

A PETROGRAPHIC STUDY
OF THE
ALDERMAC MINE

DEPOSITED BY THE FACULTY OF
GRADUATE STUDIES AND RESEARCH

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A PETROGRAPHIC STUDY

of the

ALDERMAC MINE

- Being -

A THESIS

Submitted to

The Faculty of Graduate Studies and Research, McGill
University, in partial fulfilment of the requirements
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I N T R O D U C T I O N

The entire mining world has watched the growth of the Rouyn mining district in the last few years, from a practically unknown and unexplored territory into an area which gives promise of becoming one of the world's important sources of copper.

To those who are interested in this area, either financially or otherwise, any small contribution to the petrography or ore relations of any part of the region is likely to prove valuable.

It is the purpose of this Thesis to make some such contribution, and it is the hope of the writer, that, at least, a few of the results obtained will lead to a better and more detailed knowledge of a part of this interesting area.

SOURCE OF MATERIAL:

The material for this Thesis was obtained from the 125 ft. level of the Aldermac Mine. This property is located in the Western half of Boischatel Township, Quebec. It is approximately 25 chains east of the West boundary and 55 chains south of the north boundary of the Township.

TYPE OF MATERIAL:

The material consisted of fifty-one thin sections of

of rocks and nine polished sections of ore, together with specimens. their hand/ The thin sections were made both from diamond drill cores taken from horizontal holes which fan the country about the 125 foot level, and from rock samples taken at various places along this level. The polished sections were made from specimens selected from various parts of the ore body.

LIMITATIONS:

Owing to the writer's inability to visit the district and his lack of any first-hand information about it, the following work is entirely of a petrographic nature, and what little geology, etc., is included was derived entirely from published reports dealing with the area.

ACKNOWLEDGMENTS:

The writer wishes to acknowledge his indebtedness to the firm of Alderson, McKay and Armstrong for their kindness in supplying the material, (rocks, polished sections and maps) for this thesis. He particularly wishes to express his appreciation for the unstinted cooperation and advice given by Doctors R.P.D. Graham and J.J.O'Neil in the microscopic examination of the thin sections.

GENERAL GEOLOGY AND PETROGRAPHY

(#) "The rocks around the mine include a series of acid lavas, tuffs and breccias striking north 75 to 80 degrees east and dipping south south at angles of from 65 to 70 degrees. These are intruded by igneous rocks of three ages. The older gabbro, or diorite, is the oldest. It forms wide dike-like masses of irregular shape, striking almost parallel to the bedding of the lavas, and probably dipping steeply southward.

The next intrusion, in order of age, is a coarse syenite porphyry, with large reddish felspar phenocrysts. It forms dykes, striking northwest and dipping about 70 degrees toward the northeast. The youngest intrusive in the area is a large dyke of the later gabbro that strikes in a northwest direction with a nearly vertical dip."

"OLDER GABBRO:"

~~From published~~ descriptions (##) the "older gabbro" or diorite is composed of primary quartz, 5 to 6%, ~~often~~ forming graphite intergrowths, with labrodorite felspar,

(#) Ore relations at the Horne and Aldermac Mines, Quebec. By H.C.Cooke, Trans. C.I.M.M. 1928

(##) C.G.S., Summary Report, 1926 Part C. Page 51

20 to 35% and greenish hornblende crystals averaging 1 mm. in diameter. The hornblende forms from 60 to 75% of the rock and shows no evidence of being secondary after pyroxene.

SYENITE PORPHYRY:

The syenite from Rouyn map area is described by W.F. Jones^(#) as being of two varieties. The first is a porphyritic rock composed of albite, orthoclase, and microcline and a little quartz. Abundant blue soda rich hornblende occurs interstitial to the feldspars. Other accessories are biotite, and zircon. The second variety is a rock with a porphyritic tendency composed of large crystals of greenish augite set in a groundmass of equigranular feldspars, orthoclase, microcline, and a little albite. Some green hornblende crystals are present and the augite is partially altered to hornblende. Accessory minerals are epidote, splene, apatite, and a little biotite.

An intrusive mass of syenite porphyry, lying slightly north east of the Aldermac Mine is described by H.C. Cooke^(##) somewhat as follows: It is a large mass of syenite porphyry of non-uniform composition varying from a basic type containing 35% of femic minerals and no free quartz, through

(#) C.G.S. Summary Report, 1923, Part C₂ Page 138

(##) C.G.S. Summary Report, 1923, Part C₁ Page 122.

various forms of felspar porphyry, to acid types containing from 10 to 15% free quartz and very little femic mineral. Each phase has a fairly uniform composition and forms a mass with definite and sharp outlines in intrusive contact with other phases.

It would therefore appear that here we have a case of intrusion during or after differentiation, and not before. The general composition of the porphyry is unusual because of the high soda content. The felspars are orthoclase, microcline and albite, the femic minerals include biotite, diopside, aegirine-augite and glaucophane, the last named forming as an alteration product from the pyroxenes. The normal order ^{of} crystallization has apparently been reversed, the potash minerals forming first and being partly resorbed in the fluid residue high in soda and silica.

LATER GABBRO:

The "Later Gabbro" is described by W.F. James in the same publication, page 138. This "Later Gabbro" is apparently a diabase where it forms dykes. It is described as having an ophitic texture, often carrying large felspar phenocrysts and usually containing some quartz. The femic mineral is usually colourless diopside after partially altered to hornblende. The felspar is labradorite.

AGE RELATIONS OF INTRUSIVES:

The age of the diorite and the syenite porphyry is definitely pre-Cobalt and appears to be post-Temiskaming. The age of the "later gabbro" is doubtful but appears to be pre-Cobalt.

ACID LAVAS AND TUFFS:

The acid lavas and tuffs are undoubtedly of Keewatin age. They are described by W.F. James (#) for the Rouyn Map Area. They consist of rhyolites and trachytes and their tuffaceous equivalents.

The rhyolites are of both equiangular and porphyritic types. The phenocrysts of the porphyritic type are mostly fine laths of albite or rounded grains of quartz.

The trachytes contain little or no quartz. They are composed of large grains up to 1 mm in length, of orthoclase and albite in a matrix of the same material. The tuffs have a similar appearance and their elastic origin is hard to determine as considerable re-crystallization has taken place. Pyrite, magnetite, and epidote are generally present.

SEDIMENTS:

As stated by T.C. Denis (##) a band of old metamorphosed

(#) C.G.S. Summary Report 1923 Part C1 Page 131

(##) C.I.M.M. , May 1926, P. 619

sediments, both Cobalt and Temiskaming, in age, beginning some thirty miles west of Swastika Station, runs in an easterly direction, more or less continuously, for a distance of about 160 miles. The northern contact of this band of sediments with the underlying Keewatin lavas passes through the southern part of Boischatel township about twenty chains south of the Aldermac Mine. Most geologists who have done any amount of field work in Quebec are of the opinion that some of these sediments occur north of the contact as it is now known.

MINERALIZATION AND PRESENT THEORY OF THE ORE FORMATION

"The ore consists of the sulphides pyrite, pyrrhotite, sphaelenite, and chalcopyrite. The sulphide deposited in individual grains at a distance from the ore-body is entirely pyrite. Where replacement is complete, and the massive type of sulphide has been formed, pyrrhotite begins to appear and seems to increase in proportion as the lens of ore thickness, until much of it is solid pyrrhotite. Chalcopyrite is evidently somewhat later replacing both pyrite and pyrrhotite where replacement is intense and only pyrrhotite where replacement is less complete." (#)

According to Cooke the ore body is of the replacement type. "The evidence indicates that the sulphide body has replaced a lens of breccia lying between the acid rhyolite on the north and the somewhat more basic rhyolite on the south. Apparently the size and position of the ore-body has been determined by the size and position of the original lens of breccia. The introduction of the ore appears to have been accompanied or preceded by a pronounced silicification of the breccia." (##)

(#) Ore Relations at the Horne and Aldermac Mines by H.C.Cooke.

(##) Ore Relations at the Horne and Aldermac Mines by H.C.Cooke.

Cooke notes that the syenite porphyry is intrusive into the sulphide. He also notes that small stringers of sulphide run into porphyry and that these stringers consist of chalcopyrite only.

From these facts, and from others of minor importance, he draws the conclusion that the mass of pyrite, and the pyrrhotite were formed first. They were subsequently intruded by syenite porphyry dykes. This intrusion, by means of the strains developed, caused slicing of the sulphide mass.

Finally, along the little cracks so developed, and along any cracks in the porphyry, solutions rich in copper were formed. Thus by the filling of minute fissure and by replacement along their walls the present copper bodies were introduced.

P E T R O G R A P H Y

OUTLINE OF METHOD FOLLOWED:

The specimens were all examined both megascopically, and microscopically in the usual manner. The structure of the rock was noted and the percentage and average size of grain of each mineral was observed. The various rock types were then correlated and classified, as to primary composition, structure, etc. Conclusions were drawn as to the relations between rock types and ore and between alteration and ore, etc.

The polished sections were examined by reflected light in an attempt to determine the common ore minerals.

The rocks are described under the following headings and subdivisions:

1. Hand Specimen

11. Thin Section

(a) Structure and Texture

(b) Original Minerals (Primary Constituents)

(1) Groundmass)

(11) Phenocrysts) If the rock is porphyritic

In order, from silic to femic minerals:

(c) Alteration.

A description of the secondary minerals,

generally in paragenetic order.

(d) Opaque Minerals

(e) Paragenesis

The paragenesis of the secondary minerals as determined by the writer.

The alteration in most cases appears to be entirely due to replacement of original material by hydrothermal action, and, to a less extent, to the deposition of various minerals in fissures and cracks. Only these minerals which show more or less conclusive evidence of having been formed after the consolidation of the rock ^{are} included under the heading of "Alteration".

Some of the criteria used to determine replacement are listed below:

- (1) The preservation of original structure or texture, e.g. pseudomorphs.
- (11) Replacement veinlets cutting the specimen or thin section and dependent on minute fissures and cracks.
- (111) The projection of a crystal of one mineral into a crystal of another mineral where the former has a ragged or irregular outline.
- (1V) The occurrence of a crystal of one mineral

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cutting across several xols of other
minerals.

- (V) The occurrence of a mineral in more or less discontin-
upus stringers throughout the rock mass.

CORRELATION AND CLASSIFICATION

On the basis of composition the rock types fall naturally into two major divisions, acid lavas and intrusive dyke rocks of a syenitic or monzonitic character and ^{or} porphyritic texture.

(a) Lavas.

In thin section the lavas appear to be of two types, rhyolites and trachytes. However, on attempting to correlate these trachytes it seemed probable that they are not really trachytes ~~it~~ ~~seemed probable that they are not really trachytes~~ but merely slight differentiates of the main mass of rock. Two of them (Core #28 and Rock #11) are included by the writer among the rhyolites, and the other (Core #13) is considered as a part of a syenite porphyry dyke. Rhyolites.

The basis on which the rhyolites are divided is the quartz-orthoclase ratio. In determining this ratio all secondary sericite was considered as representing original orthoclase.

Considered in this manner the rhyolites are seen to be of two types; those in which the ratio of quartz to orthoclase is greater than 2 to 1 and those in which this ratio is less than 2 to 1. The former are here termed acid and the latter basic rhyolites. A list of the various lavas is given.* It is in the form of a chart and shows the structure, composition both original and altered and the quartz-orthoclase ratio as well as the identification numbers. This chart clearly shows the two types of rhyolite and their textures.

The location of the various specimens was then plotted on the map** and the composition (acid or basic) was noted.

This clearly brings out the fact that paralleling the main drift^f and slightly to the south of it, is a band of basic rhyolite about 40ft. wide. This band apparently has a varying strike

*See map "a"
**See table (1)

but in general it trends east and west.

Lying one to the north the other to the south of this band of basic rhyolite are two bands of undetermined width, composed of acid rhyolite. These acid bands have approximately the same strike as the basic rhyolite.

The ore is seen to occur along what is taken to be the contact between the basic rhyolite and the acid rhyolite to the north.

The above agrees perfectly with the statement made by Cooke* that the ore occurs at the contact between an acid rhyolite to the north and a more basic rhyolite to the south.

With only three exceptions all the specimens shown on Map "a" as basic rhyolites have the required composition. These exceptions are core samples Nos. 11 and 18 and rock sample No. 11. They are included among the basic rhyolites largely on the basis of their texture.

Textures:

Another interesting fact brought out by noting the texture of the various specimens in the following.

All the basic rhyolites have a porphroid** ("Clastic") texture. This texture is taken by the writer to indicate a very slow cooling of the molten lava, thus allowing an equal growth of the various crystals. The acid rhyolite to the south also has this porphroid texture near the contact but with increasing distance from the contact it assumes a porphyritic texture.

The acid rhyolite to the north on the other hand, has a well developed porphyritic or even anygdaloidal texture near the contact. With increasing distance northward the porphyritic texture is less pronounced and finally becomes porphroid.

An attempt has been made to show these textures on the map.**

*Op. C. T.

**Igneous. Rocks by J.P. Iddings, Vol. 1 Page 196

*** See map "A"

Thus going from north to south the texture of the rock varies as follows:- A gradual change from porphroid to porphyritic, an abrupt change to prophroid and then a gradual change to porphyritic again. If, as Cooke states* the lavas dip towards the south this is somewhat the condition one would expect to find, the flows becoming more porphyritic near their tops.

Considered in this manner, the basic rhyolite is seen to be lying on the porphyritic or amygdaloidal top of the acid rhyolite flow to the north.

The fact that the base of the basic flow has a porph^{oid} texture is presumed^{ably} due to it having been extruded before the underlying acid flow had completely cooled. Thus it would cool slowly itself and so assume a prophroid texture. A similar relation appears to hold between the basic rhyolite and the acid rhyolite to the south. This latter rhyolite is of porphorid texture at the base and becomes porphyritic as its top is approached.

Another hypothesis, explaining the relation of the basic rhyolite to the acid rhyolite to the south, is that the former represents a differentiation of the acid flow. This might be accomplished by the slightly more basic portion being segregated under gravitational forces to the base of the flow. Some such explanation seems likely, when one considers the fact that, if the basic band is considered as a separate flow it should have a porphyritic texture near its top. This was not observed and consequently it seems probable that the basic band is a differentiation of the overlying acid rhyolite to the south.

To sum up: the lavas appear to be all rhyolites. They occur as bands trending east and west and are represented by a band of basic rhyolite between two acid ones. The acid flow to the north

*See page 3

shows a good gradation in texture from bottom to top. Lying on top of this acid flow is a more basic rhyolite. It probably represents the basic base of the acid flow to the south from which it was formed by differentiation. This latter acid rhyolite assumes a porphyritic texture as its top is approached.

(b) Dyke Rocks.

On the basis of composition the dyke rocks fall into two divisions.

(i) Those containing little or none of the femic minerals. These are termed ^{syenite} porphyry dykes.

(ii) Those containing abundant femic minerals, principally biotite and aegirine augite. Class (ii) is subdivided into two types.

(i) Those containing abundant biotite and striking about north 40 degrees east. These are termed the mica syenite porphyry dykes.

(ii) Those containing biotite and generally some aegirine and striking from north 15 degrees west to north 40 degrees west. These are termed the augite syenite porphyry dykes.

A correlation of the various dykes specimens was made on the basis of the petrographic character, width and position of the specimen.

The dykes which are cut by the level and fully represented by samples. Samples of those cut by diamond drill holes, on the other hand, do not form a complete collection. Therefore, where a dyke was noted on the log of a drill hole but no specimen furnished, the field determination was used to connect this sample with others of a similar character.

A chart of the various dyke specimens similar to that given for the lavas accompanies this thesis.

Description of Dykes:

(i) Syenite Porphyry Type.

This type is represented by five dykes as shown on Map "a" where they are numbered from 1 to 5.

They are composed of a syenite porphyry containing practically no femic mineral although as seen by the chart, dykes Nos. 2 and 5 carry from 5 to 10% apatite and sphene. This is shown in core sample #17 and in rock Sample #15. This type usually carries both microcline and orthoclase in addition ot plagioclase and is generally considerably altered. It is also characterized by containing abundant secondary actinolite and ~~practically~~ no blue amphibole, only one specimen showing the latter (Core #17) Core sample #13 is included in dyke No.2. This sample is termed a trachyte but from its location it probably represents a chilled portion of the dyke near the contact.. These dykes strike from north 5 degrees east to north 40 degrees west, the general trend being about north 20 degrees west. They are represented on the original map as cutting through the ore and therefore apparently later through it. The examination of sections however indicates that they are probably earlier*

(ii) Augite Syenite Porphyry Type.

This type is represented by three dykes, shown on map "a" as nos. 6,7, & 8. They strike from north 15 degrees west to north 40 degrees west with a general trend of about north 35 degrees west.

As their relation to it could not be determined directly.

As indicated, this type contains abundant primary biotite, generally accompanied by aegirine-augite. Sphene and apatite are usually present as accessories. Here too orthoclase and Microcline

*See page. 18

accompany the plagioclase. As a rule these dykes are rather badly altered the characteristic alteration product being abundant blue amphibole. The blue amphibole probably owes its origin to the fact that these rocks carry soda rich pyroxene. Calcite, though generally in minor amount, is also a characteristic secondary mineral.

Dyke #6 is projected through core sample #9 in spite of the fact that this sample is here called a rhyolite. From the description of the sample it is seen that a part of the rock consists of an augite syenite porphyry and the other part of a rhyolite. From the relations shown on the map it seems likely that the sample represents a piece of the rhyolite caught in the dyke.

Dyke #8 is seen from the chart to be bordered on the western side by a narrow strip of rock rich in aegirine-augite. The portion of the dyke to east of this pyroxene rich strip apparently contains no pyroxene. It would seem as if the western portion is a differentiation, either in place or at depth of the main dyke material.

(iii) Mica Syenite Porphyry Type.

This type is represented by two narrow dykes, Nos. 9 and 10.

They are fairly rich in primary biotite and contain no augite. They are usually only slightly altered the characteristic products being calcite and chlorite. They contain no amphibole and are very poorly mineralized.

The general strike of these dykes is north 40 degrees east.

Andesite.

Only one specimen of andesite was observed. (Core Sample #10) No indication of the shape or size of the rock mass from which this was obtained could be formed. It seems possible, however,

(14)

that on the basis of composition this rock represents an offshoot of some mass of the "older gabbro" lying either to the south or slightly below the point from which the specimen was taken.

ALTERATION.

An attempt to correlate the various rocks on the basis of the kind and extent of alteration met with no success. The various kinds of alteration have affected the whole area without showing any marked preference for a particular rock type.

When, however, the various kinds of alteration were considered quantitatively as to cause and controlling factors, definite results were obtained.

The method used was as follows:-

A reproduction was made of the original tracing of the diamond drill holes and the ore bodies. The point from which each specimen was obtained was plotted on this map. The amount of each secondary mineral in the specimen was then plotted opposite the point from which the specimen was taken. Lines were drawn through those points which had undergone a certain type of alteration of approximately the same extent. Thus contours of equal alteration were obtained for each type of metamorphism.

These results are shown on Maps "b" and "c"

To facilitate the plotting, a table of the various specimens was made. This table* shows the rock type. The total alteration, and the extent of which each secondary mineral is represented in each thin section.

The alteration is seen to be of three types. Biotite, Propylitic and amphibolic.

(i) Biotitic Alteration.

This type is characterized by the formation of abundant secondary biotite. A study of the contours of biotitic alteration** brings out the following interesting relations. The sources from

* See table 111.

** See Map B

which the solutions causing this alteration emanated are clearly shown to be those syenite porphyry dykes containing abundant femic minerals. Namely, dykes Nos. 7, 8, 9 and 10. (7)

Considering first the area enclosed by dykes Nos. 7, 8, and

9. This area has apparently been strongly impregnated by solutions emanating from these dykes. The amount of secondary biotite is seen to increase from a trace, close to the dykes, to a maximum of 20% and then to decrease gradually. This condition is to be expected.

Close to the dykes the temperature was probably so high that the solutions emanating from these dykes could not deposit much of their load of material carried in solution. As a greater distance from the dykes was attained the temperature would be lower and so conditions would be more favourable for the formation of secondary minerals from material carried in solution. Thus with increasing distance from the ^{Dyke an increasing amount of biotite} ~~would be~~ ^{would be} formed until most of the material forming the biotite had been used up. After this point the amount of biotite formed would naturally decrease and finally become zero when the solutions became completely impoverished.

As the biotite occurs to the north east of dyke no. 7 it would seem that this dyke must dip in this direction. This conclusion seems plausible from the fact that the solutions causing the formation of the biotite would tend to rise and thus any minerals formed would be found above the dyke.

From this same reasoning dyke No. 8 presumably dips to the south west.

Dyke #10 apparently dips to the north west. The dip

however must be nearly vertical as a considerable amount of biotite is formed immediately to the south east of this dyke. The way in which the amount of biotite to the south east varies from 95% close to the dyke to

only a trace at a distance of fifty feet is explained by the above assumption. The rock immediately beneath the dyke would be cool compared to the rock above and so here most of the biotite would form and with increasing distance from the dyke, the amount would decrease as the solutions were impoverished.

Dyke #9 has also caused the formation of some biotite, but here the action was apparently much less intense. This dyke probably dips to the south east.

The syenite porphyry type of dyke (as represented by Nos 1,2,3,4, & 5) has been considered to be later than the ore.

From the fact that these dykes have been altered by the formation of secondary biotite in the same manner as the rhyolites it would seem that the syenite porphyry dykes high in femic minerals are later than those with no femic minerals.

(ii) Propylitic Alteration.

This type of alteration is described by Lindgren* as consisting of the formation by hydrothermal action, of chlorite and pyrite often accompanied by epidote, calcite, and cericite.

Therefore, in determining the contours of ^{propylitic} ~~porphyritic~~ alteration the sum of the amounts of these five minerals in each thin section was plotted.

These contours are shown on Map b. They are seen to form a "halo" about the ore body. The amount of propylitic alteration increases from a trace close to the ore body to about 45% and then decreases again. This is similar to the variation in the amount of biotite and is probably due to the same cause.

The zonal arrangement of the contours clearly indicates that this type of alteration is closely connected with ore formation.

*Mineral Deposits by W. Lindgren 3rd edition Page 531.

It was probably caused by the hydrothermal action on the country rock of solutions derived from the same source as those which formed the orebody.

Propylitic alteration is indicative of both low and intermediate temperature types of ore deposits, principally the former. However, on considering the fact that the ore minerals are assuredly not those of a low temperature deposit, it seems likely that the ore body belongs to that type referred to as intermediate.

The alteration affects the dykes as well as the lavas and from the close connection between the alteration and the ore, this fact is significant.

From the fact the alteration covers a much larger area and is more intense to the south east of the ore body it is deduced that the ore body must dip slightly in this direction.

It will be noted that the amount of propylitic alteration to the south east decreases to a trace and increases again to about 35%. It is possible that this indicates the position of another orebody somewhat to the south east of the area shown on the map.

→ The contours are unaffected by the dykes and this
~~It~~ is taken by the writer to indicate that the ore was

~~formed~~ somewhat later than the dykes and not earlier as has been previously assumed.

(iii) Amphibolic Alteration.

The contours of this type of alteration are shown on Map C. In arrangement they resemble those of propylitic alteration. They do not however, follow the shape of the ore body so closely and it therefore seems probable that the secondary amphibole is not so intimately connected with the formation of the ore.

To obtain these contours the total amount of secondary amphibole in each section plotted. It will be noticed that the blue

^
minimum

variety of amphibole occurs only in those dykes which contain aegirine augite. This is probably due to the fact that only in this type of rock were the solutions able to dissolve sufficiently soda to form the blue amphibole the ordinary type in the form of actinolite or tremolite, being formed elsewhere.

The contours are not affected in any way by the dykes and this fact furnishes additional evidence that the ore was formed somewhat after the dykes were injected.

It will also be noticed that the amphibolitic alteration increases again to the southeast in a similar manner to the propylitic alteration. Thus we have additional evidence of some source of alteration, possibly an ore body lying somewhat in this direction, the area shown on the map.

Paragenesis:

The paragenesis of the various types of alteration as determined microscopically is:- Biotitic, propylitic, and amphibolitic.

Summary of Alteration:

The significant facts about the alteration are:

(i) Both the propylitic and the amphibolitic alteration show a strong zonal arrangement about the ore body and are therefore closely connected with its formation.

(ii) The biotitic alteration does not appear to be connected with the ore body but its source seems to be those dykes rich in feldspar minerals.

(iii) The formation of the dykes appears to be earlier than the ore. This conclusion is indicated by the fact that the propylitic and the amphibolitic alteration affects the dykes to the same extent as the lavas.

Additional evidence is furnished by the fact that the propylitic and amphibolitic alterations are superimposed on the biotitic.

EXAMINATION OF POLISHED SECTIONS

The polished sections were examined microscopically by reflected light. Due to the writer's inexperience with this type of work no detailed results were obtained. Nevertheless, the following minerals and their manner of occurrence were noted.

(i) Pyrite.

Pyrite occurs abundantly ^Nmost of the sections. It generally has good crystals outline and appears to be the first mineral formed.

(ii) Pyrrhotite.

Pyrrhotite occurs abundantly in some of the sections. It was observed to surround and embay most of the pyrite crystals. On the other hand some of the pyrite is undoubtedly later than the pyrrhotite. Thus it would seem as if pyrrhotite started to form after pyrite but that pyrite continued after the cessation of pyrrhotite mineralization.

The pyrrhotite in these sections is unusual in that it gives a strong reaction with KCN. While this mineral is undoubtedly pyrrhotite it gives all the reactions of enargite, and it is possible that the two minerals may occur intimately intergrown. Any such intergrowth however, could not be seen, even under the highest magnification. Marsh's test for arsenic was applied to see if enargite could be present. While a faint reaction was obtained it was not considered conclusive. It has been suggested that the pyrrhotite may be nickeliferous and thus might give reactions differing from those ordinarily obtained.

(iii) Zinc blende

Zinc blende was observed in several sections. It occurs as ~~veinlets~~ and irregular masses replacing both pyrite and pyrrhotite.

A very little of the pyrite appears to be later than the sphalerite. From this it would appear that the sphalerite was formed before the pyrite mineralization had ceased.

(iv) Chalcopyrite.

Chalcopyrite was observed in practically every section. It occurs as irregular masses eating into and replacing the crystals and grains of the other minerals. It is distinctly the last sulphide mineral formed.

(v) Specularite.

(vi) Tremolite.

Tremolite, or actinolite occurs as needles and blades in every section. It preserves its crystal outline even where it is surrounded by chalcopyrite. The edges of the fibres are not embayed by any of the sulphides and the mineral has every appearance of replacing them.

From the study of the polished sections it seems probably that the following conditions of ore formation obtained:- A long period of pyrite mineralization during which pyrrhotite and sphalerite were formed. This was followed some time later by a period during which chalcopyrite was developed. The concluding phase of mineralization seems to have been a period during which abundant amphibole and a little specularite were formed, both throughout the country rock and in the orebody.

A few small irregular veinlets of specularite were observed in some of the sections. These veinlets cut through all the sulphide minerals and so it was concluded that this mineral was the last to be formed.

CONCLUSIONS

The writer's view of the history of the area is as follows:

The area is underlain by a succession of acid lava flows of Keewatin Age. The flows show differentiation and were probably extruded in rapid succession. After the formation of the flows the whole district was subjected to mountain making forces, and the various formations were crumpled into folds which trended east and west.

Some time after the folding numerous dykes of syenite porphyry were intruded. The syenite porphyry varies in composition from dyke to dyke and this variance is probably due to differentiation at depth. The basic type of dyke was the source of solutions which caused the formation of abundant biotite in the intruded lavas.

Following the dyke injection the area was impregnated by solutions emanating from some igneous source. The solutions followed the main lines of weakness in the area, in this case the contact between two flows. These solutions caused the formation of ^{the}pyrite, pyrrhotite, ^{of the}sphalerite, and chalcopyrite ^{ore body} as well as the

prophylic and amphibolic alteration of the surrounding rocks. It is possible that these solutions were derived from the same underlying source as were the syenite porphyry dykes.

The ore body is of the replacement type and was formed at intermediate depths, that is, from 4000 to 12,000 feet. It has been laid bare by the subsequent erosion.

In conclusion the writer wished to again emphasize the fact that the results obtained are based entirely on petrographic work, unsupported by any field observations, and therefore, of necessity, lack finality.

DESCRIPTION OF SECTIONS

CORE #1

RHYOLITE

The rock is seen to have been a rhyolite. It is now badly altered by the formation of biotite, sericite, and chlorite. The specimen was probably taken from the centre of a deep flow.

Handspecimen:

In handspecimen the rock appears dark coloured, porphyritic and highly siliceous. It is mineralized by a few specks of pyrite.

Thin Section:

Structure and Texture.

The rock is seen to have a porphroid texture, approaching aplitic in places and with a seriate fabric. The grain size ranges from 0.05 mm. to 0.25 mm.

Original Minerals:

(i) Quartz.

Quartz occurs as allotriomorphic grains, from 0.05 to 0.25 mm. size, either clear or with dust like inclusions. It now comprises about 60% of the section.

(ii) Felspar.

There also occur in the section scattered masses of chlorite, and sericite which are taken to represent original felspar, probably orthoclase. It was probably less than 5% of the rock.

Alteration:

(i) Biotite.

Biotite is present in fair amount forming about 10% of the section. It occurs as nests of small crystals, now partially altered to chlorite, as is shown by its green colour.

It has every appearance of being secondary and as such it represents the first product of alteration.

(ii) Sericite.

Sericite occurs as masses and nests of small flakes, often intergrown with chlorite. It appears to be replacing original felspar.

It also occurs with chlorite between the quartz grains.

(iii) Chlorite.

Chlorite occurs as irregular shaped masses between the quartz grains, often associated with sericite. It is also seen to be replacing the biotite.

The chlorite and sericite together make up about 25% of the section.

Opaque minerals:

(i) Pyrite.

CORE #1(cont)

Pyrite was the only opaque mineral observed and represents the last stage of alteration. It occurs as a few scattered crystals.

Paragenesis:

The rock was probably a siliceous rhyolite with a porphroid texture. The texture indicates that the specimen probably taken from the centre of a very thick flow. It has been altered by the introduction of biotite, sericite, chlorite and pyrite, in the order named.

These were apparently not primary femic minerals.

MICA SYENITE PORPHYRY, RICH IN SODA

CORE #2.

The rock is seen to be a mica syenite porphyry now altered by the formation of amphibole calcite, quartz, pyrite and possibly some biotite.

Hand specimen:

The rock has a dark, coarse, even grained appearance, showing biotite and hornblende and laths of feldspar.

Thin Section:

Structure and Texture.

The section has an unpronounced panidiomorphic structure, seriate fabric and the crystals show a diverse arrangement both tabular and prismatic.

Original Minerals:

(I) Feldspar.

The feldspar occurs as lath shaped and tabular crystals about 0.4 mm. size. They consist of microcline, orthoclase, and plagioclase in the following proportion:- 45%, 45%, 10%.

The feldspars now make up about 40% of the section.

(II) Biotite.

The biotite forms large, lath shaped pleochroic, brown crystals from 0.1 to 1.0 mm. size. It makes up about 25% of the rock. Most of the biotite appears to be primary but some of it has the appearance of being secondary.

(III) Apatite.

Several irregularly shaped crystals of apatite were seen; up to 0.3 mm. in size. This mineral comprises about 5% of the section.

(IV) Sphene.

Sphene was observed as large euhedral crystals. It was apparently the earliest mineral formed and now forms about 2% of the section.

The order of formation of the original mineral appears to be, sphene, apatite, biotite and feldspar.

Alteration:

(1) Biotite.

As mentioned above some of the biotite

Core #2. (Cont).

appears to be secondary. The secondary biotite, if any, is of small amount.

(11.) Silicification.

There is apparently a little secondary quartz developed. It is seen eating into the edges of a few of the feldspar crystals.

The silification has been very slight.

(111). Amphibole.

The amphibole is of the blue variety, Arfvedsonite.

It occurs as lath-shaped and acicular crystals arranged in both radiating and parallel groups. The crystals occur up to 0.8 mm. size and replace biotite, feldspars, and apatite.

The amphibole makes up about 25% of the rock.

(1V) Calcite.

Calcite occurs as small irregular masses throughout the section and replaces the feldspars, biotite and apatite and is associated with the hornblende in places. It makes up about 2% of the rock.

Opaque Minerals:

(1) Pyrite was the only opaque mineral observed. It occurs as small scattered grains making up possibly 1% of the rock.

Paragenesis:

The paragenesis of the secondary minerals is:-
biotite, ~~quartz~~, calcite, arfvedsonite, pyrite.

CORE #3

RHYOLITE

The rock is seen to be a fine grained rhyolite intruded by an acid pegmatite.

Hand specimen:

The handspecimen is a fine grained mottled rock mineralized by pyrite and chalcopryrite.

Thin section:

Structure.

The section shows a very fine, almost crypto-crystalline groundness with pseudo-veins of some coarser material.

Original Minerals:

(1) A very fine grained material, averaging 0.01 mm. in size and consisting of alkali plagioclase, 80%, orthoclase, 15% and quartz, 5%, forms about 40% of the rock.

Alteration:

(1) The rock has been intruded by what appears to have been an acid pegmatite.

It is composed of quartz and orthoclase in about equal proportions. It occurs as tongues replacing and including the fine grained material. As indicated it is composed of quartz and orthoclase in allotriomorphic grains up to 1.0 mm. size.

It makes up about 50% of the rock.

(11) Calcite.

A considerable amount of calcite was observed replacing mainly feldspar but also some quartz, both fine and coarse grained.

It occurs as irregular masses and veinlets making up about 8% of the rock.

(111) Sphene.

One large crystal of sphene was observed.

Core #3 (Cont).

Opaque Minerals:

(1) Pyrite.

Pyrite was observed as small scattered crystals replacing all the silicate minerals.

(11) Chalcopyrite.

Chalcopyrite was observed, associated with the pyrite and of similar occurrence.

Paragenesis:

The paragenesis of the secondary minerals is:-
pegmatite intrusion, calcite and opaque minerals.

The rock appears to have been either a rhyolite or a fine grained trachyte which has been intruded by quartz and feldspar in a plastic condition and then still further altered by the formation of calcite and sulphides.

CORE #4

RHYOLITE

The rock is seen to have been an amygdaloidal rhyolite probably with hornblende phenocrysts. Now altered by the formation of calcite, epidote, chlorite, hornblende, leucoxene, sericite, pyrite, and block iron ore.

Handspecimen:

The handspecimen is a dark colored, fine grained, amygdaloidal rock. It apparently contains epidote and hornblende and is mineralized by specks of pyrite.

Thin section:

Structure.

The section has an Amygdaloidal structure, the ground mass being fine grained but crystalline.

Original minerals:

(a) Groundmass.

The Groundmass is a very fine granular mass of quartz and orthoclase, from 0.01 to 0.05 mm. in size. It is composed of about equal amounts of quartz and orthoclase. It forms about 40% of rock.

(b) Amygdaloidal

The amygdules are filled with

(1) Quartz.

About 90% of the filling occurs as large irregular grains of quartz up to 0.2 mm. in size.

(11) Orthoclase.

Orthoclase forms about 5% of the filling. In occurrence it is similar to quartz.

(111) Epidote.

Epidote occurs in two of the amygdules of which it forms about 20%. It is probably secondary.

(1V) Sericite.

Sericite occurs in only one amygdule where it evidently was formed by the alteration of Orthoclase. Possibly 1% of rock.

Core #4 (cont.)

Amydgules are bordered in most cases by a narrow band of chlorite. They comprise about 30% of the rock.

Alteration

(I) Epidote.

Epidote occurs as granular masses throughout the section and in some amygdules as indicated. It forms 2% of the rock.

(II) Chlorite.

Chlorite occurs as a ring surrounding the amygdules and as flakes throughout the section. It is often associated with secondary hornblende in masses of such a shape as to suggest replaced phenocrysts. It forms about 2% of the section.

(III) Sericite.

As indicated above sericite occurs as masses of small flakes probably replacing original orthoclase.

(IV) Amphibole.

The amphibole occurs as rests of small, pleochroic green hornblende often associated with chlorite. It makes up about 25% of the rock.

(V) Leucoxene.

This mineral is seen surrounding small crystals of black iron ore.

It is only present in small amount.

Opaque Minerals: (In small quantity)

(1) Black iron ore (Ilmenite)

Occurs as small secondary crystals scattered throughout the groundmass.

(II) Pyrite.

As scattered crystals throughout the groundmass.

Paragenesis:

The paragenesis of the secondary minerals is:-
Sericite, epidote, chlorite, amphibole, black iron ore, leucoxene, pyrite.

CORE #5.

AUGITE SYENITE PORPHYRY

The rock is seen to be a dyke rock of monzonitic type, altered by the formation of blue amphibole.

Handspecimen:

The handspecimen is a dark colored, coarse even grained rock apparently consisting of large crystals of biotite and pyroxene embedded in plagioclase.

Thin Section:

Structure.

The section shows a porphyritic structure and a seriate fabric.

Original Minerals:

(a) Groundmass.

The groundmass is composed of lath shaped crystals of plagioclase, 75% and blunder crystals of orthoclase 20%. The average size is about 0.1 mm. The groundmass makes up about 50% of the section.

(b) Phenocrysts.

(1) Pyroxene.

The pyroxene is of the aegerine or aegerine-augite type. It occurs with good crystal outlines of a size from 0.05 to 0.4 mm. It is being altered in places to blue hornblende and it forms about 22% of the rock.

(11) Biotite.

Occurs as large, well formed, pleochroic crystals up to 0.5 mm. in size. It comprises about 22% of rock.

(111) Apatite.

Apatite occurs as small well shaped crystals and sparingly as larger irregular masses. It forms about 1% of the section.

The order of formation of the original constituents is:- Apatite, Biotite, Pyroxene and Felspar.

Core #5, (Cont).

Alteration:

(1) Amphibole.

The pyroxene is badly altered in spots, especially along the edges and along cleavage cracks, to a blue amphibole, probably glaucophane.

This makes up about 5% of the rock and is the only product of alteration except a little kaolin from some of the orthoclase.

The blue amphibole is also observed replacing the feldspars in places.

Core #6

RHYOLITE

The rock is seen to be a rhyolite cut by actinolite epidote veinlets and silicified.

Handspecimen:

The handspecimen is a light coloured, very fine grained, highly siliceous rock cut by numerous, narrow, reticulating, veinlets of hornblende. Associated with the hornblende are specks of pyrite.

Thin Section:

Structure.

The rock has a porphyritic structure and a seriate fabric.

Original Minerals:

(a) Groundmass.

The groundmass is composed essentially of 70% quartz and 30% orthoclase of about 0.02 mm. size. It makes up about 60% of the section.

(b) Phenocrysts.

The phenocrysts comprise about 20% of the section.

They are composed of quartz 80% and orthoclase 20%. Each phenocryst consists of several allotriomorphic grains of the above, of about 0.25 mm. size.

Alteration:

(1) Silicification.

Two narrow quartz veins were observed cutting the section.

(11) Calcite.

A few irregular patches of calcite were observed. They were later than the vein quartz.

(111) Sericite.

A few of the feldspars were observed to be slightly altered to sericite.

Core No.6 (cont.)

(1V) Actinolite and Epidote.

Both phenocrysts and groundmass are cut by several veins composed of hornblende and epidote in about equal proportions. In addition to this radiating groups of hornblende crystals, and granular masses of epidote were observed throughout the groundmass. The hornblende is of the pale green variety, probably actinolite. The hornblende and epidote together make up about 20% of the section.

Paragenesis:

The paragenesis of the secondary minerals is: Quartz, Calcite, Epidote, and Actinolite.

RHYOLITE

Core #7

The rock is seen to be a rhyolite which has been altered by the introduction of biotite and pyrite. The specimen was probably taken from the centre of a thick flow.

Handspecimen:

The rock is dark coloured, porphyritic and fine grained. It is highly silicious rock and is sparsely mineralized by specks of pyrite.

Thin Section:

Structure:

The section has a porphroid structure and a seriate fabric. The grain ranges from 0.01 to 0.2 mm. in size.

Original Minerals:

(1) Quartz.

The section consists of about 60% quartz which occurs in two ways.

(a) As even sized, irregular grains up to 0.2 mm. in size. This phase comprises about 90% of the quartz.

(b) As very fine grained, almost crypto-crystalline quartz; averages 0.02 mm. in size. This quartz simulates a veinlet cutting the coarse quartz. It was probably formed by the crushing of the coarse quartz, due to movement along a fault plane. The site of the fault plane is now represented by a string of pyrite crystals.

(11) Felspar.

A few crystals of orthoclase and plagioclase were observed associated with the coarse quartz and similar to it in occurrence. The feldspars make up about 5% of the section.

Alteration:

(1) Biotite.

The biotite is the green, pleochroic variety. It is distinctly secondary and occurs between the quartz grains and as narrow rectangular crystals replacing the quartz and feldspars. It probably owes its green colour to chloritic alteration but only a very few small flakes of

Core #7 (cont.)

chlorite were observed. The biotite forms about 32% of the section.

Opaque Minerals:

Pyrite occurs as scattered crystals and as narrow veinlets as indicated above. It forms about 3% of the rock.

Paragenesis:

The pyrite is distinctly later than the biotite.

Core #8.

SYENITE PORPHYRY

The rock is seen to be a dyke rock composed originally of plagioclase and now altered by the formation of biotite, Calcite, tremolite and pyrite.

Handspecimen:

The hand specimen is a light coloured, medium grained, porphyritic rock, traversed by hornblende veinlets and mineralized by specks of pyrite.

Thin Section:

Structure:

The section shows a porphyritic structure, with fairly coarse texture and has a seriate fabric.

Original Minerals:

(a) Groundmass.

The groundmass is composed of twinned and untwinned plagioclase feldspar. It is either albite or andesine, as it is optically positive, probably the former. It occurs as crystals from 0.05 to 0.1 mm. in size and makes up about 60% of the section.

(b) Phenocrysts.

The phenocrysts consist of large crystals of plagioclase of similar composition to the groundmass. The size ranges from 0.25 up to 1.5 mm. They make up about 15% of the section. One large mass of apatite was observed.

Alteration:

(1) Biotite.

Biotite occurs as nests of small crystals throughout the groundmass forming about 15% of the section. The size of the nests is about 0.5 mm. It also occurs penetrating the phenocrysts places.

Core #8 (cont).

(11) Calcite.

The calcite occurs as irregular masses throughout the groundmass and often associated with the biotite which it replaces. It forms about 8% of the rock.

(111) Tremolite (Actinolite?)

Pale green, nearly colourless amphibole occurs in small quantity as flakes and needles replacing phenocrysts, groundmass, biotite and calcite.

Opaque Minerals:

(1) Black Iron Ore (Primary)

Black iron ore occurs chiefly associated with the biotite, but also scattered through the groundmass. It was observed to be altering in places to leucoxene.

(11) Pyrite.

Pyrite occurs as small scattered crystals throughout the groundmass.

Paragenesis:

The paragenesis of the secondary minerals is biotite, calcite, tremolite and pyrite.

Core #9.

RHYOLITE

The rock is seen to be a rhyolite altered by the formation of quartz, epidote, calcite, blue amphibole, and black iron ore.

Handspecimen:

The handspecimen is a fine grained, siliceous rock, containing epidote and mineralized by small specks of pyrite.

Thin Section:

Structure:

The section has a porphyritic structure and a hiatal febric.

Original Minerals:

(a) Groundmass.

The groundmass is very fine grained (0.04 mm.) and consists of quartz, 90% and orthoclase 10%. It forms about 70% of the rock.

(b) Phenocrysts.

Small phenocrysts of quartz were observed. They are about 0.25 mm. in size. They comprise about 20% of the rock.

Alteration:

(1) Silicification:

Several quartz veinlets were observed traversing the section. The quartz in them is fairly coarse.

(11) Calcite.

A little calcite in the form of irregular masses was observed replacing the groundmass.

(111) Epidote.

Epidote is present as granular masses scattered throughout the section, and replacing the groundmass. It forms about 5% of the section.

Core #9 (cont).

(1V) Blue Amphibole.

Blue amphibole is everywhere present as small needles replacing both groundmass and phenocrysts. It forms about 4% of the rock.

Opaque Minerals:

(1) Black iron ore is present as many small crystals throughout the groundmass. It possibly forms 1% of the rock.

Paragenesis:

The paragenesis of the secondary minerals is: quartz, calcite, epidote, blue amphibole and black iron ore.

There is an inclusion in one corner of the slide of a piece of some rock composed of a groundmass of plagioclase and originally containing phenocrysts of biotite, hornblende and felspar. It has been altered by the introduction of blue amphibole, epidote and black iron ore.

The blue amphibole apparently radiates out from this inclusion into the main rock. Thus it would seem as if the syenite porphyry as represented by the inclusion had caused the formation of the secondary amphibole at least.

Core #10.

ANDESITE

The rock has been classed as an andesite because of the high proportion of femic constituents and because of the fact that much of the "orthoclase" is probably untwinned plagioclase. The rock is really a dyke rock with the composition of a basic monzonite. It has been altered by the formation of biotite, calcite, epidote, chlorite, quartz, sericite and actinolite, pyrite and black iron ore.

Handspecimen:

The handspecimen is a light grayish rock and has porphyritic texture with small phenocrysts of plagioclase. It is mineralized with specks of pyrite.

Thin Section:

Structure:

The section shows a porphyritic structure and a seriate fabric.

Original Minerals:

(a) Groundmass.

The groundmass is rather fine grained (up to 0.06 mm.) and appears to consist of orthoclase, 65% and plagioclase 35%. It is probable, however, that most of the "orthoclase" is untwinned plagioclase. It forms about 45% of the rock.

(b) Phenocrysts.

(1) Felspar.

Large phenocrysts (0.3 to 1.5 mm. in size) of plagioclase making up about 30% of the section were observed. As they are optically biaxial and negative with an extinction angle of about 16° they are probably oligoclase.

(11) Hornblende.

Medium sized (0.5 mm) ghost crystals of what appears to have been hornblende occur throughout the rock. They now consist of a mass of chlorite, sericite, biotite, and often calcite. They originally formed about 10% of the rock.

(111) Apatite and Sphene.

These two minerals are present as original constituents. They occur as small, well-shaped crystals throughout the section.

Core #10, (cont.)

(1V) Biotite.

Biotite occurs as elongated bunches of small crystals throughout the section. Much of it has the appearance of being primary but some, especially that which replaces the original hornblende, is undoubtedly secondary. The biotite is the pleochroic, green, variety and is badly altered in places to chlorite. Biotite now forms about 5% of the rock.

Alteration:

(1) Biotite.

As mentioned above some of the biotite appears to be secondary.

(11) Calcite.

Calcite occurs as irregular masses and veinlets cutting and replacing both phenocrysts and groundmass.

It is the most abundant secondary mineral and forms about 5% of the section.

(111) Quartz.

In the calcite vein mentioned above a little quartz occurs.

(1V) Sericite.

Sericite occurs as small crystals, often inter-grown with chlorite, replacing both groundmass and phenocrysts.

(V) Chlorite.

Chlorite occurs replacing original hornblende phenocrysts and is abundant throughout the groundmass and associated with biotite.

(VI) Epidote.

Epidote is present in small quantity as granular masses.

(VII) Amphibole.

A very little pale green amphibole (actinolite) occurs as radiating the parallel groups of fibres.

Opaque Minerals:

(1) A considerable amount of pyrite was observed scattered through the section.

(11) Black iron ore (primary)

A little black iron ore was observed.

Core #10 (cont).

Paragenesis:

The paragenesis of the secondary minerals is: biotite, calcite, quartz, sericite, chlorite, epidote, actinolite, and pyrite.

Core #11.

RHYOLITE

The rock is seen to be a rhyolite from the centre of a thick flow. Altered by the formation of biotite, sericite, chlorite, and pyrite. The specimen is probably from the centre of a thick flow.

Handspecimen:

The rock is nearly black in colour, medium grained and shows quartz and chlorite grains. It is mineralized by specks of pyrite.

Thin Section:

Structure:

The structure is Porphyroid and the fabric seriate. The rock approaches an aplite in texture.

Original Minerals:

(1) Quartz.

Quartz now forms about 80% of the rock. It occurs as grains from 0.1 to 0.3 mm. in size.

Alteration:

The following minerals are formed between the quartz grains, probably by hydrothermal action.

(1) Biotite.

Biotite occurs as nests of small crystals. It is now badly altered to chlorite.

(11) Sericite.

Sericite occurs as masses of minute flakes, probably replacing what was originally feldspar in the rock. It now forms about 10% of the section.

(111) Chlorite.

Chlorite was observed to form about 10% of the section. It occurs replacing the biotite, and as patches and veinlets throughout the section.

Opaque Minerals:

(1) Pyrite

A few scattered crystals of pyrite were seen

Core #11 (Cont)

throughout the section.

Paragenesis:

The paragenesis of the secondary minerals is biotite, sericite, chlorite and pyrite.

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Core No.12

RHYOLITE

The rock is seen to be a rhyolite, probably from the centre of a thick flow. It has been altered by the introduction of chlorite, sericite, quartz, muscovite and pyrite.

Handspecimen:

The handspecimen is a dark grey to black, medium grained rock, showing quartz and chlorite in patches and sparsely mineralized with specks of pyrite.

This Section:

Structure:

The rock has a Porphyroid structure and a seriate fabric. The texture approaches aplitic and indicates that the specimen came from the centre of a very thick flow.

Original Minerals:

The original material is composed of quartz 70% and orthoclase 30%. Together they form about 60% of the rock. They occur as allotriomorphic grains from 0.05 to 0.5 mm in size, with an average of about 0.2 mm.

Alteration:

(1) Chlorite and Sericite.

Chlorite and minute flakes of sericite occur intergrown and form patches throughout the section. They also occur between the quartz grains and probably represent original feldspar which has been altered. They form about 20% of the rock.

(ii) Quartz.

Secondary silica occurs replacing feldspar and primary quartz around the edges of the crystals. It appears to be slightly later than the chlorite and sericite.

(iii) Muscovite.

Muscovite was observed as fairly large flakes replacing all the above minerals. It forms about 15% of the section.

Opaque Minerals:

(i) Pyrite.

Pyrite was observed occurring as scattered grains throughout the section. It is in small quantity.

Core No.12 (cont).

Paragenesis:

The paragenesis of the secondary minerals is: sericite, chlorite, quartz, muscovite and pyrite.

Core No.13

TRACHYTE

The rock is seen to be a trachyte. Altered by the introduction of biotite, chlorite, epidote, calcite, sericite and pyrite. The orthoclase is not seen in This Section.

Handspecimen:

The rock is light grey in colour and has a porphyritic texture. It shows a fine grained groundmass and large phenocrysts of plagioclase and pink orthoclase. It is very sparsely mineralized with specks of pyrite.

Thin Section:

Structure:

The specimen has a Porphyritic structure, pandiomorphic texture and hiatal fabric.

Original Minerals:

(a) Groundmass.

The groundmass is composed of fairly large, lath-shaped crystals of plagioclase, from 0.1 to 0.5 mm. in size. They are probably albite and oligoclase as they are both optically positive and negative. They make up about 65% of the rock.

(b) Phenocrysts.

(i) A few large phenocrysts of plagioclase (albite) were observed. They were about 3.5 mm. long and formed approximately 15% of the section.

(ii) A few small crystals of apatite were seen.

Alteration:

(1) Biotite.

Biotite occurs as nests of small crystals, now badly altered to chlorite, and forms about 10% of the rock. It is distinctly secondary.

(ii) Chlorite.

Chlorite occurs replacing biotite and feldspars, mainly the former. It forms about 6% of the section.

(iii) Epidote.

Epidote occurs as granular masses throughout the section, often associated with chlorite. It forms about 1% of the rock.

(iv) Calcite.

Calcite occurs as irregular masses throughout the section replacing feldspars and biotite. It forms about 2% of the section.

(v) Sericite.

A few small flakes of sericite were observed replacing feldspar.

Core No.13 (cont).

Opaua. Minerals.

(1) Pyrite.

Several crystals of pyrite were observed scattered throughout the section.

Paragenesis:

The paragenesis of the secondary minerals is:-
biotite, calcite, chlorite, epidote and pyrite.

Core #14.

SYENITE PORPHYRY

The rock is seen to be porphyry with a composition that corresponds to an acid monzonite. It has been altered by the formation of biotite, chlorite, sericite, epidote, quartz, and pyrite.

Handspecimen:

The rock is dark gray to black in colour and has a texture showing a fine grained groundmass and several large phenocrysts of felspar. It is heavily mineralized with pyrite and some chalcopyrite.

Thin Section:

Structure.

The section shows a porphyritic structure and a seriate fabric.

Original Minerals:

(a) Groundmass.

The groundmass is composed of fairly coarse crystals (0.1 to 0.5 mm. in size.) of orthoclase and plagioclase in about equal proportions. The groundmass forms about 40% of the rock.

(b) Phenocrysts.

(1) The phenocrysts consist of large, euhedral crystals of plagioclase (albite and Oligoclase up to 1.6 mm. in size. They comprise about 40% of the rock.

(11) Apatite.

Two large allotrimorphic crystals of apatite were observed. They were apparently the first material to crystalize.

Alteration:

(1) Biotite.

Secondary biotite occurs replacing both phenocrysts and groundmass. It is of both the green and the brown variety. A little of it has the appearance of being primary. It makes up about 8% of the rock.

Core #14 (Cont.)

(11) Silicification.

One vein of quartz was observed cutting the section. It was distinctly later than the biotite.

(111) Chlorite and Sericite.

These minerals occur intergrown as nests and veinlets replacing and cutting all the above minerals. The chlorite also occurs replacing the biotite. Together they form about 8% of the section.

(1V) Epidote.

A few small granular masses of epidote were seen.

Opaque Minerals.

(1) Pyrite.

Large crystals of pyrite occur scattered through the section.

(11) Chalcopyrite.

Several crystals of chalcopyrite were seen associated with the pyrite.

Together these minerals make up about 4% of the section.

The paragenesis of the secondary minerals is: biotite, quartz, sericite, chlorite, epidote and opaque minerals.

RHYOLITE

The rock shows a flow (banded) structure in this section and is seen to be a rhyolite altered by the formation of biotite, quartz, calcite, and tremolite. The specimen is probably from the centre of a thick flow.

Handspecimen:

Missing.

Thin Section:

Structure.

The texture is porphyroid approaching aplitic and is very fine grained. The section shows a crude banding and is cut by veins whose general direction is at 90° to the banding.

Original Minerals:

The original minerals consist of a fine grained mosaic of quartz and orthoclase. Most of the material is less than 0.04 mm. size. It now forms about 50% of the section.

Alteration:

(i) Biotite.

Abundant brown biotite occurs as a large nests of small crystals and as little stringers cutting and replacing the original material. It forms about 20% of the section.

(ii) Silification.

The rock is transversed by numerous veins containing coarsely crystalline quartz and forming about 10% of the section.

(iii) Calcite.

Calcite occurs chiefly associated with the quartz veins, but also to a lesser extent as irregular masses throughout the section of which it forms about 15%.

(iv) Tremolite.

Several masses of matted fibres of tremolite were observed. They replace all other minerals except pyrite but are chiefly found replacing the vein quartz. Tremolite forms about 5% of the section.

Opaque Minerals:

(1) Pyrite.

Pyrite occurs as scattered crystals throughout the section but is more common associated with veins.

CORE #15(cont)

Paragenesis:

The paragenesis of the secondary minerals is:-
biotite, quartz, calcite, tremolite, and pyrite.

AUGITE SYENITE PORPHYRY

The rock is not a true syenite porphyry but is more of the monzonite type; as shown by the high proportion of feldspar minerals and the preponderance plagioclase.

Handspecimen:

A dark grey to black mottled rock showing feldspar phenocrysts. Very sparsely mineralized by specks of pyrite.

Thin Section:

Structure.

The structure is porphyritic, the texture poikilitic, and the fabric seriate.

Original Minerals:

(a) Groundmass.

The groundmass is composed of fairly coarse laths, (0.2 mm) of plagioclase and mosaic of feldspar grains. It forms about 20% of the rock.

(b) Phenocrysts.

(i) Feldspar.

Plagioclase phenocrysts (up to 1.5 mm) comprise about 40% of the rock. They are either andesine or labradorite as they are optically positive. Microcline phenocrysts occur but to a lesser extent.

(ii) Aegirine-Augite.

Aegirine-Augite occurs as phenocrysts from 0.25 to 1.0 mm. in size. Several phenocrysts are often surrounded by a single feldspar phenocryst giving a poikilitic structure to the rock.

The pyroxene is being altered to blue amphibole in places. It forms about 20% of the rock.

(iii) Biotite.

Biotite occurs as fairly large crystals throughout the groundmass and included in the feldspar phenocrysts. It is often associated with the pyroxene. It has the appearance of being primary. Biotite makes up about 10% of the rock.

The order of crystallization appears to be aegirine-augite, biotite, and feldspar.

Alteration:

(i) Calcite.

Calcite forms about 5% of the section and occurs as irregular masses, replacing both groundmass and feldspar phenocrysts.

(ii) Muscovite.

Muscovite occurs as a few scattered crystals, often bordered by hornblende.

(iii) Amphibole.

Blue Amphibole occurs as needles throughout the section and especially replacing pyroxene. It is either arfvedsonite or glaucophane, probably the former. It makes up about 5% of the rock.

Opaque Minerals:

(i) Pyrite.

Pyrite occurs as a very few scattered crystals.

CORE #16 (Cont.)

Paragenesis:

The paragenesis of the secondary minerals,
is:- Calcite, muscovite, amphibole and pyrite.

SYENITE PORPHYRY

The rock is seen to be a normal syenite porphyry altered by the formation of quartz and blue amphibole.

Handspecimen:

A very dark coloured, porphyritic rock with a fine grained groundmass and large phenocrysts of felspar. No mineralization noted.

Thin Section:

Structure.

A Porphyritic structure, hiatal fabric. were noted.

Original Minerals:

(a) Groundmass.

The groundmass is coarse grained (0.25 to 0.5 mm) and composed of plagioclase 60%, orthoclase 40%. The plagioclase is both albite and oligoclase (optically negative and positive). The groundmass makes up about 50% of the section.

(b) Phenocrysts.

(i) Felspar.

The felspar phenocrysts are of large size (1.0 to 3.0 mm) and are composed largely of microcline. They make up about 30% of the rock.

(ii) Apatite.

Apatite occurs as a few small crystals throughout the groundmass.

(iii) Sphene.

Sphene occurs as small specks and as larger, well shaped crystals throughout the groundmass. It forms about 5% of the rock.

Alteration:

(i) Silicification.

A little secondary silica was observed eating into the edges of the felspar phenocrysts.

(ii) Amphibole.

Amphibole occurs as various sized crystals (up to 0.5 mm) both as parallel groups of fibres and as veinlets cutting and replacing the groundmass. It is often dark owing to the minute specks of sphene which are associated with it. Where it is clear it is seen to be the blue, soda, variety either arfvedsonite or glaucophane, probably the former. It forms about 15% of the rock.

Paragenesis:

The amphibole is distinctly later than the quartz.

RHYOLITE

The rock has been very badly altered but it has the appearance of having been a rhyolite. This is however, rather uncertain. The alteration has been the development of chlorite, amphibole and pyrite.

Handspecimen:

A dark grey to black, mottled rock showing hornblende. It is fairly well mineralized with pyrite.

Thin Section:

Structure.

The structure is aplitic, very fine grained, and now practically obliterated by alteration.

Original Minerals.

The original rock probably consisted of fine grained quartz and feldspar. It has been so badly altered as to be almost indistinguishable.

Alteration:

(i) Chlorite.

Chlorite occurs as large irregular, isotropic greenish masses, shot through with tremolite needles. It forms about 40% of the section.

(ii) Sericite.

A very few flakes of sericite were observed.

(iii) Amphibole.

Amphibole, in the form of tremolite or actinolite, occurs very abundantly throughout the section as small blades and groups of fibres. There are several long thin needles of actinolite which appears to be later than the rest of the amphibole. Altogether the actinolite forms about 55% of the section.

Opaque Minerals.

(i) Pyrite.

Pyrite occurs as several large, well-shaped crystals throughout the section. It forms about 5% of the rock.

Paragenesis:

The paragenesis of the secondary minerals is:- Sericite, chlorite, actinolite and pyrite.

RHYOLITE

The rock is seen to be a very fine grained rhyolite, highly altered by the formation of biotite, calcite, sericite, ilmenite and pyrite.

Handspecimen:

A dark grey mottled rock showing quartz and biotite. It is very fine-grained and fairly well mineralized with pyrite.

Thin Section:

Structure.

The rock has a very fine-grained texture.

Original Minerals:

The rock is almost cryptocrystalline, (less than .01 mm). It is probably composed of quartz and felspar. This cryptocrystalline material makes up about 50% of the section.

Alteration:

(i) Biotite.

Secondary biotite occurs as large bleached crystals and as little nests of crystals, closely associated with calcite. Biotite makes up about 15% of the rock.

(ii) Calcite.

Calcite occurs as irregular patches replacing the original minerals and the biotite. It comprises about 5% of the rock.

(iii) Sericite.

Sericite forms about 20% of the rock and occurs as minute dust like flakes plus a few larger crystals. It apparently replaces original orthoclase.

Opaque Minerals:

(i) Pyrite.

Pyrite occurs as well shaped crystals scattered throughout the section.

It forms about 5% of the rock.

(ii) Ilmenite.

Several crystals of ilmenite occur throughout the section. They are altered around the edges to leucoxene.

Paragenesis:

The paragenesis of the secondary minerals is:-
Biotite, sericite, calcite, ilmenite, leucoxene, and pyrite.

TREMOLITE ROCK.

This rock has been so badly altered to tremolite and sericite, that no remnant of the original rock could be seen.

Handspecimen:

A light grey rock showing many groups of coarse radiating tremolite crystals.

It is well mineralized by pyrite, pyrrhotite, and chalcopyrite.

Thin Section:

Structure - obliterated.

Original Minerals - None.

Alteration:

(i) Tremolite.

Tremolite makes up most of the rock, at least 55%. It occurs as colourless radiating groups of acicular crystals, about 0.5 mm. long by 0.1 mm wide as a maximum.

(ii) Sericite.

Sericite occurs as small flakes and crystals up to 0.25 mm. size. It is often intergrown with the tremolite and forms about 40% of the rock.

(iii) Chlorite.

Chlorite occurs very sparingly, only two small masses having been observed.

Opaque Minerals:

(i) Pyrrhotite & Chalcopyrite.

Pyrrhotite occurs associated with chalcophryite between the tremolite fibres and apparently later than the tremolite. No pyrite was observed in the section. The pyrrhotite and the chalcophryite together make up about 5% of the rock.

Paragenesis:

The paragenesis is indefinitely shown but probably is:- Sericite, chlorite, tremolite and the sulphides.

The abundant sericite suggests original orthoclase and from its location the rock is probably a completely altered rhyolite.

SYENITE PORPHYRY

The rock is seen to be a syenite porphyry, altered by the formation of biotite, chlorite, calcite and sulphides.

Handspecimen:

A black porphyritic rock showing phenocrysts of plagioclase and flakes of biotite. It is sparsely mineralized by pyrite and chalcopyrite.

Thin Section:

Structure.

The structure is porphyritic, the texture poikilitic and the fabric hiatal.

Original Minerals:

(a) Groundmass.

The groundmass is fine-grained (0.05 to 0.2 mm) and is composed of plagioclase and orthoclase in about equal proportions. It makes up about 15% of the section.

(b) Phenocrysts.

(i) The phenocrysts are of large size (1.0 to 3.0 mm) and are composed of plagioclase, both albite and oligoclase. These phenocrysts make up about 60% of the section.

(ii) Biotite.

Abundant brown biotite occurs throughout the section as nests of medium sized crystals. It is very slightly altered to chlorite and contains many small zircons in places. These zircons may be epidote in part, but as they were all surrounded by a pleochroic halo they are called by the former name. Some of the biotite occurs embedded in the felspar phenocrysts which phenomenon gives rise to the poikilitic structure.

Much of the biotite appears to be primary, but in places it is undoubtedly secondary. It probably occurs as both primary and secondary, and makes up about 20% of the rock.

Alteration:

(i) Biotite.

As mentioned above, some of the biotite is secondary but the proportion is indefinite.

(ii) Calcite.

A very little calcite was observed as small irregular masses replacing the felspar.

(iii) Chlorite.

Chlorite was observed associated with pyrite in veinlets butting the groundmass, phenocrysts, and in places the biotite. Those veinlets which cut the biotite had either none or only a very little pyrite.

The veinlets were arranged either with pyrite in the centre and chlorite along the edges or vice versa.

CORE #21 (Cont.)

The chlorite forms about 3% of the section.

Opaque Minerals:

(i) Pyrite.

Pyrite occurs in veinlets associated with chlorite as described above, and also as scattered crystals throughout the section. It forms about 2% of the section.

Paragenesis:

The paragenesis of the secondary minerals is:-
Biotite, calcite, chlorite and pyrite.

BIOTITE ROCK

The section is composed almost entirely of biotite. It is probably that it was originally a rhyolite.

Handspecimen:

The rock is dark coloured, coarse grained and is composed of biotite crystals. It is well mineralized with pyrite and chalcopyrite.

Thin Section:

Structure - Obliterated.

Original Minerals:

One small remnant of the original rock was observed, near the edge of the section. It was seen to consist of two fairly large crystals of orthoclase.

Alteration:-

v (i) Biotite.

The biotite occurs as crystals from 0.25 to 0.8 mm. in size. The crystals are all matted together in an irregular manner.

Much of the biotite contains small zircons surrounded by the characteristic halo. The mica is brown and pleochroic and in a few places is very slightly altered to chlorite.

It makes up about 95% of the rock, and is distinctly secondary as it is seen to be replacing orthoclase where the latter is visible.

Opaque Minerals:

(i) Pyrite and Chalcopyrite.

Pyrite and chalcopyrite make up about 5% of the section. They occur as crystals and grains throughout the rock and were apparently the last minerals formed.

The remnant of orthoclase suggests that the rock was originally a rhyolite but this is very uncertain.

AUGITE SYENITE PORPHYRY

The rock has in this case more nearly the composition of a true syenite porphyry. The alteration has also been unusually slight.

Handspecimen:

The rock is dark grey to black in colour and has a porphyritic texture. It is fairly coarse-grained and shows feldspar, biotite and pyroxene. It has been sparsely mineralized by pyrite and chalcopyrite.

Thin Section:

Structure.

The structure is porphyritic and the fabric hiatal.

Original Minerals:

(a) Groundmass:

The groundmass is fairly coarse grained (0.25 mm) and composed of plagioclase and orthoclase in about equal proportions. It makes up about 10% of the section.

(b) Feldspar.

The feldspar phenocrysts range in size from 1.0 to 5.0 mm. They are composed of albite (optically positive) and make up about 60% of the rock.

The feldspar phenocrysts show good crystalline outlines.

(ii) Aegirine-Augite.

Aegirine-augite occurs as well shaped crystals from 0.5 to 2.5 mm. in size. It presents idiomorphic outlines to all other primary minerals except sphene. It forms about 25% of the rock.

(iii) Sphene.

Two large, euhedral, twinned, crystals of sphene were observed.

The order of crystallization of the original minerals was: Sphene, pyroxene and feldspar.

Alteration:

(i) Biotite.

Biotite occurs as large (up to 0.5 mm) greenish brown crystals replacing the groundmass and phenocrysts of both pyroxene and feldspar. It forms about 4% of the rock.

(ii) Calcite.

Calcite occurs in very minor amount, as small masses and stringers replacing the feldspars.

(iii) Amphibole.

Amphibole is of the blue variety, probably arfvedsonite. It occurs as parallel needles replacing the pyroxene along cleavage cracks and to a lesser extent replacing the feldspar. It forms about 1% of the rock.

Paragenesis:

The paragenesis of the secondary minerals is:-
Biotite, Calcite, and Amphibole.

SYENITE PORPHYRY

While the thin section appears to have a hypidiomorphic structure it is probable that the rock is coarsely porphyritic. It is seen to be a syenite porphyry, now altered by the formation of quartz, calcite, sericite and blue amphibole.

Handspecimen:

Missing.

Thin Section:

Structure.

A hypidiomorphic structure only, is seen in this section but it is probable that the rock has a panidiomorphic structure.

Original Minerals:

(i) Felspars.

Plagioclase occurs as large crystals, up to 8 mm in size. It is probably albite or andesine as it is optically positive.

It forms about 70% of the rock.

(ii) Biotite.

Primary biotite occurs throughout the section as crystals up to 0.3 mm. in size. It is associated with blue amphibole and calcite and forms about 10% of the section.

(iii) Apatite.

Several large allotriomorphic crystals of apatite were observed.

(iv) Sphene.

Sphene occurs throughout the section as large well shaped crystals.

The order of formation of the original minerals was:- Sphene, Apatite, biotite and felspars.

Alteration:

(i) Calcite.

Calcite occurs as irregular masses and stringers throughout the section, chiefly replacing felspars, but also associated with the biotite and the amphibole.

(ii) Silicification.

Secondary silica occurs replacing the felspar crystals around their margins. It is only present in small quantity.

(iii) Amphibole.

The variety arfvedsonite occurs as large fibrous crystals up to 2.0 mm. in size. It has the appearance of having replaced aegerine augite although none of the latter is now present. It is often associated with calcite and biotite.

Paragenesis:

The paragenesis of the secondary minerals is:- Calcite, Quartz and Amphibole.

SYENITE PORPHYRY*white*

The rock might be called a mica syenite porphyry. In thin section it appears to be a syenite ~~with the~~ handspecimen clearly shows the porphyritic structure. It has been altered by the formation of calcite and amphibole.

Handspecimen:

The rock is light greyish in colour, with a porphyritic structure and shows large phenocrysts of orthoclase. Hornblende, biotite, and sphene are also visible.

Thin Section: Structure.

The slide shows granitic structure and the relations between the biotite, sphene and feldspar give the rock a poikilitic texture.

Original Minerals:

(i) Feldspar.

Feldspar now forms about 30% of the rock. It consists of both orthoclase and albite in crystals from 1.0 to 2.0 mm. in size. The feldspar crystals enclose crystals of biotite and sphene giving rise to the poikilitic structure.

(ii) Biotite.

Biotite forms about 20% of the section. It occurs as large crystals, up to 0.5 mm. in size of the brown pleochroic variety.

(iii) Sphene.

The section is unusually rich in sphene being about 20% this mineral. It occurs as large well shaped crystals up to 1.0 mm. in size, many of them showing the characteristic twinning.

(iv) Black iron ore.

Black iron ore occurs as little black specks scattered throughout the section, generally associated with sphene.

(v) Apatite.

Apatite occurs throughout the slide as irregular masses, often associated with the feldspar. It forms about 2% of the rock.

The order of formation of the primary constituents is:- Apatite, sphene, black iron ore, biotite, and feldspars.

Alteration:

(i) Calcite.

A few stringers of calcite were observed replacing the feldspars. It also occurs associated with the amphibole and probably contemporaneous with it.

(ii) Amphibole.

The amphibole is of the blue variety, arfvedsonite, and forms about 30% of the section.

CORE #25 (Cont.)

It occurs as large fibrous crystals, up to 1.0 mm. in size, often associated with calcite, and sometimes as parallel growth with the biotite. In places it appears to be primary, but is probably secondary and replacing aegerine, although none of the latter mineral was noticed.

BADLY ALTERED TRACHYTE OR RHYOLITE

The rock is so badly altered that its original character is uncertain but the presence of quartz makes it seem likely that it was a rhyolite. It is now largely altered to tremolite & biotite.

Handspecimen:

The rock is dark coloured, mottled grey and black, fine grained, and shows tremolite in places. It is well mineralized with pyrite.

Thin Section:

Structure - Indistinguishable.

Original Minerals:

(i) Felspar.

A little plagioclase and orthoclase were observed. They occur as crystals up to about 0.25 mm. maximum size and form about 5% of the rock. They have the appearance of having been re-crystallized.

(ii) Quartz.

Quartz occurs as fairly large grains, chiefly associated with the pyrite. It forms about 5% of the rock and appears to be a remnant of the original material.

Alteration:

(i)

Biotite.

Two large, badly bleached crystals of brown biotite were observed. They form about 5% of the rock. In addition to this biotite occurs as small flakes intergrown with the tremolite.

(ii) Tremolite.

Tremolite occurs as radiating fibres up to 0.8 mm long. It is intergrown with small flakes of badly bleached biotite. The tremolite and flaky biotite make up about 60% of the section.

(iii) Chlorite.

Much of the material throughout the section appears to be isotropic and has the appearance of chlorite. It forms about 10% of the section.

(iv) Epidote.

A few scattered, granular masses of epidote were observed. It makes up about 2% of the section.

Opaque Minerals:

(i) Pyrite and a little chalcopyrite occur as veinlets and scattered crystals throughout the section. They make up about 10% of the rock.

Paragenesis:

The paragenesis of the secondary minerals appears to be: - Biotite, Chlorite, Epidote, Tremolite, and Pyrite.

RHYOLITE

The rock is seen to be a rhyolite, probably the centre of a thick flow, and altered by the formation of biotite, chlorite and a little amphibole.

Handspecimen:

The rock is dark grey to black, mottled and fine grained. It shows quartz and is fairly well mineralized by pyrite, plus a little chalcopyrite.

Thin Section:

Structure.

The structure is porphroid approaching aplitic and the crystals are fairly even grained. (From 0.1 to 0.4 mm. in size)

Original Minerals:

Quartz and orthoclase occur in about the proportion of four to one. Together they make up about 60% of the section.

Alteration:

(i) Biotite.

Biotite occurs abundantly as nests of small crystals forming about 20% of the section. It is now badly altered to chlorite.

(ii) Chlorite.

Chlorite occurs replacing the biotite, as ~~being~~ cutting both quartz and felspar, and as scattered crystals. It makes up about 20% of the section.

(iii) Amphibole.

Actinolite occurs as radiating needles replacing quartz, felspar and occasionally biotite. It is only present in minor amounts.

Opaque Minerals:

(i) Pyrite.

Pyrite occurs sparingly as scattered crystals throughout the section.

Paragenesis:

The paragenesis of the secondary minerals is:-
Biotite, chlorite, tremolite and pyrite.

TRACHYTE

The rock is seen to be a typical trachyte altered by the formation biotite, calcite, amphibole, sericite and pyrite.

Handspecimen:

The rock is mottled, black and greenish-white, with a porphyritic structure. The groundmass is black and the phenocrysts greenish-white, of medium size, and apparently plagioclase. It is mineralized by a very few specks of pyrite.

Original Minerals.

(a) Groundmass.

The groundmass is composed of a cryptocrystalline mosaic of feldspars with possibly a little quartz. The grains range in size from 0.01 to 0.05 and form about 40% of the section.

(b) Phenocrysts.

(i) Feldspar.

Large idiomorphic crystals of plagioclase make up about 35% of the section. They range in size from 0.5 to 1.5 mm. They are composed of both albite and oligoclase.

(ii) Apatite.

Apatite occurs abundantly as small idiomorphic crystals.

(iii) Black Iron Ore.

Ilmenite occurs as small crystals throughout the section. It is altered around the edges to leucoxene.

Alteration:

(i) Biotite.

Several large crystals of biotite occur, ranging in size from 0.25 to 0.5 mm.

They are badly altered by calcite and contain numerous specks of black iron ore, scattered through them. The biotite forms about 15% of the section.

(ii) Calcite.

Calcite occurs as irregular masses and veinlets replacing the groundmass and the biotite. It forms about 5% of the rock.

(iii) Amphibole.

Blue Amphibole, either reibeckite or arfvedsonite, occur as fibrous patches throughout the groundmass associated with calcite and biotite. It probably replaces original aegerine. It now forms about 5% of the rock.

(iv) Sericite.

A few flakes of sericite were observed replacing the feldspar phenocrysts.

CORE #28 (cont)

Opaque Minerals:

(i) Black iron ore.

As indicated above, black iron ore occurs both primary and as an alteration product of biotite. Some of it shows alteration to leucoxene.

(ii) Pyrite.

Pyrite occurs sparingly as a few scattered crystals.

Paragenesis:

The paragenesis of the secondary minerals is:-
Biotite, Calcite, Sericite, Amphibole and Pyrite.

SYENITE PORPHYRY

The rock is seen to be an acid variety of syenite porphyry. It has been altered by the formation of biotite, calcite, tremolite and pyrite.

Handspecimen:

The rock is light grey in color and has a porphyritic texture. It contains phenocrysts of plagioclase and microperthite, and is sparsely mineralized by pyrite.

Thin Section:

Structure.

The structure is coarsely porphyritic and the fabric hiatal.

Original Minerals:

(a) Groundmass.

The groundmass is a coarse mosaic of orthoclase and plagioclase, ranging in size from 0.05 to 0.05 mm. with an average of 0.25 mm. It now makes up about 30% of the section.

(b) Phenocrysts.

(i) Felspars.

The felspar phenocrysts are of large size (from 1.0 mm to 2.5 mm) and form about 60% of the section. They are composed of albite and oligoclase and often show a microperthitic structure.

(ii) Black Iron Ore.

Ilmenite occurs as small grains throughout the section and is generally surrounded by a ring of leucoxene.

Alteration:

(i) Biotite.

Biotite occurs as small flakes and stringers throughout the section. It forms possibly 1% of the rock.

(ii) Calcite.

Calcite occurs as fairly large irregular masses throughout the groundmass and also associated with biotite in the stringers. It forms about 10% of the section.

(iii) Tremolite.

A very few small blades of tremolite, were observed.

Opaque Minerals:

(i) Black Iron Ore.

Ilmenite occurs as indicated above.

(ii) Pyrite.

Pyrite was seen to occur in moderate amount as large crystals.

Paragenesis:

The paragenesis of the secondary minerals is:- Biotite, Calcite, Tremolite and pyrite.

RHYOLITE

The rock is seen to be a rhyolite, altered by the formation of quartz, chlorite, epidote, sericite, amphibole and pyrite.

Handspecimen:

The rock is dark grey to black mottled, fine-grained and shows quartz and chlorite. It is cut by chlorite-epidote veinlets and is sparsely mineralized by specks of pyrite.

Thin Section:

Structure.

The structure is porphyritic and very fine grained, the fabric is seriate.

Original Minerals:

(a) Groundmass.

The groundmass is composed of a very fine grained mosaic of quartz and possibly a little orthoclase. The grains occur up to 0.04 mm. maximum size. The groundmass forms about 30% of the section.

(b) Phenocrysts.

Several small phenocrysts (0.4 mm) were observed. They are made up of groups of quartz crystals and form about 5% of the section.

Alteration:

(i) Silicification.

Secondary silica occurs in several narrow veinlets cutting the section.

(ii) Chlorite.

Chlorite occurs as irregular masses and plates scattered through the groundmass. It forms about 10% of the section.

(iii) Epidote.

Epidote forms about 15% of the section. It occurs as granular masses throughout the groundmass, and is of two varieties, iron-rich, yellow, allanite and ordinary, colourless epidote. The allanite is earlier than the ordinary epidote.

(iv) Amphibole.

The amphibole is green pleochroic hornblende. It occurs as short prisms, sometimes twinned, and rarely as radiating needles, throughout the groundmass. It forms about 25% of the section.

(v) Sericite.

Several flakes of sericite were observed scattered throughout the groundmass and probably representing original orthoclase. They form about 10% of the section.

Opaque Minerals.

(i) Pyrite.

Pyrite occurs as medium-sized crystals scattered through the section.

Paragenesis:

The paragenesis of the secondary minerals is:- Quartz, sericite, chlorite, epidote, hornblende and pyrite.

SYENITE PORPHYRY

The rock has a hypidiomorphic texture in this section, but the handspecimen shows it to be porphyritic. Due to the amount of biotite present it might be called a mica syenite porphyry. It has been altered by the formation of calcite, amphibole and pyrite.

Handspecimen:

The rock is light grey in colour and has a porphyritic texture with a coarse grained groundmass and one large phenocryst of orthoclase. It shows biotite and hornblende but no mineralization.

Thin Section:**Structure.**

The structure is granitic, the section being so cut that no phenocrysts appear.

Original Minerals:**(i) Felspar.**

Large lath shaped crystals of plagioclase form 70% of the felspar, orthoclase forming 20% and microcline 10%. Together they make up about 65% of the rock and range in size from 0.5 to 1.0 mm.

(ii) Biotite.

Biotite occurs as large crystals, from 0.25 to 1.0 mm. in size, scattered throughout the section and altered in places to chlorite.

It forms about 10% of the section.

(iii) Apatite.

Apatite occurs as irregular masses up to 0.3 mm. in size.

Alteration:**(i) Chlorite & Epidote.**

Chlorite and epidote occur together in about equal proportions replacing both felspar and biotite, and as patches throughout the section. They form about 5% of the section.

(ii) Calcite.

Calcite occurs sparingly as small irregular masses throughout the section.

(iii) Amphibole.

The amphibole is the variety arfvedsonite, and forms about 22% of the section. It occurs as fibrous patches up to 0.75 mm. in size and rarely as radiating needles. It is distinctly secondary and the last mineral formed.

Opaque Minerals:**(i) Pyrite.**

Pyrite occurs throughout the section as large crystals. It forms about 2% of the section. This is surprising as no pyrite was seen in the handspecimen.

CORE #31 (Cont.)

Paragenesis:

The paragenesis of the original mineral is:- Apatite, biotite, and feldspars. Of the secondary minerals it is:- Calcite, chlorite epidote, amphibole and pyrite.

ROCK #1

RHYOLITE

The rock is seen to be a rhyolite from the centre of a thick flow. It has been altered by the formation of sericite and chlorite and mineralized with a little pyrite.

Handspecimen:

The rock is dark grey to black in colour, highly siliceous and fine grained. It shows quartz and is sparsely mineralized with specks of pyrite.

Thin Section.

Structure.

The structure is porphroid, tending to aplastic and the fabric is seriate.

Original Minerals:

The original minerals consist of quartz 65% and felspar 35%. The felspar is both orthoclase and plagioclase. Together these minerals make up about 60% of the section. They occur as a fairly coarse, more or less even grained mosaic. The grains range from 0.05 to 0.2 mm. in size.

Alteration:

(i) Chlorite and Sericite.

Chlorite and sericite together, make up about 40% of the rock.. They occur in about equal proportions intergrown, with the sericite slightly earlier than the chlorite. They are found chiefly between the grains of the original rock, but also replacing them and as masses and veinlets throughout the section

Opaque Minerals:

(i) Pyrite.

A few scattered crystals of pyrite were observed.

ROCK #2

RHYOLITE

The rock is seen to be a rhyolite, probably from the centre of a thick flow. It has been altered by the formation of biotite, sericite, calcite, chlorite, epidote and pyrite.

Handspecimen:

The rock is dark grey to black in colour mottled, fine grained, and highly siliceous. It shows quartz, felspar, and biotite and is sparsely mineralized with specks of pyrite. It also has one slickensided surface.

Thin Section:

Structure.

The structure is porphorid, tending to aplitic and the ~~matrix~~ ^{f b} is seriate.

Original Minerals:

Quartz and orthoclase represent the original minerals and form about 75% of the section. They occur in about equal proportions as a massaic of allotrimorphic crystals ranging in size from 0.1 to 0.2 mm. y

Alteration:

(i) Biotite.

Biotite occurs sparingly as medium sized, irregular, brown crystals. It forms about 5% of the rock.

(ii) Calcite.

One large irregular mass and a few minute specks of calcite were observed.

(iii) Sericite.

Sericite occurs as small flakes both alone and intergrown with chlorite. Much of it probably represent original orthoclase. It forms about 5% of the section.

(iv) Chlorite.

Chlorite forms about 7% of the section and occurs associated with sericite and epidote as small flakes and patches.

(v) Epidote.

Epidote forms about 7% of the section. It occurs as granular masses both alone and associated with the chlorite.

Opaque Minerals:

(i) Pyrite.

Pyrite occurs as scattered crystals forming about 1% of the section.

Paragenesis:

The paragenesis of the secondary minerals is:- Biotite, calcite, sericite, chlorite, epidote, and pyrite.

SYENITE PORPHYRY

The rock is seen to be a syenite porphyry which has been altered by the formation of calcite, epidote tremolite and pyrite. It has also been intruded by an acid pegmatite in a similar manner to core #3.

Handspecimen:

The rock is dark grey in colour and is porphyritic, with phenocrysts of orthoclase, up to 1 inch in length, in a groundmass of felspar, biotite, and epidote. It is very poorly mineralized by a few specks of pyrite.

Thin Section:

Structure.

The structure is coarsely porphyritic and the fabric seriate.

Original Minerals:

(a) Groundmass.

The groundmass is composed of plagioclase, 80% and orthoclase and microcline 20%. The felspars occur as fairly coarse crystals, the plagioclase as laths. The size ranges up to 0.25 mm. The groundmass makes up about 15% of the section.

(b) Phenocrysts.

(i) Felspar.

The felspar phenocrysts form about ⁴⁵~~54~~% of the section and range in size up to 1.0 mm. They are composed either of albite or andesine, probably the former.

(ii) Biotite.

Biotite occurs as medium sized crystals., throughout the groundmass. It is the brown pleochroic variety and forms about 5% of the section. The crystals range in size up to 0.25 mm.

(iii) Sphene and apatite.

Sphene and apatite occur as small crystals scattered throughout the section.

The order of crystallization of the original minerals was :- apatite, sphene, biotite and felspars.

Alteration:

(i) The rock has been intruded by pegmatitic quartz and orthoclase apparently in a plastic condition. This intrusion shows in the section as tongues of the pegmatitic material replacing and including the original minerals. It forms about 15% of the section.

ROCK #3 (cont)

(ii) Calcite.

Calcite occurs as irregular masses replacing the groundmass. It forms about 15% of the section.

(iii) Epidote.

Epidote occurs sparingly as granular masses throughout the groundmass.

(iv) Amphibole.

The amphibole is the blue variety, probably arfvedsonite. It occurs as fibrous patches and radiating needles throughout the groundmass. It forms about 5% of the section.

Opaque Minerals:

(i) Pyrite.

Pyrite occurs in minor amount as crystals scattered through the section.

Paragenesis:

The paragenesis of the secondary minerals is:- Pegmatitic intrusion, ~~calcite~~ calcite, epidote, ~~amphibole~~ amphibole and pyrite.
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ROCK #4

RHYOLITE

The rock is seen to be a rhyolite altered by the formation of biotite, quartz, chlorite, epidote, amphibole and pyrite.

Handspecimen:

The rock is very dark greyish-green in colour and fine grained. It shows quartz and is traversed by epidote veins. It is sparsely mineralized by specks of pyrite.

Thin Section:

Structure.

The structure is porphyritic, though fine-grained, and the fabric is roughly seriate.

Original Minerals:

(a) Groundmass.

The groundmass is very fine grained, almost cryptocrystalline, the size ranging from less than 0.01 mm to 0.04 mm.

It is composed of quartz 90% and orthoclase 10% the two minerals forming a mosaic and together comprising about 30% of the section.

(b) Phenocrysts.

The phenocrysts are of various sizes from 0.1 to 0.4 mm and form about 20% of the rock. They are apparently composed entirely of quartz.

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Alteration:

(i) Biotite.

Biotite occurs as a few small flakes throughout the groundmass. It appears to be secondary and is badly altered to chlorite.

(ii) Silicification.

A few stringers of quartz were observed cutting the rock. They form about 5% of the section.

(iii) Chlorite.

Chlorite occurs as a very few small flakes altering the biotite.

(iv) Epidote.

Epidote occurs as granular masses throughout the section and in veinlets associated with tremolite. Much of it is allanite which appears to be slightly earlier than the ordinary kind. Epidote forms about 25% of the section.

(v) Amphibole.

The amphibole is pale green actinolite and occurs as radiating fibres and associated with epidote in veinlets. It forms about 20% of the section.

Opaque Minerals:

(i) Pyrite.

A few small crystals of pyrite were observed.

ROCK #4 (cont)

Paragenesis:

The paragenesis of the secondary minerals is :- Biotite, quartz, chlorite, epidote, amphibole and pyrite.

ROCK #5

RHYOLITE

The rock appears to have been a rhyolite. It is now badly altered by the formation of epidote and actinolite with a little quartz, biotite, chlorite, and pyrite.

Handspecimen:

The handspecimen shows the contact between the rhyolite and a syenite porphyry. The rhyolite is highly altered to a greenish mass, cut by darker green epidote veins and small veinlets of the dyke material. Both syenite and rhyolite are very poorly mineralized with specks of pyrite.

Thin Section:

Structure.

The original structure is practically obliterated but it gives the impression of having been porphyritic.

Original Minerals:

The only original mineral observed was quartz. It occurs as grains up to 0.1 mm as a maximum size and forms about 10% of the section.

Alteration:

(i) Biotite.

A very few small crystals of biotite were observed. It is now badly altered to chlorite.

(ii) Silicification.

Secondary quartz occurs in veinlets cutting the section. It occurs as allotrimorphic grains up to 0.2 mm in size and forms about 10% of the section.

(iii) Chlorite.

Chlorite occurs as flakes and tabular crystals throughout the section and replacing biotite. It forms about 5% of the section.

(iv) Epidote.

Epidote forms about 40% of the ^{ro}ck. It occurs as granular masses and is light coloured variety.

(v) Amphibole.

The amphibole is pale ^green actinolite and forms about 35% of the section.

It occurs as blades and radiating fibres.

Opaque Minerals:

(i) Pyrite.

Pyrite occurs as small crystals scattered through the section.

Paragenesis:

The paragenesis of the secondary minerals is:- Biotite, quartz, chlorite, epidote, actinolite and pyrite.

RHYOLITE

The rock is seen to be a rhyolite now badly altered by the formation of quartz and epidote with a little calcite, chlorite, cericite and pyrite.

Handspecimen:

The rock is grey and green mottled in colour and is fine grained. It shows epidote in veinlets and patches, and quartz in veinlets. It is sparsely mineralized with pyrite.

Thin Section:

Structure.

The structure is porphyritic, possibly amygdaloidal, and the fabric is seriate.

Original Minerals:

(a) Groundmass.

The groundmass is a very fine grained mosaic of quartz 90% and orthoclase 10%. It forms about 20% of the section.

(b) Phenocrysts.

Quartz occurs as phenocrysts up to 0.5 mm. in size and forms about 10% of the section.

Alteration:

(i) Quartz.

Several large quartz veins cut the section. The quartz in the veins is coarsely crystalline and forms about 20% of the section.

(ii) Calcite.

Calcite occurs as irregular masses throughout the section and along cracks in the quartz veins. It forms about 5% of the section.

(iii) Sericite.

A few small flakes were observed throughout the section.

(iv) Chlorite.

Chlorite occurs as flakes and associated with epidote.

(v) Epidote.

The epidote occurs throughout the section as irregular granular masses and veinlets. It is mostly the colourless to brownish variety but around the pyrite it changes to deep yellow allanite. It forms about 30% of the section.

(vi) Actinolite.

Actinolite occurs as fibrous patches and radiating groups of needles forming about 10% of the section.

Opaque Minerals:

(i) Pyrite.

ROCK #6 (cont)

Pyrite forms about 5% of the section and occurs as large scattered crystals associated with the epidote. The crystals range in size up to 1 mm.

Paragenesis.

The paragenesis of the secondary minerals is:-
Quartz, calcite, sericite, chlorite, epidote actinolite and pyrite.

ROCK #8

RHYOLITE

The rock is seen to be a rhyolite, probably from the centre of a thick flow. It is altered by the formation of biotite, sericite, chlorite, amphibole, pyrite and sphaelerite.

Handspecimen:

The rock is grey coloured, fine grained, and highly siliceous. It shows quartz grains and is fairly well mineralized by specks of pyrite. The handspecimen also shows a slickensided surface.

Thin Section:

Structure.

The structure is porphyroid, tending to aplitic and the fabric is seriate.

Original Minerals:

The original rock was composed of quartz 65% and orthoclase 35%. They formed a mosaic of grains of an average size of about 0.25 mm. The orthoclase is now almost completely altered to sericite and the remaining quartz forms about 55% of the section.

Alteration:

(i) Biotite.

Secondary brown biotite forms about 4% of the section. It occurs as crystals up to 0.25 mm. in size scattered through the section.

(ii) Sericite.

Sericite occurs as flakes and aggregates of small crystals throughout the rock, probably replacing original orthoclase. Sometimes it is intergrown with chlorite. It forms about 30% of the section.

(iii) Chlorite.

Chlorite occurs as small flakes throughout the section, of which it forms about 3%

(iv) Amphibole.

The amphibole is green pleochroic hornblende and occurs as nests of small crystals and as fibres replacing the other minerals. It forms about 8% of the section.

(v) Sphaelerite.

Two small crystals of zinc blende were observed. They were recognized by their yellow colour, their high index of refraction and their isotropic behavior under crossed nicols.

Opaque Minerals.

(i) Pyrite.

Pyrite occurs in fair amount as crystals up to 0.15 mm in size.

(ii) Black iron ore.

A few small crystals of black iron ore were

ROCK #8 (cont)

observed.

Paragenesis:

The paragenesis of the secondary minerals appears to be:- Biotite, sericite, chlorite, amphibole and sulphides.

SYENITE PORPHYRY

The rock might be called a mica syenite porphyry. It has been altered by the formation of sericite, chlorite, calcite, actinolite, leucoxene and pyrite.

Handspecimen:

The rock is dark grey in colour and has a porphyritic texture. It shows small specks of pyrite. It has a slickensided surface.

Thin Section:

Structure.

The structure is panidiomorphic and the fabric is seriate.

Original Minerals:

(a) Groundmass.

The groundmass is composed of jumbled laths of albite with a little quartz and some microcline. It is fairly coarse grained, and the crystals ranging in size from 0.1 to 0.25 mm. It forms about 20% of the rock.

(b) Phenocrysts.

(i) Felspar.

The felspar phenocrysts are of large size ranging from 0.5 to 1.0 mm, and form about 40% of the rock. They are composed mostly of albite but some microcline is seen.

(ii) Biotite.

Biotite forms about 15% of the rock. It occurs as large crystals (up to 0.25 mm in size) and is both brown and green in colour. The green is probably due to chloritic alteration.

(iii) Apatite.

One large irregular grain and several small crystals of apatite were observed.

(v) Ilmenite.

Ilmenite occurs throughout the section as many small specks. It is altering around the edges to leucoxene.

Alteration:

(i) Calcite.

Calcite forms about 2% of the section. It occurs as irregular masses often replacing biotite and sometimes intergrown with chlorite.

(ii) Sericite.

Sericite forms about 10% of the section. It occurs as flakes replacing felspar and as nests of larger crystals throughout the section.

(iii) Chlorite.

Chlorite forms about 5% of the rock. It occurs as flakes throughout the section, after intergrown

ROCK #9 (cont)

with calcite; and has a strong tendency to replace biotite.

(iv) Leucoxene.

Leucoxene forms about 3% of the section. It occurs as granular masses, largely replacing biotite, and associated with chlorite in veinlets.

(v) Amphibole.

Actinolite occurs very sparingly as radiating needles. It forms parallel growths with the biotite and often replaces calcite.

Opaque Minerals:

(i) Ilmenite.

Ilmenite occurs as mentioned above.

(ii) Pyrite.

Pyrite occurs sparingly as small scattered crystals.

Paragenesis:

The paragenesis of the secondary minerals is:- Calcite, sericite, chlorite, leucoxene, actinolite and pyrite.

RHYOLITE

The rock is seen to be a rhyolite with a strong tendency to form amygdules. It is altered by the formation of biotite, quartz, chlorite, calcite actinolite and pyrite.

Handspecimen:

The rock is black, very fine grained and silicious. It shows flakes of biotite, and it cut by quartz veins. It is well mineralized with pyrite.

Thin Section:

Structure.

The structure appears to be amygdaloidal but this is rather indefinite.

Original Minerals:

(a) Groundmass.

The groundmass is made up of a mosaic of quartz grains, probably with a little orthoclase. The grains range in size from 0.05 to 0.25 mm. and make up about 40% of the section.

(b) Amygdules.

The "amygdules" form about 10% of the rock and are filled with quartz grains. They occur up to 0.5 mm. in size.

Alteration:

(i) Biotite.

Biotite forms about 10% of the section. It occurs as large nest (up to 1mm) of small flakes and has isolated crystals. It is both brown and green. The latter probably owes its colour to chlorite alteration. It is badly altered to chlorite in places.

(ii) Silicification.

Secondary quartz occurs in veins cutting the section. The veins form about 15% of the section.

(iii) Calcite.

Calcite occurs sparingly as small irregular masses.

(iv) Chlorite.

Chlorite forms about 20% of the section. It occurs replacing the biotite, in veinlets, and as flakes between the quartz grains.

(v) Actinolite.

Actinolite occurs as small needles scattered through the section. It forms at the most 1% of the section.

Opaque Minerals:

(i) Pyrite.

Pyrite occurs as large crystals up to 1.0 mm in size and forms about 5% of the rock.

Paragenesis:

The paragenesis of the secondary minerals is:-
Biotite, quartz, calcite, chlorite, actinolite, pyrite

TRACHYTE

The rock appears to be a trachyte, originally vesicular, the vesicles now filled with chlorite. It has been altered by the formation of chlorite, epidote actinolite and pyrite.

Handspecimen:

The rock is black, fine grained and shows very small felspar phenocrysts. It is sparsely mineralized by pyrite, pyrrhotite and chalcopyrite.

Thin Section:

Structure.

The structure is seen to be porphyritic.

Original Minerals:

(a) Groundmass.

The groundmass has a pilotaxitic texture, being formed of large narrow laths of plagioclase all jumbled together. They range in size from 0.05 mm. to 0.2mm and form about 50% of the rock.

(b) Phenocrysts.

The phenocrysts form about 20% of the rock. They occur as groups, up to 1.0 mm in size, of albite crystals, and as large single crystals of albite up to 3.0 mm in size. 1c

Alteration:

(i) Chlorite.

Chlorite forms about 20% of the section. It occurs as large masses and small flake throughout the section. Much of it appears to be filling vesicles.

(ii) Epidote.

Epidote forms about 5% of the section and occurs as granular mass and small particles scattered through the rock.

(iii) Actinolite.

Actinolite occurs as small fibres and flakes, often intergrown with chlorite. It forms about 1% of the section.

Opaque Minerals:

(i) Pyrite.

Pyrite occurs as two large masses along one edge of the slide. It forms about 5% of the rock.

Paragenesis:

The paragenesis of the secondary minerals is:- Chlorite and actinolite.

SYENITE PORPHYRY

The rock is seen to be a syenite porphyry altered by the formation of biotite, calcite, sericite, chlorite, epidote and green hornblende.

Handspecimen:

The rock is black, fine grained and porphyritic. It shows small, lath shaped and blunt phenocrysts of feldspar. It is heavily mineralized along one edge by pyrite and chalcopryrite. The handspecimen shows a slickersided surface.

Thin Section:

Structure.

The structure is porphyritic and the fabric is roughly seriate.

Original Minerals:

(a) Groundmass.

The groundmass forms about 80% of the specimen. It is composed of laths of plagioclase and microcline ranging in size from 0.1 to 0.25 mm. The plagioclase is probably oligoclase as most of it is optically negative.

(b) Phenocrysts.

(i) Feldspars.

The phenocrysts form about 25% of the section. They range in size from 0.75 to 1.5 mm. and are composed of oligoclase and microcline.

(ii) Apatite.

Apatite occurs sparingly as small crystals.

Alteration:

(i) Biotite.

Biotite occurs as small flakes and nests of crystals forming about 3% of the section. It is often crowded with small specks of black iron ore. It all appears to be secondary.

(ii) Calcite.

A few small, irregular masses of calcite were observed.

(iii) Sericite (Muscovite)

Sericite forms about 3% of the rock and occurs as flakes and groups of crystals replacing the feldspars.

(iv) Epidote.

Epidote occurs as granular masses forming about 2% of the section.

(v) Hornblende.

Deep green hornblende forms about 8% of the section. It occurs as blades and nests of small crystals, often associated with sericite. It also occurs as a veinlet associated with chlorite.

(vi) Chlorite.

Chlorite occurs as small flakes forming about 2% of the section.

(vii) Feldspar.

Some of the phenocrysts show a secondary growth

ROCK #12a (cont)

of felspar around their margins.

Opaque Minerals:

(i) Pyrite.

A few scattered crystals of pyrite were observed.

Paragenesis:

The paragenesis of the secondary minerals is:-
Biotite, calcite, sericite, chlorite, epidote, horn-
blende and pyrite.

SYENITE PORPHYRY

The rock is seen to be a syenite porphyry low in femic minerals, and altered by the formation of small amounts of sericite, epidote, actinolite and pyrite.

Handspecimen:

The rock is dark grey to black in colour and has a porphyritic texture. It shows feldspar as laths and larger crystals with nearly square outline. It is fairly well mineralized with pyrite. The rock shows a slickersided surface.

Thin Section:

Structure.

The structure is porphyritic and the fabric is roughly seriate.

Original Minerals:

(a) Groundmass.

The groundmass forms about 35% of the section. It is composed of oligoclase, 60% microcline 30% and orthoclase 10%. These feldspars occur as laths and irregular grains ranging in size from 0.03 to 0.1 mm.

(b) Phenocrysts.

The phenocrysts form about 50% of the rock and are composed of oligoclase and microcline. They occur as large crystals ranging in size from 0.75 to 2.0 mm

Alteration:

(i) Sericite (Muscovite)

Sericite occurs as groups of crystals throughout the section. It is often associated with actinolite and forms about 5% of the section.

(ii) Calcite.

A very few irregular grains of calcite were observed.

(iii) Chlorite.

Chlorite forms about 2% of the section and occurs as little patches.

(iv) Epidote.

Epidote occurs scattered through the groundmass as granular patches and forms about 3% of the section.

(v) Actinolite.

Actinolite occurs as needles and flakes, both associated with sericite and epidote, and scattered through the section of which it forms about 3%.

Opaque Minerals:

(i) Pyrite.

Pyrite occurs as crystals up to 0.25 mm. in size and forms about 2% of the section.

Paragenesis:

The paragenesis of the secondary minerals is:-
Sericite, calcite, chlorite, epidote, actinolite, pyrite.

RHYOLITE

The rock is seen to be a rhyolite probably from the centre of a thick flow. It has been altered by the formation of sericite and actinolite with a little biotite and chlorite and mineralized by pyrite, pyrrhotite and chalcopyrite.

Handspecimen:

The rock is light grey in colour, fine grained and highly silicious. It is abundantly mineralized with pyrite and chalcopyrite.

Thin Section:

Structure.

The structure is ~~proph~~^{oph}roid tending to aplitic and the fabric is seriate.

Original Minerals:

The original material is a coarse grained mosaic of quartz and orthoclase, about 60% of the former and 40% of the latter. The grains range in size from 0.1 to 0.4 mm. and form about 50% of the section.

Alteration:

(i) Biotite.

Biotite forms about 2% of the section and occurs as large, badly bleached crystals now considerably altered to chlorite.

(ii) Sericite.

Sericite forms about 20% of the slide and occurs as flakes and crystal groups throughout the section, ~~after~~^{after} associated with actinolite. Much of it probably represents altered orthoclase.

(iii) Chlorite.

Chlorite occurs sparingly as small shreds and flakes throughout the section. Much of it replaces biotite.

(iv) Actinolite.

Actinolite forms about 20% of the section and occurs as very pale green radiating groups of needles and as flakes. It is often associated with sericite.

Opaque Minerals:

The opaque minerals form about 8% of the section and occur as crystals ranging in size from 0.25 to 1.0 mm, scattered through the slide and in a large vein cutting the rock. They consist of pyrite, pyrrhotite, and chalcopyrite in about equal proportions plus a few small crystals of sphalerite. The chalcopyrite is evidently much later than the other sulphides.

Paragenesis:

The paragenesis of the secondary minerals is:- Biotite, sericite, chlorite, actinolite, and the opaque minerals, of which chalcopyrite is the latest.

RHYOLITE

The rock is seen to be a porphyritic rhyolite altered by the formation of actinolite, plus a little calcite, sericite and pyrite.

Handspecimen:

The rock is dark grey in colour fine grained and highly silicious, with small quartz and hornblende phenocrysts. It is cut by an epidote veinlet and sparsely mineralized with pyrite.

Thin Section:

The structure is definitely porphyritic and the fabric is roughly seriate.

Original Minerals:

(a) Groundmass

The groundmass forms about 50% of the section and is made up of a mosaic of quartz, 80%, and orthoclase, 20%. The grains range in size from 0.01 to 0.05 mm.

(b) Phenocrysts.

The phenocrysts form about 30% of the section and occur chiefly as single, allotrimorphic quartz crystals, but also as groups of quartz grains. They vary in size, the maximum being about 0.7 mm.

Alteration:

(i) Calcite.

Calcite, forms about 5% of the section and occurs as irregular masses scattered through the groundmass.

(ii) Sericite.

A few small flakes of sericite were observed.

(iii) Amphibole.

The amphibole is probably actinolite though some of it has a faint suggestion of a blue colour. It occurs as radiating groups of needles, and as flakes scattered through the section, of which it forms about 15%.

Opaque Minerals:

(i) Pyrite.

Pyrite occurs sparingly as scattered crystals and grains.

Paragenesis:

The paragenesis of the secondary minerals is calcite, sericite, actinolite and pyrite.

SYENITE PORPHYRY

The rock is seen to be a syenite porphyry of intermediate to acid composition and altered by the formation of actinolite plus a little biotite, calcite, leucosene and specularite.

Handspecimen:

The handspecimen is a greyish coloured, coarse grained, porphyritic rock, showing large, nearly square phenocrysts of feldspar, smaller patches of hornblende and flakes of biotite. It also shows some crystals of sphene and a few specks of pyrite.

Thin Section:

Structure.

The structure is porphyritic with the phenocrysts very much larger than the groundmass. This gives the rock a hiatal fabric.

Original Minerals:

(a) Groundmass.

The groundmass forms about 45% of the section and is composed of laths of plagioclase, with possibly a little orthoclase. The laths have an average size of about 0.25 mm and have no regular arrangement.

(b) Phenocrysts.

(i) Feldspar.

The phenocrysts form about 20% of the section and consist of one very large crystal, and several small ones of albite. The small crystals have an average size of 0.5 mm and the large one is at least 5.0 mm long.

(ii) Apatite.

Apatite forms about 5% of the section and occurs as irregular masses and small crystals scattered through the groundmass.

(iii) Sphene.

Sphene forms about 8% of the section and occurs as well shaped crystals throughout the groundmass.

(iv) Black iron Ore.

Black iron ore occurs as scattered specks forming about 1% of the section.

The order of formation of the original minerals appears to be:- Apatite, sphene, black iron ore and feldspar.

Alteration:

(i) Biotite.

Biotite forms about 5% of the section and occurs as irregular crystals apparently replacing the groundmass. The crystals are both green and brown in colour and have an average size of 0.5 mm.

(ii) Calcite.

Calcite forms about 3% of the section and occurs as irregular masses replacing the groundmass, phenocrysts and biotite.

ROCK #15 (cont)

(iii) Leucoxene.

Leucoxene forms about 2% of the section and occurs as irregular grains replacing the biotite. It is probably formed from black iron ore, which latter was likely a decomposition product of the biotite.

(iv) Actinolite.

Actinolite forms about 20% of the section. It occurs as fibrous patches up to 0.5 mm in size, as radiating groups of fibres, and as needles scattered through the section.

Opaque Minerals:

(i) Black Iron Ore.

The black iron ore has been described above.

(ii) Specularite.

Specular hematite forms about 1% of the section. It occurs as medium sized crystals scattered through the groundmass and also associated with the biotite.

Paragenesis:

The paragenesis of the secondary minerals appears to be:- Biotite, calcite, leucoxene, actinolite and specularite.

RHYOLITE

The rock has been very badly altered but appears to have been a rhyolite. It is possible, however, that the rock was a quartz diorite. Judging from the few remnants of quartz and from the position of the rock it seems more likely that it was the former.

Handspecimen:

The rock is dark greyish green in colour and is grained. It shows fibrous hornblende and is cut by epidote and quartz veinlets. It is very poorly mineralized by scattered crystals, of pyrite.

Thin Section:

Structure:

The rock is very badly altered but has the appearance of having been a porphyritic rhyolite.

Original Minerals:

The original minerals now form about 15% of the rock and consist of quartz crystals and a little plagioclase. The grains have an average size of about 0.25 mm. The quartz crystals have a tendency to occur in discontinuous strings and are possibly secondary.

Alteration:

(i) Biotite.

Biotite forms about 5% of the section and occurs as long narrow laths now badly altered along their edges to epidote and hornblende.

(ii) Chlorite.

Chlorite forms about 5% of the section through which it occurs as scattered flakes.

(iii) Epidote.

Epidote occurs abundantly as granular masses throughout the section of which it forms about 35%.

(iv) Amphibole.

Green pleochroic hornblende occurs as large nests of crystals. Actinolite also occurs as scattered fibres and needles. Both appear to be about the same age. The amphiboles form about 40% of the rock.

Opaque Minerals:

(i) Black Iron Ore.

Black iron ore occurs as crystals and small specks scattered through the section. It is often associated with the epidote.

Paragenesis:

The paragenesis of the secondary minerals is:-
Biotite, chlorite epidote, amphibole and black iron ore.

RHYOLITE.

The rock is seen to be a slightly altered rhyolite, probably from the centre of a thick flow. The alteration products are:- Biotite, epidote, Zoisite, sericite, chlorite, quartz, actinolite and pyrite.

Handspecimen:

The rock is light grey in colour and is very fine grained. It shows patches of clear quartz and is cut by quartz veinlets. It also shows epidote in a few places and is sparsely mineralized with pyrite.

Thin Section:

Structure;

The structure is porphyroid tending to aplitic and the fabric is seriate.

Original Minerals:

The original minerals form about 80% of the rock. They consist of a fine to coarse grained mosaic of quartz 60% and orthoclase 40%. The size of the grains ranges from 0.05 to 0.25 mm.

Alteration:

(i) Biotite.

Biotite occurs as small flakes forming about 1% of the rock.

(ii) Silicification.

Secondary quartz forms about 3% of the section and occurs as veinlets cutting the rock.

(iii) Chlorite.

Chlorite occurs sparingly as small flakes.

(iv) Epidote.

Epidote forms about 10% of the section.

It occurs as colourless to pale yellow granular masses. About half of it is in the form of zoisite.

(v) Sericite.

Sericite occurs as small flakes chiefly associated with the zoisite.

(vi) Actinolite

Actinolite forms about 5% of the section and occurs as fibrous patches and radiating groups of needles.

Opaque Minerals:

(i) Pyrite.

Pyrite occurs sparingly as small scattered crystals.

Paragenesis:

The paragenesis of the secondary minerals is:- Biotite, quartz, sericite, chlorite, epidote, actinolite and pyrite.

SYENITE PORPHYRY

The rock is seen to be a syenite porphyry, possibly with aegerine altered by the formation of biotite, calcite, epidote, arfvedsonite and pyrite.

Handspecimen:

The rock is dark grey in colour and has a porphyritic texture. The groundmass is fairly coarse and shows felspar laths and flakes of biotite. The phenocrysts are large and apparently consist of orthoclase. The rock is very poorly mineralized by pyrite specks.

Thin Section:

Structure.

The structure is porphyritic, with very large phenocrysts which gives the rock a hiatal fabric.

Original Minerals:

(a) Groundmass.

The groundmass forms about 40% of the section. It consists of interlocking laths of plagioclase and microcline. The laths range in size from 0.2 to 1.0 mm.

(b) Phenocrysts.

(i) Felspar.

Two very large felspar phenocrysts form about 30% of the section. They are about 4.0 mm in size. One is comprised of oligoclase, the other of microcline.

(ii) Biotite.

Primary biotite occurs as medium sized crystals up to 0.3 mm in size. It is greenish brown and pleochroic. Biotite also occurs as nest, up to 1.0 mm. in size, of small crystals. These nests appear to be secondary biotite, while the larger crystals are apparently primary. Altogether biotite, makes up about 10% of the section.

(iii) Apatite.

Apatite occurs as irregular mass, up to 0.25 mm in size, and as scattered small crystals.

The order of crystallization of the primary minerals appears to be:- apatite, biotite and felspar.

Alteration:

(i) Biotite.

As mentioned above secondary biotite occurs as nests of small crystals.

(ii) Calcite.

Calcite forms about 5% of the section. It occurs as irregular masses, often replacing biotite.

(iii) Epidote.

Epidote also forms about 5% of the section. It occurs as granular masses associated with the biotite. Some of it is in the form of zoisite.

(iv) Amphibole.

The amphibole is of the blue variety,

ROCK #18 (cont)

Probably argvedsonite. It forms about 10% of the section as occurs as fibrous patches and radiating groups of needles. It often appears to be replacing original aegerine, although none of this mineral was seen. In addition it occurs, associated with calcite, replacing biotite.

Opaque Minerals:

(i) Black Iron Ore.

Black iron ore occurs as small specks included in the biotite, from which it was probably derived by alteration.

(ii) Pyrite.

A few scattered grains of pyrite were observed, usually associated with the biotite.

Paragenesis:

The paragenesis of the secondary minerals is:- Biotite, calcite, epidote, amphibole and pyrite.

SYENITE PORPHYRY

The rock is seen to have been a syenite porphyry intruded by quartz in a plastic condition, somewhat similar to a pegmatitic injection, and further altered by the formation of epidote and actinolite plus a little pyrite and chalcopryrite. The thin section also shows that the rock probably contained aegerine at one time although none is now left.

Handspecimen:

The rock is very dark grey in colour and has a porphyritic texture. The groundmass is fairly coarse and the phenocrysts are of plagioclase, up to $\frac{1}{2}$ inch in size. The rock is cut by quartz veinlets and sparsely mineralized by pyrite.

Thin Section:**Structure.**

The structure is porphyritic and the phenocrysts are of such a size as to give the rock a hiatal fabric.

Original Minerals:**(a) Groundmass.**

The groundmass is a fine to coarse grained mass of felspar, laths ranging in size from 0.05 to 0.25 mm. It makes up about 20% of the section.

(b) Phenocrysts.

The phenocrysts are of plagioclase and form about 50% of the section. The plagioclase is probably albite. It occurs in several small phenocrysts up to 1.5 mm. in size and in one large crystal 4.5 by 3.5 mm in section.

Alteration:**(i) Silicification:**

Secondary quartz forms about 15% of the section. It occurs in irregular veins cutting both groundmass and phenocrysts. The size of the quartz in these veins is about 1.0 mm. The veins are not sharply defined, but send out little tongues into the surrounding rock. They also include laths of plagioclase having remarkably sharp and regular outlines. Thus it would seem likely that the quartz was squeezed and soaked through the rock in a plastic condition, and probably represents a phase of pegmatitic injection.

(ii) Epidote.

Epidote forms about 2% of the section and occurs as granular masses, and in veinlets cutting the secondary quartz.

(iii) Amphibole.

The amphibole occurs in two ways, as an ordinary pleochroic, green hornblende and as arfvedsonite. The former occurs in nests of small crystals apparently replacing original aegerine-augite. The arfvedsonite forms a very minor amount and occurs as small blades.

ROCK #19(cont)

Together the two amphiboles form about 10% of the section.

Opaque Minerals:

(i) Pyrite and Chalcopyrite.

A little pyrite and chalcopyrite occur throughout the section as scattered grains.

Paragenesis:

The paragenesis of the secondary minerals is:- Quartz, epidote, amphibole, pyrite and chalcopyrite.

ROCK #20

SYENITE PORPHYRY

This rock is very similar to rock #19. It is a syenite porphyry which has been intruded by quartz in a pegmatitic condition and then still further altered by the formation of epidote, chlorite and actinolite

Handspecimen:

The rock is dark grey-green in colour and has a porphyritic texture. It contains medium sized phenocrysts of plagioclase and is cut by quartz veinlets. It is sparsely mineralized by specks of pyrite.

Thin Section:

Structure.

The structure is porphyritic and the fabric is roughly seriate.

Original Minerals:

(a) Groundmass.

The groundmass forms about 20% of the section and consists of jumbled laths and grains of plagioclase. The size of this material ranges from 0.01 to 0.10 mm.

(b) Phenocrysts.

The phenocrysts are of plagioclase and range in size from 1.00 to 2.5 mm. They consist of albite and oligoclase and form about 50% of the section.

Alteration:

(i) Silicification.

Secondary quartz forms about 15% of the section. It occurs in veinlets which cut the original minerals in all directions. These veinlets have the same characteristics as those of rock #19, and here too, the quartz was apparently intruded in a plastic or pegmatitic condition.

(ii) Chlorite.

A little chlorite occurs in veinlets associated with actinolite.

(iii) Epidote.

Epidote occurs sparingly as small granular masses.

(iv) Amphibole.

Actinolite occurs in veinlets, as fibrous patches and as radiating needles. It forms about 15% of the section.

Opaque Minerals.

(i) Pyrite & Chalcopyrite.

Pyrite and chalcopyrite occur as large crystals scattered throughout the section, often associated with actinolite.

(ii) Sphalerite.

Sphalerite occurs as large grains and is

ROCK #20 (cont)

apparently later than the sulphides.

Paragenesis:

The paragenesis of the secondary minerals is:-
Quartz, chlorite, epidote, amphibole, sulphides &
specularite.

Table I

Showing Correlation of Minerals and a Texture

Note	Original Minerals				Texture	Alteration								Quartz	Ortho	Glass
	Quartz	Ortho	Albite	Pyroxene		Total	Biotite	Calcite	Quartz	Serulite	Chalcite	Epigrite	Ortho-biotite			
Numbers refer to the mineral in 1/4" Section																
Pt = porphyritic texture																
Pd = idiosyncratic texture																
Orange Crystalline texture																
+ = Minor amount																
Northern Acid Rhyolite																
Core Sample # 4	47	21			Gm. y	29			+	2	2	25		2:1		
" # 6		22			Pt	20		+	+	+		10	10	5:2		
" # 9	83	7			Pt	9						5	4	12:1		
" # 15	10	10			Pd	50	20	15	10				5	4:1		
Rock Sample # 7	48	32			Pd	19	1		3	+	+	10	5	3:2		
" # 4	47	3			Pt	50	+		5		+	25	20	16:1		
" # 6	28	2			Pt	70		5	20	+	+	30	10	14:1		
" # 10	45	5			Gm. y	5	10	+	15		20	5	1	9:1		
" # 14	70	10			Pt						+		15	7:1		
" # 16	12	3			Pt						5	35	40	4:1		
Basic Rhyolite																
Core Sample # 11	80				Pd	20				10	10			8:1		
" # 12	40	20				35				25	10			1:1		
" # 18	4	1				95				+	40		50	4:1		
" # 19	4	10				45	15	5		20				4:3		
Rock Sample # 1	33	2				40				20	20		+	3:2		
" # 2	40	35				25	5	+		5	7	7		1:1		
" # 3	36	19				45	4			30	3		8	2:3		
(Trachyte) # 11	0	0	70			3					20	5	1	0:0		
Southern Acid Rhyolite																
Core Sample # 1	60	5			Pd	35	10			+	25			12:1		
" # 7	60	5			Pd	35	32							12:1		
" # 26	5	3	2		(Pd)	87	10				10	2	60	5:3		
" # 27	48	12			Pd	40	20				20			4:1		
(Trachyte) # 28	0	0	75			25	15	5		+			5	0:0		
Core Sample # 30	33	2			Pt	60			+	10	10	15	25	5:2		

Table II

Showing Correlation of Dyke rocks and Composition

Note.	Location		Original Minerals								Alteration									
	Core Sample 11a	Rock Sample 12a	Sulph				Feldic				Total	Biotite	Calcite	Quartz	Sericite	Chlorite	Epidote	Amphibole		
			Plagioclase	Microcline	Orthoclase	Total Feldspar	Total Feldic	Biotite	Pyroxene-Augite	Quartzite + Sphene								Total Amphibole	Actinolite	Blue Amphibole
Numbers refer to % of the mineral in thin section Peg = Pegmatitic injection + = Minor amt																				
Syenite Porphyry																				
Dyke #1	8		75			75					23	15	8					+	+	
		15	60		5	65				10	29	5	3					20	20	
Dyke #2	13		80			80				+	19	10	2		+	6	1			
		12a	45	40		85					18	3	+		3	2	2	8	8	
Dyke #3		12b	46	35	4	85					15		+		5	2	3	3	3	
		19	70			70					27			Peg 10		+	2	10	10	
		20	70			70					30			Peg 10		+	+	15	15	
Dyke #4	29		75		15	90					11		10							
		14	60		20	80					20	8		+	5	5	+			
Dyke #5	17		30	30	20	8				5	15			+				15		15

Augite Syenite Porphyry

	5		37	3	10	50	45	22	22	1	5							5		5
Dyke #6	9		See Under Rock Sample #9																	
		3	57	1	2	60	5	5		+	35		15	15			+	5		5
		18	35	35		70	8	8		+	22	2	5			5		10		10
Dyke #7	31		45	7	13	65	10	10			29		+			2	3	22		22
	16		50	0		50	30	10	20		10		5					5		5
	23		65		5	70	25		25	+	5	4	+					1		1
	24		70			70	10	10		+	20		1					20		20
Dyke #8	25		15		5	30	40	20		20	30							30		30

Mica Syenite Porphyry

Dyke #9		9	55	5		60	15	15			17		2		10	5		+	+	
Dyke #10	21		67		8	75	14	14			11	6	+			3				

Table III

Showing Alteration

Core Sample No	Rock Type	Texture	Total Alteration	Biotite	Calcite	Quartz	Sericite	Chlorite	Epidote	Amphibole					Opaque Minerals				
										Total	Actinolite	Tremolite	Green Hornblende	Blue Amphibole	Total	Pyrite	Pyrrhotite	Chalco-Pyrite	Specularite
1	Rhyolite	Pa	35	10			+	25							+	+			
2	S.P. (Augite)		28	+	2	+				25				25	1	1			
3	Rhyolite	Pa	38		8	50									+	+		+	
4	Rhyolite	amg	29				+	2	2	25			25		+	+			
5	S.P. (Augite)		5							5				5					
6	Rhyolite	pt	20		+	+	+		10	10	10								
7	Rhyolite	Pa	35	32											3	3			
8	S.P.		23	15	8					+	1				+	+			
9	Rhyolite	pt	9		+	+			5	4				4					
10	Andesite		8	2	5	+	+	+	+	+	+				+	+			
11	Rhyolite	Pa	20					10	10						+	+			
12	Rhyolite	Pa	35			+	25	10							+	+			
13	Trochylite		19	10	2		+	6	1						+	+			
14	S.P.		20	8		+	3	5	+						4	2		2	
15	Rhyolite	Pa	50	20	15	10				5	5				+	+			
16	S.P. (Augite)		10		5					5				5	+	+			
17	S.P.		15			+				15				15					
18	Rhyolite	Pa	95				+	40		50	50				5	5			
19	Rhyolite	Pa	45	15	5		20								5	5			
20	Tremolite block		100				40	+		55	55				5	3		2	
21	S.P. (Augite)		11	6	+			3							2	2			
22	Biotite block		100	95											5	3		2	
23	S.P. (Augite)		5	4	+					1				1					
24	S.P. (Augite)		20		+	+				20				20					
25	S.P. (Augite)		30		+					30				30					
26	Rhyolite	Pa	87	5				10	2	60	60				10	5		5	
27	Rhyolite	Pa	40	20				20		+	+				+	+			
28	Trochylite		25	10	5		+			5				5	+	+			
29	S.P. (Augite)		11	1	10					+	+				+	+			
30	Rhyolite	PT	60			+	10	10	15	25			25		+	+			
31	S.P. (Augite)		29		+			2	3	22				22	2	2			
Rock Sample No																			
1	Rhyolite	Pa	40				20	20							+	+			
2	Rhyolite	Pa	25	5	+		5	7	7						1	1			
3	S.P. (Augite)		35		15	15			+	5				5	+	+			
4	Rhyolite	PT	50	+		5		+	25	20	20				+	+			
5	Rhyolite	PT	90	+		0		5	40	35	35				+	+			
6	Rhyolite	PT	70		5	20	+	+	30	10	10				5	5			
8	Rhyolite	Pa	45	+			30	3		8					+	2.6			
9	S.P. (Augite)		17		2		10	5		+	+				+	+			
10	Rhyolite	amg	51	10	+	15		20		1	1				5	5			
11	Trochylite		31					20	5	1	1				5	5			
12	S.P.		18	3	+		3	2	2	8	8				+	+			
12a	S.P.		15		1		5	2	3	3	3				2	2			
13	Rhyolite	Pa	50	2			20	+		20	20				8	2.8	+	+	
14	Rhyolite	PT	20		5		+			10	10				+	+			
15	S.P.		29	5	3					20	20				1				+
16	Rhyolite	PT	85	5				5	35	40			40						
17	Rhyolite	Pa	19	1		3	+	+	10	5	5				+	+			
18	S.P. (Augite)		22	2	5				5	10				10	+	+			
19	S.P.		27			peg			2	10	10			+	+	+		+	
20	S.P.		30			peg			+	10	10				+	+			+

S.P. = Syenite Porphyry

S.P. (Augite) = Augite Syenite Porphyry

S.P. (Augite) = Augite Syenite Porphyry

PT = Porphyritic Texture

Pa = Porphyroid texture

Amg = Amygdales Texture

Numbers refer to % of mineral or alteration as determined in thin sections

+

Z.B. = Zinc blende

Peg. = Pegmatitic Injection

Alderson Mac Kay Mine

1250' Level

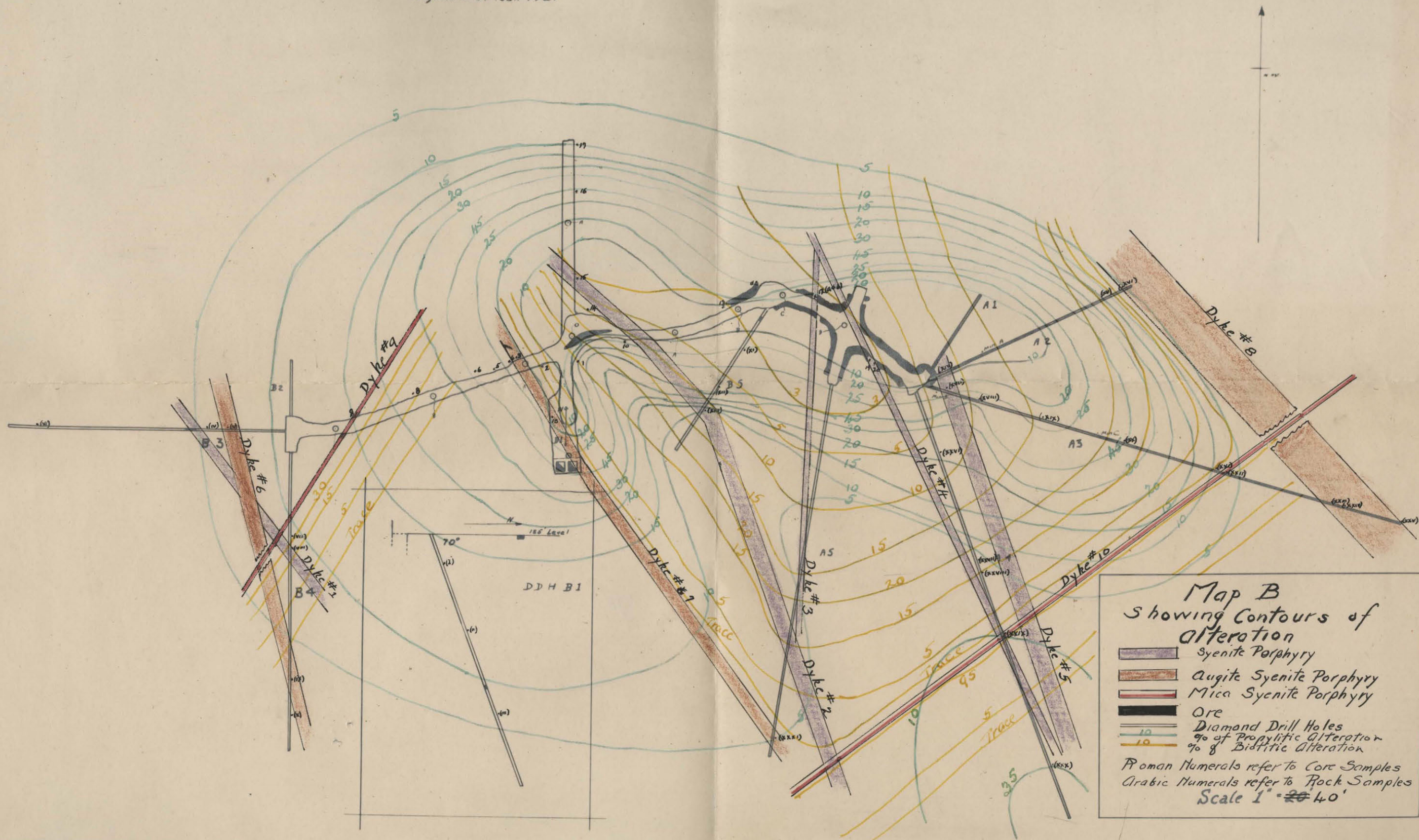
Progress to 31st Jan 1927



Alderson Mac Kay Mine

125 ft. Level

Progress to 31st Jan 1927

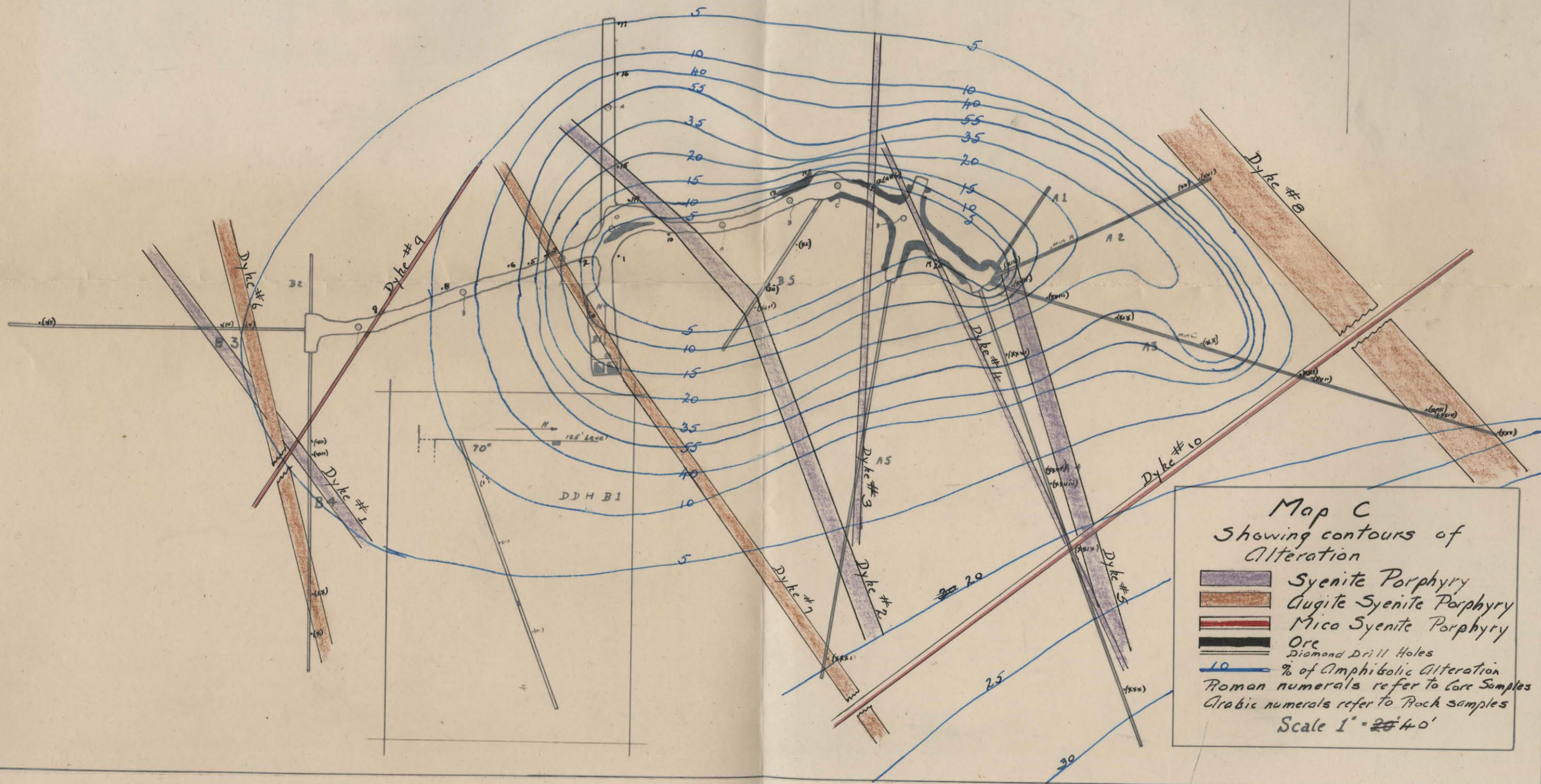


Alderson Mac Kay Mine

125 ft Level

Progress to 31st Jan 1927

N. 0.5° E.



Map C
Showing contours of
Alteration

- Syenite Porphyry
- Augite Syenite Porphyry
- Mica Syenite Porphyry
- Ore
- Diamond Drill Holes
- % of Amphibolite Alteration
- Roman numerals refer to Core Samples
- Arabic numerals refer to Rock samples
- Scale 1" = 40'



