Prospector 012670

ARCHER CATHRO 75/76

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Report for

Bob Cathro,

ARCHER CATHRO

27 samples

(porphyry environment- quartz diorite to quartz monzonite intrusive rocks and porphyritic dikes intruding quartzo-feldspathic gneiss; alteration to sericite and K-feldspar (plagioclase) and to chlorite (mafic minerals). Numerous veins containing pyrite, chalcopyrite, and minor molybdenite)

John Payne,
October, 1975.

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Report for: Bob Cathro,
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27 samples from altered porphyry intrusive rocks and metasediments

Summary

Plutonic rocks range from quartz diorite to quartz monzonite; most have plagioclase phenocrysts and many have quartz phenocrysts. They grade into porphyry intrusive (dike?) rocks. The intensity and type of alteration is varied, but most commonly plagioclase is moderately altered to sericite with a little calcite, and less commonly to K-feldspar. Mafic minerals generally are altered to chlorite and various other minerals in minor amounts. Characteristic vein types are quartz-sulfide, commonly with sericitic halos. Sulfides include pyrite and chalcopyrite in most samples and molybdenite in a few.

Metasedimentary rocks include mainly quartz-plagioclase gneiss with lesser amounts of more pelitic and more feldspathic units. The are interbanded in the scale of a thin section. They show a wide variety of alteration assemblages. Plagioclase is generally altered to sericite and mafic minerals are either fresh biotite or altered to chlorite. K-feldspar is a common secondary mineral, commonly restricted to certain layers or patches in a thin section. Vein types include quartz-sulfide and calcite, with lesser K-feldspar-bearing veins. Pyrite is the most common sulfide, generally with lesser chalcopyrite; molybdenite occurs in one sample.

Many samples show superimposed alteration types, with vein alteration altering pervasive alteration. The intensity of alteration varies widely within samples, especially between different compositional layers. Because of this no simple summary of alteration types is made. However, alteration of plagioclase and mafic minerals as well as vein type and alteration halos are described for each sample.

In answer to some specific questions the following notes are made.

1) One sample (3-284) shows a skarny texture of poikilitic sulfides intimately intergrown with silicates. HORNFELSED PLAGIOCLASE PORPHYRY

2) Magnetite has two origins, original in a few plutonic rocks, and secondary related to strong K-feldspar alteration.

3) Sulfides were mainly examined on unpolished surfaces; only hydrothermal sulfides were recognized. Molybdenite occurs in a few samples, and in those examined in polished section does not occur with mafic minerals as very fine grains. Fine grained material with altered mafic minerals is Ti-oxides.

Sample 10-121 Quartz Monzonite Porphyry

The rock contains phenocrysts of K-feldspar, plagioclase, quartz and altered mafic minerals.

K-feldspar phenocrysts are up to 15 mm long and occupy 5% of the rock. They contain a fine perthitic intergrowth of plagioclase and scattered calcite patches. Inclusions in the largest phenocryst consist of quartz-calcite-chlorite.

Plagioclase phenocrysts (20-25%) are up to 5 mm long, and form equant to slightly elongated crystals. They are weakly to moderately altered with patches of clay minerals, and with minor sericite along fractures and widely scattered calcite patches. A few phenocrysts are moderately altered to calcite-K-feldspar patches.

Quartz (5%) is up to 3 mm across in equant grains; some are rounded and some appear to be resorbed by the matrix, the latter having convexly curved borders against the matrix.

Mafic phenocrysts (2%) are up to 1 mm long and consist of chlorite in fine grained irregular to lamellar aggregates with high-relief to opaque Ti-oxides intergrown parallel to cleavage of chlorite.

Magnetite (3-5%) forms aggregates of rounded grains separated by thin selveges of matrix minerals, with coarser grained chlorite and K-feldspar common near magnetite.

Apatite forms a few prismatic crystals up to 0.6 mm long.

The matrix (60-65%) is fine grained (0.015-0.04 mm) and consists of quartz, K-feldspar-plagioclase (altered to clay)-calcite-chlorite.

One zircon grain 0.015 mm long occurs in the matrix.

The rock contains several inclusions of a second type of plutonic rock; these are up to 3 mm across, and consist of fine grained quartz-plagioclase (0.15 mm) with interstitial clay minerals.

Sample 10-285 Quartz Monzonite Porphyry

The rock contains two zones, one with abundant K-feldspar, the other without K-feldspar; the K-feldspar appears to be of replacement origin, altering plagioclase phenocrysts with calcite and minor sericite.

The sample is similar in many respects to sample 10-121.

Plagioclase phenocrysts are up to 5 mm and show patchy to veiny alteration to clay minerals and calcite (weak to moderate) with minor sericite.

Two types of mafic phenocrysts appear to have been present. The first is represented by lamellar chlorite with calcite and Ti-oxides along cleavage directions, and with apatite growing across cleavage. These probably represent original biotite.

The second is represented by patches of equant chlorite-calcite-quartz-K-feldspar-opaque (pyrite-chalcopyrite); these may have been original hornblende. Pyrite and chalcopyrite also occur away from altered mafic phenocrysts, but are most abundant in them.

The matrix is as in sample 10-121, and several coarser grained zones may represent inclusions of another plutonic rock as in sample 10-121.

Sample 10-309 Porphyritic Granodiorite with Alteration Veins

The rock contains plagioclase phenocrysts (25-30%) which are up to 3 mm across and generally equant to prismatic. They are moderately to strongly altered to patchy clay-calcite with lesser sericite, and a few patches of K-feldspar and chlorite.

Quartz phenocrysts (2-3%) are up to 1.5 mm across and fresh.

Mafic phenocrysts (probably biotite) up to 4 mm long are completely altered to chlorite with lesser sericite and lenses of Ti-oxides and calcite along cleavage planes; a few altered mafic zones consist of irregular patches of chlorite and sericite with abundant calcite.

Apatite forms a few grains (0.2%) up to 0.2 mm long.

The matrix consists of quartz (40-45%) and K-feldspar (15-20%) with lesser altered plagioclase (10-15%). Matrix plagioclase grades into plagioclase phenocrysts with increasing grain size. The average matrix grain size is 0.2-0.3 mm.

The central part of the sample (15-20 mm wide) consists of a series of veinlets containing pyrite and quartz (0.5-1.0 mm wide) surrounded by an alteration zone containing quartz and sericite. Quartz is about the same grain size as in the matrix, and sericite forms aggregates of grains about 0.08 mm across, with the size of the aggregate being about the same as that of plagioclase crystals in the less altered part of the sample. K-feldspar is also destroyed in the alteration halo.

Pyrite occurs scattered through the alteration halo and in the rock outside the quartz-sericite alteration halo.

Sample 12-240 Granodiorite

The rock consists of an aggregate of medium to coarse grained plagioclase (60-65%), quartz (15-20%), K-feldspar (5%), and altered mafic minerals (10-15%) in a sparse matrix of the same minerals. Grain size ranges from 3 mm down to 0.05 mm, with most of the rock being from 0.2-1.0 mm.

Plagioclase is fresh to weakly altered to clay.

Mafic phenocrysts now consist of irregular intergrowths of chlorite-quartz-apatite-Ti-oxides-K-feldspar-opaque(pyrite).

Small zones of myrmekitic quartz in plagioclase comprise 5% of the rock. Minor minerals include abundant apatite (1%) to 0.15 mm, two grains of euhedral zircon to 0.04 mm, and rutile up to 0.15 mm long.

Much of the K-feldspar occurs with chlorite, but a little occurs as alteration of coarse grained plagioclase.

The rock is cut by calcite veinlets with no alteration halos.

Sample 9-220 Quartz Diorite

The rock is medium grained (0.1-0.5 mm) with plagioclase (55-60%), quartz (20-25%), generally interstitial to plagioclase, and altered mafic minerals (20-25%).

Plagioclase is moderately altered to patches of calcite, lesser patches of K-feldspar and chlorite, and veinlets to individual flakes of sericite. Myrmekitic intergrowth of quartz in plagioclase occurs in a few grains.

Mafic minerals, probably originally biotite, consist of patches of chlorite with Ti-oxides intergrown along cleavage planes. A few grains of sphene occur with chlorite. Chlorite is very abundant in a vein-like or shear zone about 3-5 mm wide; the zone is weakly foliated parallel to its length.

Chalcopyrite (1-2%) and lesser pyrite (1%) occur throughout the rock, generally with the mafic minerals. However, the chlorite-rich vein-like zone does not contain sulfides.

Sample 17-170 Arkosic Quartzite with Pelitic Interlayers

The rock is a medium grained (0.2-0.7 mm) moderately foliated arkosic quartzite composed of granular quartz (75-80%), altered plagioclase (10-15%), chlorite (2-5%), and biotite (2-5%). Minor minerals include apatite (0.2-0.5%) and calcite.

Plagioclase is moderately to strongly altered to sericite, minor chlorite, and minor biotite.

Pelitic interlayers are rich in chlorite with quartz, calcite, biotite, and apatite; some layers are rich in biotite.

Sulfides are scattered through the rock and consist of pyrite (2%) and chalcopyrite (2%); they probably are more abundant with chlorite.

Sample 17-267 Banded Metasediment

The rock consists of thin layers of various compositions, commonly with gradational borders. Three main types of layers are present: (1) quartz-rich, (2) plagioclase-rich, and (3) polymineralic with quartz, K-feldspar, and plagioclase.

The grain size is about 0.3 mm, with a few coarser grained quartz lenses or layers. Chlorite with lesser biotite occur throughout, and are most abundant with plagioclase-rich layers.

Alteration of plagioclase ranges from weak at one end of the sample to strong at the other. Weak alteration is to calcite-K-feldspar-sericite with minor epidote. Strong alteration is to calcite-clay-sericite. Chlorite is commonly intimately intergrown in plagioclase-rich layers in the strongly altered zone, and may be in part an alteration of plagioclase.

Minor myrmekitic quartz occurs in plagioclase, and apatite forms 0.1-0.2% of the rock.

The rock is cut by wispy veinlets of quartz with pyrite and chalcopyrite with no alteration halos. Other veinlets (fractures) with calcite-clay alteration halos cut the plagioclase-rich layers; these veinlets cannot be seen cutting quartz-rich layers. A few of these also contain chlorite-pyrite.

Sample 16-338 Banded Metasediment

The rock has a similar texture to that of sample 17-267, but contains much more K-feldspar. A good foliation is defined by compositional banding and elongation of mineral grains. The overall composition of the rock is quartz (45-50%), plagioclase (10-15%), K-feldspar (20%), mafic minerals (10-15%), pyrite (5-7%).

Plagioclase is moderately to strongly altered to very fine grained sericite in quartz-rich layers, and to sericite and coarser grained biotite (?) in plagioclase-pelitic layers. The biotite may not be an alteration of plagioclase, but it is intimately intergrown with fine grained sericite. One layer consists mainly of coarse grained biotite, and other layers contain abundant coarse biotite; this biotite appears to be of metamorphic origin rather than hydrothermal.

Chlorite is probably an alteration of biotite, especially related to the large vein containing pyrite, chalcopyrite, and carbonate; although most of the carbonate has been leached, some at least appears to be siderite.

The rock is cut by K-feldspar veinlets; they are at about right angles to the foliation and are discontinuous. Some contain pyrite.

Sample 13-230 Altered Metasediment

The rock is strongly altered and cut by several veins; some alteration halos occur about the veins, which are superimposed on previously altered rock. The banded texture of the original rock is preserved.

The rock now consists of quartz (80%) and sericite (15%) with minor biotite, apatite, and sphene. Quartz is 0.15-0.5 mm in size, sericite is 0.007-0.10 mm in size, and forms aggregates up to 0.5 mm across.

The rock is cut by veins of quartz-pyrite; the veins do not have sharp borders, but quartz in the vein is intimately intergrown with quartz of the rock. The alteration halos about the veins are not as pronounced in thin section as in hand sample, but may represent two types of alteration: (1) addition of quartz to the rock, and/or (2) replacement of sericite directly along the vein by clay minerals. However, neither of these alterations correspond in distribution and size to the color variations seen in the cut block. Biotite occurs only along borders of pyrite. Pyrite forms 2-3% of the rock.

The rock is cut by a late wispy siderite veinlet. Limonite is a surface weathering product of pyrite, and occurs in fractures in the sulfide grains.

John Payne,
September, 1975.

Sample 2-236 Metasediment

The sample is a fine grained gneissic metasediment which has been strongly altered, and cut by later veins with alteration halos.

The original rock was probably a quartz-plagioclase-mica gneiss with minor apatite. Grain size in fine grained layers is 0.01-0.03 mm. Coarser quartz lenses (5% of rock) have grains up to 0.3 mm. Plagioclase is mainly fine grained, with a few (3-5%) coarser grained porphyroblasts (augen) to 2 mm.

The plagioclase is altered to a very fine grained aggregate of calcite, sericite, and chlorite, with K-feldspar(?) in the porphyroblasts. Quartz may also be an alteration product of plagioclase.

Mafic minerals are represented by chlorite laths up to 4 mm with intimately intergrown calcite lenses and very fine grained leucoxene (Ti-oxide). Sericite is intergrown with chlorite along cleavage planes. Locally light brown biotite is present as medium grains with chlorite.

The corner of the sample is cut by a vein of quartz-pyrite-chalcopyrite, with a weak halo of sericite-quartz rich rock up to 1 mm out from the vein. Pyrite is disseminated throughout the rock. Percentages of sulfides in the sample are pyrite (1-2%), chalcopyrite (0.2-0.5%).

A patchy irregular zone rich in sericite cuts the rock parallel to the length of the sample and may represent a weak alteration zone related to the quartz-sulfide veins.

Sample 2-240 Metasediment, Alteration Zone about Quartz-Sulfide Vein

The sample is a fine grained gneissic metasediment similar to sample 2-236, except banding is more pronounced.

The rock consists of plagioclase moderately to strongly altered to sericite (20-25%), quartz (55-60%), biotite and chlorite(10-15%), sericite patches (5%), disseminated pyrite and chalcopyrite (1-2%), and apatite (0.5%). Grain size of chlorite and biotite is 0.04 mm, quartz is up to 0.4 mm. K-feldspar occurs in a few layers.

The rock is cut by a vein containing quartz and abundant pyrite, with a halo up to 5 mm wide in which all minerals but quartz are altered to coarser grained sericite (up to 0.04 mm) and patches of secondary chlorite. The alteration zone extends further out along certain bands in the gneiss, but the intensity of alteration is less than in the main halo.

A late veinlet contains limonite.

Sample 16-442 Banded Metasediment

The sample is fine to medium grained (0.1-0.4 mm) and shows strong compositional banding, with bands rich in quartz, others rich in K-feldspar, and others rich in sericite.

Most of the sample originally was a quartz-feldspar-mica gneiss. Quartz (55-60%) is abundant in all layers except the pelitic layers. Plagioclase (20-25%) occurs in most layers, and is moderately to strongly altered to fine grained sericite with patches of coarser calcite. K-feldspar is concentrated in certain layers either alone or with quartz and forms 10-15% of the rock. Mafic minerals (10%) are altered to chlorite and sericite with minor leucoxene. Apatite (0.5%) is commonly elongated parallel to foliation.

The pelitic layers (whitish layers in hand sample) consist mainly of sericite with minor chlorite, calcite, and opaque. The layers at the end of the sample next to the pelitic layers contain abundant very fine grained disseminated opaque.

The quartz-rich layers appear to be original segregations in the gneiss rather than alteration veins. However, the presence of the sericite-rich layers along the borders of and interior to the quartz-rich layers suggests that they might represent an alteration vein and halo.

Pyrite (1-2%) is disseminated throughout the rock.

The rock is cut by a K-feldspar-sericite veinlet containing minor pyrite; the borders of the vein are not sharp.

Sample 17-209 Banded Metasediment

The sample is a fine to medium grained (0.1-0.3 mm) banded metasediment, showing three main types of layers.

1) The most abundant type is a quartz-rich type composed of quartz (50-70%), plagioclase (20-40%), chlorite (5-7%), with minor opaque (pyrite), K-feldspar, calcite, and apatite. Plagioclase is moderately altered to sericite with minor calcite and chlorite.

2) Pelitic layers (creamy white in hand specimen-stained) consist of plagioclase (70-75%) strongly altered to sericite, quartz (5-7%, and chlorite with minor biotite and sericite (15-20%). Pelitic layers grade into quartz-rich layers with increasing quartz content and decreasing intensity of plagioclase alteration.

3) One end of the section contains layers rich in feldspar. Plagioclase (50-55%) is fresh to slightly altered to sericite. Composition of one grain by the Michel-Levy method on albite twins gave An_{44}. K-feldspar (20-25%) is very abundant in certain bands parallel to foliation. Quartz (10-15%) is scattered. Biotite (10-15%) has very strong birefringence, and is partly altered along cleavage to chlorite.

Disseminated pyrite and lesser chalcopyrite (1-2%) occur mainly in the quartz-rich layers. One flake of molybdenite is also present.

The rock is cut by a vein containing K-feldspar, chlorite, pyrite, and chalcopyrite, with minor quartz. An alteration halo occurs in part of the plagioclase-rich unit; plagioclase is strongly altered to sericite up to 2 mm from the vein. However, this alteration halo does not extend across all of this unit.

Two grains of a dark green mineral (tourmaline?) occur in the third unit (plagioclase-rich unit).

Sample 1-140 Banded Metasediment

The sample is a banded, medium grained metasedimentary gneiss. Several distinct compositional units are distinguished.

1) Quartz-plagioclase-muscovite gneiss comprises 2/3 of the section and consists of bands rich in quartz and plagioclase with lesser bands rich in muscovite with lesser K-feldspar, epidote, and calcite. Overall composition is quartz (45-50%), plagioclase (25-30%), muscovite (7-10%), chlorite (5-7%), epidote (3-5%), calcite (3-5%), disseminated pyrite (2-3%). Quartz forms rounded grains 0.06-0.15 mm. Plagioclase (An_{48}) forms anhedral to interstitial grains, and is moderately altered to sericite and minor calcite. K-feldspar is concentrated in certain layers and patches. Chlorite occurs mainly in quartz-plagioclase layers as fine interstitial grains. Muscovite-rich layers contain up to 50% coarse grained muscovite (to 0.30 mm), with medium grained epidote and fine grained calcite. Apatite is minor (0.1-0.2%).

2) Two layers up to 0.4 mm thick contain tourmaline(schorlite). One layer is interbanded in the quartz-plagioclase-muscovite gneiss near its border, the other layer is at the border with the third major unit. Tourmaline forms rounded to prismatic grains with very strong pleochrism from colorless to dark olive green. The layer at the border contains up to 50% tourmaline; it is discontinuous and is interrupted by a coarse grained quartz vein.

3) The quartz vein (patch) is up to 7 mm across, but does not continue across the section. It intrudes the sample at about the contact between units 1 and 4. It contains minor fine grained calcite.

4) Actinolite gneiss comprises about 1/3 of the section. It contains two main layers which have up to 50% biotite, while elsewhere biotite is uncommon. The overall composition of the unit is actinolite (30-70%), biotite (0-50%), plagioclase (altered strongly to sericite) (10-15%), quartz (7-10%), apatite (2-3%).

Against the quartz vein the unit is strongly altered to chlorite-quartz-actinolite-calcite-sericite. One layer consists entirely of chlorite; this may represent an altered zone of biotite, although biotite adjacent to it is fresh.

5) The rock is cut by thin calcite and calcite-pyrite veinlets; one veinlet crosscuts the quartz-plagioclase-muscovite gneiss, the other cuts the quartz vein.

Sample 16-188 Banded Metasediment

The sample contains several distinct zones, some of which represent original compositionally different layers, others which are alteration products of these layers.

1) Much of the sample is a quartz-plagioclase-sericite gneiss composed of quartz (55-60%), plagioclase (25-30%) very strongly altered to sericite, mica (10-15%), apatite (2-3%), pyrite (1-2%), and calcite (1-2%). Mica was originally biotite, which is preserved near one end of the sample. Much of the biotite has been altered to sericite with fine intergrowths of Ti-oxides.

(continued)

Sample 16-188 (continued)

2) the light colored band in the center of the sample is similar to the gneiss except that the abundances of quartz and plagioclase are reversed, i.e., 55-60% plagioclase and 25-30% quartz.

3) The light-colored rock near the quartz vein consists of medium grained plagioclase very strongly altered to sericite and fine grained, high-relief minerals (70%), with rounded quartz grains (15%) which suggest a possible tuffaceous origin, and coarser patches of what appears to be introduced quartz (15%). Borders of the latter, however, are interlocking with plagioclase. Near the contact with the quartz-plagioclase-sericite gneiss is a discontinuous layer containing quartz, fine grained muscovite and pyrite; this probably is a vein.

4) The coarse patchy zone of quartz at one end of the sample has an alteration halo in which rock of unit 3 is altered to sericite with rounded quartz grains and minor calcite. On the other side of the quartz vein is a layer composed of muscovite, quartz, sphene, and minor apatite.

5) The rock is cut by a calcite vein at the other end of the sample; an alteration halo extends out for 1 to 2 mm in which biotite is replaced by muscovite.

6) A small veinlet contains calcite and epidote. Locally it appears to have a weak halo of K-feldspar, but elsewhere in the same unit no halo exists.

Sample 17-276 Banded Metasediment

The rock consists of three main metasedimentary types.

1) Plagioclase-quartz-chlorite gneiss occupies 1/3 of the section and consists of medium grained (0.2-0.4 mm), equigranular plagioclase (An_{30}) (60-65%), fresh to moderately altered to sericite, finer grained (0.06-0.15 mm) quartz (20-25%) as rounded grains interstitial to plagioclase, chlorite (7-10%) as ragged laths after biotite and locally containing biotite cores, and abundant Ti-oxides (3-5%) with chlorite.

2) Biotite-plagioclase-quartz gneiss occupies 1/3 of the section. It consists of medium grained plagioclase (45-50%) (An_{38}) similar to that in unit 1, and commonly concentrated in plagioclase-rich layers; biotite (30-35%) as coarse grained (up to 1 mm) very poikilitic crystals with inclusions of quartz, plagioclase and fine grained opaque, and as unpoikilitic laths to 0.3 mm; quartz (15-20%) as fine grains (0.05-0.10 mm) in biotite and interstitial to plagioclase; and apatite (1-2%) as subhedral grains to 0.4 mm. Biotite occurs mainly as poikilitic grains and is partly altered to chlorite and calcite.

3) Biotite-sericite gneiss occupies 1/3 of the section, and is in part interlayered with unit 2. It consists of two rock types, one of which may be an alteration product of the other. The first consists of biotite (35-40%) as laths up to 1 mm long surrounded by very fine grained sericite (50-55%) with very abundant, very fine grained, disseminated opaque, and scattered patches of quartz (5%).

(continued)

Sample 17-276 (continued)

Included in the biotite-sericite gneiss are elongated patches composed of poikilitic chlorite with fine grained inclusions of calcite and sericite intergrown along cleavage planes. Opaque minerals form very fine grained disseminated inclusions and quartz forms scattered grains. A few patches of sericite with opaque inclusions occur; they are similar to that in the biotite-sericite gneiss.

Opaque minerals include pyrite and magnetite, although most is too fine grained to recognize in the binocular microscope.

The sample is cut by a quartz-chlorite vein with no alteration halo.

Sample 16-362 Metasediment

The sample is a quartz-plagioclase-chlorite gneiss. Quartz (45-50%) is finer grained (0.1-0.2 mm) than plagioclase (35-40%) (0.15-0.3 mm). Plagioclase is moderately to strongly altered to very fine grained sericite; in more strongly altered rock near one end of the section, some sericite is coarser (up to 0.07 mm) and patches of calcite are common. K-feldspar (5-7%) occurs mainly near one end of the sample as scattered grains. Chlorite (10-15%) is an alteration product of biotite and forms ragged laths up to 0.3 mm in length; it contains sericite parallel to cleavage planes and very fine patches of Ti-oxides.

Pyrite (0.1-0.2%) is disseminated in rock containing K-feldspar.

The rock is cut by several calcite veinlets. Along one veinlet at the edge of the section is a narrow alteration halo containing K-feldspar. The more abundant sericitic alteration near one end of the section may be related to a vein outside the sample.

Sample 3-284 Hornfelsed(?) Plagioclase Porphyry

(Polished Section)

The sample consists of altered plagioclase phenocrysts in a matrix containing very abundant biotite and lesser quartz. Locally the texture of the matrix shows relic plagioclase laths. The biotite appears to be mainly secondary, and the rock may represent a hornfelsed plagioclase porphyry.

Plagioclase phenocrysts (20-25%) range widely in size up to 3 mm; they are moderately to strongly altered to sericite, and many also contain biotite laths.

The matrix consists of very fine grained to medium grained biotite (55-60%) with lesser quartz (15-20%), apatite (1-2%), and plagioclase (5%). Biotite occurs in patches which are almost entirely biotite and intergrown with other matrix minerals; the patches may represent original mafic phenocrysts.

The rock contains patches of quartz, sulfides, chlorite, and sericite with minor calcite. Generally grains in the patches are coarser grained than in the matrix. Sulfides are pyrite (1-2%), chalcopyrite (1-2%), and molybdenite (one grain 0.25 mm long by 0.025 mm wide). Pyrite is more abundant in coarse grains, while chalcopyrite is more abundant in finer grains.

The sample is cut(?) by a veinlet of plagioclase-quartz which extends halfway across the section and ends abruptly. Biotite is present, but only in minor amounts, and plagioclase is much fresher than in the rock.

Sample 3-227 Altered Metasediment

The rock is a strongly altered metasediment (quartz-plagioclase gneiss). The first alteration is a pervasive replacement by K-feldspar and biotite of original plagioclase and mafic minerals. Quartz appears to be stable in this alteration, and the texture of the gneiss is mainly preserved. The second alteration is a patchy to veiny alteration by quartz-chlorite-calcite-sulfides-apatite; during this alteration the rock texture is destroyed. Late calcite veins cut the rock, and may be related in origin to the second stage of alteration.

The original rock is medium grained (0.15-0.3 mm) and consists mainly of quartz and plagioclase with lesser mafic minerals. The K-feldspar-biotite alteration produced the following mineral composition: quartz (45-50%), plagioclase (15-20%), K-feldspar (15-20%), biotite (10-15%), apatite (1-2%), opaque (1-2%)-(pyrite, chalcopyrite). Plagioclase is moderately altered to biotite and K-feldspar, or locally to sericite. K-feldspar is commonly concentrated in layers. Biotite is slightly altered to chlorite.

The alteration patches of the second type consist of quartz (55-60%), chlorite (20-25%), calcite (7-10%), pyrite (2-3%), chalcopyrite (3-5%), apatite (2-3%). Much of this is medium grained (0.2-0.5 mm). Chlorite contains moderate to abundant patches of Ti-oxides.

Sample 3-277 Strongly Altered Metasediment

The sample shows complicated relations between two rock types and several vein and alteration types.

1) Quartz-rich gneiss occupies one corner of the section. It is weakly banded and consists of quartz (85-90%) with interstitial patches of calcite (5-7%), sericite with lesser biotite (5-7%), chlorite (1-2%), and apatite (0.3-0.5%).

2) The central part of the sample consists of a compact mass of biotite laths up to 0.15 mm long with 20% poikilitic sulfide grains (pyrite, chalcopyrite). Sulfide grains are strongly interlocking with biotite, and contain inclusions of biotite and calcite. This rock is irregularly altered on its borders and into the interior to an aggregate of sericite (45-50%), quartz (40-45%) and calcite (5-10%); sulfides are preserved in the altered rock, but in general the alteration occurs between sulfide grains in the biotite-sulfide rock. This alteration zone grades outwards into patches rich in quartz with lesser calcite and a few coarse grains of apatite.

3) A possible third rock type consists of an aggregate of quartz, sericite and biotite with minor apatite and 5-7% rounded sulfide grains, mainly pyrite. It occurs along one end of the sample, and is separated from the other rock types by a quartz-calcite vein. It may have a similar origin to unit 2, but with a different alteration history.

4) A patch consisting of fine grained calcite and lesser sericite in a matrix of chlorite with a few coarser grains of quartz occurs on the border of a calcite-quartz vein, and extends into the sericitic alteration of unit 2.

5) Late veins consist of quartz-sulfide (pyrite, chalcopyrite), with minor chlorite. Calcite occurs in some veins with quartz, and forms later veins and replacement zones.

Sample 11-166 Porphyritic Quartz Diorite

The sample is a massive, medium to strongly altered quartz diorite with a very variable grain size. Plagioclase phenocrysts (25-30%) are up to 3 mm across. These are mediumly to strongly altered to calcite and sericite. Mafic phenocrysts are of two types (compare with sample 10-285). Both are completely altered. The first was probably biotite, and is altered to chlorite with patches of calcite and finely disseminated Ti-oxides along cleavage planes. The second was probably hornblende, and consists of more-equigranular intergrowths of chlorite-calcite-sericite-Ti-oxides-quartz. Biotite occupied 7-10% of the rock and hornblende 3-5%.

The matrix consists of quartz and plagioclase with lesser amounts of calcite, apatite, and sericite. Plagioclase is altered as in the phenocrysts. Grain size varies from 0.03-0.5 mm, with most being 0.05-0.2 mm. Calcite occurs with coarser grained quartz. Apatite is very abundant (0.5-1.0%).

The rock is cut by a veinlet of quartz-chlorite-sericite-calcite-sulfides.

Sulfides occur in the veinlet and disseminated in the rock; they consist of pyrite (1-2%) and chalcopyrite (0.1-0.2%).

Sample 16-409 Strongly Altered Metasediment + Pyrite Vein
(POLISHED SECTION)

The sample is a strongly altered, uniform, medium grained metasediment composed of quartz (80%), sericite (10%), and kaolinite (10%). Quartz is 0.07-0.2 mm in grain size, and the other minerals form fine grained aggregates between the quartz grains, and elongated roughly parallel to banding.

The sample is cut by a series of veins containing pyrite centerlines and an alteration halo about 3 mm out from the centerline in which kaolinite has been replaced by sericite, and in which disseminated pyrite and minor chalcopyrite occur. Near one edge of the slide, sericite is very coarse grained (up to 0.1 mm), but generally it is only slightly coarser in the alteration halo than in the rock.

The vein (and rock) is cut by a small fault, which offsets the vein about 4 mm. The fault contains kaolinite, and between the segments of the pyrite vein the fault contains finely ground up pyrite.

Sample 2-271 Porphyritic Andesite

The sample contains 20% phenocrysts of plagioclase, quartz, and amphibole in a matrix of plagioclase, biotite, chlorite, amphibole, and quartz, with minor apatite and calcite.

Plagioclase phenocrysts (5-7%) are up to 1.5 mm long, subhedral, and moderately concentrically zoned. They show Carlsbad-albite twins; one determination gave a composition of An_{36} for the core and An_{30} for the rim. Cores are fresh, while many phenocrysts contain abundant tiny inclusions along their rims.

Quartz phenocrysts (5-7%) are up to 3 mm across.

Hornblende phenocrysts (1-2%) are up to 2 mm across and most contain numerous inclusions of plagioclase and quartz. Actinolite-tremolite phenocrysts (3-5%) are up to 0.3 mm across and most have ragged borders. One biotite phenocryst 1.5 mm across occurs in the rock.

The matrix consists of lathy plagioclase (35-40%) about 0.15 mm long, biotite (10-15%), actinolite (7-10%), chlorite (7-10%), quartz (5-7%), apatite (0.2-0.5%) and calcite (0.2-0.5%). The matrix also contains patches of actinolite-tremolite up to 1.0 mm across; the patches consist of a compact aggregate of elongate prismatic crystals.

Pyrite (1-2%) is disseminated and in a vein with very fine grained chlorite.

The sample contains a fragment of rock 3 mm across. The fragment contains biotite phenocrysts 1.5 mm across, patches of coarse grained chlorite, quartz, and opaque (0.2-0.5 mm across) in a fine grained matrix of plagioclase, chlorite, and minor quartz and apatite.

Sample 14-183 Porphyritic Dacite

The sample is strongly altered, and little of the original texture is preserved.

Plagioclase phenocrysts (7-10%) up to 3 mm long are strongly to completely altered to sericite. Very scattered mafic phenocrysts (probably biotite) are altered completely to chlorite, sericite, and opaque (Ti-oxides). Apatite forms a few crystals up to 0.4 mm long. The matrix probably originally consisted of quartz, plagioclase, and mafic minerals (grain size 0.03-0.05 mm).

The rock appears to have been altered in two main episodes. In the first, the alteration assemblage is quartz-sericite-pyrite-chalcopyrite-K-feldspar-magnetite(?). This alteration is pervasive. In the second, the alteration is confined to halos about calcite and calcite-kaolinite veins. Alteration minerals consist of K-feldspar, calcite, and kaolinite. Some sulfides appear to have been destroyed in this alteration.

Sample 9-138 Porphyritic Quartz Diorite

The sample is a coarse grained porphyritic quartz diorite which has been altered and then cut by a quartz-pyrite vein with a sericitic alteration halo.

Plagioclase (40-45%) forms medium grains grading upwards to phenocrysts 4 mm across. It is slightly to moderately altered to sericite with patches of calcite. Some plagioclase crystals, especially phenocrysts, are partly to completely altered to K-feldspar, commonly with calcite along the borders. K-feldspar is slightly perthitic in coarse grains (5-7%). Quartz (10-15%) forms fine to medium grained, strongly interlocking crystals interstitial to plagioclase. Quartz also forms myrmekitic intergrowths with plagioclase (10-15%); these are most abundant along borders of phenocrysts. Mafic minerals (15-20%), probably originally biotite, are altered to chlorite with sericite common along cleavage planes, and patches of calcite and scattered very fine Ti-oxide aggregates. Apatite (1-2%) is scattered through the rock. Zircon forms one elongate prismatic grain 0.15 mm long. One euhedral sphene grain is pseudomorphically replaced by a network of rutile needles.

The rock is cut by several quartz-calcite veins; these contain scattered pyrite and have very patchy alteration halos containing patches of sericite. Disseminated through the rock is pyrite (1-2%) with minor chalcopyrite and molybdenite.

The main vein is quartz-pyrite with a halo up to 5 mm containing sericite, quartz, and calcite with disseminated pyrite and chalcopyrite.

Sample 9-287 Porphyritic Quartz Diorite

The sample is similar to sample 9-138; the original rock has smaller plagioclase phenocrysts, and only minor myrmekitic intergrowths of quartz in plagioclase. Plagioclase is moderately to strongly altered to sericite with a few patches of calcite. Mafic minerals (probably originally biotite) are altered to sericite with patches of calcite and fine aggregates of Ti-oxides. Magnetite forms a few relic primary grains. Apatite (1-2%) is abundant with sulfides. K-feldspar is minor; it forms patches with calcite scattered through the rock, and is abundant along the main quartz vein near one end of the sample again with calcite. Sericite forms a few patches through the rock, some with coarse grained sulfides and calcite. Chlorite is minor.

The main vein consists of quartz with minor sericite and calcite. Chalcopyrite forms a discontinuous center-line in the vein, and one grain of molybdenite occurs away from the center-line. Disseminated sulfides include pyrite (1%), chalcopyrite (0.5%) and minor molybdenite.

Sample 10-319 Altered Quartz-Plagioclase Porphyry

The original rock is a quartz-plagioclase porphyry granodiorite with 15-20% plagioclase phenocrysts up to 4 mm long and 7-10% quartz phenocrysts up to 3 mm across. Plagioclase is moderately altered to sericite with a few patches of calcite. Some quartz phenocrysts have abundant inclusions of feldspars near their borders.

Mafic phenocrysts (probably biotite) (7-10%) are up to 1.5 mm across and consist to chlorite with patches of calcite and scattered Ti-oxides.

The matrix is fine grained (0.03-0.15 mm) and consists of a granular intergrowth of quartz (25-30%), K-feldspar (15-20%), and plagioclase (5-10%). Apatite (0.2-0.5%) forms scattered euhedral to subhedral grains, and one small grain of tourmaline was noted.

The main alteration of the sample consists of a network of parallel quartz veins with pervasive alteration of the rock to quartz-K-feldspar-magnetite-chlorite-calcite. Plagioclase phenocrysts are cut by the quartz veins, but generally are not altered in the vein zone. Elsewhere, plagioclase phenocrysts are replaced by K-feldspar, and some or much of the matrix K-feldspar may be of secondary origin.

Elsewhere in the sample are patches of coarser grained magnetite-calcite-chlorite. Sulfides are disseminated in the rock, and are more abundant outside the K-feldspar-magnetite alteration zone. Pyrite (1-2%) and chalcopyrite (0.2-0.5%) form individual grains and aggregates.

The rock is cut by an irregular chlorite veinlet which has a weak K-feldspar-calcite halo.

John Payne

John Payne,
October, 1975.

THE CASH:

A NEW COPPER-MOLYBDENUM PORPHYRY TARGET

IN THE

DAWSON RANGE, YUKON TERRITORY.

BY

EARL MARTIN JENSEN

APRIL 23, 1975

GEOLOGY 499

UNIVERSITY OF B.C.

DESCRIPTION OF ROCK UNITS

Yukon Metamorphic Complex (PPsn - Paleozoic and/or Proterozoic)

This unit consists of well foliated, fine grained muscovite-biotite schists and gneisses occurring in a northwest trending roof pendant in the center of the Cash Property (Figure 4). Two pyritic gossans are formed in this unit immediately west of Big Creek and one small outcrop of amphibolite gneiss (dominantly hornblende) occurs to the west of Big Creek as well.

Two zones of hydrothermal alteration have been found in this unit south of Big Creek, one occurs between Styan and Jensen Creeks and is the main zone of interest on the property while another, smaller zone occurs to the east of Jensen Creek. The formation of skarn in the main zone of interest indicates that limy horizons are present in this unit as well.

Few foliations can be measured because of the scarcity of outcrop, consequently, the attitude of the metamorphic rocks in the hydrothermally altered zone west of Jensen Creek is not known. East-west trends apparent in ground magnetic survey patterns, however, may refect the metamorphic grain of this area.

Gabbro (Pub - Paleozoic and/or Mesozoic)

The main outcrop of this unit occurs along Big Creek (Figure 4). This unit is bounded on the north by Mount Nansen Group, other contacts are obscured by overburden. Ground magnetic results indicate, however, that this unit is an elongate body (about 2000 feet by 800 feet) parallel to Big Creek. The shape of the body suggests a Gabbro plug rather than a dyke. A small outcrop of Hornblende Andesite in contact with Quartz Monzonite to the east of the main outcrop and north of Big Creek (Figure 4) has been tentatively included in this unit. Bostock (1936) indicated that this unit also occurred west of Big Creek (northwest corner of Figure 4), but the writer has interpreted this occurrence as belonging with the volcanic rocks of the Mount Nansen Group.

Three thin sections and two polished sections were examined from the outcrops along Big Creek. Fine to medium-grained Augite Gabbro with magnetite and pyrite occur in the central outcrop and Hornblende Andesite occurs in the eastern one.

Fine-grained Augite Gabbro consisted of 25% augite, 10% biotite, 10% olivine and 10% enstatite in a fine-grained ground mass of 25% saussuritized plagioclase (An_{60}) and 10% apatite. Magnetite and pyrite, have correded borders, occur in equal amounts, and account for the remaining 10% of the rock.

Medium-grained Augite Gabbro consisted of 30% augite (rimmed by horn-blende and tremolite-actinolite), 5% biotite and 55% saussuritized normally zoned plagioclase (An_{56}). Magnetite and pyrite occur in the same manner as in the fine-grained Augite Gabbro and account for the remaining 10% of the rock.

The outcrop to the east consists of a very fine-grained Hornblende Andesite with 40% hornblende, 10% plagioclase phenocrysts, 5% quartz phenocrysts and 5% opaques. The fine-grained ground mass (40%), is dominantly normally zoned, extensively saussuritized plagioclase.

Hornblende Syenite, Monzonite (My - Triassic?)

This intrusive unit is located south of the metamorphic roof pendant. The Rocks of this intrusive unit are very resistant to weathering compared to the Granite-Granodiorite unit (Mgd) (see next page). Felsenmeer and sub-bedrock float are generally sharp, blocky and very fresh in appearance. A pronounced foliation is imparted by oriented hornblende crystals. Grain size is variable, ranging from medium to coarse-grained. Some phases are porphyritic. The composition of coarsely porphyritic rocks, dominated by phenocrysts of potassium feldspar, is probably syenite. Medium-grained varities of this unit contain less potassium feldspar and more quartz and correspond to monzonite.

One thin section and four medium-grained stained rock slabs were examined. Point counts of the stained slabs (Table 1) averaged 28% potassium feldspar, 34% plagioclase, 7% quartz and 32% hornblende. Calculation of a mafic free mode yielded 41% potassium feldspar, 50% plagioclase and 9% quartz indicating a rock of monzonite composition, as plotted on the triangular diagram of Figure 3.

The thin section gave an average plagioclase composition of An_{36}. Cores of the plagioclase were extensively saussuritized indicating normal zoning. Hornblende laths were slightly chloritized and weakly aligned. Accessory constituents include apatite and specular hematite. Epidote veining is common in this unit but no epidote was observed in the thin section examined.

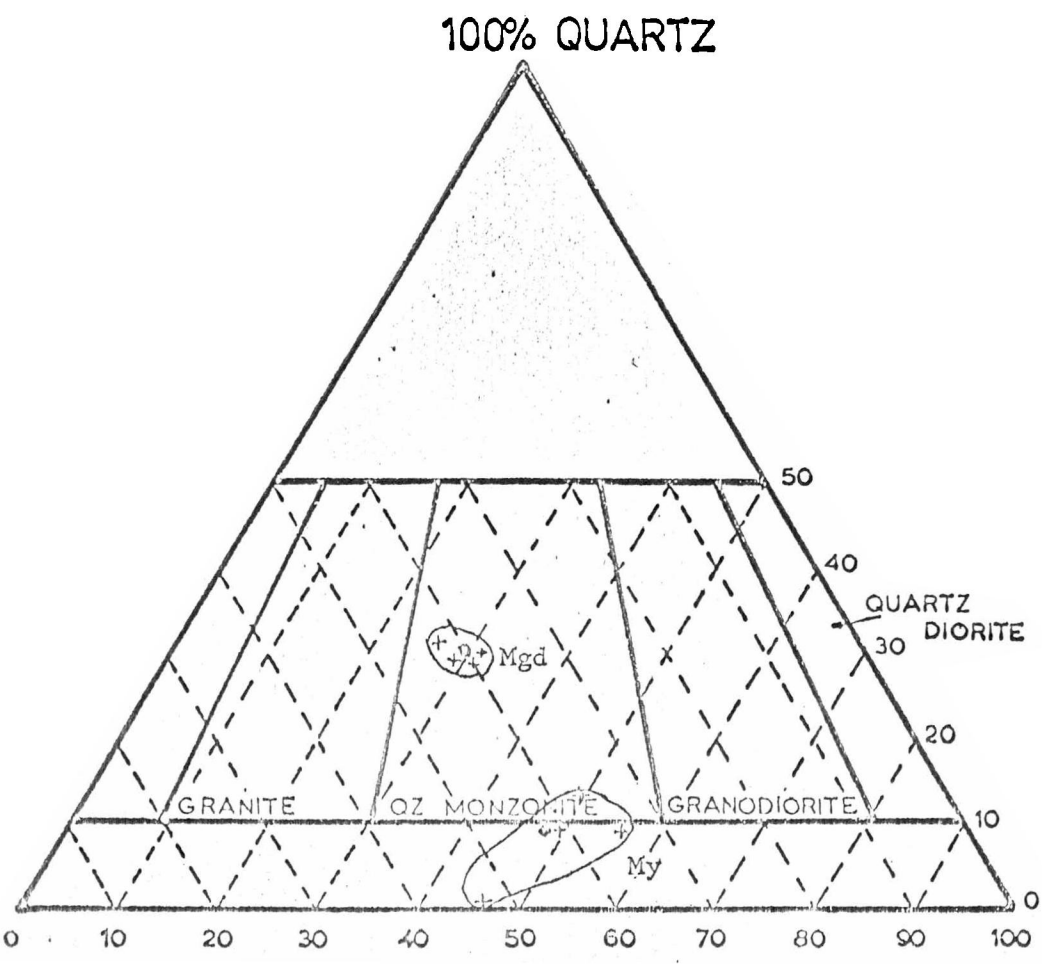
Granite-Granodiorite (Mgd - Mesozoic)

This intrusive unit is easily recognized in the field by medium-grain size, equigranularity, and low mafic content. This unit is generally deeply weathered and several occurrences at the tops of ridges were noted where the feldspars were partly decomposed by weathering.

Two thin sections and four stained rock slabs were examined to correlate the two main areas of outcrop (northeast and southwest of Big Creek). Differences in An content are minor, thus this unit is thought to be part of a single granitic body.

Average modal composition (Table 1) indicates 39% potassium feldspar, 28% plagioclase, 29% quartz and 4% mafics. Mafic free adjusted modes average 40% potassium feldspar, 30% plagioclase and 30% quartz. This composition plots in the quartz monzonite field on the triangular diagram of Figure 3.

Examination of the thin sections gave a plagioclase determination of An_{30} (northeast) and An_{34} (southwest), or an average of An_{32}. Textures are hypidiomorphic granular with more extensive saussuritization of feldspar interiors (normal zoning) toward the southwest where rocks are also slightly finer grained. Mafics are extremely altered to chlorite and difficult to identify but seem to be mostly biotite with minor hornblende.



MODE:	My	Mgd
QUARTZ:	6%	29%
ORTHOCLASE:	28%	39%
PLAGIOCLASE:	34%	28%
HORNBLENDE:	32%	
BIOTITE:		4%
OTHER:		

	My	Mgd
COLOUR INDEX:	32	4
AN:	36	32

FIGURE 3: MAFIC-FREE MODAL COMPOSITION (+) AND MEAN (•) OF GRANITIC UNITS My AND Mgd IN CASH PROPERTY AREA

Mount Nansen Group (Tmn - Eocene)

This unit consists of fine-grained, dark weathering acidic volcanic tuffs and tuff breccias. An occurrence west of Big Creek (northwest corner of Figure 4) has been included in Mount Nansen Group. This area was formerly mapped as the Gabbro (Pub) unit (Bostock, 1936). Four thin sections were examined from this unit, and indicate that the rocks to the far west corner of Figure 4 and in contact with the Gabbro along Big Creek are tuffs. The occurrence formerly included in the gabbro unit consits of tuff breccias.

Tuff in the western corner of Figure 4 is very fine-grained and has a pronounced flow texture in thin section. Possible rock fragments, consisting of clinopyroxene clusters, clinopyroxene laths and apatite laths form 5% of the rock. The matrix consists mainly of glass, plagioclase and clinopyroxene. A thin section from the outcrop in contact with the Gabbro outcrop in the center of the property is similar except for a greater percentage and variety of phenocrysts and lack of flow texture. Phenocrysts consist of 10% plagioclase (An_{28}), 4% clinopyroxene, 1% apatite and 5% opaques, making up 20% of the rock. The ground mass of plagioclase and volcanic glass forms the rest of the rock and account for 80%.

The occurrence to the northwest of Big Creek thought to be part of the Gabbro (Pub) unit by Bostock (1936) is assigned, here, to the Mount Nansen Group on thin section criteria. Both thin sections examined from this area were similar and were tuff breccias. The rocks have a fine-grained matrix containing fragments of larger, fractured mineral grains. Outlines of the larger mineral grains are faint.

Pheocrysts make up to 75% of the rock and consist of 33% hornblende, 66% plagioclase (An_{32}) and trace potassium feldspar. Composition of the matrix is unknown in detail but seems to consist largely of plagioclase and volcanic glass.

Carmacks Volcanics (eTcv - Eocene or Younger)

Rocks of this unit are fine-grained, dark green to black on fresh surfaces (weathers to a dark brown) and are generally of Andesite to Basalt in composition (Templeman-Kluit, 1974). At the Cash occurrence this unit caps Quartz Monzonite above the 3700 foot level to the north of Big Creek (Figure 4). No thin sections or rocks were examined from this unit.

GEOLOGICAL INTERPRETATION

This plan was prepared using information obtained from Western's drilling, the 1974 KJV surface mapping of rock chips and magnetic data.

The source of the mineralization and accompanying alteration is assumed to be the Tertiary Feldspar Porphyry (Tfp) which occurs in Hole 14, 16, and 17 as a dike and in Hole 10 as a stock. The 0 gamma magnetic contour probably indicates the approximate contact of the stock or dike swarm.

ALTERATION FACIES

Western's drill core exhibits the classical potassic, phyllic, argillic and propylitic alteration facies found in porphyry copper-molybdenum deposits. A brief description of these faces is as follows:

1. Potassic - (Potash feldspar, biotite, sericite, calcite, magnetite)

   The zone is well developed in Holes 3 and 10 and weakly exhibited in Hole 9, 16 & 17. It has a linear shape, reflecting the northeast dike swarm trend, with a length of 3000 to 7000 ft. On the KJV ground, this facies is possibly outlined by the 0 gamma magnetic contour.

   Potash feldspar rims or completely replaces plagioclase, occurs as envelopes around calcite veinlets, and is associated with quartz-sericite-magnetite-chlorite-pyrite veinlets. Biotite has a poikilitic texture and replaces mafic minerals. Magnetite occurs as veinlets and disseminations. Fine felted sericite with patchy calcite replaces plagioclase.

2. Phyllic (Quartz-sericite pyrite)

   This zone appears to form a halo around the potassic facies from 300 to 3000 ft wide.

   Plagioclase has been moderate to strong altered to pervasive sericite with patches of chlorite and epidote. Well developed quartz sericite envelopes enclose pyrite veinlets, especially near the potassic contact.

Pyrite is the most common sulphide, occurring as veinlets rather than disseminations. It amounts to as much as 7 per cent by volume, decreasing away from the potassic facies.

3. Argillic (Kaolinite)

This zone is not well developed and has only been logged in Hole 12, where kaolinite has formed from plagioclase along a fault zone. A few thin sections show weak kaolinization of the plagioclase around potash feldspar-calcite veinlets.

4. Propylitic (Chlorite and calcite)

Respectfully submitted,

ARCHER, CATHRO & ASSOCIATES LTD.

M.P. Phillips

SUMMARY OF THIN SECTION ALTERATION BY M.P. PHILLIPS

Hole 1	(136')	Phyllic	Plagioclase - moderately to strongly altered to sericite
		Propylitic?	Chlorite - 5-7% - primary Epidote - 3-5% - altered Calcite - 3-5%
Hole 2	(236')	Phyllic	Plagioclase - strongly altered to sericite, calcite, and chlorite K-spar - primary ? Note: Calcite and chlorite - Does this indicate propylitic?
	(240')	Phyllic	Plagioclase-moderately to strongly altered to sericite Biotite Chlorite - 10-15%
Hole 3	(227')	Potassic	Plagioclase and mafics replaced by K-spar and biotite Note: Some plagioclase to sericite
	(277')	Potassic	Biotite - poikilitic secondary? Sericite and calcite Note: This looks like potassic attacked by phyllic alteration
	(284')	Potassic	Secondary biotite ex-hornblende? Plagioclase - moderately to strongly altered to serici Patches of chlorite and sericite
Hole 9	(138')	Potassic	Plagioclase - slightly to moderately altered to sericite , patches of calcite Some plagioclase replaced by K-spar; mafics to chlorit
	(287')	Phyllic	Plagioclase -moderately-strongly altered to sericite patches of calcite Mafics - altered to sericite ? K-spar - minor
Hole 10	(121')	Potassic	K-spar phenocrysts - secondary Plagioclase - weak to moderately altered to clay, sericite and calcite Mafics - to chlorite Magnetite - 3-5%
	(285')	Potassic	K-spar replacing plagioclase
		Argillic (supergene)	Plagioclase patchy alteration to weak-moderate clay and calcite Chlorite ex-biotite?

Hole 10	(309')	Argillic?	Plagioclase -moderately-strongly altered to patchy clay, calcite and few patches K-spar and chlorite
	(319')	Potassic	Quartz, K-spar, magnetite chlorite - calcite veinlets K-spars replace plagioclase - strong Plagioclase moderately altered to sericite and patches of calcite Veinlet - chlorite and weak K-spar calcite halo
Hole 11	(166')	Phyllic	Plagioclase medium to strongly altered to calcite and sericite Biotite to chlorite and calcite Hornblende to chlorite , calcite and sericite
Hole 12	(140')	Argillic Weak Potassic	Plagioclase fresh to weakly altered to clay Mafic altered to chlorite quartz K-spar K-spar associated with chlorite K-spar minor alteration of coarse plagioclase
Hole 13	(230')		Quartz sericite envelope
Hole 14	(183')	Phyllic	Plagioclase strong to completely altered to sericite Mafics (biotite) to chlorite Alteration sequence: 1/ Quartz sericite pyrite K-spar & Magnetite? 2/ Halos around calcite and calcite-kaolinite veins is K-spar, calcite and kaolinite
Hole 16	(188')	Phyllic Weak Potassic	Plagioclase very strongly altered to sericite and calcite Biotite to mica Calcite veinlet Calcite - epidote veinlet Weak halo - K-spar
	(338')	Potassic	Plagioclase altered moderately to strongly to sericite and coarse biotite(metamorphic)? Chlorite ex biotite Carbonate: siderite K-spar veinlets K-spar primary? - pervasive
	(362')	Phyllic Weak Potassic	Plagioclase moderate-strongly altered to sericite, some patches calcite K-spar - pervasive-secondary? Biotite to chlorite Pyrite and K-spar rock K-spar halo around calcite veinlet

Hole 16	(409')	Phyllic	Quartz sericite and kaolinite envelope
	(442')	Phyllic Weak Potassic	Plagioclase altered moderately to strongly to sericite and patches of calcite Mafics altered to chlorite and sericite K-spar-sericite veinlet with pryite
Hole 17	(209')	Phyllic Weak Potassic	Plagioclase moderate to strongly altered to sericite and minor calcite and chlorite Note: variable alteration - plagioclase fresh Biotite K-spar - chlorite pyrite veinlet
	(276')	Potassic Phyllic	Plagioclase- fresh to moderately altered to sericite Chlorite ex biotite Poikilitic biotite-secondary? Biotite altered to chlorite and calcite Quartz-chlorite veinlet

Note: Thin section work has shown that what was identified in the field as hypogene clay is really fine felted sericite. Location of the thin sections and brief alteration assemblage is included on the drill logs.

TABLE.

TO ACCOMPANY DRILL HOLE SECTIONS OF WESTERN MINES LTD

CASH PCAR CLAIMS CLAIMS)

CARIBIG CREEK AREA

YUKON YUKON

ROCK TYPE

PLEISTOCENE

SOIL, WEATHERED BEDROCK, FLUVIAL

EOCENE OR YOUNGER

CARMACKS GROUP - PORPHYRITIC ANDESITE

EOCENE(?)

MOUNT NANSEN GROUP - DARK COLORED VOLCANIC-TUFF BRECCIA

FELDSPAR PORPHYRY

TRIASSIC (?)

HORNBLENDE SYENITE - FOLIATED.

PALEOZOIC AND/OR MESOZOIC.

YUKON GROUP - MICACEOUS QUARTZITES, BANDED BIOTITE FELDSPAR QUARTZ SCHIST/GNEISS.

PYRITE

1	<	1 %
2		1 - 2 %
3		2 - 4 %
4		4 - 6 %

ALTERATION FACIES DESCRIPTIONS

PO = POTASSIC = POTASH FELDSPAR, BIOTITE, SERICITE CALCITE MAGNETITE

PH = PHYLLIC = QUARTZ SERICITE PYRITE

AR = ARGILLIC = KAOLINITE - SOME OR ALL MAY BE SUPERGENE

PR = PROPYLITIC = CHLORITE, CALCITE

FR = FRESH

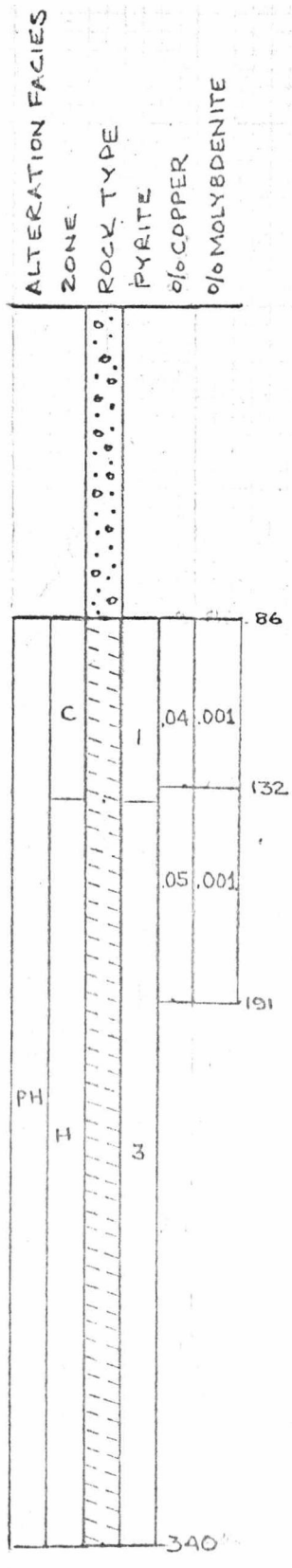
ZONE

C = CAP : JAROSITE, HEMATITE (AFTER MAGNETITE)

O = OXIDE - COPPER OXIDES (TENORITE & NEOTOCITE), MALACHITE; AZURITE MINOR PYRITE, TRACES CHALCOPYRITE

S = SUPERGENE - CHALCOCITE ONLY AND COATING. PYRITE & CHALCOPYRITE

H = HYPOGENE - CHALCOPYRITE; PYRITE, MOLYBDENITE

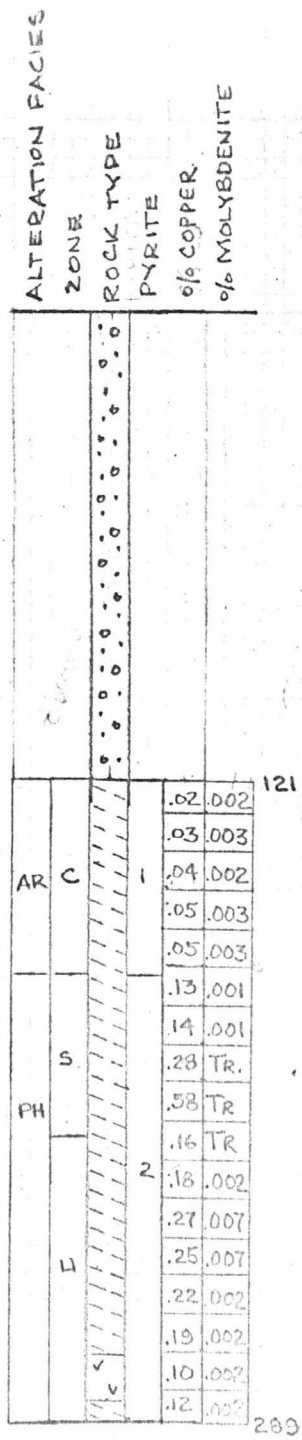


WESTERN MINES LTD

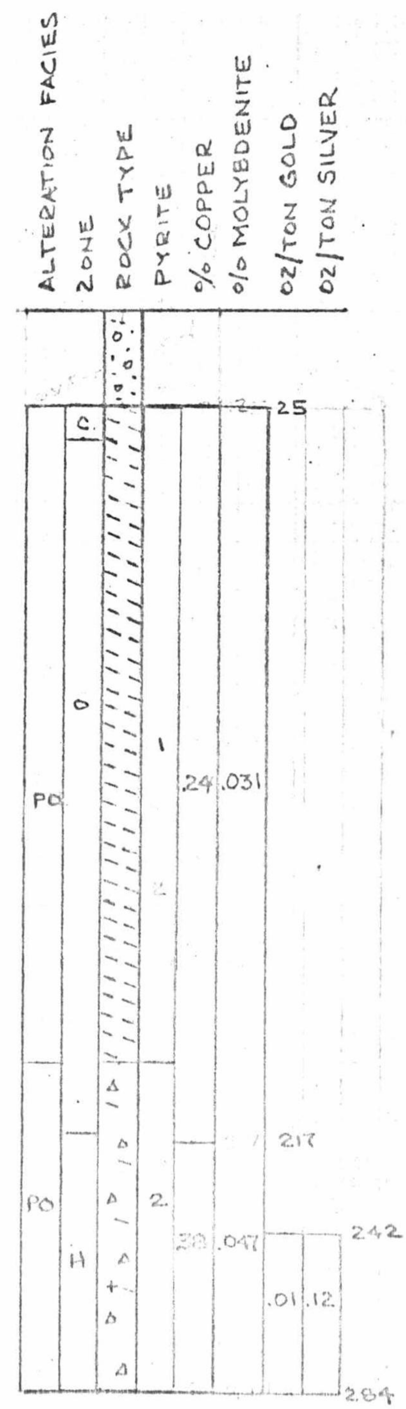
CAR CLAIMS

SECTION HOLE 1

SCALE 1 IN = 50 FT



WESTERN MINES LTD
CAR CLAIMS
SECTION HOLE 2
SCALE 1 IN = 50 FT

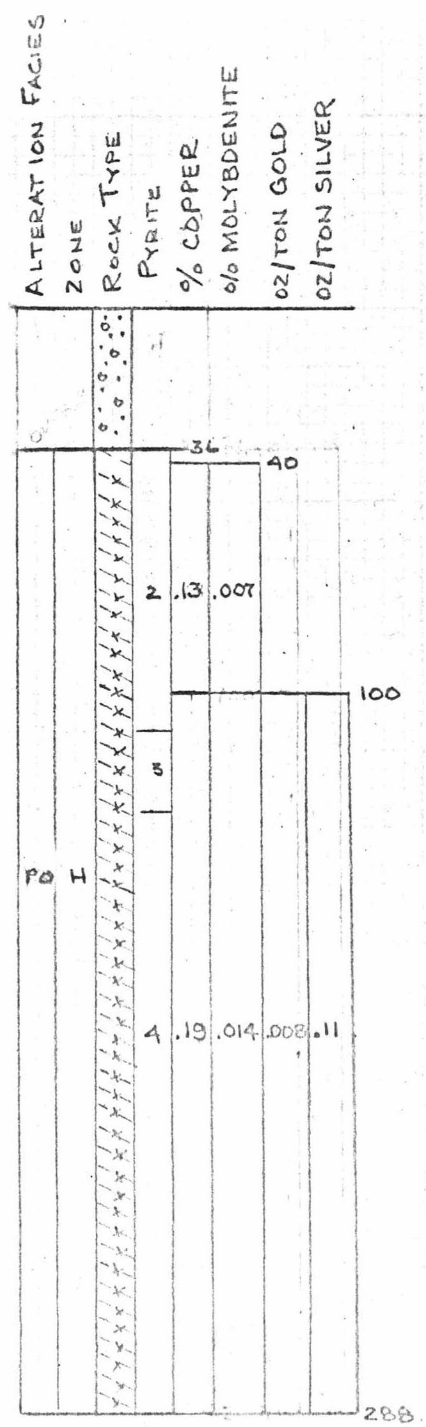


WESTERN MINES LTD

CAR CLAIMS

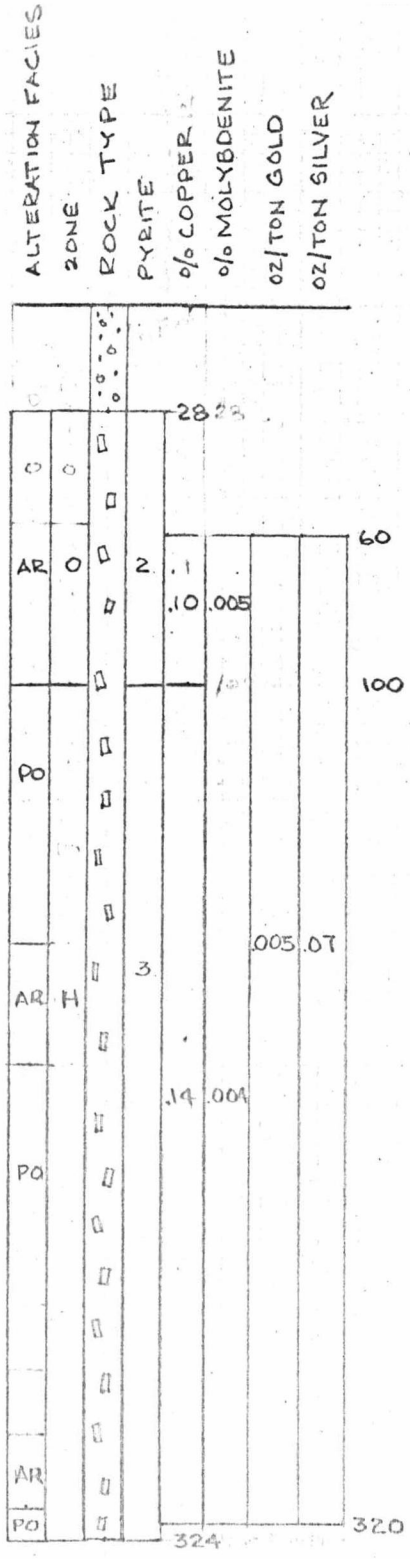
SECTION HOLE 3.

SCALE 1 IN = 50 FT



WESTERN MINES LTD
CAR CLAIMS
SECTION HOLE 9

SCALE 1 IN = 50 FT

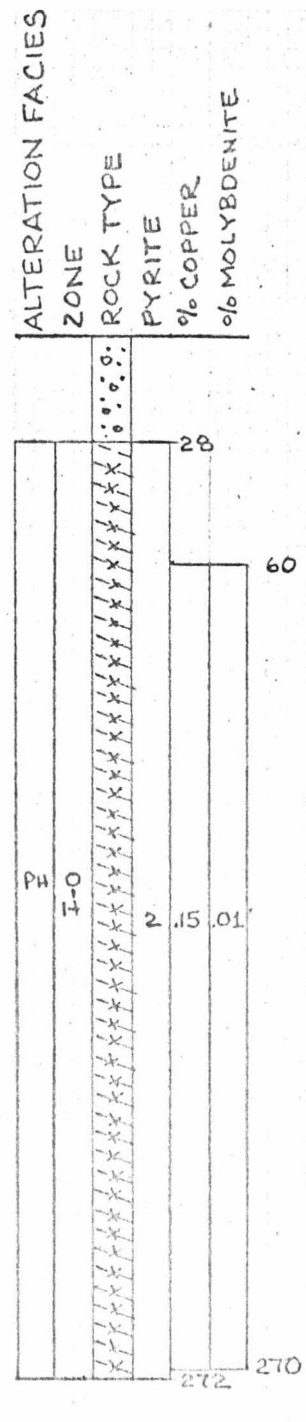


WESTERN MINES LTD

CAR CLAIMS

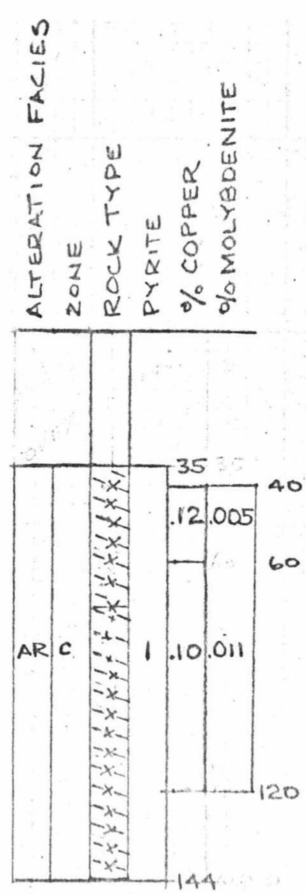
SECTION HOLE 10

SCALE 1 IN = 50 FT

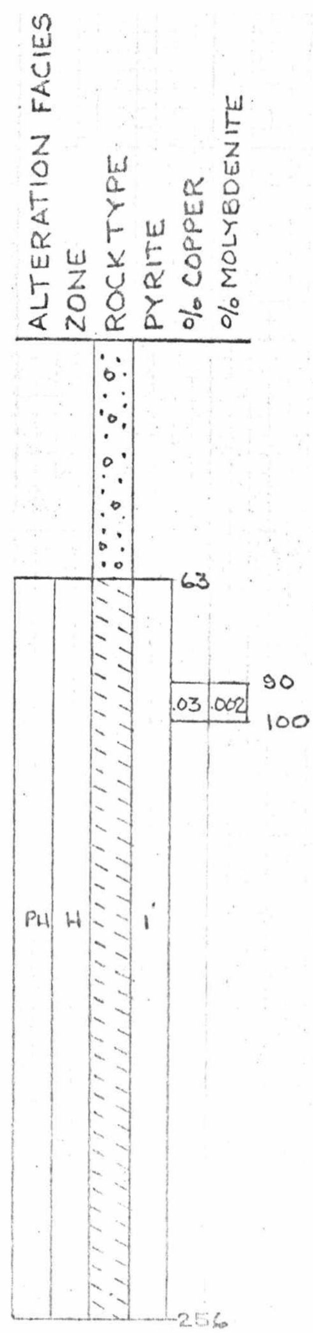


WESTERN MINES LTD
CAR CLAIMS

SECTION HOLE 11
SCALE 1IN=50FT

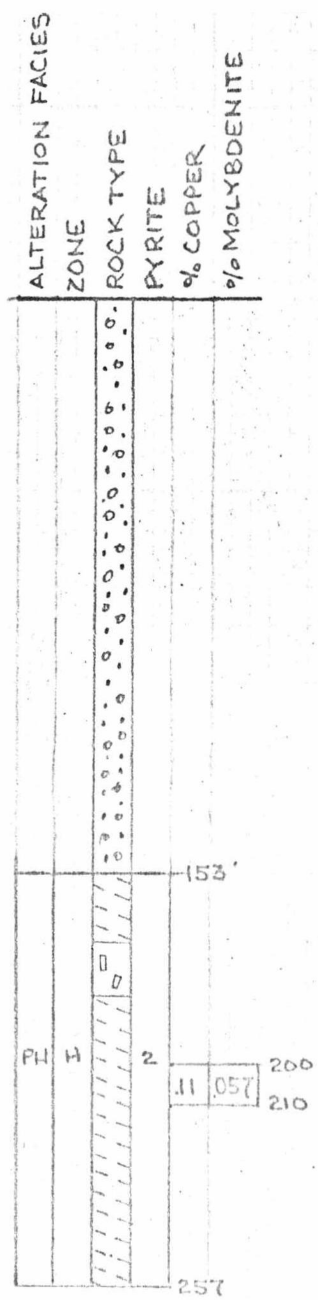


WESTERN MINES LTD
CAR CLAIMS
SECTION HOLE 12
SCALE 1 IN = 50 FT



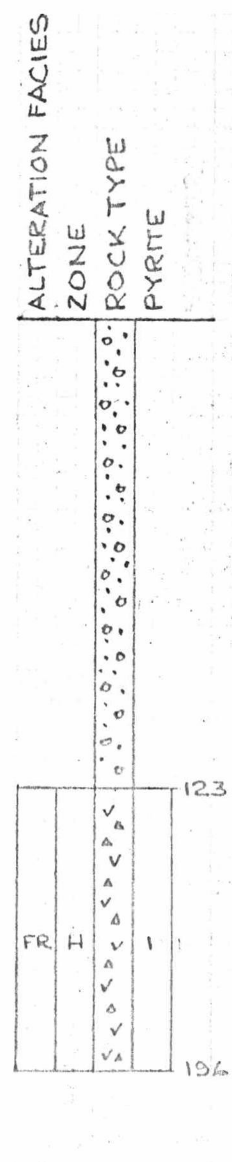
WESTERN MINES LTD.
CAR CLAIMS

SECTION HOLE 13
SCALE 1 IN = 50 FT

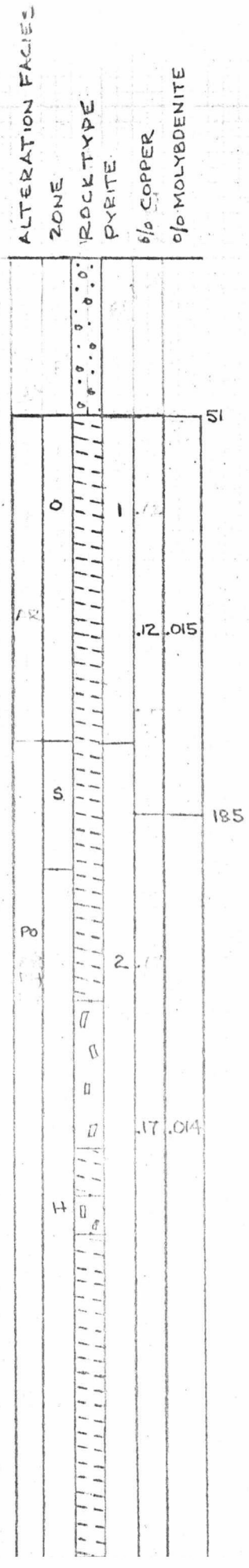


WESTERN MINES LTD
CAR CLAIMS

SECTION HOLE 14
SCALE 1 IN = 50 FT



WESTERN MINES LTD
CAR CLAIMS
SECTION HOLE 15
SCALE 1IN = 50FT.

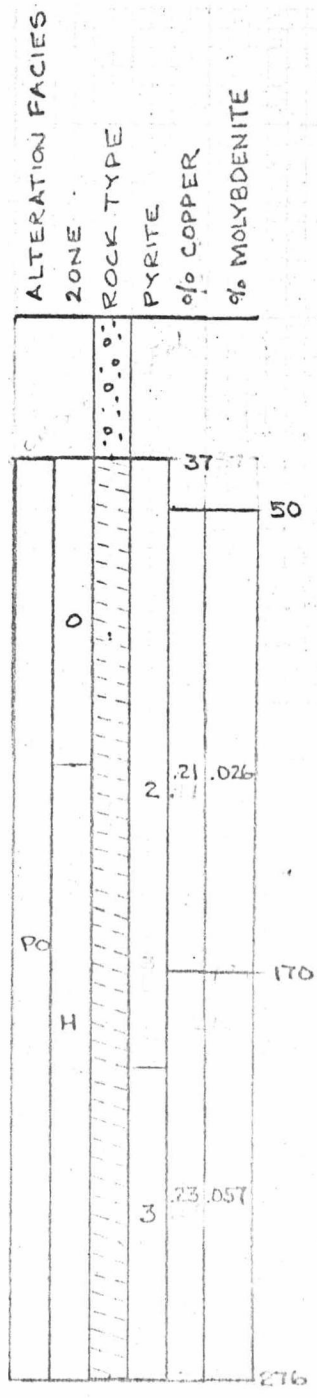


WESTERN MINES. LTD

CAR CLAIMS

SECTION HOLE 16

SCALE 1 IN = 50 FT



WESTERN MINES LTD
CAR CLAIMS

SECTION HOLE 17
SCALE 1 IN = 50 FT

DRILL HOLE LOG

CAR CLAIMS
WESTERN MINES LTD.

HOLE No. 1
PAGE 1 OF 2.

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE 1.5 IN = 50 FT.

CORE SIZE BQ
HOLE STARTED } JUNE-JULY/75
HOLE COMPLETED
LOGGED BY M.P. PHILLIPS

FOOTAGE	DESCRIPTION	FOLIATION DIP
0	**OVERBURDEN**	
	UP TO 8 IN. BOULDERS OF HORNBLENDE SYENITE & MT NANSEN VOLCANICS - MASSIVE DARK GREEN AND TUFF BRECCIA.	
50		
86	**YUKON GROUP**	
100	STRONG SUPERGENE CLAY ALTERATION. PYRITE VEINLETS TO LIMONITE.	
	LIGHT GREY, MICACEOUS, CHLORITIC QUARTZ GNEISS. PYRITE VEINLETS AND ENVELOPES ~2-3%. PERVASIVE PYRITE - <½%.	70°
124	BANDED METASEDIMENT	
140	THIN SECTION { CALCITE, EPIDOTE, PLAGIOCLASE, MODERATELY TO STRONGLY ALTERED TO SERICITE, PERVASIVE PYRITE 2%	
150		
200		
250		

DRILL HOLE LOG

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE

CORE SIZE
HOLE STARTED
HOLE COMPLETED
LOGGED BY

FOOTAGE	DESCRIPTION	DIP
	YUKON GROUP	
340	END OF HOLE	

DRILL HOLE LOG

CAR CLAIMS
WESTERN MINES LTD

HOLE No. [illegible]
PAGE 1 OF 1

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE 1.5 IN = 50 FT.

CORE SIZE BQ
HOLE STARTED } JUNE-JULY 75
HOLE COMPLETED }
LOGGED BY M.P. PHILLIPS

FOOTAGE	DESCRIPTION	DIP
0	OVERBURDEN	
50		
100		
121	YUKON GROUP	
	STRONGLY WEATHERED STRONG SUPERGENE CLAY, SULPHIDES PITTED & LEACHED. TO LIMONITE	
	LIGHT COLORED, QUARTZ, MUSCOVITE CHLORITE GNEISS WITH BANDS OF DARK COLORED BIOTITE, CHLORITE FELDSPAR GNEISS	
150		70°
173	FAIR CLAY ALTERATION.	
	CHALCOCITE COATING. VEIN & PERVASIVE PYRITE, REPLACING. & ENCAPSULE PERVASIVE CHALCOPYPYRITE. FRESH SULFIDES <1/4%	
200		
213	FRESH PYRITE STARTS	
	FAIR - MODERATE CLAY ALTERATION PYRITE VEIN > PERVASIVE = 2%	
	METASEDIMENTS	
	THIN SECTION - PLAGIOCLASE TO CALCITE, SERICITE, CHLORITE	
236		
240	THIN SECTION - PLAGIOCLASE TO SERICITE; BIOTITE & CHLORITE	
250		
	THIN SECTION - PORPHYRITIC ANDESITE	
271	CARMACKS VOLCANICS	
283		
289	END OF HOLE.	

DRILL HOLE LOG

HOLE No. 3
PAGE 1 OF 3.

CAR CLAIMS.
WESTERN MINES LTD

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE 1.5 IN = 20 FT

CORE SIZE BQ
HOLE STARTED } JUNE-JULY 75
HOLE COMPLETED }
LOGGED BY M.P. PHILLIPS

FOOTAGE	DESCRIPTION	FOLIATION DIP
	OVERBURDEN	
20		
25	YUKON GROUP LIGHT COLORED, STRONGLY WEATHERDED - IN PLACES TO MUD, MICACEOUS. QUARTZITE AND BIOTITE CHLORITE MICA FELDSPAR GNEISS. STRONG CLAY ALTERATION - SUPERGENE. TRACES OF PYRITE, WEAK MALACHITE, AZURITE, COPPER OXIDE (TENORITE?) IN VEINLETS. PYRITE VEINLETS COATED WITH LIMONITE.	
34	— COPPER OXIDES STARTS	
40		
60		
80		
100		

DRILL HOLE LOG

HOLE NO.

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE

CORE SIZE
HOLE STARTED
HOLE COMPLETED
LOGGED BY

FOOTAGE	DESCRIPTION	FOLIATION DIP
	YUKON GROUP	
126	— MALACHITE STARTS	
140		
160		
179	— VEINLETS GYPSUM STARTS	
180		
196		
200	BRECCIA - ANGULAR UP TO ½ IN. FRAGMENTS. STRONG MAGNETITE-HEMATITE, CHALCOPYRITE > PYRITE LOW CLAY IS HIGH SLICKENSIDES PARALLEL CORE AXIS — CORE RECOVERY POOR - ONLY COMPETENT QUARTZ-SERICITE - PYRITE ENVELOPES RECOVERED	
205		
209	— PYRITE VEINLETS START — DARK COLORED BANDED, QUARTZ. FELDSPAR, BIOTITE, CHLORITE GNEISS. HIGHLY FRACTURED PYRITE PERVASIVE > VEINLETS = 2% CHALCOPYRITE PERVASIVE > VEINLETS = ½ %. MOLYDENITE ASSOCIATED WITH QUARTZ VEINLETS. MAGNETITE VARIABLE - LOW TO HIGH	
214	— RECOVERY IMPROVES	
216	BRECCIA - UP TO ½ IN ANGULAR FRAGMENTS OF QUARTZ - PYRITE IN A MAGNETITE MATRIX	45°
220		
	ALTERED METASEDIMENT	
227	— THIN SECTION — SECONDARY K-FELDSPAR & BIOTITE AFTER PLAGIOCLASE	
232	— — — CORE SHOWS INCREASING BRECCIATION, GOUGE ZONES — DARK & LIGHT COLORED CHLORITIC QUARTZITE WITH QUARTZ - SERICITE PYRITE ENVELOPES	

DRILL HOLE LOG

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE

CORE SIZE
HOLE STARTED
HOLE COMPLETED
LOGGED BY

FOOTAGE | DESCRIPTION | FOLIATION DIP

YUKON GROUP

PYRITE - PERVASIVE > VEINLET = <2%
CHALCOPYRITE = ½%. MOLYBDENITE IN QUARTZ VEINS FAIR, MAGNETITE PATCHY AMOUNT = FAIR TO MODERATE

248 — BRECCIA - UP TO ½ IN ROUNDED
250 — FRAGMENTS. MAGNETITE HIGH

256 — 2 IN. HORNBLENDE SYENITE?

BRECCIA - ANGULAR TO ROUNDED QUARTZ & QUARTZITE FRAGMENTS IN A CHLORITE-MAGNETITE MATRIX.
GOUGE, CHLORITE AND HEMATITE COMMON IN LOWER PART OF BRECCIA

260
262
2685

FAULT ZONE - CRUMBLY CORE
GOUGE & CLAY COMMON
BRECCIA - 0.5 FT MAGNETITE - HEMATITE MATRIX.

SHEARED & BROKEN IN PART FINELY BRECCIATED ROCK, MAINLY DARK COLORED CHLORITIC QUARTZITE, HORNBLENDE SYENITE? AND VEIN QUARTZ. MAGNETITE VEINLETS > PERVASIVE, PYRITE > PERVASIVE > VEINLET UP TO 5%. CHALCOPYRITE VEINLET > PERVASIVE SOMETIMES WITH QUARTZ VEINLET, USUALLY VERY COARSE

277 — THIN SECTION ALTERED METASEDIMENT
QUARTZ, SERICITE
BIOTITE CALCITE.

280
282.5 — LAST CORE MARKER - END OF HOLE
284 — ±1 FT OF BROKEN CORE BELOW CORE MARKER

HORNFELSED PLAGIOCLASE PORPHYRY
ABUNDANT SECONDARY BIOTITE
THIN SECTION — PLAGIOCLASE - TO STRONG SERICITE PATCHES - CHLORITE, MINOR CALCITE, CHALCOPYRITE > PYRITE

DRILL HOLE LOG

CAR CLAIMS
WESTERN MINES LTD

Hole No.

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE 1.5 IN = 50 FT

CORE SIZE BQ
HOLE STARTED } JUNE-JULY 75
HOLE COMPLETED }
LOGGED BY M.P. PHILLIPS

FOOTAGE	DESCRIPTION	FOLIATION DIP
	OVERBURDEN	
36	HORNBLENDE SYENITE	
50	MALACHITE ALONG FRACTURES DARK COLORED, MEDIUM TO COARSE GRAINED, HORNBLENDE SYENITE PYRITE PERVASIVE & VEINLETS BORDERED BY NARROW QUARTZ SERICITE ENVELOPES = MAGNETITE VEINLETS & PERVASIVE.	
60	STRONG CHLORITE EX HORNBLENDE FAIR CHLORITE EX HORNBLENDE	60°
100		
110	PYRITE 2-4% PYRITE 3-4%	
132	MAGNETITE VEINLETS STOP. — PYRITE 3-4% PYRITE - 5%	
138	THIN SECTION PORPHYRITIC QUARTZ DIORITE PLAGIOCLASE ALTERED MODERATELY TO SERICITE, SOMEPLACES TO K-FELDSPAR, BIOTITE TO CHLORITE, PATCHES CALCITE	
150		
162	SOFT CHALKY FELDSPARS SLIGHTLY SOFT, GREENISH FELDSPARS	
200		
230	PERVASIVE MAGNETITE STOPS	
250		
287	THIN SECTION - PORPHYRITIC QUARTZ DIORITE PLAGIOCLASE - MODERATELY TO STRONGLY ALTERED TO SERICITE & PATCHES OF CALCITE, MINOR K-FELDSPAR, MAFICS (BIOTITE?) TO SERICITE	
288	END OF HOLE	

DRILL HOLE LOG

CAR CLAIMS
WESTERN MINES LTD

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE 1.5 IN = 20 FT.

CORE SIZE BQ
HOLE STARTED } JUNE - JULY/75
HOLE COMPLETED }
LOGGED BY M.P. PHILLIPS

FOOTAGE | DESCRIPTION | FOLIATION DIP

OVERBURDEN

28

FELDSPAR PORPHYRY

BLEACHED, IN PLACES PINK APPEARANCE, CROWDED FINE TO MEDIUM GRAINED FELDSPAR PHENOCRYSTS, FAIR MEDIUM TO COARSE GRAINED QUARTZ PHENOCRYSTS AND RARE BIOTITE PHENOCRYS IN AN APHANITIC MATRIX.
SUPERGENE CLAY STRONGLY DEVELOPED
PYRITE VEIN > PERVASIVE = 3-4%
MINOR MALACHITE, AZURITE AND CHALCOCITE. QUARTZ, SERICITE, PYRITE ENVELOPES UP TO 1 IN WIDE. DENSITY 1/1 FT.

40 — HIGHLY WEATHERED CRUMBLY, SUPERGENE CLAY HIGH

57

60

72 — QUARTZ-SERICITE PYRITE ENVELOPES START

80

82 — CHALCOPYRITE & PYRITE BECOME MORE COMMON SOMETIMES RIMMED BY CHALCOCITE

105 — BASE OF SUPERGENE CLAY ALTERATION

FELDSPARS CHALK COLOR, FAIRLY HARD. MATRIX AN ANEMIC GREEN COLOR WITH CHLORITE (BIOTITE) BOOKS. MOST SULFIDES ON QUARTZ-MUSCOVITE SERICITE ENVELOPES & LESSER AMOUNT ON FRACTURES

110 — PERVASIVE MAGNETITE HIGH

118

120 — FELDSPARS CHANGE FROM CHALK COLORED SLIGHTLY SOFT TO WHITE & HARD. SOME FELDSPARS PINK - POTASH FELDSPARS?

121 — THIN SECTION — QUARTZ MONZONITE PORPHYRY
PLAGIOCLASE - WEAK - MODERATELY ALTERED TO CLAY, WEAK K-FELDSPAR, CHLORITE & MAGNETITE

FAULT
FAULT ZONE - CRUMBLY CORE

134 — AFTER 134 FT MAGNETITE CONTENT LOW, USUALLY AS VEINLETS

DRILL HOLE LOG

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE

CORE SIZE
HOLE STARTED
HOLE COMPLETED
LOGGED BY

FOOTAGE | DESCRIPTION | FOLIATION DIP

FELDSPAR PORPHYRY

145 — POTASH FELDSPARS BECOMING MORE COMMON - UP TO 10 MM DIAMETER

158 — — QUARTZ, CHLORITE (BIOTITE?) VEINLET
160

168 — — — — — — —

180 INTENSE QUARTZ, MUSCOVITE PYRITE ENVELOPES CUTTING STRONGLY BLEACHED AND FELDSPARS ALTERED TO SERICITE, MINOR POTASH FELDSPARS, CHLORITE ex BIOTITE HIGH, PYRITE 5-7% IN UP TO ½ IN. VEINS

200 — — — — — — —

PLAGIOCLASE FELDSPARS WHITE SLIGHTLY SOFT, POTASH FELDSPAR UP TO 10 MM COMMON, QUARTZ SERICITE PYRITE ENVELOPES FAIR, PYRITE VEINS > PERVASIVE ± 2-3%, CHLORITIZED MAFICS - BIOTITE? - HIGH, SERICITE PERVASIVE LOW, SULFIDES REPLACING CHLORITE GYPSUM VEINLETS FAIR.

216 — MAGNETITE VEINLETS START
220 FAIR TO MODERATE

240 — ½ IN QUARTZ, MAGNETITE, CHALCOPYRITE VEINLET

SUGARY QUARTZ, MAGNETITE CHALCOPYRITE VEINLETS COMMON, POTASH FELDSPAR, FELDSPAR AND MAGNETITE VEINLETS WITH CHALCOPYRITE MODERATE CHALCOPYRITE COARSE GRAINED ± 1% PYRITE PERVASIVE > VEINS, CHLORITE (BIOTITE?) VEINLETS FAIR, QUARTZ, SERICITE, PYRITE ENVELOPES NOT COMMON. POTASH ALTERATION ZONE? CHALCOPYRITE > PYRITE & PERVASIVE > VEINLETS

DRILL HOLE LOG

HOLE No.

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE

CORE SIZE
HOLE STARTED
HOLE COMPLETED
LOGGED BY

FOOTAGE	DESCRIPTION	DIP
261	FELDSPAR PORPHYRY	
	STRONG QUARTZ SERICITE PYRITE ENVELOPES WITH WALLROCK PLAGIOCLASE FELDSPAR TO SOFT, CHALK COLOR - SERICITE AND IN PLACES CHLORITE (BIOTITE?) BLEACHED	
277	TRANSITION	
280	POTASH FELDSPAR & MAGNETITE COMMON	
282		
285	QUARTZ, SERICITE PYRITE ENVELOPES COMMON. MAGNETITE NIL, POTASH FELDSPAR. NOT COMMON. PYRITE 2-3%	
	THIN SECTION - QUARTZ MONZONITE PORPHYRY SECONDARY K-FELDSPAR, PLAGIOCLASE TO CALCITE & CLAY MINERALS, CHLORITE	
294	MAGNETITE VEINING	
298		
300	STRONG, UP TO 6 IN. QUARTZ SERICITE PYRITE ENVELOPES SEPARATED BY BLEACHED SLIGHTLY SOFT FELDSPARS. POTASH FELDSPARS BLEACHED	
305	FAULT	
309	THIN SECTION - PORPHYRITIC GRANODIORITE - PLAGIOCLASE ALTERED MODERATELY TO CLAY - CALCITE	
317	LAST FOOTAGE MARKER	
319	POTASH FELDSPARS - PERVASIVE & VEINLET. CHLORITE - VEIN & PERVASIVE MAGNETITE & MAGNETITE QUARTZ VEINLETS. COARSE PERVASIVE CHALCOPYRITE.	
321	? END OF HOLE	
	THIN SECTION - ALTERED QUARTZ PLAGIOCLASE PORPHYRY PLAGIOCLASE TO SERICITE & K-FELDSPAR, QUARTZ, K-FELDSPAR, MAGNETITE VEINLETS	

DRILL HOLE LOG

CAR CLAIMS
WESTERN MINES LTD.

HOLE No. 11
PAGE OF

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE 1.5 IN = 50 FT

CORE SIZE BQ
HOLE STARTED } JUNE - JULY | 75
HOLE COMPLETED }
LOGGED BY M.P. PHILLIPS

FOOTAGE	DESCRIPTION	FOLIATION DIP
0	OVERBURDEN	
28	YUKON GROUP	
34	HORNBLENDE SYENITE? DARK COLORED, MEDIUM GRAINED, HORNBLENDE, CHLORITE GNEISS WITH MINOR NARROW BANDS OF LIGHT COLORED CHLORITE MUSCOVITE QUARTZ GNEISS. FAIR NARROW QUARTZ SERICITE PYRITE ENVELOPES. GYPSUM VEINLETS COMMON. IN PLACES CLAY ALTERATION ABOVE AVERAGE. PERVASIVE PYRITE < ½%. MALACHITE & AZURITE ALONG FRACTURES COMMON	60° - 80°
166	THIN SECTION - PORPHYRITIC QUARTZ DIORITE PLAGIOCLASE TO SERICITE & CALCITE, BIOTITE TO CHLORITE, HORNBLENDE TO CHLORITE.	
270	DYKE - MT NANSEN.	
272	END OF HOLE	

DRILL HOLE LOG

CAR CLAIMS
WESTERN MINES LTD

HOLE No. 16

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE 1.5 IN = 20 FT.

CORE SIZE BQ
HOLE STARTED } JUNE-JULY/75
HOLE COMPLETED }
LOGGED BY M.P. PHILLIPS

FOOTAGE	DESCRIPTION	FOLIATION DIP
	OVERBURDEN	
20		
35		
	HORNBLENDE SYENITE	
40	WEATHERED, SLIGHT RUST COLOR, FAIRLY COMPETENT, COARSE GRAINED, HORNBLENDE TO CHLORITE, FELDSPARS - SOFT WHITE TO PALE GREEN (SAUSSURITE). VEIN GYPSUM HIGH. PYRITE FAIR TO LIMONITE ON FRACTURES & PERVASIVE. CHALCOPYRITE LOW. SUPERGENE CLAY - FAIR TO MODERATE. MINOR COPPER OXIDE	
60		20° - 40°
67	± 0.5 FT BLEACHED SYENITE? OR GRANOPHYRE DYKE	
72		
	FAULT ZONE? HIGHLY DECOMPOSED ROCK. CORE RECOVERY LOW - ONLY COMPETENT QUARTZ SERICITE PYRITE ENVELOPES RECOVERED.	
80		
100		

DRILL HOLE LOG

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE

CORE SIZE
HOLE STARTED
HOLE COMPLETED
LOGGED BY

FOOTAGE	DESCRIPTION	DIP
	HORNBLENDE SYENITE	
140	THIN SECTION — GRANODIORITE PLAGIOCLASE WEAKLY ALTERED TO CLAY. MINOR K FELDSPAR REPLACING PLAGIOCLASE MAFICS TO CHLORITE, CALCITE VEINLETS	
144	END OF HOLE.	

DRILL HOLE LOG

HOLE No. 13
PAGE 1 OF 1

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE 1.5 IN = 50 FT

CORE SIZE BQ
HOLE STARTED } JUNE-JULY 75
HOLE COMPLETED
LOGGED BY M.P PHILLIPS

FOOTAGE	DESCRIPTION	FOLIATION DIP
0	OVERBURDEN	
50		
63	YUKON GROUP LIGHT GREY MUSCOVITE QUARTZ GNEISS WITH OCCASIONAL DARKER BANDS CONTAINING CHLORITE & BIOTITE. QUARTZ, SERICITE PYRITE ENVELOPES UP TO 2 IN NOT COMMON. PERVASIVE PYRITE < 1%	50° – 70°
100		
150		
121	DYKE - MT. NANSEN - PYRITE < 1%	
155		
200		
230	THIN SECTION - ALTERED METASEDIMENT QUARTZ-SERICITE ENVELOPE	
250		
256	END OF HOLE	

DRILL HOLE LOG

CAR CLAIMS
WESTERN MINES LTD

HOLE No. 14
PAGE OF

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE 1.5 IN = 50 FT.

CORE SIZE BQ
HOLE STARTED } JUNE-JULY 75
HOLE COMPLETED }
LOGGED BY M.P. PHILLIPS

FOOTAGE	DESCRIPTION	FOLIATION DIP
	OVERBURDEN	
	BOULDERS TO 4 IN OF HORNBLENDE SYENITE, MT NANSEN AND YUKON GROUP	
50		
100		
150		
153	**YUKON GROUP**	
168	LIGHT COLORED, BLEACHED, CHLORITE MUSCOVITE QUARTZ GNEISS WITH STRONG CLAY ALTERATION, SOME WEAK QUARTZ VEINING.	
183	FELDSPAR PORPHYRY LIGHT COLORED, BLEACHED STRON CLAY ALTERATION TO FELDSPARS	70°
200	THIN SECTION - PORPHYRITIC DACITE PLAGIOCLASE TO SERICITE, BIOTITE TO CHLORITE K-FELDSPAR, CALCITE & KAOLINITE	
250		
252	STRONG FAULT-GOUGE	
257	END OF HOLE	

DRILL HOLE LOG

CAR CLAIMS
WESTERN MINES LTD.

HOLE NO.
PAGE 1 OF 1

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE 1.5 IN = 50 FT.

CORE SIZE BQ
HOLE STARTED } JUNE - JULY / 75
HOLE COMPLETED }
LOGGED BY M.P. PHILLIPS

FOOTAGE	DESCRIPTION	FOLIATION DIP
	OVERBURDEN	
50		
100		
123	MT. NANSEN VOLCANICS - DARK GREEN APHANITIC WITH PHENOCRYSTS OF HORNBLENDE INTERBEDDED WITH TUFF BRECCIA HAVING 1/8 - 1 IN LIGHT COLORED FRAGMENTS	
150		
196	END OF HOLE	

DRILL HOLE LOG

CARI CLAIMS
WESTERN MINES LTD.

HOLE No. 16
PAGE 1 OF 4

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE 1.5 IN = 20 FT.

CORE SIZE BQ
HOLE STARTED } JUNE-JULY/75
HOLE COMPLETED }
LOGGED BY M.P PHILLIPS

FOOTAGE	DESCRIPTION	FOLIATION DIP
0	OVERBURDEN	
52.	YUKON GROUP HIGHLY FRACTURED AND BROKEN MAINLY LIGHT COLORED QUARTZ RICH GNEISS, OCCASIONAL BANDS, DARK COLORED FELDSPAR AND MAFIC HIGH. MODERATE CLAY ALTERATION. COPPER OXIDE } MALACHITE & AZURITE MAINLY ALONG FRACTURES AND SOMETIMES PERVASIVE, CHALCOPYRITE, PYRITE & MOLYBDENITE PERVASIVE - LOW AMOUNT. PYRITE CORRODED RIMS OR COMPLETELY LEACHED OUT.	
60	— MAGNETITE VEINLETS	
80		70°
90	— — SUPERGENE CLAY INCREASES TO STRONG PROBABLY DUE TO INCREASING FELDSPAR BIOTITE/CHLORITE. AZURITE & COPPER OXIDE IN VEINS, PERVASIVE PYRITE 4½%	QUARTZ HIGH BANDS COMPETENT, FELDSPAR HIGH BANDS CRUMBLY, QUARTZ HIGH BAND PERVASIVE PYRITE ± 2% CHALCOPYRITE CONTENT LOW. OCCASIONAL. QUARTZ VEIN WITH MOLYBDENITE
100		

DRILL HOLE LOG

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE

CORE SIZE
HOLE STARTED
HOLE COMPLETED
LOGGED BY

FOOTAGE | DESCRIPTION | FOLIATION DIP

YUKON GROUP

140

150 — COPPER OXIDES DECREASES

160 — TOP CONTACT GYPSUM. ROCK BECOMES MORE COMPETENT — BASE OF STRONG CLAY ALTERATION

LIGHT COLORED QUARTZITE GNEISS MALACHITE, AZURITE & COPPER OXIDE LOW TO FAIR. SULFIDES - LOW, TRACE MOLYBDENITE. CLAY - MODERATE.

170

DARK COLORED, BIOTITE, CHLORITE SERICITE QUARTZ FELDSPAR GNEISS CLAY FAIR - MODERATE, PERVASIVE PYRITE = 1%

180

182 — QUARTZITE GNEISS WITH QUARTZ SERICITE PYRITE ENVELOPES CHALCOPYRITE PERVASIVE > VEINLETS WITH CHALCOCITE COATING. PYRITE > CHALCOPYRITE = 2%

186

189

THIN SECTION - BANDED METASEDIMENT
PLAGIOCLASE STRONGLY ALTERED TO SERICITE
BIOTITE TO MICA, MINOR CALCITE, VEINLET CALCITE
EPIDOTE, WEAK K-FELDSPAR HALO

200

201 — QUARTZITE GNEISS WITH VEIN QUARTZ STRONG QUARTZ SERICITE PYRITE ENVELOPES, FAIR MOLYBDENITE PYRITE - 3%. CHALCOPYRITE < ½%

LIGHT COLORED MUSCOVITE QUARTZ CHLORITE GNEISS TOWARDS BOTTOM ROCK DARKER COLOR INCREASING FELDSPAR AND CHLORITE. CLAY FAIR TO MODERATE. PYRITE PERVASIVE > VEINS. QUARTZ SERICITE PYRITE ENVELOPES LOW. PYRITE = LOW. CHALCOPYRITE PERVASIVE > VEIN = LOW MOLYBDENITE WITH QUARTZ & IN DRY FRACTURES

208

212 — CHALCOCITE? BORNITE

80°

220

80°

DRILL HOLE LOG

HOLE NO. [illegible]

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE

CORE SIZE
HOLE STARTED
HOLE COMPLETED
LOGGED BY

FOOTAGE | DESCRIPTION | FOLIATION DIP

YUKON GROUP

246 — CONTACT GROUND - CHILLED NEAR CONTACT

FELDSPAR PORPHYRY

LIGHT COLORED, BLEACHED, NUMEROUS, SOFT WHITE, MEDIUM TO COARSE GRAINED FELDSPAR PHENOCRYSTS, MINOR MEDIUM GRAINED QUARTZ AND BLEACHED BIOTITE PHENOCRYSTS IN A PALE GREEN APHANITIC MATRIX, IN PLACES COMPLETELY ALTERED TO CLAY CLAY - MODERATE TO STRONG, QUARTZ SERICITE PYRITE ENVELOPES FAIR TO MODERATE UP TO 2 IN. WIDE. PYRITE VEIN > PERVASIVE = 1-2%. CHALCOPYRITE & MOLYBDENITE = LOW TO FAIR.

253 — XENOLITH - YUKON GROUP
254

260

280

295 — CONTACT GROUND

YUKON GROUP

300 — ALTERNATING BANDS OF SOFT DARK COLORED FELDSPAR, BIOTITE, QUARTZ, GNEISS AND LIGHT COLORED QUARTZ, CHLORITE BIOTITE GNEISS. PYRITE PERVASIVE > VEIN = 2% CHALCOPYRITE = LOW TO FAIR. MOLYBDENITE IN QUARTZ & DRY FRACTURES

310 — CONTACT GROUND - SLICKENSIDE 0°

FELDSPAR PORPHYRY

AS PREVIOUS. CHILLED CONTACTS. STRONG CLAY ALTERATION IN CENTER. PYRITE VEIN > PERVASIVE = < 1%

320

322 — CONTACT LOST

YUKON GROUP

LIGHT TO MEDIUM GREY CHLORITE QUARTZ GNEISS WITH BANDS OF DARKER COLORED BIOTITE CHLORITE, FELDSPAR QUARTZ GNEISS. PYRITE VEINS > PERVASIVE = 1%. CHALCOPYRITE PERVASIVE = LOW. MOLYBDENITE LOW IN QUARTZ VEINS AND PERVASIVE. 80°

THIN SECTION - BANDED METASEDIMENT
PLAGIOCLASE ALTERED STRONGLY TO SERICITE, BIOTITE METAMORPHIC? K-FELDSPAR VEINLETS. CHLORITE ex BIOTITE.

338
340
342 — CLAY ALTERATION WEAKENS UP TO 6 IN QUARTZ-SERICITE PYRITE ENVELOPES

350

DRILL HOLE LOG

HOLE No. 16
PAGE 4 OF 4

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE

CORE SIZE
HOLE STARTED
HOLE COMPLETED
LOGGED BY

FOOTAGE | DESCRIPTION | FOLIATION DIP

362 — CORE BLEACHED, INCREASING CLAY ALTERATION — YUKON GROUP

BRECCIATED QUARTZ VEIN - FAULT ± 30°

BLEACHED, CLAY ALTERATION ABOVE AVERAGE TO STRONG. PYRITE > CHALCOPYRITE = 1-2% PERVASIVE > VEIN. CHALCOPYRITE CONTENT PATCHY.

370 — FRACTURE & PERVASIVE CHALCO - PYRITE COATED BY CHALCOCITE

THIN SECTION METASEDIMENT

380

382 — FAULT - GOUGE

PLAGIOCLASE STRONGLY ALTERED TO SERICITE, CALCITE COMMON, CHLORITE EX BIOTITE, K-FELDSPAR VEINLET.

390 — DARK COLORED, FELDSPAR BIOTITE QUARTZ GNEISS. CLAY ALTERATION ABOVE AVERAGE

396 — ~2 IN STRONG CHALCOPYRITE

398

400 — LIGHT COLORED, CHLORITE QUARTZ HIGH GNEISS. MOLYBDENITE & CHALCOPYRITE IN QUARTZ VEINS

409

410 — THIN SECTION — STRONGLY ALTERED METASEDIMENT

QUARTZ, SERICITE VEINLET

BLEACHED DARK CHLORITE BIOTITE FELDSPAR QUARTZ GNEISS

420

425 — PERVASIVE MAGNETITE BECOME COMMON

430 — CARMACKS VOLCANICS - FELDSPAR PHENOCRYSTS IN A DARK GREEN APHANITIC MATRIX

432

440

442 — END OF HOLE — THIN SECTION - BANDED METASEDIMENT

PLAGIOCLASE STRONGLY ALTERED TO SERICITE & CALCITE, MAFICS TO CHLORITE, K-FELDSPAR. SERICITE VEINLET.

DRILL HOLE LOG

HOLE NO.

CAR CLAIMS
WESTERN MINES LTD

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE 1.5 IN = 20 FT

CORE SIZE BQ
HOLE STARTED } JUNE-JULY 75
HOLE COMPLETED }
LOGGED BY M.P. PHILLIPS

FOOTAGE	DESCRIPTION	FOLIATION DIP
	OVERBURDEN	
20		
37	YUKON GROUP	
40	LIGHT - MEDIUM GREY MUSCOVITE, CHLORITE FELDSPAR QUARTZ GNEISS, INCREASING CLAY ALTERATION. TRACE PYRITE	
50	HIGHLY BROKEN, STRONG QUARTZ VEINS, CLAY ABOVE AVERAGE FRACTURE MALACHITE, AZURITE & COPPER OXIDE. TRACE PYRITE	70°
60	ROCK BECOMES MORE COMPETENT ABOVE AVERAGE MALACHITE & AZURITE, COPPER OXIDE & PYRITE FAIR.	DARK COLORED BIOTITE, FELDSPAR QUARTZ GNEISS WITH MINOR QUARTZ SEGREGATIONS. VEIN GYPSUM MODERATE. VEIN MAGNETITE LOW
70	TRANSITION OXIDE / HYPOGENE PYRITE > CHALCOPYRITE, PYRITE 1% CHALCOPYRITE 1% MOLYBDENITE IN DRY FRACTURES. COPPER OXIDES IN VEINS LOW	70° 75°
80		
81	GRANOPHYRE - LIGHT COLORED GRAPHIC TEXTURE	
85		ALTERNATING LIGHT & DARK COLORED FINELY BANDED, CHLORITE BIOTITE FELDSPAR QUARTZ GNEISS. CLAY PERVASIVE > VEIN - MODERATE TO HIGH. GYPSUM - LOW. MAGNETITE ABOVE AVERAGE. STRONG FRACTURING.
96	FAULT
98	GRANOPHYRE FAULT
100	COPPER OXIDES > CHALCOPYRITE VEINS > PERVASIVE	
106		LIGHT COLORED, QUARTZ RICH, MUSCOVITE QUARTZ GNEISS. CLAY ALT MODERATE AS VEINS. COPPER OXIDES > SULFIDES.

DRILL HOLE LOG

HOLE No.

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE

CORE SIZE
HOLE STARTED
HOLE COMPLETED
LOGGED BY

FOOTAGE | DESCRIPTION | FOLIATION DIP

YUKON GROUP

140
142

LIGHT TO MEDIUM GREY QUARTZ > BIOTITE > FELDSPAR GNEISS. CLAY ALTERATION FAIR. CHALCOPYRITE = PYRITE = 2% PERVASIVE > VEINLET. MOLYBDENITE FAIR PERVASIVE > VEIN. GYPSUM IN VEINS LOW. MAGNETITE NIL, MINOR QUARTZ VEINLETS.
QUARTZ HIGH SECTIONS OF CORE BETTER MOLYBDENITE

158
160

70°

NOTE - CHALCOPYRITE BETTER IN BIOTITE STRONG SECTIONS

170 — THIN SECTION - ARKOSIC QUARTZITE
PLAGIOCLASE MODERATELY ALTERED TO SERICITE
MINOR CALCITE, CHLORITE & BIOTITE.

180
183 — — —

BLEACHED QUARTZ VEINLETS TO 1 IN WITH PERVASIVE & VEIN CLAY MODERATE. MOLYBDENITE IN QUARTZ VEINS ABOVE AVERAGE.

193
196 FAULT - GOUGE

200

THIN SECTION - BANDED METASEDIMENT
PLAGIOCLASE FRESH TO STRONGLY ALTERED, MINOR CHLORITE & BIOTITE, K-FELDSPAR, CHLORITE VEIN

LIGHT TO DARK GREY BIOTITE QUARTZ GNEISS, DARKER COLOR DUE TO BIOTITE. PYRITE PERVASIVE = VEINLET = 2% CHALCOPYRITE PERVASIVE > VEINLET 1-2%. MOLYBDENITE PERVASIVE & FRACTURE FILLING. PYRITE VEINLETS HAVE NO ENVELOPES

205

213 — — —

WEAK QUARTZ, SERICITE PYRITE ENVELOPES

218 — — —
220

227 — 1 FT PERVASIVE MAGNETITE HIGH

DRILL HOLE LOG

HOLE No. [illegible]

COORDINATES
ELEVATION
DIP
AZIMUTH
SCALE

CORE SIZE
HOLE STARTED
HOLE COMPLETED
LOGGED BY

FOOTAGE	DESCRIPTION	FOLIATION DIP
242	YUKON GROUP	
	PARTINGS, VEINLETS AND NARROW BANDS OF PERVASIVE MAGNETITE	
258		
260	BRIGHT RED COATING ON FRACTURES - ZEOLITE?	
262		70°
267	THIN SECTION — BANDED METASEDIMENT PLAGIOCLASE WEAK ALTERATION CALCITE, K-FELDSPAR, SERICITE STRONG ALTERATION - CALCITE, CLAY SERICITE; CHLORITE	80°
276	END OF HOLE 2 FT OF BROKEN & REDRILLED CORE? MISLATCH. THIN SECTION BANDED METASEDIMENT PLAGIOCLASE FRESH TO MODERATELY ALTERED TO SERICITE, CHLORITE AFTER BIOTITE, SECONDARY? BIOTITE	