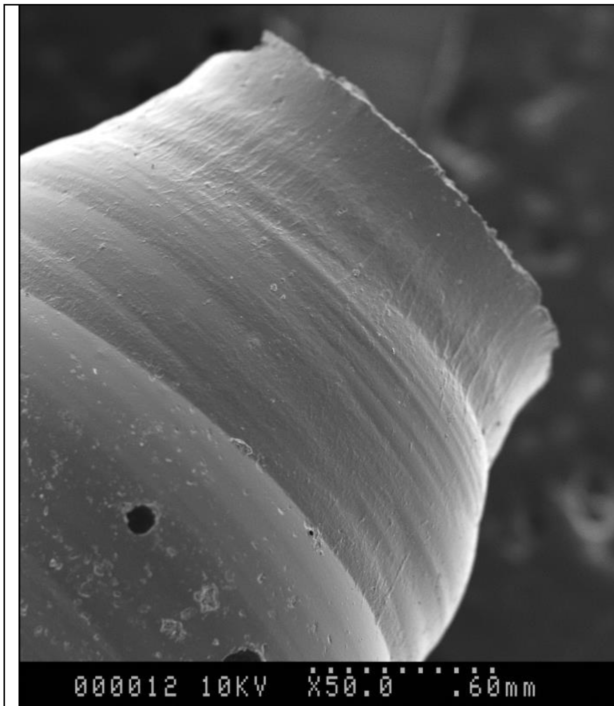
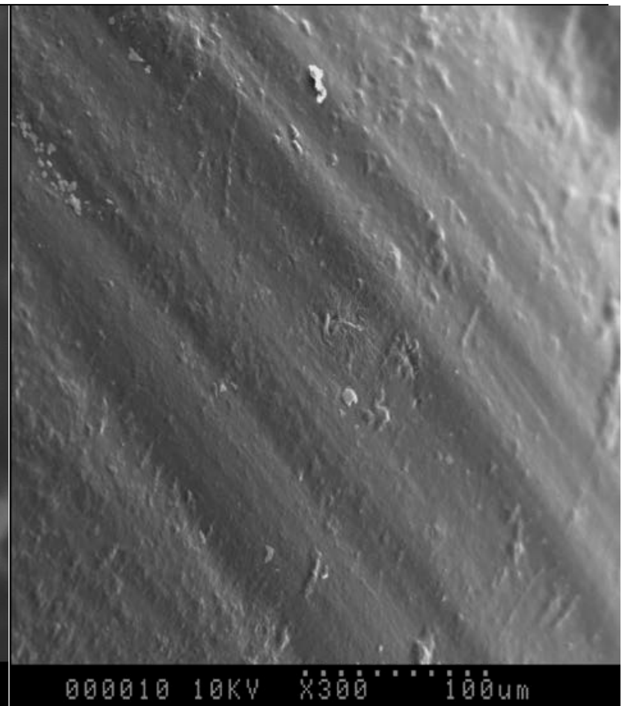
	

Figure 4.69 J0070 SEM 50x	Figure 4.770 J0070 SEM 300x

J0097 (Figure 4.71) is a small, spherical carnelian bead which was found by a farmer somewhere around Saitobaru (all non-tomb areas are under cultivation) in the 1980s (Miyazaki Prefecture General Museum 1982). It is un-dated, but since the tomb complex was in use from the 4th to 7th century CE (Hongo 2005:34), we can generally conclude that it is from the Kofun period. Another factor which supports this is that the bead is diamond drilled and heavily worn pointing to a long period of use before it was lost sometime during the Kofun period (Figure 4.72).

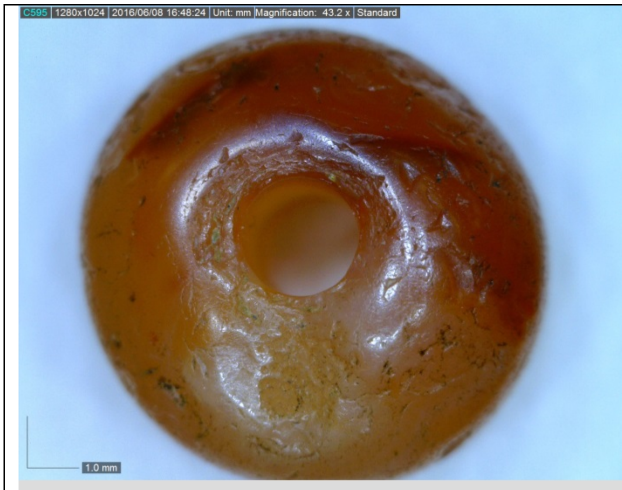
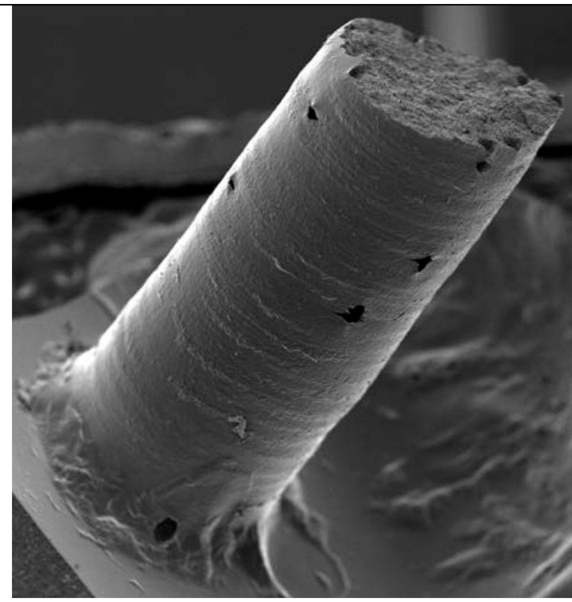
	

Figure 4.71 J0097 spherical carnelian bead	Figure 4.72 J0097 SEM 20x showing the regular drilling of diamond drilling but heavily worn by string wear

Sakamoto no Ue at Saitobaru is a 7th century CE pit tomb (specifically 6-1) which is near Tomb 202 (Hongo 2005:42). One jadeite *magatama* from the site was examined (Figure 4.73). Like most jadeite *magatama* examined in this study, the bead showed signs of heavy string wear around the edges of the drill hole along with wear inside the drill hole. Faint signs of drilling striations are visible suggesting it was drilled with a tapered metal drill and abrasive (Figure 4.74).

Figure 4.73 J0091 jadeite *magatama*

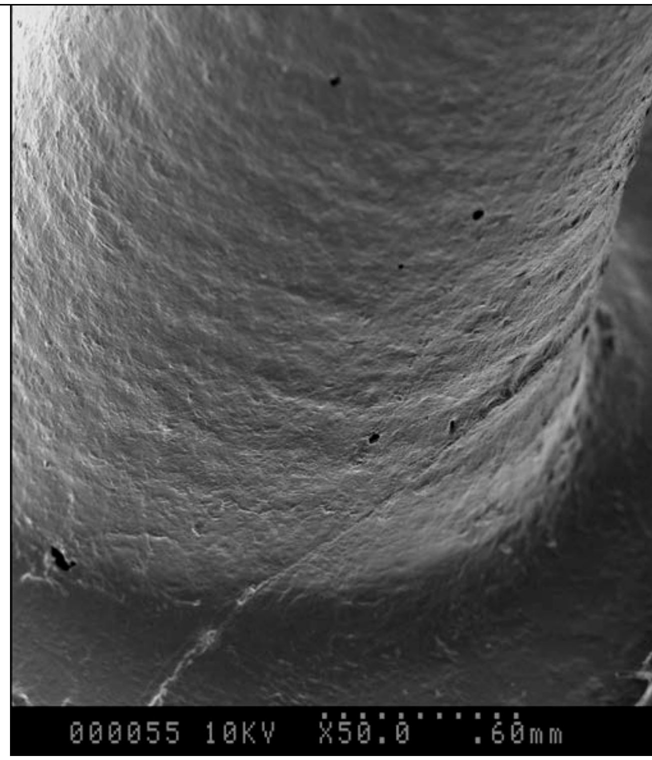


Figure 4.74 J0091 SEM x 50 striations still visible through heavy wear

Mutsunobaru is a mid-5th century tomb excavated in the 1940s (Ishigawa 1944:15-17). The burials contained iron weapons and armor, pottery, mirrors, three *magatama* and five cylindrical beads. Two jadeite *magatama* and one cylindrical jasper bead were examined from this tomb. Both the jadeite beads (Figure 4.75a and 4.75b) have a shape that is more reminiscent of Yayoi period *magatama*. J0072 in particular is an unusual ‘U’ shape. They are also both quite small, have high taper drill holes and show signs of heavy string wear (Figure 4.76 and 4.76).

Figure 4.75a J0071 jadeite *magatama*

Figure 4.75b J0072 jadeite *magatama*

Figure 4.76 J0072 drill hole close up showing heavy string wear along the edges

Figure 4.77 J0071 high taper impression

J0072 was chosen for SEM analysis due to its unusual shape. It was drilled from both sides and examination of the impression revealed it had heavy wear. Examination of the SEM images showed that it had faint, uneven drilling (Figure 4.78 and Figure 4.79). This uneven drilling and areas of smoothness and roughness is characteristic of stone drilling. While there is evidence of string wear, especially near the drill hole and where the drill holes meet in the center of the bead, some of the apparent smoothness of the impression was probably from the stone drilling process.

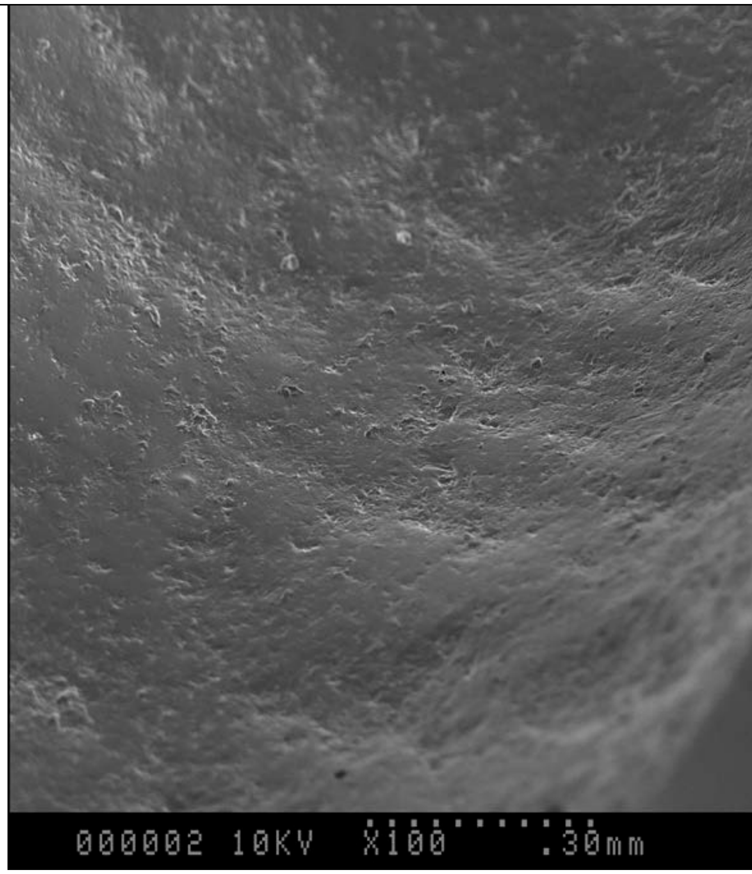


Figure 4.78 J0072a SEM 100x power, body showing worn down irregularly spaced drilling striations

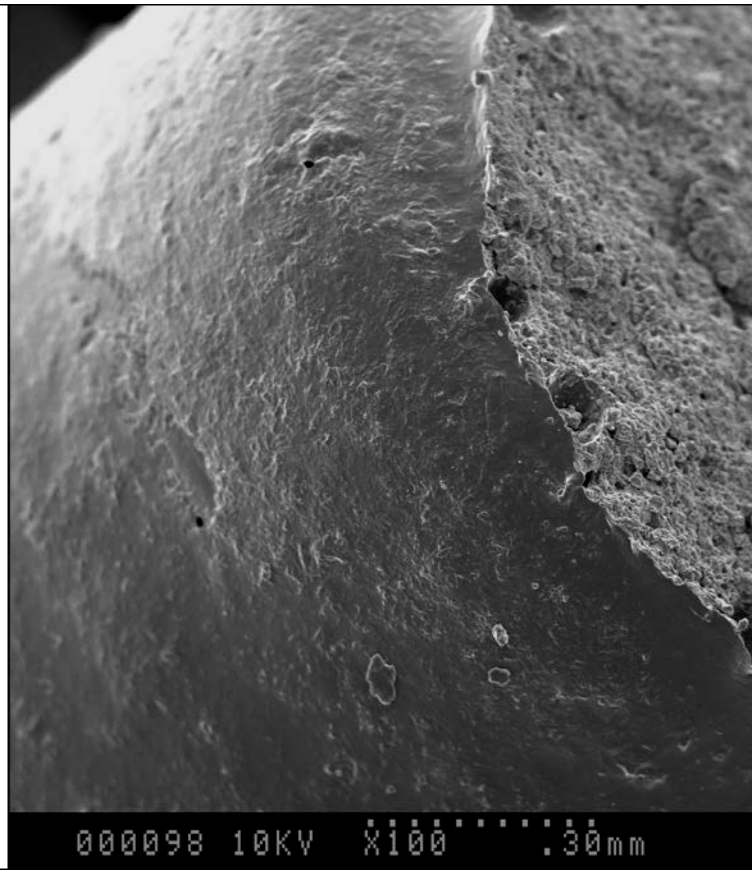


Figure 4.79 J0072a 100x power with a rough, angle changing surface

Ko-onji Pit tomb is a mid-6th century pit tomb which contained pottery and beads (Miyazaki Prefecture School Board 1973:20). Two chalcedony *magatama*, one rock crystal *magatama*, one jasper cylindrical bead, one rock crystal hexagonal biconicalal bead and one square biconicalal bead were examined. J0080, the square biconicalal rock crystal bead was drilled from two sides with tapered drills. The longer side shows a rough surface with no sign of drilling striations (Figure 4.80). The shorter side (Figure 4.81) has semi-regular striations visible suggesting it was drilled with a metal drill and abrasive. There is visible string wear where the two drills meet.

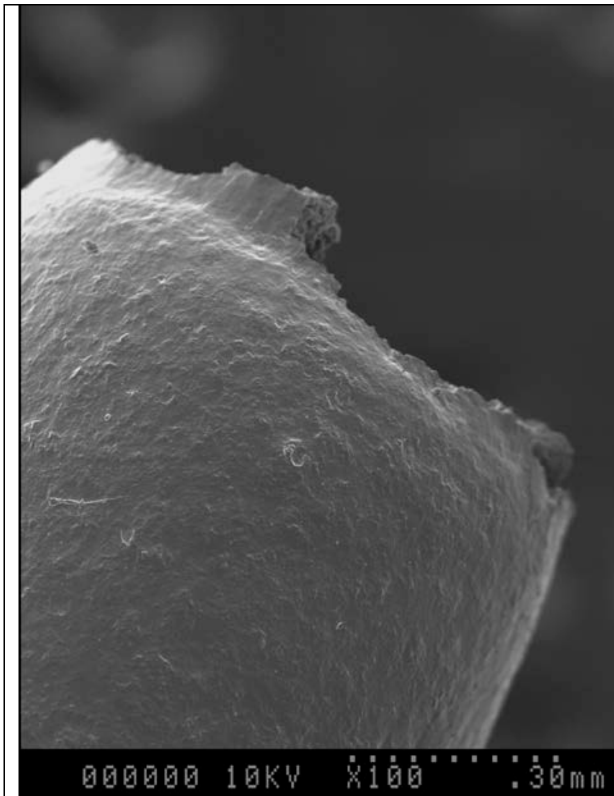


Figure 4.80 J0080b SEM x100 the tip of the longer side

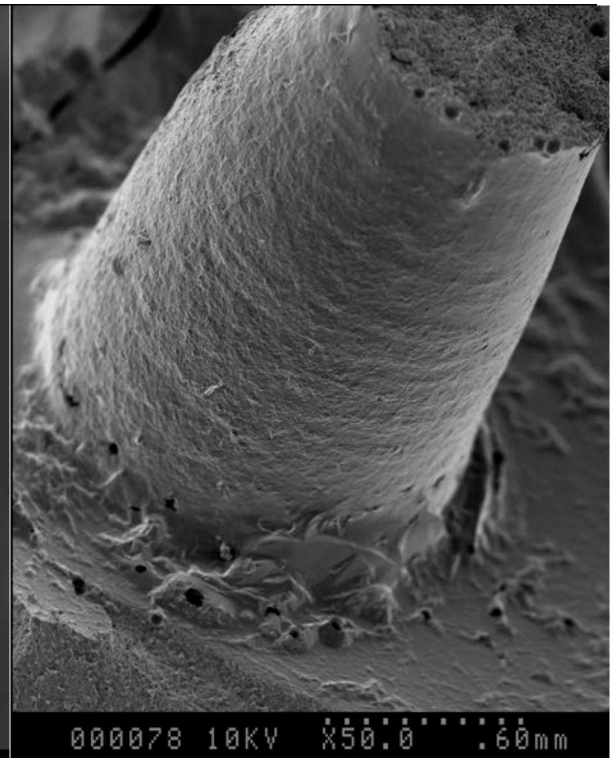


Figure 4.81 J0080a SEM 50x the shorter drilled section with visible striations

Another mid-6th century CE tomb is Kusaba (Reikyo-Duka) (Miyazaki Prefecture School Board 1955:63-64). In addition to the beads and iron implements, this tomb is known for having one of the few belled mirrors inside; the bronze mirror has eight bells attached to the outer rim of the mirror. This is the same type of mirror seen being worn by priestesses and priests in *haniwa* figurines. One jadeite *magatama* and one cylindrical jasper bead were examined.

Tachigiri Subterranean tomb 30 is from the 5th century CE (Takahara Board of Education 1991:41-43). It contained the remains of seven people, iron tools and weapons, two swords and ten cylindrical beads. One cylindrical bead made of black steatite was examined. It showed heavy string wear and end wear on both sides of the bead (Figure 4.82). The bead was drilled with a cylindrical drill from two sides and the bead does not seem to have been secured properly during manufacture since there are multiple occurrences of drilling sessions visible where the direction of the drill changed.

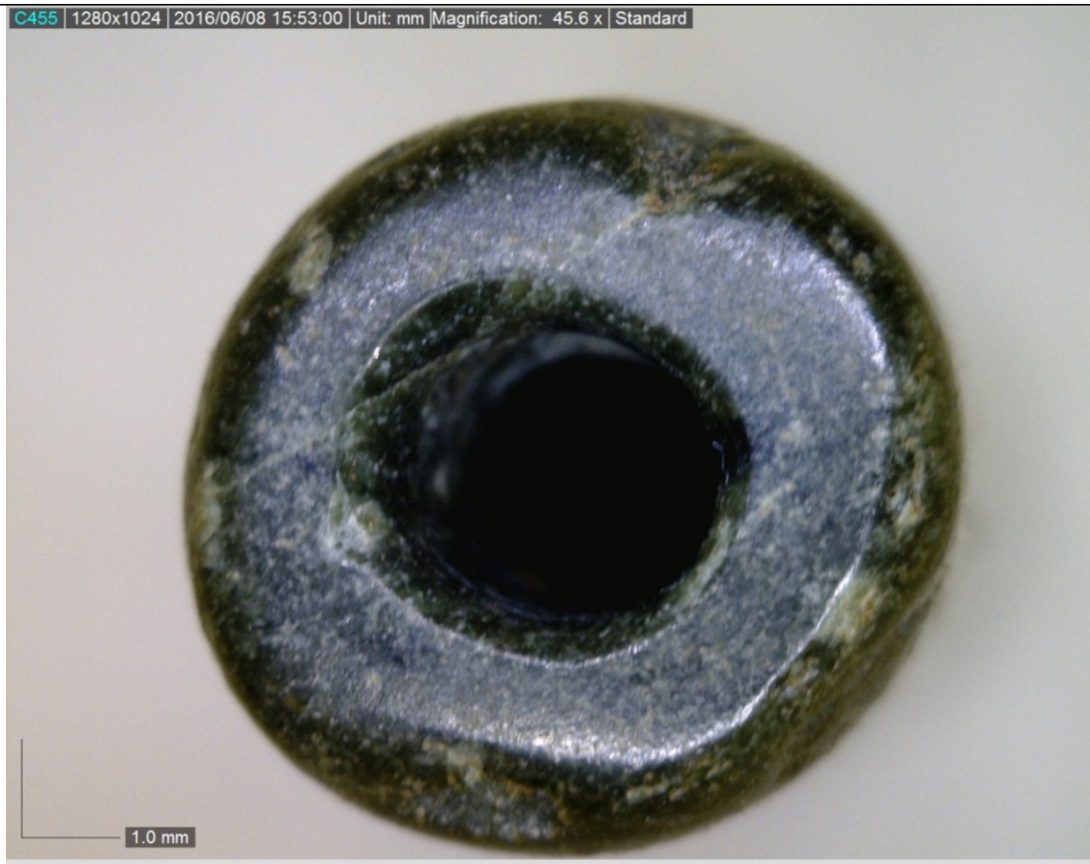


Figure 4.82 J0083 black steatite cylindrical bead showing heavy end and string wear

Iimori Subterranean tomb (no 3) is from the 5th-6th century CE (Miyazaki Prefecture School Board 1980:20-23). It contained two partial burials, iron knives and 11 cylindrical beads. Two cylindrical green tuff or jasper beads were examined.

Nagayama tomb dates to the mid-6th century CE (Kijo Board of Education 1990:25-26). The tomb held pottery, iron weapons and ornaments and several different types of beads. Two cylindrical beads, one rock crystal *magatama* and one biconical bead were examined.

Ikeuchi Tombs (specifically C6) dates to the 6th to 7th century CE and contains horizontal chamber tombs unique to the Miyazaki Plain during the Late Kofun period (Miyazaki Prefecture School Board 1997:133). C6 tomb contained only a sparse amount of grave goods due to postdepositional processes (Miyazaki Prefecture School Board 1997:47). One chalcedony *magatama* was analyzed.

Kitsunezuka tomb is located on the coast and contained several different beads, pottery and iron ornaments (Higashi, Okamoto and Emoto 2006: 15). It dates to before the middle of the 7th century. One quartz *magatama* and one jadeite *magatama* were examined from this tomb along with two hexagonal bionic rock crystal beads and a semi-irregular carnelian bead. The carnelian bead is diamond drilled and shows heavy wear.

4.3d Saga

Twenty-seven beads were examined from Saga prefecture in northwest Kyushū. All of these beads were examined at the Saga Cultural Research Center and date to the late Kofun period or into the Asuka period. However, the Kofun period dates later in Kyushū so these beads are rightfully classified as Kofun period despite their late dates. All beads were from tomb contexts. Prior research had revealed that there were a number of carnelian beads in this region and when I arrived and demonstrated what I was looking for, more were pulled out of the research center's storage.

Miyakodani (Saga Prefecture Board of Education 1991:137-138) is a late Kofun period site which contained a beautiful, mixed stone and glass bead necklace (Figure 4.83 and 4.84). I was able to examine several stone beads from this necklace. The necklace was worn along with a bangle style gilt-bronze bracelet, gilt bronze earrings and a large steatite disc. The three red-orange beads on the necklace are carnelian while the square and spherical light green beads are glass. The faceted hexagonal biconical and flat circular beads are rock crystal. The central jadeite *magatama* has a blue tint suggesting its' raw material was obtained from Itoigawa. J0231 is unremarkable on the outside but inside, the diamond drilling has created a spiral shaped drill hole (Figure 4.85). Talks with Dr. Kenoyer (Personal Communication May 2016) suggest that this was caused by one diamond chip falling out of a double diamond drill during drilling, but further research is required to confirm this.

Figure 4.83 Miyakodani necklace *not to scale

Figure 4.84 Various beads from the Miyakodani necklace (J0228, J0230, J0229).

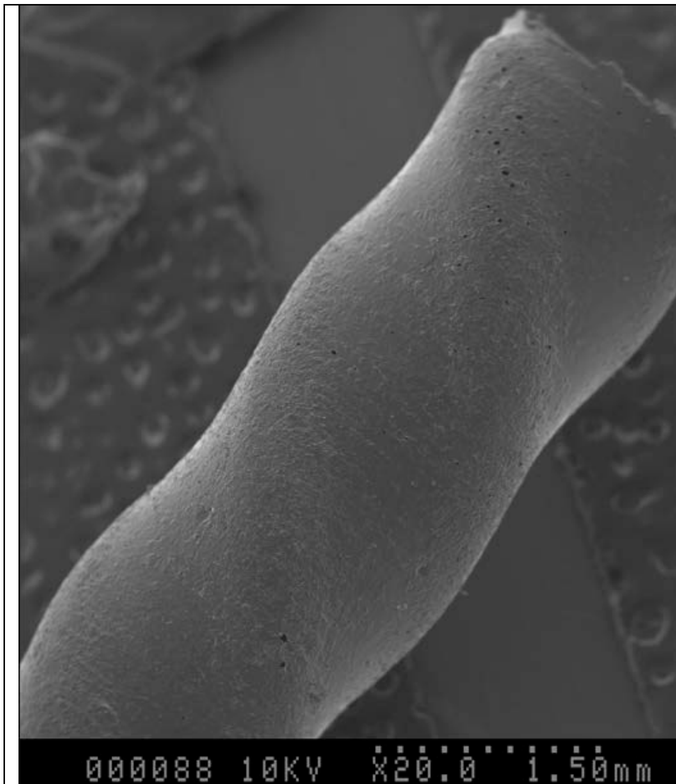


Figure 4.85 J0231 SEM x 20 spiral shaped drill hole

Tofukuji Kofun group (Saga Prefecture Board of Education 1994:204,215,240,251-253,279-280) also dates to the Late Kofun period and contained a large amount of carnelian beads. Burials included iron tools and weapons, pottery, earrings, silver necklaces and beads. All the carnelian except for one was diamond drilled. Despite being from the Late Kofun period, this site contained a heavily worn, stone drilled carnelian short cylindrical bead (Figure 4.86 and 4.87). In contrast, the squared off, C-shape of the chalcedony *magatama* is typical of Late Kofun period *magatama* made in Shimane prefecture (Figure 4.88).

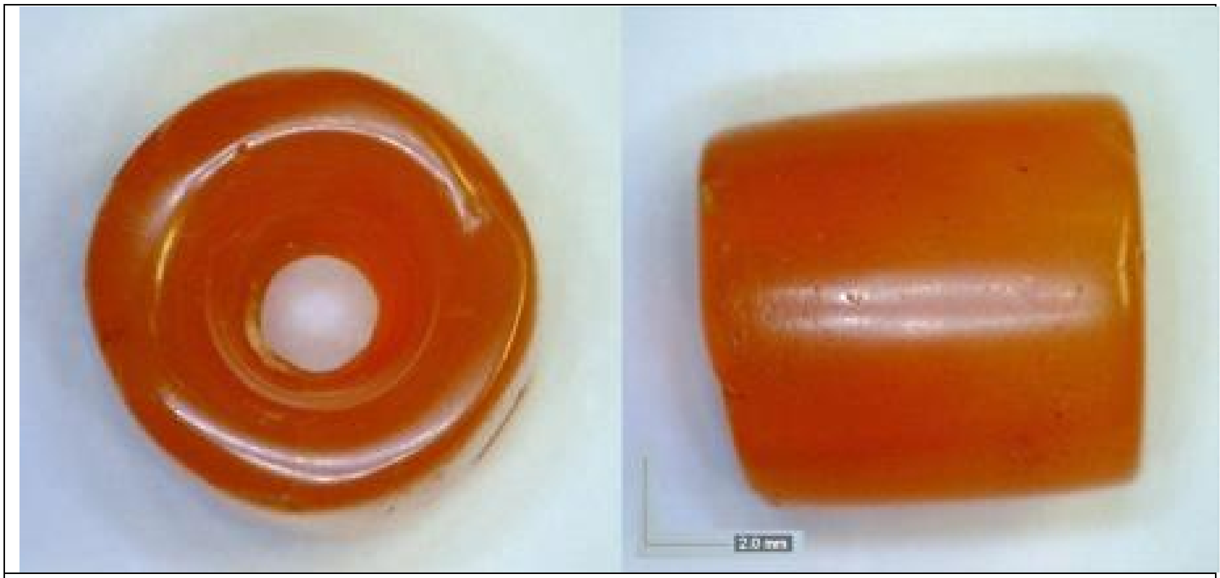


Figure 4.86 J0222 short cylindrical carnelian bead

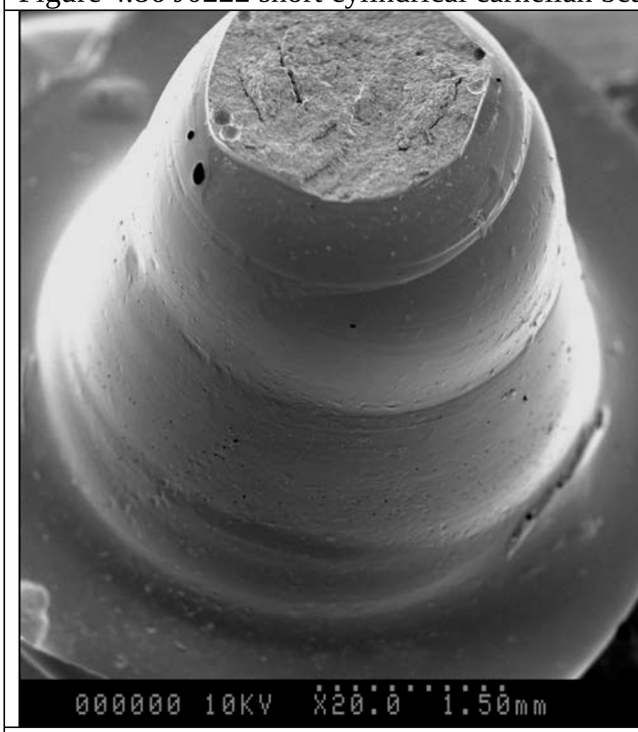


Figure 4.87 J0222 SEM 20x showing stone drilling

Figure 4.88 J0226 chalcedony *magatama*

Like Tofukuji, Tsuzumi site (Saga Prefecture Board of Education 1983:59) dates to the late Kofun period (the end of the 6th to the early 7th century CE) and also held a faceted hexagonal carnelian bead which was diamond drilled (Figure 4.89). The site has never been published except for the brief, one page summary referenced above, but this bead came from Kofun #5.

Figure 4.89 J0227 carnelian hexagonal biconical

The earliest site with an exact date I examined in Saga prefecture was Nagata (Umesaka) Kofun group (Saga Prefecture Board of Education 2002:41, 96, 149). These kofun dated to the early 6th century CE and were located on a ridge. One chalcedony *magatama* and several diamond drilled carnelian beads were examined from the site.

Kouda site (Saga Prefecture Board of Education 1981:82) contained tombs dating to the late 6th to early 7th century CE. It contained two diamond drilled carnelian beads. When examined under the SEM, J0211 shows the Khambhat method of drilling with a larger then smaller diamond drill (Figure 4.90).

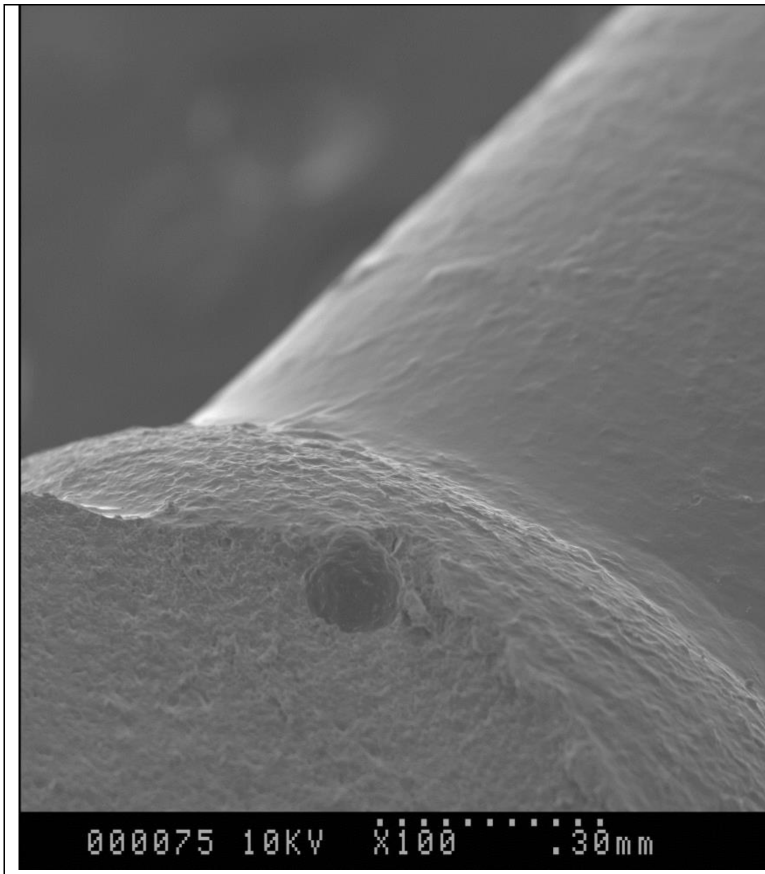


Figure 4.90 J0211 SEM x100 Khambhat drilling method of using a larger drill to star the hole before drilling with a smaller drill

Two carnelian beads were examined from Tsubuteishi site (Saga Prefecture Board of Education 1989:116) which dates to the early to mid-7th century CE. Most of the beads from the tombs at this site were glass apart from the carnelian.

Even later is the mid to late 7th century CE site of Daimonishi (Saga Prefecture Board of Education 1980:93-94). The tombs in this group held a variety of pottery, iron tools, earrings and beads. One partial chalcedony *magatama* was examined.

Finally, a carnelian *magatama* from Tomb 20 at the Nishibara site (Saga Prefecture Board of Education 1983:102) was examined though the site dates to the late 7th to early 8th century so there is the possibility it is from the Asuka or early Nara period. Interestingly, the bead itself does not resemble the flat, C-shape that is so common in late Kofun period workshops in Shimane prefecture suggesting it was made much earlier (Figure 4.91). It was drilled with a conical metal drill and abrasive from one side and then a spall was popped out.

Figure 4.91 J0233 carnelian *magatama*

4.3e North Kyushū

Three sites from northern Kyushu were examined for this study though only one fell into the Kofun period. However, each site had jasper cylindrical beads available for analysis so it was a good opportunity to examine how manufacturing methods and styles were changing over time in that region. The earliest site examined was the Amakubo Dolmen burial (Nagasaki Prefectural Board of Education 1994). This site dates to the 8th to 5th century BCE (Middle-Late Jomon period). Three bead impressions were taken from three short, pale green colored cylindrical beads (Figure 4.92a and 2.92b). They were all drilled with drills of similar size 2.2-2.8mm in diameter from two sides. SEM analysis revealed they were all drilled with stone drills with one drill being a freshly made stone drill (Figure 4.93a and 4.93b).

	
Figure 4.92a J0052 jasper cylindrical bead	Figure 4.92b J0052 drill hole impressions

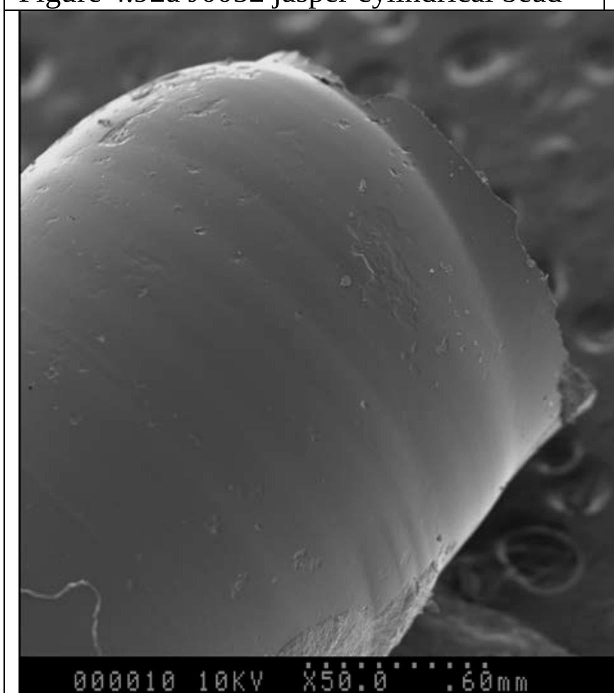
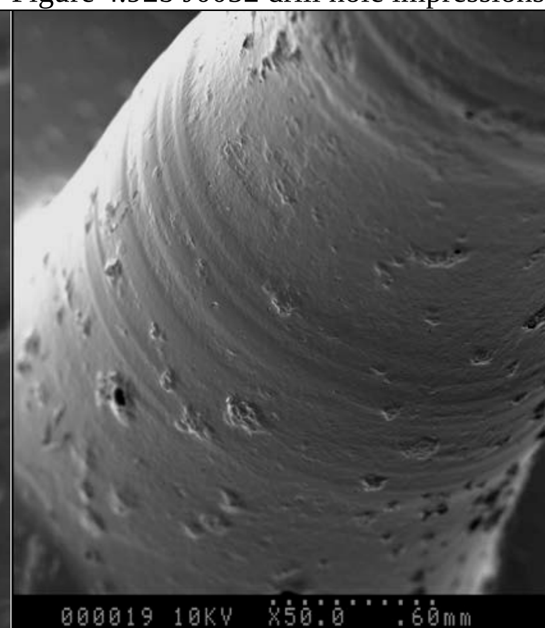

	

Figure 4.93a J0052 SEM x50 drill tip showing stone drilling	Figure 4.93b SEM x50 showing drilling with a new stone drill

Next was an early Yayoi period site dating to the 3rd to 2nd century BCE called Ukikunden (Karatsu City Board of Education 2013). This site has several anthropomorphic or animal shaped jadeite *magatama* in addition to the cylindrical jasper beads. Six beads were examined from the Ukikunden site. These beads were a darker green jasper but still cylindrical beads of roughly the same size as the Amakubo beads with the exception of one which was several millimeters longer than all the others (Figure 4.94). Although there is some variation between drillings, they largely seem to have been drilled with cylindrical metal drills (Figure 4.95).

Figure 4.94 J0057 jasper cylindrical

Figure 4.95 Impression from J0056 suggesting a cylindrical metal drill

Finally there was Banzuka Kofun, a keyhole shaped tomb (Kyushu University 1993:53) which dates to circa 500CE. The design of the tomb with an entrance for multiple burials is thought to be imported from Korean peninsular tombs (Kyushu University 1993: 304). Inside the main burial chamber, in addition to the beads, were a bronze mirror, iron tools and weapons, horse trappings, and fine pottery. Although only the jasper cylindrical beads were examined from this tomb, jadeite and amber *magatama*, glass and spherical agate beads were also present (Kyushu University 1993: 305). There is marked change in size and shape of these dark green jasper cylindrical beads in this time period. 25 beads were found in this tomb (Figure 4.96). They are now longer and wider compared to the Yayoi and Jomon beads. The nine beads examined can be divided into two groups one of which is shorter in length but much wider in width and a second group which are longer and thinner but still 2-3mm wider than the Yayoi period beads. Many were drilled from one or two sides with a long tapered metal drill (Figure 4.97).

Figure 4.96 All cylindrical jasper beads from Banzuka Kofun. Courtesy of Kyushū University. Photo by Lauren Glover. *not to scale

Figure 4.97 J0069 long tapered impression

The majority of these stone beads in both the Korean peninsula and the Japanese archipelago came from tomb contexts. The only exception to this were the beads from Shimane prefecture which consisted of partial or complete beads from stone bead workshops in the region of Izumo, Shimane and three beads found in villages which date to the end of after the end of the Kofun period. These beads will be statistically analyzed in the next chapter.

Chapter 5

Quantitative Analysis of Bead Assemblages

This chapter explores the results of the quantitative analysis of the stone beads. This includes bead measurements, measurements of taper and statistical analysis. Interpretive analysis will be addressed in chapter 6. It is divided into sections by raw material, and in the case of carnelian, by broad region as well since carnelian results for the peninsular beads versus the archipelago beads were only partially analogous. Each raw material is discussed separately because they presented different results when analyzed. Jadeite and nephrite were only used to make *gogok/magatama* and often being heirloomed. Deliberate marks were being made around the heads of the beads whose purpose will be discussed in chapter 6. The patterns of size and drill hole size of diamond drilled carnelian in both the peninsula and the archipelago point to a South Asian source for the carnelian as well as South Asian styles of manufacture. However, the Japanese archipelago also has its own source of carnelian which was used to create *magatama* whose distribution seems to have been restricted outside of the region where the carnelian is found in Shimane prefecture, Japan. Carnelian, both diamond drilled and metal drilled with abrasive, is rare outside of Shimane in the archipelago whereas there were thousands of carnelian beads found in burials in the Korean peninsula. Distribution of beads and types of beads within the peninsula also points to multiple workshop traditions supplying the beads as well as preferences for types with the southern Gaya and Silla polities preferring well-made faceted hexagonal biconical beads in the Three Kingdoms Period while the Baekje polity either had none or gained access only in the latter half of the period (later Baekje beads were not analyzed in this study). Jasper/green tuff and agate were discussed together since they are generally used to produce the same types of beads: cylindrical, *gogok/magatama* or the occasional rare shape such as ovaloid. The large source of dark green jasper in Shimane prefecture, Japan meant that access to the raw material was plentiful. My analysis shows the changes over time in jasper/green tuff cylindrical beads with stone drills being used during the Jomon period, then a switch in technology to metal drills in the Yayoi period (though not a change in size) until finally moving to tapered metal drills and larger beads in the Kofun period (250CE-645CE). In the Korean peninsula, much larger beads are present during earlier periods and the only overlap is between beads from the Yayoi period (400BCE-250CE) with those from the first half of the Three Kingdoms Period (300CE-500CE). Since they show similar bead size, drill hole size and manufacturing styles, it is possible these were beads being heirloomed for centuries before deposition in the peninsula whereas they were deposited earlier in the Japanese archipelago. Rock crystal and various forms of quartzite falls out of use in the Korean peninsula at the beginning of the Three Kingdoms period. The rock crystal beads from the late Proto Three Kingdoms period (1CE-300CE) had dimensions which distinguish them from the beads made in the Japanese archipelago during the Kofun period, however the apparently corresponding workshops for the Proto Three Kingdoms period beads are located on islands north of Kyushū and in northern Kyushū. A single, locally made rock crystal bead from Miyazaki prefecture in southern Kyushū also shows these Proto Three Kingdoms period drill hole shape and dimensions (long, narrow and tapered). More of these local beads need to be examined to see if there is some continuity of this manufacturing tradition occurring in Kyushū. Steatite beads were found to be heavily worn down by both string wear and end wear which often removed any signs of manufacturing.

5.1 Jade (Jadeite and Nephrite) Beads

There were 37 jade artifacts examined in this study: 24 jadeite *gogok* from Korea, 12 jadeite *magatama* from Japan and 1 nephrite *gogok* from Korea. All Korean *gogok* were from the southern kingdoms of Silla and Kaya with 14 from Kaya and 11 from Silla. 13 of the *gogok* dated to the 5th century CE. Two were from the 4th century CE and one was from the 5th-6th century CE. The remaining 9 could only be assigned to the Three Kingdoms Period. Of the Japanese *magatama*, 8 were from the first half of the Kofun period (250CE-450CE) while four were dated to the second half of the Kofun period (450CE-645CE). These *magatama* were from the prefectures of Nara, Shimane, Miyazaki and Saga. It should be kept in mind that the highest tier elite jadeite *magatama* found in Japan are often inaccessible, either because they are designated as national treasures or because they are still buried in Imperial designated tombs which are not allowed to be excavated. This is in contrast to royal tombs which have been excavated on the Korean peninsula. As a result, it is possible that the jadeite *magatama* studied for this survey represent middle to low level elites of the Kofun period in contrast with high to middle level elites in the Korean peninsula.

Jade *Gogok/Magatama*	Jadeite	Nephrite	Grooved
Three Kingdoms Period			
Silla	11	0	7
Gaya	13	1	6
Kofun Period	12	0	0

Table 5.1 Jadeite bead types and distribution studied

95% of the jade beads were drilled with metal drills and some type of abrasive. The shape and length of the drills used varied greatly with taper measurements ranging from 0.02 to 0.45. The type of abrasive used is difficult to determine because the majority of the beads are heavily worn, but most likely they were utilizing the locally available quartzite ie sand. There is also the possibility they were utilizing other harder available materials in Japan such as corundum. There is visible string wear, caused by particles of dirt/dust on the string, around nearly every drill hole and SEM analysis (Figure 5.1) showed multiple beads with heavy wear, often nearly erasing all signs of manufacture (Figure 5.3). When manufacturing features are present (Figure 5.2) they show rough striations made by the abrasive. Many *gogok/magatama* were finished on the exterior with a high polish, but it is not possible to determine if this was the result of long term use or the way they were made originally. 5% of the jadeite *gogok/magatama* were drilled with stone drills and showed heavy signs of wear. Stone drilling ended by the Middle Yayoi period so these beads were heirloomed for centuries before final deposition. These *magatama* came only from Miyazaki prefecture which was considered a more isolated region in this period and potentially suggests that the elites of the region did not have access to jadeite *magatama* produced with metal drills.

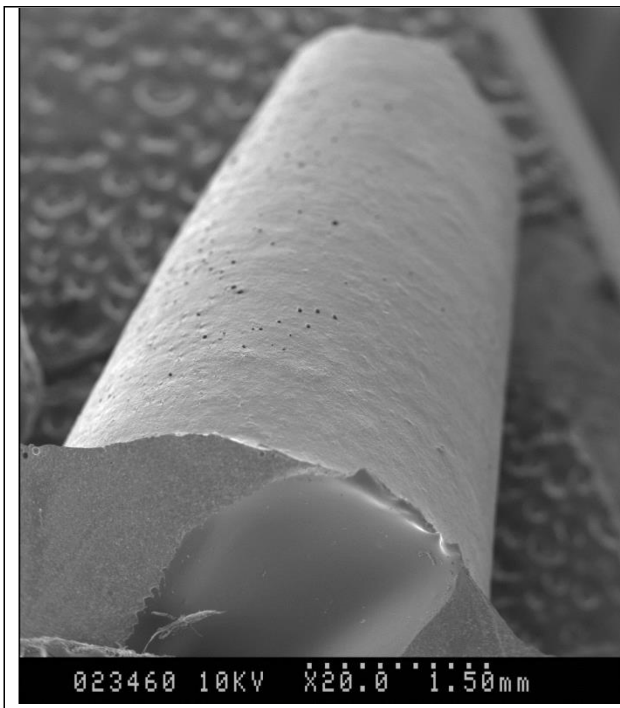


Figure 5.1 K0004 SEM x20 jadeite *gogok* worn smooth near the drill hole

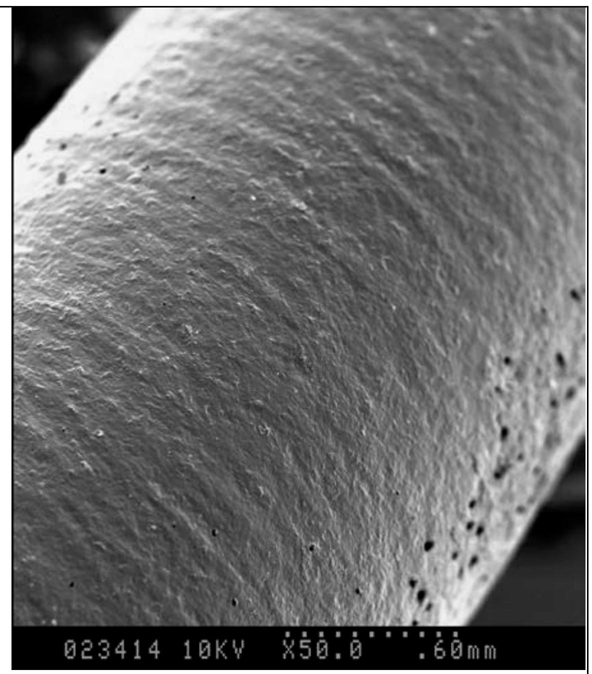


Figure 5.2 K0155 SEM x50 jadeite *gogok* with visible but worn striations

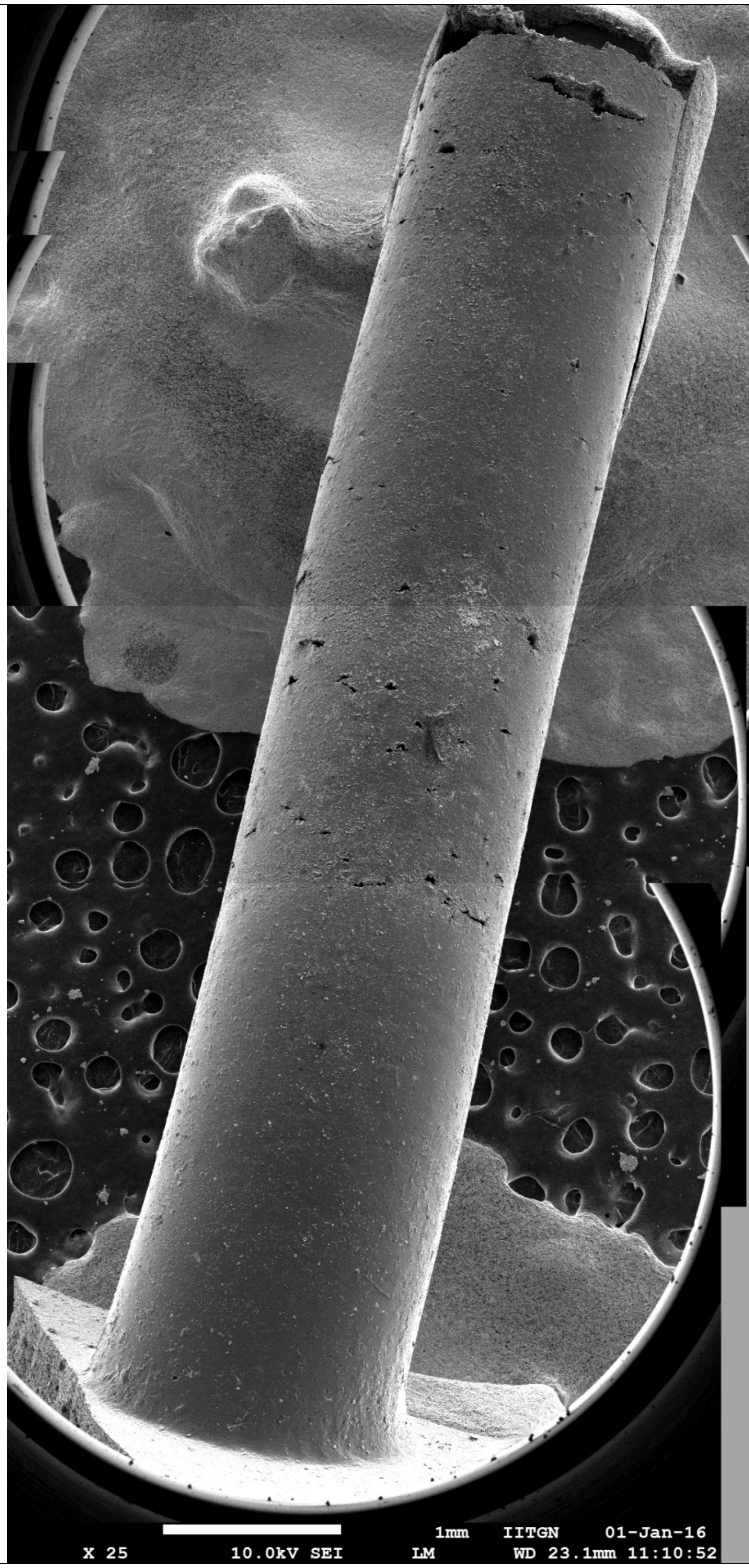


Figure 5.3 K0025 SEM x25 jadeite *gogok* drilled with a cylindrical metal drill but smoothed

down due to string wear

When the size of the jadeite beads (bead length/width) is compared to the maximum drill hole diameters (Figure 5.4), the jadeite beads found in Japan seem to mostly overlap with various jade *gogok* from the peninsula. However, the *gogok* found in Korea are much more varied in size and drill hole dimensions. The drill hole taper of all these beads were measured and compared on the assumption that craftspeople in workshops utilize similar tools through time. 75% of the Korean beads had a taper of less than 0.19 while 83% of the Japanese beads had a taper of more than 0.20 (Figure 5.5). Statistical analysis later in this chapter points to some of these differences being statistically different, meaning that beads, when they have similar tapers are likely to be from the same workshop tradition. However, it is also possible that the metal drills were simply being worn down from drilling through jadeite with a hard enough abrasive which also wears down the drill and could produce a wider taper. But since there is a statistical significance, it seems possible the *gogok* from the peninsula were mostly being drilled with a hard abrasive, most likely corundum, which would allow them to drill through the hard jadeite without deforming the drills. Typical abrasive is Mohs hardness 7 ie quartz which is equal to jadeite's 6-7 Mohs hardness. Therefore, it appears the Three Kingdoms period elites obtained the majority of their jadeite *gogok* from workshops using a high quality abrasive. Geographically, these taper differences are also born out with the Kyushū beads being 75% higher tapered drills and the same ratio for Nara prefecture jadeite *magatama*. 83% of the peninsular beads which had high tapers were from Silla suggesting Silla had some limited access to the same bead sources as the high taper magatama. The one Gaya bead which has a high taper drill hole is from the same workshop tradition as one of the Silla beads. Corundum is available on the Japanese archipelago in the Chugoku mountains in the southwest of Honshu and also in the Hida metamorphic belt along the central western coast (Figure 5.6) (Ehiro et al. 2016:31; Osakabe and Suzuki 1983:32-33). Nodules of corundum have also been found within the Himekawa River at Itoigawa which is one of the two rivers in which jadeite is found Figure 5.7 (Fossa Magna Museum 2016: Display). I was informed there are ancient corundum mines in the Nara Basin (Barnes 2018 June 08 Personal Communication), but it is not known if they were worked during the Yayoi and Kofun periods.

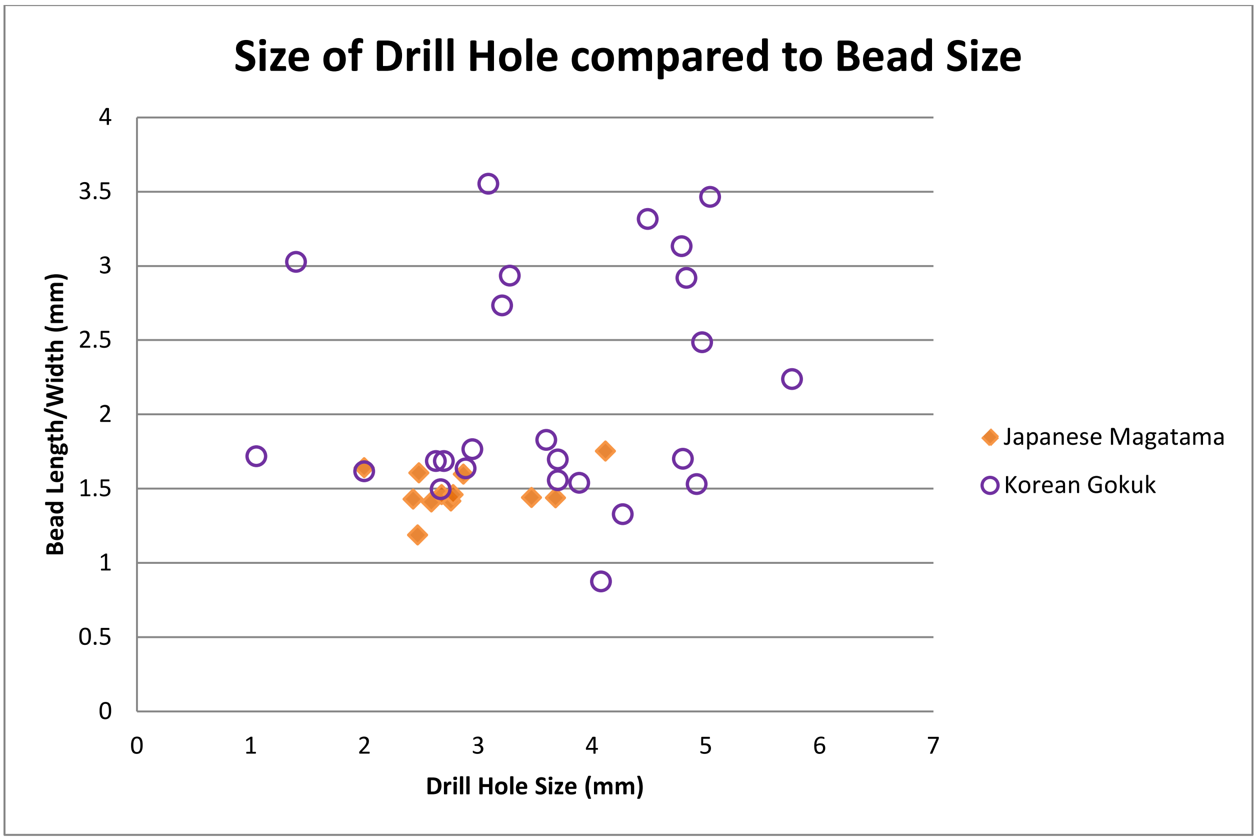


Figure 5.4 Size of jadeite *gogok/magatama* beads compared to drill hole size

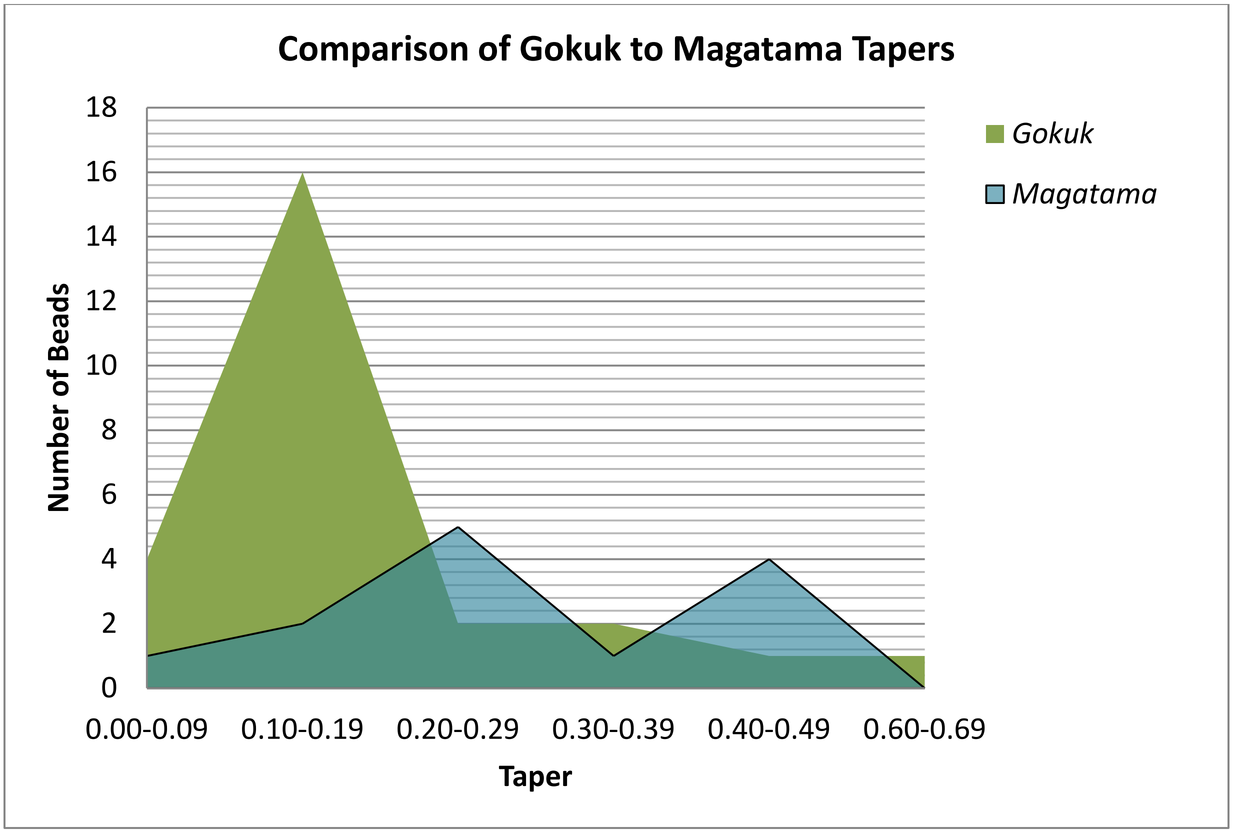


Figure 5.5 Taper of jadeite *gogok* compared to *magatama*

*not to scale

Figure 5.6 Corundum sample from Toyama, Japan

*not to scale

Figure 5.7 Corundum. Courtesy of the Magna Fossa Museum, Itoigawa, Japan. Photo by Lauren Glover.

Beads were then examined and compared on three points 1) shape 2) drill hole taper and 3) maximum drill hole size. The size of the bead was taken into consideration but not considered as a diagnostic criteria since the size of the bead would be determined by the available raw material. Jadeite is often found in naturally sized nodules, and the size of those nodules determined the maximum size of the beads (though they could have been split into smaller pieces). Based on the small jadeite *gogok* and *magatama* it is clear that the ancient people made beads of many different sizes and that all sizes of beads were used for ornaments. There is, however, a distinct preference for larger beads demonstrated in the Three Kingdoms Period beads, which may be due to them being from royal tombs. The Japanese royal tombs have not been excavated so there may be larger jadeite *magatama* in those tombs as well. There are an estimated 1500 jadeite beads recovered from excavations dating to this time period in Korea and Japan so the odds of finding beads from the same workshops is not very high. However, despite those odds, four beads from two distinct workshop traditions are present in these 37 beads. Figure 5.8a and b (K0154 and J0033) are almost exactly the same in bead size and drill hole size along with being the same shape. They fall into group 2 in Figure 5.11. They are also both drilled with a nearly straight metal drill. Due to their shape and low taper, it is likely these were made with tubular metal drills (Kenoyer 2003a:17). Figure 5.8a is from an early 5th century Daekaya tomb and Figure 5.8b is from a 5th century tomb, Matobaike, in Nara prefecture, Japan near Kashihara so they are even from the same time period and similar contexts. 1b has a blue tint embedded in the jadeite which is a characteristic alternate color of the Itoigawa jadeite, but is drilled with the low taper drills used by the majority of the jadeite *gogok* in Three Kingdoms period Korea. This could potentially mean that although the source of the raw material was in Japan, these jadeite beads were being made for the Three Kingdoms period markets. It is also possible that specific workshops utilizing lower taper drills were more likely to be trading with the Korean peninsula.

Figure 5.8a K0154 jadeite *gogok*

Figure 5.8b J0033 jadeite *magatama*

Figure 5.9a K0001 jadeite *gogok*

Figure 5.9b K0026 jadeite *gogok*

Figure 5.9a and b (K0001 and K0026) are large *gogok* with a wide rounded head and a long, rounded body. Both have four grooves across the front of their heads. Their dimensions are similar in both bead size and drill hole size. The taper of their dill holes is between 0.30-0.50; this is very high and contrasts with the majority of the peninsular jadeite *gogok*. Figure 5.9a is from a tomb at the Geumgwan Gaya site of Bokcheon dong and Figure 5.9b is from a 5th century CE, royal tomb at Gyeongju. Figure 5.9a is the only Gaya bead to have a high taper drill hole while the rest of the high taper drills found in this study were all from Silla. This suggests that either Silla or Gaya had access to the high taper drilled beads, either keeping them for themselves in the case of Silla or trading/gifting them in the case of the Gaya bead. K0023 also resembles these beads in size and shape but its' taper is very low compared to 5.9a and 5.9b and it lacks grooves. It is possible that more than one workshop was producing this style of *gogok*.

K-Means cluster analysis was performed utilizing the three different variables of bead size, maximum drill hole diameter and the taper of the bead drill holes (See Hartigan and Wong 1979:100-102 for K-Means algorithm). Five clusters was the optimal size and results in a scatter plot matrix (Figure 5.10), however since there are three variables involved, a 3D chart better represents the data (Figure 5.11). These five groups represent potential workshop traditions, however there are likely more present since some groups such as group 2 involve different manufacturing traditions such as cylindrical drilling and tapered metal drills. Despite these multiple groups, only two separate workshop traditions are 100% statistically significantly different from each other (as will be discussed below), but there are likely more workshop traditions present due to different drilling methods and styles.

All of groups 4 and 5 (Blue and orange in Figure 5.10/5.11) come from the Silla and Gaya polities while groups 1-3 (Green, blue-green and red in Figure 5.10/5.11) come from Japan along with Silla and Gaya in smaller amounts. None of these beads seem to be grouping according to linear time; beads from a group containing 4th century CE beads also have beads from the 6th century CE. This supports the idea that these beads are being heirloomed over the centuries. One way means Anova tests of the three variables of size, hole diameter and taper supports that these clusters are valid statistically significant clusters. In size (which is the standardized measurement out of the three variables), these beads follow a semi-irregular distribution so it was necessary to statistically confirm the results using multiple pairwise t-tests. Groups 5 and 4 (blue and orange on in Figure 5.11) show a low p-Value suggesting they are significantly different from the other three groups, but when compared to each other, they are not statistically different. It is the same for groups 1-3. So, 40% of the Silla and Gaya beads are coming from different workshop traditions than the other Silla, Gaya and Japanese archipelago beads. However, there are also the results of the pairwise t-tests from the hole diameter and taper of the beads. The pairwise t-tests of the taper show that Group 3 (blue-green on Figure 5.10/5.11) is statistically different from all the other groups. This was not the case when compared to the size t-test results, and in fact, groups 4 and 5 which group together by size do not group together by taper, though groups 1 and 2 do again overlap. For drill hole diameter, pairwise t-tests reveal that groups 4 and 5 are statistically different from each other, and Group 1 (red) is statistically different from groups 2, 3 and 5. . Essentially, what these pairwise t-tests mean is that different variables are stastically different, but not all variables within a group are statistically significant enough to be statistically supported. As a result, we can accept that this analysis is statistically accurate, but more data points should be aquired to broaden and develop the analysis.

Of the two workshop traditions I identified, those in Figure 5.8a and b both fall in Cluster 2 which supports them belonging to a specific workshop tradition despite being found in Daegaya versus Nara. However, the beads from Figure 5.9a and b do not fall into the same groups. This is because although the lengths of the beads are similar, their widths are quite different which led to a very different size designation. They stylistically resemble each other, however, so in the future I would like to examine more beads of this type to determine if these are two workshop traditions imitating each other in style or if they are from the same workshop tradition.

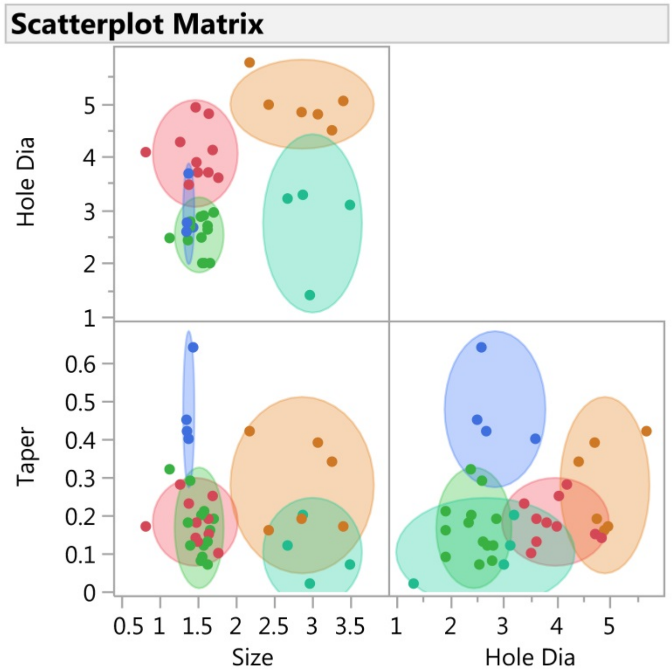


Figure 5.10 Scatterplot Matrix of Bead Size, Hole Diameter and Taper

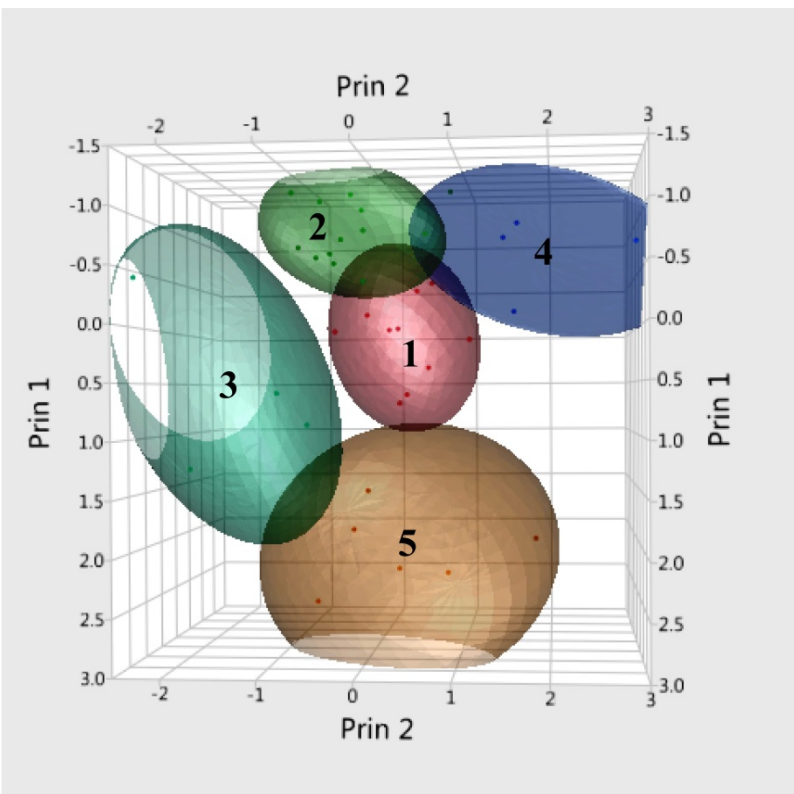


Figure 5.11 K-Means 3D Cluster (Prin 1 and 2 refer to the principle axis 1 and 2 respectively)

Of particular interest were the lines around the drill holes which were commonly found on the Korean *gogok* (13 total; 54% of my sample) (Figure 5.12). These lines are found in Japan on *magatama* as well but are fairly rare compared to Korean *gogok*. One of my research questions was to understand if these were deliberately created lines or related to the process of mounting the beads and wear since *gogok* have been found with 'caps' around their heads in tombs. While I was unable to examine any of the beads under those caps, I was able to take impressions of the grooves on the outer surface of the beads which I did examine. Analysis of the SEM images shows that these grooves were deliberately made by gouging out the surface of the bead with a metal tool (Figure 5.13). The question of their meaning will be addressed in the *gogok/magatama* section of chapter 6, but it is interesting to note that these beads were found with anywhere between 1-4 grooves. The groove most likely to be present was that at the base of the front of the head (Figure 5.12: Groove 1) if only 1 groove was present but the one *gogok* with two grooves had them on the upper and lower part of the head. On the three and four groove beads, there was one groove at the base of the head on the front then 2-3 above it at regular intervals (Figure 5.12: Groove 2 and 3). Recent work by Choi (2018:146) showed that these lines are extremely prevalent on *gogok* from the Three Kingdoms period in Korea.

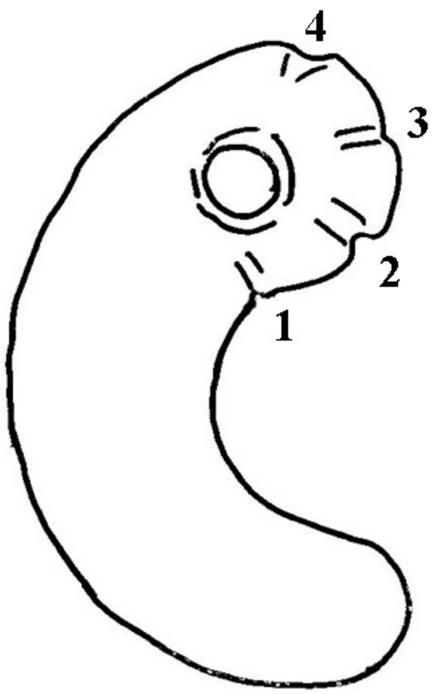
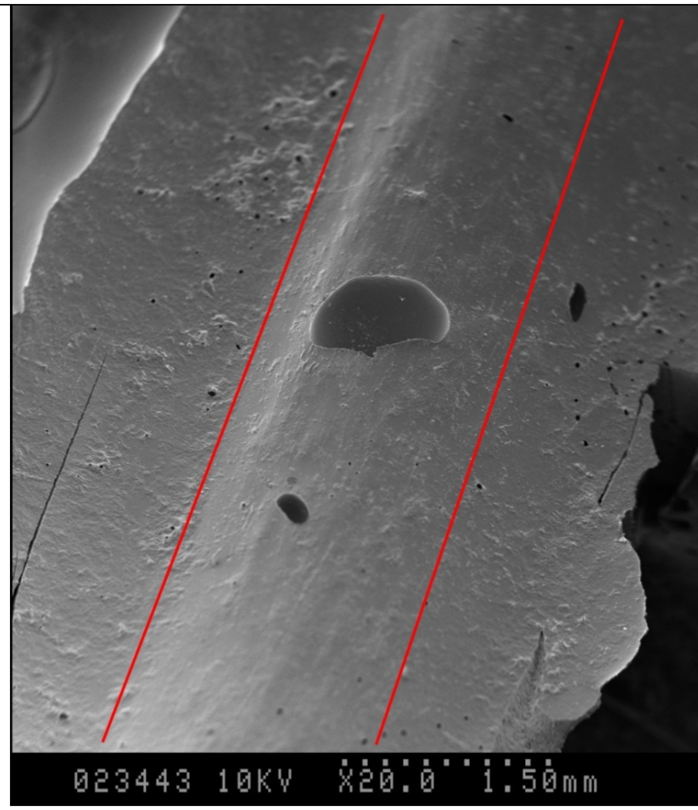
	

Figure 5.12 Sketch of typical positions of grooves on *gogok* head	Figure 5.13 SEM x20 of the groove on K0004

The nephrite *gogok* (Figure 5.14a and b) is a curious addition to a collection of jadeite *gogok* found in a single tomb in the Daegaya, Gaya tomb site which is north of the more southern Gaya polities. It is heavily stained by iron artifacts which were on top of the bead. Material wise, it does not resemble the nephrite sample I brought back from Itoigawa, Japan (Figure 5.15), the white nephrite of the Korean peninsula or nephrite from Taiwan. Chihara (1999: 9) mentions a green nephrite found south of Gyeongju but may be referring to the green tint that the white nephrite found in the peninsula can take. Shape and style wise it does not resemble any of the jadeite *gogok*. Instead of being nicely rounded off, this bead is flat with rounded edges. The tail is wide and truncated, coming to a tip on one side and there is a visible chunk chipped out of the tail though the edges of the chunk are worn or ground smooth. This bead does not have the heavy polish of the jadeite beads. The drill hole was started twice on one side before the manufacturer flipped the bead over to drill from the other side. Despite all this, it was drilled with a tapered metal drill and abrasive and the SEM image of the impression does not differ from that of the jadeite *gogok* (namely, showing heavy wear) (Figure 5.16). After a consultation with a nephrite expert (Iizuka 2018 Conference Presentation June 09), he is also unaware of where nephrite with this particular pattern comes from, but recently suggested it may be from a site in Northern Vietnam.

Figure 5.14a nephrite *gogok* side view

Figure 5.14b nephrite *gogok* front view

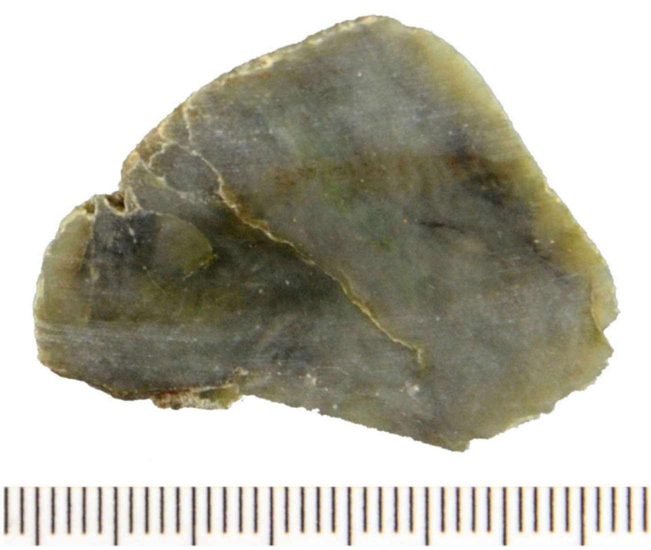


Figure 5.15 Japanese nephrite, Itoigawa locality

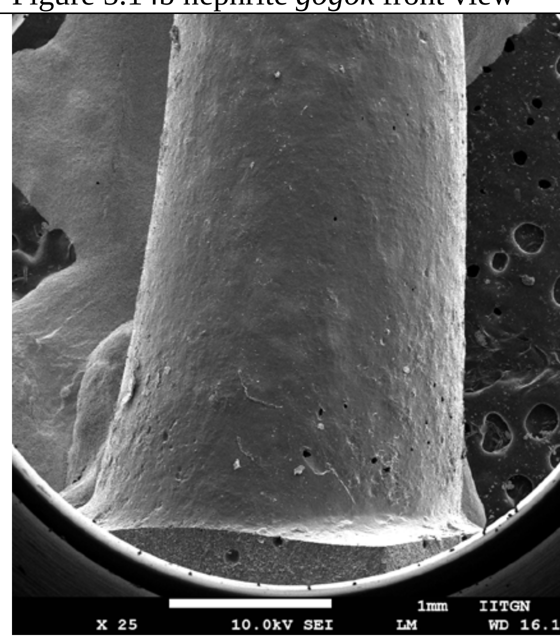


Figure 5.16 K0156 SEM x25 nephrite

	gogok

5.2 Carnelian Beads

Carnelian in the Korean peninsula and the Japanese archipelago during this period seems to have been valued for its color and, as shall be discussed below, for its difficulty to procure. There is a native source of carnelian in Japan, but there do not seem to be any local sources in the Korean peninsula (Heo 2018:141). As a result, all the carnelian that was analyzed from there was the result of long distance trade. The Japanese carnelian was a mix of local sources and long distance trade.

5.2a Korea

In Korean, carnelian is usually referred to as 마노. However, since *mano* can also refer to agate, I will instead be referring to the beads as carnelian. These beads appear in the Proto-Three Kingdoms period and continue to be found in great numbers in tombs through the Three Kingdoms Period. A single site can yield thousands of beads. The Sucheongdong, Baekje fourth-fifth century CE cemetery site had 4000 stone beads found in tombs and most of them were carnelian (Geyonggi Research Institute of Cultural Heritage Vol. 5 2012: 59). In the south of the peninsula during the Proto-Three Kingdoms period, carnelian shows up in small amounts until becoming popular in the Three Kingdoms period (Glover and Kenoyer 2019:; Heo 2018: 138). Spherical and faceted hexagonal biconal beads (types three and four) appear to be the most popular in these regions (Figure 5.19). I observed several necklaces with large amounts of well-formed carnelian beads of types 3 and 4 in the Gyeongju National Museum and the Gimhae National Museum. These necklaces contained 22 to 45 carnelian beads which were either the same size or in graduating sizes in the case of the Silla faceted hexagonal biconal beads (Glover and Kenoyer 2019:193). It seems to have been a priority of the Silla, Gaya and Baekje polities to have and display large numbers of carnelian beads before depositing them in tombs.

68 of these carnelian beads were examined from Baekje, Gaya, and Silla. They can be divided into six distinct bead types: irregular, semi-irregular, spherical, faceted hexagonal biconical, long cylindrical and faceted pentagonal barrel (Figure 5.18). Types 1-4 were diamond drilled. The irregular beads are characterized by being drilled, popped out on one side and only a minimal amount of time and effort was taken to finish the bead while for semi-irregular beads there was more time taken to try to make the bead symmetrical or to polish the surface (Glover and Kenoyer 2019:192). Types 5 and 6 were drilled with metal drills with fine abrasive. Glover and Kenoyer (2019:192) divided them into two groups. Group 1 is beads which are made quickly and with little effort to finish them: types 1 and 2. Group 1 beads appear in the Proto-Three Kingdoms Period and continue to be used into the Three Kingdoms Period. Group 2 are beads which have had more time and effort invested in them: types 3 - 6. These beads appear in the Three Kingdoms Period and seem to have been preferred by the Gaya and Silla kingdoms. However, this study did not examine the later Baekje beads so it is possible they were utilizing Group 2 beads as well.

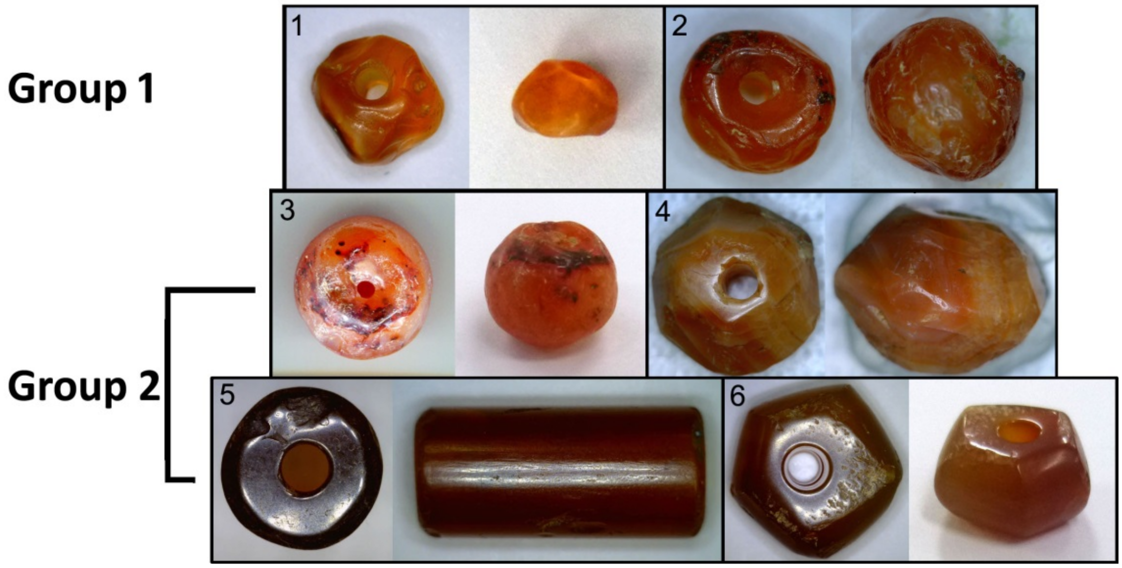


Figure 5.17 Carnelian bead types found in Korea (Glover and Kenoyer 2019:192)

	Irregular	Semi-Irregular	Spherical	Faceted hexagonal biconical	Cylindrical	Faceted pentagonal biconical
Proto Baekje	8	3	0	0	0	0
Baekje	11	22	5	0	9	1
Proto-Gaya	1	2	2	1	0	0
Gaya	0	0	0	2	0	0
Silla	0	0	1	1	0	0

Table 5.2 Carnelian bead types by time period and polity

The diamond drilled beads (types 1-4) were analyzed by comparing the bead size (length/width) to the drill hole size on the assumption that workshops producing large numbers of beads will have similar bead shape and drill hole diameters (Glover and Kenoyer 2019:193; Ludvik 2018:42-47). Figure 5.18 shows the results of this comparison divided by kingdom and over time (Glover and Kenoyer 2019:193). The Proto-Three Kingdoms Period beads tend to be of a small size and small drill hole diameter. There are four beads from Silla and Gaya which do not follow this trend. This suggests that the south-most kingdoms were receiving their beads from a different workshop or source than the Baekje region at this time (Glover and Kenoyer 2019:195).

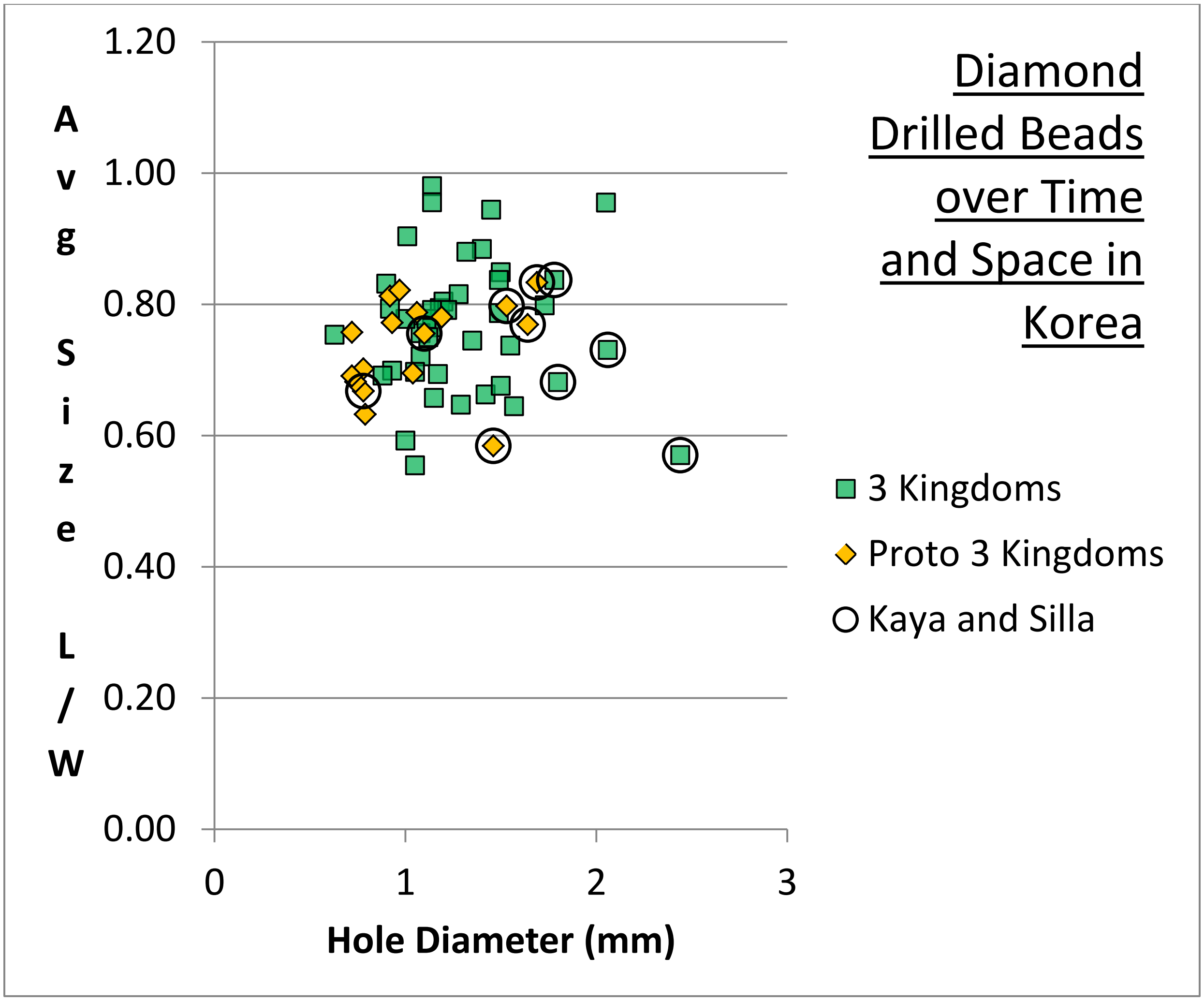


Figure 5.18 Size of diamond drilled carnelian compared to drill hole diameter divided by time and region (Glover and Kenoyer 2019:193).

The mean drill hole diameter of the proto-Three Kingdoms period beads was 1.12mm while the Three Kingdoms period beads mean diameter was 1.33mm. There was an increase in drill hole size over time and there is a larger range in size and drill hole found in the Three Kingdoms period. The Baekje beads in the Three Kingdoms were often from early contexts during the transition between the two time periods so that may explain why so many of the Baekje Three Kingdoms Period beads overlap with the Proto-Three Kingdoms Period beads. Group 1 beads also stay within a standard size range regardless of time period which suggests many of these beads are indeed overlapping in time and sources (Figure 5.19). By contrast, hexagonal biconical beads and spherical beads from Group 2 revealed distinctly different bead size and drill hole diameter ratios (Figure 5.19). The majority of Group 2 beads are from the Silla and Gaya kingdoms so this suggests they are often utilizing different workshop/sources than Baekje for their diamond drilled carnelian.

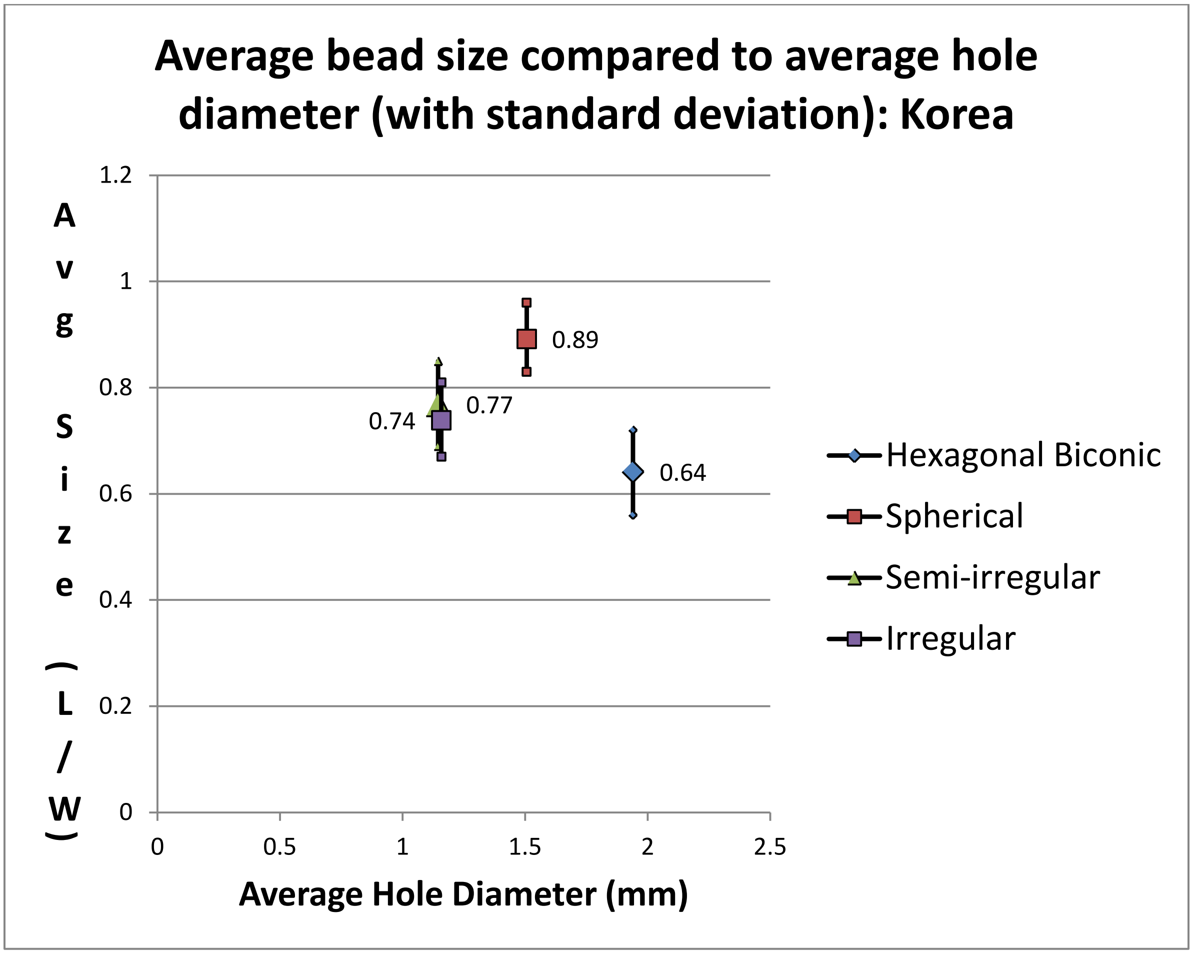


Fig. 5.19 Korean average size and drill hole diameter with standard deviation of diamond drilled carnelian.

Bead styles 5 and 6 show completely different manufacturing methods than the diamond-drilled beads (Figure 5.20 and 5.21). The cylindrical beads were drilled from two sides with a metal drill and fine abrasive which leaves an impressive shine on the interior of the drill hole. Based on their appearance, they are also made from a different type of carnelian which is more transparent and tends to be either a deep red or a lighter yellow/orange color (Glover and

Kenoyer 2019:197). They show signs of extremely heavy use wear with the ends being ground down from hitting the ends of other beads and beads breaking and being truncated before putting them back into use. Figure 5.20 shows that the original bead had the drill holes meeting roughly in the middle but it has since lost most of one side of the bead due to wear and re-shaping. K0194 has been used often enough that almost all manufacturing signs have been worn from the drill hole of the bead. Although the beads were deposited from the end of the Proto-Three Kingdoms Period to the first half of the Three Kingdoms Period, they show a remarkable consistency in drill hole size - 2.5-3mm with one outlier (Figure 5.22) (Glover and Kenoyer 2019:197). So, either these beads were all made in the same workshop during the same time period and heirloomed until their final deposition in tombs or they were made in a workshop that kept their drills uniform and the produced consistently sized beads over several centuries.

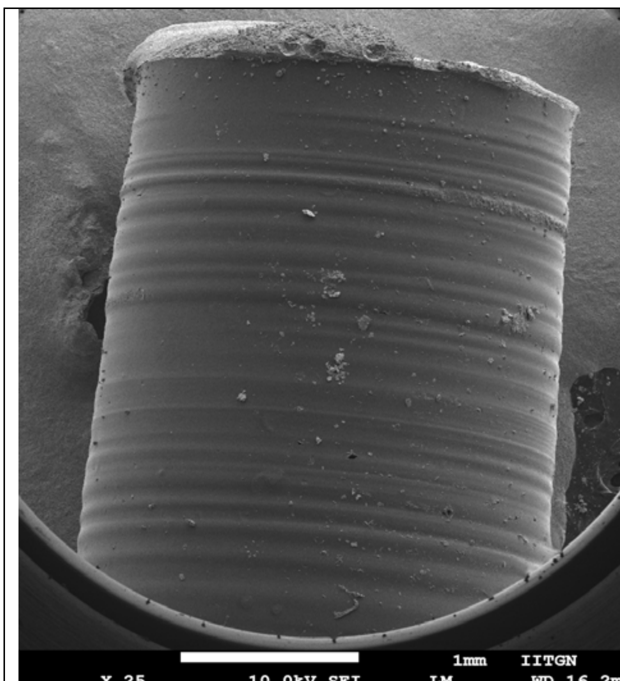


Figure 5.20 K0190 SEM x25 cylindrical carnelian

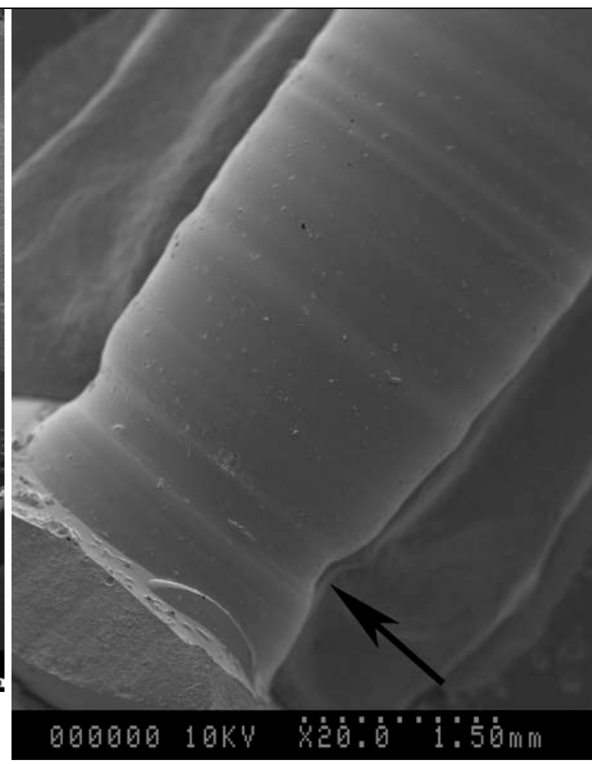


Figure 5.21 K0191 SEM x20 cylindrical carnelian with arrow showing original place where the drilling from two sides meet

The source of these cylindrical beads is unclear. Their different carnelian type and non-diamond drilling points to a different area of origin than the diamond-dilled beads. Metal drills are relatively common by this time period and were at use in the Japanese archipelago. However, the fine abrasive is unusual. The completely cylindrical shape is different from the barrel shape found in Southeast Asia before 1CE, though they are present during the first millennium CE (Bellina 2003:290). These beads do potentially resemble beads found in Yunnan, China during the Western Han dynasty (Yunnan Jinningxian Wenwu Tiyuju 2006:71), but there are multiple other sources which must be investigated in the future to determine where these beads are coming from.

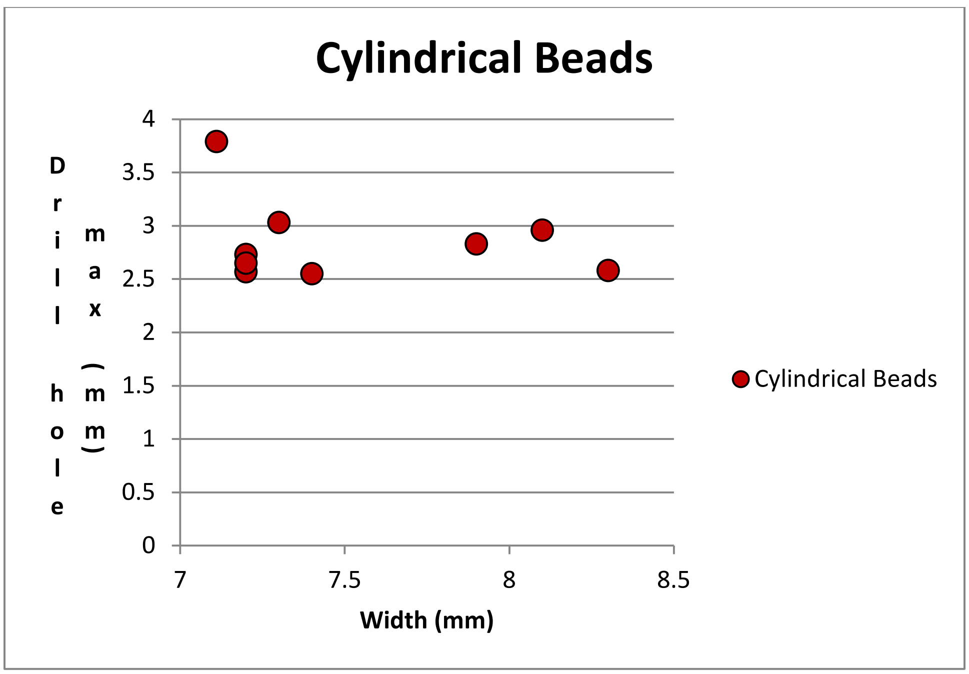


Fig. 5.22 Width of cylindrical carnelian beads compared to drill hole diameter. (Width was used instead of length since the length of these beads is inconsistent due to wear and breakage.)

Style 6 consisted of a single faceted pentagonal barrel bead which was perforated using a metal drill with fine abrasive, similar to the cylindrical beads (Figure 5.23). Its' raw material is a brown-orange instead of the traditional red-orange of carnelian suggesting it is from a different source than the diamond drilled or the cylindrical beads. The edges of the bead's facets were heavily polished or worn so they form a rounded edge instead of the sharp edges which are common to the faceted hexagonal beads. I believe this bead was made to imitate the faceted pentagonal biconical beads which were prized in the Korean peninsula, but more research is required to determine where it was manufactured and where the raw material came from.

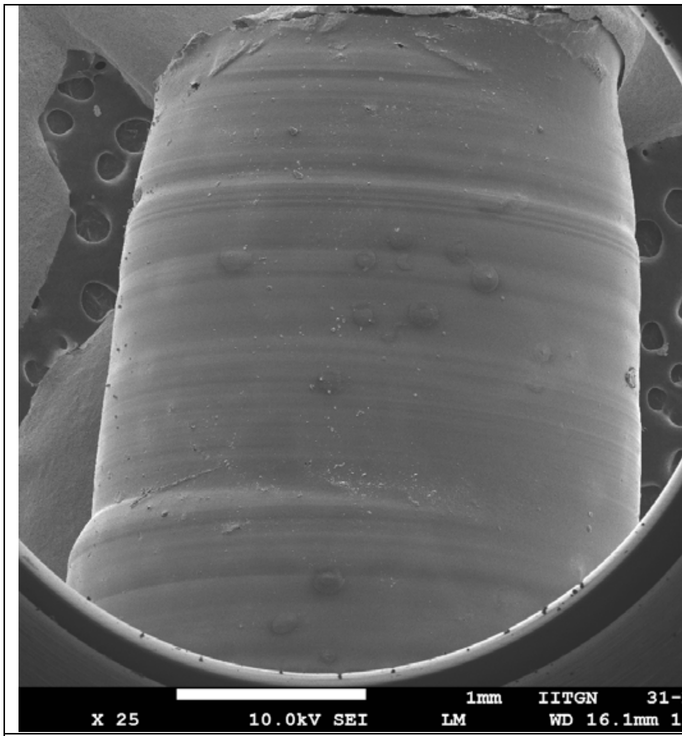


Fig. 5.23 K0186 SEM x25 pentagonal barrel

5.2b Japan

Unlike the Korean carnelian beads, Japanese carnelian beads are not as numerous in the archaeological record. Compared to the thousands found the Korean peninsula, I would estimate there are only hundreds in the Japanese archipelago. There were only a handful of diamond drilled beads observed in each prefecture visited, with the exception of Saga prefecture and to a lesser extent, Nara prefecture. In Nara, one tomb held a bracelet or necklace of several diamond drilled carnelian beads (Sakurai City Cultural Resource Center 2002). Saga prefecture had multiple diamond drilled beads coming out of Late Kofun period (500CE – 645CE) tombs and into the beginning of the Asuka period (645-710CE) (though the Kofun period lasted longer in this region so these are still Kofun period beads). 43 carnelian beads from Japan were examined in total (Table 5.3). 74% of the carnelian beads examined were diamond-drilled. These make up types one through four in Figure 5.24. Type 1 is irregularly drilled which means the bead was drilled quickly and little to no effort was made to finish the outside of the bead. Type 2 is semi-irregularly drilled which are made the same way as the irregular beads but more effort was made to partially finish the bead. Type 3 are spherical beads and type 4 are faceted hexagonal beads. Types 5 and 6 were drilled with tapered metal drills and abrasive. Type 5 is the curved bead known as the *magatama* in Japan. Type 6 are flattened spherical beads. The Japanese carnelian collected from geological sources in Shimane and Hokkaido tends to be of a darker red color or of a lighter orange yellow than the carnelian beads that were perforated using diamond drills. It is also more opaque. There is only one bead of type 7 which is a shortened cylindrical bead which has been stone drilled and shows a unique translucency and bright orange-red color. Due to their different colors and compositions, it seems the diamond drilled beads, Japanese beads and the stone drilled bead are coming from different carnelian sources.

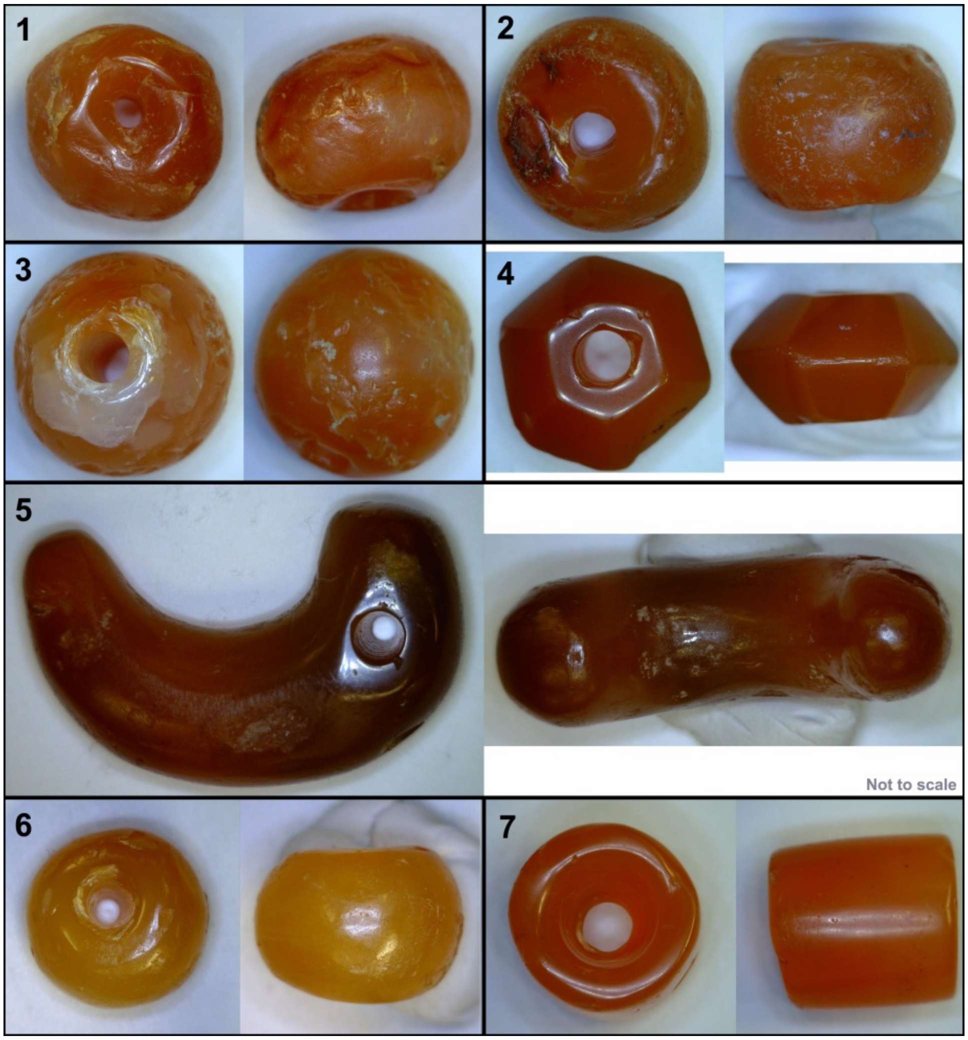


Figure 5.24 Japanese Kofun Period Carnelian Bead Types: Diamond Drilled - 1) Irregular 2) Semi-irregular 3) Spherical 4) Faceted Hexagonal Metal drilled with abrasive - 5) *Magatama* 6) Flattened spherical Stone drilled - 7) Short Cylindrical

	Irregular	Semi-Irregular	Spherical	Faceted hexagonal biconical	Cylindrical	*Magatama*	Flattened spherical	Short cylindrical
Nara	1	6	1	1	0	2	0	0
Shimane	0	1	0	0	0	5	0	0
Saga	2	12	2	2	0	0	1	1
Miyazaki	0	2	0	0	0	0	0	0
N. Kyushū	0	0	0	0	0	0	0	0

Table 5.3 Kofun period bead types by region

These diamond drilled bead types are almost identical to beads found in Korea during the Proto- Three Kingdoms Period and the Three Kingdoms period (1CE – 300CE, 300CE – 668CE) (Glover and Kenoyer 2018, Nelson 1993:173, 206). However, the distribution of different types of diamond drilled carnelian beads varies over time. Semi-irregular diamond drilled carnelian beads (Type 2) are preferred in the Japanese archipelago making up 70% of the carnelian examined. Irregular (Type 1), spherical (Type 3) and faceted hexagonal (Type 4) beads each make up 10% of the remaining diamond drilled carnelian. In contrast, Korean diamond drilled carnelian beads start out 23% irregular, 63% semi-irregular, 11% spherical and 5% faceted hexagonal before changing in the middle-late Three Kingdoms Period to 27% irregular, 39% semi-irregular, 23% spherical and 11% faceted hexagonal. More beads need to be examined from the late Three Kingdoms Period and other parts of Japan to determine if this pattern holds true, but it does suggest that there was a consistent preference for certain types of diamond drilled beads in the Japanese archipelago compared to the Korean peninsula.

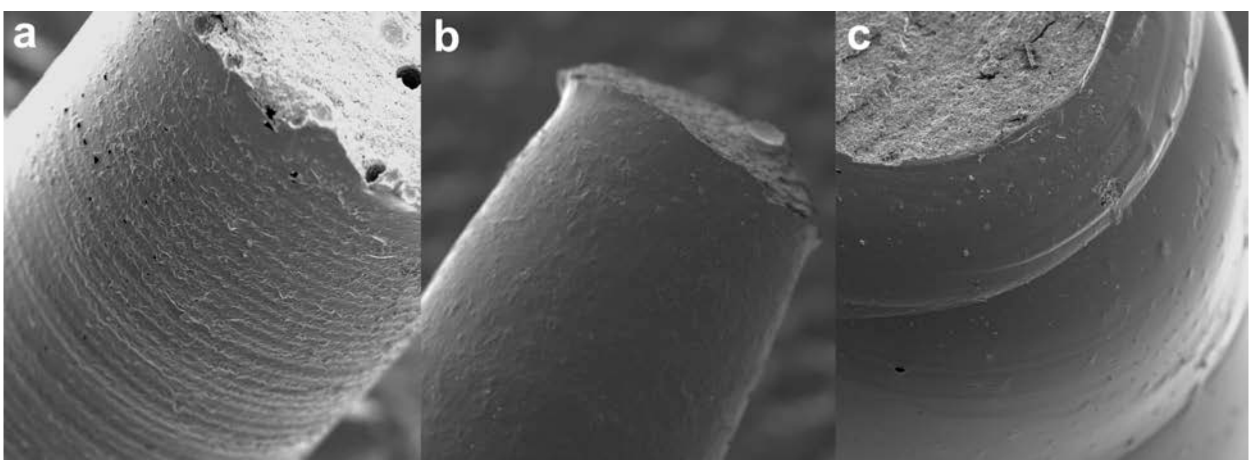


Figure 5.25 SEM x50 of examined Japanese drill types – a) diamond drilling (no wear) b) metal drilling with abrasive c) stone drilling

Stone beads can be worn down by fine silica dust on the string used to mount them or by other beads hitting them over long periods of time. The diamond drilled and metal and abrasive drilled carnelian shows highly variable levels of wear with some beads showing heavy internal wear and others none (Figure 5.25a, 5.26a). One of the diamond drilled beads shows the Khambhat drilling method (Figure 5.26b) pointing to it being made in a South Asian workshop or by South Asian craftspeople outside of South Asia. The carnelian *magatama* show the most wear over time (Figure 5.26a) both internally as shown by the SEM and externally on the outside of the beads, pointing to heavy usage. This wear is not shown on the partially drilled *magatama* from workshop sites. The stone drilled bead (Figure 5.24 type 7; Figure 5.25c) shows a very high amount of external wear. Its edges have been worn down and smoothed both by string wear and by hitting other similar sized beads over time. It dates to the late Kofun period, centuries after stone drill use had been discontinued in the Japanese archipelago. Its' unique color and translucency point to it having come from outside of Japan, but more research is needed to determine where and when it was manufactured.

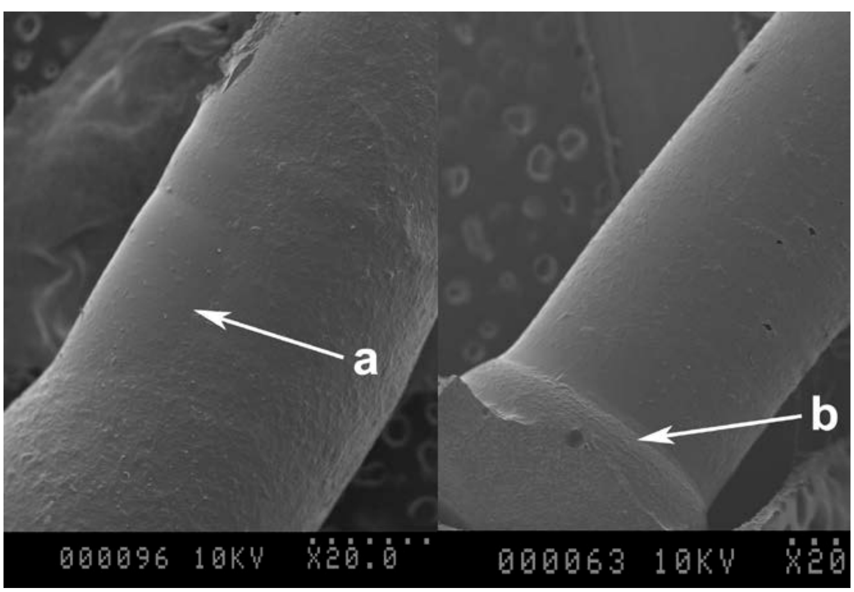


Figure 5.26 a) heavy wear on a carnelian *magatama* b) Khambhat drilling method on a diamond drilled bead

For diamond-drilled beads, the size of the beads was compared to their drill holes in order to determine uniformity and how there are changes over time and space (Figure 5.27). In Korea, there is an increase in bead size and drill hole size over time (Glover and Kenoyer 2018:194). In Japan, this is also the case with the average drill hole increasing from 1.65mm in the Early/Middle Kofun to 1.99mm in the Late Kofun Period. Even the Early/Middle Kofun period diameters are larger than the average of the Three Kingdoms Period beads. However, when examined by kingdom instead, the average for Gaya and Silla Kingdom beads is 2.02mm, and the circle in Figure 5.27 is where not only most of the Late Kofun Period (500CE-645CE) diamond drilled carnelian beads fall, but also where all the Gaya and Silla beads plot as well. Gaya and Silla are the only polities who imported the uniquely shaped faceted hexagonal beads (Figure 5.24: Type 4) in large quantities, of which two were examined in Japan during this study. This suggests that the majority of the Japanese diamond drilled carnelian came from Gaya and Silla, but late Baekje beads were not examined so they may follow this trend.

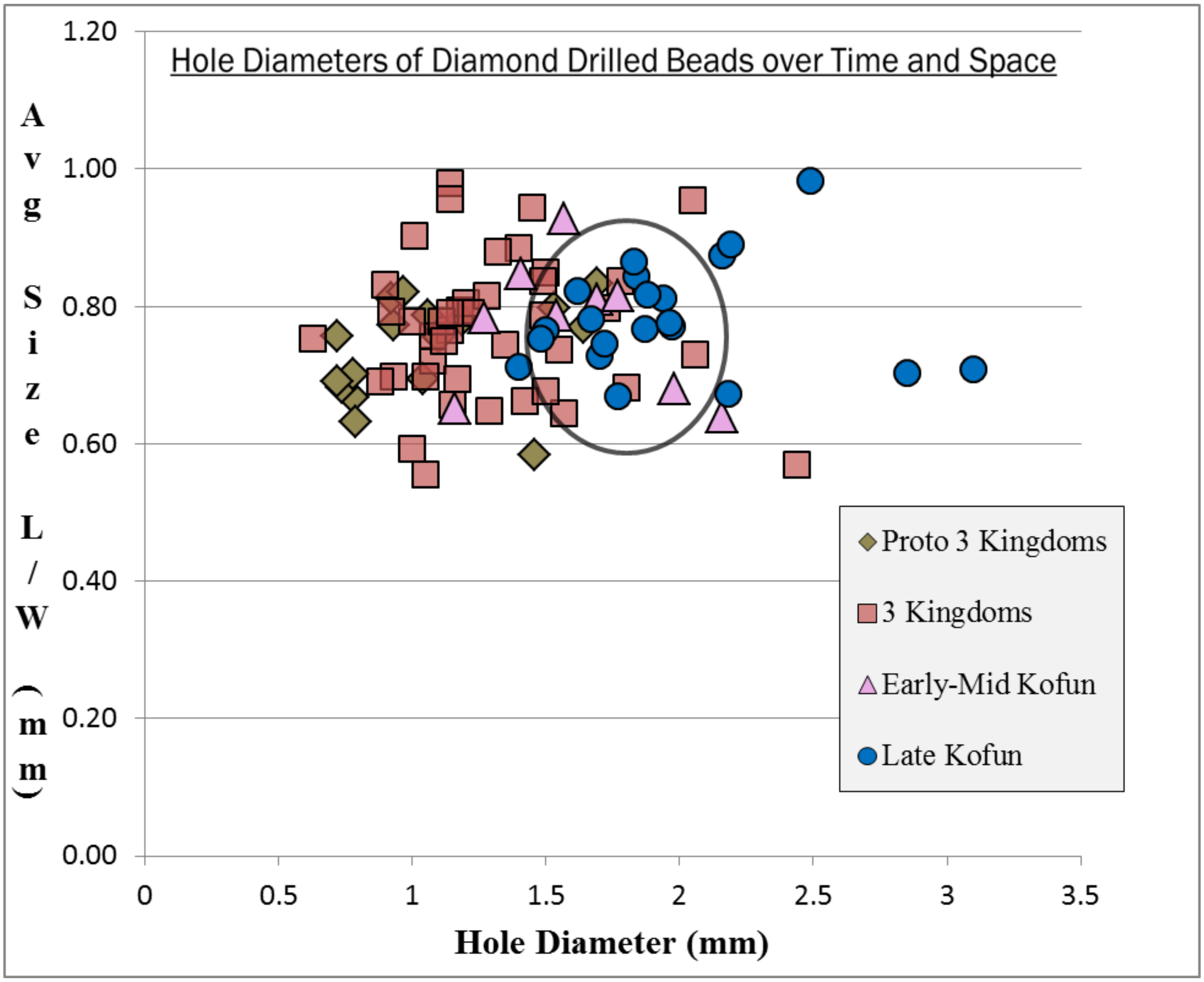


Figure 5.27 Size of diamond-drilled beads compared to hole diameters over time and space (Proto-Three Kingdoms Period beads n=17, Three Kingdoms Period beads n=42, Early-Mid Kofun Period beads n=9, Late Kofun Period beads n=21 (two Kofun period beads were undated and therefore excluded) (Glover and Kenoyer 2018).

The latter half of the Three Kingdoms Period was a time of turmoil in Korea with Gaya being conquered by Silla in 592CE and Baekje being conquered in 660CE (Farris 1995, 116-119; Park 2008: 143). Saga prefecture is close to the Korean peninsula so it is possible that elites fleeing the turmoil on the continent brought some of their diamond drilled beads with them. The Saga beads drill hole sizes compared to the bead size suggests these beads may have come from the Gaya kingdom however, late Baekje beads were not examined and more Gaya and Silla beads should be studied to confirm this connection.

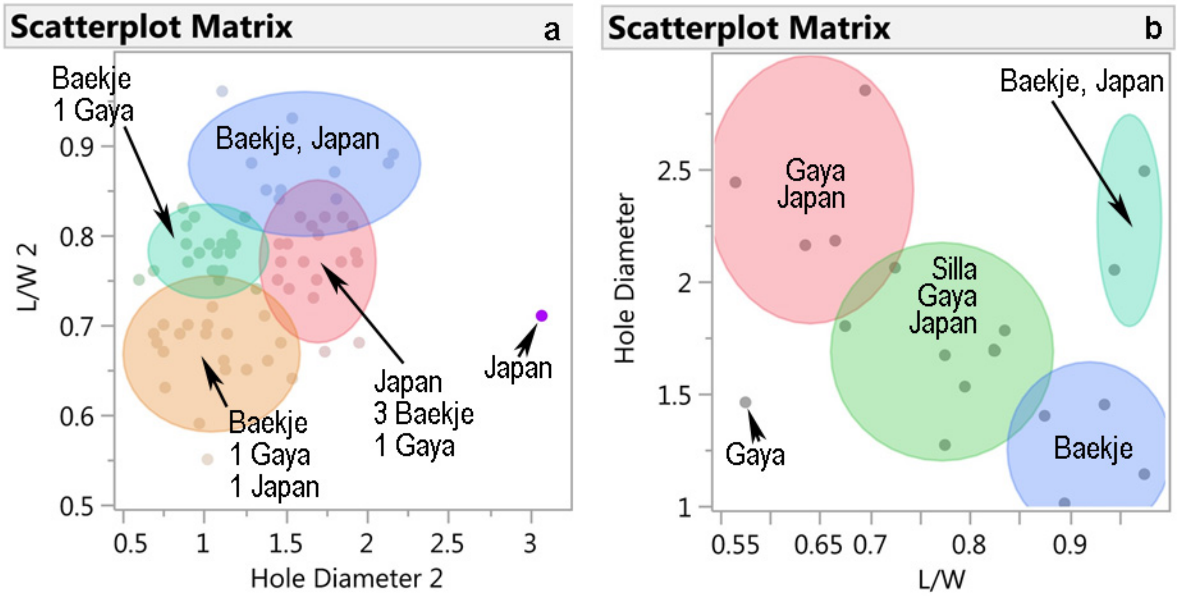


Figure 5.28 a) irregular and semi-irregular carnelian k means cluster analysis b) faceted hexagonal biconical and spherical carnelian k means cluster analysis

All the diamond drilled carnelian beads were plotted out using K-Means Cluster Analysis via the program JMP (Figure 5.28). The irregular and semi-irregular beads were similar enough in size and shape to be plotted separately from the faceted hexagonal biconical and the spherical beads. The veracity of these clusters was confirmed by one way Anova tests with a 0.01 alpha level. Looking at the irregular and semi-irregular beads it is clear that sources of these workshop traditions do overlap, however, different sources are indicated based on geological location and polity. While Japan definitely shares a source with the Baekje polity, these results suggest that Japan had its own source for diamond drilled carnelian. There were only a small number of Gaya irregular/semi-irregular beads, and no Silla beads, but Gaya and Baekje seem to have been obtaining beads from the same sources or Gaya was obtaining their beads from Baekje or vice versa. For the spherical and faceted hexagonal biconical beads, it seems to be clear is that Silla and Baekje don’t share beads from the same workshop traditions, but Japan and Gaya overlap with each other and the other two polities under discussion. Gaya may even have their own source. The Baekje beads in the blue circle are all spherical and separate nicely from the other beads. This may just be because they are a different shape, but they are not the only spherical beads and the others are divided amongst the other groups. This supports Baekje having a different workshop tradition sourcing their spherical carnelian beads from the rest of the polities and Japan.

Pairwise t-test analysis of the cluster groups for the spherical-faceted carnelian hole diameter point to there being at least three separate groups of carnelian present, though there is a fair amount of overlap. This suggests that hole diameter was not as significant as the size of the beads for classifying these beads into clusters. Analysis of the pairwise t-tests regarding size for these beads also shows three separate groups, but a lot more statistically significant, isolated clusters. Interestingly, the two clusters with Baekje group together while the two smaller clusters with Gaya also group together, and the largest cluster with Silla stands on its' own.

For the pairwise t-tests for the irregular/semi-irregular carnelian beads the hole diameter test points to there being three statistically significant groups with the two clusters containing mostly Japan and Baekje overlapping and the two other Baekje groups overlapping. The single Japanese irregular bead is statistically different from the other clusters. The pairwise t-test by size also reveals three statistically significant clusters, but this time the Baekje/Japan cluster is completely separate while the other four clusters have a slight overlap, including the single Japanese bead. The extremely small drill hole sizes of this group seem to have been more important to clustering than the size of the beads.

5.3 Agate/Jasper/Green Tuff Beads

The main source of jasper in Japan during the Kofun period were the deposits on and near Mt. Kazan in Izumo, Shimane Prefecture (Figure 5.29). The medium to dark green jasper from there can be solid in color but could also contain faint marbling of lighter/darker jasper within it (Figure 5.30). Light green jasper versus green tuff are difficult to discern since jasper in Japan carries a wide range of potential specific gravity measurements (Warashina 1992:358). This is because jasper in Japan ranges from largely being micro-quartz to being amorphous, which is a non-crystalline material that is susceptible to hydrothermal water circulation (Tsujimori 2018 Personal Correspondence). As a result, the amorphous jasper is vulnerable to alteration and may have been altered to the point that the beads were in a poor state after excavation; impressions could not be taken and specific gravity testing could not be performed. Since jasper/green tuff is mostly used to make cylindrical beads and *magatama*, it was also difficult to specific gravity test many of the larger beads due to the size limitations of my equipment. Rather than attempt to determine whether a bead is green tuff or jasper based on appearance and incomplete or overlapping specific gravity measurements, it is assumed that all dark to medium green beads are jasper. It is thought that some of the lighter green beads are green tuff and some are jasper, but they will be analyzed the same since both raw materials are used to make exactly the same type of beads.

	 *not to scale
Fig. 5.29 The mine entrance on Mt. Kazan, Shimane, Japan. Photo by Lauren Glover.	Fig. 5.30 Jasper samples gathered from Mt. Kazan, Shimane, Japan by Lauren Glover.

The Yayoi period cylindrical jasper beads examined from North Kyushū were drilled differently than Kofun period beads. These beads most resemble the beads found on the Korean peninsula in this same time period. Beads from the Machon-ni site are drilled from two sides with a slightly tapered drill and produce many lips and striations (Shoda 2007: 142). Impressions and even heavy end and string wear on the beads looks similar to the Yayoi beads (Shoda 2007: 143). More examination of these Korean beads is required to draw further conclusions.

When the size of these cylindrical jasper/green tuff beads are compared to the maximum drill hole diameter (mm), some interesting general patterns emerge (Figure 5.31). First, the Proto Three Kingdoms Period/early Three Kingdoms Period beads from the Korean peninsula do not overlap at all with the beads found in Korea during just the Three Kingdoms Period (Figure 5.31). They are clearly from different workshop traditions even though they were all from Baekje cultural areas. Second, what does overlap with those Three Kingdoms Period beads are beads from the Yayoi period in Kyushū, Japan. They all form a group of small drill hole and small bead sizes with a few beads from later periods. Those beads from later periods resemble the Yayoi period beads despite being from hundreds of years later (Figure 5.32) and seem to show similar drilling methods. It seems clear that these isolated beads were held onto for a long period of time before final deposition. Interestingly, the earlier Jomon beads from Japan do not show the same small size and drill as the Yayoi period beads. Despite them falling in the same group as Kofun period beads, they were stone drilled so they are not from the same workshop tradition (Figure 5.33 and 5.34). The Early, Middle and Late Kofun period beads do not seem to have changed much over time except for some of the Late Kofun period beads which show larger drill hole sizes (Figure 5.31).

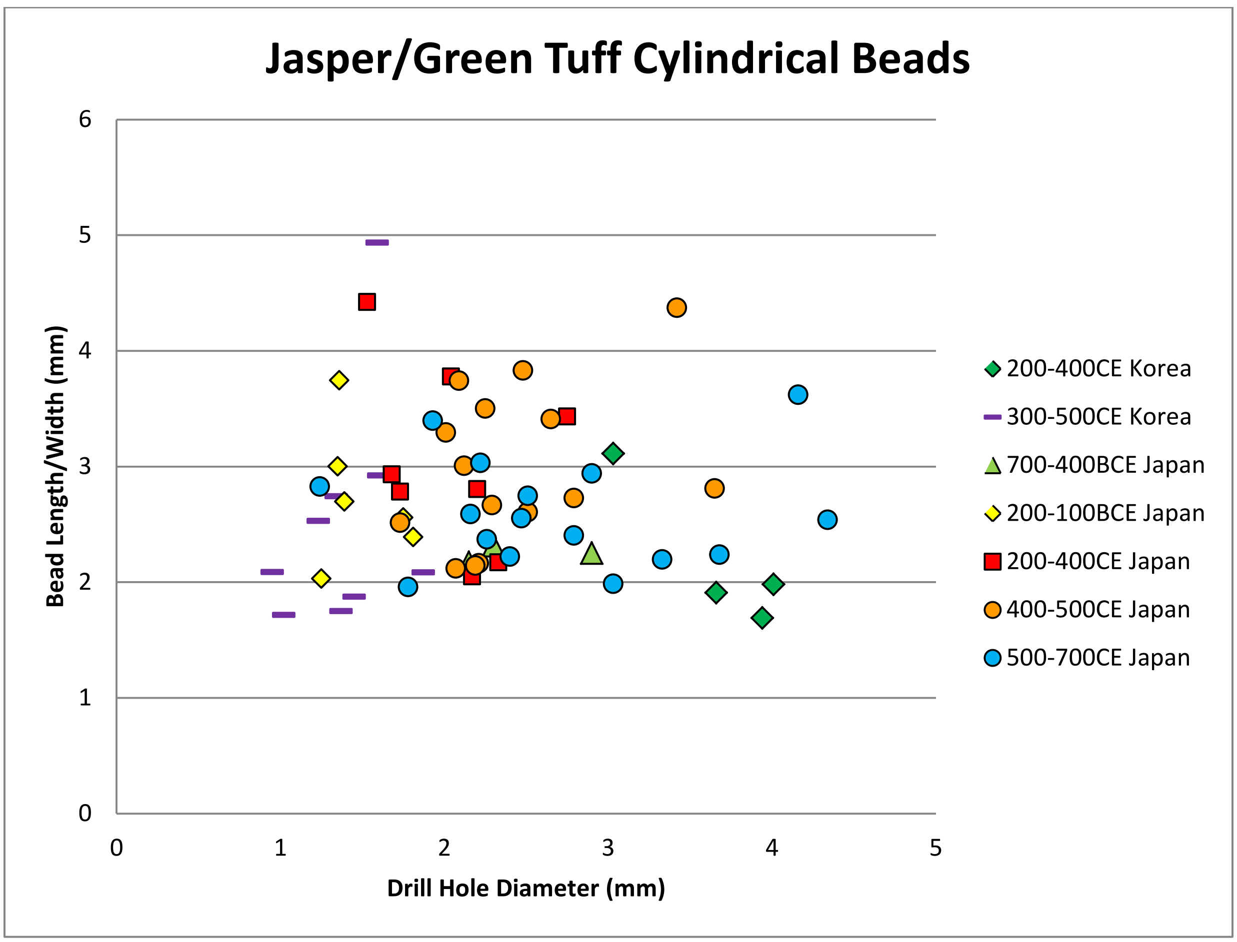


Figure 5.31 Jasper/green tuff cylindrical bead size compared to drill hole diameter

Figure 5.32 Jasper cylindrical beads J0059 from the Yayoi period and J0206 from the Kofun period

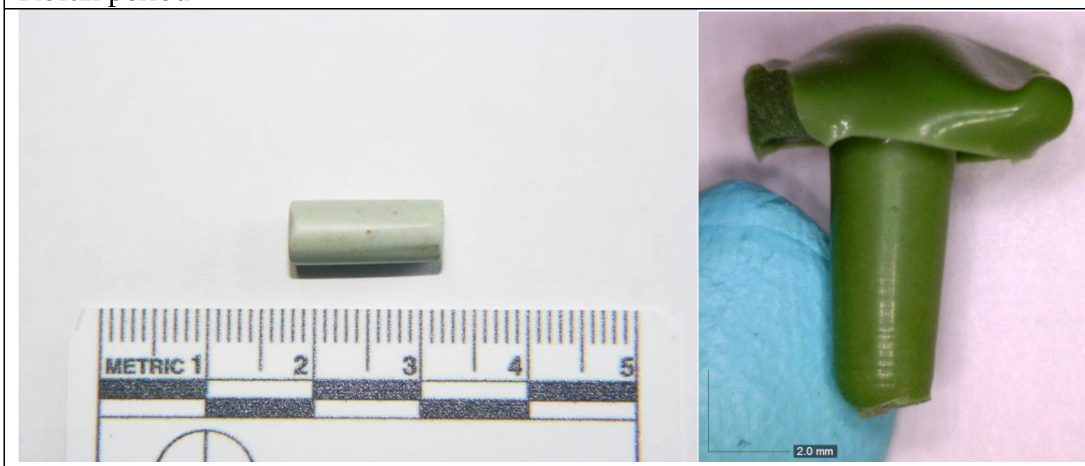


Fig. 5.33 J0053 Stone drilled cylindrical jasper/green tuff bead from the Jomon period

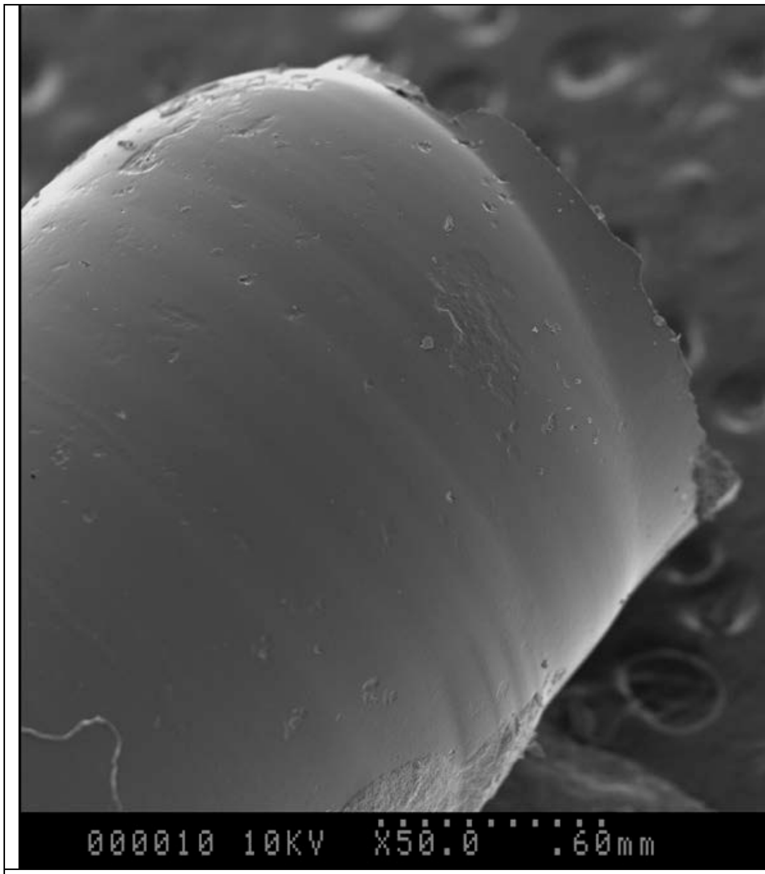


Figure 5.34 SEM x50 stone drilled jasper/green tuff cylindrical bead from the Jomon period

K-Means Cluster analysis of the cylindrical jasper beads produced mixed results which are not reflective of the normally distributed results from jadeite, carnelian and the rock crystal beads. Eight different groups found to be the optimal amount of clusters for jasper/green tuff (Please see Appendix 1). This is a large amount and seems to be the result of the beads a) not being normally distributed and b) being a very common shape produced for thousands of years. Although some of the beads fell into their respective groups based on time period, they also tended to overlap with completely unrelated beads. So the Late Proto-Three Kingdoms (1CE-300CE) beads group mostly together, however they were placed in the same cluster as Late Kofun Period (500CE-645CE) beads from several centuries later which visually don't resemble the Late Proto-Three Kingdoms Period beads. Pairwise t-tests of the clusters support them being statistically significant and there being between 5-6 actual groups present. This seems extremely low when you consider there were dozens of workshops producing these beads during these periods. My theory is that since this is a much more common form of bead during these periods which is being produced in 50+ bead workshops, it requires a larger data pool of beads to draw from before any statistical conclusions can be supported. It is also possible that beads drilled with different drilling methods such as stone drills vs metal drills should not be compared since the different drilling methods produce similar, but unrelated drill hole sizes. Since these beads are not normally distributed it is also possible that the entire test is simply being skewed and should be disregarded.

When the workshops are considered, it must be kept in mind that these are unfinished beads which means their size is not comparable to a finished bead (Figure 5.35). (One bead has been excluded since the drill hole was never completed). These beads fall in a range which agrees with the other Kofun Period beads (some seem to be slightly smaller than the finished beads). The majority of the workshop beads are from the Middle Kofun period and many of them fall close to particular Middle Kofun beads (Figure 5.35).

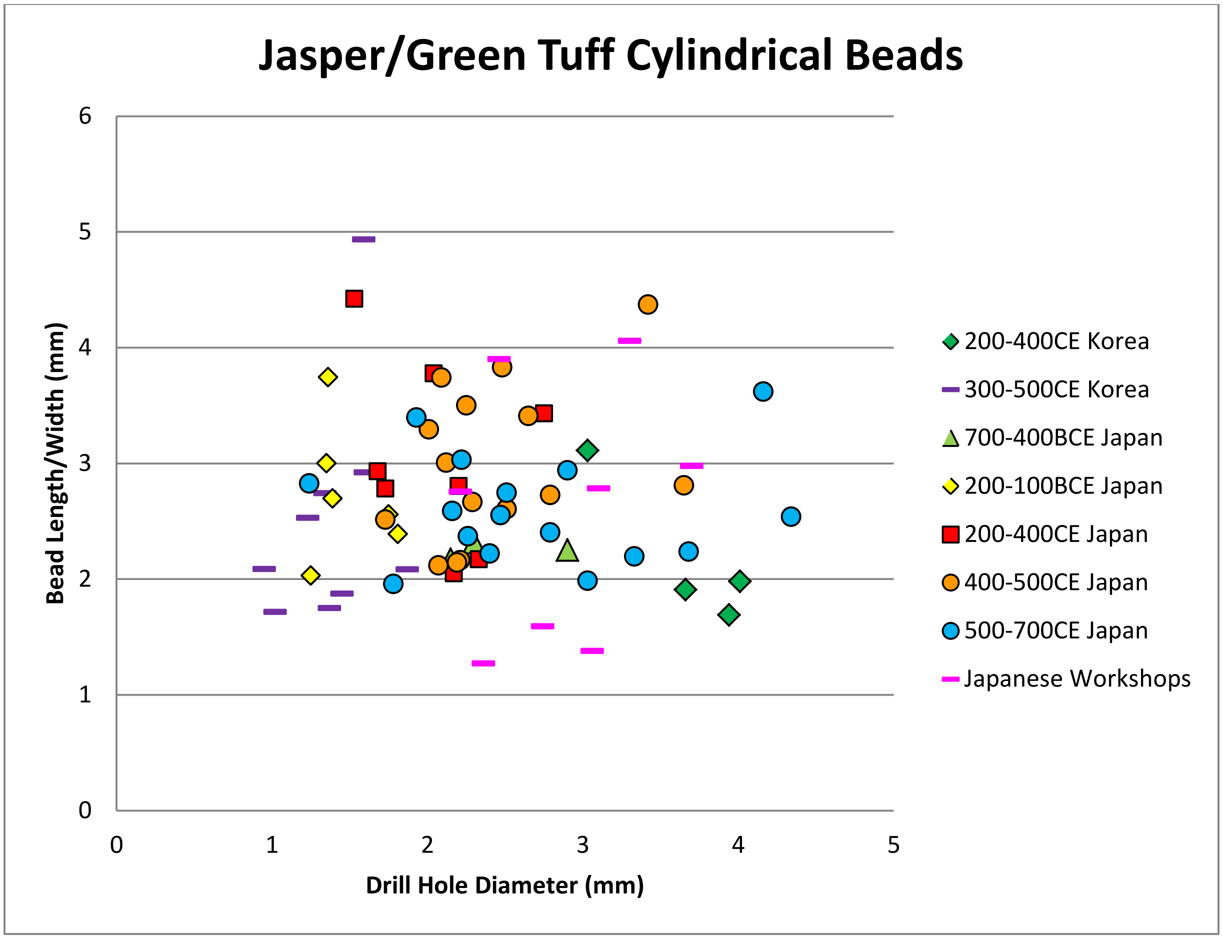


Figure 5.35 Jasper/green tuff cylindrical beads through time including workshops.

I was able to visually examine broken jasper beads from the Soga workshop site in Kashihara, Nara. These beads were drilled through but seem to have fractured during their polishing. The fractures often split lengthwise, causing one side of the bead to crack off, leaving part of the bead hole intact. This is the same type of fracture seen on some of the jasper beads in Shimane (Figure 5.36). J0204 and J0205 were found in a tomb ditch at Iwayaguchi South tomb so perhaps this is a fracture from too much pressure being put on the sides of a cylindrical bead.

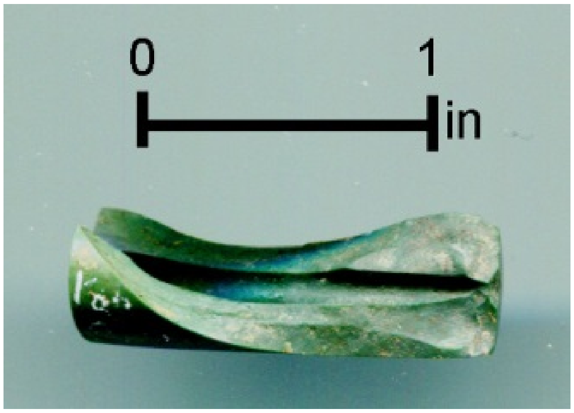


Figure 5.36 J0204 jasper cylindrical bead from Iwayaguchi South. Half of the bead has fractured off.

Jasper/green tuff *gogok/magatama* beads were not as numerous on tomb sites as the cylindrical beads. Three of the Late Kofun period *magatama* were actually found on a settlement sites which is unusual outside of a ritual context. They may have been more available due to the proximity of multiple workshops or it is possible that the Shimane locals were practicing different rituals in association with *magatama* which allowed them to be deposited on settlement sites. All show the same drilling method of tapered metal drills with abrasive. When the *gogok/magatama* and workshop *magatama* are compared (Figure 5.37), they all fall within a fairly tight range of 2.25-3.31 mm in drill hole diameter. The lone jasper *gogok* found in a Silla royal tomb from the peninsula is much larger than the Japanese jasper/green tuff *magatama* though one of the Japanese *magatama* is close. While there appears to be two groupings in drill hole sizes, these do not divide by workshop. For example, the four beads from the Middle Kofun workshop site of Ohara range in drill hole size from 2.47 to 2.94mm diameter with an average of 2.63mm. Considering the close overlap of the workshop and non-workshop beads, it seems quite likely that the jasper/green tuff *magatama* found in tombs and settlements in Shimane and Nara prefecture were made in Shimane workshops; the possible exceptions to this are the two larger *gogok/magatama*, though their drill hole sizes are well within range.

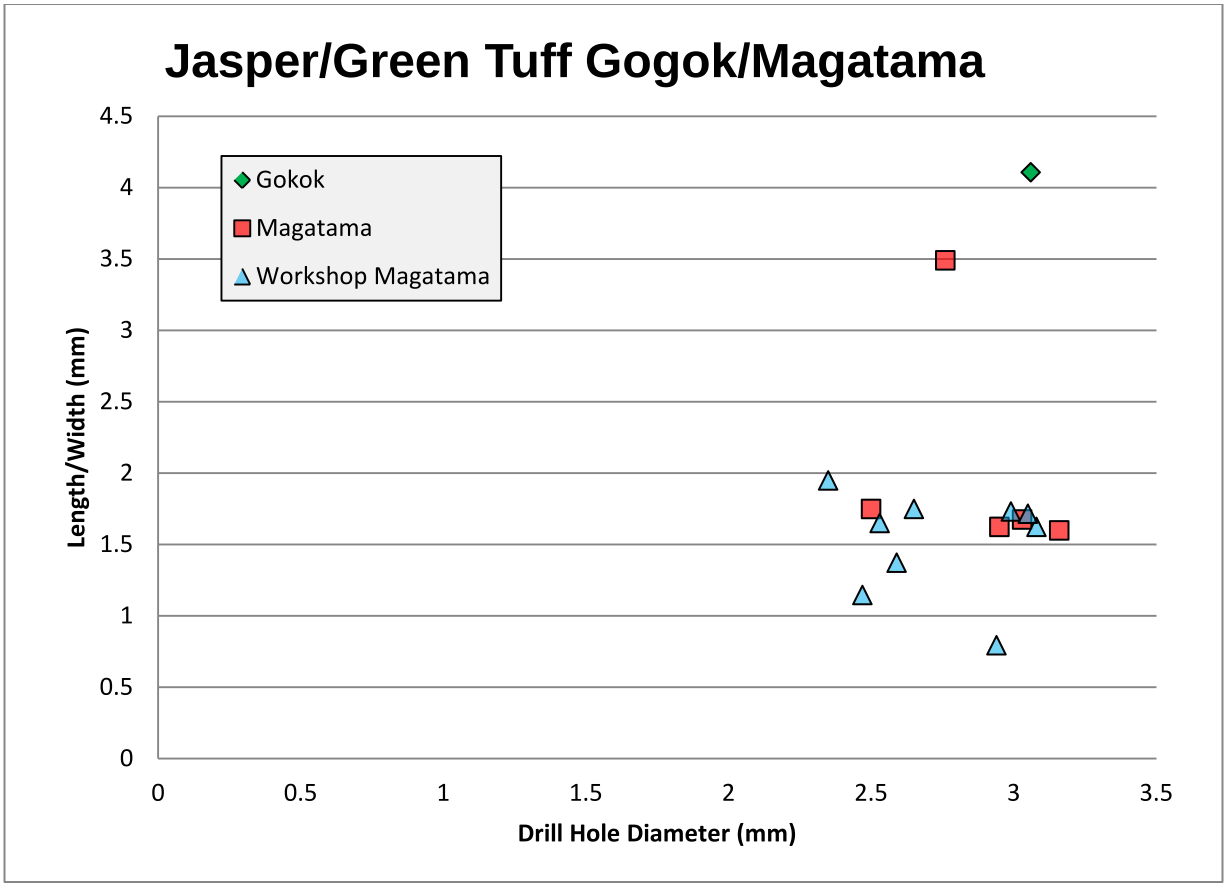


Figure 5.37 Jasper/green tuff *gogok/magatama* size compared to drill hole size

Agate *magatama* produced in Izumo are dated to a later period based on shape. They take on a flatter, squarer shape in the second half of the Kofun period (Hamada et al 1927: 13), though I disagree with the authors that this was a "corruption of the *magatama* shape" since my research in chapter 6 on *gogok/magatama* has shown that the *magatama* shape is highly variable. Rather, this seems to be a stylistic change which was welcomed by Kofun period elites judging by their prevalence across the archipelago in the latter half of the Kofun period.

K0133 from Sucheong-dong site, Baekje, Korea is the only banded brown/black/white agate bead which I have encountered in this study. Beads of this material were popular in South Asia and Southeast Asia. The standard shape for the Southeast Asian beads is a barrel shape, while this bead is cylindrical, but cylindrical beads did exist in Southeast Asia during this time period. No impressions were taken, but microscopic images of the interior or the drill hole indicate it was diamond drilled.

5.4 Rock Crystal Beads

Of the rock crystal beads, all were drilled with metal drills and abrasive (Table 5.4). Since rock crystal can be seen through, it is possible to see that even though some have very low tapers, they are still tapering to a point and not cylindrical.

Rock crystal/quartz bead type	**Count**
Faceted hexagonal biconical	27
Square biconical	1
Cylindrical	2
Hexagonal cylindrical	1
Biconical	6
Gogok/magatama	11
Spherical	4
Spherical - quartz	2
Flat circular	1
Incomplete beads from workshops	5
Undiagnostic (popped end from a workshop, bead fragment)	2

Table 5.4 Rock Crystal Types

First, the size of the hexagonal biconical beads were compared to the hole diameter (Figure 5.38). The three in light green circles are the peninsular beads, and specifically the Proto-Three Kingdoms period beads. Their distinctly separate grouping and low taper suggests these beads are coming from their own dedicated workshop utilizing extremely thin, tapered metal drills. The other Three Kingdoms Period bead and one of the early-middle Kofun period beads also fall into this category and may have been made in the same workshop tradition. Also of interest is the red circle which represents the lone square biconical bead from Miyazaki prefecture. These beads are thought to be locally made. The beads location close to the other Korean beads could mean it is from a similar workshop tradition, but this may also be due to the isolation of the region (which is surrounded by mountains and far from the Kofun period central regions). The average drill hole size for the early-mid Kofun period beads was 2.63mm and the late Kofun period beads was 3.34mm. Late Kofun period beads have a much larger average drill diameter.

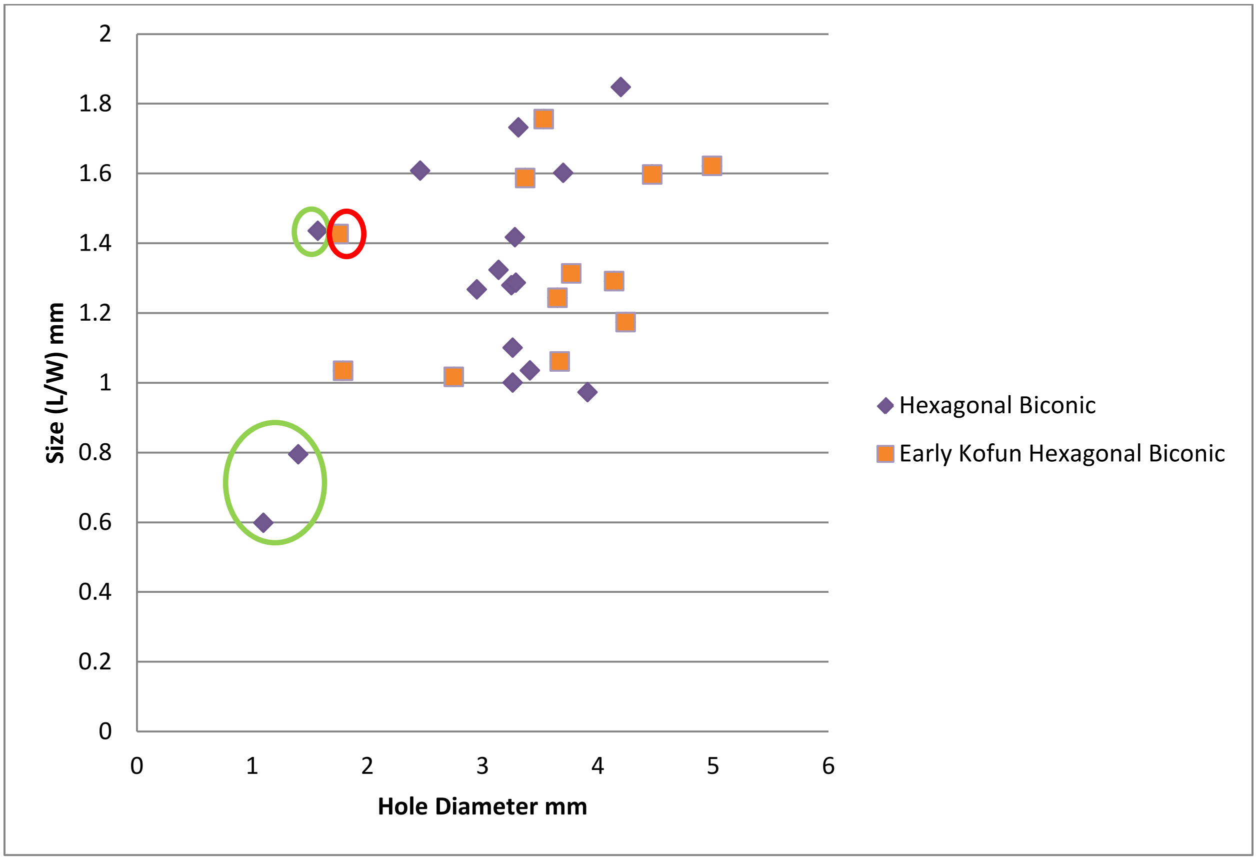


Figure 5.38 Rock crystal hexagonal biconical bead size compared to drill hole size over time

When we look at the hexagonal biconical beads as divided by region (Figure 5.39), we see that the Nara and Shimane prefecture beads largely overlap with wide 3-4mm drills being used. They seem to have been made in the same workshops or by craftspeople utilizing the same techniques in both regions. There is only a single bead from Saga prefecture in North Kyushū but it overlaps with these two groups as well. The beads from the Korean peninsula are all on the far left side of the graph. They all date to the proto-Three Kingdoms period or the early Three Kingdoms Period, as does the one Nara bead which is in that area. What is interesting is that the square biconical bead from Miyazaki (furthest to the left, as can be seen on Figure 5.38 in the red circle) is from the middle Kofun period (400CE-500CE). It is possible that this is a continuation of earlier traditions due to the isolation of the region or a unique local tradition. Examining the SEM (Figure 5.40) reveals the bead is heavily worn in places which suggests it might have been heirloomed before deposition. Considering the other four beads from Miyazaki show different drilling methods, it seems like Miyazaki was reaching out to numerous areas to obtain their beads.

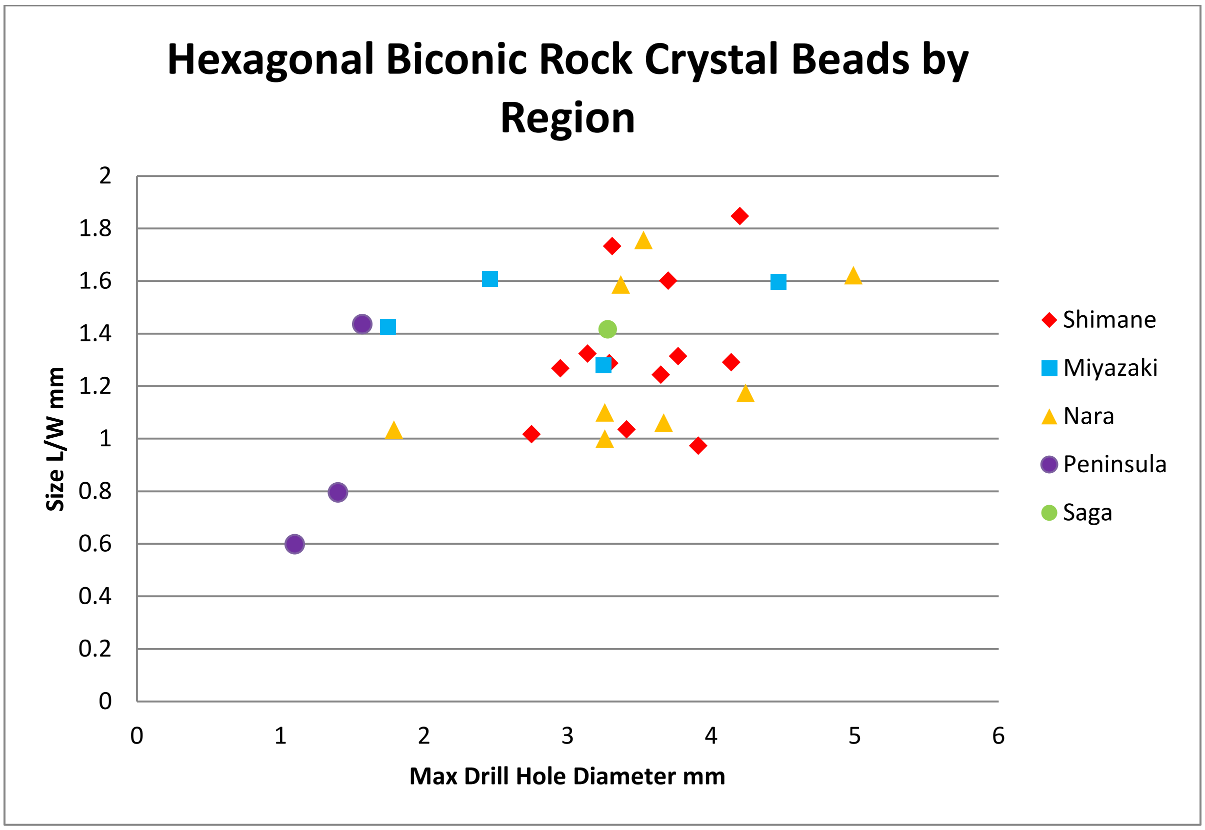


Figure 5.39 Hexagonal biconical rock crystal beads size compared to drill hole by region

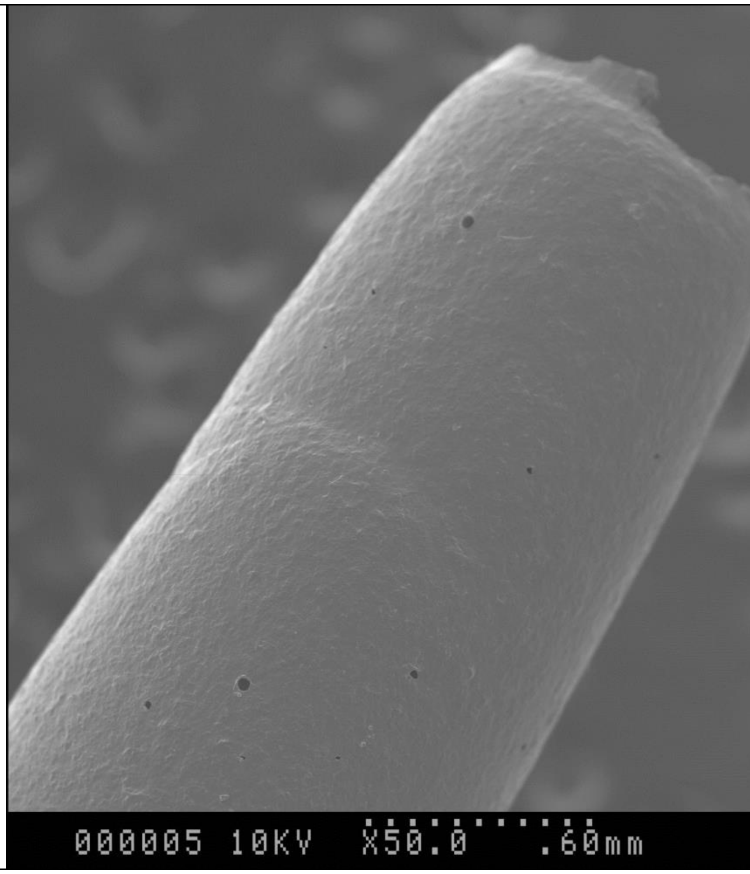


Figure 5.40 J0080 SEM x50 square biconical rock crystal impression showing heavy wear

K-Means cluster analysis of the rock crystal hexagonal beads (along with the single faceted square biconical bead) shows some distinct results (Figure 5.41). This test confirms that the proto-Three Kingdoms Period beads (Green group 2, Figure 5.41) are statistically different from the rest of the faceted hexagonal biconical beads. They are also statistically different from the single Three Kingdoms Period bead. The Japanese beads fall into three main groups with the majority in Group 4 (Orange group, Figure 5.41). Group 3 (Blue group, Figure 5.41) contains both the Three Kingdoms Period bead and the faceted square biconical. The size of the beads was standardized, so the pairwise t-test indicates a slight overlap in two groups with most of the groups being statistically different from each other. Group 4 and Group 3 could therefore potentially be combined. Group 1 (Red group, Figure 5.41) and Group 4 suggest there are at least two competing faceted hexagonal biconical bead workshops operating during the Three Kingdoms/Kofun Period while an earlier workshop tradition was producing Proto-Three Kingdoms Period beads.

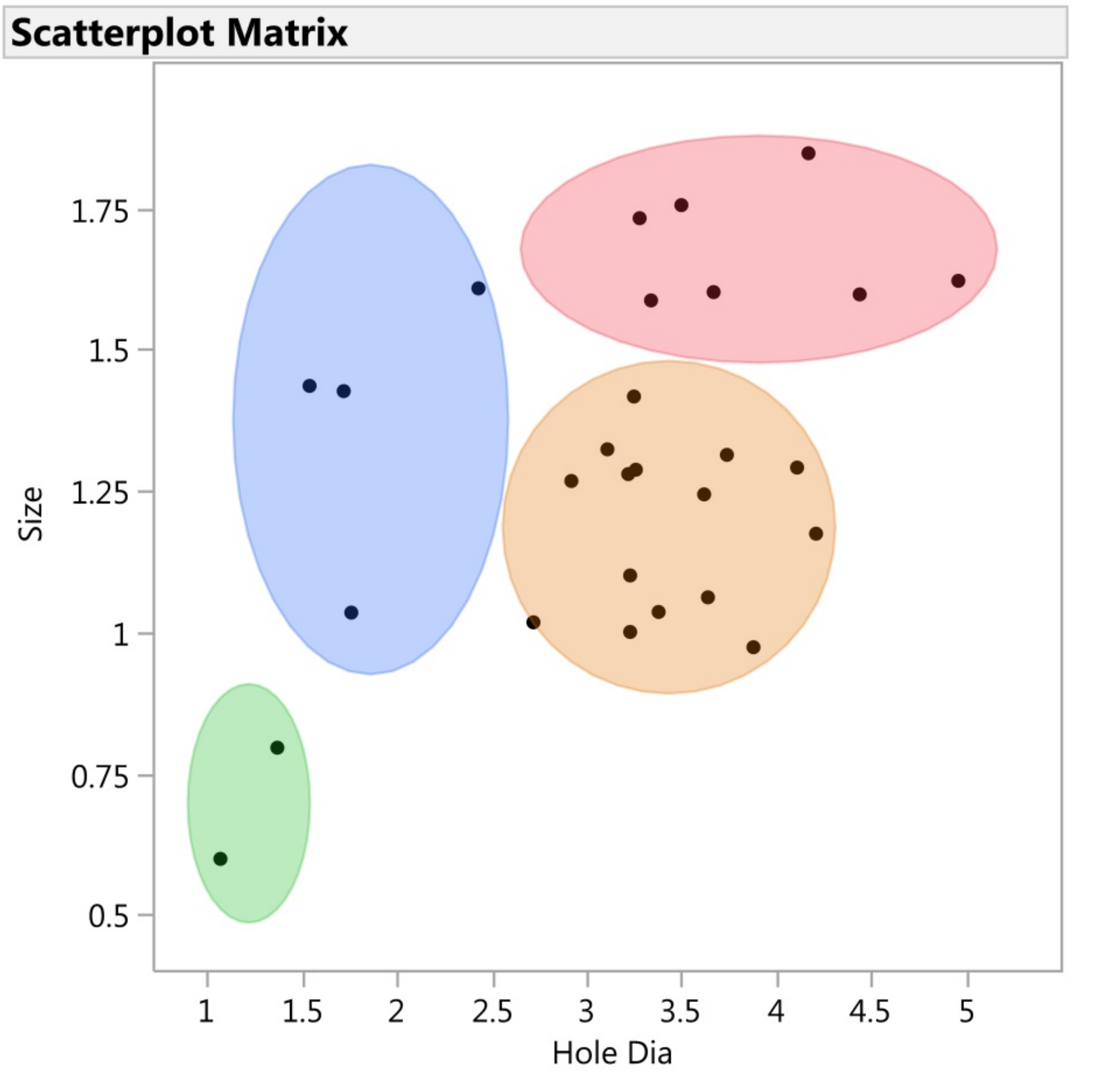


Figure 5.41 K-Means cluster analysis chart showing four potential workshop traditions.

Since these beads were all measured in the same way with max length being along the drill hole, the hexagonal/square biconical beads can be compared to the biconical, spherical, flat circular, cylindrical and cylindrical hexagonal beads (Figure 5.42). The results from incomplete beads from the Shimane workshops are included, but it should be kept in mind that these beads were broken which means their dimensions may not be as accurate as a complete bead. The light green circles are the Korean peninsular beads. Regardless of shape, the peninsular beads tend to have small drill hole circumferences. The two spherical beads have the same drill size as the hexagonal biconical beads so they were probably made in a similar workshop tradition. The spherical beads are from the early Baekje but probably came from a workshop at the end of the Proto-Three Kingdoms period before deposition a century or so later. This also raises the possibility that the four Kofun period beads which have a maximum drill hole diameter under 2.50mm could have been produced in the same workshop tradition as the Proto/Early Three Kingdoms Period beads.

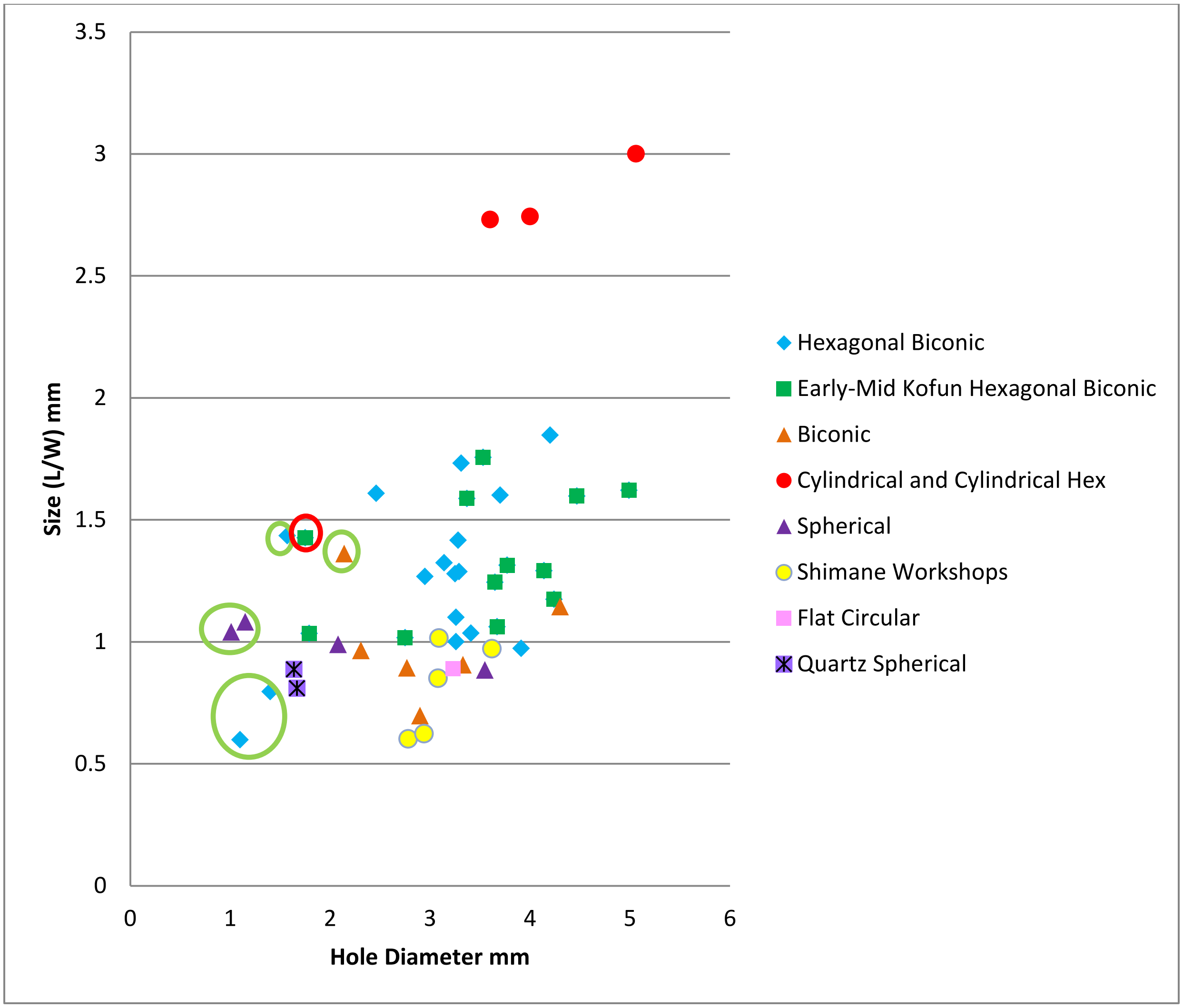


Figure 5.42 All rock crystal beads where length is measured along the drill hole size and drill hole diameter compared.

Figure 5.42 shows that the biconical, spherical and flat circular beads which have a maximum drill hole diameter above 2.50mm all fall within the same area as the hexagonal biconical beads. Some of the beads sizes for the incomplete beads from Shimane workshops are a little low, but they are utilizing the same sized drills as the complete beads. These beads are from three different workshops, and four of them utilize roughly the same sized drills (~3.00mm). The one which was drilled with a larger drill is still from the same workshop as one of the other beads drilled with a ~3.00mm drill. Although they are off to the top right corner due to their size, the cylindrical and hexagonal cylindrical beads utilized large drills which are not much larger than those used on other rock crystal beads. Their large size drills agrees with the increase in drill size in the late Kofun period (500CE-645CE) which is when these beads date to.

The rock crystal *gogok/magatama* were examined separately (Figure 5.43). The Proto-Three Kingdoms Period *gogok* are the same as the other rock crystal peninsular beads with a small drill diameter. In point of fact, the two hexagonal biconical beads' drill measurements are within 0.1mm of the two *gogok*. All four beads also have extremely low tapers ranging from 0.02-0.09. These four beads are likely to have come from the Haranotsuji site on Iki island or the Junchitōukyū workshop site in northern Kyushū since those are the only rock crystal workshop sites with these narrow, tapered beads (Yoneda 2014: 28). All but one of the *magatama* had a uniform size of ~1.70 which seems to have been followed through time. Potentially, the size of the *magatama* was determined by the size of the rock crystal which was designated for being made into the *magatama*. Drill hole sizes vary. It is interesting that the late Kofun (500CE-645CE) *magatama* beads group together considering two are from Shimane prefecture and one is from Miyazaki prefecture. It is possible with its' larger dimensions and smaller drill hole that the middle Kofun period (400CE-500CE) *magatama* (2.05mm hole diameter) belongs to a different workshop tradition than the other *magatama*.

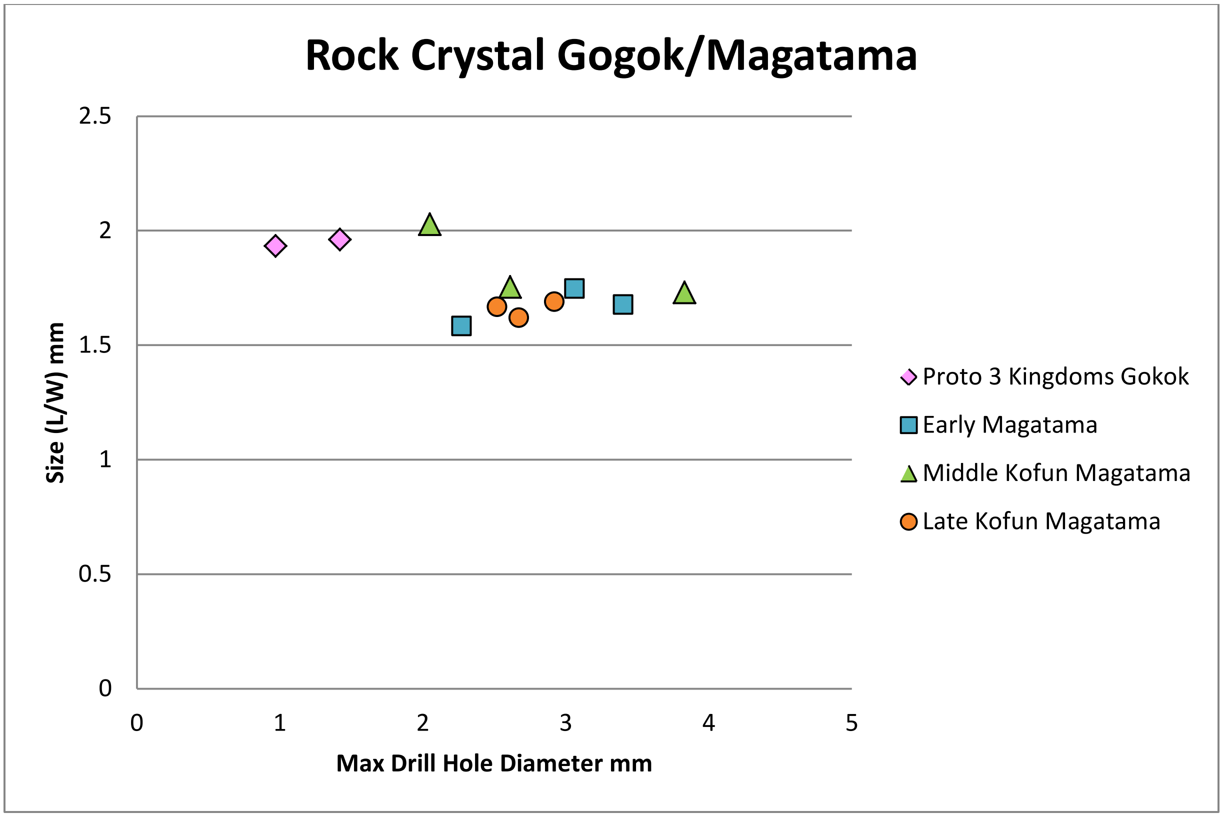


Figure 5.43 Rock crystal *gogok/magatama* size compared to max drill hole diameter through time

5.5 Steatite Beads

Due to having a Moh's hardness of 1, steatite artifacts which were examined in this study often showed heavy signs of wear and use. This often included string wear inside the hole which could obscure manufacturing signs and also wear around the hole from other beads (Figure 5.44 and 5.45). It is therefore difficult to come to a consensus on how the beads were manufactured or used except to note that they were often worn to the point of destruction before final deposition. Steatite beads are rare in the Korean peninsula being largely found in the most southern areas in the Silla and Kaya polities. Only two steatite beads were examined from Korea in this study, but there have been other caches of them found in the style of the votive offerings prominent on the Japanese archipelago from 400-500CE (Ishino 1992:212). The *moja gogok* (K0118) examined in this study is also presumed to be related to ideological beliefs of the time period. More of their analysis will be discussed in chapter 6.

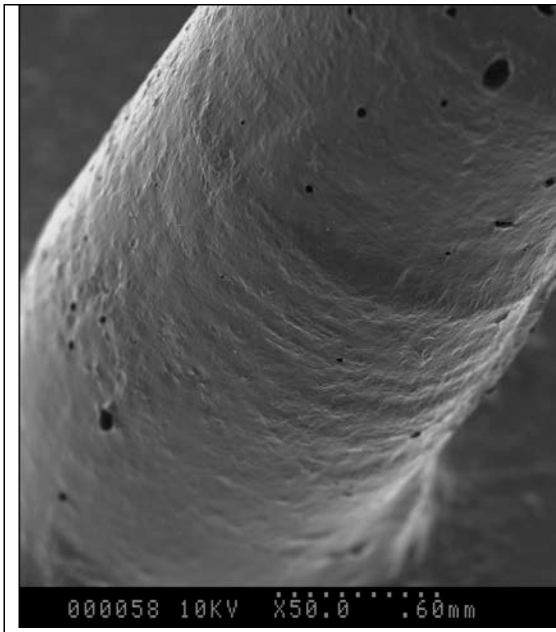


Figure 5.44 J0066 SEM x50 steatite *magatama* with only some striations remaining in the center of the drill hole impression. Everything else has been worn away.

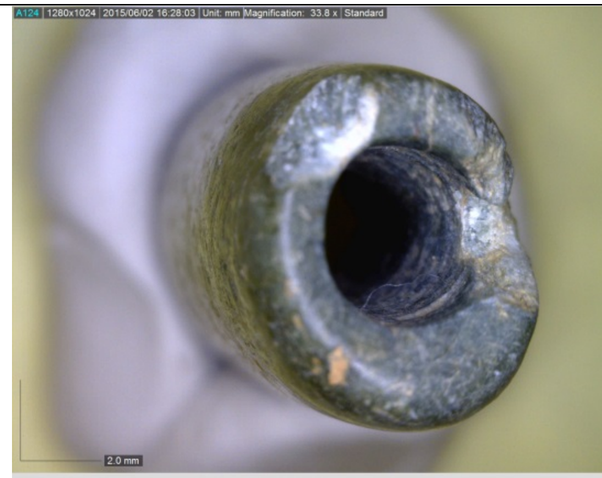


Figure 5.45 K0096 steatite cylindrical bead from Gaya with ends worn down and string wear breaking the sides of the bead.

5.6 Miscellaneous Beads

Although they were briefly addressed in the rock crystal section, K0009 and K0010, opaque quartz spherical beads, (Figure 4.5) deserve a little more consideration. Figure 5.46 shows that they plot very close together when comparing their size to drill hole size and that they fall within the drill hole size range of the other Korean peninsular beads. These beads were found on a Proto-Three Kingdoms Period/early Three Kingdoms Period site. No impressions were taken, so no tapers can be calculated. They may possibly be from the Proto-Three Kingdoms Period and belong to the Haranotsuji site on Iki island or the Junchitōukyū workshop site in northern Kyushū along the coast (Yoneda 2014: 28), but it is also possible these are part of the early Three Kingdoms Period workshop tradition which had smaller maximum drill holes.

Amber and jet share some characteristics with each other in this study in that they are formerly organic products which have turned to stone and are found throughout the Japanese archipelago and the Korean peninsula. Their low Moh's hardness makes them easy to work, though also somewhat fragile so only one impression was taken on an amber *gogok* which gave little information due to the nature of the material.

Chapter 6

Interpretive Analysis

This chapter discusses issues which are related to or arise from the quantitative analysis of the stone beads. For jadeite, this involves discussing where the raw material was coming from and where it was being manufactured before final deposition. The discussion on carnelian is divided into two sections based on region since the high amounts of stone beads in the Korean peninsula contrast sharply with the much lower quantity of carnelian beads in the Japanese archipelago. There is also a discussion on where the diamond drilled carnelian beads were coming from with South Asia being more likely due to several beads utilizing very specific South Asian manufacturing methods. The jasper/green tuff section discusses how the sample size and distribution were not large enough or evenly distributed to produce useful results. The extremely tapered narrowly drilled rock crystal does not seem to have been manufactured on the peninsula but instead on an island off the northern coast of Kyushū and in northern Kyushū itself. There is also a brief discussion of the *moja gogok/komochi magatama* under the steatite section, but it will be addressed more in the *gogok/magatama* section. The final section of this chapter brings together multiple lines of evidence from my own research in order to form a new hypothesis as to the meaning of the *gogok/magatama* in the past. These lines of evidence include historical and proto-historical accounts, art, ethnographic studies, non-bead depictions or replicas of *gogok/magatama* from this period such as on mirrors and staffs, the multiple hypotheses for what these beads mean, mythology and my quantitative research. My hypothesis is that these were vessels for moving and communing with specific gods/spirits, and it will be elaborated more in the second half of this chapter.

6.1 Raw Material Analysis

6.1a Jade

Jadeite from Itoigawa, Japan tends to be opaque and can be found in the following colors: white, green, violet, blue and black (Abduriyim et al. 2017: 50). The white jadeite is the 'pure' jadeite without admixture and the green jadeite is actually jadeite mixed with the mineral omphacite. The blue jadeite has been enriched by samples of titanium (Abduriyim et al. 2017: 51). Abduriyim et al. (2017:54) also observed gem quality jadeite samples from other regions. For example, both green and lavender jadeite from Itoigawa tends to have a different fluorescence than Burmese green and lavender jadeite. The Guatemalan jadeite which was lavender and blue most closely resembled Itoigawa blue and lavender jadeite while the white and green Guatemalan jadeite was more coarse and could be semi-translucent. Polar Urals (Russian) jadeite was only found in green which was semi to fully translucent with occasional black spots of magnetite. These different colors and inclusions of different associated minerals suggests it is possible to provenance jadeite from around the world but since some of the tests are destructive, they will likely never be done on jadeite artifacts.

Those jadeite artifacts which were tested in Korea by Warashina (2014: 255) showed that two of my *gogok* were from Itoigawa. At least two of the other *gogok* I examined were also blue tinged (Figure 6.1a and b) which suggests they are also from Itoigawa since the Burmese source was not available during this time period. Some of the Japanese jadeite beads have the blue tint as well. However, there are also beads such as K0070 which are a semi-transparent green with white cloud pattern and a smattering of small black splotches or K0001 and K0004 which are semi-transparent bright green and white which do not follow the opaque trend observed in Itoigawan jadeite. While it is possible these were fairly atypical pieces from Itoigawa (the only source known to occasionally have translucent jadeite in Japan (Tsujimori and Harlow 2017: 188)) , it is also possible these beads came from the Russian sources which are known for their transparency (Harlow et al. 205:112; Tsujimori and Harlow 2012:372).

	
Figure 6.1a K0080 jadeite *gogok* with blue tints	Figure 6.1b K0151 jadeite *gogok* with blue tints

Takahashi (2005: 10-11) shows the distribution of jadeite artifacts over time in the Japanese archipelago. There is no distinction made between jadeite artifacts and *magatama* in these distribution maps so it must be kept in mind that during the Jomon period, the majority of these artifacts were not the *magatama* of later periods. Jadeite *magatama* become the dominant form for their use in the Yayoi period onwards. Nevertheless, in the middle to early late Jomon period, jadeite artifacts are located almost exclusively in the northern half of the archipelago. Since the only source of bead quality jadeite in Japan is in Itoigawa, Niigata prefecture in the north, this is unsurprising. By the later part of the Jomon period, they have spread out more to cover the top two thirds of the archipelago and a fair number are found in the southern island of Kyushuu. In the Yayoi period, the jadeite distribution shifts. There is a concentration around the jadeite source in Itoigawa, Niigata, but the majority of the artifacts are now being found along coastal areas to the south. This includes both the northern coastal areas where you could expect the residents of Itoigawa had easy coastal access and the inner coastal regions such as the coast of Okayama prefecture. A substantial number were also making their way to the Kinki region where some of the earliest Kofun period tombs are located. They did this either by traveling around the southern tip of the main island of Honshu or by traveling overland near Lake Biwa. In the Kofun period, the distribution of jadeite artifacts is still concentrated in those same coastal areas but there are also concentrations inland and in greater densities. Northern Kyushū and the Kansai region (which includes the Kinki region) show heavy concentrations throughout the whole period. The Kantō region shows a heavy concentration in the early Kofun period (250-400CE) but by the late Kofun (500CE-645CE), those clusters have shifted into various parts of the Chūbu region to the west and the south of the Kantō region (See the map in Figure 3.1 for locations of these regions).

The distribution of jadeite as a raw material poses a puzzle during the Kofun period. In the Middle Yayoi period (100BCE-100CE), various bead workshops in Itoigawa and along the coast to the south of Itoigawa have raw jadeite which is being made into *magatama* (Museum of Ancient Izumo 2009:60). However, by the late Yayoi (100CE-250CE), the only raw materials found on a bead making site are in Niigata (Takahashi 2012b: 6). Late Yayoi bead workshops in the northwest coast still have jadeite, but only in a blank, half circle shape or as partially drilled or finished *magatama* (Takahashi 2012c:24-25). This continues into the early Kofun period on those sites which still exist. Itoigawa and sites near it are then the only bead manufacturing places which still has raw jadeite material during the Kofun period (Kishima 2012:46). The one exception to this is the central, elite controlled workshop in Kashihara, Soga workshop, which had a small amount of jadeite found in a raw, unshaped form (Kashihara Archaeological Center 1989: Summary pages before page 1 of bead context distribution charts; Shimane Museum of Ancient Izumo 2009: 17). Bead workshops besides Soga workshop in the Kansai and Chūbu region have no evidence of jadeite beads being manufactured for the entirety of the Kofun period and even the Five Thousand Stones bead workshop in Niigata (150km north of Itoigawa) during the early Kofun period still only had a single, nearly complete jadeite *magatama*. Interestingly, the Fuesuita site (笛吹田遺跡) in Itoigawa was a bead workshop with evidence of making steatite and jasper beads, however it also only had raw jadeite material, though there are some signs of blanks being shaped (Itoigawa City Board of Education 1983: 23, 1984: 30). There are nine other workshops in and around Itoigawa that have some raw jadeite materials found or have *magatama* beads in various stages of completion (Kishima 2012: 46).

This dearth of manufacturing material is surprising considering Oga (2012: 53) mentions at least 500 jadeite artifacts found in Japan during the Kofun period. Then there are the numerous jadeite *gogok* found in Silla, Baekje and Gaya tombs during this period (including crowns with 50-100 jadeite *gogok* decorating them). A single Silla crown (tomb 155 in Gyeongju) had 58 jadeite *magatama* (Chihara 1999: 10). This would suggest a minimum of 1500 beads in the Korean peninsula and across Japan during the Kofun period. The bead workshops in Itoigawa during the Kofun period was not in heavy production compared to the Jomon and Yayoi period (Itoigawa City Board of Education 1984: 30) and Soga workshop only had small amounts of material so where were all these jadeite artifacts coming from?

This change in distribution of jadeite raw material with it largely being found in Itoigawa and the central, elite controlled workshop in Kashihara, Nara suggests that jadeite manufacture came under elite control sometime in the late Yayoi to Early Kofun period. After this time, jadeite raw materials are only found at the Soga workshop and in Itoigawa workshops. This does not necessarily mean that jadeite was not being worked outside of these two places, but it seems to have been distributed in different ways. Namely, Itoigawa workshops switch to sending out prepared *magatama/gogok* (semi-circle) blanks (Figure 6.2). These blanks have been found since the Jomon period at Itoigawa (Figure 6.3) and are found with drill holes and partially finished in the Hokuriku region in the late Yayoi (100CE-250CE) and early Kofun period (250CE-400CE). For example, the bead workshop in Toyama (along the coast south of Itoigawa), Shimooigosasagawa (下老子笹川遺跡) during the late Yayoi period had lots of jasper cylindrical beads in various stages of preparation, white chalcedony, grinding stones, stone drills and exactly two partially-complete jadeite *magatama* (Figure 6.4)(Toyama Cultural Promotion Foundation Buried Cultural Property Research Office 2014:35-37). One was simply a blank whose hole was drilled and someone began to grind out the inner curve on the front. The other was mostly complete except for a final shaping and polishing. The Fuesuita workshop site in Itoigawa which dates to the first half of the Kofun period also supports this since it had jadeite raw material and the beginnings of two jadeite *magatama* blanks (Kishima 2012: 40; Itoigawa City Board of Education 1984: 30). Soga workshop in Nara and one of the larger workshops in Itoigawa are the two major production centers for jadeite beads during the Kofun period and it could be argued that they were not enough to produce the thousand plus jadeite beads found in Korea and Japan during this time. So another possible explanation is that the beads were being heirloomed for decades if not centuries before their final deposition. Considering the lack of jadeite workshops in the late Kofun period, this is almost certainly the case for late Kofun period jadeite *magatama*.

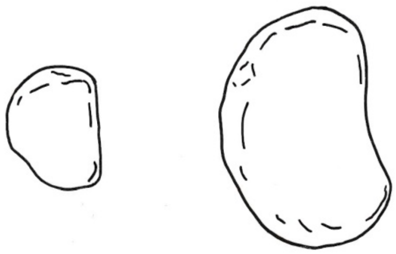


Figure 6.2 Kofun period jadeite blanks from Mitsumataiseki workshop, Itoigawa, Chojagahara Archaeological Museum. Drawn by Lauren Glover.

Figure 6.3 Final Jomon period jadeite blanks, Itoigawa, Chojagahara Archaeological Museum. Drawn by Lauren Glover.

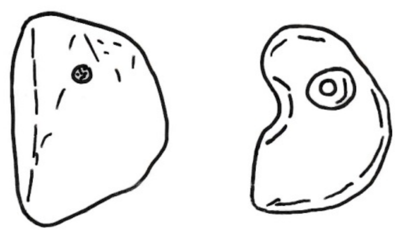


Fig. 6.4 Late Yayoi jadeite *magatama* blank and semi completed bead, Shimooigosasagawa workshop, Toyama (Toyama Cultural Promotion Foundation Buried Cultural Property Research Office 2014:Fig12). Drawn by Lauren Glover.

Takahashi (2012b:6) believes that the jadeite *magatama* were manufactured in the Yayoi period and heirloomed throughout the Kofun period, but his work only turns out a handful of Yayoi sites with jadeite raw material being worked. However, my research found a wide variety of drills, shapes and styles found in jadeite artifacts of the Kofun period pointing to them not being from the small number of workshops found with raw jadeite in the Yayoi period. They also are not being heirloomed from the Jomon or early Yayoi period since then they would be drilled with stone drills that were still in use into the Yayoi period. The exception to this are the two jadeite *magatama* from Miyazaki prefecture which seem to be stone drilled. Considering their different shapes, the stone drilling, and heavy wear on the bead drill holes, it seems likely that these two beads were heirloomed from the Early-Middle Yayoi period.

For the rest of the jadeite beads, the advent of metal drills, especially the iron drills found on various sites across Japan, means that they, with the help of abrasive, would have made drilling jadeite a much less arduous process than it was with stone drills. If craftspeople were provided with jadeite *magatama/gogok* blanks, then only an iron drill and some sort of hard stone to grind the rest of the bead into shape would be required to make jadeite *gogok/magatama* while leaving very little archaeological evidence behind. Most of the iron drills decay into the acidic soil of the Korean peninsula and the Japanese archipelago and if they were found outside of a bead workshop context, would most likely be mistaken for nails. A grinding stone used to make a single bead is not going to show much wear as well. There was a potential heavily grooved grinding stone for beads found in Sokch'on-dong Tombs, an early Paekche tomb group (Seoul National University 1997: 186). This is the only evidence for bead working on the peninsula I have found during the Three Kingdoms Period and it may be a stone mold instead. However, it does raise the possibility that the people of the Korean peninsula could have been finishing their own beads (even if the raw material and basic blanks were coming from elsewhere).

Kishima (2012) notes that the jadeite *magatama* of the Itoigawa workshops during the Kofun period are larger than those of the Yayoi period, so it is possible that those on the large side could explain the larger, more irregular jadeite *gogok* found in the Korean peninsula. However, this would suggest a direct trade connection between the peninsula and Itoigawa which is a considerable distance up the north coast of Japan's main island. The Itoigawa workshops would be making jadeite *gogok* to specific specifications - larger and with grooves around the holes - then shipping the majority of them directly to Korea. Or an alternative explanation could be that Kofun period elites were specifically choosing those beads to send to the Korean peninsula as political gifts or precious trading materials. The workshops in Itoigawa have a lot of dark green jasper and light green tuff being worked on site (Yamagishi 2012: 64). Although dark green jasper was available in small amounts nearby, it could also have been obtained through trade with the south along the coast since the largest supply of dark green jasper is in Izumo on the northwest coast of the main island. The grooves may be more common in the north of Japan, but to determine that would require a much more comprehensive survey of jadeite *magatama* than is available. Analysis of the size and drill holes of jadeite *magatama* within Itoigawa could possibly be compared to those of the Korean peninsula in the future. There is also the possibility that the 'best' jadeite *magatama* which would more closely resemble those found in the tombs of Three Kingdoms kings and queens has not been excavated because it is still within the Japanese undisturbed imperial tombs.

Were these workshops working independently? A study of urban craftspeople at Moche sites revealed that although they were not located in 'controlled' areas, they were reliant on others to supply them with valuable raw materials and used technology which also may have required costly materials (Bernier 2010:36). Bernier (2010:37) suggests that they created goods which aligned with Moche cultural and elite ideology and which were used by elites, but they did not produce exclusively for elites so they were not tightly controlled by elites. However, in Itoigawa, we have some evidence of connections with Kofun period culture (Yamaegi 2012:65) and also some mythological mentions of elite control of the jade production. In the 8th century, the mythology of the region records that Niigata prefecture (which includes Itoigawa) was the center of an ancient state called Koshi which was ruled by an empress or princess who wore jadeite *magatama* (Abduriyim et al. 2017: 49). There are supposed remnants of her rule present in various ceremonies and shrines in the present day region (Tsuchida 2003:202) and I witnessed statues of her when I visited the area (Figure 6.5). Tsuchida (2003: 324) places the beginning of her rule circa 200CE which is roughly around the time when jadeite manufacture becomes strictly controlled so that raw jadeite is no longer being exported out of the region. However, if there was a ruler(s) controlling the jadeite trade in the Yayoi or Kofun period, their power waned by the end of the Kofun period since jadeite bead manufacture declines and disappears by the early Nara period with the actual source being lost until rediscovered by Eizo Ito in 1938 (Abduriyim et al. 2017: 49; Kawano 1939). The last jadeite *magatama* found in the Nara period are on the mid-8th century crown of a Buddhist statue in Todaiji temple, Nara (Miyajima 2017:229). The jadeite raw material which was leaving Itoigawa seems to have gone directly to Soga workshop, located within the palace grounds at Kashihara, so almost certainly under central elite control.

Figure 6.5 A statue of Itoigawa’s princess during the Kofun period

6.1b Carnelian

6.1b – 1 Korea

Carnelian can be found in multiple sources across Asia, but diamond drilling is a unique manufacturing method which originated from the site of Nagara in Gujarat, India around 600BCE (Kenoyer 2017a: 138-140). Diamond drilling is still ongoing today in Khambhat, Gujarat, India. One or two chips of diamonds are crimped on the end of a metal drill bit (Kenoyer 2017a:141). A drill with a single, relatively large diamond is called a single diamond drill or *tekni* and is used in Khambhat to create a depression on one side of the bead (Kenoyer et al. 1991:53). The drill with two smaller chips of diamonds on the end is called a double diamond drill or *sayedi* and is used to finish drilling the bead (Kenoyer and Vidale 1992:514-515). Both of these diamond drills leave regular, even, and deep striations on the drill hole of the bead so it can be difficult to distinguish them archaeologically. However, this Khambhat method of drilling leaves a distinct pattern on the inside of the bead where there is a larger, drilled depression followed by a smaller diameter drill hole (Figure 6.6). Since the depression is microscopic, it can often be removed by the bead being finished or by wear, but nonetheless there were ten beads from this study which were drilled with a larger single diamond drill and then a smaller double diamond drill (Glover and Kenoyer 2018). The size difference between the larger and smaller drill hole diameters on these beads ranged between 0.2 - 0.5mm with an average of 0.4mm (Glover and Kenoyer 2019:). So ten of these beads were made using a distinctly South Asian manufacturing technique which is still being used today in Khambhat and with a fairly standardized drill hole size.

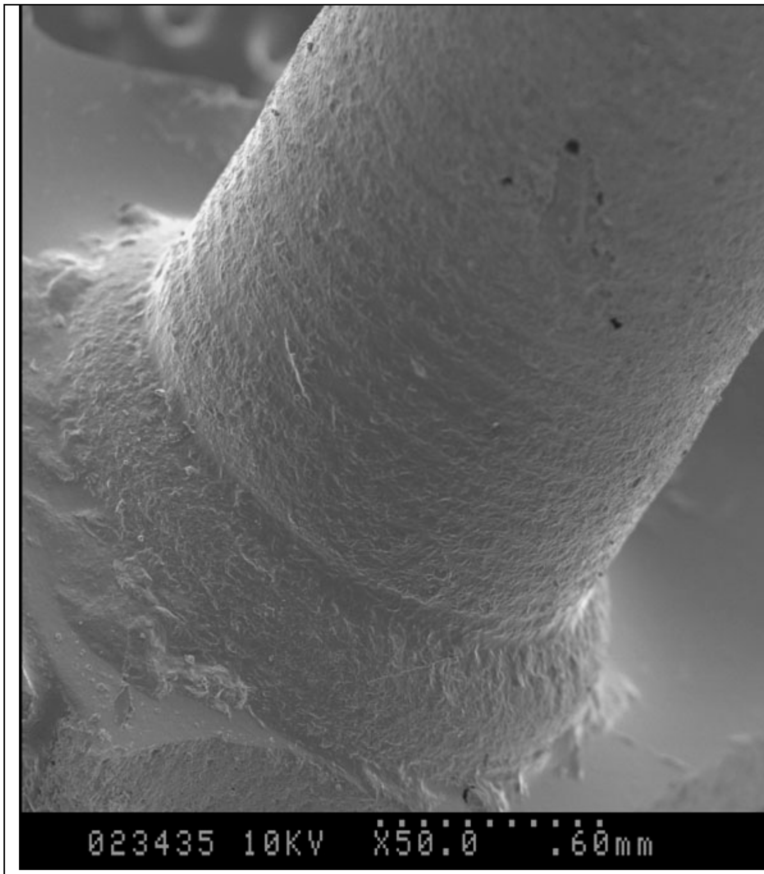


Figure 6.6 K0140 SEM x50 Baekje irregular carnelian bead with Khambhat drilling method

There is some evidence of connections with South or Southeast Asia in Korean texts. They claim that a queen from South or Southeast Asia came and married a Gaya king during the Proto-Three Kingdoms Period (Kwon 2009: 210-211). Her tomb and the apparent stupa she brought with her are still extant in the former Gaya region (Figure 6.7) (Mohan 2002:102-103). However, this may have been an attempt by the Gaya elites to link themselves to an early advent of Buddhism in the peninsula and aggrandize themselves to the Silla elites of the Late Three Kingdoms Period (Mohan 2002:104). Wearing carnelian beads from South or Southeast Asia may have been another way for elites to show their links with the region. Other evidence is the prevalence of Indo-Pacific glass beads which are found in great numbers in many of the tombs from the Three Kingdoms Period (Pak J. 2016: 172). The glass “face” bead from one of the Silla tombs seems to have come from Southeast Asia (Lee 2006: 230).

Figure 6.7 The South or Southeast Asian Queen Suro’s Tomb

6.1b – 2 Japan

Japanese carnelian, as a raw material, was accessible to multiple workshops in Shimane and Soga workshop in Nara. There were, however, many more which did not have access and lack the distinctive red-orange material. Whether it is naturally red-orange through a geological process, or if those supplying the raw materials knew the secret of heat treating the stone is unknown, but it was certainly not available compared to the large quantities of agate and chalcedony. My own experiments in heat treating Japanese carnelian samples (Figure 6.8) revealed that not all Japanese chalcedony responds to heat treatment, so if they were deliberately heating it, someone must have figured out which sources to utilize. Japanese carnelian seems to have been used almost exclusively to make *magatama*. Carnelian *magatama* are only found in large quantities in Shimane (Shimane Museum of Ancient Izumo 2009:63), which is also the location of the dozens of bead workshops which make up the majority of the stone bead workshops during the Kofun period in Japan. It seems likely that the inhabitants of the area placed a high value on the carnelian beads and possibly limited their exportation to other regions and even limited their use within the area since some show heavy wear. The votive offering excavated from under the grand shrine at Izumo, Shimane, which was built at the end of the Kofun period, was made up of stone beads including a large carnelian *magatama* (Shimane Museum of Ancient Izumo 2009:71). This parallels the offering of stone beads and especially carnelian under Buddhist temples on the Korean peninsula during this period (Bokcheon Museum 2013b:240).

Figure 6.8 Japanese carnelian heat treatment test: 1) unheated 2) heated

There are no diamond drills being used in Japan, and local carnelian is being drilled with metal drills and abrasive. As a result, these diamond drilled beads must have been obtained through long-distance trade. Diamond drilled beads which match the irregular, semi-irregular and spherical shapes (Figure 1, Type 1-3) are found in both South Asia and Southeast Asia (Carter 2015:740, Kelly 2013:101, 122). There seems to have been some South Asian craftspeople or at least those who were trained in their techniques using diamond drills in

Thailand from 100CE (Bellina 2014:365-368; Carter 2015:735). Studies have shown that in Thailand and Cambodia the diamond drilled beads start off well-made and nicely formed then over time become mass produced and irregular (Bellina 2003:291, 2014; Carter 2015:739). This is the opposite of the pattern observed in the South Korean diamond drilled beads (Glover and Kenoyer 2018) and the same pattern is reflected in the Kofun period beads examined for this study. There are very few irregular beads and instead there are somewhat well finished semi-irregular beads, spherical and faceted hexagonal beads. Whether this means the beads were not made in Southeast Asia or that the elites in Southeast Asia were exporting their better quality beads for trade requires more study. Only one example of the faceted hexagonal beads found in Korea and Japan has been found in Southeast Asia during this time period (Bellina 2014:356) which makes Southeast Asia an unlikely source for the hundreds of faceted hexagonal beads found in Gaya and Silla graves. The faceted hexagonal bead style can be found in greater numbers in South and Central Asia (Kenoyer personal communication, Rienjang et al. 2017) so it is also possible that certain types of beads were being traded along different routes to Korea and Japan. There is also the presence of the Khambhat style drilled bead in the semi-irregular style found in Japan, along with the ten beads found in South Korea. Since this method originated in South Asia and is still used there today, it seems likely the beads were either manufactured there or elsewhere by South Asian craftspeople that were privy to the closely guarded secret of the Khambhat drilling method.

There has long been a debate about the origin of the carnelian used as the raw material for stone beads in Southeast Asia. The region of Gujarat, India has one of the largest supplies of carnelian. It has been suggested that the Southeast Asian beads were made utilizing both imported and local sources of carnelian (Theunissen et al. 2000:101-102). However, there are ongoing studies of carnelian sourcing using INAA suggesting that the Southeast Asian sources were not widely utilized (Law et al. 2013: 118). It should be noted that in addition to being chemically distinct, some of these carnelian sources are also visibly distinct. There is a clear difference between the more opaque, darker red or lighter yellow carnelian of the Japanese archipelago compared to the diamond drilled carnelian. And the single short cylindrical stone drilled carnelian bead is also more translucent and a brighter orange in color than the diamond drilled beads. Future INAA studies of East Asian carnelian sources are needed to clear up the sources for these beads.

6.1c Jasper/Green Tuff

The size and manufacturing methods of green tuff/jasper cylindrical beads change over time with both the bead size and maximum drill hole size getting bigger in the Japanese archipelago. In the Korean peninsula during the early Three Kingdoms Period, the bead size, drill hole size and manufacturing methods seem to reflect those which were used in the archipelago centuries before. The beads were not normally distributed and were only a small fraction of one of the most common bead types and materials from the Kofun period so it is unsurprising that the statistical cluster analysis produced results which boil down to there being at least five different workshop traditions present. Considering there are multiple workshops across the Japanese archipelago which were producing these beads, five actually seems to be too small of a number. It is likely there were much more, but that the sample size itself was not large enough.

6.1d Rock Crystal

In the proto-Three Kingdoms period, there were two types of drilling that were prominently used on rock crystal beads. A long, narrow tapered drill and a wide tapered drill. These produce distinctive drill holes which are often visible due to the transparency of the materials (Figure 6.9). A small amount of these beads were analyzed in this study. K0009 and K0010 (Figure 6.10) were also drilled in the narrow style and date to the same period, though no impressions were taken. They are made out of an opaque pale orange-pink quartz. There were bead workshops, mostly working rock crystal, in the proto-Three Kingdoms period in Korea, but the only drill I have seen from these sites appears to not be narrow enough (Mahan Cultural Research Center 2011: 448). The only evidence I have found of a partially drilled bead with a long narrow drill is from two workshop sites during the Middle Yayoi period: the Haranotsuji site on Iki Island, north of the coast of Kyushū, with a rock crystal bead which is 3/4 of the way drilled through and the Junchitōukyū workshop site in northern Kyushū along the coast (Yoneda 2014: 28). A series of workshops in northern Kyushu and the intervening islands between Korea and Japan would have been an excellent location for trading with both the peninsula and the archipelago.

Figure 6.9 K0102 drill hole visible through rock crystal *gogok*

Figure 6.10 K0009 spherical quartz

The site of Seokpyeong is a settlement site in the midwest of the peninsula where rock crystal beads were made at the end of the Proto-Three Kingdoms period. The sites AMS dates range from 75-470CE, but the majority fall within 195-310CE which is the last 100 years or so of the Proto-Three Kingdoms Period (Mahan Cultural Research Center 2011: 637-656). This site shows a different production method from the rock crystal workshops in Japan. The rock crystal beads are barely being shaped before drilling (Mahan Cultural Research Center 2011: 252, 387) with most of them retaining their crystalline shape at the time of drilling. After drilling, they seem to be shaped almost entirely by grinding in the case of both the biconicalal hexagonal beads and the *gogok*. In contrast to the hexagonal beads, partially finished *gogok* were ground into a rough shape before being drilled and finished (Mahan Cultural Research Center 2011: 554). This preference for grinding, rather than chipping, seems to be characteristic of this set of workshops and is borne out by the large number of grinding stones with deep grooves found on the site. Like many of the late Yayoi/early Kofun period sites in Japan, this site seems to have been using iron drills. The one recovered in association with rock crystal debitage is long and tapered but not narrow (Mahan Cultural Research Center 2011: 448).

In the Three Kingdoms Period, rock crystal manufacture within the Korean peninsula seems to stop. There is only one potential bead grinding stone found in a Paekche tomb from the early Three Kingdoms Period (Seoul National University Museum 1997: 186). Rock crystal beads continue to be manufactured in Japan across a wide range of workshops. However, the narrow taper drilled beads disappear and are replaced with wider drills.

6.1e Steatite

The *moja gogok/komochi magatama* (of which a handful have been found in the Korean peninsula) are fairly common in Japan during the period, presenting as a larger *gogok/magatama* with smaller *gogok/magatama* growing out of the edges of the larger bead (Figure 6.11). They are often carved out of steatite most likely because a large amount of material is needed and due to the ease of carving the soft stone. Although they could have been manufactured in any bead workshop with access to steatite, the only partially constructed *komochi magatama* I have encountered during the Kofun period appear in the Itoigawa workshops (Kishima 2012: 40). The chaîne opératoire involves making an ovaloid rough out of the bead, drilling the hole, then shaping the bead. In this region at least, they seem to have foregone the smaller magatama on the back of the bead while retaining those on the sides and front. A varying amount of care goes into carving the smaller *gogok/magatama* on the bead, resulting in some *moja gogok* with only vague representations of the smaller *gogok/magatama* while others are carefully carved and defined. Some *komochi magatama* have circle with a dot patterns across their bodies in addition to the miniature *magatama*.

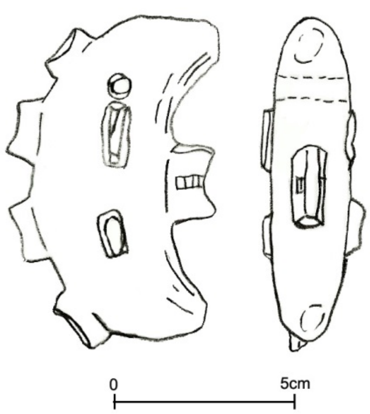


Figure 6.11 An example of a *moja gogok/komochi magatama*. Drawn by Lauren Glover.

Two of these beads were examined. A complete *moja gogok* from a late Silla burial (K0118) and a partial *komochi magatama* (J0202 - only the head) from a tomb in Izumo (Figure 6.12a and b). Both were drilled with a large drill which left irregular striations on the bead so probably a metal drill with abrasive. However, both beads are extremely worn inside their drill holes, showing visible vertical lines throughout the drill hole suggesting heavy wear on the soft stone beads and heavy wear around the drill holes (Figure 5.53). Surprisingly, the Silla *moja gogok* seems to have been either unknowingly or deliberately carved without regard for representing the smaller *gogok/magatama* on the sides of the bead - there is an odd number of bumps on the outer and side edges of the bead meaning if they were less abstract they would only represent 2.5 *gogok/magatama*. This is interesting because the other three *moja gogok* from Silla which I have seen, properly represent the smaller *gogok* on their sides (Bokcheon Museum 2013: 232-233). An unfinished *komochi magatama* at a workshop in Itoigawa does have three bumps on the side, but they may have planned to shape them into three individual smaller *magatama* at a later time (Kishima 2012: 40). Did the manufacturer of K0118 not understand the symbolism of the smaller *gogok*? Was it a mistake or was having the smaller *gogok* depicted properly not seen as important? This bead was found on the northern edges of Silla territory so it is possible the long distance from Japan where this shape holds more prominence meant that this bead was imitating a form without fully understanding it.

Figure 6.12a K0118 Complete *moja gogok* from a Silla tomb

Figure 6.12b J0202 The head only of a *komochi magatama* from a Shimane tomb

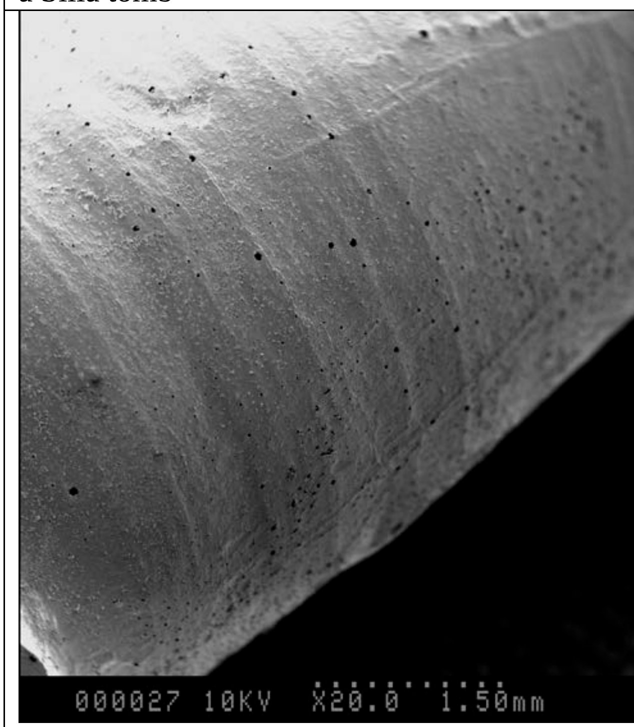


Figure 6.13 J0202 SEM x20 drill hole from a *komochi magatama* showing heavy string wear

Barnes (2014: 4) suggests the *moja gogok/komochi magatama* became more streamlined over time and that the mini bead carved on the front became flatter in order to accommodate hafting the bead with the front facing down on top of a staff. They could even have used the other protrusions to ‘tie’ the rest of the bead to the staff and secure it. Since steatite is a very soft stone which can be easily worn down, there should be evidence of wear from hafting if this were the case. Unfortunately, I only examined two of these beads total and only one was complete so I can only speak to hafting evidence on the body of the bead on one of them. The Silla *moja gogok* showed no signs of wear from hafting though it did have a number of scratches on its surface. The drill hole itself was very worn down pointing to it being suspended through the drill hole. This is similar to the wear I found on the *komochi magatama* from Shimane prefecture. Its' body also was covered in scratches which suggests these beads were handled frequently in the past though some of those marks were undoubtedly from accidental damage during excavation. More of the *komochi magatama* and *moja gogok* which are whole should be examined for use wear, but the two I examined do not support this staff mounting theory.

6.1f Miscellaneous

Hydrogrossular commonly occurs mixed with jadeite or in association with it (Tsujimori 2017: 221), so it is unsurprising that I analyzed a single *gogok* of hydrogrossular which was likely obtained from the same source as the jadeite *gogok* (identification confirmed via specific gravity). In appearance (Figure 6.14), there is little to divide hydrogrossular from the Itoigawa jadeite since both are often an opaque white with hints or veins of green. With a similar Moh's hardness and appearance, it is likely that this bead was mistakenly thought to be jadeite and worked accordingly, though there is also the possibility that it was chosen deliberately.

Figure 6.14 Hydrogrossular *gogok* from a Gaya tomb

Figure 6.15 J0015 an alabaster *magatama* from Nara prefecture

One type of stone which I believe was chosen deliberately were the handful of alabaster/gypsum *gogok/magatama* which I analyzed (Figure 6.15). These beads were found in the tombs of elites in the same contexts as jadeite *gogok/magatama*. Although many of them were in poor shape once excavated due to poor soil and thermal conditions, new alabaster is a smooth, opaque white. Many of the actual jadeite *gogok/magatama* are an opaque white so it is easy to believe that these alabaster beads were deliberately passed off as jadeite; alabaster would have been much easier to obtain than jadeite and much easier to work with a Moh's hardness of 2. The situation may have been similar for the single amblygonite *gogok* but its' higher hardness could also mean it was mistaken for jadeite.

How much were these beads worth? Their value was not recorded until after the Kofun period but in 738CE your average stone bead would cost around 3 yen in 1927 (converted from the equivalent amount of rice by Hamada et al. 1927: 15). Utilizing a historical currency converter, results in a price of 40-80 US dollars per bead in comparison to 2015 gold and silver exchange rates (Edvinsson 2018:1). It should be noted that these were only the prices for non-jadeite beads since jadeite beads were worth more.

Gogok/Magatama

Before addressing the potential meaning of *gogok/magatama*, it is important to first analyze how these beads were used as a symbol. These beads were in use for thousands of years. Did they hold the same symbolic meaning in the Jomon period compared to the Kofun period? Considering how the basic form varied over time, probably not. Holtom (1928:50) says that eventually the symbolic meaning of the beads (and mirrors and swords) changed to represent the idea that holding these three symbols was evidence of a rightful, ethical and proper ruler, but is not clear on what they meant before that point. Did the *gogok/magatama* hold the same meaning in every region? Their representative use across regions and time does suggest they held similar enough meanings to be understood across borders, but the different utilizations between the peninsula and the archipelago could support differing interpretations of the symbol.

There are multiple theories about the purpose of the *gogok/magatama* shape and its importance in ancient Korea and Japan. Most of those theories are based around what the bead resembles; the 'comma shape' has been interpreted as a crescent moon, a fish hook, a kidney, a silk worm, a soul, part of the yin-yang symbol, a fetus, or animal teeth and claws (Arnheim 1961: 391; Hamada et al. 1927: 16; Holtom 1928:40; Itoigawa City Board of Education 2016:18; Kim C. 1999: 104; Kim, Y., 2015:1; Shimane Museum of Ancient Izumo 2009: 9). The issue is that while there are some *magatama* that fit these theories, there are many others that do not. And these theories fail to take into account two different points. The first is that these shapes do not account for the more unusually shaped *gogok/magatama* - from the lines which are often found on the head of the bead to protrusions, extra holes or the *moja gogok/komochi magatama*. There are twinned *magatama* as well with two beads carved with one of their sides joined together and others where their backs are joined but they face in opposite directions.

The second point that must be addressed is that these beads were not worn sideways. Depictions of the beads being worn by *haniwa* figures (Figure 6.16) show them being worn facing outwards with the tip of the tail pointing up. The Silla crowns have the *gogok* hanging from what have been interpreted as either branches of trees or antlers facing outwards from the branches (Bokcheon Museum 2013:195) There are similar reports of *magatama* being hung on trees in the *Nihon shoki* (Ishino 1992:212). The *gogok/magatama* used to make earrings and hung on royal belts were freer to twist around, but the majority of these particular beads were worn with the tip of the tail facing outwards. These two points must be explained before any theory on the meaning of the *gogok/magatama* can be accepted.

Figure 6.16 A priestess *haniwa*; note the *magatama* around her neck and beads at her wrist and ankles. Tsukaoka Tomb 3. *haniwa* can be found in the Gunma Prefecture Historical Museum. Art by Lauren Glover.

Other questions which need to be addressed are whether these *gogok/magatama* were a universally understood symbol or if the meanings of the bead varied across regions and over time. The southern Japanese island of Kyushū had much more elaborately and figuratively shaped *magatama* during the Yayoi period (Miyajima 2017:228). Agate and chalcedony *magatama* manufactured in Shimane prefecture became flatter and more C-shaped by the end of the Kofun period. The first jadeite *magatama* of the Late Jomon period had large drill holes and were much thicker and curved than later *magatama* (Miyajima 2017:228). Some of the *gogok* and *magatama* which I examined were extremely different in form (Figure 6.17) and yet were from the same time period. The *moja gogok* from a Silla site seems to have been made by someone who did not quite understand or care about the meaning of the bead. All these examples show there was a lot of variation in *gogok* and *magatama* shapes.

Figure 6.17 A jadeite *magatama* from Miyazaki, and two jadeite *magatama* from Silla in the 5th century CE

Another question to answer is if *gogok/magatama* were being heirloomed before deposition? In the case of jadeite, they almost certainly were, though it is difficult to determine how long they were being held onto before deposition. But the majority of jadeite *magatama* show heavy wear both on the edges of the hole and inside the drill hole to the extent that sometimes the manufacturing indicators were almost worn smooth. All steatite *magatama* examined in this study were heavily worn both inside the drill hole and also around the drill hole.

There were circular depressions where the end of a bead (most often cylindrical beads) was grinding against the steatite surface. Jasper and agate *gogok/magatama* were a lot more variable.

One way of understanding their meaning is to see how the beads were utilized for public display. Royalty on the Korean peninsula seem to have considered them enough of a socially understood symbol that they were essential to their "tool kit" of royal regalia, and by this I refer to both the crowns and the belts found in tombs. Several of these belts have been found in royal tombs (all preserved ones are made of gold) and seem to have served a purpose of a charm belt or even a ritual tool kit (Lee, H. 2006:240-265). Pak (1984:18-19) suggests these belts were originally from the nomadic steppe, but then spread to China and Korea with similar belts being worn during the Tang dynasty and by a prince in Gaochang, Central Asia. There are certain symbols which consistently repeat on these belts. A golden fish is common as is some sort of small gold tool, often a knife, and each is thought to have a purpose. For example, the fish is supposed to be a chard fish which is meant to ward off evil (Pak 1984:18). But what consistently appears at least once, and sometimes several times on these belts is *gogok* (Figure 6.18). The general goal seems to be to have at least one jadeite *gogok* on display, with a cap of gold which is sometimes decorated, and then at least one other *gogok*, sometimes made of gold, sometimes carnelian, sometimes chalcedony. Belts vary from one *gogok* to four. These belts were worn in the Silla polity and deposited during the 5th and 6th century CE (Lee, H. 2006:240-265), though they may have been in use for much longer before those periods. A closer look at the belt from the southern tomb of Hwangnam shows one bead has a potential mini *gogok* or protrusions in the center of the front curve along with gold making criss-cross lines across the jadeite bead (National Research Institute of Cultural Heritage 1993: Photo page 99). The lines across the entire bead and protrusions are much more reminiscent of Yayoi period jadeite bead style in

Kyushu in the Japanese archipelago than the 5th century CE which is the tomb's date (Itoigawa City Board of Education 2016:16; See The Chūhara site jadeite beads for example (Saga Prefectural School Board 2010:Fig 12)). Since my research has shown wear and sometimes very heavy wear on all the jadeite beads, it is not inconceivable that some were heirloomed for centuries before deposition.

*not to scale

Figure 6.18 A close-up at *gogok* from one of the Silla belts. A fourth *gogok* was on the other end of the belt. Courtesy of Seoul National Museum. Photo by Lauren Glover.

The crowns found on the Korean peninsula are largely unique. Only the greatest of them seem to have had *magatama* attached but there is a common motif of stylized tree branches and leaves which is often encountered (Figure 6.19). Crowns with this motif are present in Baekje, Gaya and Silla (Daegaya Museum 2006:66; Lee, H. 2009: 160-186). Crowns are rare in the Japanese archipelago and only appear after the 5th century CE - but at least two of those crowns continue the Korean tree motif (Hosoi 1976:115). In addition, one of the earliest Buddhist statues in Japan has *gogok/magatama* on its crown (Itoigawa City Board of Education 2016:20). Hosoi

(1976:118) believes that the trees on crowns were a Western Asian tradition passed to the Korean peninsula and that the tree was a cosmic tree used as a shamanic emblem.

*not to scale

Figure 6.19 A side view of one of the Silla crowns, Courtesy of Seoul National Museum. Photo by Lauren Glover.

There are also bronze ritual ornaments from Korea (Figure 6.20) which are edged with *gogok* or possibly birds (Kwon 2009:245). The one on the left appears to be more *gogok*-like while on the right they are more bird-like. A staff made of jasper in Japan (Figure 6.21) has two *magatama* on its head, facing outwards. This is very similar to other ritual staffs of the time period, but the other ritual staffs tend to have ends on their heads which resemble the top of parasols. There is at least one other jasper staff with four *magatama* attached to its' head though (Barnes 2007: 167). Finally, there is a mirror in Shikinzan Kofun near Osaka which is locally made; the outer edge is decorated with a ring of *magatama* (Sakaguchi 2011:12). Interestingly, like the twined *magatama* which are joined at their back, these staves and mirror are some of the few instances where the beads would be viewed from the side, presenting a curved profile.

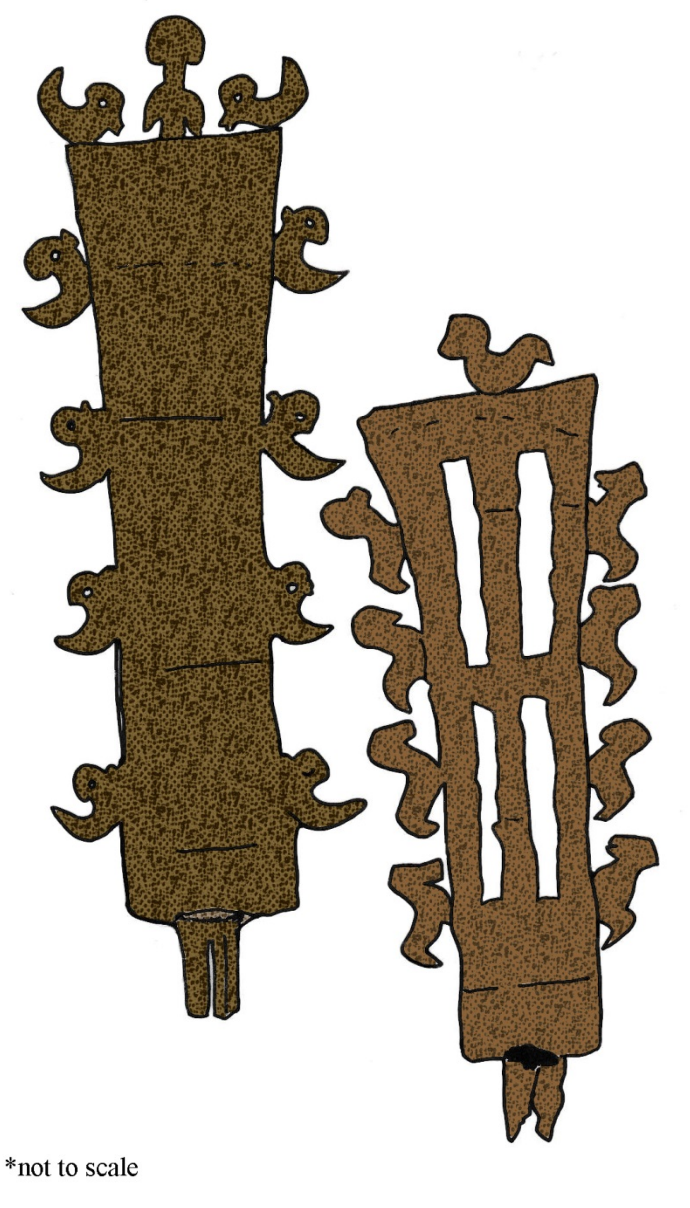


Figure 6.20 Gaya 5th century CE ritual implements, Seoul National Museum. Art by Lauren Glover.

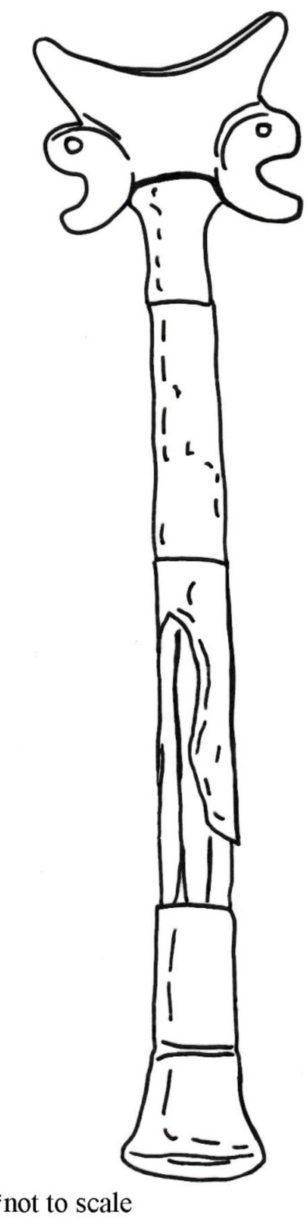


Figure 6.21 *Magatama* jasper staff. As seen in the Tokyo

	National Museum. Sketch by Lauren Glover.

Another question which must be asked is if there is meaning to the lines around the head of the *gogok* (and occasionally *magatama*)? There seems to be judging by the way it required a) extra manufacturing work and b) was done in places where it was unnecessary. So for example, one of the jadeite *gogok* on the gold belt in the southern Hwangnam tomb has a gold cap obscuring the head of the bead. However, there is a line visible on the lower part of the bead and someone has taken the effort to add three more gold lines on the gold cap covering the rest of the head (National Research Institute of Cultural Heritage 1993: Photo page 99). If these grooves had been carved in order to mount beads in specific ways (by using the grooves as string guides) then we would find some evidence of this method archaeologically either through wear in the grooves or wires in that shape/position or on the *haniwa* representations and this has thus far not been found. Due to their location on the beads, if these grooves were being used to guide strings, then they would cause the beads to be mounted with the tail pointing straight up which is visible on some *haniwa* necklaces. However, it does not explain why the grooves are so prevalent on the Korean jadeite *gogok* and not the Japanese *magatama* since the *magatama* were much more likely to be worn as necklaces. It is important to note that if these beads were viewed from the front (which is, overwhelmingly, the way they were displayed), then these lines would have been highly visible and there may have been some significance to having more or less lines on your *gogok*. The lines are not always visible if the *gogok/magatama* are viewed from the side (Figure 6.22). Another point to make is that lines are found on earlier, anthropomorphic jadeite *gogok/magatama* (Itoigawa City Board of Education 2016:16). The lines on the “feet” (ie front of the bead) of the bead would not have been useful for mounting on these earlier shapes (Figure

6.23). Another jadeite bead from Japan with multiple drill holes and incised lines could have possibly been fastened along them, but it is also thought that the multiple holes actually allowed the bead to be used as a musical instrument like an ocarina (Figure 6.24) (Itoigawa City Board of Education 2016:16).

Figure 6.22 K0079 Jadeite *gogok* viewed from the side with lines invisible

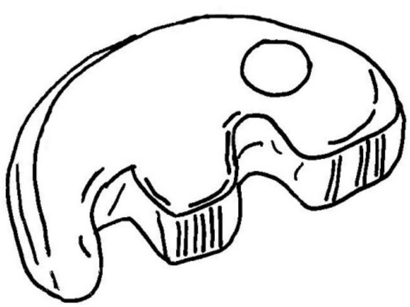


Figure 6.23 Yayoi anthropomorphic jadeite *magatama*. Sketch by Lauren Glover.

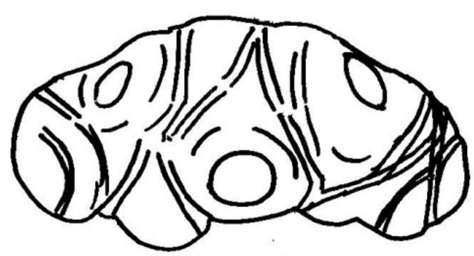


Figure 6.24 Yayoi 'ocarina' jadeite *magatama*. Sketch by Lauren Glover.

Beyond examining the archaeological evidence, there is also religious history. Namely, the native religion of Japan, Shintō, has its' origins well before the Kofun period. In fact, the first codified mythology of the island was written down in the Nara period right after the Kofun and Asuka periods ended (the *Kojiki* in 712CE) (Barnes 2007:20-21). How much modern Shintō resembles the ancient religion of Japan has been debated by scholars and is also heavily mixed with discussions of nationalism due to its association with the origins of the Japanese imperial family (Pearson 1992: 123). However, these origins are well outside the purview of this study. I will instead look at if archaeological evidence confirms or denies some of the modern facets of Shintō, then discuss what these beads mean in Shintō today.

Shintō traditionally has shrine maidens (*miko*) who are supposed to be virgins and tend to shrines (Yamaguchi 2016:60). Seike (2004) hypothesized that this was not the case in ancient times. He analyzed female ritual practitioners burials from the Yayoi and Kofun period and found that many of them had signs of being pregnant. He also found that there was little difference in grave goods between male and female graves besides more weapons in some male graves. So this research supports the idea that Shintō has changed from the past, though this change was recorded in the Nara period historical writings which talk of marriages of spiritual women. On the other hand, the excavation of the area around the Izumo shrine, which is one of Japan's most important and oldest Shintō shrines, found that the inner shrine had been continually rebuilt since the end of the Kofun period with a unique three pillar construction method and style which still persists to this day (Shimane Museum of Ancient Izumo 2012:96) (Figure 6.25). Therefore, Shintō has definitely changed over time, but some of those changes were recorded and other aspects of the religion have remained constant through thousands of years.

Figure 6.25 The excavated three pillars of wood, Courtesy of the Shimane Museum of Ancient Izumo. Photo by Lauren Glover.

The next step then is to look at Shintō and see if there is any archaeological support for the Shintō interpretation of the beads. First, there are three main sacred objects which are allowed to be housed in the main hall of a Shintō shrine: a mirror, a sword and a precious stone (Yamaguchi 2016: 22). Their purpose is to provide a place for the god to inhabit when it descends and their alternate name is “the divine body” and the “august-spirit-substitute” (Blacker 1975:40; Underwood 1934:52; Yamaguchi 2016: 22). Some of the most famous shrines in Japan have Kofun period mirrors, swords and beads in them. One of the most famous is in Isonokami Shrine in Nara - the seven branch sword stored there is a national treasure which was given to elites during the Kofun period from the Baekje polity in 372CE (Aoki 1991:30; Hirano 1977:68). The *Yasakani no Magatama* (whose name means the always shining green (or possibly red) jewel) is housed in the Tokyo Imperial Palace and used in rituals during the enthronement of the

Emperor (Holtom 1928:34, 55). One chant or prayer for good luck is performed by the Emperor in a room with jewels placed at the four corners to drive away darkness (Underwood 1934: 80-81). Another ritual to bring happiness to the Emperor involves white jewels to symbolize the white hair i.e. old age the Emperor will reach and red jewels so he will have a ruddy countenance i.e. be healthy (Underwood 1934: 82). Having beads in green, red and white colors seems to have been important in Shintō and in the past since the majority of examined beads fall into these color categories.

Shintō mythology pulled from the *Nihon Shoki* and the *Kojiki* written at the beginning of the Nara period details some origins for these three sacred objects. Amaterasu-Omikami (Japan's progenitor goddess) is supposed to have given these three objects to her grandson (the progenitor of Japan's royalty) with a command to worship all of them, especially the mirror, as herself (Yamaguchi 2016: 102). Another myth about Amaterasu says she once hid herself in a cave, bringing darkness to the land since she is the sun goddess, and the other gods tried to lure her out. They hung many *magatama*, white cloth and a mirror on a tree outside the cave and one of the gods performed a wild strip dance to get her to come out (Blacker 1975:40). Another tale tells of her wearing a necklace of beads which were turned into gods by her brother while she transforms his sword into goddesses (Aoki 1991:26). Amaterasu was given the beads by her heavenly father when making her the high ruler of heaven (Aoki 1991: 25). At one point Amaterasu became angry and she tied *magatama* around her arms and in her hair and grabbed bows and arrows while shouting and stamping the earth (Blacker 1975:105). Amaterasu is clearly and consistently linked with these three symbols.

Other aspects of Shintō may also relate to stone beads (Figure 6.26). Kofun period people made ritual deposits in places which were considered sacred or closer to the gods like the foot of certain mountains. At the foot of Mt. Akagi, archaeologists found stone replicas of swords, mirrors and a variety of beads (Blacker 1975:80). Blacker believes that the shape of these beads (cylindrical, *magatama* and mortar shaped) and all the other objects found there were meant to draw in the gods to use them as dwelling places. Shintō believes that ancestors become gods over time and must be worshiped and given offerings (Yamaguchi 2016:104). *Magatama* and mirrors seem to have been designed as "spirit-lures" drawing spirits and gods towards the objects (Blacker 1975:106). There is also a consecration ceremony for new building sites which involves a sacred tree which the god inhabits and then the ritual burial of an iron figurine, mirror and dagger (Yamaguchi 2016:90). Branches of sacred trees are commonly used or placed on or near the altars in shrines today (Figure 6.27).

Figure 6.26 At the Tamatsukuri Onsen (bead making hot springs) shrine - the volcanic spring water flows from a giant, sacred stone bead. Photo by Lauren Glover.

Figure 6.27 Branches of *sakaki* (*Cleyera japonica*) being used at a small Jizo shrine in Yamaguchi City near Rurikoji Temple. Photo by Lauren Glover.

Is there evidence of these practices archaeologically? An elite burial in the Mumun Period in Korea, Daejeon Goejeong-dong site, has a bronze mirror, dagger and *gogok* accompanying it (Rhee et al. 2007:423). Deposits of steatite replicas of swords, mirrors and beads found on Kofun period sites does seem to support the continuing importance of these sacred objects (Ishino 1992:211). There are also burials of high status women surrounded by stone beads, swords and mirrors suggesting both the spiritual and political importance of their owners (Allen 2003:87; Aoki 1991:21-22; Chikatsuasuka 2008:45,48). Accounts in the *Kojiki/Nihon Shoki* sometimes mention beads or specific, still extant goods. One boat pilot for one of the Kofun emperor's was said to have used an evergreen tree decorated with beads, a bronze mirror and an iron sword as an essential tool for an overseas journey (Aoki 1991: 5). Often the *sakaki* (*Cleyera japonica*) is specified as this tree and it is still used today in Shintō rituals (Figure 6.28). One of the Kofun period Emperors is said to have been welcomed to Kyushu by a local chief with branches of a tree hung with mirrors, swords and jewels (Pearson 1992: 197). The god encouraging Empress Jingu to conquer Silla in the tale says that she can specifically find gold, silver and multi-colored beads there (Aoki 1991:5). The *Kojiki/Nihon Shoki* describes the seven branched sword, still in Isonokami Shrine today, as being given to Empress Jingu from Baekje (Aoki 1991:15). *Haniwa* from the time period depict female priestesses wearing beads, mirrors, swords, and sometimes carrying a bow (See Figure 6.16) (Chikatsuasuka 2008:63; Miki 1967:100). The male *haniwa* are also often depicted wearing beads, especially *magatama* around their necks though they do not tend to have the multiple *magatama* found on the *haniwa* priestesses (Miki 1967:95; Pearson 1992:206).

Figure 6.28 Purification ritual at Ise Grand Shrine with a *sakaki* tree branch. Photo from Wikimedia Commons.

Mitsudera is a case study of an elite family residence from the late 5th to early 6th century CE located northwest of Tokyo (Shiraishi 1992:220). The site is a well preserved moated elite residence which is 1 km away from three large kofun from the same period. It contained houses, surplus storage areas and high skill craft workshops for working bronze and iron (Shiraishi 1992:221). Half of the compound is devoted to ritual activities involving water - which was diverted with a large amount of effort from the nearby river to flow around the compound. Small pools were found with stone daggers, mirrors and *magatama* inside. In the central house and the moat were high class pottery vessels, miniature ritual objects, weapons, and wood agriculture and weaving tools (Shiaraishi 1992:221). Another example is the moat around Nonaka tomb, Osaka which held 40,000+ steatite replica beads: *magatama*, perforated discs (thought to represent mirrors), swords, and mortar shapes (Ishino 1992:212).

We also have a number of artifacts found as votive deposits at places which are still considered sacred by Shintō today. At the foot of Mt. Miwa near Nara they found *komochi* *magatama*, special ceramics, wooden bird effigies, weaving implements and ceremonial staffs of the same quality found in kofun burials (Figure 6.29)(Pearson 1992:197). These artifacts date from the 4th century onwards and suggest a long continuity of mountain worship. *Iwakura* - large rocks felt to be a dwelling place for the gods - are still worshiped today, but they were also used in the past. The Nishiomuro Maruyama site has a 2m long *iwakura* which was surrounded by large amounts of steatite replica beads from the 6th century CE (Ishino 1992: 210).

Figure 6.29 The modern day foot of Mt. Miwa and the start of a pilgrimage path up the mountain. Photo by Lauren Glover.

There has been very little investigation into the ritual life of non-elites in the Kofun period, but the site of Kuroimine, a late Kofun period (500CE-645CE) village in northern Honshū that was buried under 6 1/2ft of volcanic ash, allows archaeologists to have some insight (Tsude 1992:223-225). Tracing the actual pathways that were used in the past which were preserved under the ash, they were able to see that people were regularly visiting ritual sites of trees both inside and outside the compound and leaving pottery vessels and steatite beads underneath them (Ishino 1992:201; Tsude 1992:223-225). Considering the prevalence of trees with something (cloth, mirrors, beads) hanging from them being used as temporary habitations by the gods in myths and Shintō (Blacker 1975:40; Underwood 1934:52; Yamaguchi 2016: 22), it is possible these trees were used for a similar purpose (Figure 6.30). The actual prepared trees (before they were used for this purpose) have been found in ritual pits at the Hasshi-in site in Nara (Ishino 1992:211). Another site in the same region, Nakasuji village, was covered by pyroclastic flow in the 6th century and had defined ritual areas filled with pebbles and river rocks along with wild boar teeth, steatite beads and special pottery (Ishino 1992:201). None of these steatite beads were *magatama*. This suggests that at least in this region in the Late Kofun period (500CE-645CE), *magatama* were not an accessible symbol at the village level. Another common ritual of the time period involving beads is that of putting steatite replica objects into bowls and floating them down irrigation channels along with placing mini clay vessels near water spouts (Ishino 1992:202). The Miyame River site (3rd cent CE) had a giant camphor tree standing on the bank of the river which was surrounded by thousands of pieces of local and non-local pottery, clay artifacts, and miniature pottery vessels (Ishino 1992:203). Ishino (1992:204) believes that all these miniature pottery vessels were for sharing food with the gods. From the above examples, those mini vessels were placed in locations where the gods dwelled such as the foot of trees or at water sources.

Figure 6.30 A sacred tree at the Shintō Inari Shrine in Matsue City, Shimane, Japan. Photo by Lauren Glover.

Another place to look for evidence of the use of these beads is the Ryūkyū islands to the southwest of Japan. They were trading partners with the peoples in Japan during the Yayoi/Kofun period and the source of the beautiful shell bracelets found in tombs (Pearson 2000:912). Their religion is said to combine aspects of Shintō mixed with Buddhism, Taoism and Confucianism (Bollinger 1969: 1). Before 1500CE, village rulers, feudal lords and even kings followed a system where the male was the political ruler while one of his female relatives was in charge of the religious life of the village or kingdom (Bollinger 1969:2). This system will sound familiar to anyone who has read the *Nihon Shoki* and the Chinese chronicles of contact with ancient Japan; Queen Himiko, who ruled in Japan at the end of the Yayoi/beginning of the Kofun period is said to have ruled together with her brother who handled the more mundane matters (Aoki 1991:17). And this idea of pair rule in ancient Japan has been suggested to be common in the late Yayoi/Kofun period, but it should be kept in mind that the roles were not always fixed with women addressing spiritual matters and men the administrative - there are cases of the reverse as well (Allen 2003: 88; Piggott 1997:39; Tonomura 2007:352). The Ryūkyū priestesses held the ceremonies that sustained the village or kingdom, controlled who could perform the ceremonies and consecrate the shrines and utilized sacred items: robes, and a crystal necklace with *magatama* (Haring 1953:110). Pearson (2001:274) believes that these beads were introduced to Okinawa during the Kofun period as “a powerful and ubiquitous religious symbol.” Around 1000CE, priestesses were said to go with their group’s warriors to the battlefield to shout curses at their opponents (Bollinger 1969:19). There are also Japanese accounts of female rulers casting spells on their enemies before joining their male partner in an attack (Nelson 2003:8; Piggott 1997:39). In the early 8th century, shamanesses were still leading troops into battle to cast divinations, inspire troops and curse their opponents (Allen 2003:89).

On a trip to the Seoul University Museum, I observed a temporary display on Korean shamanism. Beads were no longer being worn by shamans in the 20th century, but they were (and are) still using bronze mirrors and knives in their rituals (Figure 6.31). The current bronze mirrors used in shamanism are decorated with suns, moons and stars and are actually thought to represent the face of a god to be worshiped when hung up (The National Folk Museum of Korea 2013:235). They are buried in the ground when a shaman retires. Sacred trees, which they hang colorful ribbons from, are still present in some rural villages in South Korea, as well (Park D. 2011:133) (Figure 6.32). There are also sacred or divine poles, some of which guard areas of a village (often with a bird shape on top) while others are vessels to move a god from the sky to the earth or vice versa (Choi 2005: 112; National Folk Museum of Korea & Bae 2016:Divine

Pole) (Figure 6.33). There is no agreement on what type of bird is put on top of these poles, but the birds are seen to represent heavenly beings who could transport messages between heaven and earth (Choi 2005:111-112). These wooden birds may also have played a role in Kofun period religion considering wooden bird effigies were found in votive deposits at the foot of Mt. Miwa (Pearson 1992:197). The first mention of the use of these cut and mounted trees/poles is from the *Mahanjeon* (a Chinese account of the Three Kingdoms Period) which said that the people had a sanctuary where they placed a ‘cut’ tree and decorated it with bells and drums (Choi 2005:112). This tradition of sacred poles/trees is found in the Japanese texts as well with a “pole of heaven” being used to send Amaterasu-Oomikami up to the heavens (Holtom 1928:46). The Yashaka Shrine in Kyoto has a god who descended from the heavens in the Goguryeo polity and ended up enshrined in Kyoto (Choi 2005:113-115). Shintō shrines continued to mount poles with sacred tree branches, mirrors, swords, beads and streamers of paper or cloth on them outside of their shrines until the 1900s. Pearson also (2002: 142-143) discusses how quartz and other semi-precious stones were seen as part of the shamanic tool kit; these were objects of spiritual power which helped the shamans complete their duties.

*not to scale

Figure 6.31 Shaman knives from the early 20th century, Courtesy of the Seoul National University Museum. Photo by Lauren Glover.

Figure 6.32 A sacred tree decorated with ribbons in the five traditional colors near Hongdae, Seoul. Photo by Lauren Glover.

Figure 6.33 Sacred trees, poles and figures which acted as boundary markers and signposts on display outside the Korean Folklore Museum in Seoul. Photo by Lauren Glover.

Other legends which involve jewels from this time period are detailed in local versions of mythology which did not always make it into the official imperial mythology that is the *Kojiki/Nihon Shoki*. One of Empress Jingu's maternal ancestors is said to be descended from a common Silla woman and a shaft of sunlight who gave birth to a red jewel (Aoki 1991:3). That jewel was then traded to a Silla prince who married her. But when he scorned her she returned to her family's country i.e. the Japanese archipelago, where the Sun goddess was from. Another tale tells of a leading shamaness or priestess surrendering her region to Emperor Keiko (one of the earlier, mythical emperors) through bringing a sacred tree from the mountain in her territory and hanging a sword, mirror and beads from it (Barnes 2007:170; Hosoi 1976:114). By this act, she seems to have symbolically surrendered her god and by association, its territory to the Emperor. Chinese Wei texts speak of the Proto-Three Kingdoms period people setting up a tree that they hung with bells and drums to worship (Hosoi 1976:118). This practice seems to have evolved in that the branches and trees on crowns then had beads and golden leaves attached instead during the Three Kingdoms Period. Lewin (1994:222) speculates that the Hata - a prominent elite clan in Late Kofun/Asuka/Nara period Japan who originally came from Silla on the Korean peninsula - took easily to local Japanese religious customs because it was familiar to them. They also were one of the first clans to accept Buddhism in the early 7th century. This is also thought to be because they were familiar with Buddhism from their time on the peninsula (Lewin 1994:220). The mythology of Saka province explains the shamaness's surefire way to pacify gods was with clay figures of humans and horses (Ishino 1992:207). In the 5th century, those clay figurines were joined by the steatite replica beads of *magatama*, mirrors, swords and mortar shaped beads. Another Japanese folktale speaks of a god giving a man two tide-controlling jewels which when dipped in water could cause the tides to go in and out respectively (Holtom 1928:44). In Itoigawa, the local legends about Princess ‘Nunakawa’ and the precious green stones she was associated with were actually what led Eizo Ito to rediscover the jadeite source there in 1938 (Miyajima 2017:227). The river down which the jadeite flows into the sea is known as the ‘princess river’.

Trees hung with swords, mirrors and beads are mentioned several times in various historical or mythological sources and there is also archaeological confirmation of the use of these artifacts in various combinations with each other (Ishino 1992:211). The *magatama* in particular are thought to be the main beads hung from this sacred tree. They are also depicted attached to staffs and *magatama* are also shown being attached to each other as either twins or *moja gogok/komochi magatama* (Figure 6.34). They were deposited as offerings at the foot of sacred trees, boulders and in moats or rivers. In the Korean peninsula, gold and silver crowns seem to mimic tree branches with golden leaves attached amidst jadeite *gogok*. Elaborate royal belts show that at least one *gogok* needed to be hanging there to be essential royal attire. In Japan, *haniwa* figures of elite societal members are shown wearing *magatama*. Dancers, warriors and musicians do not wear them, but priests and priestesses do, as do high status individuals. High ranking priestesses wear multiple *magatama* around their necks. Female shamanesses in Okinawa wore *magatama* around their necks up until the past few decades.

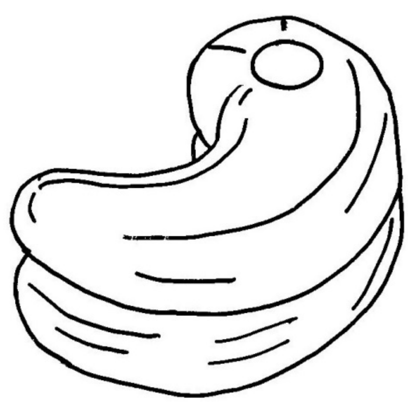


Figure 6.34 Sketch of the twinned jadeite

magatama seen in the Kashihara Archaeological Museum. By Lauren Glover.

There are three main contexts that we find *gogok/magatama*. First, hanging from trees or replicas/stand ins for those trees. Second, hanging from high status members of society (crowns, necklaces, belts, earrings), and third, votive deposits both natural and man-made (the foot of mountains, around sacred boulders and trees, in moats/irrigation ditches, in rivers, on islands). The only possible exception to this is the mirror with *magatama* on it, but since we know from the historical texts and from the *haniwa* that the mirrors were also worn by people or hung from trees, it falls into the first category. The crowns with their fake branches and leaves fall into both contexts 1 and 2. The rods/stands/banners with *gogok/magatama* attached either fall into context 1 or could be considered a separate context if the poles are not stand-ins for trees.

From all this, it is possible to say that *gogok/magatama*, through their shape, color and raw material, held a symbolic, high-status, ideological place in Three Kingdoms/Kofun period society. This may not have been the same symbolic meaning they held before this time period, especially since the shapes were much more anthropomorphic and variable in Japan during the Jomon and Yayoi periods. From remains in tombs and from *haniwa*, we know these beads were worn by men and women. And they were worn by people of high status either politically or in the religious sphere or both since ritual duties and high status were often intertwined based on archaeological sites such as Mitsudera (Shiraishi 1992:220) and the historical texts. When not associated with elites, these beads are associated with the gods. Wearing and handling *gogok/magatama*, therefore, visibly linked these elites with the divine.

Based on this information, I have developed a theory for the meaning and use of *gogok/magatama*. Shintō considers the *magatama* to be the dwelling place of the gods (Blacker

1975:40; Underwood 1934:52; Yamaguchi 2016: 22), but that terminology and translation implies a permanent habitation. Instead, a more accurate term might be 'vehicle'. *Gogok/magatama* serve as vehicles which are resting places for gods, but also a means for them to *move* about the world.

The gods, like their mortal counterparts, the elites and rulers of the time period, have their own hierarchy as well. The gods with the highest rank find passage in jadeite and carnelian. The more varied shapes of jadeite *magatama* during the Yayoi period were meant to attract specific gods to their particular vehicles. In the Kofun/Three Kingdoms Period, that variation in shape is no longer as needed. The various kingdoms of the Korean peninsula are instead indicating rank of the gods' vehicles via the lines about the *gogok* heads. This agrees with the complicated bone-rank system being used in Silla and similar complicated bureaucratic ranks in Baekje (Kim, C. 1999:106; Kim, S. 2008:6-7). In the Japanese archipelago, there is either not as much need for further ranking (though small numbers of *magatama* with lines on their head are present in high ranking tombs which have been excavated), or the highest ranked jadeite beads with lines on their heads are still hidden inside the un-excavated royal tombs.

Specific gods are being invoked, perhaps with the understanding that they must be summoned from certain locations, and still maintaining the tradition that gods must be conveyed to their vehicles via a sacred pole or tree, hence why they are often hanging on movable versions of sacred trees/poles. This explains the portable metal banners found in Korea and the *magatama* on the end of a wand/short staff from Japan. Mounting them with the tail pointing up may have been seen as a way of providing easy access for a god to enter and leave the bead. If a god is not being worn by an actual person then they should be on the sacred tree/pole or placed in a location related to the gods (rivers, sacred trees, boulders etc.). Gods must be invoked within the domain where they dwell, hence them being conveyed towards elites when the authority over a land changes hands. This also explains why this particular shape is not being traded outside of the Korean peninsula and the Japanese archipelago because they would be trading away both their gods *and* their territory. The gods can also be invoked when their control over their specific domain is needed; this explains the navigator calling up a god in order to navigate treacherous waters in the *Fujiki/Nihon Shoki* and also the way certain *magatama* were said to control the tides. The twined jadeite *magatama* may be representing a pair of deities or siblings. Depending on which god was inhabiting the vessel, the meaning and powers of the *gogok/magatama* would change which means that multiple interpretations of the bead shape and meaning could be correct depending on circumstances. So a *magatama* controlling the tides would be inhabited by a god of the moon, hence supporting Holtom's (1928:40) theory of *magatama* solely representing a crescent moon and a moon god, but a *magatama* deposited at the base of a sacred tree might be representing a different god and a different meaning.

The one bronze mirror with *magatama* depicted on it has a ring of 35 *magatama* surrounding stylized animals and figures in the inner circle (Sakaguchi 2011:12). Han dynasty mirrors, which many of the Japanese mirrors of the Kofun period were based on, often treated the mirror as a representation of the universe with the central boss as the center of the universe and the rest of the universe spreading to the rim (Cammann 1955:47). This mirror appears to be a much copied version of a Late Han mirror type (*hsi-wang-mu*) with two deities presiding over the East and West while several divine beasts occupy the other areas (Cammann 1955:48). The forms are vague and it is possible that it was copied so many times that the outer rim lost its original decoration and was replaced with the ring of *magatama* by Kofun period craftspeople.

This makes it difficult to say what this depiction meant, but a ring of gods surrounding divine rulers and beasts would be the suggested interpretation.

Soga workshop and its' intensive production of steatite *magatama* under the control of elites in a palace complex is directly controlling both the production and distribution of the vehicles of the gods. These vehicles, due to the nature of the material, were not as permanent. They were either distributing a small fraction of the essence of one of the higher ranking gods who the elites had authority over; in much the same way as the bodies of saints or the Buddha's ashes were divided into smaller and smaller pieces and distributed to specific people and locations. Or these beads represented the return of a local god from a visit to the higher ranking gods. Either way, the *moja gogok* and *komochi magatama* represent a return of that essence or local gods to a designated location of religious significance hence those found at the foot of Mt. Miwa (Pearson 1992:197). *Moja gogok* and *komochi magatama* may have been returned according to some cycle since cycles of destruction and rebirth are common in Shintō (as seen in the periodic rebuilding/re-consecration of their shrines (Yamaguchi 2016:50).

In the 6th century, bead production declines in Soga workshop and everywhere except for Shimane prefecture (Yoneda 2008:23). With the growing popularity of Buddhism, the state rituals perhaps no longer revolved solely around the stone beads. This seems to have also been the case in the Korean peninsula and would explain why such powerful symbols of religious and secular authority such as the crowns covered in jadeite *gogok* would be deposited in tombs – they were no longer useful due to the shift to Buddhism. The votive deposits in the late Three Kingdoms Period Buddhist temple, Hwangyongsa (Figure 6.35), include the last of the jadeite, glass, rock crystal and carnelian *gogok* along with miscellaneous carnelian, jasper and rock crystal beads, and there is a corresponding decline in grave goods at the end of the Three

Kingdoms Period (Kwon 2008:94). A gilt-bronze Silla bodhisattva statue (seen in the Gyeongju National Museum Figure 6.36) from the end of the Three Kingdoms Period (early 7th century CE) still made a point to have the bodhisattva wearing long necklace of spherical and cylindrical beads, but after this period those beads disappear from Buddhist statuary.

	
Figure 6.35 Hwangyongsa votive bead deposits, Courtesy of Gyeongju National Museum. Photo by Lauren Glover.	Figure 6.36 Silla gilt bronze bodhisattva statue, early 7th century CE, Courtesy of Gyeongju National Museum. Photo by Lauren Glover.

In Japan, local elites in Shimane prefecture and elsewhere, as well as any shamanesses - depicted in *haniwa*, the historical texts, and seen in Okinawa - would still have had a need for *magatama*. Without Soga and other centrally located workshops dominating the supply, the bead workshops in Shimane would have picked up the slack and proliferated, and this is exactly what we see happening during the Late Kofun period.

Another factor for the decline in elite bead use may have been the proliferation of steatite “imitation ornaments” in the Middle/Late Kofun period (450-550CE). These replicas of swords, mirrors, *magatama* and mortars were pierced for suspension and have been found across Japan and sometimes in the southern coastal regions of the Korean peninsula (Ishino 1992:212). Their rough shapes would have made them exceptionally easy to make and easily disposable; this is how they are found during this period with deposits of large amounts of beads in ritual locations. 40,000+ of the talc imitation beads were found in the moat around Nonaka tomb near Osaka for example (Ishino 1992:212). Once this change in religious ritual resulted in thousands of these beads being accessible to non-elites, the *magatama* as a symbol of political power linked with divine power may have declined in value. This decrease combined with the advent of Buddhism and potentially the loss of links to the jadeite source at Itoigawa, all led to elites phasing out much of their use of the beads.

There is evidence in the historical texts and myths of gods inhabiting stone beads. Archaeologically, a good confirmation would be if the steatite beads found across Japan during the Kofun period could be traced back to Soga workshop which would confirm they are being centrally distributed. As it is, this study can confirm that the steatite *magatama* show heavy wear before deposition in tombs meaning they were considered important enough to be worn for long periods of time. There were also some regions which did not participate as much in Kofun period culture such as Izumo and parts of the Chūbu region (Mizoguchi 2008:24) so it would be interesting to compare Chūbu beads to Nara region beads and see how their beads are being utilized. The Izumo region still seems to have utilized the beads in similar ways to the main Kinai region despite the archaeological evidence for differing organization of elites and different mythological traditions during this period. However, access to local carnelian, agate and jasper seems to have resulted in a different hierarchy of value with carnelian becoming more important judging by its wide distribution within Shimane, but rarity outside of the region.

Chapter 7

Conclusion

Stone ornaments were of extreme importance in East Asia for thousands of years. These ornaments acted as visual and material reminders of their owner's wealth, power, class and ideology. The period from 200-700CE is extremely important because classical aspects of Korean and Japanese culture were established that influenced later social, political and ideological developments, some of which persist today. The *gogok/magatama* stood as an enduring symbol in the past, and this value persists even as the meaning behind the symbol has evolved and changed. As a result, the history of the Korean peninsula and the Japanese archipelago is important not just to scholars, but to the people living in Korea and Japan today (Kim, M., 2008; Pearson, 1992). This study's goal was to learn more about the nature of exchange during this period, but also give insight into how different polities were intersecting and diverging through their ideological rites and political interactions which go beyond modern day national borders. This research can be used in other regions as a model of how to use non-destructive analysis to understand trade, exchange and manufacture of stone ornaments across a wide variety of regions and polities in the past.

The polities in the Korean peninsula and the Japanese archipelago from 200-700CE were treating and using stone beads differently over time. The Korean peninsular elites stopped manufacturing stone beads using local materials in local workshops around 300CE and instead relied heavily on imported stone beads, made overseas of various material and imported into the peninsula. Each polity had their own sources of trade for diamond drilled carnelian, many of which overlapped, but K-means cluster analysis indicates that some polities such as Baekje had separate sources as well. In contrast, the Kofun period elites did stop manufacturing stone beads out of local materials, but the production of stone beads of jasper, carnelian, agate, and steatite intensified in the Kofun period. Diamond drilled carnelian beads were still being imported from overseas in small numbers to the Japanese archipelago. These beads likely came from ties with various Korean peninsular polities, but statistical analysis indicates that there may also have been a separate source supplying these carnelian diamond drilled beads to the Japanese archipelago. Around 100-200CE, the production of jadeite *magatama* in the Japanese archipelago came under elite control. Raw jadeite material disappeared from all workshops along the western coast of Japan except for those in Itoigawa, the source of the jadeite. Some of these workshops still had what I term *magatama* “bead blanks” in small numbers, and other signs of the full stages of manufacture for other, more plentiful raw materials. The only other workshop I have found which had jadeite raw material outside of Itoigawa is the Soga workshop, which is located in a palace complex in Nara prefecture.

My hypothesis about raw material being intrinsically related to these beads in terms of their value and their purpose is supported with some clarifications. Both jadeite and carnelian were valued for their unique properties and color. Rock crystal was valued in the Korean peninsula during the Proto-Three Kingdoms Period, but does not seem as popular in the Three Kingdoms period. In contrast, the rock crystal beads were numerous in Japan during the same period. Jasper cylindrical beads were produced in large quantities in Kofun Period Japan and were valuable enough that only high level elites had full necklaces. Buddhist temples and Shinto shrines with votive deposits from this period specifically seem to have included beads of various prescribed colors such as red (carnelian) and white (rock crystal). However, it seems to have also been possible for both elites (and potentially non-elites) in both regions to substitute steatite beads for more precious materials in various ritual activities. In those cases, I argue that the value of the bead's shape and symbolism was contextually more important than the value of the raw material. It is also possible that steatite had its' own intrinsic properties for which it was valued in addition to the fact that it was a common raw material and easy to produce.

The answer to why stone beads continued to be used when glass was present needs to be answered separately for every material. No bright orange-red colored glass was produced at this time period and it is possible that carnelian continued to be used because of its unique color and hardness. Another factor was probably the prestige and power demonstrated by obtaining carnelian from distant lands. Jadeite probably continued to be used because of the important ideological aspects of the stone and its physical properties; jadeite does not break easily and has always held a place of prominence in multiple regions across East Asia. The Three Kingdoms elites were also able to demonstrate their economic power by obtaining the jadeite and nephrite via long distance trade. Rock crystal may also have had special symbolic value and though it is a locally available material in some regions, it is still very difficult to drill and shape. Green jasper/tuff may have been valued for the availability of raw material and the ease of production compared to harder stones. White and green are key colors of beads mentioned in the *Nihon Shoki/Kojiki* (Holtom 1928:34, 55; Underwood 1934: 82) so their colors were likely considered important. It is also possible that green jasper/tuff and rock crystal could 'stand in' for jadeite (because of their colors) when jadeite was not available. With its ease of production and availability across several areas on the Japanese archipelago, steatite would have been the easiest stone to work, especially in large quantities like we see in votive deposits and in Soga workshop. More research is needed on how long it takes to make a steatite bead compared to a glass bead.

My studies of carnelian bead technology and the fact that no local production of carnelian is found in Korea confirms that Korean peninsular elites switched to external sources of high value stone beads in the Proto- Three Kingdoms/Three Kingdoms period. Mumun and Proto-Three Kingdoms beads are largely made of locally obtained materials such as aquamarine, jasper, nephrite and rock crystal. The last workshops of the Proto-Three Kingdoms Period are for rock crystal. In the early Three Kingdoms period, there has been a potential bead grinding stone found, but there is otherwise no evidence of bead manufacture. Three Kingdoms Period people could have modified or finished partly made bead blanks, but seem to have wholly abandoned making them despite the fact that raw materials were still accessible locally. Despite this lack of workshops, stone beads, especially those of carnelian and jadeite, are still very plentiful. They were accompanied by hundreds, if not thousands, of glass beads; a majority of which were Indo-Pacific in origin (Lankton and Dussubieux 2006: 137; Pak 2016:172). The only bead workshops found during this period were for glass beads and they seem to have existed to produce beads that could not be obtained from abroad such as larger spherical beads and glass *gogok*. Otherwise, a concerted effort was made to obtain thousands of *gogok* and other stone beads, which by the nature of their materials (especially carnelian and jadeite), had to have been from outside of the Korean peninsula.

Many beads were being worn for short or long periods of time before their final deposition in ritual contexts such as burials and sacred locations. The only beads which consistently showed no signs of wear were the ones from the Shimane workshops in Japan. The majority of the steatite beads showed extremely heavy wear. Jadeite and carnelian *gogok/magatama* commonly showed heavy wear pointing to long periods of use before final deposition. Jadeite *magatama*, which were stone drilled, (most likely during the Yayoi period) being found in the Kofun period along with jadeite *magatama* being found in the Late Kofun period despite there being no workshop sites working with jadeite at that time supports the idea that some of these beads were being heirloomed and used for centuries before final deposition in elite burials.

Beads were expensive so they do not seem to have been available to your average person during the Three Kingdoms/Kofun period. *Haniwa*, the terracotta/wood/stone images placed on tombs, only show elites and religious practitioners (which were likely one and the same) wearing them. The exception to this were steatite beads which were used all at the village level as votive deposits. Elites in these time periods had separate residences with their own votive deposits. There are a few excavated village sites in northern Japan with evidence for steatite beads, but they were not utilizing the *magatama* shape (Ishino 1992:201). The only exception to this are the Late Kofun/Asuka Period village sites in Shimane prefecture which may have followed their own ideological uses or were reacting to the decline in the use of the *magatama* by high level elites in the Kinai region. More research is needed into the stone beads in village and votive contexts to determine if certain bead shapes were restricted to different levels of society and to investigate if this was a widespread phenomenon or limited to certain regions.

Jadeite *magatama* in Japan were being manufactured in the Hokuriku region from the middle to late Yayoi period. In the late Yayoi period, bead workshops with jadeite raw material are highly concentrated in and around Itoigawa which is the source of the jadeite. Other workshop sites of the late Yayoi and early Kofun period in the Hokuriku region have partially or nearly completed jadeite *magatama* present in small numbers, often only one or two on a whole site. The Fuesuita site in Itoigawa dates to the first half of the Kofun period and had jadeite raw material and jadeite blanks similar to those found on other sites. While Takahashi (2012b) suggests that the jadeite *magatama* were all being manufactured in the Yayoi period this does not account for the hundreds of jadeite beads found in Japan and Korea during the Kofun/Three Kingdoms Period. If jadeite beads were only being made in the middle to late Yayoi period this would mean that beads were being used for 300-400 years or longer before deposition for the late Kofun period jadeite beads. Instead, it seems that manufacture of jadeite *magatama* was limited to elite controlled workshops such as Soga workshop in Nara, or to workshops at the source in Itoigawa. Sometime in the Late Yayoi or Early Kofun period, the ruling elites appear to have brought the jadeite manufacture and distribution under their control.

Due to the practice of creating jadeite *magatama* blanks, it is possible that the jadeite *magatama/gokok* could have been finished in designated workshops outside of Itoigawa and Soga workshop. The different drill tapers indicate the use of specific shapes of drills made of stone or metal drills with abrasives. The size and shape of the bead is also a factor that comes into play when determining the type of drilling and drill hole taper.

Carnelian in Japan was valued for its unique color. Local carnelian beads were manufactured using metal drills with abrasives and were mostly used to make *magatama* beads. Those beads were occasionally exported out of the main bead producing areas of Shimane but only in small numbers. Not all workshops in the Shimane region had access to the carnelian. These beads are mostly found in tombs, but have also been used as foundational deposits under shrines. They often show signs of being used for long periods of time before their deposition.

Diamond drilled carnelian beads were imported in small amounts across Kofun Period Japan. By the late Kofun period, large numbers of these beads were traded to northern Kyushu. This may have been due to turmoil in Korea, but it is also possible that there was simply new access to trade in diamond drilled beads (or the new access was because of the turmoil). These diamond drilled beads were probably made of South Asian carnelian. They were either manufactured in South Asia or by South Asian craftspeople in Southeast Asia utilizing South Asian drilling methods. Several beads show evidence of drilling using two sizes of drill tips (single followed by double diamond) a drilling method that is still used in Gujarat, India today. The beads were either made in South Asia or made by craftspeople trained in this technique in some other region. Since they are not common in Southeast Asia, it is possible the faceted hexagonal beads were arriving in Korea and Japan via a different route. More study of diamond drilled, late Three Kingdoms Period beads in Korea and Japan is needed in order to support the idea that the imported carnelian beads in Korea were being traded onward to the Japanese archipelago and not reaching there via other routes. This is important to distinguish because if the carnelian beads were reaching the Japanese archipelago independently it would suggest a separate trade route and source providing the stone beads to Kofun period Japan.

Steatite beads were being manufactured in great numbers at the Soga workshop in Nara prefecture, Japan. This suggests that their manufacture and distribution of stone beads directly came under elite control both in the Kinai region and beyond. I believe the steatite *magatama*, after being endowed with ritual meaning, were being distributed by Kinai region elites to those participating in the kofun system, where they were being heavily utilized in life before deposition in tombs. Isolated or more independent regions may have produced their own steatite *magatama* but more research is needed into the origins of the raw materials and distribution in order to support this theory. In the case of the *moja gogok/komochi magatama*, they are found in both votive and burial deposits. The two I examined showed heavy string wear suggesting they were active ritual implements. I developed a hypothesis in chapter 6 about the meaning of the *gogok/magatama* shape based on multiple lines of evidence from historical sources, mythology, art, archaeological research and my own research. My hypothesis for the meaning behind these shapes is that they were 'calling back places' or a 'meeting place' for the gods utilizing individual *gogok/magatama* as their vehicles. The Silla *moja gogok* I examined suggests that this purpose may not have always been understood on the peninsula. I hope to examine more of these beads in the future.

Rock crystal beads were prominent during the Proto-Three Kingdoms Period in the Korean peninsula and were being manufactured there. In the Three Kingdoms Period, they become less numerous, most likely due to either a lack of prestige for obtaining local, easily obtained goods or due to a shift in the meaning of the beads which required different materials. In the Japanese archipelago, rock crystal beads are quite common throughout the southern four islands. This seems to have been due to the readily available sources in multiple places across Japan as well as a continued importance for elites to obtain and display stone beads. Analysis of the overall bead size compared to drill hole size of the beads shows clear differences between the peninsular beads and the beads from the archipelago with the possible exception of the unusual square biconical bead from Miyazaki prefecture. The peninsular beads show the narrow, tapered drill holes often found on Proto-Three Kingdoms Period beads and seem to have been made on Iki Island and other workshops in Northern Kyushū during the Yayoi period, then exported to the peninsula.

My hypothesis on the meaning of the *gogok/magatama* supports multiple other interpretations of the bead's shapes. This hypothesis was developed as a result of my research finding that different raw materials for beads were treated differently with jadeite and carnelian seemingly higher valued and used for much longer periods of time, that there was heavy use wear present on many of the beads and that the lines on the head of *gogok/magatama* were being deliberately made. There are multiple theories as to the meaning of these particular beads, but they are based on the bead shape as seen from the side and mythology without taking into account how these beads are worn or used and do not take into account the more unusual shapes such as twinned *magatama* or the *moja gogok/komochi magatama*. I brought together archaeological data from ritual sites, historical sources, proto-historic sources and mythological accounts which were written at the time when some of these last beads were being used, historic and modern day ethnographic accounts of their use in the Okinawan islands, depictions of the beads being worn on *haniwa* from the Kofun period, Shintō studies, Korean shamanic and folklore studies, accounts of how the beads are still being used today in shrines and in the Japanese Imperial protocol, and non-bead depictions of the *gogok/magatama* on staves and mirrors. After examining all these data, I found that these beads are intricately linked to being hung from sacred trees/poles when they are not being worn by a person. They are also only worn by elites and not present on village sites until the Asuka Period (645CE-710CE). Historical and mythological accounts attribute several 'powers' to the *gogok/magatama* from guiding a boat safely through rough waters, being inhabited by a fortune telling spirit/god, luring a goddess out of her self-imposed darkness and needing to be placed on a sacred tree in order for a female chieftain/shamaness to surrender her territory. In Shintō, the beads are thought to be dwelling places of the gods/spirits, and in Korean folklore, Chinese historical accounts and Shintō, the sacred poles/trees are used to lower and raise gods/spirits to the heavens (Choi 2005:111-112; Yamaguchi 2016: 22). Based on all these data, I developed a hypothesis that the *gogok/magatama* were acting as vehicles for the inhabitation and transport of various gods/spirits and that the rank of the god determined which vehicle ie *gogok/magatama* they would inhabit with the highest ranking gods/spirits found in the highly controlled jadeite and to a lesser extent, carnelian. If the *gogok/magatama* were acting as vehicles for the transportation and temporary housing of particular gods, then the powers of the particular bead would be determined by which god the bead was housing; a *magatama* housing a god of sea or the moon could control the tides, but one housing a god whose domain was on land, could not. The various materials used to make *gogok/magatama* and the deliberate lines around the head of some of the *gogok* (and a few of the *magatama*) were meant to indicate the rank of the godly vessel the same way there were elaborate ranks in the Silla and Baekje system. Jadeite housed the highest ranking gods and is the most likely to have lines around the head of the bead giving an even more refined ranking system for this particular material. Unusual shapes to the *gogok/magatama* such as twinned *magatama* were used to house twined or mirrored gods. Depictions of *gogok/magatama* outside of the actual beads are found on the top or side of banners/poles known ethnographically to be used to lower and raise gods from the heavens. I think that *moja gogok/komochi magatama* were a way to gather or return all the gods to a single place, hence why they are usually deposited in ritual locations. While I do not believe it will ever be possible to fully explain what these beads meant during the Three Kingdoms/Kofun period, my hypothesis accounts for the variety of ways these beads were used for in the past, ethnographic usage, and for the results of my own research. In the future, I hope to study the provenience of steatite from the Soga workshop in Nara, Japan and determine if the elite controlled workshop was the source of the steatite *magatama* appearing in elite tombs across the archipelago since that would mean that the Kofun period elites were controlling the spread and distribution of this specific bead type. The way to determine if the lines on the bead heads indicate rank is to survey higher and lower ranking elite tombs to determine if the lines are randomly distributed or are only found in the higher ranking elite tombs.

This study has revealed unknown long-distance trade connections across the length of the Asian continent suggesting contacts which are not accounted for or only briefly mentioned in the proto-historic sources written after these periods. Diamond drilled carnelian beads were probably being traded from as far as South Asia and at least from Southeast Asia to reach the Korean peninsula and the Japanese archipelago. It is unknown what they traded in return for the beads, but it may have been perishable materials such as silk or raw materials like iron and gold. These beads were also used as part of the tributary system with the various Chinese dynasties as a way of reinforcing the ideological and economic networks of local elites and their political power. Diplomatic gifts between dynasties, polities, regions and tributaries played an essential role in establishing authority and power during this period. Stone beads, especially valuable ones obtained through long-distance trade and created using specialized methods such as diamond-drilling, were highly sought out symbols of a person's status, wealth and political power. Their shapes, especially the *gogok/magatama* were a visually understood symbol of political and, most likely, ideological power. Higher status bead acquisition was highly controlled, either falling only to those who could afford to import the beads in the Korean peninsula during the Three Kingdoms Period or those who could control the workshops and supply of raw materials in Kofun Period Japan. It is not surprising that jadeite was highly valued and the production and distribution of jadeite beads and raw materials was controlled by elites during this period.

In the future, my plan is to expand this research along the various trade routes across Asia as well as to look at more regional variation in Korea and Japan. I hope to also utilize LAICPMS in order to analyze beads in archaeological collections in order to develop more precise distribution maps. The 'biography' of numerous bead types, but especially steatite and jadeite, requires more research into how distribution was limited and controlled by elites.

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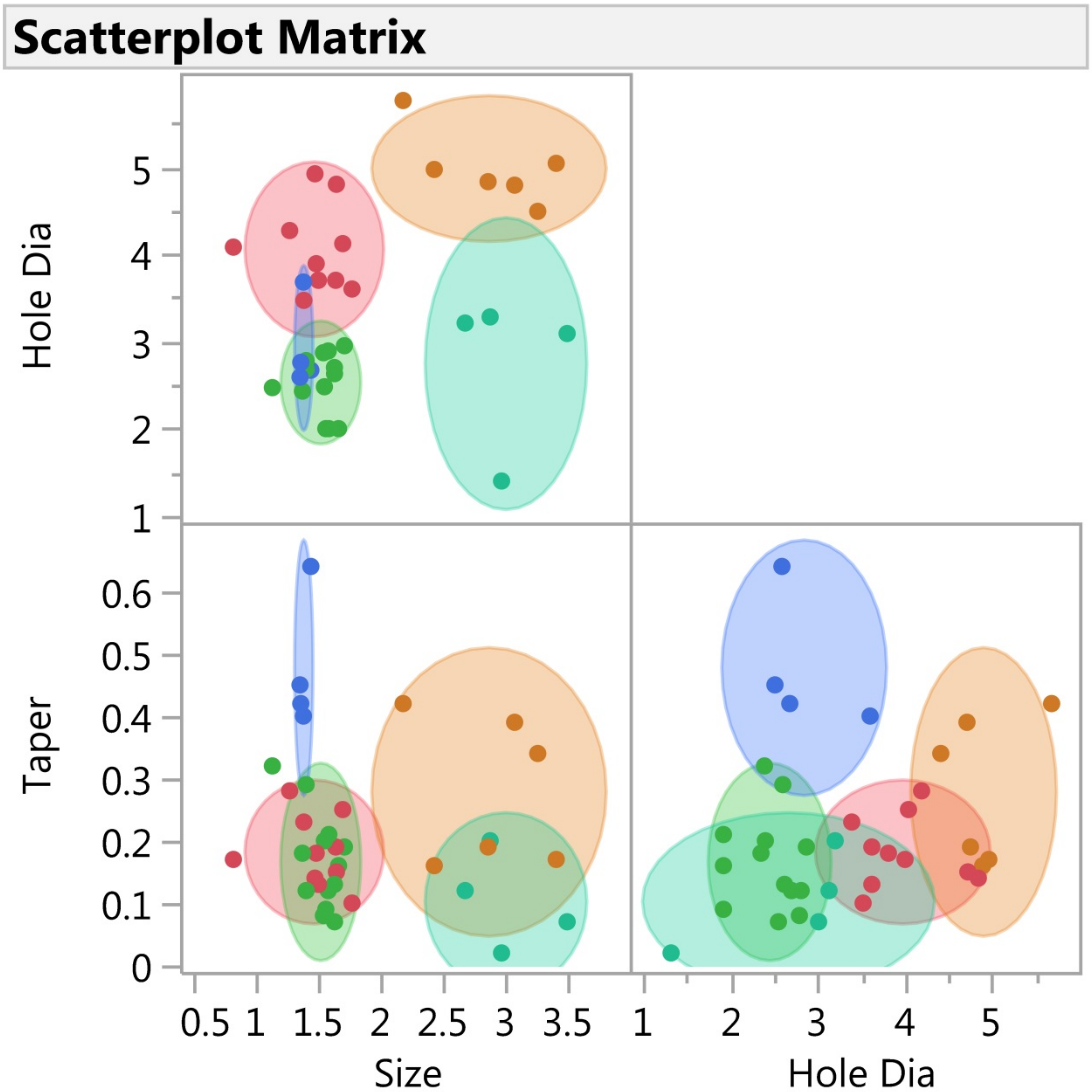
Appendix 1

Statistical and Cluster Analysis Files

A1a: Jadeite



K Means NCluster=5

Columns Scaled Individually

Cluster Summary

Cluster	Count	Step	Criterion
1	10	3	0
2	13		
3	4		
4	6		
5	4		

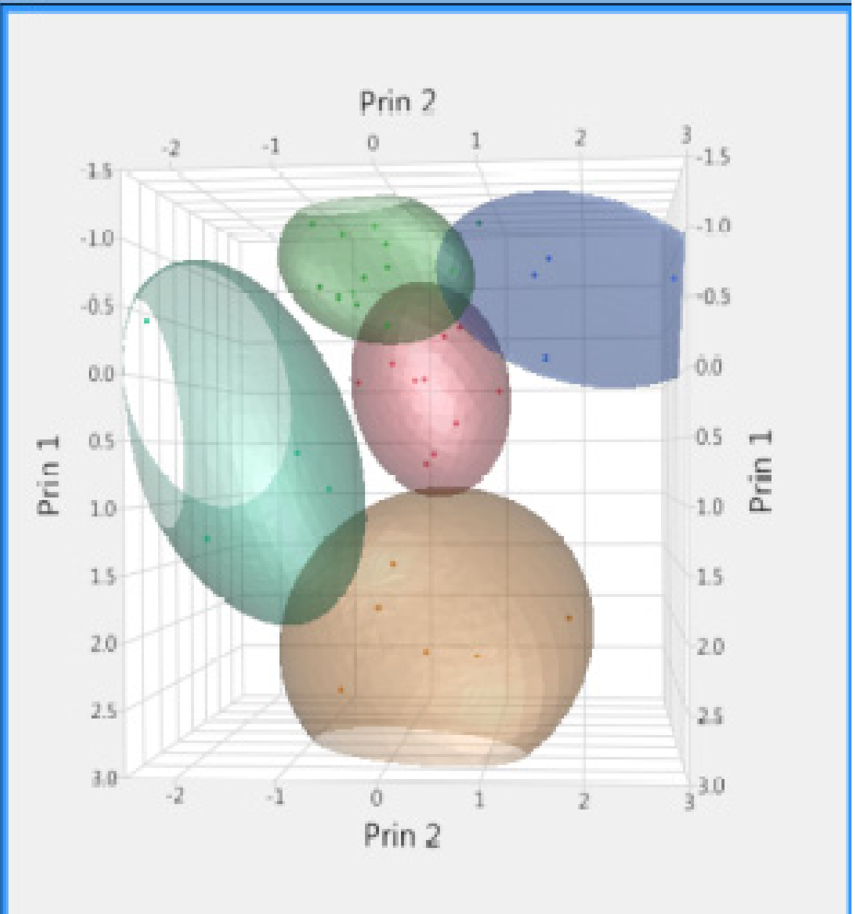
Cluster Means

Cluster	Size	Hole Dia	Taper
1	1.52406749	4.055	0.182
2	1.57543185	2.52923077	0.16615385
3	1.43925559	2.925	0.4775
4	2.92494015	4.98	0.27833333
5	3.06107855	2.745	0.1025

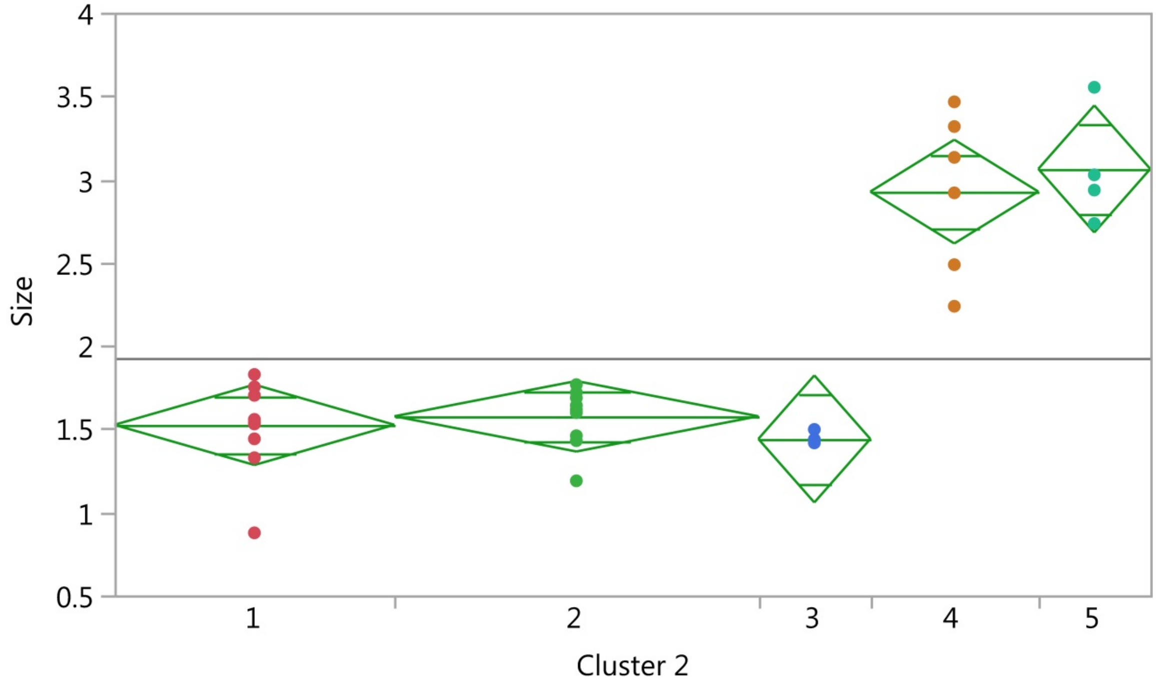
Cluster Standard Deviations

Cluster	Size	Hole Dia	Taper
1	0.25939973	0.4672098	0.0538145
2	0.14963836	0.32866774	0.07385417
3	0.03438331	0.44002841	0.09549215
4	0.43835322	0.38961519	0.1079223
5	0.30217959	0.77950305	0.06647368

Biplot 3D



Oneway Analysis of Size By Cluster 2



Oneway Anova

Summary of Fit

Rsquare	0.860199
Adj Rsquare	0.842723
Root Mean Square Error	0.278774
Mean of Response	1.926277
Observations (or Sum Wgts)	37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Cluster 2	4	15.301751	3.82544	49.2241	<.0001*
Error	32	2.486874	0.07771		
C. Total	36	17.788625			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 99%	Upper 99%
1	10	1.52407	0.08816	1.2827	1.7655
2	13	1.57543	0.07732	1.3637	1.7872
3	4	1.43926	0.13939	1.0575	1.8210
4	6	2.92494	0.11381	2.6133	3.2366
5	4	3.06108	0.13939	2.6794	3.4428

Std Error uses a pooled estimate of error variance

Means Comparisons

Comparisons for each pair using Student's t

Confidence Quantile

t	Alpha
2.73848	0.01

LSD Threshold Matrix

Abs(Dif)-LSD

	5	4	2	1	3
5	-0.5398	-0.3566	1.0491	1.0854	1.0820
4	-0.3566	-0.4408	0.9727	1.0066	0.9929
2	1.0491	0.9727	-0.2994	-0.2697	-0.3003
1	1.0854	1.0066	-0.2697	-0.3414	-0.3668
3	1.0820	0.9929	-0.3003	-0.3668	-0.5398

Positive values show pairs of means that are significantly different.

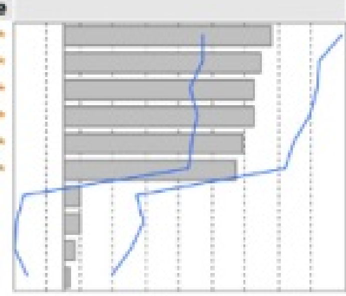
Connecting Letters Report

Level			Mean
5	A		3.0610785
4	A		2.9249401
2		B	1.5754318
1		B	1.5240675
3		B	1.4392556

Levels not connected by same letter are significantly different.

Ordered Differences Report

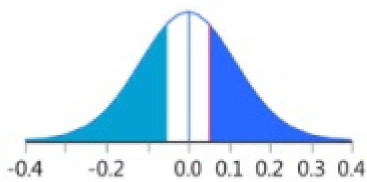
Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
5	3	1.621823	0.1971228	1.08201	2.161640	<.0001*
5	1	1.537011	0.1649248	1.08537	1.988654	<.0001*
4	3	1.485685	0.1799477	0.99290	1.978468	<.0001*
5	2	1.485647	0.1593950	1.04915	1.922147	<.0001*
4	1	1.400873	0.1439581	1.00665	1.795099	<.0001*
4	2	1.349508	0.1375883	0.97273	1.726291	<.0001*
2	3	0.136176	0.1593950	-0.30032	0.572676	0.3993
5	4	0.136138	0.1799477	-0.35664	0.628922	0.4549
1	3	0.084812	0.1649248	-0.36683	0.536455	0.6106
2	1	0.051364	0.1172584	-0.26975	0.372474	0.6643



Detailed Comparisons Report

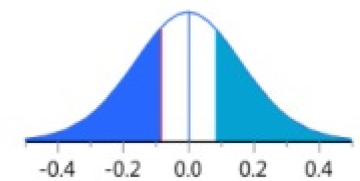
Comparing 2 with 1

Difference	0.05136	t Ratio	0.438044
Std Err Dif	0.11726	DF	32
Upper CL Dif	0.37247	Prob > |t|	0.6643
Lower CL Dif	-0.26975	Prob > t	0.3321
Confidence	0.99	Prob < t	0.6679



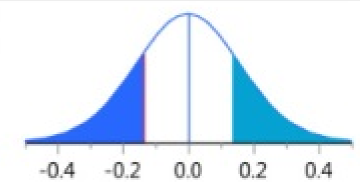
Comparing 3 with 1

Difference	-0.08481	t Ratio	-0.51425
Std Err Dif	0.16492	DF	32
Upper CL Dif	0.36683	Prob > |t|	0.6106
Lower CL Dif	-0.53646	Prob > t	0.6947
Confidence	0.99	Prob < t	0.3053



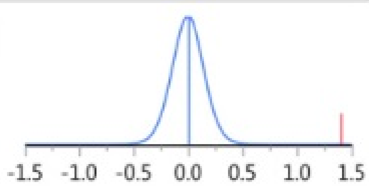
Comparing 3 with 2

Difference	-0.13618	t Ratio	-0.85433
Std Err Dif	0.15939	DF	32
Upper CL Dif	0.30032	Prob > |t|	0.3993
Lower CL Dif	-0.57268	Prob > t	0.8004
Confidence	0.99	Prob < t	0.1996



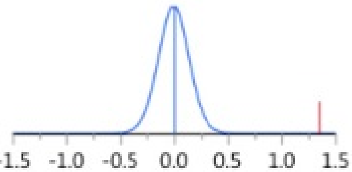
Comparing 4 with 1

Difference	1.40087	t Ratio	9.731111
Std Err Dif	0.14396	DF	32
Upper CL Dif	1.79510	Prob > |t|	<.0001*
Lower CL Dif	1.00665	Prob > t	<.0001*
Confidence	0.99	Prob < t	1.0000



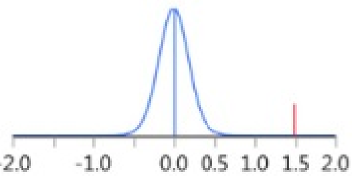
Comparing 4 with 2

Difference	1.34951	t Ratio	9.80831
Std Err Dif	0.13759	DF	32
Upper CL Dif	1.72629	Prob > |t|	<.0001*
Lower CL Dif	0.97273	Prob > t	<.0001*
Confidence	0.99	Prob < t	1.0000



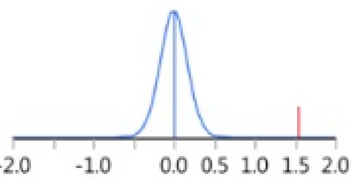
Comparing 4 with 3

Difference	1.48568	t Ratio	8.256203
Std Err Dif	0.17995	DF	32
Upper CL Dif	1.97847	Prob > |t|	<.0001*
Lower CL Dif	0.99290	Prob > t	<.0001*
Confidence	0.99	Prob < t	1.0000



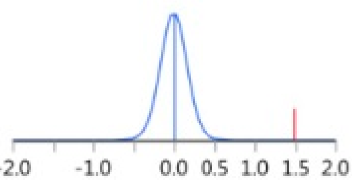
Comparing 5 with 1

Difference	1.53701	t Ratio	9.319468
Std Err Dif	0.16492	DF	32
Upper CL Dif	1.98865	Prob > |t|	<.0001*
Lower CL Dif	1.08537	Prob > t	<.0001*
Confidence	0.99	Prob < t	1.0000



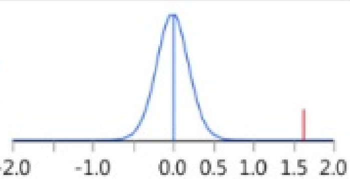
Comparing 5 with 2

Difference	1.48565	t Ratio	9.320536
Std Err Dif	0.15939	DF	32
Upper CL Dif	1.92215	Prob > |t|	<.0001*
Lower CL Dif	1.04915	Prob > t	<.0001*
Confidence	0.99	Prob < t	1.0000



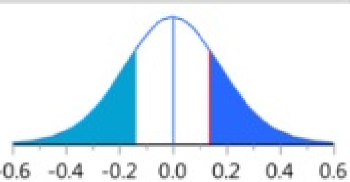
Comparing 5 with 3

Difference	1.62182	t Ratio	8.227475
Std Err Dif	0.19712	DF	32
Upper CL Dif	2.16164	Prob > |t|	<.0001*
Lower CL Dif	1.08201	Prob > t	<.0001*
Confidence	0.99	Prob < t	1.0000

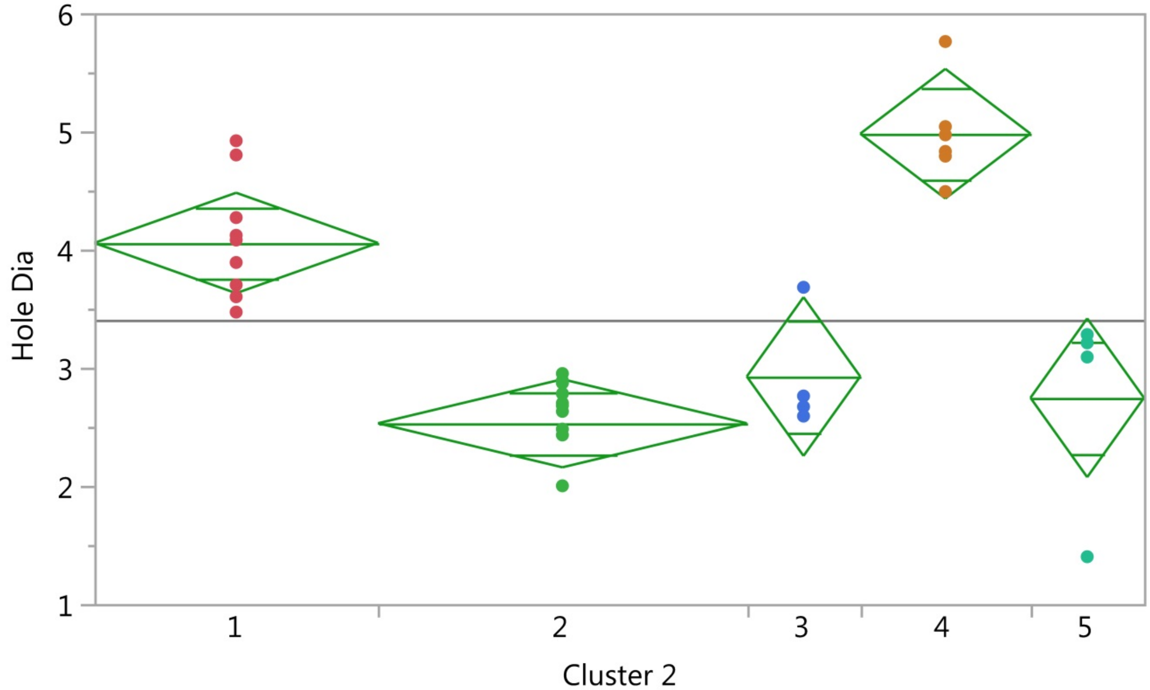


Comparing 5 with 4

Difference	0.13614	t Ratio	0.756544
Std Err Dif	0.17995	DF	32
Upper CL Dif	0.62892	Prob > |t|	0.4549
Lower CL Dif	-0.35664	Prob > t	0.2274
Confidence	0.99	Prob < t	0.7726



Oneway Analysis of Hole Dia By Cluster 2



Oneway Anova

Summary of Fit

Rsquare	0.804723
Adj Rsquare	0.780314
Root Mean Square Error	0.490629
Mean of Response	3.405135
Observations (or Sum Wgts)	37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Cluster 2	4	31.743382	7.93585	32.9675	<.0001*
Error	32	7.702942	0.24072		
C. Total	36	39.446324			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 99%	Upper 99%
1	10	4.05500	0.15515	3.6301	4.4799
2	13	2.52923	0.13608	2.1566	2.9019
3	4	2.92500	0.24531	2.2532	3.5968
4	6	4.98000	0.20030	4.4315	5.5285
5	4	2.74500	0.24531	2.0732	3.4168

Std Error uses a pooled estimate of error variance

Means Comparisons

Comparisons for each pair using Student's t

Confidence Quantile

t	Alpha
2.73848	0.01

LSD Threshold Matrix

Abs(Dif)-LSD

	4	1	3	5	2
4	-0.7757	0.2312	1.1877	1.3677	1.7876
1	0.2312	-0.6009	0.3351	0.5151	0.9606
3	1.1877	0.3351	-0.9501	-0.7701	-0.3725
5	1.3677	0.5151	-0.7701	-0.9501	-0.5525
2	1.7876	0.9606	-0.3725	-0.5525	-0.5270

Positive values show pairs of means that are significantly different.

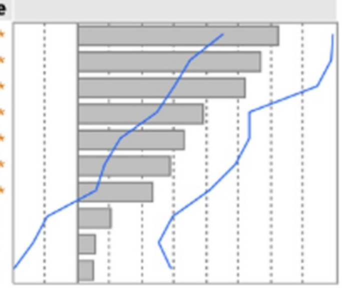
Connecting Letters Report

Level				Mean
4	A			4.9800000
1		B		4.0550000
3			C	2.9250000
5			C	2.7450000
2			C	2.5292308

Levels not connected by same letter are significantly different.

Ordered Differences Report

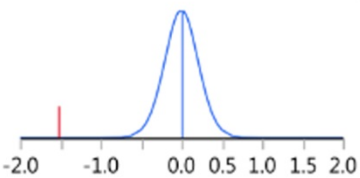
Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
4	2	2.450769	0.2421491	1.78765	3.113890	<.0001*
4	5	2.235000	0.3166997	1.36772	3.102276	<.0001*
4	3	2.055000	0.3166997	1.18772	2.922276	<.0001*
1	2	1.525769	0.2063695	0.96063	2.090908	<.0001*
1	5	1.310000	0.2902601	0.51513	2.104872	<.0001*
1	3	1.130000	0.2902601	0.33513	1.924872	0.0005*
4	1	0.925000	0.2533598	0.23118	1.618821	0.0009*
3	2	0.395769	0.2805279	-0.37245	1.163990	0.1680
5	2	0.215769	0.2805279	-0.55245	0.983990	0.4474
3	5	0.180000	0.3469272	-0.77005	1.130054	0.6074



Detailed Comparisons Report

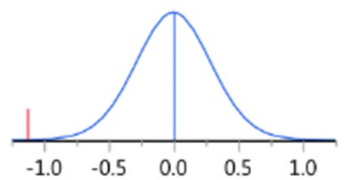
Comparing 2 with 1

Difference	-1.5258	t Ratio	-7.39338
Std Err Dif	0.2064	DF	32
Upper CL Dif	-0.9606	Prob > |t|	<.0001*
Lower CL Dif	-2.0909	Prob > t	1.0000
Confidence	0.99	Prob < t	<.0001*



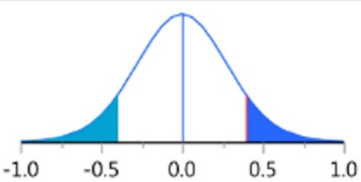
Comparing 3 with 1

Difference	-1.1300	t Ratio	-3.89306
Std Err Dif	0.2903	DF	32
Upper CL Dif	-0.3351	Prob > |t|	0.0005*
Lower CL Dif	-1.9249	Prob > t	0.9998
Confidence	0.99	Prob < t	0.0002*



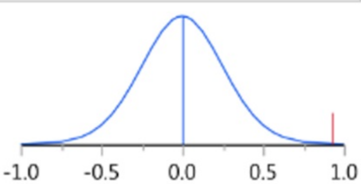
Comparing 3 with 2

Difference	0.3958	t Ratio	1.410801
Std Err Dif	0.2805	DF	32
Upper CL Dif	1.1640	Prob > |t|	0.1680
Lower CL Dif	-0.3725	Prob > t	0.0840
Confidence	0.99	Prob < t	0.9160



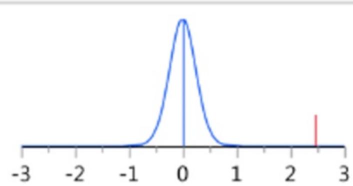
Comparing 4 with 1

Difference	0.92500	t Ratio	3.650934
Std Err Dif	0.25336	DF	32
Upper CL Dif	1.61882	Prob > |t|	0.0009*
Lower CL Dif	0.23118	Prob > t	0.0005*
Confidence	0.99	Prob < t	0.9995



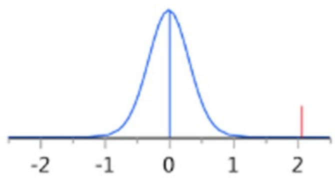
Comparing 4 with 2

Difference	2.45077	t Ratio	10.12091
Std Err Dif	0.24215	DF	32
Upper CL Dif	3.11389	Prob > |t|	<.0001*
Lower CL Dif	1.78765	Prob > t	<.0001*
Confidence	0.99	Prob < t	1.0000



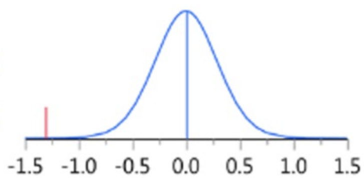
Comparing 4 with 3

Difference	2.05500	t Ratio	6.488796
Std Err Dif	0.31670	DF	32
Upper CL Dif	2.92228	Prob > |t|	<.0001*
Lower CL Dif	1.18772	Prob > t	<.0001*
Confidence	0.99	Prob < t	1.0000



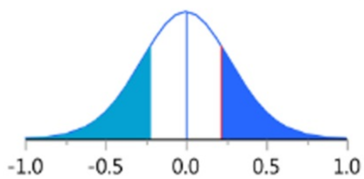
Comparing 5 with 1

Difference	-1.3100	t Ratio	-4.51319
Std Err Dif	0.2903	DF	32
Upper CL Dif	-0.5151	Prob > |t|	<.0001*
Lower CL Dif	-2.1049	Prob > t	1.0000
Confidence	0.99	Prob < t	<.0001*



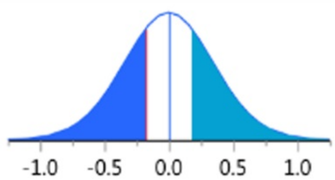
Comparing 5 with 2

Difference	0.21577	t Ratio	0.769154
Std Err Dif	0.28053	DF	32
Upper CL Dif	0.98399	Prob > |t|	0.4474
Lower CL Dif	-0.55245	Prob > t	0.2237
Confidence	0.99	Prob < t	0.7763



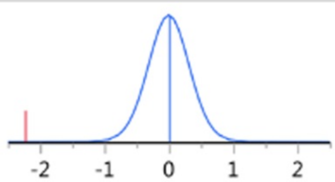
Comparing 5 with 3

Difference	-0.1800	t Ratio	-0.51884
Std Err Dif	0.3469	DF	32
Upper CL Dif	0.7701	Prob > |t|	0.6074
Lower CL Dif	-1.1301	Prob > t	0.6963
Confidence	0.99	Prob < t	0.3037

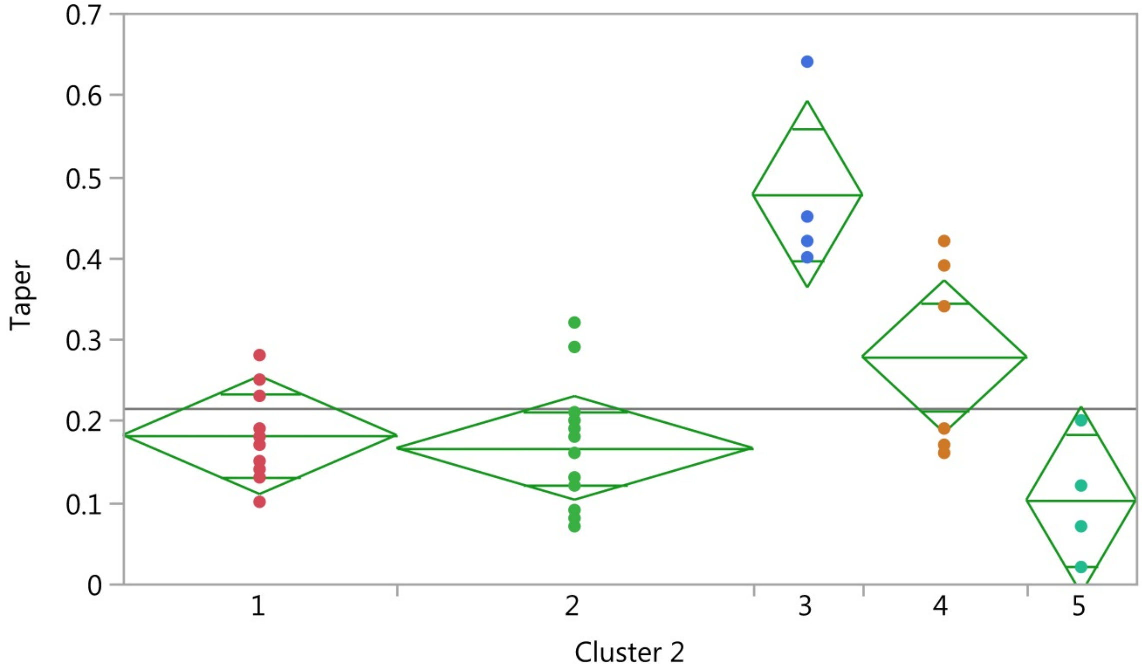


Comparing 5 with 4

Difference	-2.2350	t Ratio	-7.05716
Std Err Dif	0.3167	DF	32
Upper CL Dif	-1.3677	Prob > |t|	<.0001*
Lower CL Dif	-3.1023	Prob > t	1.0000
Confidence	0.99	Prob < t	<.0001*



Oneway Analysis of Taper By Cluster 2



Oneway Anova

Summary of Fit

Rsquare	0.636594
Adj Rsquare	0.591169
Root Mean Square Error	0.083648
Mean of Response	0.215405
Observations (or Sum Wgts)	37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Cluster 2	4	0.39221789	0.098054	14.0140	<.0001*
Error	32	0.22390103	0.006997		
C. Total	36	0.61611892			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 99%	Upper 99%
1	10	0.182000	0.02645	0.10956	0.25444
2	13	0.166154	0.02320	0.10262	0.22969
3	4	0.477500	0.04182	0.36297	0.59203
4	6	0.278333	0.03415	0.18482	0.37185
5	4	0.102500	0.04182	-0.0120	0.21703

Std Error uses a pooled estimate of error variance

Means Comparisons

Comparisons for each pair using Student's t

Confidence Quantile

t	Alpha
2.73848	0.01

LSD Threshold Matrix

Abs(Dif)-LSD

	3	4	1	2	5
3	-0.16197	0.05130	0.15998	0.18037	0.21303
4	0.05130	-0.13225	-0.02196	-0.00088	0.02797
1	0.15998	-0.02196	-0.10244	-0.08050	-0.05602
2	0.18037	-0.00088	-0.08050	-0.08985	-0.06732
5	0.21303	0.02797	-0.05602	-0.06732	-0.16197

Positive values show pairs of means that are significantly different.

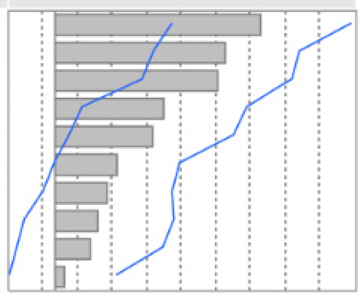
Connecting Letters Report

Level				Mean
3	A			0.47750000
4		B		0.27833333
1		B	C	0.18200000
2		B	C	0.16615385
5			C	0.10250000

Levels not connected by same letter are significantly different.

Ordered Differences Report

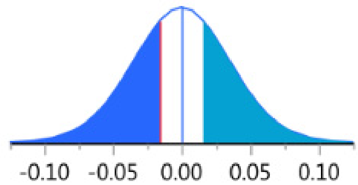
Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
3	5	0.3750000	0.0591477	0.213025	0.5369750	<.0001*
3	2	0.3113462	0.0478273	0.180372	0.4423203	<.0001*
3	1	0.2955000	0.0494865	0.159982	0.4310180	<.0001*
3	4	0.1991667	0.0539942	0.051304	0.3470289	0.0008*
4	5	0.1758333	0.0539942	0.027971	0.3236956	0.0027*
4	2	0.1121795	0.0412841	-0.000876	0.2252352	0.0105*
4	1	0.0963333	0.0431954	-0.021956	0.2146231	0.0329*
1	5	0.0795000	0.0494865	-0.056018	0.2150180	0.1180
2	5	0.0636538	0.0478273	-0.067320	0.1946280	0.1926
1	2	0.0158462	0.0351840	-0.080505	0.1121969	0.6555



Detailed Comparisons Report

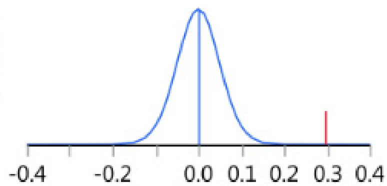
Comparing 2 with 1

Difference	-0.01585	t Ratio	-0.45038
Std Err Dif	0.03518	DF	32
Upper CL Dif	0.08050	Prob > |t|	0.6555
Lower CL Dif	-0.11220	Prob > t	0.6723
Confidence	0.99	Prob < t	0.3277



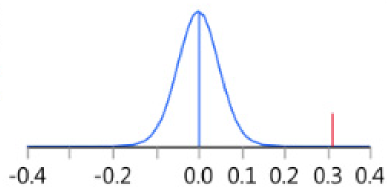
Comparing 3 with 1

Difference	0.295500	t Ratio	5.971321
Std Err Dif	0.049487	DF	32
Upper CL Dif	0.431018	Prob > |t|	<.0001*
Lower CL Dif	0.159982	Prob > t	<.0001*
Confidence	0.99	Prob < t	1.0000



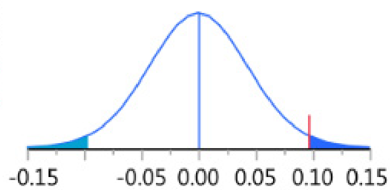
Comparing 3 with 2

Difference	0.311346	t Ratio	6.5098
Std Err Dif	0.047827	DF	32
Upper CL Dif	0.442320	Prob > |t|	<.0001*
Lower CL Dif	0.180372	Prob > t	<.0001*
Confidence	0.99	Prob < t	1.0000



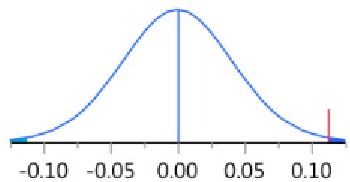
Comparing 4 with 1

Difference	0.09633	t Ratio	2.230176
Std Err Dif	0.04320	DF	32
Upper CL Dif	0.21462	Prob > |t|	0.0329*
Lower CL Dif	-0.02196	Prob > t	0.0164*
Confidence	0.99	Prob < t	0.9836



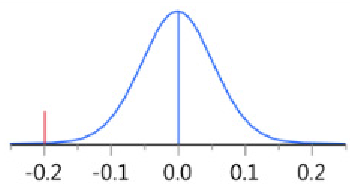
Comparing 4 with 2

Difference	0.11218	t Ratio	2.717258
Std Err Dif	0.04128	DF	32
Upper CL Dif	0.22524	Prob > |t|	0.0105*
Lower CL Dif	-0.00088	Prob > t	0.0053*
Confidence	0.99	Prob < t	0.9947



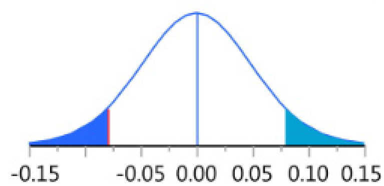
Comparing 4 with 3

Difference	-0.19917	t Ratio	-3.68867
Std Err Dif	0.05399	DF	32
Upper CL Dif	-0.05130	Prob > |t|	0.0008*
Lower CL Dif	-0.34703	Prob > t	0.9996
Confidence	0.99	Prob < t	0.0004*



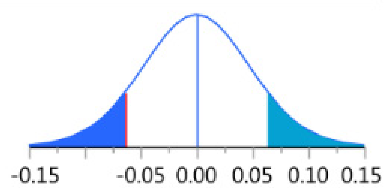
Comparing 5 with 1

Difference	-0.07950	t Ratio	-1.6065
Std Err Dif	0.04949	DF	32
Upper CL Dif	0.05602	Prob > |t|	0.1180
Lower CL Dif	-0.21502	Prob > t	0.9410
Confidence	0.99	Prob < t	0.0590



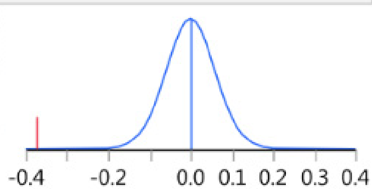
Comparing 5 with 2

Difference	-0.06365	t Ratio	-1.33091
Std Err Dif	0.04783	DF	32
Upper CL Dif	0.06732	Prob > |t|	0.1926
Lower CL Dif	-0.19463	Prob > t	0.9037
Confidence	0.99	Prob < t	0.0963



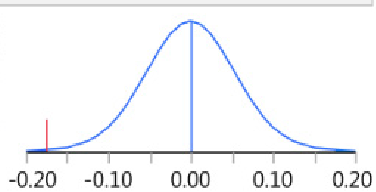
Comparing 5 with 3

Difference	-0.37500	t Ratio	-6.34006
Std Err Dif	0.05915	DF	32
Upper CL Dif	-0.21303	Prob > |t|	<.0001*
Lower CL Dif	-0.53697	Prob > t	1.0000
Confidence	0.99	Prob < t	<.0001*



Comparing 5 with 4

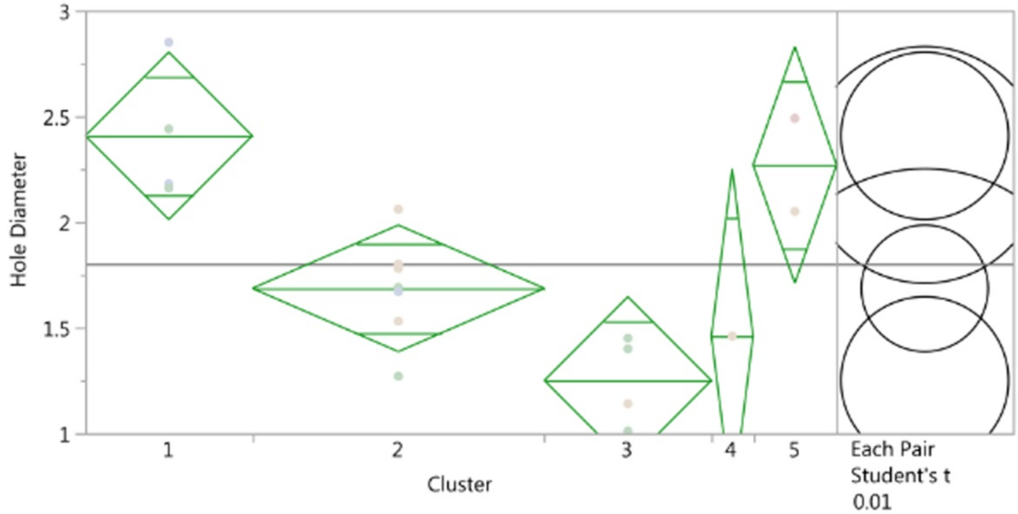
Difference	-0.17583	t Ratio	-3.25652
Std Err Dif	0.05399	DF	32
Upper CL Dif	-0.02797	Prob > |t|	0.0027*
Lower CL Dif	-0.32370	Prob > t	0.9987
Confidence	0.99	Prob < t	0.0013*



A1b: Carnelian

Hexagonal/Spherical Diamond Drilled Carnelian

Oneway Analysis of Hole Diameter By Cluster



Oneway Anova

Summary of Fit

Rsquare	0.787812
Adj Rsquare	0.722523
Root Mean Square Error	0.262861
Mean of Response	1.801667
Observations (or Sum Wgts)	18

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Cluster	4	3.3350036	0.833751	12.0666	0.0003*
Error	13	0.8982464	0.069096		
C. Total	17	4.2332500			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 99%	Upper 99%
1	4	2.40750	0.13143	2.0116	2.8034
2	7	1.68571	0.09935	1.3864	1.9850
3	4	1.25000	0.13143	0.8541	1.6459
4	1	1.46000	0.26286	0.6682	2.2518
5	2	2.27000	0.18587	1.7101	2.8299

Std Error uses a pooled estimate of error variance

Means Comparisons

Comparisons for each pair using Student's t

Confidence Quantile

t	Alpha
3.01228	0.01

LSD Threshold Matrix

Abs(Dif)-LSD

	1	5	2	4	3
1	-0.5599	-0.5482	0.2255	0.0622	0.5976
5	-0.5482	-0.7918	-0.0506	-0.1598	0.3343
2	0.2255	-0.0506	-0.4232	-0.6208	-0.0606
4	0.0622	-0.1598	-0.6208	-1.1198	-0.6753
3	0.5976	0.3343	-0.0606	-0.6753	-0.5599

Positive values show pairs of means that are significantly different.

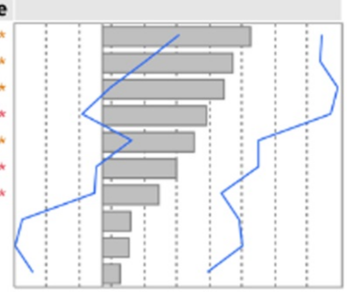
Connecting Letters Report

Level				Mean
1	A			2.4075000
5	A	B		2.2700000
2		B	C	1.6857143
4		B	C	1.4600000
3			C	1.2500000

Levels not connected by same letter are significantly different.

Ordered Differences Report

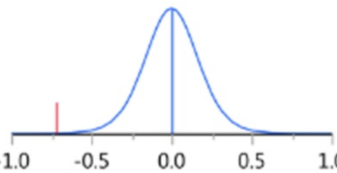
Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
1	3	1.157500	0.1858708	0.597606	1.717394	<.0001*
5	3	1.020000	0.2276443	0.334273	1.705727	0.0006*
1	4	0.947500	0.2938875	0.062230	1.832770	0.0067*
5	4	0.810000	0.3219376	-0.159765	1.779765	0.0258*
1	2	0.721786	0.1647568	0.225493	1.218079	0.0007*
5	2	0.584286	0.2107576	-0.050574	1.219146	0.0158*
2	3	0.435714	0.1647568	-0.060579	0.932007	0.0202*
2	4	0.225714	0.2810102	-0.620766	1.072194	0.4363
4	3	0.210000	0.2938875	-0.675270	1.095270	0.4875
1	5	0.137500	0.2276443	-0.548227	0.823227	0.5562



Detailed Comparisons Report

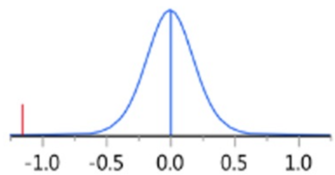
Comparing 2 with 1

Difference	-0.7218	t Ratio	-4.38092
Std Err Dif	0.1648	DF	13
Upper CL Dif	-0.2255	Prob > |t|	0.0007*
Lower CL Dif	-1.2181	Prob > t	0.9996
Confidence	0.99	Prob < t	0.0004*



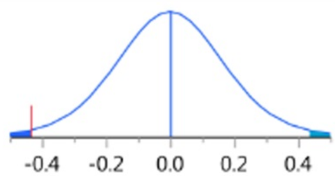
Comparing 3 with 1

Difference	-1.1575	t Ratio	-6.22745
Std Err Dif	0.1859	DF	13
Upper CL Dif	-0.5976	Prob > |t|	<.0001*
Lower CL Dif	-1.7174	Prob > t	1.0000
Confidence	0.99	Prob < t	<.0001*



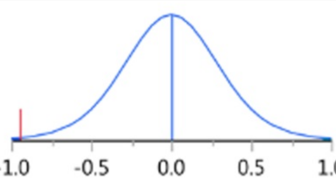
Comparing 3 with 2

Difference	-0.43571	t Ratio	-2.64459
Std Err Dif	0.16476	DF	13
Upper CL Dif	0.06058	Prob > |t|	0.0202*
Lower CL Dif	-0.93201	Prob > t	0.9899
Confidence	0.99	Prob < t	0.0101*



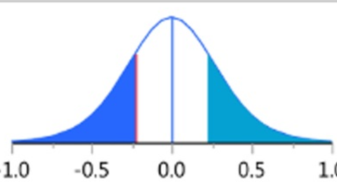
Comparing 4 with 1

Difference	-0.9475	t Ratio	-3.22402
Std Err Dif	0.2939	DF	13
Upper CL Dif	-0.0622	Prob > |t|	0.0067*
Lower CL Dif	-1.8328	Prob > t	0.9967
Confidence	0.99	Prob < t	0.0033*



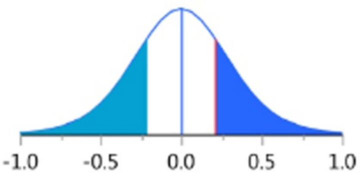
Comparing 4 with 2

Difference	-0.2257	t Ratio	-0.80322
Std Err Dif	0.2810	DF	13
Upper CL Dif	0.6208	Prob > |t|	0.4363
Lower CL Dif	-1.0722	Prob > t	0.7819
Confidence	0.99	Prob < t	0.2181



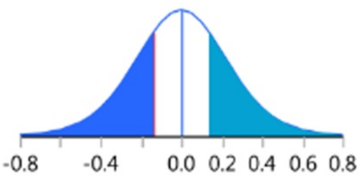
Comparing 4 with 3

Difference	0.2100	t Ratio	0.714559
Std Err Dif	0.2939	DF	13
Upper CL Dif	1.0953	Prob > |t|	0.4875
Lower CL Dif	-0.6753	Prob > t	0.2438
Confidence	0.99	Prob < t	0.7562



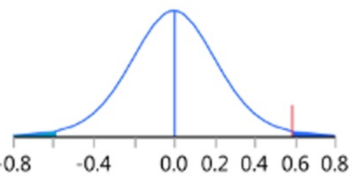
Comparing 5 with 1

Difference	-0.13750	t Ratio	-0.60401
Std Err Dif	0.22764	DF	13
Upper CL Dif	0.54823	Prob > |t|	0.5562
Lower CL Dif	-0.82323	Prob > t	0.7219
Confidence	0.99	Prob < t	0.2781



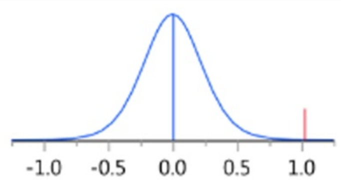
Comparing 5 with 2

Difference	0.5843	t Ratio	2.772311
Std Err Dif	0.2108	DF	13
Upper CL Dif	1.2191	Prob > |t|	0.0158*
Lower CL Dif	-0.0506	Prob > t	0.0079*
Confidence	0.99	Prob < t	0.9921



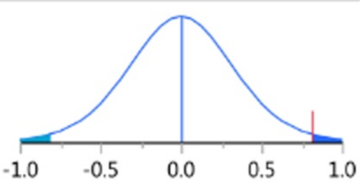
Comparing 5 with 3

Difference	1.02000	t Ratio	4.480675
Std Err Dif	0.22764	DF	13
Upper CL Dif	1.70573	Prob > |t|	0.0006*
Lower CL Dif	0.33427	Prob > t	0.0003*
Confidence	0.99	Prob < t	0.9997

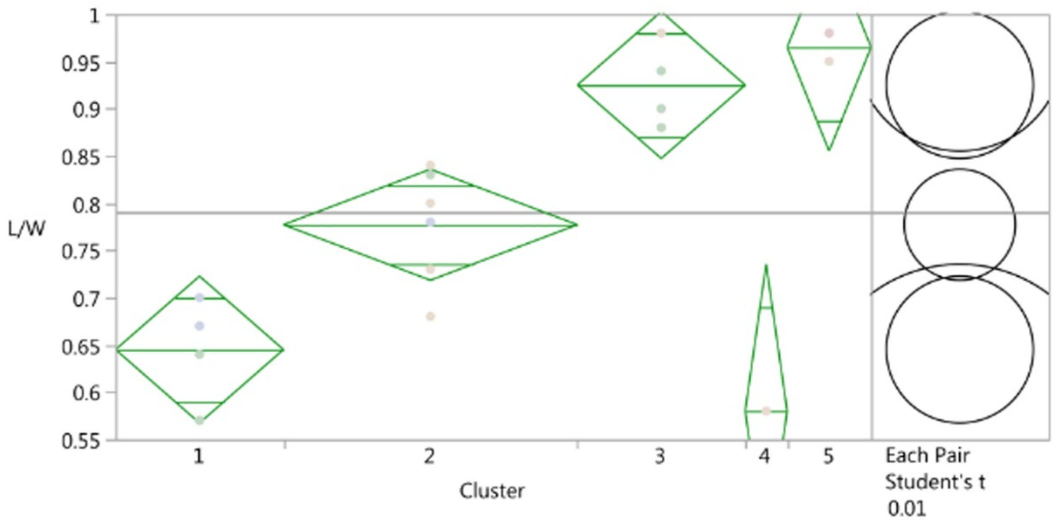


Comparing 5 with 4

Difference	0.8100	t Ratio	2.516016
Std Err Dif	0.3219	DF	13
Upper CL Dif	1.7798	Prob > |t|	0.0258*
Lower CL Dif	-0.1598	Prob > t	0.0129*
Confidence	0.99	Prob < t	0.9871



Oneway Analysis of L/W By Cluster



Oneway Anova

Summary of Fit

Rsquare	0.883953
Adj Rsquare	0.848247
Root Mean Square Error	0.051585
Mean of Response	0.790556
Observations (or Sum Wgts)	18

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Cluster	4	0.26350159	0.065875	24.7560	<.0001*
Error	13	0.03459286	0.002661		
C. Total	17	0.29809444			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 99%	Upper 99%
1	4	0.645000	0.02579	0.56731	0.7227
2	7	0.777143	0.01950	0.71841	0.8359
3	4	0.925000	0.02579	0.84731	1.0027
4	1	0.580000	0.05158	0.42461	0.7354
5	2	0.965000	0.03648	0.85512	1.0749

Std Error uses a pooled estimate of error variance

Means Comparisons

Comparisons for each pair using Student's t

Confidence Quantile

t	Alpha
3.01228	0.01

LSD Threshold Matrix

Abs(Dif)-LSD

	5	3	2	1	4
5	-0.15539	-0.09457	0.06327	0.18543	0.19469
3	-0.09457	-0.10988	0.05046	0.17012	0.17127
2	0.06327	0.05046	-0.08306	0.03475	0.03103
1	0.18543	0.17012	0.03475	-0.10988	-0.10873
4	0.19469	0.17127	0.03103	-0.10873	-0.21975

Positive values show pairs of means that are significantly different.

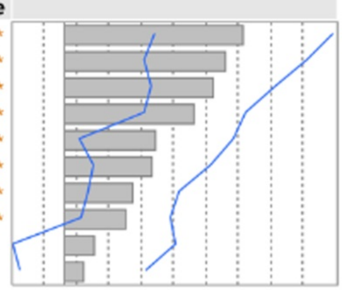
Connecting Letters Report

Level				Mean
5	A			0.96500000
3	A			0.92500000
2		B		0.77714286
1			C	0.64500000
4			C	0.58000000

Levels not connected by same letter are significantly different.

Ordered Differences Report

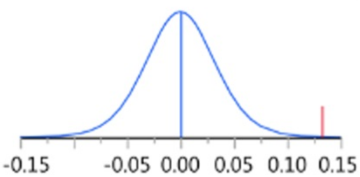
Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
5	4	0.3850000	0.0631782	0.194690	0.5753101	<.0001*
3	4	0.3450000	0.0576735	0.171271	0.5187286	<.0001*
5	1	0.3200000	0.0446737	0.185430	0.4545696	<.0001*
3	1	0.2800000	0.0364759	0.170124	0.3898756	<.0001*
2	4	0.1971429	0.0551464	0.031027	0.3632592	0.0034*
5	2	0.1878571	0.0413598	0.063270	0.3124444	0.0006*
3	2	0.1478571	0.0323325	0.050463	0.2452515	0.0005*
2	1	0.1321429	0.0323325	0.034749	0.2295372	0.0013*
1	4	0.0650000	0.0576735	-0.108729	0.2387286	0.2801
5	3	0.0400000	0.0446737	-0.094570	0.1745696	0.3869



Detailed Comparisons Report

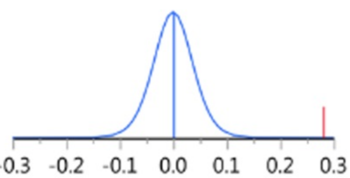
Comparing 2 with 1

Difference	0.132143	t Ratio	4.087002
Std Err Dif	0.032332	DF	13
Upper CL Dif	0.229537	Prob > |t|	0.0013*
Lower CL Dif	0.034749	Prob > t	0.0006*
Confidence	0.99	Prob < t	0.9994



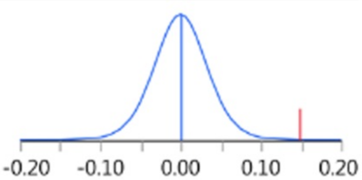
Comparing 3 with 1

Difference	0.280000	t Ratio	7.676292
Std Err Dif	0.036476	DF	13
Upper CL Dif	0.389876	Prob > |t|	<.0001*
Lower CL Dif	0.170124	Prob > t	<.0001*
Confidence	0.99	Prob < t	1.0000



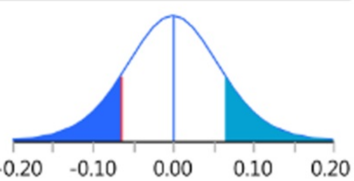
Comparing 3 with 2

Difference	0.147857	t Ratio	4.573024
Std Err Dif	0.032332	DF	13
Upper CL Dif	0.245251	Prob > |t|	0.0005*
Lower CL Dif	0.050463	Prob > t	0.0003*
Confidence	0.99	Prob < t	0.9997



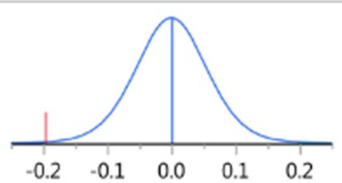
Comparing 4 with 1

Difference	-0.06500	t Ratio	-1.12703
Std Err Dif	0.05767	DF	13
Upper CL Dif	0.10873	Prob > |t|	0.2801
Lower CL Dif	-0.23873	Prob > t	0.8599
Confidence	0.99	Prob < t	0.1401



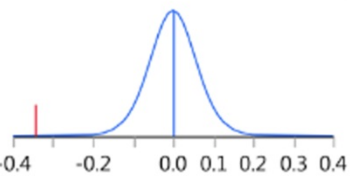
Comparing 4 with 2

Difference	-0.19714	t Ratio	-3.5749
Std Err Dif	0.05515	DF	13
Upper CL Dif	-0.03103	Prob > |t|	0.0034*
Lower CL Dif	-0.36326	Prob > t	0.9983
Confidence	0.99	Prob < t	0.0017*



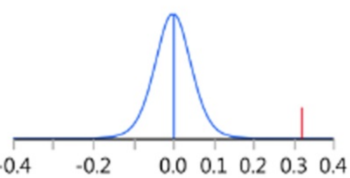
Comparing 4 with 3

Difference	-0.34500	t Ratio	-5.98195
Std Err Dif	0.05767	DF	13
Upper CL Dif	-0.17127	Prob > |t|	<.0001*
Lower CL Dif	-0.51873	Prob > t	1.0000
Confidence	0.99	Prob < t	<.0001*



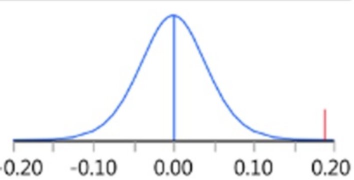
Comparing 5 with 1

Difference	0.320000	t Ratio	7.163047
Std Err Dif	0.044674	DF	13
Upper CL Dif	0.454570	Prob > |t|	<.0001*
Lower CL Dif	0.185430	Prob > t	<.0001*
Confidence	0.99	Prob < t	1.0000



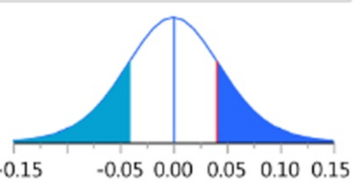
Comparing 5 with 2

Difference	0.187857	t Ratio	4.542019
Std Err Dif	0.041360	DF	13
Upper CL Dif	0.312444	Prob > |t|	0.0006*
Lower CL Dif	0.063270	Prob > t	0.0003*
Confidence	0.99	Prob < t	0.9997



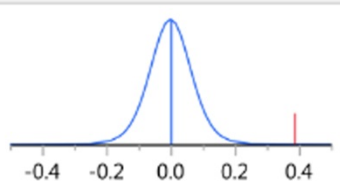
Comparing 5 with 3

Difference	0.04000	t Ratio	0.895381
Std Err Dif	0.04467	DF	13
Upper CL Dif	0.17457	Prob > |t|	0.3869
Lower CL Dif	-0.09457	Prob > t	0.1934
Confidence	0.99	Prob < t	0.8066

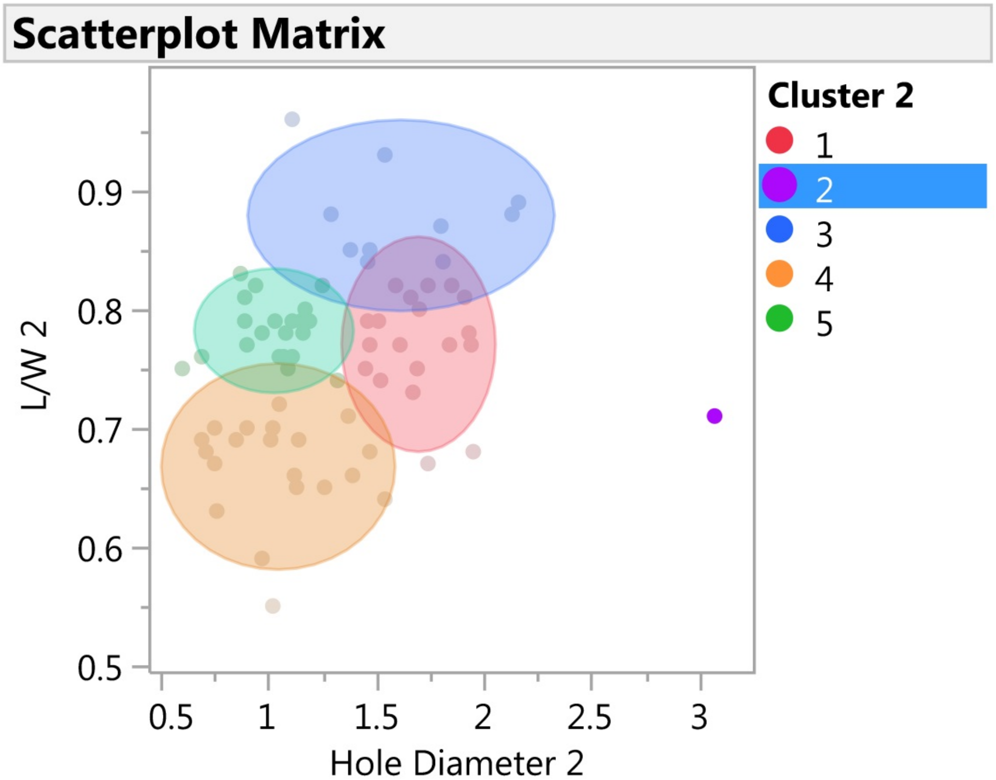


Comparing 5 with 4

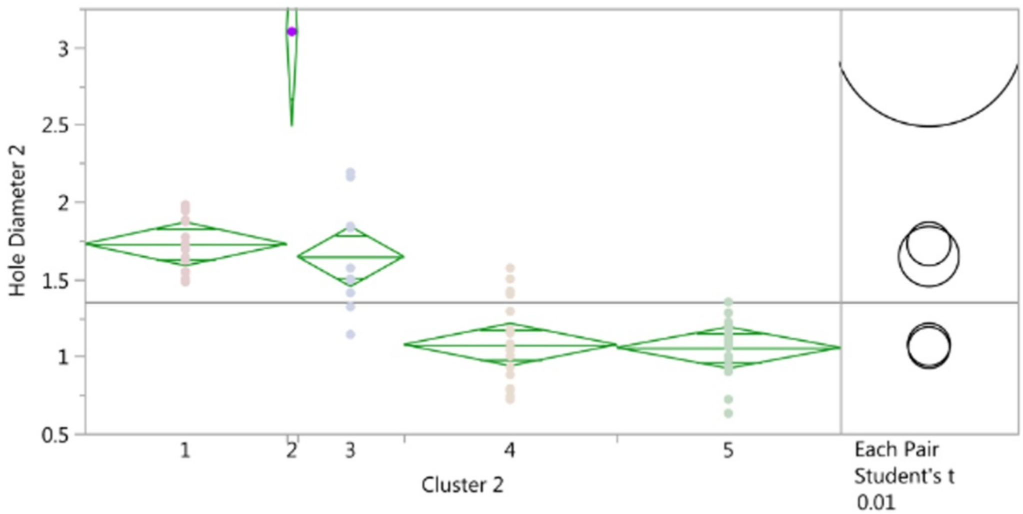
Difference	0.385000	t Ratio	6.093875
Std Err Dif	0.063178	DF	13
Upper CL Dif	0.575310	Prob > |t|	<.0001*
Lower CL Dif	0.194690	Prob > t	<.0001*
Confidence	0.99	Prob < t	1.0000



Irregular/Semi-irregular Diamond Drilled Carnelian


Scatterplot Matrix
Cluster 2
1
2
3
4
5
L/W 2
0.9
0.8
0.7
0.6
0.5
0.5
1
1.5
2
2.5
3
Hole Diameter 2

Oneway Analysis of Hole Diameter 2 By Cluster 2



Oneway Anova

Summary of Fit

Rsquare	0.738332
Adj Rsquare	0.722473
Root Mean Square Error	0.231265
Mean of Response	1.352254
Observations (or Sum Wgts)	71

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Cluster 2	4	9.960124	2.49003	46.5569	<.0001*
Error	66	3.529916	0.05348		
C. Total	70	13.490039			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 99%	Upper 99%
1	19	1.72632	0.05306	1.5856	1.8670
2	1	3.10000	0.23127	2.4866	3.7134
3	10	1.64500	0.07313	1.4510	1.8390
4	20	1.07500	0.05171	0.9378	1.2122
5	21	1.05524	0.05047	0.9214	1.1891

Std Error uses a pooled estimate of error variance

Means Comparisons

Comparisons for each pair using Student's t

Confidence Quantile

t	Alpha
2.65239	0.01

LSD Threshold Matrix

Abs(Dif)-LSD

	2	1	3	4	5
2	-0.8675	0.7443	0.8117	1.3964	1.4169
1	0.7443	-0.1990	-0.1583	0.4548	0.4769
3	0.8117	-0.1583	-0.2743	0.3324	0.3541
4	1.3964	0.4548	0.3324	-0.1940	-0.1719
5	1.4169	0.4769	0.3541	-0.1719	-0.1893

Positive values show pairs of means that are significantly different.

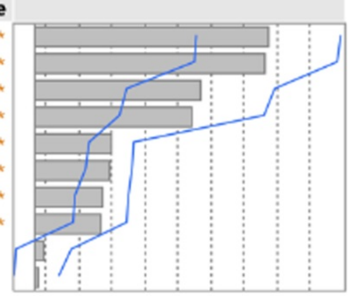
Connecting Letters Report

Level				Mean
2	A			3.1000000
1		B		1.7263158
3		B		1.6450000
4			C	1.0750000
5			C	1.0552381

Levels not connected by same letter are significantly different.

Ordered Differences Report

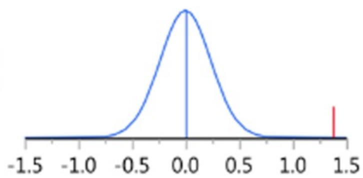
Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
2	5	2.044762	0.2367074	1.41692	2.672603	<.0001*
2	4	2.025000	0.2369763	1.39645	2.653554	<.0001*
2	3	1.455000	0.2425529	0.81165	2.098346	<.0001*
2	1	1.373684	0.2372730	0.74434	2.003026	<.0001*
1	5	0.671078	0.0732241	0.47686	0.865297	<.0001*
1	4	0.651316	0.0740885	0.45480	0.847828	<.0001*
3	5	0.589762	0.0888549	0.35408	0.825440	<.0001*
3	4	0.570000	0.0895686	0.33243	0.807571	<.0001*
1	3	0.081316	0.0903509	-0.15833	0.320962	0.3714
4	5	0.019762	0.0722566	-0.17189	0.211415	0.7853



Detailed Comparisons Report

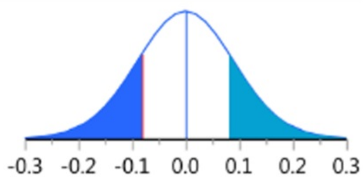
Comparing 2 with 1

Difference	1.37368	t Ratio	5.789466
Std Err Dif	0.23727	DF	66
Upper CL Dif	2.00303	Prob > |t|	<.0001*
Lower CL Dif	0.74434	Prob > t	<.0001*
Confidence	0.99	Prob < t	1.0000



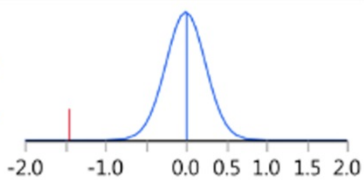
Comparing 3 with 1

Difference	-0.08132	t Ratio	-0.9
Std Err Dif	0.09035	DF	66
Upper CL Dif	0.15833	Prob > |t|	0.3714
Lower CL Dif	-0.32096	Prob > t	0.8143
Confidence	0.99	Prob < t	0.1857



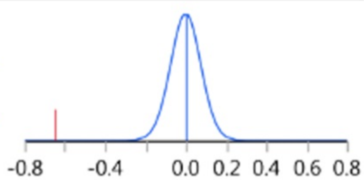
Comparing 3 with 2

Difference	-1.4550	t Ratio	-5.99869
Std Err Dif	0.2426	DF	66
Upper CL Dif	-0.8117	Prob > |t|	<.0001*
Lower CL Dif	-2.0983	Prob > t	1.0000
Confidence	0.99	Prob < t	<.0001*



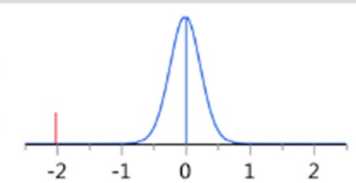
Comparing 4 with 1

Difference	-0.65132	t Ratio	-8.79105
Std Err Dif	0.07409	DF	66
Upper CL Dif	-0.45480	Prob > |t|	<.0001*
Lower CL Dif	-0.84783	Prob > t	1.0000
Confidence	0.99	Prob < t	<.0001*



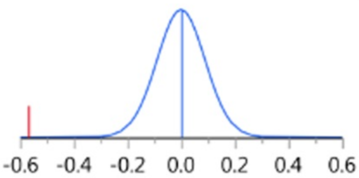
Comparing 4 with 2

Difference	-2.0250	t Ratio	-8.54516
Std Err Dif	0.2370	DF	66
Upper CL Dif	-1.3964	Prob > |t|	<.0001*
Lower CL Dif	-2.6536	Prob > t	1.0000
Confidence	0.99	Prob < t	<.0001*



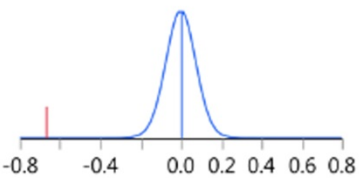
Comparing 4 with 3

Difference	-0.57000	t Ratio	-6.36384
Std Err Dif	0.08957	DF	66
Upper CL Dif	-0.33243	Prob > |t|	<.0001*
Lower CL Dif	-0.80757	Prob > t	1.0000
Confidence	0.99	Prob < t	<.0001*



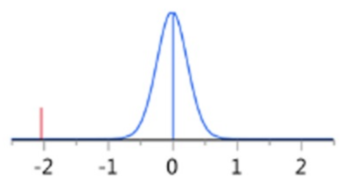
Comparing 5 with 1

Difference	-0.67108	t Ratio	-9.16472
Std Err Dif	0.07322	DF	66
Upper CL Dif	-0.47686	Prob > |t|	<.0001*
Lower CL Dif	-0.86530	Prob > t	1.0000
Confidence	0.99	Prob < t	<.0001*



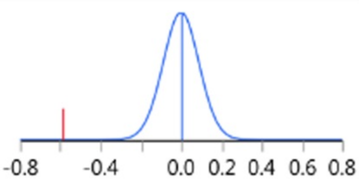
Comparing 5 with 2

Difference	-2.0448	t Ratio	-8.63835
Std Err Dif	0.2367	DF	66
Upper CL Dif	-1.4169	Prob > |t|	<.0001*
Lower CL Dif	-2.6726	Prob > t	1.0000
Confidence	0.99	Prob < t	<.0001*



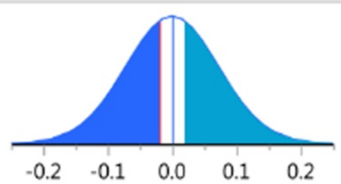
Comparing 5 with 3

Difference	-0.58976	t Ratio	-6.63736
Std Err Dif	0.08885	DF	66
Upper CL Dif	-0.35408	Prob > |t|	<.0001*
Lower CL Dif	-0.82544	Prob > t	1.0000
Confidence	0.99	Prob < t	<.0001*

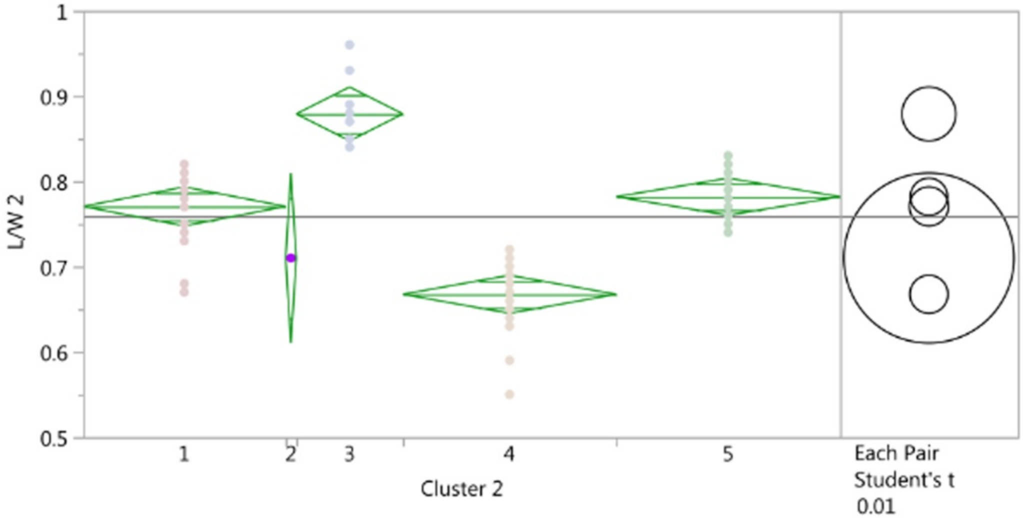


Comparing 5 with 4

Difference	-0.01976	t Ratio	-0.2735
Std Err Dif	0.07226	DF	66
Upper CL Dif	0.17189	Prob > |t|	0.7853
Lower CL Dif	-0.21141	Prob > t	0.6073
Confidence	0.99	Prob < t	0.3927



Oneway Analysis of L/W 2 By Cluster 2



Oneway Anova

Summary of Fit

Rsquare	0.778247
Adj Rsquare	0.764808
Root Mean Square Error	0.037595
Mean of Response	0.759296
Observations (or Sum Wgts)	71

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Cluster 2	4	0.32738124	0.081845	57.9072	<.0001*
Error	66	0.09328355	0.001413		
C. Total	70	0.42066479			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 99%	Upper 99%
1	19	0.770526	0.00862	0.74765	0.79340
2	1	0.710000	0.03760	0.61028	0.80972
3	10	0.879000	0.01189	0.84747	0.91053
4	20	0.667500	0.00841	0.64520	0.68980
5	21	0.781905	0.00820	0.76014	0.80366

Std Error uses a pooled estimate of error variance

Means Comparisons

Comparisons for each pair using Student's t

Confidence Quantile

t	Alpha
2.65239	0.01

LSD Threshold Matrix

Abs(Dif)-LSD

	3	5	1	2	4
3	-0.04459	0.05878	0.06952	0.06442	0.17288
5	0.05878	-0.03077	-0.02019	-0.03016	0.08325
1	0.06952	-0.02019	-0.03235	-0.04178	0.07108
2	0.06442	-0.03016	-0.04178	-0.14102	-0.05968
4	0.17288	0.08325	0.07108	-0.05968	-0.03153

Positive values show pairs of means that are significantly different.

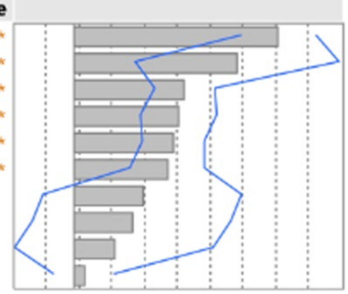
Connecting Letters Report

Level				Mean
3	A			0.87900000
5		B		0.78190476
1		B		0.77052632
2		B	C	0.71000000
4			C	0.66750000

Levels not connected by same letter are significantly different.

Ordered Differences Report

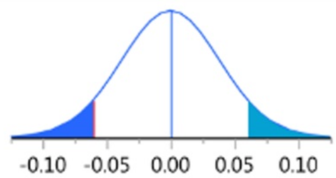
Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
3	4	0.2115000	0.0145605	0.172880	0.2501202	<.0001*
3	2	0.1690000	0.0394300	0.064416	0.2735839	<.0001*
5	4	0.1144048	0.0117462	0.083249	0.1455603	<.0001*
3	1	0.1084737	0.0146877	0.069516	0.1474312	<.0001*
1	4	0.1030263	0.0120440	0.071081	0.1349718	<.0001*
3	5	0.0970952	0.0144445	0.058783	0.1354077	<.0001*
5	2	0.0719048	0.0384798	-0.030159	0.1739682	0.0661
1	2	0.0605263	0.0385717	-0.041781	0.1628336	0.1214
2	4	0.0425000	0.0385235	-0.059679	0.1446794	0.2739
5	1	0.0113784	0.0119035	-0.020194	0.0429512	0.3426



Detailed Comparisons Report

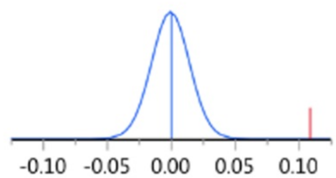
Comparing 2 with 1

Difference	-0.06053	t Ratio	-1.56919
Std Err Dif	0.03857	DF	66
Upper CL Dif	0.04178	Prob > |t|	0.1214
Lower CL Dif	-0.16283	Prob > t	0.9393
Confidence	0.99	Prob < t	0.0607



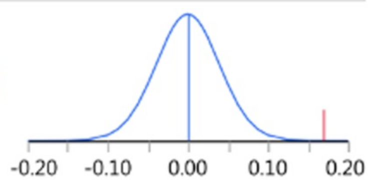
Comparing 3 with 1

Difference	0.108474	t Ratio	7.385359
Std Err Dif	0.014688	DF	66
Upper CL Dif	0.147431	Prob > |t|	<.0001*
Lower CL Dif	0.069516	Prob > t	<.0001*
Confidence	0.99	Prob < t	1.0000



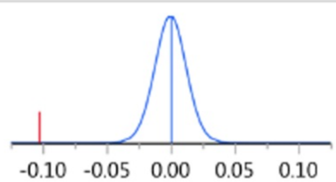
Comparing 3 with 2

Difference	0.169000	t Ratio	4.286075
Std Err Dif	0.039430	DF	66
Upper CL Dif	0.273584	Prob > |t|	<.0001*
Lower CL Dif	0.064416	Prob > t	<.0001*
Confidence	0.99	Prob < t	1.0000



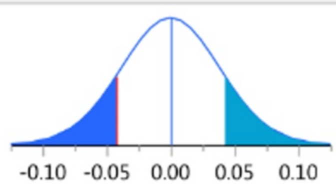
Comparing 4 with 1

Difference	-0.10303	t Ratio	-8.55415
Std Err Dif	0.01204	DF	66
Upper CL Dif	-0.07108	Prob > |t|	<.0001*
Lower CL Dif	-0.13497	Prob > t	1.0000
Confidence	0.99	Prob < t	<.0001*



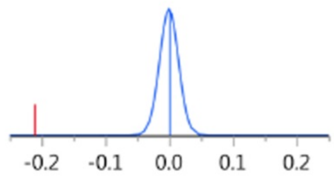
Comparing 4 with 2

Difference	-0.04250	t Ratio	-1.10322
Std Err Dif	0.03852	DF	66
Upper CL Dif	0.05968	Prob > |t|	0.2739
Lower CL Dif	-0.14468	Prob > t	0.8630
Confidence	0.99	Prob < t	0.1370



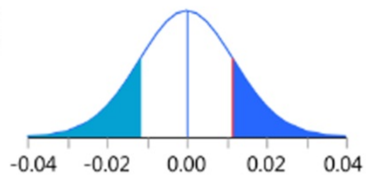
Comparing 4 with 3

Difference	-0.21150	t Ratio	-14.5256
Std Err Dif	0.01456	DF	66
Upper CL Dif	-0.17288	Prob > |t|	<.0001*
Lower CL Dif	-0.25012	Prob > t	1.0000
Confidence	0.99	Prob < t	<.0001*



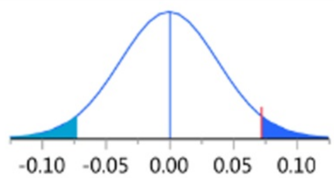
Comparing 5 with 1

Difference	0.01138	t Ratio	0.955892
Std Err Dif	0.01190	DF	66
Upper CL Dif	0.04295	Prob > |t|	0.3426
Lower CL Dif	-0.02019	Prob > t	0.1713
Confidence	0.99	Prob < t	0.8287



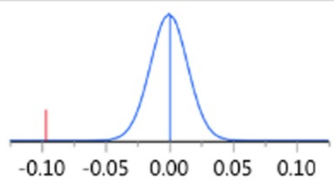
Comparing 5 with 2

Difference	0.07190	t Ratio	1.868639
Std Err Dif	0.03848	DF	66
Upper CL Dif	0.17397	Prob > |t|	0.0661
Lower CL Dif	-0.03016	Prob > t	0.0331*
Confidence	0.99	Prob < t	0.9669



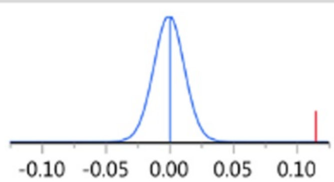
Comparing 5 with 3

Difference	-0.09710	t Ratio	-6.72196
Std Err Dif	0.01444	DF	66
Upper CL Dif	-0.05878	Prob > |t|	<.0001*
Lower CL Dif	-0.13541	Prob > t	1.0000
Confidence	0.99	Prob < t	<.0001*



Comparing 5 with 4

Difference	0.114405	t Ratio	9.739715
Std Err Dif	0.011746	DF	66
Upper CL Dif	0.145560	Prob > |t|	<.0001*
Lower CL Dif	0.083249	Prob > t	<.0001*
Confidence	0.99	Prob < t	1.0000

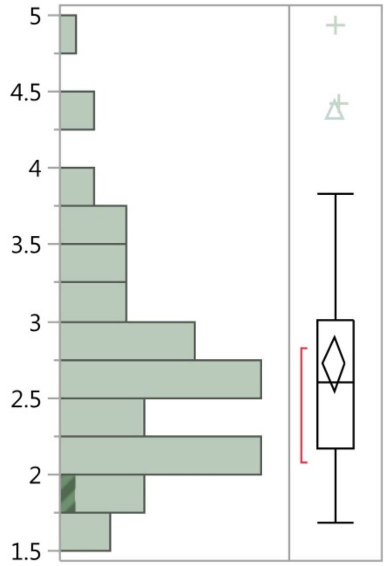


A1c: Jasper/Green Tuff/Agate

Cylindrical beads

Distributions

Size



Quantiles

100.0%	maximum	4.933333333
99.5%		4.933333333
97.5%		4.639444444
90.0%		3.744231975
75.0%	quartile	3.012455918
50.0%	median	2.595896989
25.0%	quartile	2.16811936
10.0%		1.964209518
2.5%		1.704298091
0.5%		1.690205011
0.0%	minimum	1.690205011

Summary Statistics

Mean	2.7134612
Std Dev	0.6994535
Std Err Mean	0.0888307
Upper 95% Mean	2.8910892
Lower 95% Mean	2.5358333
N	62

Iterative Clustering

Cluster Comparison

Method	NCluster	CCC	Best
K-Means Clustering	3	-3.5789	
K-Means Clustering	4	-2.2699	
K-Means Clustering	5	-2.7769	
K-Means Clustering	6	-3.1242	
K-Means Clustering	7	-2.6118	
K-Means Clustering	8	-0.8712	Optimal CCC
K-Means Clustering	9	-0.9829	
K-Means Clustering	10	-1.6767	

Columns Scaled Individually

K Means NCluster=8

Columns Scaled Individually

Cluster Summary

Cluster	Count
1	7
2	2
3	8
4	11
5	2
6	19
7	1
8	12

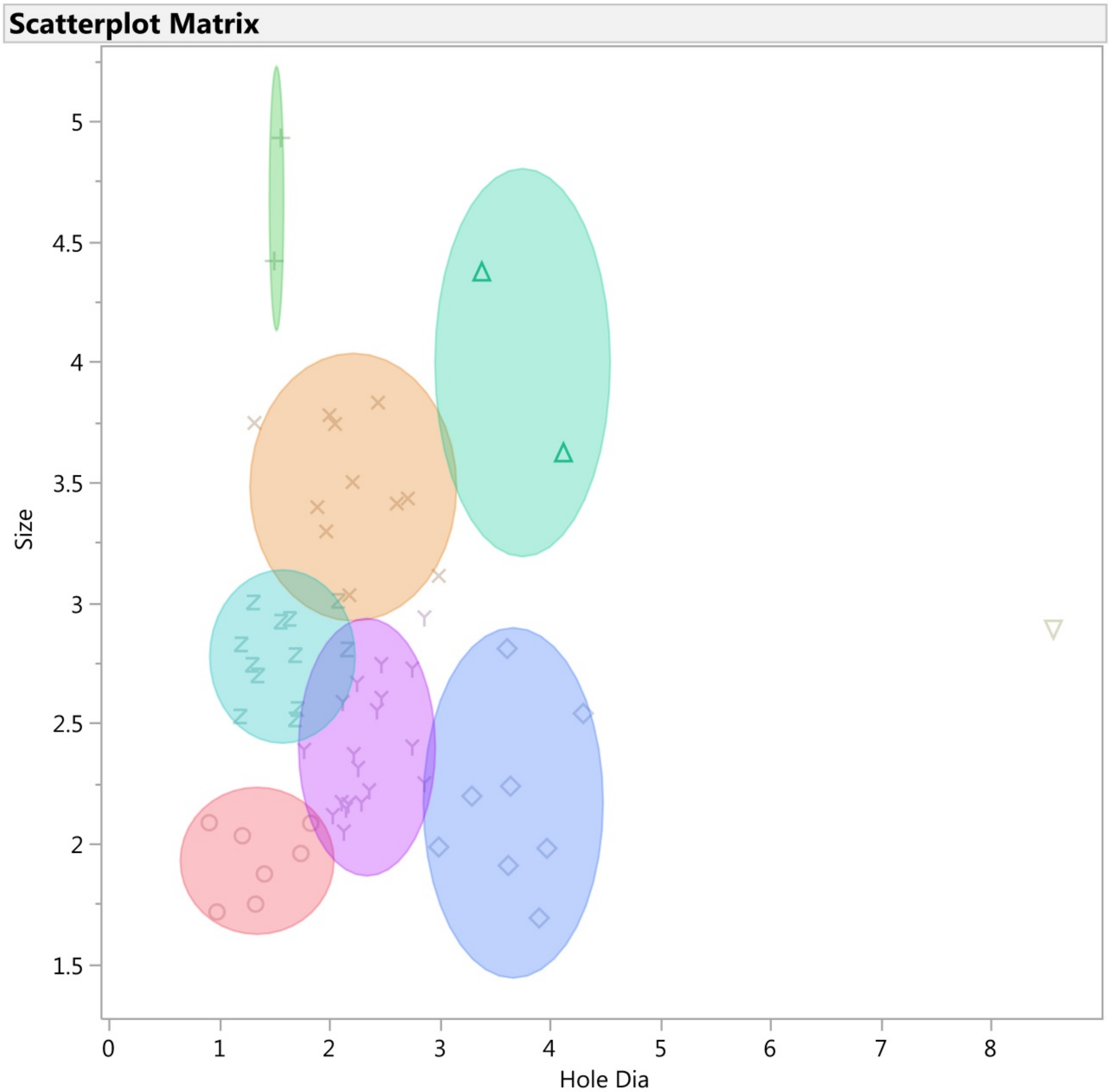
Step	Criterion
5	0

Cluster Means

Cluster	Hole Dia	Size
1	1.38428571	1.92746356
2	1.56	4.67777778
3	3.705	2.1678107
4	2.25545455	3.47903084
5	3.79	3.99624226
6	2.37947368	2.39920976
7	8.6	2.89
8	1.61333333	2.7756251

Cluster Standard Deviations

Cluster	Hole Dia	Size
1	0.3243392	0.14220084
2	0.03	0.25555556
3	0.37970383	0.3389165
4	0.43627272	0.25894668
5	0.37	0.37555261
6	0.2885622	0.24916707
7	0	0
8	0.3070921	0.16770903

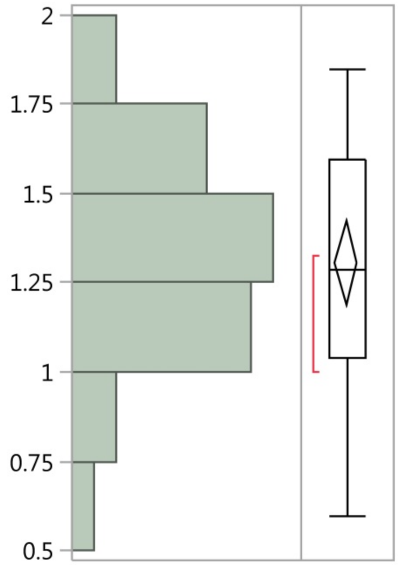


A1d: Rock Crystal

Faceted Rock Crystal Bead Distribution

Distributions

Size

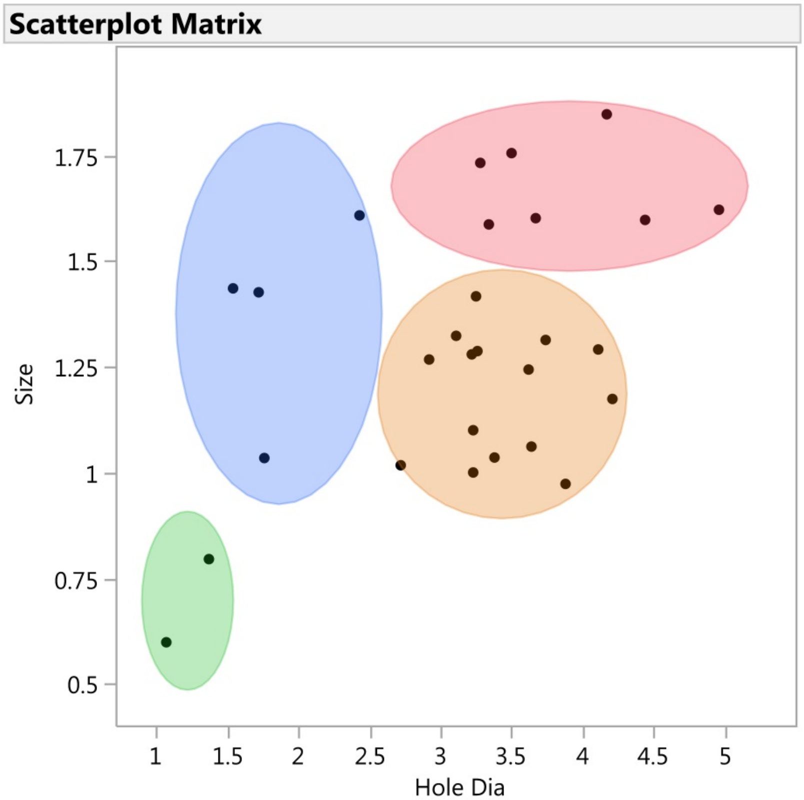


Quantiles

100.0%	maximum	1.847222222
99.5%		1.847222222
97.5%		1.847222222
90.0%		1.734594687
75.0%	quartile	1.594746163
50.0%	median	1.289018902
25.0%	quartile	1.041861818
10.0%		0.955183872
2.5%		0.598360656
0.5%		0.598360656
0.0%	minimum	0.598360656

Summary Statistics

Mean	1.300769
Std Dev	0.3033692
Std Err Mean	0.0573314
Upper 95% Mean	1.4184033
Lower 95% Mean	1.1831347
N	28


Scatterplot Matrix
Size
1.75
1.5
1.25
1
0.75
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Hole Dia

Iterative Clustering

Cluster Comparison

Method	NCluster	CCC	Best
K-Means Clustering	3	-2.8595	
K-Means Clustering	4	-1.4969	Optimal CCC
K-Means Clustering	5	-1.7965	
K-Means Clustering	6	-2.2836	

Columns Scaled Individually

K Means NCluster=4

Columns Scaled Individually

Cluster Summary

Cluster	Count
1	7
2	2
3	4
4	15

Step	Criterion
2	0

Cluster Means

Cluster	Hole Dia	Size
1	3.93857143	1.67743045
2	1.25	0.69672131
3	1.8925	1.37600238
4	3.46466667	1.18547107

Cluster Standard Deviations

Cluster	Hole Dia	Size
1	0.58535529	0.09368662
2	0.15	0.09836066
3	0.33796265	0.21022067
4	0.40855627	0.13721451

K Means NCluster=5

Columns Scaled Individually

Cluster Summary

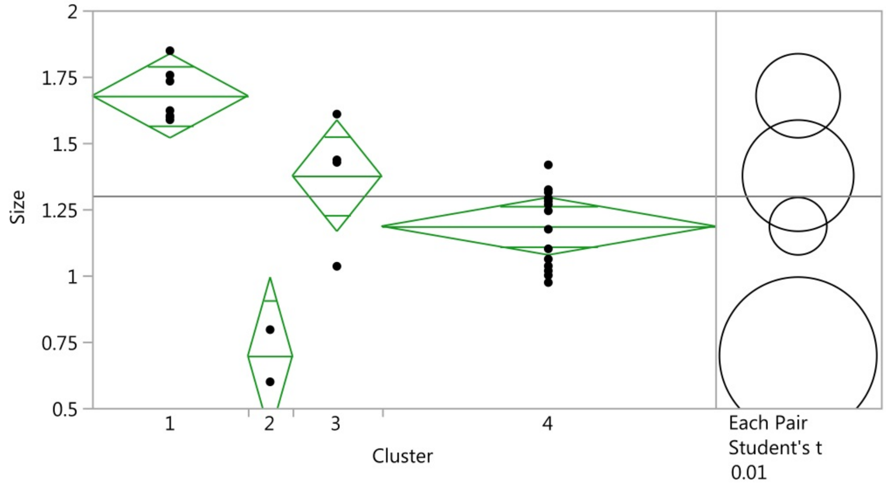
Cluster	Count
1	6
2	2
3	3
4	14
5	3

Step	Criterion
3	0

Cluster Means

Cluster	Hole Dia	Size
1	3.275	1.61678909
2	1.25	0.69672131
3	1.70333333	1.2986338
4	3.47785714	1.1689571
5	4.55333333	1.68868446

Oneway Analysis of Size By Cluster



Oneway Anova

Summary of Fit

Rsquare	0.782695
Adj Rsquare	0.755532
Root Mean Square Error	0.149997
Mean of Response	1.300769
Observations (or Sum Wgts)	28

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Cluster	3	1.9449086	0.648303	28.8146	<.0001*
Error	24	0.5399782	0.022499		
C. Total	27	2.4848868			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 99%	Upper 99%
1	7	1.67743	0.05669	1.5189	1.8360
2	2	0.69672	0.10606	0.4001	0.9934
3	4	1.37600	0.07500	1.1662	1.5858
4	15	1.18547	0.03873	1.0771	1.2938

Std Error uses a pooled estimate of error variance

Means Comparisons

Comparisons for each pair using Student's t

Confidence Quantile

t	Alpha
2.79694	0.01

LSD Threshold Matrix

Abs(Dif)-LSD

	1	3	4	2
1	-0.22425	0.03847	0.29992	0.64433
3	0.03847	-0.29665	-0.04555	0.31596
4	0.29992	-0.04555	-0.15319	0.17294
2	0.64433	0.31596	0.17294	-0.41953

Positive values show pairs of means that are significantly different.

Connecting Letters Report

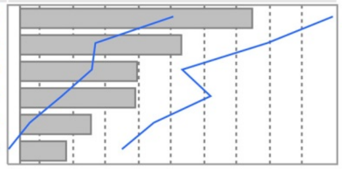
Level				Mean
1	A			1.6774305
3		B		1.3760024
4		B		1.1854711
2			C	0.6967213

Levels not connected by same letter are significantly different.

Levels not connected by same letter are significantly different.

Ordered Differences Report

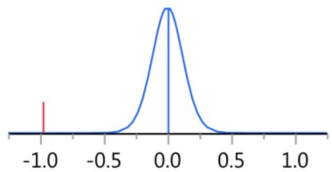
Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
1	2	0.9807091	0.1202651	0.644335	1.317083	<.0001*
3	2	0.6792811	0.1299012	0.315955	1.042607	<.0001*
1	4	0.4919594	0.0686593	0.299924	0.683995	<.0001*
4	2	0.4887498	0.1129136	0.172937	0.804562	0.0002*
1	3	0.3014281	0.0940156	0.038472	0.564384	0.0038*
3	4	0.1905313	0.0844080	-0.045553	0.426615	0.0334*



Detailed Comparisons Report

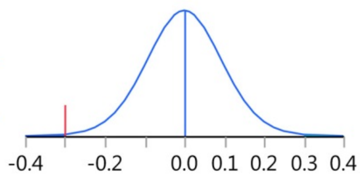
Comparing 2 with 1

Difference	-0.9807	t Ratio	-8.15456
Std Err Dif	0.1203	DF	24
Upper CL Dif	-0.6443	Prob > |t|	<.0001*
Lower CL Dif	-1.3171	Prob > t	1.0000
Confidence	0.99	Prob < t	<.0001*



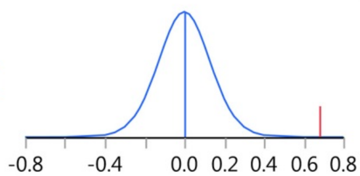
Comparing 3 with 1

Difference	-0.30143	t Ratio	-3.20615
Std Err Dif	0.09402	DF	24
Upper CL Dif	-0.03847	Prob > |t|	0.0038*
Lower CL Dif	-0.56438	Prob > t	0.9981
Confidence	0.99	Prob < t	0.0019*



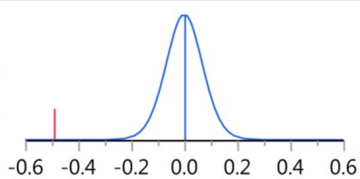
Comparing 3 with 2

Difference	0.67928	t Ratio	5.229214
Std Err Dif	0.12990	DF	24
Upper CL Dif	1.04261	Prob > |t|	<.0001*
Lower CL Dif	0.31596	Prob > t	<.0001*
Confidence	0.99	Prob < t	1.0000



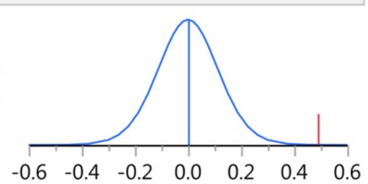
Comparing 4 with 1

Difference	-0.49196	t Ratio	-7.16523
Std Err Dif	0.06866	DF	24
Upper CL Dif	-0.29992	Prob > |t|	<.0001*
Lower CL Dif	-0.68400	Prob > t	1.0000
Confidence	0.99	Prob < t	<.0001*



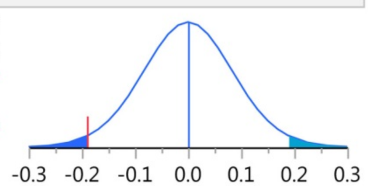
Comparing 4 with 2

Difference	0.488750	t Ratio	4.328528
Std Err Dif	0.112914	DF	24
Upper CL Dif	0.804562	Prob > |t|	0.0002*
Lower CL Dif	0.172937	Prob > t	0.0001*
Confidence	0.99	Prob < t	0.9999

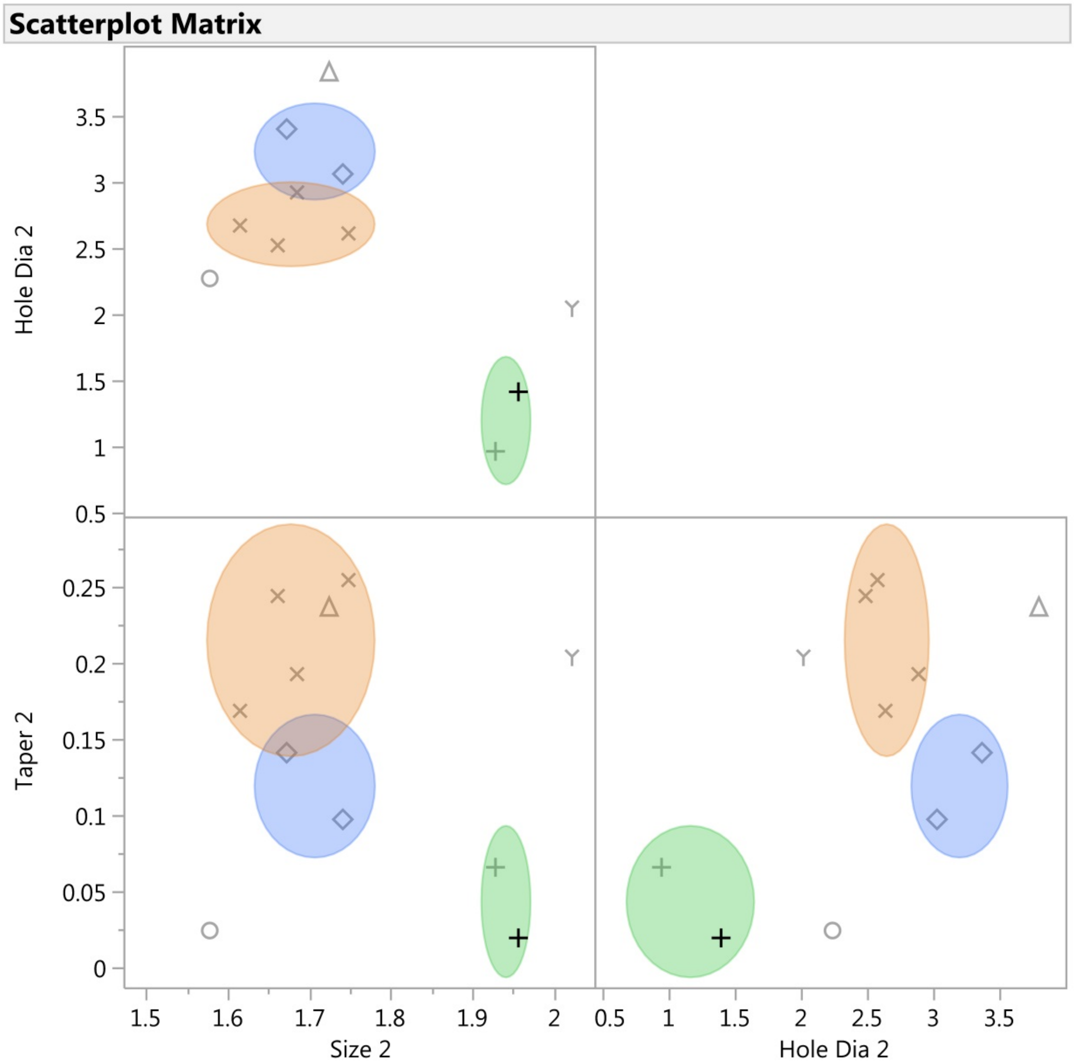


Comparing 4 with 3

Difference	-0.19053	t Ratio	-2.25727
Std Err Dif	0.08441	DF	24
Upper CL Dif	0.04555	Prob > |t|	0.0334*
Lower CL Dif	-0.42662	Prob > t	0.9833
Confidence	0.99	Prob < t	0.0167*



Rock Crystal *Gogok/Magatama*



Iterative Clustering

Cluster Comparison

Method	NCluster	CCC	Best
K-Means Clustering	3	-1.2753	
K-Means Clustering	4	-1.0881	
K-Means Clustering	5	-1.2065	
K-Means Clustering	6	-0.5863	Optimal CCC

Columns Scaled Individually

K Means NCluster=6

Columns Scaled Individually

Cluster Summary

Cluster	Count
1	1
2	2
3	2
4	4
5	1
6	1

Step	Criterion
2	0

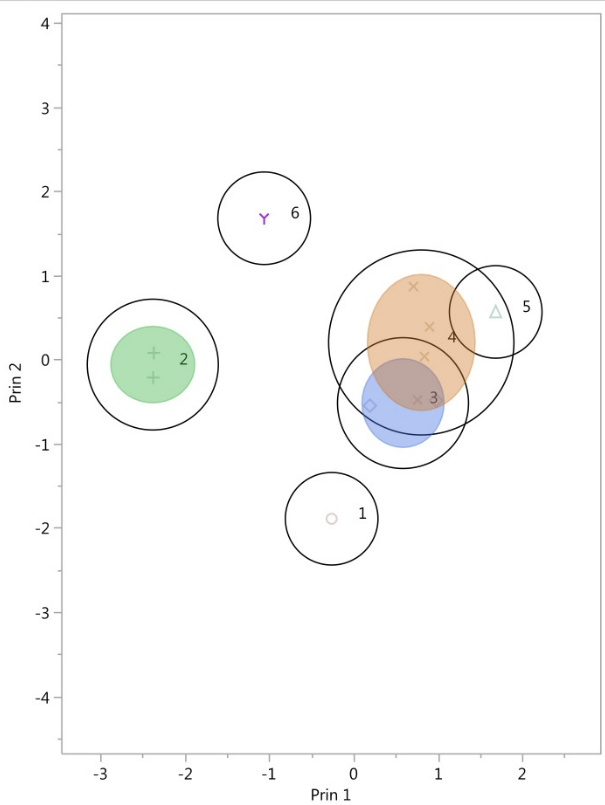
Cluster Means

Cluster	Size 2	Hole Dia 2	Taper 2
1	1.58333333	2.27	0.0242
2	1.94647937	1.195	0.0432
3	1.71205523	3.23	0.1191
4	1.68271297	2.68	0.21485
5	1.72972973	3.83	0.2365
6	2.02752294	2.05	0.2041

Cluster Standard Deviations

Cluster	Size 2	Hole Dia 2	Taper 2
1	0	0	0
2	0.01404694	0.225	0.0232
3	0.03442365	0.17	0.0219
4	0.04794192	0.14849242	0.03553692
5	0	0	0
6	0	0	0

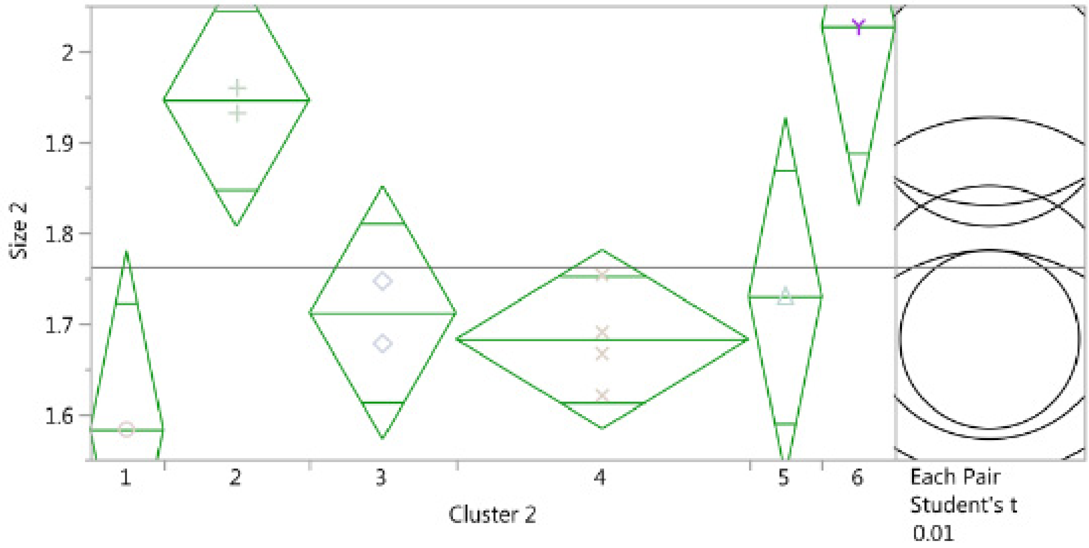
Biplot



Save Colors to Table

Eigenvalues
1.8941362 0.8436494 0.2622143

Oneway Analysis of Size 2 By Cluster 2



Oneway Anova

Summary of Fit

Rsquare	0.944021
Adj Rsquare	0.888041
Root Mean Square Error	0.048905
Mean of Response	1.762592
Observations (or Sum Wgts)	11

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Cluster 2	5	0.20166170	0.040332	16.8637	0.0038*
Error	5	0.01195832	0.002392		
C. Total	10	0.21362002			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 99%	Upper 99%
1	1	1.58333	0.04890	1.3861	1.7805
2	2	1.94648	0.03458	1.8070	2.0859
3	2	1.71206	0.03458	1.5726	1.8515
4	4	1.68271	0.02445	1.5841	1.7813
5	1	1.72973	0.04890	1.5325	1.9269
6	1	2.02752	0.04890	1.8303	2.2247

Std Error uses a pooled estimate of error variance

Means Comparisons

Comparisons for each pair using Student's t

Confidence Quantile

t	Alpha
4.03214	0.01

LSD Threshold Matrix

Abs(Dif)-LSD

	6	2	5	3	4	1
6	-0.27887	-0.16046	0.01892	0.07396	0.12434	0.16532
2	-0.16046	-0.19719	-0.02476	0.03723	0.09299	0.12164
5	0.01892	-0.02476	-0.27887	-0.22383	-0.17345	-0.13247
3	0.07396	0.03723	-0.22383	-0.19719	-0.14143	-0.11279
4	0.12434	0.09299	-0.17345	-0.14143	-0.13943	-0.12109
1	0.16532	0.12164	-0.13247	-0.11279	-0.12109	-0.27887

Positive values show pairs of means that are significantly different.

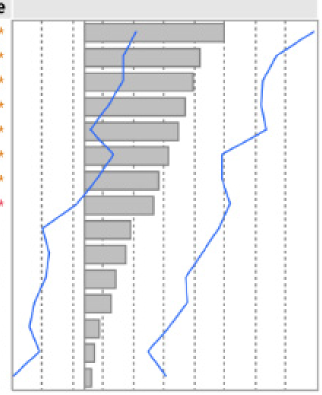
Connecting Letters Report

Level				Mean
6	A			2.0275229
2	A	B		1.9464794
5		B	C	1.7297297
3			C	1.7120552
4			C	1.6827130
1			C	1.5833333

Levels not connected by same letter are significantly different.

Ordered Differences Report

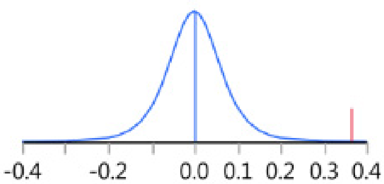
Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
6	1	0.4441896	0.0691616	0.165320	0.7230591	0.0014*
2	1	0.3631460	0.0598957	0.121638	0.6046541	0.0018*
6	4	0.3448100	0.0546770	0.124344	0.5652756	0.0015*
6	3	0.3154677	0.0598957	0.073960	0.5569758	0.0033*
6	5	0.2977932	0.0691616	0.018924	0.5766627	0.0077*
2	4	0.2637664	0.0423527	0.092994	0.4345384	0.0016*
2	3	0.2344241	0.0489046	0.037234	0.4316146	0.0049*
2	5	0.2167496	0.0598957	-0.024758	0.4582577	0.0152*
5	1	0.1463964	0.0691616	-0.132473	0.4252659	0.0879
3	1	0.1287219	0.0598957	-0.112786	0.3702299	0.0843
4	1	0.0993796	0.0546770	-0.121086	0.3198453	0.1288
6	2	0.0810436	0.0598957	-0.160464	0.3225516	0.2340
5	4	0.0470168	0.0546770	-0.173449	0.2674824	0.4291
3	4	0.0293423	0.0423527	-0.141430	0.2001142	0.5193
5	3	0.0176745	0.0598957	-0.223834	0.2591826	0.7798



Detailed Comparisons Report

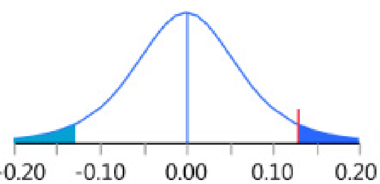
Comparing 2 with 1

Difference	0.363146	t Ratio	6.062973
Std Err Dif	0.059896	DF	5
Upper CL Dif	0.604654	Prob > |t|	0.0018*
Lower CL Dif	0.121638	Prob > t	0.0009*
Confidence	0.99	Prob < t	0.9991



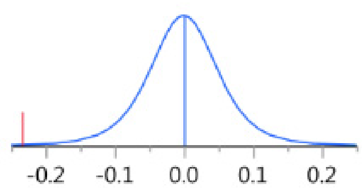
Comparing 3 with 1

Difference	0.12872	t Ratio	2.149101
Std Err Dif	0.05990	DF	5
Upper CL Dif	0.37023	Prob > |t|	0.0843
Lower CL Dif	-0.11279	Prob > t	0.0422*
Confidence	0.99	Prob < t	0.9578



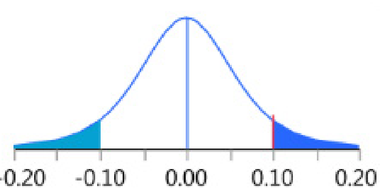
Comparing 3 with 2

Difference	-0.23442	t Ratio	-4.7935
Std Err Dif	0.04890	DF	5
Upper CL Dif	-0.03723	Prob > |t|	0.0049*
Lower CL Dif	-0.43161	Prob > t	0.9975
Confidence	0.99	Prob < t	0.0025*



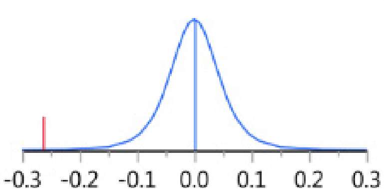
Comparing 4 with 1

Difference	0.09938	t Ratio	1.817575
Std Err Dif	0.05468	DF	5
Upper CL Dif	0.31985	Prob > |t|	0.1288
Lower CL Dif	-0.12109	Prob > t	0.0644
Confidence	0.99	Prob < t	0.9356



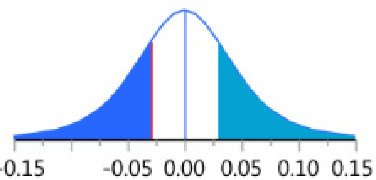
Comparing 4 with 2

Difference	-0.26377	t Ratio	-6.22786
Std Err Dif	0.04235	DF	5
Upper CL Dif	-0.09299	Prob > |t|	0.0016*
Lower CL Dif	-0.43454	Prob > t	0.9992
Confidence	0.99	Prob < t	0.0008*



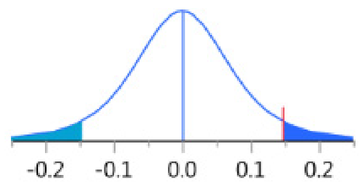
Comparing 4 with 3

Difference	-0.02934	t Ratio	-0.69281
Std Err Dif	0.04235	DF	5
Upper CL Dif	0.14143	Prob > |t|	0.5193
Lower CL Dif	-0.20011	Prob > t	0.7404
Confidence	0.99	Prob < t	0.2596



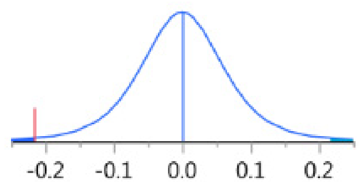
Comparing 5 with 1

Difference	0.14640	t Ratio	2.116729
Std Err Dif	0.06916	DF	5
Upper CL Dif	0.42527	Prob > |t|	0.0879
Lower CL Dif	-0.13247	Prob > t	0.0439*
Confidence	0.99	Prob < t	0.9561



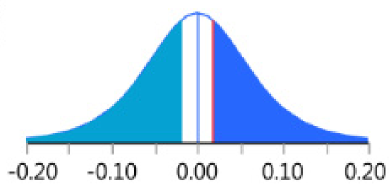
Comparing 5 with 2

Difference	-0.21675	t Ratio	-3.61878
Std Err Dif	0.05990	DF	5
Upper CL Dif	0.02476	Prob > |t|	0.0152*
Lower CL Dif	-0.45826	Prob > t	0.9924
Confidence	0.99	Prob < t	0.0076*



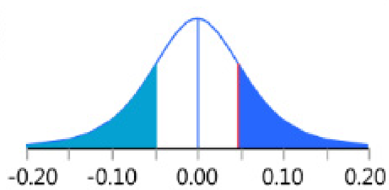
Comparing 5 with 3

Difference	0.01767	t Ratio	0.295088
Std Err Dif	0.05990	DF	5
Upper CL Dif	0.25918	Prob > |t|	0.7798
Lower CL Dif	-0.22383	Prob > t	0.3899
Confidence	0.99	Prob < t	0.6101



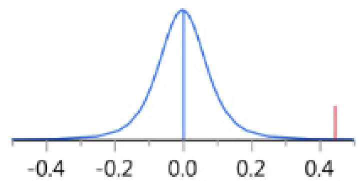
Comparing 5 with 4

Difference	0.04702	t Ratio	0.859899
Std Err Dif	0.05468	DF	5
Upper CL Dif	0.26748	Prob > |t|	0.4291
Lower CL Dif	-0.17345	Prob > t	0.2146
Confidence	0.99	Prob < t	0.7854



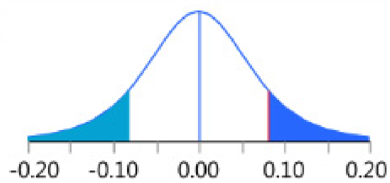
Comparing 6 with 1

Difference	0.444190	t Ratio	6.422489
Std Err Dif	0.069162	DF	5
Upper CL Dif	0.723059	Prob > |t|	0.0014*
Lower CL Dif	0.165320	Prob > t	0.0007*
Confidence	0.99	Prob < t	0.9993



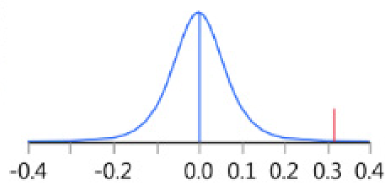
Comparing 6 with 2

Difference	0.08104	t Ratio	1.353078
Std Err Dif	0.05990	DF	5
Upper CL Dif	0.32255	Prob > |t|	0.2340
Lower CL Dif	-0.16046	Prob > t	0.1170
Confidence	0.99	Prob < t	0.8830



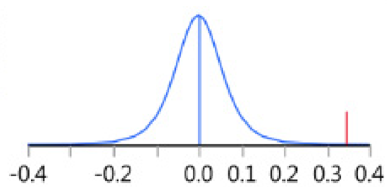
Comparing 6 with 3

Difference	0.315468	t Ratio	5.26695
Std Err Dif	0.059896	DF	5
Upper CL Dif	0.556976	Prob > |t|	0.0033*
Lower CL Dif	0.073960	Prob > t	0.0016*
Confidence	0.99	Prob < t	0.9984



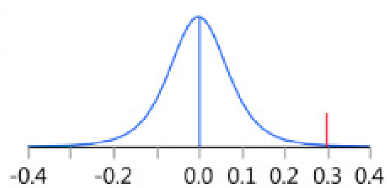
Comparing 6 with 4

Difference	0.344810	t Ratio	6.306302
Std Err Dif	0.054677	DF	5
Upper CL Dif	0.565276	Prob > |t|	0.0015*
Lower CL Dif	0.124344	Prob > t	0.0007*
Confidence	0.99	Prob < t	0.9993



Comparing 6 with 5

Difference	0.297793	t Ratio	4.305759
Std Err Dif	0.069162	DF	5
Upper CL Dif	0.576663	Prob > |t|	0.0077*
Lower CL Dif	0.018924	Prob > t	0.0038*
Confidence	0.99	Prob < t	0.9962



Appendix 2

Raw Data Files

The data recorded in an Excel worksheet covers multiple horizontally oriented pages. Artifact number has been included on each page to indicate which artifacts are being discussed across pages. The same has been done for taper measurements in A2b only vertically oriented. Some taper measurements were not performed either because the drill holes were visibly straight or because impressions were not taken.

A2a: Raw Data

(Raw Data begins next page.)

Beads				**DA number**	
Year	**Site**	Structure	Locus	**REG.NUMBER**	NUMBER
3 kingdoms Gaya	Bucheon dong	tomb		K0001	N/A
3 kingdoms Gaya	Bucheon dong Tomb 15	tomb		K0002	DB15(big)
3 kingdoms Gaya	Bucheon dong Tomb 15	tomb		K0003	DB15(small)
3 kingdoms Gaya	Bucheon dong Tomb 80	tomb		K0004	N/A
Proto/3 Kingdoms	Unyangdong site, Gimpo City			K0005	32 1-11 지점 12 호(19)
Proto/3 Kingdoms	Unyangdong site, Gimpo City			K0006	32 1-11 지점 12 호(20)
Proto/3 Kingdoms	Unyangdong site, Gimpo City			K0007	321-11
Proto/3 Kingdoms	Unyangdong site, Gimpo City			K0008	2-9 지점 2 호분구요묵관바닥 109
Proto/3 Kingdoms	Unyangdong site, Gimpo City			K0009	2-9 지점 4 호수혈
Proto/3 Kingdoms	Unyangdong site, Gimpo City			K0010	2-9 지점 2 호분구묘 모관바닥 101
3 kingdoms	Unknown			K0015	H1071p
3 kingdoms	Unknown			K0016	H1072p
3 kingdoms	Unknown			K0017	H1073p
3 kingdoms	Unknown			K0018	H1074p
3 kingdoms	Unknown			K0019	H1075p
3 kingdoms	Unknown			K0020	H1077p
3 kingdoms	Unknown			K0021	H1070p
3 kingdoms	Unknown			K0022	H1080p
5th cent.	화오 3437 호출도	tomb		K0023	N/A
5th cent.	경주 황오 213437 호출도 A	tomb		K0024	N/A
5th cent.	경주 황오 213437 호출도 B	tomb		K0025	N/A
5th cent.	경주 미추 왕릉지구출도 A	tomb		K0026	N/A
5th cent.	경주 미추 왕지구출도 B (smaller, thicker)	tomb		K0027	N/A
5th cent.	경주 미추 왕지구출도 C(smaller, thinner)	tomb		K0028	N/A
5th cent.	경주 미추 왕릉지구출도 A (black green)	tomb		K0029	N/A
5th cent.	경주 미추 왕릉지구출도 b (white	tomb		K0030	N/A

	green)				
3 kingdoms	풍납	walled site		**K0068**	풍납문연 1284
	U	U		**K0069**	HL2584
	U	U		**K0070**	HL2591
	U	U		**K0071**	HL2531
3 kingdoms	Unknown	U		K0072	H195t
3 kingdoms	U	U		K0073	H195t
3 kingdoms	U	U		K0074	H195t
3 kingdoms	U	U		K0075	H195t
3 kingdoms	U	U		K0076	H195t
3 kingdoms	U	U		K0077	H195t
3 kingdoms	U	U		K0078	H195t
4th-5th 3 kingdoms Silla	경주황오리 1 호분	tomb		K0079	1999.1
4th-5th 3 kingdoms Silla	경주황오리 1 호분	tomb		K0080	1999.2
4th-5th 3 kingdoms Silla	경주황오리 1 호분	tomb		K0081	2001
3 kingdoms Silla	경주황남동지구출토	tomb		K0084	KHA1
3kingdoms Silla	경주황남동지구출토	tomb		K0085	KHA1
3 kingdoms Gaya	Bokcheon dong 54 호주곽	tomb		K0086	BDB3-67/도판 29-35
3 kingdoms Gaya	Bokcheon dong 54 채집	tomb		K0087	미귀속
3 kingdoms Gaya	Bokcheon dong 채집	tomb		K0088	미귀속
3 kingdoms Gaya	Bokcheon dong 304 호	tomb		K0089	304
3 kingdoms Gaya	Bokcheon dong 304 호	tomb		K0090	N/A
3 kingdoms Gaya	Bokcheon dong 51 tomb	tomb		K0091	N/A
3 kingdoms Gaya	Bokcheon dong 51 tomb	tomb		K0092	N/A
3 kingdoms Gaya	Bokcheon dong tomb 73	tomb		K0093	DB73
3 kingdoms Gaya	Bokcheon dong 38 호	tomb		K0094	N/A
3 kingdoms Gaya	Bokcheon dong 38 호	tomb		K0095	N/A
3 kingdoms Gaya	Yeonsan dong 21 호 석곽	tomb		K0096	N/A

Proto 3 kingdoms	Nopoh dong 4 호 옹관	tomb		K0097	노포 73-141
Proto 3 kingdoms	Nopoh dong 10 호	tomb		K0098	73-66
Proto 3 kingdoms	Nopoh dong 8 호	tomb		K0099	73-62
Proto 3 kingdoms	Nopoh dong 24 뭉	tomb		K0100	점 (미등)
Proto 3 kingdoms	Nopoh dong 142-1 분지	tomb		K0101	12-73-73
Proto 3 kingdoms	Nopoh dong 142-1 분지	tomb		K0102	28-73-133
Proto 3 kingdoms	Nopoh dong 142-1 분지	tomb		K0103	6 (3-43)
Proto 3 kingdoms	Nopoh dong 142-1 분지	tomb		K0104	6 (73-43)
4th cent AD	Bokcheon dong 35 호	tomb		K0105	DB 35-1
4th cent AD	Bokcheon dong 35 호	tomb		K0106	DB 35-2
3rd cent AD	Nopoh dong 31 호	tomb		K0107	노포동 夫 3
3rd cent AD	Nopoh dong 43 호	tomb		K0108	노포동 43
3rd cent AD	Nopoh dong 43 호	tomb		K0109	노포동 43
5th-6th cent Silla	Deokcheon-ri 신울진 1 석곽 17-7	tomb		K0116	335
5th-6th cent Silla	Deokcheon-ri 신울진 1 석실 24-2	tomb		K0117	336
5th-6th cent Silla	Deokcheon-ri 신울진 1 석실 24-2	tomb		K0118	337
3 Kingdoms Baekje	오산 2 호토장묘	tomb		K0119	594
3 Kingdoms Baekje	오산 5 호주 구부묵관묘	tomb		K0120	800
3 Kingdoms Baekje	오산 56 호주 구부묵관묘	tomb		K0121	991
3 Kingdoms Baekje	오산 옹관묘	tomb		K0122	1058
3 Kingdoms Baekje	오산 20 호주구부목관묘	tomb		K0123	871
3 Kingdoms Baekje	오산 35 호주구부목	tomb		K0124	916
3 Kingdoms Baekje	오산 28 호 목관묘	tomb		K0125	1171
3 Kingdoms Baekje	오산 28 호 주구부	tomb		K0126	894
3 Kingdoms Baekje	오산 8 호주구부목관묘	tomb		K0127	1209
3 Kingdoms Baekje	오산 10 호 주구부	tomb		K0128	1219
3 Kingdoms Baekje	오산 12 호 주구부	tomb		K0129	1227
3 Kingdoms Baekje	오산 39 호주구부	tomb		K0130	1353
3 Kingdoms Baekje	오산 45 호 주구부	tomb		K0131	1375
3 Kingdoms Baekje	오산 46 호 주구부	tomb		K0132	1381

3 Kingdoms Baekje	오산 25 호 목관묘	tomb		K0133	1165
3 Kingdoms Baekje	오산 4 호목간묘	tomb		K0134	1416
3 Kingdoms Baekje	오산 4 호목간묘	tomb		K0135	1415 (small)
3 Kingdoms Baekje	오산 22 호 목관묘	tomb		K0136	182
3 Kingdoms Baekje	오산 1 호수혈	tomb		K0137a	565
3 Kingdoms Baekje	오산 1 호수혈	tomb		K0137b	565
early 3 Kingdoms	한타강댐포천 13 지역 5 지정 2 호	tomb		K0139	112
3 Kingdoms Baekje	오산 청학동 15 호	tomb		K0140	530-(616)(1)
3 Kingdoms Baekje	오산 청학동 15 호	tomb		K0141	530-(616)(2)
3 Kingdoms Baekje	오산 청학동 15 호	tomb		K0142	530-(616)(3)
3 Kingdoms Baekje	오산 청학동 15 호	tomb		K0143	530-(616)(4)
3 Kingdoms Baekje	오산 청학동 15 호	tomb		K0144	530-(616)(5)
3 Kingdoms Baekje	오산 청학동 15 호	tomb		K0145	530-(616)(6)
3 Kingdoms Baekje	오산 청학동 16 호	tomb		K0146	533-1 (1)
3 Kingdoms Baekje	오산 청학동 16 호	tomb		K0147	533-1 (2)
3 Kingdoms Baekje	오산 청학동 16 호	tomb		K0148	533-1 (3)
3 Kingdoms Baekje	오산 청학동 16 호	tomb		K0149	533-1 (4)
3 Kingdoms Baekje	오산 청학동 16 호	tomb		K0150	533-1 (5)
early 5th cent	高靈 池山洞 Daegaya 73 호	tomb		K0151	77 big
early 5th cent	高靈 池山洞 Daegaya 73 호	tomb		K0152	77 small
early 5th cent	高靈 池山洞 Daegaya 73 호	tomb		K0153	78 biggest
early 5th cent	高靈 池山洞 Daegaya 73 호	tomb		K0154	78 gray
early 5th cent	高靈 池山洞 Daegaya 73 호	tomb		K0155	78 green-white
early 5th cent	高靈 池山洞 Daegaya 73 호	tomb		K0156	78 smallest
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 3 호 토광묘	tomb		K0161	179-6
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 3 호 토광묘	tomb		K0162	179-5
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 7 호 주구토광묘	tomb ditch		K0163	41-1
3rd-4th century AD	성남~여주 복선전철 제 9 공구내	tomb ditch		K0164	72-(10)

	유적 10 호 주구토광묘				
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 6 호 주구토광묘	tomb ditch		K0165	41-9
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 6 호 주구토광묘	tomb ditch		K0166	41-10
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 2 호 주구토광묘	tomb ditch		K0167	19-7
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 2 호 주구토광묘	tomb ditch		K0168	19-8
2nd century AD	오산 궐동유적 1 호 구획저택 1 호 수혈유구 오산 세교 2 지구 택지개발 사업내(1~5 지점)	tomb		K0169	국 295
2nd century AD	오산 궐동유적 1 호 구획저택 1 호 수혈유구 오산 세교 2 지구 택지개발 사업내(1~5 지점)	tomb		K0170	국 295
2nd century AD	오산 궐동유적 1 호 구획저택 1 호 수혈유구 오산 세교 2 지구 택지개발 사업내(1~5 지점)	tomb		K0171	국 295
2nd century AD	오산 궐동유적 1 호 구획저택 1 호 수혈유구 오산 세교 2 지구 택지개발 사업내(1~5 지점)	tomb		K0172	국 295
2nd century AD	오산 궐동유적 1 호 구획저택 1 호 수혈유구 오산 세교 2 지구 택지개발 사업내(1~5 지점)	tomb		K0173	국 295
2nd century AD	오산 궐동유적 1 호 구획저택 1 호 수혈유구 오산 세교 2 지구 택지개발 사업내(1~5 지점)	tomb		K0174	국 295
2nd century AD	오산 궐동유적 1 호 구획저택 1 호 수혈유구 오산 세교 2 지구 택지개발 사업내(1~5 지점)	tomb		K0175	국 295
2nd century AD	오산 궐동유적 1 호 구획저택 1 호 수혈유구 오산 세교 2 지구 택지개발 사업내(1~5 지점)	tomb		K0176	국 295
2nd century AD	오산 궐동유적 1 호 구획저택 1 호 수혈유구 오산 세교 2 지구	tomb		K0177	국 295

	택지개발 사업내(1~5 지점)				
2nd century AD	오산 궐동유적 1 호 구획저택 1 호 수혈유구 오산 세교 2 지구 택지개발 사업내(1~5 지점)	tomb		K0178	국 295
2nd century AD	오산 궐동유적 1 호 구획저택 1 호 수혈유구 오산 세교 2 지구 택지개발 사업내(1~5 지점)	tomb		K0179	국 295
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 18 호 주구	tomb ditch		K0180	110-6
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 18 호 주구	tomb ditch		K0181	110-4
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 19 호 주구	tomb ditch		K0183	121-11
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 21 호 주구	tomb ditch		K0184	146-12
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 1 호 주구	tomb ditch		K0185	(7-14)
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 13 호 주구	tomb ditch		K0186	77-7
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 13 호 주구	tomb ditch		K0187	77-9
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 8 호 주구	tomb ditch		K0188	52-21
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 8 호 주구	tomb ditch		K0189	52-20
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 2 호 토광묘	tomb		K0190	174-9
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 2 호 토광묘	tomb		K0191	174-10
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 2 호 토광묘	tomb		K0192	174-12
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 2 호 토광묘	tomb		K0193	174-13
3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 2 호 토광묘	tomb		K0194	157-8

3rd-4th century AD	성남~여주 복선전철 제 9 공구내 유적 2 호 토광묘	tomb		K0195	157-11
mid 6th cent	Kamakubo Otani Higashihara かものくばおおたにひがしはら古墳	tomb		J0001	004024/B16/22-11
mid 6th cent	Kamakubo Otani Higashihara かものくばおおたにひがしはら古墳	tomb		J0002	B14/23-57
mid 6th cent	Kamakubo Otani Higashihara かものくばおおたにひがしはら古墳	tomb		J0003	B15/23-54
mid 6th cent	Kamakubo Otani Higashihara かものくばおおたにひがしはら古墳	tomb		J0004	B3:B4/23-41
mid 6th cent	Kamakubo Otani Higashihara かものくばおおたにひがしはら古墳	tomb		J0005	B1/23-40
mid 6th cent	Kamakubo Otani Higashihara かものくばおおたにひがしはら古墳	tomb		J0006	23-42
mid 6th cent	Kamakubo Otani Higashihara かものくばおおたにひがしはら古墳	tomb		J0007	23-45
mid 6th cent	Kamakubo Otani Higashihara かものくばおおたにひがしはら古墳	tomb		J0008	23-59
mid 6th cent	Kamakubo Otani Higashihara かものくばおおたにひがしはら古墳	tomb		J0009	22-18
mid 6th cent	Kamakubo Otani Higashihara かものくばおおたにひがしはら古墳	tomb		J0010	22-13
mid 6th cent	Kamakubo Otani Higashihara かものくばおおたにひがしはら古墳	tomb		J0011	22-14
late 5th cent	Ushirode Kofun	tomb		J0012	19-88
late 5th cent	Ushirode Kofun	tomb		J0013	19-90
3rd to 5th cent	Kitahara West Kofun	tomb		J0014	34-994
3rd to 5th cent	Kitahara West Kofun	tomb		J0015	34-996
3rd to 5th cent	Kitahara West Kofun	tomb		J0016	34-997
5th-6th cent	Noyama site	tomb		J0017	127-1
5th-6th cent	Noyama site	tomb		J0018	137-1
5th-6th cent	Noyama site	ditch		J0019	63-1

5th-6th cent	Noyama site	tomb		J0020	136-1
1st half of 6th cent	Takada Gaito Kofun tomb #4	tomb	228-8	J0021	63-7
1st half of 6th cent	Takada Gaito Kofun tomb #4	tomb	228-6	J0022	63-9
1st half of 6th cent	Takada Gaito Kofun tomb #4	tomb	228-4	J0023	63-4
1st half of 6th cent	Takada Gaito Kofun tomb #4	tomb	228-3	J0024	63-10
1st half of 6th cent	Takada Gaito Kofun tomb #4	tomb	229	J0025	63-1
5th cent	Matobaike Kofun tomb #8	tomb	41(166A)	J0026	68-75
mid 7th cent-9th cent (probably Nara period)	Mitsuzuka Kofun cremation burial	tomb	760	J0027	168-7
7th cent (Asuka period)	Mitsuzuka Kofun	tomb	3-Nov	J0028	63-106
4th-5th cent	Mida Oosawa Kofun	tomb		J0029	J7
5th cent	Matobaike Kofun	tomb		J0030	66-1
5th cent	Matobaike Kofun	tomb		J0031	32-1
5th cent	Matobaike Kofun	tomb		J0032	66-2
5th cent	Matobaike Kofun	tomb		J0033	66-4
5th cent	Matobaike Kofun	tomb		J0034	66-3
3rd-4th cent	Horinowo Kofun No 4	tomb		J0035	27-?
3rd-4th cent	Horinowo Kofun No 2	tomb		J0036	14-46
5th-7th cent	Ishigami North Tomb No. 7	tomb		J0037	34-J1
3rd-4th cent	Horinowo Kofun No 4	tomb		J0038	27-?
5th-7th cent	Ishigami North Tomb No. 7	tomb		J0039	34-J5
3rd-4th cent	Horinowo Kofun No 4	tomb		J0040	27-?
5th-7th cent	Ishigami North Tomb No. 7	tomb		J0041	34-J6
4th-5th cent	Ikenoichi Kofun Tomb No. 5 1st burial	tomb		J0042	41-16
4th-5th cent	Ikenoichi Kofun Tomb No. 5 1st burial	tomb		J0043	41-17
4th-5th cent	Ikenoichi Kofun Tomb No. 5 3rd Burial	tomb		J0044	46-31
4th cent	Ikenoichi Kofun Tomb No. 1	tomb		J0045	455-2 east 104

4th cent	Ikenoichi Kofun Tomb No. 1	tomb		J0046	455-2 east 41(8)
4th cent	Ikenoichi Kofun Tomb No. 1	tomb		J0047	455-2 east 114
4th cent	Ikenoichi Kofun Tomb No. 1	tomb		J0048	No. 013 (larger)
4th cent	Ikenoichi Kofun Tomb No. 1	tomb		J0049	No. 013 (shorter)
5th-6th cent	Ishihousan Tomb No. 6	tomb		J0050	J4
5th-6th cent	Ishihousan Tomb No. 6	tomb		J0051	J3
8th-5th cent BC	Amakubo Dolmen burial	tomb		J0052	24-8
8th-5th cent BC	Amakubo Dolmen burial	tomb		J0053	24-12
8th-5th cent BC	Amakubo Dolmen burial	tomb		J0054	24-9
3rd-2nd cent BC	Ukikunden Site 宇木汲田遺跡	tomb		J0055	K75(1)
3rd-2nd cent BC	Ukikunden Site 宇木汲田遺跡	tomb		J0056	K75(4)
Yayoi period	Ukikunden Site 宇木汲田遺跡	tomb	surface find	J0057	No. 11
Yayoi period	Ukikunden Site 宇木汲田遺跡	tomb	surface find	J0058	No. 1
3rd-2nd cent BC	Ukikunden Site 宇木汲田遺跡	tomb		J0059	K95
3rd-2nd cent BC	Ukikunden Site 宇木汲田遺跡	tomb		J0060	K95(1)
~500AD	Banzuka Kofun	tomb		J0061	12
~500AD	Banzuka Kofun	tomb		J0062	3-1(or 2)
~500AD	Banzuka Kofun	tomb		J0063	22
~500AD	Banzuka Kofun	tomb		J0064	23
~500AD	Banzuka Kofun	tomb		J0065	18
~500AD	Banzuka Kofun	tomb		J0066	11
~500AD	Banzuka Kofun	tomb		J0067	12
~500AD	Banzuka Kofun	tomb		J0068	10
~500AD	Banzuka Kofun	tomb		J0069	9
4th cent AD	Saitobaru Kofun Tomb 13	tomb		J0070	STB13-63
mid 5th cent AD	Mutsunobaru	tomb		J0071	149-1-(2)
mid 5th cent AD	Mutsunobaru	tomb		J0072	149-1-(1)
mid 5th cent AD	Mutsunobaru	tomb		J0073	149-2
mid 6th cent AD	Saitobaru Kofun Tomb 202 (Himezuka)	tomb		J0074	29-130

mid 6th cent AD	Ko-onji pit tomb # 6	tomb		J0075	Picture 8 (long)
mid 6th cent AD	Ko-onji pit tomb # 6	tomb		J0076	Picture 8 (colorful)
mid 6th cent AD	Ko-onji pit tomb # 6	tomb		J0077	Picture 8 (rock crystal)
mid 6th cent AD	Ko-onji pit tomb # 6	tomb		J0078	Picture 8 (broken near small hole end)
mid 6th cent AD	Ko-onji pit tomb # 6	tomb		J0079	Picture 8 (Large)
mid 6th cent AD	Ko-onji pit tomb # 6	tomb		J0080	Picture 8 (small)
mid 6th cent AD	Kusaba (Reikyo-Duka)	tomb		J0081	#4
mid 6th cent AD	Kusaba (Reikyo-Duka)	tomb		J0082	#7
5th cent AD	Tachigiri Subterranean tomb 30	tomb		J0083	66-10
5th-6th cent AD	Iimori Subterranean tomb 3	tomb		J0084	3-4: 94-9
5th-6th cent AD	Iimori Subterranean tomb 3	tomb		J0085	3-4: 94-10
mid 6th cent AD	Nagayama	tomb		J0086	14-29
mid 6th cent AD	Nagayama	tomb		J0087	14-30/31 (smaller)
mid 6th cent AD	Nagayama	tomb		J0088	14-33~39 #7
mid 6th cent AD	Nagayama	tomb		J0089	14-33~39 #9
6th-7th cent AD	Ikeuchi Tomb C6	tomb		J0090	61-1
7th cent AD	Saitobaru, Sakamoto no Ue 6-1 pit tomb	tomb		J0091	6-1:10
before mid 7th cent	Kitsunetsuka Kofun	tomb		J0092	nomi
before mid 7th cent	Kitsunetsuka Kofun	tomb		J0093	nomi
before mid 7th cent	Kitsunetsuka Kofun	tomb		J0094	nomi big w/ a chip off 1 end
before mid 7th cent	Kitsunetsuka Kofun	tomb		J0095	nomi small w/ chipped end
before mid 7th cent	Kitsunetsuka Kofun	tomb		J0096	nomi menou
Kofun period?	Saibobaru (supposedly)	?		J0097	Unknown
early middle Kofun period	Akaokumagatani Kofun group	tomb		J0098	34-1
early middle Kofun period	Akaokumagatani Kofun group	tomb		J0099	34-2
early middle Kofun period	Akaokumagatani Kofun group	tomb		J0100	35-9
early middle Kofun	Akaokumagatani Kofun group	tomb		J0101	35-11

period					
early middle Kofun period	Akaokumagatani Kofun group	tomb		J0102	35-14
early middle Kofun period	Akaokumagatani Kofun group	tomb		J0103	35-12
4th-5th cent	Ikenoichi Kofun	tomb		J0104	14-11
4th-5th cent	Ikenoichi Kofun	tomb		J0105	14-12
4th-5th cent	Ikenoichi Kofun	tomb		J0106	43-5
early middle Kofun period	Akaokumagatani Kofun group	tomb		J0107	35-13
early middle Kofun period	Akaokumagatani Kofun group	tomb		J0108	35-10
early middle Kofun period	Akaokumagatani Kofun group	tomb		J0109	35-15
early middle Kofun period	Akaokumagatani Kofun group	tomb		J0110	35-16
early middle Kofun period	Akaokumagatani Kofun group	tomb		J0111	35-17
late Kofun	Kitsune Zako site	workshop/tomb		J0112	4-9
late kofun	Hayashi Tomb 43	tomb		J0113	0-88
late kofun	Hayashi Tomb 43	tomb		J0114	111
late kofun	Hayashi Tomb 43	tomb		J0115	0-6
late kofun	Hayashi Tomb 43	tomb		J0116	151
late kofun	Hayashi Tomb 43	tomb		J0117	3
late kofun	Kitsune Zako site	workshop/tomb		J0118	91
second half kofun	Komesaka site	tomb		J0119	143-1
late 6th - early/mid 7th	Komosawa site, Matsue City	settlement		J0120	33-37
early 7th cent	Komuta II site, Matsue City	settlement?		J0121	4-1
late 1st half kofun	Matsumoto Kofun group	tomb		J0122	p. 73/no 137
first half of kofun	Gotanda 1 Kofun	tomb		J0123	190-1
first half of kofun	Gotanda 1 Kofun	tomb		J0124	190-2
middle Kofun	Dotoko site	workshop		J0125	110-6
middle Kofun	Dotoko site	workshop		J0126	69-14

middle Kofun	Dotoko site	workshop		J0127	52-2
middle Kofun	Dotoko site	workshop		J0128	36-9
5th-6th cent	Fukutomi I	workshop		J0129	260-1
5th-6th cent	Fukutomi I	workshop		J0130	260-2
middle Kofun	Ohara site	workshop		J0131	51-8
middle Kofun	Shimada Ike site	tomb		J0132	39-6
middle Kofun	Shimada Ike site	tomb		J0133	39-8
middle Kofun	Shimada Ike site	tomb		J0134	39-1
middle Kofun	Shimada Ike site	tomb		J0135	39-14
middle Kofun	Shimada Ike site	tomb		J0136	39-9
middle Kofun	Shimada Ike site	tomb		J0137	39-5
middle Kofun	Shimada Ike site	tomb		J0138	39-13
middle Kofun	Osumiyama site	workshop		J0139	28-17
middle Kofun	Osumiyama site	workshop		J0140	45-3-
middle Kofun	Osumiyama site	workshop		J0141	14-32
middle Kofun	Osumiyama site	workshop		J0142	14-21
middle Kofun	Osumiyama site	workshop		J0143	14-22
middle Kofun	Osumiyama site	workshop		J0144	14-16
5th-6th cent	Fukutomi I	workshop		J0145	215-1
5th-6th cent	Fukutomi I	workshop		J0146	215-2
5th-6th cent	Fukutomi I	workshop		J0147	215-4
5th-6th cent	Fukutomi I	workshop		J0148	252-1
5th-6th cent	Fukutomi I	workshop		J0149	255-1
5th-6th cent	Fukutomi I	workshop		J0150	255-6
5th-6th cent	Fukutomi I	workshop		J0151	255-5
5th-6th cent	Fukutomi I	workshop		J0152	255-4
middle Kofun	Ohara site	workshop		J0153	51-10
middle Kofun	Ohara site	workshop		J0154	51-9
middle Kofun	Ohara site	workshop		J0155	50-9
middle Kofun	Ohara site	workshop		J0156	none?

middle Kofun	Shimada Ike site	tomb		J0157	30-7
late Yayoi?	Shimada Ike site	tomb		J0158	153-3
?	Shimada Ike site	tomb		J0159	160-19
?	Shimada Ike site	tomb		J0160	137-25
?	Shimada Ike site	tomb		J0161	225-3
?	Shimada Ike site	tomb		J0162	225-4
middle Kofun	Nunoden site	village		J0163	75-1059
2nd half Kofun	Shirokokuri	tomb		J0164	159-27
2nd half Kofun	Shirokokuri	tomb		J0165	159-28
2nd half Kofun	Shirokokuri	tomb		J0166	171-42
2nd half Kofun	Shirokokuri	tomb		J0167	159-29
2nd half Kofun	Shirokokuri	tomb		J0168	159-30
2nd half Kofun	Shirokokuri	tomb		J0169	36-1
2nd half Kofun	Shirokokuri	tomb		J0170	36-2
2nd half Kofun	Shirokokuri	tomb		J0171	36-3
2nd half Kofun	Shirokokuri	tomb		J0172	36-6
2nd half Kofun	Shirokokuri	tomb		J0173	36-7
2nd half Kofun	Shirokokuri	tomb		J0174	96-8
2nd half Kofun	Kamienya 上塩冶	tomb		J0175	175-12
2nd half Kofun	Kamienya	tomb		J0176	30-5
6th cent	Hiratoko II	workshop		J0177	167-3
6th cent	Hiratoko II	workshop		J0178	161-8
6th cent	Hiratoko II	workshop		J0179	161-9
6th cent	Hiratoko II	workshop		J0180	161-6
6th cent	Hiratoko II	workshop		J0181	158-7
6th cent	Hiratoko II	workshop		J0182	158-3
6th cent	Hiratoko II	workshop		J0183	158-11
Kofun period?	Omojirodani	workshop		J0184	70-1
Kofun period?	Omojirodani	workshop		J0185	66-2
middle Kofun	Ohara site	workshop		J0186	51-11

early-mid Kofun	Yotsuzako	workshop		J0187	25-6
Kofun period?	Osumiyama site	workshop		J0188	28-13
5th-6th cent	Fukutomi I	workshop		J0189	237-17
5th-6th cent	Fukutomi I	workshop		J0190	244-7
5th-6th cent	Fukutomi I	workshop		J0191	255-7
5th-6th cent	Fukutomi I	workshop		J0192	264-11
middle Kofun	Dotoko site	workshop		J0193	75-8
middle Kofun	Dotoko site	workshop		J0194	158-10
middle Kofun	Dotoko site	workshop		J0195	29-8
middle Kofun	Dotoko site	workshop		J0196	137-18
middle Kofun	Dotoko site	workshop		J0197	127-4
middle Kofun	Dotoko site	workshop		J0198	158-4
middle Kofun	Dotoko site	workshop		J0199	137-14
2nd half Kofun	Iwayaguchi South	tomb		J0200	105-9
2nd half Kofun	Iwayaguchi South	tomb		J0201	105-10
2nd half Kofun	Iwayaguchi South	tomb		J0202	25-2
2nd half Kofun	Iwayaguchi South	tomb		J0203	110-16
2nd half Kofun	Iwayaguchi South	tomb ditch		J0204	49-1
2nd half Kofun	Iwayaguchi South	tomb ditch		J0205	49-2
2nd half Kofun	Iwayaguchi South	tomb		J0206	105-15
2nd half Kofun	Iwayaguchi South	tomb		J0207	105-11
early-mid 7th cent	Tsubuteishi	tomb	ST -5	J0208	58-256
early-mid 7th cent	Tsubuteishi	tomb		J0209	58-255
mid-late 7th cent	Daimonishi	tomb		J0210	78-317
late 6th-7th cent	Kouda	tomb		J0211	43-20
late 6th-7th cent	Kouda	tomb		J0212	43-21
early 6th cent	Nagata kofun group	tomb	ST 106-4	J0213	6-32-15
early 6th cent	Nagata kofun group	tomb	ST 202-5	J0214	6-62-14
early 6th cent	Nagata kofun group	tomb	ST 202-5	J0215	6-62-15

early 6th cent	Nagata kofun group	tomb	ST 202-5	J0216	6-62-17
early 6th cent	Nagata kofun group	tomb	ST 202-5	J0217	6-62-18
early 6th cent	Nagata kofun group	tomb	ST 303	J0218	6-99-132
early 6th cent	Nagata kofun group	tomb	ST 106-2	J0219	6-32-20
early 6th cent	Nagata kofun group	tomb	ST 104-1	J0220	6-32-171
late Kofun	Tofukuji kofun group	tomb	ST 014	J0221	168-563
late Kofun	Tofukuji kofun group	tomb	ST 013	J0222	152-228
late Kofun	Tofukuji kofun group	tomb	ST 013	J0223	152-244
late Kofun	Tofukuji kofun group	tomb	ST 014	J0224	169-575
late Kofun	Tofukuji kofun group	tomb	ST 002	J0225	143-129
late Kofun	Tofukuji kofun group	tomb	ST 014	J0226	168-545
late Kofun	Tsuzumi	tomb	ST 005	J0227	811031
late Kofun	Miyakodani	tomb	ST 014	J0228	ST014-8
late Kofun	Miyakodani	tomb	ST 014	J0229	3
late Kofun	Miyakodani	tomb	ST 014	J0230	9
late Kofun	Miyakodani	tomb	ST 014	J0231	7
late Kofun	Miyakodani	tomb	ST 014	J0232	15
late 7th-early 8th cent	Nishibara	tomb	ST 020	J0233	73-309
late Kofun	Miyakodani	tomb	ST 014	J0234	16

DA number		Material	STATE	CONC	OTHER COND.
REG.NUMBER	Artifact Type	MATERIAL	STATE	COND	OTHER COND.
K0001	gogok	Jadeite	green with white patches	Good	
K0002	gogok	Jadeite	white-beige	Good	
K0003	gogok	Jadeite	white-beige with green inclusions	Good	
K0004	gogok	Jadeite	dark green and white	Good	
K0005	cylindrical bead	green tuff	blue-gray	Good	light scratches on one end

K0006	cylindrical bead	green tuff		Good	some scratches, one very heavy
K0007	cylindrical bead	green tuff		Good	White line in stone.
K0008	cylindrical bead	green tuff		Good	rock seems to have some natural cracks
K0009	spherical bead	quartz	pink	Good	
K0010	spherical bead	quartz	pink	Good	
K0015	gogok		greenish white mix	Good	
K0016	gogok		bright green	Good	
K0017	gogok	jadeite		Good	
K0018	gogok		green with some white spots	Good	has pitting around the inner curve
K0019	gogok			Good	
K0020	gogok	nephrite	gray-green	Good	
K0021	gogok		Very pale green.	Okay	natural indents, cracks and scratches
K0022	gogok	agate	white with beige bands	Good	
K0023	gogok	Jadeite	green with patches of brown and streaks of white, a little translucent	Good	brown-white flaw on one side
K0024	gogok	Jadeite	white with bright green and some dark green spots	Good	
K0025	gogok	Jadeite	white	Good	
K0026	gogok	Jadeite	white marbled with green	Good	
K0027	gogok	Jadeite	white/green	Good	
K0028	gogok	Jadeite	white/green	Good	
K0029	gogok	jasper	black/green	Okay	brown marks
K0030	gogok	Jadeite	white/green	Good	
K0068	glass button				
K0069	Chinese jade				
K0070	Chinese jade cicada				
K0071	Chinese jade dragon				
K0072	cylindrical bead	green tuff	Gray-blue	Good	
K0073	cylindrical bead	green tuff	Gray-blue	Good	blue marbling on one half
K0074	cylindrical bead	green tuff	Gray-blue	Good	Crack on one end

K0075	cylindrical bead	green tuff	Gray-blue	Good	
K0076	cylindrical bead	green tuff	Gray-blue	Good	
K0077	cylindrical bead	green tuff	Gray-blue	Good	
K0078	cylindrical bead	green tuff	Gray-blue	Okay	One side chipped off near top
K0079	gogok	jadeite	marbled translucent green with white/beige patches.	Good	Crack across the head.
K0080	gogok	jadeite	Greenish blue fading darker near the tail.	Good	
K0081	gogok	jadeite	White with a greenish tint and some small green veins.	Good	Tail has been chipped.
K0084	hexagonal bead	carnelian	red with pale bands	Good	
K0085	gogok	alabaster	Beige with faint dark cracks and grayish green tints.	Okay	Flakes off easily. Lots of natural cracks.
K0086	gogok	amblygonite	Beige.	Crumbly	Flakes off easily. Lots of natural cracks.
K0087	gogok	hydrogrossular	White. Lighter than other gogok in tomb	Good	
K0088	gogok	jadeite	Darker. Green-gray.	Good	
K0089	gogok	jadeite	Green.	Good	
K0090	gogok	hydrogrossular	Beige.	Good	
K0091	hexagonal bead	carnelian	Red-orange	Good	Some chipping at corners.
K0092	hexagonal bead	carnelian	Red-orange	Good	
K0093	gogok	amber	Light red-brown.	Good	
K0094	gogok	steatite	gray-green	Good	
K0095	pendant	chalcedony	cloudy white	Good	
K0096	cylindrical bead	steatite	dark gray	Poor	gouges near ends which extend the holes
K0097	semi-irregular	carnelian	red-orange	Good	some gouges and chipping which have been smoothed down but not gotten rid of
K0098	hexagonal bead	rock crystal	clear	Good	
K0099	hexagonal bead	rock crystal	clear pink	Good	
K0100	bead fragment	rock crystal	clear	Broken piece	brown on one side
K0101	gogok	rock crystal	clear	Good	

K0102	gogok	rock crystal	clear	Good	
K0103	irregular	carnelian	red-orange, light bands	Good	white spot on one side
K0104	semi-irregular	carnelian	red-orange	Good	
K0105	gogok	jadeite	light green	Good	
K0106	gogok	jadeite	light green-white	Good	patches of brown on surface
K0107	hexagonal bead	carnelian	red-orange	Good	a bit of banding
K0108	spherical bead	carnelian	red-orange	Good	Lots of banding.
K0109	spherical bead	carnelian	red-orange	Good	Lots of cracks. White stone in many of those cracks.
K0116	spherical bead	carnelian	red-orange	Good	with black mottling
K0117	gogok	jadeite	white & green	Good	white with green patches and some smaller dark spots
K0118	모자 gogok	steatite	gray	Okay	Lots of scratches
K0119	irregular	carnelian	red-orange	Good	
K0120	semi-irregular	carnelian	red-orange	Good	Some black spots
K0121	short round bead	rock crystal	cloudy white	Good	
K0122	cylindrical bead	carnelian	red-orange translucent	Partial.	
K0123	Biconical bead	rock crystal	translucent	Good	
K0124	semi-irregular	carnelian	red-orange	Good	Has a darker black spot
K0125	spherical bead	rock crystal	translucent	Good	
K0126	spherical bead	carnelian	red-orange	Good	
K0127	irregular	carnelian	red-orange	Good	
K0128	cylindrical bead	carnelian	dark red	Broken	fades to a lighter color at one spot
K0129	cylindrical bead	jasper	bright green	Good	some white
K0130	semi-irregular	carnelian	red-orange	Good	
K0131	cylindrical bead	carnelian	Dark red translucent	Good	
K0132	cylindrical bead	green tuff	Blue-green gray		
K0133	cylindrical bead	agate	Banded dark brown with white flecks	Partial.	
K0134	spherical bead	carnelian	Red-orange	Good	
K0135	spherical bead	carnelian	Red-orange with lighter	Good	

			bands.		
K0136	semi-irregular	carnelian	red-orange	Good	
K0137a	cylindrical bead	carnelian	red	Good	transparent
K0137b	cylindrical bead	carnelian	red	broken	transparent
K0139	semi-irregular	carnelian	dark red-orange	Good	
K0140	irregular	carnelian	light red-orange	Good	
K0141	irregular	carnelian	red-orange	Good	dark red areas
K0142	irregular	carnelian	orange	Good	with red streaks
K0143	irregular	carnelian	red-orange	Good	
K0144	irregular	carnelian	red-orange	Good	black spots
K0145	semi-irregular	carnelian	light orange	Good	dark red areas
K0146	semi-irregular	carnelian	light orange	Good	
K0147	semi-irregular	carnelian	red-orange	Good	
K0148	semi-irregular	carnelian	red-orange	Good	
K0149	semi-irregular	carnelian	red-orange	Good	
K0150	semi-irregular	carnelian	red-orange	Good	
K0151	gogok	jadeite	blue-gray	Good	
K0152	gogok	jadeite	green-white	Good	
K0153	gogok	jadeite	Mostly white but some green areas.	Good	
K0154	gogok	jadeite	Gray green	Good	
K0155	gogok	jadeite	green-white	Good	
K0156	gogok	nephrite	green-white	Rust stained	
K0161	semi-irregular	carnelian	red-orange	Good	
K0162	irregular	carnelian	red-orange	Good	
K0163	semi-irregular	carnelian	banded	Good	
K0164	spherical bead	carnelian	red-orange	Good	
K0165	semi-irregular	carnelian	red-orange	Good	
K0166	semi-irregular	carnelian	red-orange	Good	
K0167	semi-irregular	carnelian	red-orange	Good	

K0168	irregular	carnelian	light red-orange	Good	White patch on one side
K0169	irregular	carnelian	red-orange	Good	
K0170	semi-irregular	carnelian	red-orange	Good	
K0171	semi-irregular	carnelian	red-orange	Good	
K0172	irregular	carnelian	red-orange	Good	
K0173	irregular	carnelian	red-orange	Good	
K0174	semi-irregular	carnelian	red-orange	Good	
K0175	irregular	carnelian	red-orange	Good	
K0176	irregular	carnelian	red-orange	Good	
K0177	irregular	carnelian	red-orange	Good	
K0178	irregular	carnelian	red-orange	Good	
K0179	irregular	carnelian	red-orange	Good	
K0180	spherical bead	carnelian	red-orange	Good	
K0181	cylindrical bead	carnelian	red-orange	Good	
K0183	semi-irregular	carnelian	red-orange	Good	White spot
K0184	semi-irregular	carnelian	red-orange	Good	
K0185	semi-irregular	carnelian	red-orange	Good	
K0186	pentagonal bead	carnelian	orange-red	Good	
K0187	semi-irregular	carnelian	red-orange	Good	
K0188	semi-irregular	carnelian	red-orange	Good	
K0189	hexagonal biconical bead	rock crystal leucite?	Clear	Good	
K0190	cylindrical bead	carnelian	Red-translucent	Broken	
K0191	cylindrical bead	carnelian	Light golden color	Broken	
K0192	irregular	carnelian	red-orange	Good	
K0193	irregular	carnelian	red-orange	Good	
K0194	cylindrical bead	carnelian	White area on one end.	Good	
K0195	semi-irregular	carnelian	red-orange	Good	
J0001	magatama	green tuff	dark green with faint	Good	

			marbling		
J0002	cylindrical bead	green tuff	dark green with faint marbling	Good	
J0003	cylindrical bead	green tuff	dark green with faint marbling	Good	
J0004	cylindrical bead	green tuff	light blue-green	Good	Crack irregularly running the length of the bead.
J0005	cylindrical bead	green tuff	light blueish green	Okay	Powdery.
J0006	cylindrical bead	green tuff	green with dark green spots and a brown streak	Good	
J0007	cylindrical bead	green tuff	dark green/blue with streaks of lighter green	Good	
J0008	cylindrical bead	green tuff	dark green with faint marbling	Good	
J0009	flattened circular	green tuff	light blue-green	Good	
J0010	biconic	rock crystal/chalcedony	cloudy	weathered	
J0011	hexagonal biconic	rock crystal/howlite	cloudy	weathered	
J0012	magatama	amber	dark brown	Fragile	Cracked in many places and flaking.
J0013	magatama	schist	gray-green	Okay	Rough surface with lots of flakes
J0014	magatama	carnelian	dark red	Broken	
J0015	magatama	gypsum	beige	Good	very light weight, mottled with brown
J0016	magatama	steatite	blue black	Good	has some light white marks
J0017	magatama	chalcedony	transparent white	Good	faint orange lines throughout and a red/orange tail end
J0018	magatama	steatite	dark gray	Good	large depression surrounding holes
J0019	magatama	steatite	dark gray	Good	
J0020	cylindrical bead	green tuff	dark green-blue	Good	
J0021	hexagonal biconic	rock crystal	cloudy white	Good	transparent
J0022	biconic	rock crystal	cloudy white	Good	transparent
J0023	biconic	rock crystal	cloudy white	Good	transparent
J0024	biconic	rock crystal	cloudy white	Good	transparent

J0025	biconical	jet	matte black	Good	lots of light fine cracks on surface
J0026	magatama	steatite	gray-blue	Good	
J0027	spherical bead	rock crystal	transparent cloudy	Poor	transparent with lots of cracks
J0028	short cylindrical bead	steatite	gray-blue	Good	grooved around outside cylinder area
J0029	magatama	jadeite	green with white clouds	Good	square head
J0030	magatama	green tuff	dark green	Good	darker ring around spine
J0031	magatama	steatite	beige	Good	with orange embedded, 2 scrapes on nose
J0032	magatama	quartz	cloudy white	Good	edges have ridges from not being fully smoothed
J0033	magatama	jadeite	blue-grey	Good	with beige clouds
J0034	magatama	quartz	cloudy white	Good	
J0035	hexagonal biconical	rock crystal	clear	Good	
J0036	hexagonal biconical	rock crystal	clear	Good	
J0037	cylindrical bead	jasper	dark green	Good	large flake off of bigger hole end
J0038	hexagonal biconical	rock crystal	clear	Good	a few scratches in places
J0039	hexagonal biconical	rock crystal	clear	Good	
J0040	hexagonal biconical	rock crystal	clear	Good	
J0041	hexagonal biconical	rock crystal	clear	Good	
J0042	magatama	steatite	dark grey	Good	
J0043	magatama	steatite	brown-grey	Okay	tail tip broken off
J0044	cylindrical bead	green tuff	pale green	Okay	red stains from soil
J0045	cylindrical bead	green tuff	pale green	Good	
J0046	cylindrical bead	green tuff	gray-green	Good	
J0047	cylindrical bead	green tuff	dark gray-green	Good	
J0048	cylindrical bead	green tuff	gray-green	Good	
J0049	cylindrical bead	green tuff	pale gray-blue	Good	some chips off ends

J0050	cylindrical bead	jasper	dark green	Good	
J0051	cylindrical bead	jasper	green	Good	orange line around middle
J0052	cylindrical bead	green tuff	pale green	Good	with beige bands
J0053	cylindrical bead	green tuff	pale green	Good	faint cracks
J0054	cylindrical bead	green tuff	pale green	Good	faint darker lines near one end
J0055	cylindrical bead	jasper	dark green	Good	
J0056	cylindrical bead	jasper	dark green	Good	
J0057	cylindrical bead	jasper	dark green	Good	faint marbling
J0058	cylindrical bead	jasper	dark green	Okay	Broken on one end
J0059	cylindrical bead	jasper	dark green	Good	
J0060	cylindrical bead	jasper	dark green	Good	
J0061	cylindrical bead	jasper	dark green	Good	Gouge on one side
J0062	cylindrical bead	jasper	dark green	Good	with streaks of light green
J0063	cylindrical bead	jasper	dark green	Good	
J0064	cylindrical bead	jasper	dark green	Good	
J0065	cylindrical bead	jasper	dark green marbled with lighter green	Good	1 dark line on body and one gouge
J0066	cylindrical bead	jasper	dark green	Good	gouge on body
J0067	cylindrical bead	jasper	dark green with lighter green marbling	Good	
J0068	cylindrical bead	jasper	dark green	Good	some gouges
J0069	cylindrical bead	jasper	dark green	Good	faint gouge on side
J0070	cylindrical bead	jasper	blue-green	Okay	chipped on one end
J0071	magatama	jadeite	translucent green	Good	
J0072	magatama	jadeite	translucent green	Good	with pale green patches
J0073	cylindrical bead	green tuff	gray-green	Good	
J0074	magatama	chalcedony	translucent pale brown/orange	Good	geode near tail, crack inside hole with dirt in it
J0075	magatama	chalcedony	translucent white and brown	Good	red patches
J0076	magatama	chalcedony	translucent beige to orange	Good	streaks and patches of color
J0077	magatama	rock crystal	translucent	Good	

J0078	cylindrical bead	jasper	dark green	Okay	
J0079	hexagonal biconical	rock crystal	clear	Good	
J0080	square biconical	rock crystal	clear	Good	
J0081	magatama	jadeite	green & white	Good	
J0082	cylindrical bead	jasper	dark green	Good	marbled
J0083	cylindrical bead	black steatite	black-green	Good	with white specks
J0084	cylindrical bead	green tuff	gray-green	Good	
J0085	cylindrical bead	green tuff	gray-green	Good	
J0086	magatama	rock crystal	clear	Good	
J0087	biconical	rock crystal	clear	Good	
J0088	cylindrical bead	jasper	dark green and yellow	Good	marbled
J0089	cylindrical bead	jasper	dark green	Good	Slightly marbled
J0090	magatama	chalcedony	banded orange-yellow-brown	Good	
J0091	magatama	jadeite	bright green with white marbling	Good	
J0092	magatama	quartz	transparent	Good	
J0093	magatama	jadeite	bright green head with white tail	Good	marbled
J0094	hexagonal biconical	rock crystal	transparent	Good	
J0095	hexagonal biconical	rock crystal	transparent	Good	
J0096	semi-irregular	carnelian	transparent orange	Good	
J0097	semi-irregular	carnelian	red-orange	Good	some dark red streaks and a red patch
J0098	magatama	carnelian	red-orange	Good	cloudy inclusions on head, slightly transparent
J0099	magatama	jasper	green	Good	streaks of lighter and darker green
J0100	hexagonal biconical	carnelian	red	Good	somewhat transparent
J0101	semi-irregular	carnelian	light red-orange	Good	somewhat transparent
J0102	spherical bead	carnelian	red-orange	Good	slightly transparent, color fades across the bead

J0103	semi-irregular	carnelian	red-orange	Good	slightly transparent
J0104	magatama	jadeite	green with white clouds	Good	
J0105	magatama	jadeite	green with white clouds	Good	natural flaws makes a dent on the body
J0106	magatama	chalcedony	beige	Good	transparent
J0107	semi-irregular	carnelian	red-orange	Good	some faint dark lines
J0108	semi-irregular	carnelian	red-orange	Good	beige cloud, partially transparent
J0109	irregular	carnelian	red-orange	Good	partially transparent
J0110	semi-irregular	carnelian	red-orange	Good	partially transparent, 1 dark red patch
J0111	semi-irregular	carnelian	red-orange	Good	dark red patches, slightly transparent
J0112	hexagonal biconical	rock crystal	clear	Unfinished	
J0113	cylindrical bead	rock crystal	clear	Good	
J0114	cylindrical bead	rock crystal	clear	Good	
J0115	hexagonal cylindrical bead	rock crystal	clear	Good	
J0116	hexagonal biconical	rock crystal	clear	Good	
J0117	biconical	jet	matte black	Good	faint cracks
J0118	magatama	chalcedony	yellow with darker red patches	Unfinished	
J0119	magatama	chalcedony	red-yellow-orange	Good	
J0120	magatama	jasper	light green	A bit damaged	some cracks and scratches
J0121	magatama	chalcedony	slightly transparent white to yellow	Good	
J0122	cylindrical bead	jasper	dark green marbled with lighter green	Good	
J0123	magatama	jadeite	green/white marbled	Good	pinching at head
J0124	magatama	jadeite	Cloudy white on green	Good	
J0125	cylindrical bead	green tuff or jasper	dull green	Okay	fatter at middle
J0126	magatama	green tuff or jasper	dull green	Good	
J0127	partial circular bead	rock crystal	clear	Okay	
J0128	partial	chalcedony	white transparent	Okay	with an orange patch

	magatama				
J0129	cylinder bead	green tuff or jasper	dull green	Unfinished	
J0130	cylinder bead	jasper	dark green	Unfinished	
J0131	magatama	jasper	dark green	Unfinished	
J0132	cylindrical bead	green tuff or jasper	dull green	Good	
J0133	cylindrical bead	jasper	dark green	Good	
J0134	magatama	carnelian	brown red semi-transparent	Good	
J0135	spherical bead	rock crystal	clear cloudy	Good	
J0136	hexagonal biconic	rock crystal	clear	Good	
J0137	magatama	chalcedony	orange-brown, semi-transparent	Good	
J0138	hexagonal biconic	rock crystal	clear, somewhat cloudy	Good	
J0139	magatama	carnelian	red-orange, semi-transparent	Unfinished	some sort of glue used to label bead years ago which is still stuck to the sides of the artifact
J0140	magatama	chalcedony	transparent white/yellow	Unfinished	with red clouds
J0141	magatama	green tuff	gray-green	Unfinished	
J0142	circular bead	green tuff	gray-green	Unfinished	
J0143	circular bead	green tuff	gray-green	Unfinished	
J0144	pendant?	green tuff	gray-green	Unfinished	
J0145	cylinder bead	green tuff	blue-green	Broken	
J0146	cylinder bead	green tuff	blue-green	Okay	
J0147	cylinder bead	green tuff	blue-green	Unpolished	
J0148	magatama	jasper	dark green	Broken	patches of lighter green near tail
J0149	magatama	chalcedony	semi-transparent beige	Broken	
J0150	magatama	chalcedony	semi-transparent beige	Unfinished	
J0151	magatama	carnelian	semi-transparent red/orange	Unfinished	Some banding
J0152	magatama	chalcedony	semi-transparent white	Unfinished	Red section at top
J0153	magatama	jasper	dark green	Broken	
J0154	magatama	jasper	dark green	Broken	

J0155	cylindrical bead	jasper	dark green	Broken	
J0156	magatama	jasper	dark green	Broken	lighter green on outside
J0157	magatama	rock crystal	clear	Good	
J0158	magatama	quartz	beige	Good	
J0159	magatama	chalcedony	beige, semi-transparent	Okay	patches and streaks of orange
J0160	spherical bead	chalcedony	orange, semi-transparent	Good	
J0161	hexagonal biconical	rock crystal	clear	Good	
J0162	hexagonal biconical	rock crystal	clear, somewhat cloudy	Good	
J0163	partial magatama	chalcedony	beige, semi-transparent	Broken	
J0164	magatama	chalcedony	beige, semi-transparent		patches of orange, bead has patches of cinnabar on side
J0165	magatama	rock crystal	clear-cloudy	Good	
J0166	magatama	chalcedony	beige/white, semi-transparent	Good	
J0167	hexagonal biconical	rock crystal	clear	Good	
J0168	hexagonal biconical	rock crystal	clear	Good	
J0169	magatama	chalcedony	beige	Good	orange patch one one side
J0170	magatama	rock crystal	clear	Good	
J0171	magatama	steatite	gray	Good	
J0172	hexagonal biconical	rock crystal	clear	Good	
J0173	hexagonal biconical	rock crystal	clear-cloudy	Good	
J0174	magatama	jasper	green	Good	faint marbling
J0175	semi-irregular	carnelian	red-orange	Good	
J0176	magatama	chalcedony	transparent brown-orange	Good	
J0177	incomplete bead	green tuff	light blue-green	Broken	
J0178	partial short cylindrical	rock crystal	clear	Broken	
J0179	partial short	rock crystal	clear	Broken	

	cylindrical				
J0180	partial magatama	green tuff	light green	Poor	mottled with brown
J0181	partial magatama	chalcedony	Semi-transparent white	Broken	orange patch
J0182	incomplete magatama	chalcedony/carnelian	red	Incomplete	with lighter patches
J0183	ovoid	green tuff	pale green to black	Good	
J0184	popped end	rock crystal	clear	Good	
J0185	magatama	jasper	green	Okay	deep gouge on nose
J0186	partial magatama	jasper	dark green	Broken	
J0187	pendant?/partial magatama?	steatite	gray	Broken	
J0188	incomplete cylindrical	jasper	dark-light green	Incomplete	
J0189	pendant - oval	steatite (black)	black	Good	small specks of dirt or whiteness
J0190	circular bead	steatite (black)	dark gray	Good	
J0191	incomplete magatama	chalcedony	gray-white	Incomplete	hole has dirt embedded at the bottom
J0192	incomplete hexagonal	rock crystal	clear	Broken/Incomplete	
J0193	incomplete round	rock crystal	clear	Broken/Incomplete	
J0194	incomplete pendant	green tuff	light green	Incomplete	Not in the best condition
J0195	incomplete circular	jasper	dark green	Incomplete	
J0196	partial cylindrical	green tuff?	light green	Broken	
J0197	incomplete cylindrical	green tuff?	green	Incomplete	
J0198	incomplete magatama	chalcedony	beige	Incomplete	
J0199	incomplete magatama	green tuff?	green	Incomplete	
J0200	magatama	agate	brown with white stripes	Good	chip off tail

J0201	magatama	carnelian	red	Broken	Semi-translucent
J0202	kodachi magatama	steatite	gray	Broken	Head only
J0203	hexagonal biconical	rock crystal	clear	Good	yellow spot
J0204	partial cylindrical	jasper	dark green	Broken	
J0205	partial cylindrical	jasper	dark green	Broken	
J0206	cylindrical	green tuff?	Light-ish green	Good	tiny flecks of beige
J0207	hexagonal biconical	rock crystal	clear	Good	
J0208	semi-irregular	carnelian	dark red	Good	a little translucent
J0209	semi-irregular	carnelian	red-orange	Good	patch of darker red, semi-translucent
J0210	partial magatama	chalcedony	translucent brown	Broken	red spot and faint stripes
J0211	semi-irregular	carnelian	red-orange	Good	white areas
J0212	semi-irregular	carnelian	dark red	Good	
J0213	magatama	chalcedony	yellow, semi-transparent	Good	
J0214	semi-irregular	carnelian	red with darker/lighter patches	Good	bands
J0215	semi-irregular	carnelian	red-orange, semi-transparent	Good	
J0216	semi-irregular	carnelian	red	Good	bands
J0217	spherical	carnelian	pale to dark red	Good	
J0218	irregular	carnelian	red	Good	
J0219	spherical	carnelian	red-orange	Goood	large white spot
J0220	flattened spherical	chalcedony	yellow, semi-transparent	Good	with brown patches
J0221	hexagonal biconical	carnelian	red	Good	
J0222	short cylindrical	carnelian	red-orange	Good	Semi-translucent
J0223	semi-irregular	carnelian	red-orange	Good	
J0224	semi-irregular	carnelian	red	Good	
J0225	semi-irregular	carnelian	red-orange	Good	

J0226	magatama	chalcedony	beige, semi-transparent	Good	
J0227	hexagonal biconical	carnelian	red	Good	
J0228	magatama	jadeite	blue and white clouds	Good	
J0229	flat circular	rock crystal	clear	Good	
J0230	semi-irregular	carnelian	red-orange	Good	
J0231	semi-irregular	carnelian	orange	Good	red spots
J0232	irregular	carnelian	red	Good	
J0233	magatama	chalcedony	orange-brown, semi-transparent	Good	
J0234	hexagonal biconical	rock crystal	clear	Good	

DA number	EXT. SURF	L Max	L Min	W Max	W Min	T Max	T Min
REG.NUMBER	EXT. SURF	LENGTH 1	LENGTH 2	Width 1	Width 2	Thick 1	Thick 2
K0001	3 grooves	56		64		10.8	
K0002	1 groove	51.21		20.6		20.13	15.75
K0003	4 grooves	46.24		15.85		16.99	14.28
K0004	2 grooves	44.1		13.3		14.87	12.13
K0005	Mostly straight hole shows a raised ridge in the middle	26.65		13.97		11.23	
K0006	Very smooth hole and very straight	26.76		13.52		11.7	
K0007	Chipped a little.	22.26	20.09	13.17		13.03	
K0008	Drilled from both sides with a straight drill	25.29		8.13		7.86	
K0009	Looks like they pecked it on the small hole side. Flattened on hole drilling ends.	17.41		19.62			
K0010	Might have been pecked a little around both holes. Seems flatter around holes.	17.45		21.57			
K0015	None	26.06				9.53	8.27
K0016	Faint lip on smaller hole side, larger lip on other hole.	21.3		7.74		6.34(b)	5.7(top)

K0017	lips on both sides	27.24				10.65	9.06
K0018	big lip on one side, tiny lip on the other, hole is pretty straight	21.4				7.44	6.22
K0019	3 grooves. No lips.	20.97				6.75	5.53
K0020	Very smooth hole and very straight	24.86				9.43	8.63
K0021	Holes straight. No lips.	26.32				8.93	8.46
K0022	lips on both sides	21.6				6.99	5.66
K0023	drilled on both sides. Slight groove in the inner upper circle area	56.29		16.25	13.24	16	12.7
K0024	3 grooves.	43.38		19.4	13.49	19.9	12.2
K0025	Hole sides straight and smooth but at an angle. Not round on the top, more pointed.	28.41		9.39	9.3	9.2	8.8
K0026	3 grooves, might be a forth on the inner curve	44.14		14.1	10.86	14	10
K0027	4 grooves, drilled from one side	27.99		10.24	7.93	9.7	6.4
K0028	3 grooves, drilled from both sides	29.75		10.14	8.81	9.7	8.1
K0029	Parts seem to have been gouged out, drilled on one side	34.25		8.34	8.12	9.4	7.3
K0030	3 grooves	33.49		9.43	7.27	9.1	6.5
K0068							
K0069							
K0070							
K0071							
K0072		10.29		4.94			
K0073		11.71		4.01			
K0074		9.95		3.63			
K0075		7.32		3.51			
K0076		9.45		3.74			
K0077		6.57		3.76			
K0078		5.71		3.33			
K0079	3 line across the top of the head. Has a lip on one side where a hole was started.	27.72		20.9		12.2	8.6
K0080	3 lines along the head almost reaching the holes. One at the base of the head. Hole shapes don't quite match.	31.2		18.4		12.6	8

K0081	Faint ridge along back. Flatter edges in places.	35.8		23		10.9	9.8
K0084		8.43		11.54			
K0085		43.2		27.65		15.2	10.08
K0086		56.6		37.9		23.5	18.3
K0087		31.6		18.2		9.5	8.4
K0088	Square hole on left side	30.5		16.7		20.5	9.72
K0089	Groove near nose.	27.8		17.2		7.7	
K0090		27		17.17		10.11	7
K0091		8.4		14.73			
K0092		9.5		13.94			
K0093	Rectangular holes	37.3		22.9		13.6	10.5
K0094		18.39		11.9		4.4	
K0095	looks like an arrow head	40.8		20.2		5.9	
K0096	Rectangular holes. Off center from each other.	23.8		8.9			
K0097	Depression on one side. Smooth on the other.	5.54		8.3			
K0098		9.7		12.2			
K0099		7.3		12.2			
K0100		8.4		5.6		4.7	
K0101		14.3		7.4		5.8	4.6
K0102		14.9		7.6		6.4	4.5
K0103	Chipping around hole. Depression on one side. Straight on the other.	8	7.7	10.4	9.1		
K0104	One side flat, the other side has a depression.	6.8		9			
K0105	Left side drilled at an angle.	31.6		17.9		10.7	10
K0106		27.3		16.2		9.7	8.8
K0107	Tried to drill once before main hole.	9		15.4			
K0108	Depression on one side.	13.5		16.2			
K0109		12.6		15.8			
K0116	stone shades to a lighter color in places	14.4		17.2			
K0117	Small hole.	42.2		27.6		15.6	10.3

K0118		27		57.3		25.1	12.1
K0119	Depression on one side. Kind of looks like a failed hexagonal bead	5.1		7.7			
K0120	Depression on one side.	5.1		7.3			
K0121		7.9		7.3			
K0122		11.11	8.16	7.9			
K0123		13-14.7	13	10.8			
K0124	Slight depression on one side.	4.5		7.6			
K0125		12.9		12.4			
K0126	Holes partially miss each other inside the hole.	9.8		10			
K0127	One side flat, one with a depression.	7.7		9.9			
K0128		12		7.3			
K0129		10.3		5.5			
K0130	Depression on one side.	5.54		7.35			
K0131		16		7.11			
K0132		23.68		4.8			
K0133		16.6	15.1	8.14			
K0134		14.8		15.5			
K0135	Depression on one side.	10.7		12.1			
K0136	Depression on one side.	11.8		13.9	12.8		
K0137a		2.59		8.3			
K0137b		15.1		7.4			
K0139		11.8		14.1			
K0140		4.6	3.1	5.8	5.03		
K0141	Faint depression on one side	4.4		6.8			
K0142		5	3.8	7.4	6.8		
K0143		5.3		6.7			
K0144		5.3	4	6.7	6		
K0145		5.2	4.3	6.8			
K0146		4.8		7.3			

K0147		4.7		6.8			
K0148		4.9		6.8			
K0149		4.6		6.6			
K0150		5.4	4.3	6.8			
K0151	3 grooves on head. Small drill hole near bigger drill hole	47.8		28.1		17	12.5
K0152	Thicker at the tail than the head.	19.6		13.1		6.6	6.1
K0153		35.4		23		10.4	9.1
K0154		29		17.2		10.8	8
K0155		27.8		17		10.6	8
K0156	Second drill hole. Ridge on bottom of tail. Iron resting on top of bead has stained it.	18.9		11		7.6	6.2
K0161		6.7		9			
K0162	Small depression on one side. Other side not flat but seems to be nature shape	8.6		9			
K0163	Small depression on one side. Flat on the other.	8.2		10.2			
K0164	Small depression on one side. Flat on the other. More spherical than others.	10.1		10.7			
K0165	Depression on one side	6.2		8.2			
K0166	Depression on one side but not exactly flat on the other	7		8.9			
K0167	Depression on one side. Rounded on the other.	8.8		10			
K0168	Flat on one side, small depression on other.	8.4	6.8	11.4			
K0169	Depression on one side. Rounded on the other.	6		8.8			
K0170	Depression on one side. Rounded on the other.	6.4		8.2			
K0171	Depression on one side. Rounded on the other.	6.1		7.9			
K0172	Depression on one side. Rounded on the other.	6.3		8			
K0173	Depression on one side. Rounded on the other.	5.3		7			
K0174	Depression on one side. Rounded on the other.	6.5	4.8	8			
K0175	Depression on one side. Rounded on the other.	4.7		6.7			
K0176	Depression on one side. Rounded on the other.	4.3		6.8			
K0177	Depression on one side. Rounded on the other.	4.6		5.6			
K0178	Depression on one side. Rounded on the other.	4.1		5.9			

K0179	Depression on one side. Rounded on the other.	3.8		5.5			
K0180	Slight depression on one side. Hole might narrow.	10.3		11.4			
K0181	Dent/scrape on one side	10.2		8.1			
K0183	Depression on one side.	6.9		8.3			
K0184	Large piece broken off on side opposite flat side.	9.1		11.4			
K0185	Depression on one side.	5.6		7.2			
K0186	Flat on both sides	8.5		14.3			
K0187	Depression on one side.	10.7		16.6			
K0188	Depression on one side.	9.7		11.9			
K0189	7 planes on one side, six on the other	8.9		6.2	3.2		
K0190	Pieces chipped off near one end	10.6		7.2			
K0191	Pieces chipped off near end. Groove near one hold. Can see drill marks.	11.2		7.2			
K0192	Depression on one side, flat on the other. Little lines along the depression	5.4		7.2			
K0193	Depression on one side, flat on the other.	4.3		6.2	5.3		
K0194	A few small chips lost but mostly complete	15.4		7.2			
K0195	Depression on one side, flat on the other.	5.1		9.2			
J0001	Drilled on both sides. Indentation on one side. Other side, hole is unevenly centered.	28.83		8.26		10.45	7.25
J0002	Hole is slightly irregular on one side. Drilled from one side.	26.9		9.8		9.84	9.53
J0003	Chipped on one end on edge. Drilled from one side. Smaller hole is off center.	25.46		9.84		9.87	9.59
J0004	Flake radiating from smaller hole. Chipped in places.	21.06	20.25	6.95		6.85	6.47
J0005	Not finished well. Not smooth.	20.24		5.96		5.29	4.93
J0006	Some mini pits on sides. Percussion circle possibly.	14.7		6.2		6.2	6.2
J0007	Lots of small damage around edges of bead. Otherwise pretty smooth.	21.7		9.7		9.8	9.7
J0008	Mini pits on sides	28.8		9.8		10	10
J0009	Bead is quite small so SG is very low and probably inaccurate. Gouge near the hole.	8.2		9		4.9	
J0010		8		8.3		5.2	5.2

J0011	Natural flaw in rock on smaller holes side which shows as a patch of white.	15.42		14.53	13.43	10-9.2	9.3-6.8
J0012	3 lines around the head and hole, tail narrows	39		21.1		11.1	5.75
J0013	Either dirt of pigment in the hole	37.4		19.9		4.4	4.1
J0014	Has brown-orange spots. The front of the head wasn't completely rounded.	38.4		22.53		17.2	13.1
J0015	Small crack on the head and around one hole	27.3		15.3		8.9	6.3
J0016		20.1		12.8		5.22	4.03
J0017		30		19.3	18.9	7.4	6.1
J0018	2 holes	9.8		6.1		2	2.2
J0019	flatter on head	14		8.2		2.5	3.1
J0020		10.8		5.1	4.9		
J0021		13.5		11.5			
J0022		9.6		10.6			
J0023		15.1		13.2			
J0024		9.2		10.3			
J0025	tops are not fully flattened	20		14.7	13.3		
J0026		18.1		10.7		5.2	2.9
J0027		9.2		9.3			
J0028	dirt in grooves	5.9	4.8				
J0029		26.8		16.7		9.4	8.1
J0030		36.9		23.1		10.1	8.1
J0031		22.2		14.8		5.4	3.7
J0032		24.8		14.2		8.4	6.9
J0033		29.7		18.6		10.7	8.4
J0034		25.5		15.2		9.3	7.7
J0035	Edges rather smoothed down	22.7		14			
J0036		12.1	11.1	11.7			
J0037		21.3		9.7			
J0038	Edges fairly smoothed down	24.4		13.9			
J0039	Edges fairly smoothed down	10.1		10.1			

J0040		19.2		12.1			
J0041		7.7		7			
J0042		28.9		17.8		8	6.3
J0043	tail was found with bead but is in poor condition	30.1		16.8		9.7	6.6
J0044	broken on one end	24.8		12.1			
J0045		23.8		6.3			
J0046		11.5	10.8	5.3			
J0047		19.9		4.5			
J0048		30.2		8.8			
J0049		26.7		9.6	9.1		
J0050		21.7		5.8			
J0051		20.3		5.3	5.2		
J0052	some chipping	11.8		5.1	4.7		
J0053		14.4		6.4	6		
J0054	brown spots visible under microscope	11.4		5.25	5.1		
J0055		8.6		3.6	3.5		
J0056		9.3		3.1			
J0057		13.3		5.2	5		
J0058		20.6		5.5	5.4		
J0059		8.9		3.3	3.1		
J0060		6.5		3.2	3		
J0061		26.6		7.6			
J0062	some chipping around outer edges of ends	28.9		10.6	10.2		
J0063		19.9		9.2			
J0064		25.7		7.8	7.5		
J0065		24.8		9.3	9.3		
J0066		23		7.65	7.65		
J0067		22.3		10.4	10.4		
J0068		17.6		7	7		
J0069		24.9		7.3	7.3		

J0070		11.5		4.1	4		
J0071		20.3		14.1		6.7	4.2
J0072		15.2		12.8		6.8 (mid)	5.2
J0073		12.9		4.4			
J0074	lots of pitting, pinched where the hole is	25.5		14.7		7.4 (mid)	5.6
J0075	pinched at hole, some chips off on body and head	31.9		16.9		7.8 (mid)	4
J0076	some pitting, overground on one side, chip on back	27.4		16.01 (top)	13.93 (bot)	9.2	6.5
J0077	lots of percussion fractures, chipped on back	25.6		14.8 (t)	12.2	8.4	6.2
J0078	large chip off one end	19.1		8.6			
J0079	edges smooth	24.6		15.4	14.5		
J0080		8.7		6.1		3.9	3.4
J0081	constriction around holes	22.6		12.9		7.6	6.7
J0082		26.3		10.3			
J0083	chip off one end	26.7		6.7			
J0084	chips off end	26.4		9.4			
J0085	chips off both ends	23.7		9.1			
J0086	percussion fractures and pits with black embedded in them, chipped on tail	22.1		10.9		5.8	5.2
J0087		6.9		9.9			
J0088		17.3		7.2			
J0089		13.9	12	7.1	6.9		
J0090	constriction around hole, tail points away and narrows	31.8		17.8		9	7.7
J0091	quite flat, flaw on back of head	18.7		11.4		5.3	5
J0092		22.2		13.7		7.9	5.9
J0093	Head is fat, tail constricted	16		11.2		7.5	5.9
J0094	chip off one side	17.4		13.6			
J0095	small chip off one end	11.9		7.4			
J0096		4.4		5.9			
J0097		5.6		7.7			

J0098		36.7		23.9		11.6	8.1
J0099		33.6		20.7		11.7	9.4
J0100		5.5		8.6			
J0101		7.4		9.4			
J0102		5.8		7.4			
J0103		4.9		7.2			
J0104	, shape is a bit odd, fatter in the middle	23.7		16.5		8.3	7.3
J0105	slight constriction around hole, quite flat	18.4		13		5.1	4.5
J0106		28.8		18.9		8.8	5.9
J0107		6.7		7.9			
J0108		7.7		9.5			
J0109	almost seems like they were trying to make a faceted bead	5.4		8.3	7.8		
J0110		6.4		6.9			
J0111		6.2	5.5	7.6			
J0112		16.6		13.1	12.8		
J0113		24.9		8.3	7.7		
J0114		20.3		7.4			
J0115		21.3		7.8			
J0116	quite flat on one side	10.8	9.7	11.1	8.7		
J0117		18		12.6	11.3		
J0118		37.9		20.9		10.8	8.8
J0119	Chip off the head	26.7		16.2		7.8	5.9
J0120	scratch near eye looks modern	29.9		17.1		5.4	5.8
J0121		25.6		15.9		6.9	4.6
J0122		34.1		7.8			
J0123		15.5		11		6.2	4.8
J0124		15.6		10.7		5.7	4.6
J0125	lots of scratches and chips	27.5		9.6	9.3		
J0126	pitting and some worn gouges	32.9		19.2		8.9	6.6
J0127	section of one side sheared off	7.4	6.7	12.3			

J0128		14.6		13.6			6.8
J0129		23		5.9	5.7	6	5.4
J0130	chips off side	23.1		11.3	10.4		10.1
J0131	slightly thicker at middle	33.5		20.3	19.8	10.1	7.4
J0132		31.5		8.7			
J0133		12.9		6.5			
J0134	some scratches	26.7		16.4		8.9	5.9
J0135		9.9	8.7	11.2			
J0136		17.6		13.4			
J0137	Gouges around big hole	28.8		16.5		7.4	5.3
J0138	chipped near bottom end	14.2		11			
J0139		18.3		10.5		4.7	2.9
J0140		32.8		19.8		9.5	7.3
J0141	Second drill hole on side	21.1		13		5.5	
J0142		12.2		10		4.7	2.6
J0143		14.6		7.6	6.2	4.4	2.2
J0144		27.4		8.7		8.1	6.7
J0145		9.9		7.8			
J0146	Not rounded off very well	25.6	25.2	8.6	8.2	8.1	7.5
J0147	Ridges on outer side of bead	21.7		7.8			
J0148	75% complete, tail missing,	26.8		15.5		9.5	
J0149	Broken tail, Lots of chips off	25.3		16.2		8.5	9.6
J0150		31.9		22.3		9	7.9
J0151		27.5		19.5	11.2	8.5	5.9
J0152	Tiny crystals on one side	33.3	28.1	22.1		6.4	6.4
J0153	tail broken	18.2		15.9		8.9	7.5
J0154	only the head left	17.2		21.7		11.6	
J0155	gouges on sides	28.4		7	6.4		
J0156	gouges, head only	14.4		10.5		8.8	
J0157		25.6		14.6		7	4.5

J0158	big chunk off tail, porous	15.2		9.6		4	3.4
J0159	lots of gouges	32.4		17.9		8.2 (bottom)	6.8 (top)
J0160		7.6	5.9	10.5			
J0161		14.3		11.5			
J0162		11.9	10.9	11.7			
J0163	only the head left	13.2		21.5		9.4	
J0164	pinched head	28.2		15.7		8.2	6
J0165	constricted head	23		13.8		7.9	5.6
J0166	constricted head, back not smoothed, fat tail	24.2		12.8		7.3	5.7
J0167	a bit lopsided, one side is too flat	26.6		14.4			
J0168	chipped at the middle	13.1	12.2	9.9	9.4		
J0169		38.9		24.4		12.1	9.2
J0170	chip off one side	26.2		15.5		6.7	5.3
J0171	heavy head constriction	13		7.8		3.5(bottom)	2.6(top)
J0172		22	20.8	12.7			
J0173		11.7		11.3	10.4		
J0174	chunk off one side of the nose	30.3		18.1		8.5-7.4	8
J0175		5.6		7.3			
J0176		24		15		7.3	6.8
J0177		**8.7**		16.2	10.9	13.7	
J0178		**11.4**	9.9	13.4	9.9	6.6	
J0179		13.8		14.2	10.8	8.3	
J0180		26.5	26			12.7(b)	7.8 (top)
J0181		15.6		23.8		11.5(b)	8.5(top)
J0182		24.4	24.2	15.7		8.2	6.8
J0183		11.6		8.9			
J0184		8		8		2.1	
J0185		29.7		17		9.8	9.1
J0186		14.7 (drill length)		16.9	11.9	13.1 (top)	

J0187		18.8		19.5	7.8	5.5	4.1
J0188		20.1		7.3	5.9		
J0189	Very light	31.8		17.6		3.7	
J0190		2.2		5.8			
J0191	layers of chalcedony or agate visible on side	42.6		23.7	22.2	8.7 (bot)	8.5 (top)
J0192		7.3		11.7	8.3		
J0193		12.9		12.7	10.7		
J0194		20.3		13		6.5	
J0195		16.6		16.8		10	6.4
J0196	weathered and pitted	15.9	12.6	10		5.2	
J0197		20.4		14.8	12.6		
J0198	lots of cortex remaining	36.8		19.6		10.1	8.4
J0199	dirt embedded in grooves on body	22.4		11.5		5.8-2.9 (bot)	5.7-3.4(top)
J0200		29.3		18.8		10.1 (mid)	8.2 (bot) 8.4 (top)
J0201		17.8		22		8.8 (top)	9.2 (bot)
J0202	lots of tiny cuts and dents	36.3		29.3		13.1	7
J0203		21.3		13.3			
J0204		28.9		10			
J0205		25.9		10.2			
J0206	sticker residue on side	6.5		2.3			
J0207	somewhat smoky	13		10.1			
J0208	small chips off body	10.5		12			
J0209		10.9		15.4	14.8		
J0210		20.8		20.1		8.4	
J0211		10.2		12.4			
J0212		10.3		12.2			

J0213	geode crack on one side	30.1		18.2		8.2	6.7
J0214		11.4		14.8	14.1		
J0215	circular cracks on one side	12.2		14.1			
J0216		8.1	6.8	12.1	11.25		
J0217		11.9		12.1			
J0218		7.3		9.7	9.1		
J0219		6.1		7.8			
J0220		7		10.9			
J0221		13.3		18.9	17.2		
J0222		9.5		8.9			
J0223		7.2		9.4			
J0224		11.7		14.4			
J0225		5.7		8			
J0226	constriction around the holes	29.9		17.9		9.3	7.8
J0227		9.7		14.4			
J0228		31.5		21.6		12.2	8.6
J0229		11.2		12.6		8	3.6
J0230		11.4		12.8			
J0231		10.3		12.6			
J0232		8		10.3			
J0233	constriction around holes, geode crack on head	34.7		19.6		11.3	9.4
J0234		18.7		13.2			

DA number	Dia Top	Dia Bottom	Drill hole	Drill hole	Drill Min	Curvature	SURF. DESI
REG.NUMBER	Dia 1	Dia 2	Dia 1	Dia 2	Dia 3	Curvature	SURF. DESI
K0001			4.08	2		75°	high polish, ground, chipped and worn from drilling process and string
K0002			4.97	4.23		59°	polished

K0003			4.83	2.32		65°	high polish, second drill hole
K0004			4.49	4		62°	polish, riffling visible, lateral grinding used to make grooves
K0005			3.66	3.65			
K0006			4.01	3.89			
K0007			3.94	3.69			
K0008			3.03	2.86			
K0009			1.64	0.61			
K0010			1.67	0.49			
K0015			6.41	2.29		30°	high polish
K0016			3.78	3.03		33°	polish
K0017			5.38	4.72		35°	high polish
K0018			4.66	2.34		32°	high polish
K0019			3.27	2.1		39°	polished
K0020			2.48	1.66		34°	polished
K0021			2.68	2.04		33°	polished
K0022			4.96	3.24		30°	polished
K0023			5.04	4.43		40°/78°	high polish
K0024			5.76	5.51		30°/68°	high polish
K0025			1.4	1.32		31°/90°	high polish
K0026			4.79	4.78		30°/60°	high polish, riffling or sawing for grooves
K0027			3.21	1.42		32°/80°	high polish
K0028			3.28	2.83		35°/70°	high polish
K0029			3.06	1.31		33°/77°	Chipped, ground, polished, worn.
K0030			3.09	2.9		31°/90°	Chipped, ground, polished. Grooves riffled. Worn.
K0068							
K0069							
K0070							
K0071							
K0072			1.87	2.15			

K0073			1.6	1.84			polished
K0074			1.34	1.55			polished
K0075			0.95	1.14			
K0076			1.23	1.28			
K0077			1.37	1.15			
K0078			1.02	1.26			
K0079			4.27	3.9		80°	high polish
K0080			3.7	3.6		56°	high polish
K0081			3.7	1.72		37°	high polish
K0084			2.06	1.82-3.27			high polish
K0085			4.4	2		55°	high polish
K0086			4.6	2		75°	crumbly
K0087			1.84	3.8		74°	high polish
K0088			3.6	1.5		58°	Ground. Polished.
K0089			2	0.86		65°	high polish
K0090			2.8	1.8		78°	high polish
K0091			2.44	2.26			Ground, polished and worn.
K0092			1.8	2			Chipped, ground, polished and worn. Some percussion weathering.
K0093			3.3	3.4	2.5	53°	
K0094			2.14	2.21		54°	
K0095			1.75	2.06			Ground, and high polish. Chipped from drilling
K0096			3.63-3.13	3.7-3.2			Chipped stone
K0097			0.78	0.78			Ground and polished.
K0098			1.4	0.6			Ground, some chipping from shaping
K0099			1.1	0.6			Ground and polished.
K0100							Ground and polished.
K0101			0.63	0.97		33°	Polished.
K0102			1.42	0.96		50°	Polished.
K0103			2.11 (1.64)	1.64			Chipped, ground and polished.

K0104			1.1	1.1			Chipped, ground and polished.
K0105			2.16	2.95		60°	Polished.
K0106			1	2.7		69°	Ground. Polished.
K0107			1.46	1.65			Chipped, ground and polished.
K0108			1.69	1.64			Ground and polished.
K0109			1.53	1.53			Ground and polished.
K0116			1.78	1.73			Chipped, partially ground. High polish. Worn. Lots of percussion weathering. Some string wear.
K0117			2.33	4.92		100°	Ground and worn.
K0118			4.47	4.41		88°	Lightly polished.
K0119			1.58	1.42			Chipped, ground polished.
K0120			1.12	0.93			Lots of percussion fractures.
K0121			1.15	1.13			
K0122			2.83	2.24			High polish
K0123			2.14	0.6			Lots of percussion fractures.
K0124			1	1			Ground. Some polish.
K0125			1.01	1.41			Lots of percussion fractures.
K0126			1.14	1.14			Some percussion fracturing.
K0127			1.11	1.11			Ground and polished. Some percussion fracturing.
K0128			3.03	2.24			High polish. Heavy wear from beads hitting each other.
K0129			1.45	1.81			High polish. Heavy wear from beads hitting each other.
K0130			0.63	0.63			Ground and polished. Percussion fractures.
K0131			3.79	1.86			Percussion fractures. Lots of wear on ends.
K0132			1.59	1.71			Lightly polished.
K0133			2.45	2.39			
K0134			2.05	2.05			
K0135			1.4	1.66			
K0136			1.5	1.69			Percussion fractures.
K0137a			2.58/2.55	1.99/1.8			Wear on ends.
K0137b			2.58/2.55	1.99/1.8			Wear on ends.

K0139			1.49	1.49			Heavy polish. Percussion fractures.
K0140			1.33	0.92			
K0141			1.29	1.28			
K0142			1.5	1.5			
K0143			1.37	1.22			
K0144			1.14	1.14			
K0145			1.14	1.31			
K0146			1.15	1.15			
K0147			0.88	0.88			
K0148			1.08	1.08			
K0149			1.05	1.05			
K0150			1.18	1.18			
K0151			3.76	4.8		105°	
K0152			2.55	2.67		105°	Faint earlier drill hole
K0153			3.89	2.4		85°	
K0154			1.51	2.63		65°	
K0155			2.89	1.38		80°	
K0156			1.05	2		70°	
K0161			1.35	1.35			
K0162			1.14	1.19			
K0163			1.2	1.2			
K0164			1.45	1.45			
K0165			1.09	1.08			
K0166			1.49	1.49			
K0167			1.32	1.32			
K0168			1.55	1.55			
K0169			0.74	0.74			
K0170			1.19	1.19			
K0171			0.93	0.93			
K0172			1.06	1.21			

K0173			0.73	0.72			
K0174			0.92	0.92			
K0175			0.78	0.87			
K0176			0.79	0.79			
K0177			0.97	0.97			
K0178			1.04	1.04			
K0179			0.72	0.72			
K0180			1.61	1.01			
K0181			2.96	2.87			bead has been cut down from a longer length
K0183			0.9	0.98			
K0184			1.73	1.73			
K0185			1	1			
K0186			3.37	2.44			
K0187			1.57	1.65			
K0188			1.28	1.28			
K0189			1.57	0.9			
K0190			2.52	2.73			
K0191			2.35	2.57			bead has been cut down from a longer length
K0192			1.15	1.12			
K0193			1.2	1.17			
K0194			2.65	1.73			
K0195			1.05	1.05			
J0001			2.76	1.23		80°	Polished
J0002			2.51	0.68	2.43		Polished
J0003			2.16	0.74			Polished
J0004			2.22	0.53			weathered and cracked
J0005			1.93	1.18			powdery and weathered
J0006			2.26	0.58			polished
J0007			3.68	0.88			Polished

J0008			2.9	0.58			Polished but pitted.
J0009			2.07	2.03			Polished.
J0010			2.31	1.28			Cloudy and rough probably due to acidic soil
J0011			3.67	0.95			Cloudy and rough probably due to acidic soil, not the most well facetted bead, edges smoothed
J0012			2.18	1.42		45°	Hard to say.
J0013			2.19	2.04		70°	Ground
J0014			3.8	3.31	4.22	~55°	High polish. Ground
J0015			1.42	1.47		67°	
J0016			1.77	1.77		75°	
J0017			2.54	1.09		100°	Ground
J0018			1.02/0.83	0.94/084			
J0019			1.44	1.55		75°	
J0020			2.07	1.13			
J0021	7.1	6.3	4.24	1			
J0022	6.8	6.8	3.33	0.82			Ground and polished.
J0023	7.9	7.9	4.3	1.55			Percussion fractures.
J0024	6.42	6.77	2.77	1.04			
J0025	8.3	8.6	2.43	2.24			Roughly ground.
J0026			1.79	1.56		85°	DO TAPER
J0027			2.08	1.87			Cracked inside.
J0028			3.06	2.96			Not polished.
J0029			2.48	2.19		80°	High polish. Square head.
J0030			2.17	3.16		95°	Polished. Ground.
J0031			2.3	2.06		105°	
J0032			1.87	3.06		90°	High polish
J0033			2.87	1.49		85°	
J0034			2.14	3.4		100°	High polish
J0035	7.8	8.8	4.99	1.73	4.11		Percussion fractures.
J0036	6.8	6.6	1.79	3.23			Ground

J0037			3.33	0.84			Ground
J0038	8.2	7.3	3.53	1.38			some percussion fractures
J0039	6.4	6.4	3.26	0.99			some percussion fractures
J0040	7.4	6.3	3.37	1.02			Ground
J0041	5.5	4.9	3.26	1.35			
J0042			1.15	1.75		80°	Surface has some rough spots
J0043			1.63	2.12		96°	
J0044	12.1	12.2	2.17	1.18			
J0045			2.04	1.61			
J0046			2.33	2.63			
J0047			1.53	1.67			
J0048			2.75	1.58			
J0049			1.73	2.27			ground, polished
J0050			2.09	0.74			
J0051			2.48	0.48			
J0052			2.3	2.21			
J0053			2.9	2.23			
J0054			2.15	2.36			
J0055			1.81	1.42			
J0056			1.35	1.35			DO TAPER
J0057			1.75	1.44			DO TAPER
J0058			1.36	1.81			DO TAPER
J0059			1.39	1.39			DO TAPER
J0060			1.25	1.05			DO TAPER
J0061			2.25	0.83			Ground and polished
J0062			2.79	1.36			Ground and polished
J0063			2.21	1.48	1.24		Ground and polished
J0064			2.01	0.84			Ground and polished
J0065			2.29	0.89			Ground and polished (in 2 directions)
J0066			2.12	0.84			Ground and polished (in 2 directions)

J0067			2.19	1.51			Ground and polished
J0068			1.73	0.85			Ground and polished
J0069			2.65	1.01			Ground and polished
J0070			2.2	2.2			
J0071			3.47	1.89		120°	
J0072			1.61	2.47		90°	Ground, old fashioned shape
J0073			1.68	1.72			
J0074			1.65	3.43		85°	Ground and polished
J0075			1.27	2.61		100°	Ground and polished
J0076			1.46	3.03		110°	Ground and polished
J0077			1.41	3.83		90°	Percussion fractures.
J0078			2.4	1.02	2.13		Ground and polished
J0079	8.4	8.4	4.47	1.73			Percussion fractures. Lopsided or worn on one side.
J0080			1.75	1.45			edges on body have ridges on them, worn on outside
J0081			4.12	1.8	3.76	100°	drilled twice
J0082			2.47	1.05			Ground and polished
J0083			2.38	2.38			
J0084			3.65	1.52	2.2		Ground and polished
J0085			2.51	1.38			Ground and polished
J0086			2.05	1.02		110°	Percussion fractures. Quite a flat bend, drilled at a slight angle
J0087	6.8	6-5.5	2.9	1.05			Percussion fractures.
J0088			2.79	2.18	2.42		
J0089			1.78	1.04			Ground and polished
J0090			1.25	2.19		110°	Ground
J0091			0.87	2		100°	Polished
J0092			1.34	2.67		115°	Percussion fractures
J0093			2.43	0.61		75°	
J0094	8.2	7.7	3.25	1.12			Ground, percussion fractures
J0095	4.9	4.7	2.46	1.17			Ground

J0096			1.72	1.72			Ground
J0097			1.7	1.7			Percussion fractures
J0098			1.59	3.65	3.13	100°	Ground and polished, percussion fractures
J0099			2.95	2.84		92°	Polished
J0100	4.9	4.3	2.16	2.16			ground and polished
J0101			1.54	1.54			percussion fractures
J0102			1.27	1.27			Ground, percussion fractures
J0103			1.98	1.98			Ground
J0104			2.99	3.68		90°	
J0105			2.27	2.76		100°	
J0106			1.97	1.54		95°	ground and polished
J0107			1.41	1.41			faint percussion fractures
J0108			1.69	1.69			
J0109			1.16	1.16			faint percussion fractures
J0110			1.57	1.57			percussion fractures, high polish
J0111			1.77	1.77			
J0112	10.4	8.7	2.95	N/A			Ground, percussion fractures
J0113	8.3	7.7	5.06	1.27	4.01		Heavy wear, ground
J0114			4	1.11	2.98		percussion fractures
J0115	7.8	7.4	3.6	1.38	3.2		Ground
J0116	7.5	7.4-6.2	3.91	1.22			Ground, some percussion fractures
J0117	6.9	7.4	2.72	2.24			
J0118			1.71?				
J0119			3.44	1.44		95°	Ground, tail is somewhat crooked
J0120			2.5	1.64		88°	Center is very thick - 8.3mm, head pinched, ground
J0121			1.49	3.2		88°	Ground and polished
J0122			3.42	3.11			Ground and polished
J0123			2.27	2.59		80°	
J0124			2.68	2.42		80°	Some polish
J0125			3.04	1.32			Ground

J0126			1.32	3.05		75°	Ground, not well rounded/finished
J0127			2.78				
J0128			3.27	1.42			
J0129			2.46	1.67			ground, square on top, octagonal on bottom
J0130			1.27				Roughly chipped
J0131			2.53	1.74		98°	roughly chipped and possibly ground
J0132			4.16	1.6	3.58		ground and polished, wear on edges of both ends
J0133			3.03	0.97			wear on edges of both ends
J0134			3.04	1.59		100°	ground and polished
J0135			3.55	1.3			Percussion fractures.
J0136	7.7	7.7	3.77	1.68			Ground, percussion fractures
J0137			1.28	3.55		115°	Ground
J0138	7.1	6.8	4.14	2.3			Ground, percussion fractures, edges are smooth
J0139			1.4	2.81			roughly chipped, maybe ground
J0140			3.91		3.35		Ground, roughly chipped
J0141			3.08	2nd DH - 1.35	2.58		Ground
J0142			2.52	1.92			Seems to be a flake being worked
J0143			2.51	2.22			Ground
J0144			2.47	1.38			Ground
J0145			2.36	1.5			Ground
J0146			3.7	1.09	3.36		Ground, somewhat slanted on one end
J0147			3.1	1.12			Ground, not smoothed out, popped was sort of ground out
J0148			2.99	1.74			Ground
J0149			2.78	0.9			Ground
J0150			2.12				roughly chipped, Middle thickness is 13.0
J0151			3				roughly chipped
J0152			2.72				roughly chipped, Middle thickness is 8.6
J0153			1.59	2.47			Ground, tail broke off during construction
J0154			1.47	2.94			Ground

J0155			3.3	3	2.7		Ground
J0156			2.59	1.17			Ground, tail broke off during construction
J0157			2.61	1.23		110°	
J0158			2.27	2.27		75°	
J0159			1.32	2.78	2.44	105°	ground, high polish
J0160			2.4	1.31			ground and polished
J0161	7.2	7.5	3.65	1.07			ground, percussion fractures
J0162	8.3	8	2.75	1.76			Ground, body edges are not sharp
J0163			1.59	3.34			high polish
J0164			2.72	1.06		105°	ground and polished
J0165			2.52	1.17		110°	percussion fractures
J0166			1.04	2.64		105°	ground
J0167	9.1	7.2	4.2	1.4			ground
J0168	6.3	6.3	3.14	1.88			ground
J0169			3.37	1.63		115°	Ground and polished
J0170			2.92	1.63		115°	Ground. Percussion fractures.
J0171			1.8	1.8		90°	
J0172	9.3-8.4	8	3.31	1.52			percussion fractures, ground but outside heavily worn
J0173	6.1	5.4	3.41	1.18			
J0174			1.56	3.03		105°	ground
J0175			1.87	1.87			
J0176			2.6	1.22		90°	
J0177			3.25				
J0178			3.08	1.82			
J0179			3.62				
J0180			2.55	2.08			Ground
J0181			3.27	1.48	2.88		
J0182			2.45			~110°	
J0183			3.41	1.76			Ground
J0184			1.19				

J0185			2.65	1.55		110°	Ground
J0186			1.44	3.31	2.63		Ground, percussion fractures
J0187			2.89	1.61			Ground
J0188			2.21				Ground
J0189			2.18	2.18			
J0190			1.58	1.58			Ground
J0191			2.88				
J0192			2.94	1.03 (drill tip)			Percussion fractures.
J0193			3.09	2.56	1.97		
J0194			2.66	2.42			Ground
J0195			1.37				
J0196			2.74	1.13			
J0197			3.06	1.19			Ground
J0198			2.07	1.73	Hole 2: 1.73, Hole 3: 1.47		Drilled 4 times
J0199			2.35	0.89			Ground
J0200			1.12	2.93			Ground, drilled twice
J0201			1.84	2.79			percussion fractures, tail area seems to have been smoothed out or worn
J0202			6.57	6.1			Small magatama thickness is 5 and length 15
J0203	8.1	7.5	3.7	1.14			Ground, percussion fractures
J0204			8.6	0.79			Ground
J0205			4.34	1.14	3.96 (first hole)		Ground, drilled twice
J0206			1.24	1.07			
J0207	5.7	5.8	3.29	1.16			Ground
J0208			2.16	2.26			
J0209			3.1	3.1			
J0210			1.39	3.31			Ground
J0211			1.62	1.62			
J0212			1.84	1.84			percussion fractures

J0213			3.34	1.57		105°	
J0214			1.97	1.97			
J0215			1.83	2.15			
J0216			1.77	1.77			high polish, percussion fractures
J0217			2.49	2.49			high polish
J0218			1.48	1.48			
J0219			1.67	1.67			
J0220			3.2	2.02			Ground and polished
J0221	8.7	7.6	2.85	2.85			Ground, percussion fractures
J0222			5.34	4.87			
J0223			1.5	1.5			
J0224			1.94	1.94			percussion fractures
J0225			1.4	1.4			
J0226			1.41	2.54		110°	Ground and polished
J0227	5.5	6.7-5	2.18	2.18			Percussion fractures
J0228			1.28	2.78		105°	high polish
J0229			3.23	1.64			Ground, faint percussion fractures
J0230			2.19	2.19			
J0231			1.88	1.88			faint percussion fractures
J0232			1.96	1.96			high polish, faint percussion fractures
J0233			0.96	3.43		100°	Ground
J0234	8.1	7.6	3.28	1.72			

DA number	INT. PERF	DRILL SECT	Drill Length 1	Drill Length 2	Bead End	
REG.NUMBER	INT. PERF	DRILL SECT			**Bead End 1**	**Bead End 2**
K0001	long conical	drilled from one side, roughness from an abrasive, probably quartz, worn smooth in places. Probably remounted while			string wear, perfectly circular	string wear

		drilled.		
K0002	long inverted biconical	drilled from two sides, slightly off center, high polish on inside	string wear	string wear
K0003	long inverted biconical	drilled from 2 sides, but more on one side. Polished inside. Two different drills, one fatter	string wear	string wear, lip from fatter drill
K0004	inverted biconical	solid copper drill, some wear or polish in the center of the impression, holes don't meet at the center, abrasive, lines from wear of grit on string	faint string wear	faint string wear
K0005	cylindrical			
K0006	cylindrical			
K0007	short tapered?			
K0008	?	2 sides		
K0009	long tapered	1 side, extremely small drill hole		
K0010	long tapered	1 side, extremely small drill hole		
K0015	short conical	1 side, very large drill hole on one side		
K0016	irregular inverted biconical	2 sides or popped		
K0017	irregular inverted biconical	2 sides		
K0018	short tapered	1 side		
K0019	short conical	1 side		
K0020	short conical	1 side		
K0021	short conical	1 side		
K0022	inverted biconical	2 sides		
K0023	inverted biconical	drilled from 2 sides	string wear on some parts of hole	wear along most of the edge
K0024	inverted biconical	drilled from 2 sides	wear on sides of hole	wear on sides of hole
K0025	straight	drilled from one side at an angle, high polish	wear on sides of hole	wear on sides of hole
K0026	short inverted biconical	drilled from 2 sides, don't meet at center, used abrasive	wear on sides of hole	wear on sides of hole
K0027	long curved conical	drilled from 1 side, worn	wear on sides of hole	wear on sides of hole
K0028	short inverted	drilled from 2 sides, holes don't line up		some wear

	biconical					
K0029	long conical	1 side			chipped on one side, wear on other	lots of chipping along edge
K0030	irregular convex	drilled mostly from 1 side, but a little from the other, holes don't line up,			wear on sides of hole	wear on sides of hole
K0068	N/A					
K0069	N/A					
K0070	N/A					
K0071	N/A					
K0072	N/A					
K0073	inverted biconical	drilled from 2 sides, holes barely meet, and drilled more than once			no wear	some slight chipping
K0074	long inverted biconical	drilled from 2 sides, visible striations and pauses while drilling, looks modern			faint wear or could be from drilling	faint wear
K0075	N/A					
K0076	N/A					
K0077	N/A					
K0078	N/A					
K0079	inverted biconical	drilled from 2 sides, visible crack inside hole			wear around hole and specifically in one spot	wear around hole
K0080	inverted biconical	drilled from 2 sides, holes don't line up			wear around hole	wear around hole
K0081	irregular conical	drilled from 1 side twice, and possibly widened on the other side			chipped then polished	chipped then polished
K0084	Straight cylindrical	drilled from 1 side, diamond-drilled			popped out then polished	some chipping from drill
K0085	long conical	drilled from 1 side, possibly hole widened a little on other side, metal drill possibly steel			wear along one side	sides have been smoothed
K0086	long conical	drilled from 1 side, parallel drilling stria, drilled on the side of larger hole with a smaller drill or heavily worn just there, cracks inside, abrasion drilling or could be burnt			secondary drill hole or wear	no visible wear
K0087	Convex tapered cylindrical	Drilled from 1 side and popped. Parallel drilling stria. Cracks from being popped.			Chipped and worn from wear	Chipped from wear
K0088	irregular long conical	Drilled 3 times by filling in drill hole and drilling final hole through it. Chipped on one side then ground.			smooth edges	Ground and polished.
K0089	long tapered cylindrical	Drilled from 1 side using abrasive.			wear around hole	wear around hole

K0090	tapered cylindrical	Drilled from 1 side. Parallel drilling stria.			wear around hole	wear around hole
K0091	straight cylindrical	Drilled from 1 side and popped. Parallel drilling stria. Spiral pattern from diamond-drilling. Even lines. Chipping from drilling and manufacture.				
K0092	irregular straight cylindrical	Drilled from 1 side and popped. Single or double diamond drill?				
K0093	cylindrical?	Drilled but polished from wear. Parallel drilling stria.			Curved near edges due to wear	
K0094	tapered cylindrical	Drilled from one side, abrasive, kinda dirty, rather smoothed surface			Heavy wear	Heavy wear
K0095	tapered cylindrical convex	1 side, popped.			Some wear and polish	Popped side has no wear or polish
K0096	tapered cylindrical	Irregular beveled stone/copper drill with teeth			Extreme wear from hitting other beads and string	Extreme wear from hitting other beads and string
K0097	straight cylindrical	Drilled from 1 side and popped. Diamond drilled.			Flat with some chipping.	Popped and polished.
K0098	long conical	1 side, popped.			Flat with some chipping and wear	small depression with cracks radiating outwards. May be some wear at one spot.
K0099	long conical	1 side, popped. Heavily worn near holes			Chipping from drilling.	Popped and chipped.
K0100	N/A					
K0101	conical	1 side, popped.			Wide with microfractures from drilling.	Popped with one large irregular fragment.
K0102	conical	1 side, popped.			Wide with microfractures from drilling.	Popped with small fractures.
K0103	straight cylindrical	Drilled from 1 side and popped. Parallel striations.			Some chipping from drill, not flat	Popped side. Hole edges quite sharp.
K0104	straight cylindrical	Drilled from 1 side and popped. Diamond drilled.			Chipping from drilling and possibly some wear.	Popped. Very faint chipping in places.
K0105	inverted biconical	Drilled from 2 sides, more on one, holes do not align			Wear around hole edges	Wear heavy in one spot.
K0106	long tapered cylindrical	Drilled from 1 side with abrasive, parallel drilling stria			Some wear.	Some wear.
K0107	straight cylindrical	Drilled from 1 side and popped. Parallel stria. Diamond			Chipping from drilling.	Most of the popped

		drilled.			(not second drill hole)	side has been ground down but still visible around the edges of the hole
K0108	straight cylindrical	Drilled from 1 side and popped. Diamond drilled.			Some wear.	No wear.
K0109	straight cylindrical	1 side, popped.			Some wear and polish	Some wear and chipping from drilling.
K0116	straight cylindrical	Drilled from 1 side and popped. Double diamond drilling.			Wear and polish. Faint gouges around hole.	Some wear.
K0117	long irregular conical	Drilled from one side with drill shifting at the end. Probably started with a new thinner drill near the end. Used abrasive. Parallel drilling stria.			Some wear.	Slight chipping. Some wear.
K0118	irregular cylindrical	beveled copper drill, long line inside is from pulling the drill out			Some wear.	Some wear.
K0119	straight cylindrical?				Some wear.	Some wear.
K0120	N/A				Some wear.	Sharp edges.
K0121	N/A	drilled from 1 side			Some wear.	Some wear.
K0122	N/A	Visible striations.			Heavy wear.	Broken
K0123	tapered conical	1 side, popped.			Fractures from drill.	Chipping in the popped area.
K0124	straight cylindrical	1 side, popped.			Lots of wear.	Sharp edges.
K0125	tapered conical?	1 side, popped.			May be wear in spots.	Some fracturing.
K0126	N/A	Hole doesn't seem fully aligned despite being popped. Maybe drilled again from other side after popping?			Fractures from drill.	Some fracturing.
K0127	straight cylindrical	1 side, popped.			Some wear and fractures from drill.	hole seems rather oblong - wear? Fractures coming from pop out
K0128	N/A	Drilled from 1 side.			Fractures from drill. Some wear.	Fractures from drill some wear.
K0129	N/A	?			Heavy wear and fractures from drill.	Heavy wear.
K0130	straight cylindrical	Drilled from 1 side and popped.			Fracture from drill.	Some fracturing.
K0131	N/A	Drilled from 1 side.			Heavy wear.	Heavy wear.
K0132	long tapered				Some wear on larger hole	Faint wear

K0133	tapered	2 sides?			wear	Heavy wear
K0134	straight cylindrical	1 side, popped.			some wear	
K0135	straight cylindrical	1 side, popped.			some wear	
K0136	straight cylindrical	1 side, popped.			wear	wear
K0137a	tapered	abrasive			wear, wear on ends	wear, wear on ends
K0137b	tapered	abrasive			wear, wear on ends	
K0139	straight cylindrical	Drilled from 1 side and popped. Diamond drilled. Drill wiggled.			wear	wear
K0140	straight cylindrical	1 side, popped. Larger drill used first than smaller diamond drill.				
K0141	straight cylindrical	1 side, popped, diamond drilled				
K0142	straight cylindrical	1 side, popped. Larger drill used first than smaller diamond drill.				
K0143	straight cylindrical	1 side, popped, diamond drilled			wear	wear
K0144	straight cylindrical	1 side, popped. Larger drill used first than smaller diamond drill.			wear	
K0145	straight cylindrical	1 side, popped, diamond drilled				
K0146	straight cylindrical	1 side, popped. Diamond drilled.			some wear	
K0147	straight cylindrical	1 side, popped. Diamond drilled.				
K0148	straight cylindrical	1 side, popped. Diamond drilled.				
K0149	straight cylindrical	1 side, popped. Larger drill used first than smaller diamond drill.			wear	
K0150	straight cylindrical	1 side, popped. Diamond drilled.				
K0151	irregular inverted biconical	2 sides				
K0152	inverted biconical	2 sides, abrasive drilling, different drill size than other beads on site				
K0153	short conical	1 side				
K0154	short conical	1 side, polish on edge of drill hole, than rough abrasive drilling				
K0155	tapered cylindrical	drilled with abrasive, polish at narrow edge, some wear, heavy fluctuating pressure to make the big lines on impression				
K0156	short conical	1 side, metal abrasive drill, some wear				
K0161	straight cylindrical					
K0162	straight cylindrical	1 side, popped. Larger drill used first than smaller diamond drill.				

K0163	straight cylindrical	1 side popped. Diamond drilled. A little wear.				
K0164	straight cylindrical					
K0165	straight cylindrical					
K0166	straight cylindrical	1 side, popped. Larger drill used first than smaller diamond drill.				
K0167	straight cylindrical					
K0168	straight cylindrical					
K0169	straight cylindrical	1 side, popped. Diamond drilled.				
K0170	straight cylindrical	1 side, popped. Diamond drilled. Heavy wear.				
K0171	straight cylindrical					
K0172	straight cylindrical					
K0173	straight cylindrical					
K0174	straight cylindrical	1 side, popped. Larger drill used first than smaller diamond drill.				
K0175	straight cylindrical					
K0176	straight cylindrical	1 side, popped. Larger drill used first than smaller diamond drill.				
K0177	straight cylindrical					
K0178	straight cylindrical					
K0179	straight cylindrical					
K0180	straight cylindrical	1 side, popped. Diamond drilled.				
K0181	short tapered	1 side, metal drill with fine abrasive, very shiny impression, very worn				
K0183	straight cylindrical	1 side, popped. Diamond drilled. Drilled with a larger than smaller drill.				
K0184	straight cylindrical	1 side, popped. Diamond drilled. Drilled with a larger than smaller drill.				
K0185	straight cylindrical					
K0186	tapered	metal drill with abrasive, high polish from string wear				
K0187	straight cylindrical	1 side, popped. Diamond drilled.				
K0188	straight cylindrical					
K0189	tapered	metal drill, high wear, 1 side, high polish				
K0190	long tapered	metal drill with quartz abrasive or stone drilling, very smooth				

K0191	short tapered	2 sides, metal with fine abrasive, very shiny impression		
K0192	straight cylindrical			
K0193	straight cylindrical			
K0194	tapered			
K0195	straight cylindrical			
J0001	long tapered conical	drilled twice on 1 side, one drilling extends to the end and popped out, metal drill with abrasive, roughness from an abrasive, worn smooth in places. Probably remounted while drilled.	wear	wear
J0002	long conical	drilled from 1 side, quite smooth, metal drill with abrasive	wear	wear
J0003	long conical	drilled from 1 side, striations, metal drill with abrasive	wear especially in one direction	
J0004	long conical	drilled from 1 side		
J0005	long conical	drilled from 1 side		
J0006	long conical	drilled from 1 side, metal drill with abrasive	wear and centered	wear and centered
J0007	long conical	drilled from 1 side, metal drill with abrasive, looks like they paused about 3/4 of the way through	slightly off center	slightly off center, chipping from popping was then polished
J0008	irregular long conical	drilled twice from one side, metal drill with abrasive, one drilling extends to the end and popped out	Off center large hole which might have some wear	popped a little, then polished. Small lighter ring around the hole - stress fracture?
J0009	straight cylindrical stepped	drilled from 2 sides, more from one, holes don't fully line up, possibly two sizes or resharpened bevel tipped metal drill? no abrasive?	One hole centered, string wear on lines at edges of hole	string wear on lines at edges of hole, Gouge nearby
J0010	long conical	drilled from one side and popped, metal with abrasive	large hole with polish and wear creating a lip	smaller hole has a slight depression and chipping from manufacture plus a half lip
J0011	long conical	drilled from one side and popped, metal with abrasive	Off center. Factures around the larger hole from manufacture, side - either popped or	Off center. depression has not been weathered on smaller hole

					chipped.	
J0012	conical	drilled from 1 side				
J0013	short tapered	1 side			wear	wear
J0014	tapered, tapered	Drilled from 2 sides. Holes don't meet except on sides. Each hole extends about 2/3 in			wear	wear
J0015	long tapered	1 side			some wear	some wear
J0016	straight cylindrical	Visible striations.			Wear.	Wear.
J0017	conical	Drilled from 1 side and popped			Some wear	
J0018	cylindrical	2 holes, 1 side probably			Top hole is much more heavily worn than bottom	Big depression around holes ie wear on end
J0019	cylindrical	1 side probably			wear, heavy end wear	wear, heavy end wear
J0020	long tapered	Drilled from 1 side.			Wear and marks, heavy end wear	Heavy wear, heavy end wear
J0021	conical	Drilled from 1 side and popped.			wear	shiny edges, chipping from manufacture, popped
J0022	conical	Drilled from 1 side and popped.			wear and chipping	string wear or a crack since mostly in one place
J0023	conical	Drilled from 1 side.			Pitting around holes. Off center, some wear	Popped or chipping from drill.
J0024	conical	Drilled from 1 side and popped.			Oblong and off center. Large flake off top.	Oblong and off center.
J0025	N/A				off center, wear in 1 place, light wear around edges	wear on part of the hole edge
J0026	cylindrical, not meeting	Drilled from 2 sides			Wear.	Wear.
J0027	N/A				Off center	Large flake chipped off and smaller chipping
J0028	cylindrical				wear	string wear - 2 grooves
J0029	short conical, shorter conical	Drilled from 2 sides. Holes off center			Some wear	

J0030	long tapered	Drilled from 1 side.			Some wear	Some wear
J0031	cylindrical	Drilled from 1 side?			Some wear	Some wear
J0032	tapered	Drilled from 1 side.			Wear	Wear
J0033	long tapered	Drilled from 1 side.			Some wear	Wear
J0034	long tapered	Drilled from 1 side			Chipping around edges	Some wear
J0035	long tapered	Drilled from 1 side				
J0036	tapered	Drilled from 1 side			Chipping around edges	a little oval
J0037	long conical	Drilled from 1 side, drilled at least twice			wear	wear, off center
J0038	long conical	Drilled from 1 side and popped.			wear, end wear	wear, end wear
J0039	long conical	Drilled from 1 side and popped.			wear	wear
J0040	conical	Drilled from 1 side and popped.			Slightly off center, wear	
J0041	conical	Drilled from 1 side			Chipping around edges	chipping around edges
J0042	tapered, tapered	Drilled from 1 side, at an angle			wear	wear
J0043	tapered, tapered	Drilled from 2 sides, ends don't quite meet			wear	oblong from string wear
J0044	long tapered	Drilled from 1 side? Possibly a small amount of drilling on other end				chipping around edge
J0045	long tapered	Drilled from 2 sides, one side about 75% of length				
J0046	cylindrical	Drilled from 2 sides			At an angle due to wear	
J0047	cylindrical	2 sides			Slightly off center, wear	Slightly off center, wear
J0048	long tapered	Drilled from 2 sides, one side about 75% of length			Wear	Wear
J0049	long tapered, conical	2 sides, long tapered is about 60%			Wear on outside of bead end, off-center	Wear on outside of bead end
J0050	long conical	1 side, popped			Wear, wear on outside of bead end	Wear on outside of bead end
J0051	long conical	1 side, popped, drilled two times			oblong hole, some wear on outside of bead end	not entirely flat, some wear on outside of bead end
J0052	tapered cylindrical	2 sides, stone drill high polish			heavy wear on hole, wear on ends	wear on ends
J0053	cylindrical, cylindrical	2 sides, smooth but faint lines of drilling, stone drill high polish			off center, not fully smooth on one end of	off center, wear on ends

					the cylinder, wear on ends	
J0054	cylindrical, tapered	2 sides, off center, freshly chipped stone drill			wear on ends	wear on ends
J0055	tapered	1 side			slanted from wear	walls very thin
J0056	tapered cylindrical	1 side, smooth for about halfway then striations, metal cylindrical drill			walls very thin	
J0057	long cylindrical, short cylindrical	2 sides				worn down from wear
J0058	cylindrical, cylindrical	2 sides, some lipping, visible striations			pitted on the non-broken side	3 scratches alongside of the hole, string wear
J0059	tapered, tapered	2 sides, lots of lips			walls very thin	
J0060	cylindrical, cylindrical	2 sides, deep uneven striations			some wear on ends, wear around hole	wear around hole
J0061	long tapered conical	drilled from 1 side			wear	chipped
J0062	inverted biconical; long tapered and short tapered	drilled from 2 sides			wear	
J0063	long tapered, short tapered	2 sides, holes barely meet up			vermillion inside, slightly irregular, light green patch, possible string wear	slightly off center, oval shape
J0064	long tapered conical	1 side, lipped			wear, wear on ends	off center, wear on ends
J0065	long tapered conical	1 side, faint lip			faint string wear	chipping from manufacture, slightly off center
J0066	long tapered	1 side			wear	wear on ends, off center
J0067	long tapered, short tapered	2 sides, heavy abrasive - emery?, drilled at an angle			wear, wear on ends	wear, slightly off center, wear on ends and chipping
J0068	long tapered	1 side, popped			wear on ends	popped, small flakes from drill, off center, wear on ends
J0069	long tapered	1 side, popped	24.1	0.7	wear, slightly off center, wear on ends	wear on ends
J0070	cylindrical	2 sides, some bulges from drill slippage	8.98	2.63	heavy wear, wear on	slight wear on end

					ends	
J0071	conical	1 side	5.64		heavy wear	wear
J0072	conical, conical	2 sides	3.68	2.42	wear	wear
J0073	tapered, tapered	2 sides	7.13	6	some wear, wear on end	some wear, wear on end
J0074	conical	1 side, ring of stone missing inside hole	6.06	0.36	fractures around hole	wear
J0075	short tapered conical	1 side	6.47	0.3	some chipping	wear, wear is focused on one side
J0076	short tapered conical	1 side, popped, wear inside	7.51	0.2	wear	heavy wear
J0077	short tapered conical	1 side, popped, wear inside	6.92	1.34	wear	wear
J0078	long tapered conical	1 side, wear inside	16.94	2.04	wear, oval shaped, off center, heavy wear on ends	some wear, half flaked off, heavy wear on ends
J0079	tapered conical	1 side	24.14	0.33	wear	wear
J0080	tapered conical	2 sides, lipped, abrasive	6.83	2.11	wear	wear
J0081	tapered, tapered	2 sides, lipped, angled	7.53	1.34	wear	wear
J0082	long tapered conical	1 side	26.25	0.54	wear, slightly off center, wear on ends	off center, chipping around hole, wear on end
J0083	cylindrical	2 sides, lots of lips, drill shifted a lot	18.04	9.38	wear, wear on ends	wear on end
J0084	long tapered conical	1 side	26.49		oval, wear, faint wear on end	off center, faint wear on end
J0085	long tapered conical	1 side, popped	23.88	0.33	wear, faint wear on the end	popped, off center, faint wear on the end
J0086	short tapered conical	1 side, popped			faint wear possibly	
J0087	short conical	1 side, popped				wear on end
J0088	tapered, tapered	2 sides, visible striations			oval, heavy wear, heavy wear on ends	wear, heavy wear on ends
J0089	tapered	1 side			wear, slightly off center, heavy wear on ends, depression around part of the hole	heavy wear on ends

J0090	tapered	1 side, popped			wear	wear
J0091	short tapered	1 side			heavy wear	heavy wear
J0092	short tapered	1 side			heavy wear	heavy wear
J0093	tapered	1 side, drilled twice			mis-drilled, heavy wear	heavy wear
J0094	conical	1 side, popped			wear	wear, lots of chipping
J0095	conical	1 side, popped			heavy wear	some chipping
J0096	straight cylindrical	1 side, popped, diamond drilled but heavily worn			heavy wear	heavy wear
J0097	straight cylindrical	1 side, diamond drilled			heavy wear	heavy wear
J0098	short tapered	1 side, crack in the middle of the hole			off center	slightly oval, off center, string wear on one side of hole
J0099	conical, tapered	2 sides			wear	wear
J0100	straight cylindrical	1 side, diamond drilled			wear	wear
J0101	straight cylindrical	1 side, popped, diamond drilled			heavy wear	heavy wear
J0102	straight cylindrical	1 side, popped, diamond drilled			wear	heavy wear
J0103	straight cylindrical	1 side, popped, diamond drilled			heavy wear	
J0104	conical, tapered	2 sides, angled so holes misaligned			wear	wear
J0105	conical, conical	2 sides, holes misaligned			wear	heavy wear
J0106	tapered cylindrical	1 side, heavy abrasive			some wear, off center	off center
J0107	straight cylindrical	1 side, popped, diamond drilled				
J0108	straight cylindrical	1 side, popped, diamond drilled			wear	wear on end
J0109	straight cylindrical	1 side, popped, diamond drilled			wear on end	wear
J0110	straight cylindrical	1 side, popped, diamond drilled			wear	wear
J0111	straight cylindrical	1 side, popped, diamond drilled			wear	some wear
J0112	tapered (unfinished)	1 side	8.22			
J0113	long conical	1 side, drilled twice			pinched and worn, off center, oval shaped, heavy wear	wear
J0114	long conical	1 side, popped			oval, heavy wear, wear on end	slightly off center, wear
J0115	long conical	1 side, popped			oval, wear, wear on end	off center, wear,

						faint wear on end
J0116	conical	1 side, popped			slightly off center, heavy wear	chipped on one edge, wear
J0117	?	2 sides			wear, wear on end	wear, wear on end
J0118	No hole					
J0119	conical	1 side, popped			wear	wear
J0120	short tapered	1 side			wear	wear
J0121	conical	1 side, popped			wear	wear
J0122	long tapered, tapered	2 sides			wear, wear on end	slightly off center, wear, wear on end
J0123	short conical, short conical	2 sides			off center, wear	wear, drilled at an angle to meet other hole
J0124	short conical, short conical	2 sides, heavy abrasive, heavy wear			heavy wear	heavy wear
J0125	long tapered	1 side, popped			slightly off center, some wear	slightly off center, some wear
J0126	conical	1 side, popped			heavy wear	wear
J0127	N/A	1 side	3.64			
J0128	conical	1 side, popped			a little wear	
J0129	N/A	2 sides, tried drilling one side at least twice			off center	very off center, oval shaped
J0130	N/A	1 side				
J0131	short tapered	1 side, hole angles down and twds front of head, popped and broke off part of the head				chipped
J0132	long conical	1 side			heavy wear, oval, end wear	wear, end wear
J0133	long tapered	1 side, drilled 3 times			heavy wear, slightly off center, wear on end	some wear, off center, wear on end
J0134	tapered	1 side, popped a little then ground down and polished			wear	wear
J0135	short conical	1 side popped			heavy wear, off center	off center
J0136	tapered conical	1 side, popped then ground away			slightly off center, wear, some end wear	wear, some end wear
J0137	short tapered conical	1 side popped			wear, end wear	wear
J0138	tapered conical	1 side			end wear, chipping	end wear

					from drilling	
J0139	short tapered conical	1 side popped				
J0140	N/A	1 side				
J0141	drilled first and broke, short tapered, then drilled again and unfinished	1 side				
J0142	N/A	2 sides				
J0143	short tapered	1 side, drilled at an angle				
J0144	short tapered	1 side, popped				popped area has been ground down
J0145	short tapered	1 side, popped			Broken end ground or worn	
J0146	long conical	1 side, popped			Slightly oval, faint marbling, wear	slightly off center, wear
J0147	long conical	1 side, popped			Heavy string wear or drilled twice, off center	off center, wear?
J0148	short tapered	1 side			Slightly low on head, wear	chiseled or popped?
J0149	short conical	1 side, popped			Large flake off side	
J0150	N/A	1 side				
J0151	N/A	1 side, stopped very close to finishing the hole, did the bottom snap off?				
J0152	N/A					
J0153	short tapered	1 side			chipping	chipping
J0154	tapered	1 side				chipping
J0155	short tapered, tapered	2 sides			Off center, chipping	Off center, chipping
J0156	short conical	1 side			chipping	chipping, Cracks within head around hole
J0157	short conical	1 side, popped			chipping	
J0158	cylindrical	1 side			heavy wear	heavy wear
J0159	short conical	1 side, popped			heavy wear	oval

J0160	short tapered	1 side, popped, drilled at an angle			heavy wear, wear on end	off center, wear, wear on end
J0161	conical	1 side, popped			Lipped, end wear, heavy wear	end wear
J0162	tapered	1 side, popped			chipping, some wear, off center	chip off the end
J0163	short conical	1 side			heavy wear	wear on end
J0164	short conical	1 side, popped, drilled at an angle			off center, pinched head side	heavy pits on lower side of hole
J0165	short conical	1 side, popped, drilled at an angle			wear	chipping
J0166	short conical	1 side			off center, heavy wear	off center, lip due to flaw in stone, wear
J0167	long conical	1 side, popped			some wear	some wear
J0168	long tapered	1 side			wear, end wear	wear, end wear
J0169	conical	1 side, popped, drilled at an angle			heavy wear	wear
J0170	short tapered	1 side			wear	some wear, chipping
J0171	N/A	2 sides			wear, heavy end wear	wear, heavy end wear
J0172	long conical	1 side			off center, heavy wear	off center, wear
J0173	conical	1 side			heavy wear, end wear	heavy wear, end wear
J0174	short tapered	1 side			wear	wear, faint grooves leading to the hole
J0175	straight cylindrical	1 side, popped, diamond drilled			heavy wear	wear
J0176	short tapered conical	1 side, popped				
J0177	short conical	1 side				
J0178	tapered conical	1 side				
J0179	conical	1 side	10.53			
J0180	N/A	1 side, angled			Chipping	
J0181	conical	1 side, popped			Oval	
J0182	tapered	1 side, tip inside is heavily polished			Some chipping	
J0183	tapered	1 side			Heavy wear, faint wear on end	wear, faint wear on end
J0184	N/A	1 side, popped				

J0185	tapered	1 side			Wear	wear
J0186	conical	1 side, popped, drilled twice			Chipping	
J0187	tapered	1 side, visible striations				Wear?
J0188	N/A				Off center	
J0189	short tapered, short tapered	2 sides, abrasive			some wear	some wear
J0190	straight	1 side			wear	wear
J0191	N/A	1 side, visible ridges			Chipping	
J0192	short tapered	1 side	5.4			
J0193	N/A	1 side, 2 holes started and never finished	3.88		Chip off the side of one hole	
J0194	straight cylindrical	1 side			Chipping	
J0195	N/A					
J0196	long conical	1 side				
J0197	long conical	1 side			slightly off center	off center
J0198	N/A	2 sides				
J0199	Conical	1 side			Chipping	
J0200	Conical	1 side, popped			Some wear	
J0201	tapered	1 side			heavy wear	wear
J0202	straight cylindrical	1 side?			wear	wear
J0203	long conical	1 side, popped			heavy wear	wear
J0204	long conical	1 side, popped				
J0205	long conical	1 side			wear?	
J0206	straight cylindrical	1 side, uneven striations visible			wear	wear on end
J0207	long conical	1 side, popped			wear, wear on end	wear on end
J0208	straight cylindrical	1 side, popped, diamond-drilled, some wear, visible striations	8.96	1.45		hole is triangle shaped on non popped side
J0209	straight cylindrical	1 side, popped, diamond-drilled, drilled at an angle, visible striations	9.25	1.61		off center
J0210	short conical	1 side, popped, at an angle	8.13	0.47	wear	heavy wear
J0211	straight cylindrical	1 side, popped. Diamond drilled. Drilled	9.18	1.36		

		with a larger than smaller drill.				
J0212	straight cylindrical	1 side, popped, diamond-drilled	9.21	0.4	some wear	some wear
J0213	short conical	1 side, popped, visible striations	7.05	0.95	heavy wear	wear
J0214	straight cylindrical	1 side, popped, diamond-drilled	11.3		heavy wear	
J0215	straight cylindrical	1 side, popped, diamond-drilled, hole at angle	10.69	1.46		
J0216	straight cylindrical	1 side, popped, diamond drilled	6.2	1.47	wear	heavy wear
J0217	straight cylindrical	1 side, popped, diamond drilled	11.03	0.4	heavy wear	wear
J0218	straight cylindrical	1 side, popped, diamond drilled	6.29	1.32	some wear	
J0219	straight cylindrical	1 side, popped, diamond drilled	4.93	1.05	some wear, chipping	
J0220	short tapered	1 side, popped	6.88	0.37	slightly off center, wear	wear
J0221	straight cylindrical	1 side, popped then smoothed out, diamond drilled			wear, slightly off center, chipping	wear
J0222	short conical, short conical	2 sides, stone drilled				
J0223	straight cylindrical	1 side, popped, diamond drilled			wear	wear on end
J0224	straight cylindrical	1 side, popped, diamond drilled			slight wear	
J0225	straight cylindrical	1 side, popped, diamond drilled, popped area smoothed out			wear	
J0226	short tapered	1 side			wear	wear
J0227	straight cylindrical	1 side, popped, diamond drilled			some wear	some wear
J0228	tapered	1 side, drilled twice			wear	wear
J0229	conical	1 side, popped and fractured off one side			wear	wear
J0230	straight cylindrical	1 side, popped, diamond drilled			wear	wear
J0231	straight cylindrical with corkscrew	1 side, popped, diamond drilled			wear, end wear	end wear
J0232	straight cylindrical	1 side, popped, diamond drilled			wear, end wear	
J0233	short conical	1 side, popped			wear	some wear
J0234	long tapered	1 side, popped			wear, wear on end	wear, wear on end

DA number	Specific	Ref/Publication	Institution	Drawing/Photo	Polity	Extra Notes

			Description			
REG.NUMBER	Gravity	Ref/Publication	Institution Description	Drawing/Photo	Polity	Extra Notes
K0001	3.34	Bokcheon museum		Y/Y	Gaya	All measurements in mm.
K0002	3.31	Bokcheon museum Tomb 15		Y/Y	Gaya	
K0003	3.33	Bokcheon museum Tomb 15		Y/Y	Gaya	
K0004	3.37	Bokcheon museum Tomb 80		Y/Y	Gaya	
K0005		Hangang Heritage Instiute 2011		Y/Y	Baekje	This is the first time Hangang have found this stone so they called it 'stone' but Insook Lee says it's usually called blueish-gray jasper.
K0006		Hangang Heritage Instiute 2011		Y/Y	Baekje	Same stone as above.
K0007		Hangang Heritage Instiute 2011		Y/Y	Baekje	Same stone as above.
K0008		Hangang Heritage Instiute 2011		Y/Y	Baekje	This site is an international trade and exchange area.
K0009		Hangang Heritage Instiute 2011		Y/Y	Baekje	Beads were all attached to each other so hard to measure.
K0010		Hangang Heritage Instiute 2011		Y/Y	Baekje	Beads were all attached to each other so hard to measure.
K0015		Hanseong Baekje Museum	Center of a necklace made of blue glass beads			xrf shows high strontium.
K0016		Hanseong Baekje Museum		Y/Y		xrf shows low strontium
K0017		Hanseong Baekje Museum		Y/Y		xrf shows high strontium.
K0018		Hanseong Baekje Museum		Y/Y		xrf shows low strontium
K0019		Hanseong Baekje Museum		Y/Y		xrf shows high strontium.
K0020		Hanseong Baekje Museum		Y/Y		xrf shows low strontium
K0021		Hanseong Baekje Museum		Y/Y		xrf shows high strontium.
K0022		Hanseong Baekje Museum		Y/Y		xrf inconclusive
K0023	~3.52	Daegu	said jade	Y/Y	Silla	
K0024	3.36	Daegu	said jade	Y/Y	Silla	Very fat.
K0025	3.33	Daegu	said jade	Y/Y	Silla	
K0026	3.38	Daegu	said jade	Y/Y	Silla	
K0027	3.33	Daegu	said jade	Y/Y	Silla	Quite curvy.

K0028	3.3	Daegu	said jade	Y/Y	Silla	
K0029	~2.61	Daegu		Y/Y	Silla	Width was slightly wider at bottom. Seems lighter than the next one. Very shiny. Bigger hole visible from side.
K0030	3.26	Daegu	said jade	Y/Y	Silla	hole drilled on both sides
K0068				Y/Y		
K0069				Y/Y		
K0070				Y/Y		
K0071				Y/Y		
K0072	1.97	Hanseong Baekje Museum	green tuff	Y/Y		Specific gravity done on cleanest of beads since holes so small. Very light beads though so scale might be inaccurate.
K0073	1.97	Hanseong Baekje Museum	green tuff	Y/Y		
K0074	1.97	Hanseong Baekje Museum	green tuff	Y/Y		
K0075	1.97	Hanseong Baekje Museum	green tuff	Y/Y		
K0076	1.97	Hanseong Baekje Museum	green tuff	Y/Y		
K0077	1.97	Hanseong Baekje Museum	green tuff	Y/Y		
K0078	1.97	Hanseong Baekje Museum	green tuff	Y/Y		
K0079	3.29	황오리 1 호분발굴조사보고서 1969	jade gogok	Y/Y	Silla	
K0080	3.31	황오리 1 호분발굴조사보고서 1969, p. 100	jade gogok	Y/Y	Silla	
K0081	3.26	황오리 1 호분발굴조사보고서 1969, p. 23, 100		Y/Y	Silla	
K0084	2.47-2.54			Y/Y	Silla	
K0085	2.39			Y/Y	Silla	Heavy.
K0086	3.06			Y/Y	Gaya	
K0087	3.48			Y/Y	Gaya	
K0088	3.39			Y/Y	Gaya	
K0089	3.3			Y/Y	Gaya	
K0090	3.45			Y/Y	Gaya	
K0091	2.6			Y/Y	Gaya	Wider of the two beads from same

						necklace.
K0092	2.58			Y/Y	Gaya	
K0093	1.18		Amber.	Y/Y	Gaya	Slightly transparent.
K0094	2.67			Y/Y	Gaya	
K0095	2.63		Think from Japan.	Y/Y	Gaya	
K0096	2.61			Y/Y	Gaya	
K0097	2.52	Busan Nopoh-dong Tomb 1985		Y/Y	Gaya	
K0098	2.61	Busan Nopoh-dong Tomb 1985		Y/Y	Gaya	
K0099	2.55	Busan Nopoh-dong Tomb 1985		Y/Y	Gaya	
K0100	2.58	Busan Nopoh-dong Tomb 1985		Y/Y	Gaya	
K0101	2.57	Busan Nopoh-dong Tomb 1985		Y/Y	Gaya	
K0102	2.54	Busan Nopoh-dong Tomb 1985		Y/Y	Gaya	
K0103	2.49	Busan Nopoh-dong Tomb 1985		Y/Y	Gaya	Lopsided and semi-rectangular. White inclusion on one side.
K0104	2.53	Busan Nopoh-dong Tomb 1985		Y/Y	Gaya	
K0105	N/A	Busan National University Museum 2011-12, - Tombs at Bokcheon-dong, Dong-nae, Tomb No. 35-36, 2012, Vol 37	Jadeite. XRF done by Warashina.	Y/Y	Gaya	
K0106	N/A	Busan National University Museum 2011-12, - Tombs at Bokcheon-dong, Dong-nae, Tomb No. 35-36, 2012, Vol 37	Jadeite. XRF done by Warashina.	Y/Y	Gaya	
K0107	2.57	Busan Nopoh-dong Tomb 1985		Y/Y	Gaya	
K0108	2.58	Busan Nopoh-dong Tomb 1985		Y/Y	Gaya	
K0109	2.58	Busan Nopoh-dong Tomb 1985		Y/Y	Gaya	
K0116	2.62	Sunglim Institute of Cultural Properties, Deokcheon-ri, Uljin, 2014, vol 89		Y/Y	Silla	Excavated 2011.
K0117	3.36	Sunglim Institute of Cultural Properties, Deokcheon-ri, Uljin, 2014, vol 89	Jadeite. XRF in site report.	Y/Y	Silla	
K0118	N/A	Sunglim Institute of Cultural Properties, Deokcheon-ri, Uljin, 2014, vol 89	Talc. XRF inside site report.	Y/Y	Silla	

K0119	N/A	Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)	Agate	Y/Y	Baekje	
K0120	N/A	Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)	Agate	Y/Y	Baekje	Part of a necklace.
K0121	2.53	Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)		Y/Y	Baekje	
K0122	2.53	Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)		Y/Y	Baekje	
K0123	2.6	Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)		Y/Y	Baekje	
K0124	2.53	Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)		Y/Y	Baekje	
K0125	2.59	Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)		Y/Y	Baekje	
K0126	2.57	Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)		Y/Y	Baekje	
K0127	2.5	Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)		Y/Y	Baekje	
K0128	2.54	Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)		Y/Y	Baekje	
K0129	2.42	Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)		Y/Y	Baekje	
K0130	2.49	Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)		Y/Y	Baekje	
K0131	2.58	Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)		Y/Y	Baekje	
K0132	2.35	Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)		Y/Y	Baekje	
K0133	2.36-2.41	Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)		Y/Y	Baekje	
K0134	N/A	Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)		Y/Y	Baekje	
K0135	2.56	Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)		Y/Y	Baekje	
K0136	2.62	Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)		Y/Y	Baekje	Lopsided. Other beads on necklace seem to have depressions on one side as well and holes on each side of

					several beads seem to be the same size. See photos.
K0137a		Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)	Y/Y	Baekje	Slashes are because two different cylinder beads on a bracelet were measured. The broken drill hole of a third measured 2.24 and 2.12 but was too fragile to measure fully. See photos.
K0137b		Gyeonggi Cultural Heritage Research Institute, Osan Suchong-dong Baekje Tumulus 2012 vol 139 (I-V)	Y/Y	Baekje	Slashes are because two different cylinder beads on a bracelet were measured. The broken drill hole of a third measured 2.24 and 2.12 but was too fragile to measure fully. See photos.
K0139	2.6	Gyeore Insitute of Cultural Heritage, Hantankangteim 2015	Y/Y	Baekje	
K0140	2.4	Gyeore Insitute of Cultural Heritage, Cheonghak-dong Site, Osan 2013, vol 25	Y/Y	Baekje	
K0141	2.5	Gyeore Insitute of Cultural Heritage, Cheonghak-dong Site, Osan 2013, vol 25, p. 409	Y/Y	Baekje	
K0142	2.46	Gyeore Insitute of Cultural Heritage, Cheonghak-dong Site, Osan 2013, vol 25, p. 409	Y/Y	Baekje	
K0143	2.47	Gyeore Insitute of Cultural Heritage, Cheonghak-dong Site, Osan 2013, vol 25, p. 409	Y/Y	Baekje	
K0144	2.48	Gyeore Insitute of Cultural Heritage, Cheonghak-dong Site, Osan 2013, vol 25, p. 409	Y/Y	Baekje	
K0145	2.53	Gyeore Insitute of Cultural Heritage, Cheonghak-dong Site, Osan 2013, vol 25, p. 409	Y/Y	Baekje	
K0146	2.52	Gyeore Insitute of Cultural Heritage, Cheonghak-dong Site, Osan 2013, vol 25, p. 414	Y/Y	Baekje	
K0147	2.53	Gyeore Insitute of Cultural Heritage, Cheonghak-dong Site, Osan 2013, vol 25, p. 414	Y/Y	Baekje	
K0148	2.49	Gyeore Insitute of Cultural Heritage, Cheonghak-dong Site, Osan 2013, vol 25, p. 414	Y/Y	Baekje	
K0149	2.44	Gyeore Insitute of Cultural Heritage, Cheonghak-dong Site, Osan 2013, vol 25, p. 414	Y/Y	Baekje	
K0150	2.54	Gyeore Insitute of Cultural Heritage, Cheonghak-dong Site, Osan 2013, vol 25, p. 414	Y/Y	Baekje	
K0151	~4	大東 Daedong Cultural Research	Y/Y	Gaya	

		Institute 2012				
K0152	3.31	大東 Daedong Cultural Research Institute 2012		Y/Y	Gaya	
K0153	3.32	大東 Daedong Cultural Research Institute 2012		Y/Y	Gaya	
K0154	3.32	大東 Daedong Cultural Research Institute 2012		Y/Y	Gaya	
K0155	3.29	大東 Daedong Cultural Research Institute 2012		Y/Y	Gaya	
K0156	2.98	大東 Daedong Cultural Research Institute 2012		Y/Y	Gaya	
K0161	2.54	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	Site name in English is Songnam-Yoju Boksonchonchul
K0162	2.46	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	
K0163	2.57	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	
K0164	2.59	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	
K0165	2.54	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	
K0166	2.51	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	
K0167	2.5	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	
K0168	2.59	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	Drilling barely visible under microscope.
K0169	2.5	Chungang Cultural Heritage Institute2013, vol 199, p. 275	사진 239-79~90	Y/Y	Early Baekje	
K0170	2.48	Chungang Cultural Heritage Institute2013, vol 199, p. 275	사진 239-79~90	Y/Y	Early Baekje	
K0171	2.49	Chungang Cultural Heritage Institute2013, vol 199, p. 275	사진 239-79~90	Y/Y	Early Baekje	
K0172	2.55	Chungang Cultural Heritage Institute2013, vol 199, p. 275	사진 239-79~90	Y/Y	Early Baekje	
K0173	2.54	Chungang Cultural Heritage Institute2013, vol 199, p. 275	사진 239-79~90	Y/Y	Early Baekje	

K0174	2.53	Chungang Cultural Heritage Institute2013, vol 199, p. 275	사진 239-79~90	Y/Y	Early Baekje	
K0175	N/A	Chungang Cultural Heritage Institute2013, vol 199, p. 275	사진 239-79~90	Y/Y	Early Baekje	Too small to measure accurate for SG.
K0176	N/A	Chungang Cultural Heritage Institute2013, vol 199, p. 275	사진 239-79~90	Y/Y	Early Baekje	Too small to measure accurate for SG.
K0177	N/A	Chungang Cultural Heritage Institute2013, vol 199, p. 275	사진 239-79~90	Y/Y	Early Baekje	Too small to measure accurate for SG.
K0178	N/A	Chungang Cultural Heritage Institute2013, vol 199, p. 275	사진 239-79~90	Y/Y	Early Baekje	Too small to measure accurate for SG.
K0179	N/A	Chungang Cultural Heritage Institute2013, vol 199, p. 275	사진 239-79~90	Y/Y	Early Baekje	Too small to measure accurate for SG.
K0180	2.57	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	
K0181	2.44	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	
K0183	2.5	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	
K0184	2.56	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	Somewhat irregular in shape.
K0185	2.49	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	
K0186	2.59	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	
K0187	2.6	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	Assuming centering the hole is a goal, does this mean we can tell what side they started to drill on?
K0188	2.6	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	
K0189	2.49	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	
K0190	2.52	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	
K0191	2.52	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	
K0192	2.51	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	
K0193	N/A	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	Too small to measure accurate for SG.

K0194	3	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	
K0195	2.56	Kukbang Cultural Heritage Institute 2015		Y/Y	Baekje	
J0001	N/A	Yoshimura Kazuaki, Kashihara 2009	green tuff/jasper	Y/Y		Context: A-6, 84, 43-1, 22-11
J0002	N/A	Yoshimura Kazuaki, Kashihara 2009	green tuff/jasper	Y/Y		Context: A-6, 82, 42-1, 23-57, 17.6
J0003	N/A	Yoshimura Kazuaki, Kashihara 2009	green tuff/jasper	Y/Y		Context: A-6, 83, 42-2, 23-54, 17.6
J0004	N/A	Yoshimura Kazuaki, Kashihara 2009	green tuff/jasper	Y/Y		Context: A-6, 72, 37-1, 23-41, 17.6
J0005	N/A	Yoshimura Kazuaki, Kashihara 2009	green tuff/jasper	Y/Y		Context: A-6, 70, 36-1, 23-40, 17.6 Bulge in the middle. Uniform appearance. XRF seems to point to it being a different material than the other 'green tuff'.
J0006	2.45	Yoshimura Kazuaki, Kashihara 2009	green tuff/jasper	Y/Y		
J0007	N/A	Yoshimura Kazuaki, Kashihara 2009	green tuff/jasper	Y/Y		
J0008	N/A	Yoshimura Kazuaki, Kashihara 2009	green tuff/jasper	Y/Y		
J0009	2.1	Yoshimura Kazuaki, Kashihara 2009	green tuff/jasper	Y/Y		
J0010	2.61	Yoshimura Kazuaki, Kashihara 2009	green tuff/jasper	Y/Y		
J0011	2.46	Yoshimura Kazuaki, Kashihara 2009	green tuff/jasper	Y/Y		
J0012		後出古墳、Kashihara vol 61		Y/Y		
J0013		後出古墳、Kashihara vol 61		Y/Y		
J0014		北原西古墳、Kashihara 1993		Y/Y		
J0015	2.3	北原西古墳、Kashihara 1993		Y/Y		Only 1 impression taken bc the gypsum stained
J0016	2.696	北原西古墳、Kashihara 1993		Y/Y		
J0017		野山遺跡、Kashihara vol56, 1989	I was told that this	Y/Y		

			square type of magatama is from the late 5th-6th century and that it might be from Shimane.			
J0018		野山遺跡、Kashihara vol 59		Y/Y		
J0019		野山遺跡、Kashihara vol 59		Y/Y		
J0020		野山遺跡、Kashihara vol59		Y/Y		
J0021	2.62	高田垣内古墳群 Kashihara vol 63, p. 89				
J0022	2.61	高田垣内古墳群 Kashihara vol 63, p. 89				
J0023		高田垣内古墳群 Kashihara vol 63, p. 89				
J0024		高田垣内古墳群 Kashihara vol 63, p. 89				
J0025		高田垣内古墳群 Kashihara vol 63, p. 89				
J0026	2.71	的場池古墳, 当麻町 cultural research report vol 1				
J0027		三ツ塚古墳群 Kashihara vol 81, 2002, p. 199				
J0028		三ツ塚古墳群 Kashihara vol 81, 2002, p. 86				
J0029	3.33	見田・大沢古墳群 Kashihara vol 44, 1982, p. 63				
J0030	2.57	的場池古墳群 Touma Town vol 1, 1982, p. 52				
J0031	2.62	的場池古墳群 Touma Town vol 1, 1982, p. 30				
J0032	2.65	的場池古墳群 Touma Town vol 1, 1982, p. 52				

J0033	3.32	的場池古墳群 Touma Town vol 1, 1982, p. 52				
J0034	2.64	的場池古墳群 Touma Town vol 1, 1982, p. 52				
J0035		豊田古墳群 ホリノヲ vol 20, 1975, p. 49				
J0036	2.62	豊田古墳群 ホリノヲ vol 20, 1975、p.34				
J0037		豊田古墳群-石上北古墳 vol 27, 1976, p. 44				
J0038		豊田古墳群 ホリノヲ vol 20, 1975, p. 49				
J0039		豊田古墳群-石上北古墳 vol 27, 1976, p. 44				
J0040		豊田古墳群 ホリノヲ vol 20, 1975, p. 49				
J0041	2.59	豊田古墳群-石上北古墳 vol 27, 1976, p. 44				
J0042						
J0043						
J0044						
J0045	2.45					
J0046	2.49					
J0047	2.48					
J0048						
J0049						
J0050	2.51					
J0051	2.5					
J0052	2.07					
J0053	2.39					
J0054						
J0055			no drawings of beads in site report			dirt embedded in hole so no impression taken
J0056						

J0057	2.28		unknown context but part of a necklace of similar beads			
J0058						many other beads on this necklace were broken as well
J0059	3.14					
J0060						
J0061		番塚古墳, 1993, Kyushu University, p. 53				
J0062		番塚古墳, 1993, Kyushu University, p. 53				
J0063		番塚古墳, 1993, Kyushu University, p. 53				Hole is blocked, no impression taken
J0064		番塚古墳, 1993, Kyushu University, p. 53				
J0065		番塚古墳, 1993, Kyushu University, p. 53				
J0066		番塚古墳, 1993, Kyushu University, p. 53				
J0067	2.49	番塚古墳, 1993, Kyushu University, p. 53				
J0068	2.55	番塚古墳, 1993, Kyushu University, p. 53				
J0069		番塚古墳, 1993, Kyushu University, p. 53				
J0070		宮崎県教育委員会　2015『西都原古墳群総括報告書』				
J0071	3.33	宮崎縣　1944『六野原古墳調査報告』史跡名勝天然記念物調査報告第 13 輯				
J0072	3.28	宮崎縣　1944『六野原古墳調査報告』史跡名勝天然記念物調査報告第 13 輯				
J0073		宮崎縣　1944『六野原古墳調査報告』史跡名勝天然記念物調査報告第 13 輯				
J0074		宮崎県教育委員会　2013『西都原 202 号墳』特別史跡西都原古墳群発掘調査報告書第 10 集				
J0075		宮崎県教育委員会　1973「高鍋町光音寺横穴調査報告書」『宮崎県文化財調査報告書』第 17 集				

J0076		宮崎県教育委員会　1973「高鍋町光音寺横穴調査報告書」『宮崎県文化財調査報告書』第 17 集		
J0077		宮崎県教育委員会　1973「高鍋町光音寺横穴調査報告書」『宮崎県文化財調査報告書』第 17 集		
J0078	2.58	宮崎県教育委員会　1973「高鍋町光音寺横穴調査報告書」『宮崎県文化財調査報告書』第 17 集		
J0079		宮崎県教育委員会　1973「高鍋町光音寺横穴調査報告書」『宮崎県文化財調査報告書』第 17 集		
J0080		宮崎県教育委員会　1973「高鍋町光音寺横穴調査報告書」『宮崎県文化財調査報告書』第 17 集		
J0081	3.16	宮崎県教育委員会　1955「日向市鈴鏡塚調査報告」『日向遺跡調査報告書』第 2 輯		
J0082		宮崎県教育委員会　1955「日向市鈴鏡塚調査報告」『日向遺跡調査報告書』第 2 輯		
J0083		高原町教育委員会　1991『立切地下式横穴墓群』高原町文化財調査報告書第 1 集		
J0084		宮崎県教育委員会　1980「飯盛地下式横穴 53-1 号発掘調査」『宮崎県文化財調査報告書』第 22 集		
J0085		宮崎県教育委員会　1980「飯盛地下式横穴 53-1 号発掘調査」『宮崎県文化財調査報告書』第 22 集		
J0086	2.62	木城町教育委員会　1990『永山古墳・山塚原古墳群(２)』木城町文化財調査報告書第２集		
J0087	2.56	木城町教育委員会　1990『永山古墳・山塚原古墳群(２)』木城町文化財調査報告書第２集		
J0088		木城町教育委員会　1990『永山古墳・山塚原古墳群(２)』木城町文化財調査報告書第２集		
J0089	2.51	木城町教育委員会　1990『永山古墳・山塚原古墳群(２)』木城町文化財調査報告書第２集		
J0090		宮崎県教育委員会　1997『池内横穴墓群発掘調査整理報告書』		
J0091	3.28	宮崎県教育委員会　2015『西都原古墳群総括報告書』		
J0092	2.63	Kitsunetsuka, 2006, Nichinan City	東憲章・岡本武範・柄本久子　2006「宮崎県日南市風田に所在する狐塚古墳の出土遺物」『研究紀要』第 2 号、宮崎県立西都原考古博物館	
J0093	3.29	Kitsunetsuka, 2006, Nichinan City	東憲章・岡本武範・柄本久子　2006「宮崎県日南市風田に所在する狐塚古	

			墳の出土遺物」『研究紀要』第 2 号、宮崎県立西都原考古博物館				
J0094		Kitsunetsuka, 2006, Nichinan City	東憲章・岡本武範・柄本久子　2006「宮崎県日南市風田に所在する狐塚古墳の出土遺物」『研究紀要』第 2 号、宮崎県立西都原考古博物館				
J0095		Kitsunetsuka, 2006, Nichinan City	東憲章・岡本武範・柄本久子　2006「宮崎県日南市風田に所在する狐塚古墳の出土遺物」『研究紀要』第 2 号、宮崎県立西都原考古博物館				
J0096		Kitsunetsuka, 2006, Nichinan City	東憲章・岡本武範・柄本久子　2006「宮崎県日南市風田に所在する狐塚古墳の出土遺物」『研究紀要』第 2 号、宮崎県立西都原考古博物館				
J0097		Found by a farmer around Saitobaru apparently 宮崎県総合博物館　1982『西都原資料館収蔵資料目録』					
J0098		Akaokumagutani kofun, Sakurai City					
J0099		Akaokumagutani kofun, Sakurai City					
J0100		Akaokumagutani kofun, Sakurai City					
J0101	2.62	Akaokumagutani kofun, Sakurai City					
J0102		Akaokumagutani kofun, Sakurai City					
J0103		Akaokumagutani kofun, Sakurai City					
J0104		Ikenoichi, Kashihara					
J0105	3.28	Ikenoichi, Kashihara					
J0106		Ikenoichi, Kashihara					
J0107		Akaokumagutani kofun, Sakurai City					
J0108	2.59	Akaokumagutani kofun, Sakurai City					
J0109		Akaokumagutani kofun, Sakurai City					
J0110		Akaokumagutani kofun, Sakurai City					
J0111		Akaokumagutani kofun, Sakurai City					
J0112		Tamatsukuri Museum					
J0113		Tamatsukuri Museum					
J0114		Tamatsukuri Museum					
J0115		Tamatsukuri Museum					
J0116	2.61	Tamatsukuri Museum					
J0117		Tamatsukuri Museum					No impression taken
J0118		Tamatsukuri Museum					
J0119		Tamatsukuri Museum					

J0120		薦沢遺跡, 1988 Tamatsukuri Museum				
J0121	2.57	Tamatsukuri Museum, 小無田 II 遺跡				
J0122		松本古墳群 Museum of Ancient Izumo				
J0123	3.3	五反田 1 古墳 Museum of Ancient Izumo				
J0124	3.3	五反田 1 古墳 Museum of Ancient Izumo				
J0125		堂床遺跡 Museum of Ancient Izumo				
J0126		堂床遺跡 Museum of Ancient Izumo				
J0127	2.6	堂床遺跡 Museum of Ancient Izumo				
J0128	2.6	堂床遺跡 Museum of Ancient Izumo				
J0129		福富 1 遺跡　Museum of Ancient Izumo				
J0130		福富 1 遺跡　Museum of Ancient Izumo				
J0131		大原遺跡　Museum of Ancient Izumo				
J0132		島田池遺跡 Museum of Ancient Izumo				
J0133	2.52	島田池遺跡 Museum of Ancient Izumo				
J0134		島田池遺跡 Museum of Ancient Izumo				
J0135	2.6	島田池遺跡 Museum of Ancient Izumo				
J0136		島田池遺跡 Museum of Ancient Izumo				
J0137		島田池遺跡 Museum of Ancient Izumo				
J0138	2.63	島田池遺跡 Museum of Ancient Izumo				
J0139	2.86	大角山遺跡 Museum of Ancient Izumo				I think the specific gravity was messed up by the bead touching the side of the scale box when measuring

						density.
J0140		大角山遺跡 Museum of Ancient Izumo				bead drilling failed due to flaw inside the hole
J0141		大角山遺跡 Museum of Ancient Izumo				
J0142		大角山遺跡 Museum of Ancient Izumo				
J0143		大角山遺跡 Museum of Ancient Izumo				
J0144		大角山遺跡 Museum of Ancient Izumo				
J0145		福富 1 遺跡　Museum of Ancient Izumo				
J0146		福富 1 遺跡　Museum of Ancient Izumo				
J0147		福富 1 遺跡　Museum of Ancient Izumo				
J0148		福富 1 遺跡　Museum of Ancient Izumo				
J0149		福富 1 遺跡　Museum of Ancient Izumo				
J0150		福富 1 遺跡　Museum of Ancient Izumo				
J0151		福富 1 遺跡　Museum of Ancient Izumo				
J0152		福富 1 遺跡　Museum of Ancient Izumo				
J0153		大原遺跡　Museum of Ancient Izumo				
J0154		大原遺跡　Museum of Ancient Izumo				
J0155		大原遺跡　Museum of Ancient Izumo				
J0156		大原遺跡　Museum of Ancient Izumo				
J0157		島田池遺跡 Museum of Ancient Izumo				

J0158	2.64	島田池遺跡 Museum of Ancient Izumo				
J0159		島田池遺跡 Museum of Ancient Izumo				
J0160	2.58	島田池遺跡 Museum of Ancient Izumo				
J0161		島田池遺跡 Museum of Ancient Izumo				
J0162	2.65	島田池遺跡 Museum of Ancient Izumo				
J0163	2.59	布田遺跡				
J0164		白コクリ遺跡				
J0165		白コクリ遺跡				
J0166		白コクリ遺跡				
J0167		白コクリ遺跡				
J0168	2.65	白コクリ遺跡				
J0169		白コクリ遺跡				
J0170		白コクリ遺跡				
J0171	2.68	白コクリ遺跡				No impression taken
J0172		白コクリ遺跡				
J0173	2.63	白コクリ遺跡				
J0174		白コクリ遺跡				
J0175	2.65	上塩冶横 「輝く出雲ブランド-古代の玉作り」pp.55 No.207				
J0176		上塩冶横 「輝く出雲ブランド-古代の玉作り」pp.55 No.207				
J0177	1.97?	平床 II 遺跡 「輝く出雲ブランド-古代の玉作り」pp.25 No.77				measurement was taken from the center of the bead due to depression shape. SG done but the bead absorbed water and it seemed very inaccurate
J0178		平床 II 遺跡 「輝く出雲ブランド-古代の玉作り」pp.25 No.77				
J0179		平床 II 遺跡 「輝く出雲ブランド-古代の玉作				

		り」pp.25 No.77				
J0180		平床 II 遺跡 「輝く出雲ブランド-古代の玉作り」pp.25 No.77				Seem to have been trying to make a bionic hexagonal
J0181	2.61	平床 II 遺跡 「輝く出雲ブランド-古代の玉作り」pp.25 No.77				
J0182		平床 II 遺跡 「輝く出雲ブランド-古代の玉作り」pp.25 No.77				
J0183	2.22	平床 II 遺跡 「輝く出雲ブランド-古代の玉作り」pp.25 No.77				
J0184		Omojirodani, 「輝く出雲ブランド-古代の玉作り」pp.24 No.74				
J0185		Omojirodani, 「輝く出雲ブランド-古代の玉作り」pp.24 No.74				
J0186		大原遺跡				
J0187		西ツ廻 II 遺跡				
J0188		大角山遺跡				Gouge off other end seems to have discouraged them from finishing the bead
J0189		福富 I				
J0190		福富 I				
J0191		福富 I				
J0192		福富 I				I think it fractured while drilling
J0193		堂床遺跡				
J0194		堂床遺跡				
J0195		堂床遺跡				Not sure what kind of bead they were trying to make
J0196		堂床遺跡				
J0197		堂床遺跡				
J0198		堂床遺跡				
J0199		堂床遺跡				
J0200		[古代出雲における玉 II pp.72№116]				
J0201		[古代出雲における玉 II pp.72№116]				

J0202		「輝く出雲ブランド-古代の玉作り pp.51 No.197				
J0203		「輝く出雲ブランド-古代の玉作り pp.51 No.197				
J0204		「輝く出雲ブランド-古代の玉作り pp.51 No.197				
J0205		「輝く出雲ブランド-古代の玉作り pp.51 No.197				
J0206		「輝く出雲ブランド-古代の玉作り pp.51 No.197				
J0207		「輝く出雲ブランド-古代の玉作り pp.51 No.197				
J0208		Tsubuteishi A 石ぶて石 A 遺跡	Saga Cultural Research Center			
J0209		Tsubuteishi A 石ぶて石 A 遺跡	Saga Cultural Research Center			
J0210		Daimonishi　大門西遺跡	Saga Cultural Research Center			
J0211		Kouda　香田遺跡	Saga Cultural Research Center			
J0212		Kouda　香田遺跡	Saga Cultural Research Center			
J0213		Nagata Kofun Group　永田古墳群	Saga Cultural Research Center			
J0214		Nagata Kofun Group　永田古墳群	Saga Cultural Research Center			
J0215		Nagata Kofun Group　永田古墳群	Saga Cultural Research Center			
J0216	2.55	Nagata Kofun Group　永田古墳群	Saga Cultural Research Center			
J0217	2.57	Nagata Kofun Group　永田古墳群	Saga Cultural Research Center			
J0218		Nagata Kofun Group　永田古墳群	Saga Cultural Research Center			
J0219		Nagata Kofun Group　永田古墳群	Saga Cultural Research Center			
J0220	2.59	Nagata Kofun Group　永田古墳群	Saga Cultural Research Center			

J0221		東福寺古墳群	Saga Cultural Research Center			
J0222	2.6	東福寺古墳群	Saga Cultural Research Center			
J0223		東福寺古墳群				
J0224		東福寺古墳群				
J0225		東福寺古墳群				
J0226		東福寺古墳群				
J0227	2.57	*/* 鞍遺跡				
J0228		京都谷遺跡				
J0229	2.64	京都谷遺跡				
J0230		京都谷遺跡				
J0231	2.59	京都谷遺跡				
J0232	2.56	京都谷遺跡				
J0233		西原遺跡				
J0234		京都谷遺跡				

A2b: Summary Tables

M = *magatama* I = irregular SI = semi-irregular S = spherical Pen = pendant
FHB = faceted hexagonal biconical Ci = circular SC = short cylindrical
C = cylindrical B = biconical KM = *komochi magatama* O = ovoid
In = incomplete Pop = popped end SqB = faceted square biconical

Japanese Bead Chart																									
	Carnelian							Jasper/ Green Tuff							Jadeite	Rock Crystal/ Quartz									

	M	I	SI	S	FHB	C	SC	C	M	B	Ci	Pen	In	O	M	C	M	B	FHB	HC	S	SqB	Ci	SC	Pop
Nara																									
Kamonokuba Otani East Kofun								7	1		1							1	1						
Ushirode Kofun																									
Kitahara West Kofun	1																								
Noyama Site								1																	
Takada Gaito Kofun																		3	1						
Matobaike Kofun									1						1		2								
Mitsuzuka Kofun																					1				
Mida Oosawa Kofun															1										
Horinowo Kofun																			4						
Ishigami North								1											2						
Ikenoichi Kofun								6							2										
Ishihousan								2																	
Akaokumagatani Kofun	1	1	6	1	1				1																
Shimane																									
Hayashi Tomb																2			1	1					
Komosawa Site, Matsue City									1																
Matsumoto Kofun								1																	

Gotanda I Kofun															2										
Shimada Ike Site	1							2									2		4		1				
Shirokokuri									1								2		4						
Kamienyatsu			1																						
Iwayaguchi South	1							3											2						
Kitsune Zako Site																			1						
Dotoko Site								3	2		1										1		1		
Fukutomi I Site	1							5	1										1						
Ohara Site								1	5																
Osumiyama Site								1	1		2	1													
Hiratoko II Site									1				1	1										2	
Omojirodani									1																1
Yotsuzako																									
Nunoden Site																									
Komesaka Site																									
Komuta II Site, Matsue City																									
Miyazaki																									
Saitobaru Kofun			1					1																	
Mutsunobaru								1							2										
Ko-onji								1									1		1			1			
Kusaba (Reikyo-Duka)								1							1										
Tachigiri																									
Iimori								2																	
Nagayama								2									1	1							
Ikeuchi																									
Sakamoto no Ue															1										
Kitsunetsuka Kofun			1												1		1		2						
Saga																									
Tsubuteishi			2																						
Daimonishi																									
Kouda			2																						

Nagata Kofun		1	3	2																					
Tofukuji Kofun			3		1		1																		
Tsuzumi					1																				
Miyakodani		1	2												1				1				1		
Nishibara																									
North Kyushū																									
Amakubo Dolmen Burial								3																	
Ushirode Site								6																	
Banzuka Kofun								9																	

	Steatite						Chalcedony		Misc.		Total
	C	M	Ci	KM	SC	Pen	M	S	M	B	
Nara											
Kamonokuba Otani East Kofun											11
Ushirode Kofun									2		2
Kitahara West Kofun		1							1		3
Noyama Site		2					1				4
Takada Gaito Kofun										1	5
Matobaike Kofun		2									6
Mitsuzuka Kofun					1						2
Mida Oosawa Kofun											1
Horinowo Kofun											4
Ishigami North											3
Ikenoichi Kofun		2					1				11
Ishihousan											2
Akaokumagatani Kofun											11
Shimane											

Hayashi Tomb										1	5
Komosawa Site, Matsue City											1
Matsumoto Kofun											1
Gotanda I Kofun											2
Shimada Ike Site							2	1			13
Shirokokuri		1					3				11
Kamienyatsu							1				2
Iwayaguchi South				1			1				8
Kitsune Zako Site							1				2
Dotoko Site							2				10
Fukutomi I Site			1			1	4				14
Ohara Site											6
Osumiyama Site							1				6
Hiratoko II Site							1				6
Omojirodani											2
Yotsuzako						1					1
Nunoden Site							1				1
Komesaka Site							1				1
Komuta II Site, Matsue City							1				1
Miyazaki											
Saitobaru Kofun							1				3
Mutsunobaru											3
Ko-onji							2				6
Kusaba (Reikyo-Duka)											2
Tachigiri	1										1
Iimori											2

Nagayama											4
Ikeuchi							1				1
Sakamoto no Ue											1
Kitsunetsuka Kofun											5
Saga											
Tsubuteishi											2
Daimonishi							1				1
Kouda											2
Nagata Kofun							1	1			8
Tofukuji Kofun							1				6
Tsuzumi											1
Miyakodani											6
Nishibara							1				1
North Kyushū											
Amakubo Dolmen Burial											3
Ushirode Site											6
Banzuka Kofun											9

G = *gogok* I = irregular SI = semi-irregular S = spherical
FHB = faceted hexagonal biconical FPB = faceted pentagonal biconical
C = cylindrical B = biconical MG = *moja gogok*

Korean Bead Chart

	Carnelian							Jasper/Green Tuff		Jadeite		Rock Crystal				Steatite		Chalcedony		Misc.		
	G	I	SI	S	FHB	C	FPB	C	G	G		G	FHB	S	B	C	MG	Pendant		G	S	C
Baekje																						
Songnam~Yoju Subway Area 9, Seoul		4	11	2	1	4	1						1									
Unyang Dong, Seoul								4													2	
Sucheong Dong, Osan		2	4	3		5		2						2	1							1
Kwoltong, Osan		8	3																			
Cheonghak Dong, Osan		5	6																			
Silla																						
Deokcheon-ri, north of Gyeongju				1						1							1					
Hwangnam-Dong, Gyeongju					1															1		
Hwango-ri, Gyeongju										3												
King Michu's area tombs, Gyeongju									1	4												
Hwango-ri Tomb 1, Gyeongju										3												
Gaya																						
Bokcheon Dong, Busan					2					8								1		5		
Nopoh-Dong, Busan		1	2	2	1							2	2									
Yeongsan Dong, Busan																1						
DaeKaya Tombs, Daegu										5										1		

A2c: Taper Measurements

REG #	max width	min width	max length	O-all Taper	max width	min width	max length	2nd taper
K0001	4.053	2.163	10.929	**0.1729**				
K0002_1	3.896	2.773	6.921	**0.1623**				
K0002_2	4.463	2.855	6.93	**0.2320**				
K0003_1	4.513	2.355	11.433	**0.1888**				
K0003_2	2.892	1.949	1.785	**0.5283**				
K0004_1	4.282	2.36	5.649	**0.3402**				
K0004_2	3.837	2.705	4.468	**0.2534**				
K0023	4.965	3.591	8.054	**0.1706**				
K0024	6.005	2.648	7.907	**0.4246**	2.648	2.406	1.626	**0.1488**
K0025	1.858	1.711	8.026	**0.0183**				
K0026	5.184	3.269	4.892	**0.3915**	4.849	3.748	2.606	**0.4225**
K0027	3.412	2.435	7.921	**0.1233**				
K0028	3.106	2.39	3.66	**0.1956**	3.64	2.768	2.327	**0.3747**
K0029	3.277	1.948	5.174	**0.2569**				
K0030	3.696	3.337	5.174	**0.0694**				
K0072_1	2.025	1.978	5.598	**0.0084**				
K0072_2	2.057	1.957	1.445	**0.0692**	1.898	1.818	0.424	**0.1887**
K0073_1	2.102	1.337	10.132	**0.0755**	2.102	1.884	1.726	**0.1263**
K0073_2	2.051	1.339	4.485	**0.1588**	2.016	1.339	2.605	**0.2599**
K0079_1	3.935	2.922	3.647	**0.2778**				
K0079_2	3.957	3.117	2.205	**0.3810**				
K0079_3	3.054	2.146	0.576	**1.5764**				
K0080_1+2	3.735	3.066	3.605	**0.1856**	3.629	2.791	3.674	**0.2281**
K0081	3.184	2.455	5.448	**0.1338**	2.94	2.702	1.765	**0.1348**
K0084	straight							
K0085	4.07	3.532	4.464	**0.1205**	3.532	2.772	4.985	**0.1525**
K0086	3.916	3.03	13.018	**0.0681**	2.808	2.577	3.123	**0.0740**
K0087	4.24	3.569	6.125	**0.1096**	3.349	2.752	1.639	**0.3642**
K0088_1	3.085	2.117	9.681	**0.1000**				
K0088_2	2.701	1.677	5.451	**0.1879**				
K0088_3	1.399	0.809	0.582	**1.0137**				
K0089	2.169	1.69	5.157	**0.0929**				
K0090	2.942	2.297	7.401	**0.0872**				
K0091	straight							
K0092	straight							

K0093_1	2.222	2.128	3.344	**0.0281**				
K0093_2	2.358	2.112	4.392	**0.0560**				
K0094	2.397	2.098	2.295	**0.1303**				
K0095	2.006	1.94	2.573	**0.0257**				
K0096_1	3.906	3.715	2.028	**0.0942**				
K0096_2	3.78	3.925	5.476	**-0.0265**	heavily worn			
K0097	straight							
K0098	1.622	1.55	3.499	**0.0206**	1.031	0.802	3.103	**0.0738**
K0099_1	1.448	1.172	3.23	**0.0854**				
K0099_2	1.406	1.254	2.863	**0.0531**				
K0100	N/A							
K0101	1.39	1.162	3.434	**0.0664**				
K0102	1.355	1.272	4.148	**0.0200**				
K0103	straight							
K0104	straight							
K0105	2.197	2.046	0.802	**0.1883**				
K0106	3.322	2.783	4.12	**0.1308**	2.481	2.211	2.053	**0.1315**
K0107	straight							
K0108	straight							
K0109	straight							
K0116	straight							
K0117	4.81	3.392	10.471	**0.1354**	2.993	2.827	1.212	**0.1370**
K0118_1	4.463	3.674	9.197	**0.0858**				
K0118_2	3.918	3.602	4.25	**0.0744**				
K0139	straight							
K0140	straight							
K0141	straight							
K0142	straight							
K0143	straight							
K0144	straight							
K0145	straight							
K0146	straight							
K0147	straight							
K0148	straight							
K0149	straight							
K0150	straight							
K0151_1	3.894	3.316	3.79	**0.1525**				
K0151_2	3.457	3.292	1.011	**0.1632**				
K0152_1	2.7	1.802	1.413	**0.6355**				
K0152_2	2.558	1.698	1.371	**0.6273**				
K0153	4.571	3.306	7.16	**0.1767**				

K0154	2.873	2.398	6.65	**0.0714**				
K0155	3.264	2.365	7.266	**0.1237**				
K0156	2.453	1.847	3.739	**0.1621**				
K0161	straight							
K0162	straight							
K0163	straight							
K0164	straight							
K0165	straight							
K0166	straight							
K0167	straight							
K0168	straight							
K0169	straight							
K0170	straight							
K0171	straight							
K0172	straight							
K0173	straight							
K0174	straight							
K0175	straight							
K0176	straight							
K0177	straight							
K0178	straight							
K0179	straight							
K0180	straight							
K0181	straight							
K0183	straight							
K0184	straight							
K0185	straight							
K0186	straight							
K0187	straight							
K0188	straight							
K0189	1.682	1.316	6.396	**0.0572**				
K0190	straight							
K0191	straight							
K0192	straight							
K0193	straight							
K0194	straight							
K0195	straight							
J0001	2.98	2.06	4.365	**0.2108**				
J0002	2.4	2.218	3.25	**0.0560**	1.768	1.245	12.975	**0.0403**
J0003	2.168	1.745	5.812	**0.0728**	1.672	1.421	6.159	**0.0408**

J0006	2.196	0.846	10.734	**0.1258**	2.196	1.492	5.965	**0.1180**
J0007	3.033	1.665	13.977	**0.0979**	2.749	1.289	14.908	**0.0979**
J0008_1	1.669	1.41	12.862	**0.0201**	1.589	1.005	11.716	**0.0498**
J0008_2	2.079	1.536	6.963	**0.0780**				
J0009	1.83	1.771	3.197	**0.0185**				
J0010	2.33	1.433	5.656	**0.1586**				
J0011	2.972	1.453	11.343	**0.1339**				
J0014_1	3.262	1.933	7.392	**0.1798**				
J0014_2	2.849	2.154	5.311	**0.1309**				
J0015	1.512	1.256	8.479	**0.0302**				
J0016	1.604	1.529	3.861	**0.0194**	1.528	1.533	1.198	**-0.0042**
J0017	2.126	1.315	4.668	**0.1737**				
J0018_1	1.036	0.98	0.827	**0.0677**				
J0018_2	1.075	1.017	0.564	**0.1028**	smaller drill hole			
J0019	1.495	1.39	1.209	**0.0868**				
J0020	2.087	1.397	9.063	**0.0761**				
J0021	3.846	1.88	9.818	**0.2002**				
J0022	2.921	1.783	5.731	**0.1986**				
J0023	3.585	1.839	11.581	**0.1508**				
J0024	2.412	1.52	6.416	**0.1390**				
J0026	1.78	1.766	1.082	**0.0129**	1.804	1.754	1.483	**0.0337**
J0028	2.667	2.603	3.116	**0.0205**				
J0029_1	2.62	1.864	3.798	**0.1991**				
J0029_2	1.978	1.613	1.284	**0.2843**				
J0030	2.821	2.061	7.52	**0.1011**				
J0031	1.755	1.577	1.913	**0.0930**	1.744	1.701	0.475	**0.0905**
J0032	2.69	2.172	5.331	**0.0972**				
J0033	3.045	2.619	5.235	**0.0814**				
J0034	3.08	2.072	7.148	**0.1410**				
J0035	3.582	2.025	15.238	**0.1022**	3.118	1.703	14.311	**0.0989**
J0036	2.681	1.782	7.926	**0.1134**				
J0037	2.879	1.603	15.182	**0.0840**	2.318	1.354	13.234	**0.0728**
J0038	3.335	2.312	14.522	**0.0704**	2.861	1.952	14.151	**0.0642**
J0039	2.799	1.507	6.055	**0.2134**				
J0040	3.306	1.786	15.358	**0.0990**				
J0041	2.789	1.85	5.336	**0.1760**				
J0042_1	1.433	1.406	3.1	**0.0087**				
J0042_2	1.429	1.382	1.929	**0.0244**				
J0043	1.603	1.593	3.374	**0.0030**				
J0044	1.872	1.521	6.342	**0.0553**				
J0045_1	2.02	1.387	13.879	**0.0456**				

J0045_2	1.851	1.612	6.021	**0.0397**				
J0046_1	2.622	2.338	5.383	**0.0528**				
J0046_2	2.328	2.286	0.982	**0.0428**				
J0047_1	1.765	1.381	8.112	**0.0473**				
J0047_2	1.677	1.449	2.85	**0.0800**				
J0048_1	2.649	1.717	16.184	**0.0576**	2.138	1.513	12.909	**0.0484**
J0048_2	1.711	1.485	2.864	**0.0789**				
J0049_1	2.301	1.34	14.803	**0.0649**				
J0049_2	2.076	1.239	8.24	**0.1016**				
J0050	2.184	1.06	13.296	**0.0845**	1.532	0.736	13.019	**0.0611**
J0051	2.181	0.788	16.087	**0.0866**	1.938	0.694	13.893	**0.0895**
J0052_1	2.377	1.907	5.29	**0.0888**				
J0052_2	2.154	1.841	2.955	**0.1059**				
J0053_1	2.841	2.059	6.083	**0.1286**	1.982	1.928	0.604	**0.0894**
J0053_2	2.529	2.34	0.535	**0.3533**	2.265	2.005	2.857	**0.0910**
J0054_1	2.284	1.823	4.815	**0.0957**				
J0054_2	2.087	1.87	1.18	**0.1839**	1.537	1.294	1.8	**0.1350**
J0056	1.822	1.585	7.247	**0.0327**				
J0057_1	1.406	1.353	2.629	**0.0202**				
J0057_2	1.528	1.424	7.944	**0.0131**				
J0058_1	1.85	1.72	4.859	**0.0268**	1.596	1.533	4.191	**0.0150**
J0058_2	1.528	1.363	5.885	**0.0280**				
J0059_1	1.441	1.379	1.848	**0.0335**	1.271	1.157	1.102	**0.1034**
J0059_2	1.415	1.373	3.05	**0.0138**				
J0060_1	1.232	1.143	2.825	**0.0315**				
J0060_2	1.178	1.108	1.72	**0.0407**				
J0061	2.149	1.36	16.14	**0.0489**	1.672	0.901	14.46	**0.0533**
J0062_1	2.221	1.373	11.77	**0.0720**	1.855	0.778	14.681	**0.0734**
J0062_2	1.352	0.997	2.958	**0.1200**				
J0064	2.08	1.463	16.167	**0.0382**	1.782	1.173	14.826	**0.0411**
J0065	2.251	1.385	16.119	**0.0537**	1.73	1.095	14.471	**0.0439**
J0066	1.999	1.439	14.883	**0.0376**	1.744	1.137	15.306	**0.0397**
J0067_1	2.18	1.306	15.73	**0.0556**	1.694	1.078	11.348	**0.0543**
J0067_2	1.581	1.484	1.327	**0.0731**				
J0068	1.752	0.994	14.199	**0.0534**				
J0069	2.714	1.766	16.261	**0.0583**	2.274	1.43	15.324	**0.0551**
J0070_1	2.355	2.197	5.851	**0.0270**				
J0070_2	2.471	2.109	0.891	**0.4063**	2.072	1.983	0.759	**0.1173**
J0071	3.034	2.339	2.997	**0.2319**				
J0072_1	2.638	2.282	1.111	**0.3204**	2.233	1.653	1.142	**0.5079**
J0072_2	2.284	1.836	1.111	**0.4032**				

J0073_1	1.718	1.396	4.271	**0.0754**				
J0073_2	1.808	1.326	5.462	**0.0882**				
J0074	3.175	2.109	4.254	**0.2506**	2.515	2.167	1.667	**0.2088**
J0075	1.978	1.221	3.855	**0.1964**				
J0076	2.861	1.646	5.635	**0.2156**				
J0077	3.207	2.072	4.8	**0.2365**				
J0078	2.515	1.196	14.494	**0.0910**				
J0079	3.661	2.416	15.733	**0.0791**	2.988	1.853	14.034	**0.0809**
J0080_1	1.533	1.227	4.199	**0.0729**	1.575	1.039	5.582	**0.0960**
J0080_2	1.295	1.168	0.961	**0.1322**				
J0081	3.375	2.881	2.003	**0.2466**	3.291	2.917	1.857	**0.2014**
J0082	2.195	1.464	14.148	**0.0517**	1.765	1.273	13.809	**0.0356**
J0083_1	2.318	2.211	2.446	**0.0437**	2.182	2.152	3.763	**0.0080**
J0083_2	2.141	2.084	2.898	**0.0197**	2.039	2.076	1.196	**-0.0309**
J0084	2.589	1.932	15.776	**0.0416**	2.085	1.535	14.631	**0.0376**
J0085	2.548	1.703	15.247	**0.0554**	2.087	1.395	14.158	**0.0489**
J0086	2.01	1.145	4.239	**0.2041**				
J0087	2.431	1.593	4.108	**0.2040**				
J0088_1	1.988	1.394	5.725	**0.1038**				
J0088_2	1.869	1.373	6.882	**0.0721**				
J0089	1.66	1.116	11.673	**0.0466**	1.387	1.135	6.412	**0.0393**
J0090	2.254	1.328	5.771	**0.1605**				
J0091	2.337	1.731	2.87	**0.2111**	2.358	1.432	3.858	**0.2400**
J0092	2.317	1.478	4.979	**0.1685**				
J0093	2.568	2.147	2.392	**0.1760**	2.315	1.963	1.273	**0.2765**
J0094	3.098	2.81	3.722	**0.0774**	2.52	1.776	5.817	**0.1279**
J0095	2.488	1.553	9.223	**0.1014**				
J0096	straight							
J0097	straight							
J0099_1	2.489	1.602	4.847	**0.1830**				
J0099_2	2.388	1.592	2.72	**0.2926**	2.455	1.332	3.398	**0.3305**
J0100	straight							
J0101	straight							
J0102	straight							
J0103	straight							
J0104_1	3.466	2.749	1.81	**0.3961**				
J0104_2	2.982	2.403	1.117	**0.5184**				
J0105_1	2.818	2.489	0.789	**0.4170**				
J0105_2	2.518	2.249	0.675	**0.3985**				
J0106	2.007	1.697	7.07	**0.0438**				
J0107	straight							

J0108	straight							
J0109	straight							
J0112	3.1	2.301	4.017	**0.1989**				
J0113	3.639	2.3	14.094	**0.0950**	2.666	1.54	12.556	**0.0897**
J0114	3.109	1.618	13.925	**0.1071**	2.705	1.287	14.415	**0.0984**
J0115	3.186	2.049	14.372	**0.0791**	2.832	1.66	14.251	**0.0822**
J0116	3.25	1.882	7.701	**0.1776**				
J0119	3.046	2.016	4.912	**0.2097**				
J0120	2.438	1.82	4.016	**0.1539**				
J0121	2.527	1.798	4.406	**0.1655**				
J0122_1	3.022	1.425	13.958	**0.1144**	1.366	1.286	0.558	**0.1434**
J0122_2	3.471	1.721	15.293	**0.1144**	2.599	1.383	10.603	**0.1147**
J0123_1	2.713	2.133	1.288	**0.4503**	2.771	1.888	1.914	**0.4613**
J0123_2	2.472	2.073	1.118	**0.3569**				
J0124_1	2.822	2.589	0.807	**0.2887**	2.87	2.421	1.368	**0.3282**
J0124_2	2.255	1.928	0.617	**0.5300**	2.15	1.489	0.905	**0.7304**
J0125	3.158	2.265	15.018	**0.0595**	2.632	1.478	16.256	**0.0710**
J0126	3.075	1.903	5.547	**0.2113**				
J0127	missing impression							
J0128	2.921	1.91	4.039	**0.2503**				
J0129	2.406	1.921	4.424	**0.1096**				
J0130	1.185	0.964	0.333	**0.6637**				
J0131	2.757	2.051	6.485	**0.1089**				
J0132	3.839	3.019	14.846	**0.0552**	3.277	1.718	17.739	**0.0879**
J0133	1.288	1.001	1.878	**0.1528**	1.175	1.088	1.588	**0.0548**
J0134	2.66	1.538	6.973	**0.1609**				
J0135	3.124	2.181	5.214	**0.1809**	1.859	1.571	0.807	**0.3569**
J0136	3.592	1.878	15.314	**0.1119**	3.268	1.713	13.645	**0.1140**
J0137	3.393	1.917	4.23	**0.3489**				
J0138	3.674	2.153	12.416	**0.1225**				
J0139	2.731	1.759	1.666	**0.5834**	1.962	1.604	0.753	**0.4754**
J0141	1.39	1.207	1.584	**0.1155**				
J0142	2.514	1.54	1.239	**0.7861**				
J0143_1	2.395	1.51	1.264	**0.7002**				
J0143_2	2.346	1.745	1.07	**0.5617**				
J0144	2.757	1.932	4.836	**0.1706**				
J0145	2.394	1.517	8.027	**0.1093**				
J0146	3.67	2.02	15.631	**0.1056**	2.747	1.305	14.799	**0.0974**
J0147	3.185	1.497	16.003	**0.1055**	2.498	1.168	13.961	**0.0953**
J0148	2.798	1.685	7.08	**0.1572**				
J0149	2.771	2.004	4.129	**0.1858**				

J0150	2.341	1.827	1.862	**0.2760**				
J0151	2.794	1.951	4.312	**0.1955**				
J0152	2.443	1.792	2.485	**0.2620**				
J0153	2.738	1.822	7.402	**0.1238**				
J0154	2.862	1.625	10.608	**0.1166**				
J0155_1	3.341	2.763	6.893	**0.0839**	2.669	2.408	5.256	**0.0497**
J0155_2	3.005	1.844	9.325	**0.1245**				
J0156	2.452	1.621	6.26	**0.1327**				
J0157	2.89	1.668	4.803	**0.2544**				
J0158	2.264	2.204	2.481	**0.0242**				
J0159	2.452	1.852	3.699	**0.1622**				
J0160	2.473	1.48	4.672	**0.2125**				
J0161	2.962	2.092	8.812	**0.0987**				
J0162	3.003	2.001	9.989	**0.1003**				
J0163	3.156	1.774	7.079	**0.1952**				
J0164	2.209	1.328	3.812	**0.2311**				
J0165	2.522	1.562	3.936	**0.2439**				
J0166	2.443	1.423	4.242	**0.2405**				
J0167	3.473	2.44	14.777	**0.0699**	2.687	1.768	12.956	**0.0709**
J0168	3.137	1.955	11.119	**0.1063**				
J0169	3.162	1.685	8.026	**0.1840**				
J0170	2.719	1.926	4.118	**0.1926**				
J0172	3.254	2.386	14.551	**0.0597**	2.853	1.896	13.359	
J0173	3.029	1.897	8.967	**0.1262**				
J0174	2.935	1.714	6.247	**0.1955**				
J0175	straight							
J0176	2.125	1.323	5.036	**0.1593**				
J0177	4.802	2.824	1.888	**1.0477**	2.745	2.677	1.242	**0.0548**
J0178	3.732	1.811	8.157	**0.2355**				
J0179	3.89	2.882	4.701	**0.2144**				
J0181	3.009	1.294	6.461	**0.2654**				
J0182	2.438	1.738	1.681	**0.4164**				
J0183	2.835	1.691	9.767	**0.1171**				
J0185	2.429	1.545	8.176	**0.1081**				
J0186	2.843	1.664	5.72	**0.2061**	2.067	1.541	5.243	**0.1003**
J0188	2.182	1.374	2.654	**0.3044**				
J0191	2.839	1.582	5.95	**0.2113**				
J0192	2.773	2.059	2.582	**0.2765**				
J0193_1	2.551	1.429	3.659	**0.3066**				
J0193_2	2.211	1.574	0.881	**0.7230**				
J0193_3	1.818	1.176	0.575	**1.1165**				

J0194_1	2.182	2.244	0.862	**-0.0719**				
J0194_2	2.586	2.869	0.97	**-0.2918**	2.433	2.248	1.756	**0.1054**
J0195	1.43	1.009	0.492	**0.8557**				
J0196	2.48	1.292	8.444	**0.1407**				
J0197	3.259	1.734	16.133	**0.0945**	2.808	1.231	15.951	**0.0989**
J0198_1	2.144	1.269	0.818	**1.0697**				
J0198_2	1.965	1.305	0.471	**1.4013**				
J0199	2.361	1.774	2.23	**0.2632**	2.416	1.621	3.221	**0.2468**
J0200_1	2.859	1.276	5.739	**0.2758**				
J0200_2	2.104	1.565	0.81	**0.6654**				
J0201	2.427	1.719	6.928	**0.1022**				
J0202	6.454	6.365	8.557	**0.0104**				
J0203	3.362	2.335	15.675	**0.0655**	2.996	1.845	15.192	**0.0758**
J0204	3.805	3.588	2.599	**0.0835**				
J0205_1	3.655	3.009	5.754	**0.1123**				
J0205_2	3.053	2.831	2.766	**0.0803**				
J0206_1	1.069	0.998	3.855	**0.0184**	yayoi			
J0206_2	1.049	0.997	2.053	**0.0253**				
J0207	3.158	1.68	10.788	**0.1370**				
J0208	straight							
J0209	straight							
J0210	2.951	1.721	5.801	**0.2120**				
J0211	straight							
J0212	straight							
J0213	3.159	1.828	5.358	**0.2484**				
J0214	straight							
J0215	straight							
J0216	straight							
J0217	straight							
J0218	straight							
J0219	straight							
J0220	2.775	1.834	5.674	**0.1658**				
J0221	straight							
J0222_1	not done							
J0222_2	4.5	3.635	1.606	**0.5386**	3.41	2.826	1.26	**0.4635**
J0223	straight							
J0224	straight							
J0225	straight							
J0226	not done							
J0227	straight							

J0228	2.565	1.842	6.116	**0.1182**	1.522	1.416	0.563	**0.1883**
J0229	3.031	1.598	9.358	**0.1531**				
J0230	straight							
J0231	straight							
J0232	straight							
J0233	3.128	1.606	6.79	**0.2242**				
J0234	3.203	1.815	14.438	**0.0961**	2.912	1.606	14.053	**0.0929**

REG #	max width	min width	max length	**3rd taper**	Max width	Min width	Max length	4th taper
K0024	6.078	3.064	7.331	**0.4111**				
K0073_2	2.051	1.953	1.659	**0.0591**				
J0016	1.626	1.573	1.3	**0.0408**	heavy wear on central hole (measurement 2)			
J0051	1.769	0.72	12.002	**0.0874**				
J0053_2	1.938	1.85	0.808	**0.1089**				
J0081	3.15	2.747	0.607	**0.6639**				
J0082	1.547	1.099	10.674	**0.0420**				
J0083_1	1.067	1.89	6.675	**-0.1233**				
J0093	2.66	1.894	4.173	**0.1836**	1.518	1.083	1.396	**0.3116**
J0094	3.116	1.559	13.731	**0.1134**				
J0113	1.501	1.385	0.751	**0.1545**				
J0123_1								
J0124_1								
J0124_2								
J0133	2.169	0.875	7.641					
J0155_1	2.582	2.107	7.873	**0.0603**				
J0167	1.805	1.494	2.23	**0.1395**				
J0228	1.613	1.446	1.222	**0.1367**	1.626	1.383	1.811	**0.1342**