North shore of Lake Superior. No. 180A 1895

U. S. GEOLOGICAL SURVEY

FIELD SECTION BOOK

9-891

LAKE SUPERIOR DIVISION.

INSTRUCTIONS.

1. Ordinarily at least two pages of this book will be devoted to one section. On the left-hand page, place a map of as much of the section as has *actually been seen.* Denote rivers, lakes, marshes, etc., by the usual topographical signs. Denote the ledges of rock, when no structure is made out, by cross-hatching, making the cross-hatching cover as nearly as possible the areas occupied by the exposures. If the rock is a massive one, but still more or less plainly bedded, use the same sign with a dip arrow and number attached, showing the direction and amount of the dip. Denote a shaly or other very plainly bedded ledge by right parallel lines, and a ledge having a secondary structure by wavy parallel lines running in the direction of the strike, with dip arrow and number attached as before. The greatest care must be taken to avoid confusing slaty or schistose structure with bedding, and in all cases where there is the least doubt about the true bedding direction, indicate it by a query. To each exposure on the face of the map attach the number of the specimen representing it. In mapping the section count each of the spaces between the blue lines as 100 paces, and twenty of these spaces to one mile, or 2,000 paces. Usually the southeast corner will be placed at the bottom of the page, or at the first black line above the bottom of the page, and at the right-hand side. If, however, for any reason, it is desirable to show portions of an adjoining section, the southeast corner may be shifted up, or the map may be turned around and the north placed at the left-hand side of the page. The ruling of the left-hand pages is also arranged so that, if desirable, a larger or a smaller scale can be used, eight inches, two inches, one inch, or one-half inch to the mile. With the two-inch scale, the squares outlined in black represent sections, and those in red, quarter sections and "forties," while the space between the blue lines is 200 paces.

2. On the right-hand page place the notes descriptive of the exposures. Begin in each case with the number of the specimen, placing the number on the left-hand side of the red line, after which give in order on the right of the same red line the position of the ledges as reckoned in paces from the southeast corner of the section and the dip and strike when observable, the latter always being expressed from the north; for instance 4025, 250 *N.*, 300 *W.*, *Strike, N.* 78° *E.*, *Dip* 50° *S.* Then follow with a full description of the ledge. When topographical maps are used for locations this paragraph applies only in part.

3. Collect a specimen from every ledge, or wherever there is a change of rock on any one ledge, taking care to get fresh material, unless for a special purpose the weathered surface is desired. In case of trips made on foot or in canoes, for long distances, neighboring ledges, unquestionably of one kind of rock, need not be specimened. The position and extent of the ledges not specimened should be marked on the map, with notes that each is of a rock identical with specimen so-and-so. Under the same conditions small-sized specimens, trimmed to a uniform size of 2 x 2½ x ¾ inches will be allowed, but in all other cases *large-sized specimens*, trimmed to a size of 3 x 4 x 1 inches, must be selected, in accordance with section 3, chapter IV, p. 44, Regulations of the U. S. Geological Survey. Specimens should not be placed together without protection in the collecting bag, as the fresh surfaces, important in determining the character of rocks, are thus destroyed. They should be damaged by no temporary mark, but the numbers should be at once marked in at least two places upon the inclosing paper or cloth bags. Specimens may be permanently marked in camp by painting the numbers upon them in white upon a black background, using Silver White and Ivory Black oil tubes for color, with turpentine as a diluent.

4. On the last twenty-five pages of the book give, as may seem desirable, a general account of the examination of the region mapped in the previous pages, correlation of observations, sketches, cross sections, etc.

5. Forward this note book as soon as filled as registered mail matter to C. R. Van Hise, U. S. Geologist, Madison, Wis.

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Trip, Van Hise, North Shore
Lake Superior, 1895

North Shore of Lake Superior

Notes taken by Prof Van Hise on a trip taken by him and Oscar Rohn in a row boat from Two Harbors to Baptism River

July 22 - 23 & 24 1895

On the west side of Beaver Bay is a remarkable series of exposures of Basic and Acid rocks Of all the rocks here found the anorthosyte is the oldest This occurs at one place as the most western rock exposed having a smooth surface which dips steeply toward the lake.

Besides this mass there are several other large masses running from about 20 to about 60 or 80 ft across In addition to these there are innumerable small fragments varying in size from separate crystals of the anorthosyte to those just described

The anorthosyte is intruded in the most complex fashion by an olivine-diabase. All of the smaller masses mentioned are plainly inclusions with pebble or boulder like forms included in the diabase. Several of the masses of considerable size are just certainly included within the diabase. The exposures are not sufficient to ascertain whether the larger fragments are thus included or not. In two cases no diabase was seen to pass under the anorthosyte but had the exposure excluded from it might be found to pass under the anorthosyte. In of the two cases mentioned the diabase passes up over the anorthosyte the same having a rounded dome like form that suggests a roundish form for the whole mass the same as the included boulders. In all the other cases the diabase was found to extend under the anorthosyte to a greater or

less extent In most cases it can be seen to pass under it- farther that than it does over it- in the one case of doming

Just South of Beaver Bay a large mass of anorthosyte showing damination was seen in the same way to have the diabase pass under its roundish form.

Immediately east of the anorthosyte and diabase is a long line of out crops running parallel with the shore of the Bay, of a wholly different character The oldest rock of this set of out crops is a porphyritic and amygdaloidal-diabase or diabases for there may be more than diabase in this older division. The diabase is cut by a complicated set of joints. The most prominent of these has a trend approximately with the line of exposures and are nearly vertical. Cutting across these joints are less prominent ones almost

horizontal. Still another set of joints dipping toward the lake cut both sets. Whether joints cutting all of these and at right angles to the lake shore was not observed That there is such a set of joints is probable from the fact that the rocks break up into forms approaching right rectangular prisms In places the joints are so close as to make the rock break into small angular masses. - it almost approaching a breccia The joints are curved in places and differential movement between them has given "slickensided" surfaces.

Cutting this diabase in a most intricate manner is a red acid rock or felsite. The dikes vary from mere seams to those several feet across Instead of being of uniform width they vary in the most extraordinary manner A dike may widen and narrow within short distances so as to be many times

as wide in one place as the other. Not only so but the dikes may vary from a mere film to a rounded mass resembling a boulder. These vary in size from that of a pebble to a foot or 15 ft across. The boulder like masses from 1 to 4 ft across are very common. In many cases these boulder like areas are strung together by minute dikes which may be compared with a string of beads. The string like dikes may be readily overlooked and the little losses or lacco-liths be thought to be included in the diabase. From the larger laccolithic bodies a number of dikes may be seen to radiate. These may branch regularly or irregularly, a wider one frequently passing from a narrower one and vice-versa. Both in the horizontal sections upon the shore and the vertical sections at the water's edge dikes may be seen to have a circular form

entirely surrounding a mass of diabase. Cross sections at right angles to the shore show dikes with similar relations. So they occur in at least three sets of planes approximately at right angles to each other. The diabase and red rock immediately adjacent weather more readily than the circular or spheroidal included areas of diabase so that the latter protrudes, in one case the water follows along the red rock zone and makes a little island of diabase. Occasionally the central masses of diabase are cut by dikes. In some places the surrounding dikes could be followed in more than one dimension, when it was seen to have curved surface and it is believed that these areas are probably oval or spheroidal, being largely and perhaps entirely surrounded by the felsite. It appears as though the diabase had developed a complicated set of joints and

perhaps a spheroidal parting before the intrusion of the red rock. Since this material permeates the diabase directly in proportion to its jointing,— where the diabase is most broken, there is most of the red rock found. It may be argued that the intrusion of the red rock is the cause of the fracturing. The former is believed however to be far more probable.

The first diabase and the red rock in places has been included by another fine grained dense black diabase, in places this material has so permeated the other rocks as to make them almost resemble conglomerate. Innumerable reddish inclusions of a fossile and diabase being included in a space matrix of the including rock. In magnitude the inclusions vary from minute specks to masses several feet in diameter. This is especially true of the red rock

for large fragments of the first
dia base were not clearly
separated or discriminated. In
one place at least one of the rounded
inclusions of the felsite was seen
to vary from a porphyry in the
center to a semi glassy crystaline
rock at its sides

South of the above set of exposures
is another exposure of granite por-
phyry which is cut by diabase. In
the diabase dyke is a large inclus-
ion which varies from a porphyry
in the center to a wholly crys-
taline rock upon its border, while
the granite porphyry about two feet
from the dike begins to change
its character and grades into
a holo crystaline rock adjacent
to the diabase. It is believed that
the most probable explanation
of these facts is that the diabase
included the acid rock before it
crystalized and thus allowed the
borders of the inclusions and
the larger mass more time
before solidifying and thus
allowed complete crystalization

Still farther to the south is a felsite breccia This and the porphyry above named are probably surface material. The material for which was furnished by the plexus of dikes cutting the diabase The more crystaline character of the dike material as compared with that of the felsete and porphyry would be explained by its being an intrusive instead of an extrusive rock Also it is possible that the first amygdaloidal diabase was not cooled when intruded by the red rock

The general succession of rocks for Beaver Bay as worked out by Rothe was confirmed At the river section conjoined with the coast section just described and on the coast just south of Beaver Bay combined with Beaver Point the same succession was observed as follows:— 1. Anorthosyte 2. Coarse olivine-diabase whether there are two diabases the finer being extru-

fine and the coarser intrusive it was not determined) A relation looking this way on the coast two or three miles north east of Beaver Bay suggests this possibility. 3. Amygdaloidal and porphyritic diabase or diabases 4. (Orthoclase) Gabbro which both in the stream and on the coast just west of Beaver Point undoubtedly includes the olivine diabase and at the river certainly cuts the amygdaloidal diabase. 5 Red rock which occurs in the form of Granulell on the point, as felsite in the flows and as porphyry and breccia in the effusive rocks. No reason was seen for believing that the red rock was of more than one age. Its difference in crystallization appearing to depend upon quantity, whether intrusive or extrusive and whether or not cut by diabase. 6. Fine-grained diabase observed to intrude the amygdaloidal diabase and all forms of red-rock.

Coast between Beaver Bay and the Palesades July 23, 1895

Pancake Island. — On this island is the largest mass of anorthosyte observed any where from Beaver Bay to the Palesades. This is a low dome rising at the highest point perhaps 150 feet above the water and having its greatest length parallel to the shore. It is fully 1/8 of a mile long and almost 1/3 as broad as long. It is large composed of anorthosyte. However this is cut in the most intricate manner by coarse grained olivine diabase (Gabbro) in all respects like that at the falls of Beaver River and on the coast between Beaver Bay and the Palesades The dikes vary in width from a dozen and even 20 ft to these only a few inches wide From the larger dikes smaller ones frequently branch The contacts between the diabase and anorthosytes are in most cases

perfectly sharp. In two places the dikes were seen to completely encircle amorthosyte which appeared to be like huge inclusions within the diabase. These great masses in their forms are identical with those observed at Beaver Bay and which are probably encircled in the same manner, thus explaining the dome like forms emphasized by Lawson which he however takes to have an entirely different meaning. For the most part the anorthosyte is without any other structure than the laminated arrangement of its component plates which a jointing may correspond. This jointing was not determined at various places however the anorthosyte is intruded in a very complicated fashion when it takes on an irregular structure due to the intrusion. At one of the places where the diabase surrounds the anorthosyte branches are seen to break off

from the diabase through the anorthosyte in a parallel direction thus. giving the rock a banded appearance This banding strikes and dips.

An almost identical banding at a locality farther south on the east side of the island strikes and dips

This is at a place also where there are numerous diabase dikes But the connection between the anorthosyte and the intrusion of the diabases was not so clear It is therefore clear that the strike of the banding at these places is almost at right-angles and consequently have no relation to bedding However this structure is identical with that observed on the south side of Beaver point which was taken as evidence of bedding by Lawson. Here also the olivine diabase presumably intruding the anorthosyte is also adjacent. At a number

of places between Beaver Bay and the Palisades considerable masses of amorphous syte were seen which were intruded in the same way by the olivine diabase as on Pukaka Island. Many of these masses as well as Pukaka Island it-self have dome like forms which however are plainly due for the most part to glacial action as shown by the grooving. These dome like forms may be further emphasized by the fact that many of the masses of amorphous syte are great roundish inclusions in the coarse olivine diabase and as this material wears away more readily the "turtle-back" form develops From the facts observed there can be no question that the amorphous syte is the oldest rock in the vacinity and that it is intruded in the most complex manner by the olivine diabase. Possibly some of the largest masses

as that at Pancake Island may be in situ. But there is not the slightest evidence that the amygdaloyte is a formation which has suffered a surface erosion before the intrusion of the olivine diabase. The supposed pre Keweenawan domed and hummocky surface through which the Keweenawan beds were intruded and over which they flowed is an undoubted illusion caused by the peculiar manner of the intrusion of the diabase resulting in the great rounded blocks in it combined with ice erosion.

The fine grained black diabase was found to dip on the coast as figured by Irving. Between this here clastic beds and lower down is the olivine diabase. Whether there is an actual transition between the phases was not worked out.

At another place farther on toward the Palisades a fine rock appears to vary suddenly into the coarser rock. There appeared however a peculiar junction. Vein-like and rounded masses of the coarser appeared in the finer rock. whether this is an intrusion of the coarser into the finer or be segregation phenomenon was not decided The regularly dipping basic flows mapped by Irving on the last mile before the little bay on which is an indian cabin were observed. Here the olivine diabase coarse and fine and the basic flows were all seen to be cut by the red rock just as at Beaver Bay. At the bay near the cabin and at points before reaching it exactly the same intricate intrusions of red rock into the diabases was observed as that described at Beaver Bay. From here to the Baptism river only very general observations were taken.

Beaver Bay Mines
Observations by O.R.Cox
July 23 1895

The oldest rock in the Beaver Bay area is the anorthosyte It's occurrences have been carefully mapped and plotted in the foregoing notes and plat. The striking feature observed more particularly this time is the great number of places in which the diabase could be proven to surround the anorthosyte and the many large exposures in which it may be seen to plainly pass under the anorthosyte

The following is a description of the individual details exposures of the anorthosyte

South of the Shingle Beach in Beaver Point the largest mass is more or less ~~broken~~ up. The whole mass is mapped to scale in the notes taken last season The one part is rounded atop while the other shows banding of lighter and darker material The most

prominent dark band is about two feet thick and trends in strike dip. The dark color is said by Dr Lawson to be due to impregnation by pyroxenic material. The highest part of the exposure is about 30 ft high and the top slopes lakeward at an angle of about 30° to the horizontal.

West of this exposure is olivine diabase of medium grain which on its surface shows several exposures of anorthosyte one about 40 feet in diameter flat on surface and rounded in outline. No red rock is here seen to cut the anorthosyte. The large banded mass seen on the north west side clearly be seen to be rounded at its base and the diabase can be seen to pass under the anorthosyte for a distance of some feet. This has been photographed. To the south of the ridge of orthoclase gabbro are two large masses

as shown in the sketch of the face. The one to the southward is cubical in outline with its corners and edges truncated, while the other larger mass is irregular in outline. These masses are without a possible question included in the dedbasal (gabbro) The same of somewhat coarser grain as that northward near the beach.

North of Beaver Point and close to it as mapped is a mass of anorthosyte which is perfectly rounded and domed. The sides at the water's edge are vertical but it can be seen under water to be strongly undercut and most plainly a rounded mass whose base is rounded and universally domed. It is plainly an inclusion though in what material can not here be determined. To the west of this are exposed a few fragments from 5 to 10 feet in diam. The larger mass is about 20 by 30 feet and projects about 15 ft

The river section shows anorthosyte at the lower falls and at the upper falls several masses one 5 to 8 feet across are clearly included while a few others appearing in the surface of the river bed can not be proven to be inclusive owing to the fact that only their upper surfaces are exposed however for that same reason they can not be proven to be any thing else and their appearance speaks most strongly in favor of them being included masses. Small breccia fragments are not found here as along the north shore of the bay. The enclosing rock here is the very coarse dioritic gabbro which continues up the river for several miles.

Going south from the mouth of the river along the shore of the bay the first exposure of anorthosyte immediately at the mouth of the river is dense very white

very white and fresh rock and is here included in diabase commingled with a brecciated red rock. Here the anorthosyte is much cut and veined by the red rock and is clearly included in the latter.

Going north beyond the point of quartz porphyry marked 19 in plate of last year's notes to pt 18 of same plate we find the whole point made up of a coarse very dark green much altered phase of the anorthosyte which shows three sets of prominent joints nearly at right angles to one another and cutting the rock into blocks from two to three feet on an edge. The anorthosyte is here cut by a medium grained diabase which is so much altered that its original nature can not be determined. The flat surface in front of this point is made up of the last named diabase holding inclusions of more or less fresh anorthosyte which vary in size

from a few inches to several feet

At the exposure next north as shown on the map the anorthosyte occupies the greater part of the little bay but. The masses here vary in size. Many measure from 5 to 10 feet in diameter several 20 to 30 and 90 feet across while it stands 15 feet out of water. The top is flat.

One of the small exposures 30 ft long is the one photographed by Dr Lawson to show "domed structure of anorthosyte passing under Keewenawan lavas" But he ignores the fact that the large mass which is not more than 100 ft away from this is rounded and cut away at the water edge and underlain by diabase showing beyond a doubt that the diabase passes under as well as over the anorthosyte. All of these exposures have been photographed. The mass photographed by Dr Lawson projects only 6 or 8

feet above water. The wall behind it is made up of large masses of quartzite enclosed in a matrix of diabase. Some of these masses are as much as 15 feet across and all are rounded and clearly inclusions. Between the two large masses above noted one in the diabase wall is 40 feet wide at the top and cuts under so that it is not more than 15 ft wide at the water's edge. The mass just north of the very large one is about 15 ft through by 15 high and is undercut on one side just as it is overlain on the other by diabase. This has been photographed to show this relation. The rear of this Bay let as has been said is made up of massive medium to coarse grained diabase (gabbro) set with the large masses of quartzite. The North and south walls show nearest the quartzite a layer from 10-40 ft thick of a breccia of quartzite frag

ments in size varying from single crystals to masses two ft in diameter; set in a matrix of diabase similar to that in the rear wall but considerably finer in grain

The very large mass above noted is flanked by the south by a dike one foot thick of a red felsitic rock which cuts the anorthosyte to some extent in small irregular dikes and stringers

Passing northward to the next baytet we find in the bottom or deepest part of the same a low flat lakeward dipping exposure of anorthosyte about 80 ft long by 30 ft broad dipping about 25° from the horizontal and topped by diabase on both sides are masses of anorthosyte of all sizes clear & inclusions in the diabase forming the sides of the baytet and forming thus a breccia blanket or zone over the larger masses as before noted for the exposures further south.

The next cove northward has

masses of amorkhosyte of not more than 3 or 4 ft detached exposed in its deepest part only.

On the second cove northward however is a mass 60 ft long sloping toward the water at an angle of 45° and rising to the drift at the top of the cliff. Of all exposures of amorkhosyte along the shore this has in greatest measure the appearance of the side or top of an underlying ledge and it is the only place in the vicinity of Beaver Bay that can not be shown to be an inclusive mass.

Here as before the amorkhosyte is flanked by diabase in which lower smaller fragments are rare and the mantle of diabase is thin. Small veins and dikes of diabase and areas of the same as much as two feet across may be seen throughout the mass of amorkhosyte. While in this cove the amorkhosyte exists in nearly a solid mass with little breccia almost the reverse is true

of the next one north ward. Here the largest masses are not more than 6 or 8 feet across while small fragments are very plentiful in the matrix of dolerite. This exposure of agglomerate is 40 ft across and about 20 ft high.

Immediately beyond a very short point there is an exposure of an orthoclase of a width of 100 ft. A horizontal parting is well developed in the orthoclase and the same is much impregnated with dolerite. One mass about 15 ft across is still solid. The whole has more the appearance of a single mass thoroughly impregnated, than of a collection of smaller fragments.

Again at the very end of this line of outcrops we find masses of orthoclase 30 ft across and smaller surrounded by dolerite. These masses are low and well rounded. But the rounding is due by recent glacial [illegible] rather than [illegible] erosion

as shown by the ice striations which are beautifully preserved upon its surface. Some of these are half an inch deep.

Immediately west of the end of the beach at the top of the hill is a mass of amphibolyte about 50 ft long and 30 ft high which shows in the side of a ravine and this is undercut to a distance of six feet and exposes the bottom of the rounded mass in a horizontal position. Looking at the top of this mass one might conclude that it was the rounded tip of a small knob of amygdaloidal rock but protruding through the diabase. But the mistake of such a supposition becomes apparent at once upon going into the ravine and the most steady denies the inclusion nature of the amphibolyte.

This completes the description of the amphibolytes immediately about Beaver Bay except a few isolated patches on top of the hill.

It will be noted in the foregoing description that the only rock associated with the anorthosyte is olivine diabase or as Irving called it gabbro This diabase (gabbro) is found in very massive exposures Just south west of the neck of Beaver Point near the limit of the map prepared from last summers notes Second Just east of the neck on the south side of the point Here it occurs in typical form, very coarse in grain and cut by other sets of joints very nearly at right angles to each other. The blocks sometimes are 10 - 15 and even twenty feet on an edge. Peculiar red spots are here developed by weathering Due I think to the iron oxide resulting from the decomposition of the augites. Beyond the ortho Mass-gabbro dike this diabase becomes finer and finer and near the great acid boss of the point it corresponds to Irvings olivine-diabase. While the lake breaks

the continuity of the exposure. It is highly probable that this was also continuous and here seems to give a gradation in the same mass from the most coarsely crystalline phase of Irvings Olivine-gabbro to the fine grained phase or Irvings Olivinitic-diabase. On the south side of the exposure near the beach at the neck is a depression in the gabbro filled by breccia, evidently a fault plane or at least a plane of some differential movement. This plane dips about 10° from the vertical toward the South east and the up throw as shown by the lamination or bedding of the breccia was in the eastward part.

Third- We find this diabase in the bottom of Beaver River Beginning at the wagon bridge and forming the bottom or bed of the river to the foot of the first falls. This is interrupted in many places by a fine-grained

rock diabasic in nature which
seams and cuts the coarser rock
in dike like fashion. At the foot
of the first falls and from here
to the foot of the second falls the
diabase carries amorkosyte as
above described and from here
on the diabase is continuous to the
edge of the area discribed. Near
the north west corner of the area
and near the west line of sec 2
on the north bank of Beaver River
was found a a small core of the
amorkosyte in a knot of the dia-
base Just above the second
falls of Beaver River a dike of red
rock three inches thick cuts the
diabase Beyond the limit in
the stream above the second
falls a similar dike about six
inches thick was observed
While this diabase (gabbro) appears
rather coarse and massive along
the north west shore of the bay
it more commonly is fine grained
and corrisponds to Pumpelly's
and Irving's olivinitic diabase

Wherever such is the case the contact between it and the "mixup" of diabase and red rock to be described later can not be made out

The fine grained diabases.

Fine grained diabases corresponding to Irvings ashbed diabase, and diabase-porphyrite, as well as ordinary-diabase types occur here in many places

Along the north west shore of the bay several fine grained diabases appear in so confused and intermingled a mass that it is almost impossible to describe it. Specimens taken from these rocks last season and examined with the microscope showed that there are all phases of ashbed diabase diabase-porphyrite ordinary-diabase and olivinitic-diabase. In places a small area of diabase will be homogeneous throughout and free from intrusions of red rock while in other places the most intricate and confusing intermingling exists

Rounded boulder like forms of one diabase will be surrounded by streaks and twisted bands of another diabase appearing like a diabase breccia enclosed in a matrix of diabase. I see again a sharp contact of excessively fine grained diabase with medium to coarse can be seen. and again excessive fine diabase will be seen to cut very irregularly in small dikelets like more massive portions of the rock. One very fine grained greenish weathering diabase always seems to contain amygdules elongated and arranged in bead-like strings. In several places and always where the amygdules are smallest this rock occurs broken up into small patches 1/2 to 3 ins across and the inter spaces are filled with a banded twisted light green weathering diabase. For convenience I have called this "curly" diabase. This may be a cooling phenomenon or may be due to ~~fracture~~ flowage with partial cooling

or it may be due to an impregnation of one rock by another. Amygdaloids occur very frequently but always in such irregularly shaped masses that they fail to indicate either their origin or their relation to the other rocks. At other places patches of solid rock will be homogeneous through out and free from impregnation. One such area measures about 40 feet across and has a circular out line. Whenever these rocks are at all homogeneous they always show a very perfect parting or jointing nearly vertical and trending nearly parallel to the general direction of the shore line of the bay. This is especially true of the large masses above mentioned, of the projecting points of the northern part of the shore line of the small island to the north east of Beaver Point and of the diabase south west of the small beach on the south side of the point. Indeed this

parting has been observed somewhat developed every where that fine grained rocks occur, to some extent even when the diabases are most cut and included by red rock. A second nearly horizontal jointing is observed and a third vertical and at right angles to the first. The last is the most in definite of the three which the first is most strongly marked

The diabases along the north west shore as described are cut by red rock using this term for a class of very different rocks

At first sight the diabase seems to hold innumerable inclusions of red rock and be cut by the same red rock at the same time Careful observation discloses the fact that almost all bolder like masses are connected by small dike lets or veins with the larger dikes or with other masses Indeed masses could hardly be found which could not be seen

to be somewhere connected with a dyke or vein of a similar rock. This intrusive red rock occurs in veins and fine seams to dikes six inches thick, often one foot and in several cases even two to three and even four feet thick. The small boulder like masses are usually from a few inches to two feet through while larger masses are quite common which attain a thickness of ten and even more feet.

The smaller masses always appear at least on the surface to be holocrystaline and very coarse grained. Many are surrounded by a crust or zone of more or less greenish material seeming to be diabase which was fused and partially mixed with the red rock. The larger masses generally show a porphyritic structure similar to that of the small point of quartz porphyry near the mouth of the river and to the porphyry of the island in the northern part of the bay

The greatest variety exists in the structure of the red rock. Every phase from a typical quartz porphyry to a typical felsite and to a fine fluidal holocrystaline rock is observed. This coarsely crystaline rock varies by more and more admixture of diabase until its color is almost that of the diabase yet in all of these phases it retains the coarsely crystaline structure.

Towards the southern end of the shore of the bay where this "mix-up and toss like impregnation of red rock is most complete the out crop is low — not more than ten feet high and presents much the same appearance throughout but wherever a vertical section can be found there appears a sort of banding. Rocks of the same kind appear arranged in thin layers curving toward the water. This would seem to indicate that the original rock at this place was laid down in

the form of flows. The numerous areas of amygdaloidal brecciated curly diabases would seem to point to a similar conclusion. The rounded areas of homogeneous rock more or less encircled by red rock and always enclosed in a more confused mass of impregnations would point toward a volcanic neck or necks. A volcanic neck would satisfactorily explain the complicated impregnations and intermingled impregnations of diabase. While either or evolving and shrinking would open lines of weakness most favorable to the intrusion of red rock

Scale 1 in = 1 mile
1 Dist = 1057

the form of flows. The numerous areas of amygdaloidal breccias & curly diabases would seem to point to a similar conclusion. The rounded areas of homogeneous rock more or less enclosed by red rock and always enclosed in a more confused mass of impregnations would point toward a volcanic neck or necks. A volcanic neck would satisfactorily explain the complicated impregnations and intrusions of diabase. while ether or cooling and shrinking would open lines of weakness most favorable to the intrusion of red rock