VOLUME IV

APPENDIX VIII

PETROGRAPHIC DESCRIPTIONS

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Samples: 24 sections from Breccia Pipe(?) & Conglomerate-Breccia Units

Summary:

Samples are grouped as follows:

1) Diorite-rich

a) Diorite

02-218.7 plagioclase megacrysts in groundmass of finer grained plagioclase, actinolite/tremolite; deformed; veinlets of actinolite/tremolite

03-95.8 plagioclase with minor biotite, ilmenite, apatite; (typical of much of diorite in breccias); strongly altered; quartz pyrite replacement; veins of quartz-sphalerite-pyrite-chlorite

b) Breccia dominated by Diorite and lesser Andesite Fragments

03-89.7 granulated groundmass; veins of calcite-quartz K-feldspar-(pyrite-chlorite)

03-101.3 diorite strongly altered; matrix of quartz-pyrite-(sphalerite)

04-148.5 matrix of granulated host rocks, patches of calcite-opaque

c) Breccia: strongly altered, origin of fragments uncertain

03-107.5 andesite and minor diorite fragments, strongly altered; matrix of quartz-dolomite-(pyrite-chlorite)

04-216.5 fragments of andesite/dacite and minor diorite; matrix of pyrite-quartz-ankerite-pyrrhotite -sphalerite-(chlorite) with trace of electrum and argentite

2) Altered Felsic Breccia

fragments dominated by felsic volcanic rocks

02-97 matrix of quartz-calcite-(pyrite- K-feldspar- sericite-chlorite)

Ø3-91.5	matrix of quartz-(sphalerite-pyrite-dolomite/ankerite-(sericite)
Ø4-24Ø.5	numerous fragment types; matrix of quartz-calcite-(pyrite-sericite)
Ø4-253	strongly altered fragments; quartz-chlorite replacement patches; replacement vein of quartz-pyrite-(sphalerite-pyrrhotite-calcite) with minor chalcopyrite and galena and trace native silver(?), argentite, electrum, and arsenopyrite

3) Altered Dacite

Ø2-57	minor altered hornblende phenocrysts in groundmass of sericite-quartz-(dolomite-pyrite); veins of quartz-pyrite-(dolomite-sphalerite) with minor arsenopyrite, galena, and chalcopyrite, and trace tetrahedrite and electrum
Ø4-236	phenocrysts of plagioclase, biotite, and quartz in groundmass of plagioclase-sericite-dolomite-(quartz-pyrite- K-feldspar- Ti-oxide); veinlet of dolomite

4) Andesite Flow or Dike (one Tuff sample)

Ø2-29.2	plagioclase-chlorite-ankerite, banded; minor amygdules of ankerite
Ø3-49	minor plagioclase phenocrysts, groundmass of plagioclase-calcite-(chlorite-opaque); veins of calcite-(quartz-pyrite) and sericite
Ø3-73	phenocrysts of plagioclase and minor hornblende in groundmass of plagioclase (altered to calcite-sericite), mica, minor opaque; seams of sericite; veinlets of albite, and of calcite-(pyrite)
Ø3-81 (fragments)	minor phenocrysts of plagioclase and hornblende in groundmass of plagioclase-(biotite-dolomite); replacement patches of calcite-quartz
Ø3-88	altered tuff: fragments of plagioclase and minor hornblende and dacite; groundmass of sericite-calcite-(quartz-chlorite-pyrite); vein of calcite-pyrite
Ø3-92.3	phenocrysts of plagioclase and much less hornblende and minor quartz; groundmass of plagioclase-(sericite-ankerite)

5) Chert-rich rocks

a) Massive

1Ø-77	chert with quartz veinlets; main vein of quartz-calcite-(chlorite-sphalerite-galena-Mineral X [= boulangerite?] with minor chalcopyrite, tetrahedrite, and pyrite, and trace arsenopyrite and electrum

Sample 02-29.2 Altered Andesite Flow or Dike

The sample is a banded, very fine to fine grained andesite flow or dike dominated by plagioclase with patches of ankerite and chlorite, and minor disseminated opaque (pyrite?) and Ti-oxide. It contains a few amygdule dominated by ankerite or calcite, locally with chlorite or quartz.

plagioclase	58-63
chlorite	10-12
ankerite	25-30
Ti-oxide	1- 2
opaque (pyrite?)	0.5
amygdules	
ankerite	1- 2
calcite	0.3
chlorite	0.1
quartz	minor

Plagioclase occurs in two main modes. It forms unoriented, lathy grains which at one end of the section average 0.05-0.15 mm in length, and which increase rapidly in grain size to an average of 0.2-0.3 mm at the other end, with a few up to 0.5 mm long. Less abundant plagioclase occurs as anhedral, interstitial grains averaging 0.01-0.02 mm in size. Plagioclase is altered slightly to moderately to extremely fine grained sericite flakes.

Chlorite forms interstitial patches averaging 0.02-0.05 mm in size of extremely fine grains intergrown coarsely with groundmass plagioclase.

Ankerite forms anhedral grains averaging 0.07-0.1 mm in size; it probably is a replacement of mafic grains.

Ti-oxide forms disseminated patches averaging 0.005-0.015 mm in size, mainly intergrown with groundmass chlorite.

Opaque forms anhedral to euhedral grains averaging 0.03-0.08 mm in size.

A few patches up to 1.2 mm in size probably are amygdules. Some consist of fine grained, moderately strained ankerite. A few consist of calcite intergrown with lesser chlorite. A few contain minor zones of very fine grained quartz.

Sample Ø2-57 **Altered Dacite(?), Disseminated Pyrite Porphyroblasts; Veins of Quartz-Pyrite-Dolomite-Sphalerite-(Muscovite)**

The rock is strongly altered, and little original texture is preserved. It is dominated by sericite with lesser quartz and much less dolomite, with moderately abundant pyrite porphyroblasts. Veins and replacement patches are of quartz-pyrite-dolomite-sphalerite-(muscovite-galena-chalcopyrite) with a trace of electrum and tetrahedrite(?).

phenocrysts			
hornblende	Ø.3%		
groundmass			
sericite	3Ø-35%		
quartz	15-17		
dolomite	4- 5		
pyrite	5- 7		
Ti-oxide	Ø.7		
veins and veinlets			
quartz	15-17	arsenopyrite	Ø.2%
pyrite	5- 7	galena	Ø.1
dolomite	2- 3	chalcopyrite	minor
muscovite	Ø.3	tetrahedrite	trace
sphalerite	2- 3	electrum	trace

Hornblende(?) forms a cluster of prismatic phenocrysts up to Ø.9 mm in length. It is altered completely to irregular, very fine grained aggregates of quartz, with minor ragged patches of sericite and of Ti-oxide, and contains inclusions up to Ø.Ø5 mm long of apatite.

Sericite forms extremely fine to locally very fine grained unoriented aggregates. Muscovite forms a few equant grains and clusters of grains averaging Ø.Ø7-Ø.1 mm in length, and locally up to Ø.3 mm across.

Quartz forms irregular, extremely fine grained patches averaging Ø.3-Ø.7 mm in size, with a few irregular patches and lenses up to 2 mm across. These contain moderately abundant dusty Ti-oxide/opaque, and less commonly contain clusters of pyrite grains averaging Ø.Ø2-Ø.Ø3 mm in grain size. The larger patches contain minor to moderately abundant disseminated patches averaging Ø.Ø3-Ø.Ø8 mm in size of extremely fine grained ankerite. Very fine grained patches and veinlets of quartz probably are largely of replacement origin.

Calcite forms scattered patches up to Ø.2 mm in size of very fine to fine grains.

Pyrite forms porphyroblasts averaging 1-1.5 mm in size. Many have thin overgrowths of dolomite grains, in part oriented perpendicular to pyrite crystal faces. Inclusions are as in pyrite grains in the veins and replacement patches (see below). Pyrite in the host rock probably was formed at the same time as the veins.

Ti-oxide forms disseminated patches up to Ø.2 mm in size of extremely fine grains intergrown with sericite.

Apatite forms anhedral to euhedral prismatic grains from Ø.Ø5-Ø.1 mm in length.

Veinlets and replacement patches ranging from less than Ø.2 mm across to veins up to a few mm across consist of very fine to fine grained quartz and lesser calcite. A few contain minor, very fine grained muscovite flakes intergrown with calcite.

(continued)

Pyrite forms abundant subhedral to euhedral grains averaging Ø.7-1.5 mm in size. It is slightly anisotropic, suggesting a gradation towards a marcasite structure. They contain minor to locally moderately abundant inclusions of chalcopyrite, galena, sphalerite, and trace tetrahedrite(?) averaging Ø.Ø2-Ø.Ø5 mm in size. Many pyrite patches contain minor, subhedral inclusions of arsenopyrite averaging Ø.Ø5-Ø.Ø8 mm in size. Pale yellow electrum forms one angular inclusion Ø.Ø15 mm in size away from sulfide inclusions.

Sphalerite forms irregular colorless to medium orange grains from Ø.Ø5-1.5 mm in size intergrown intimately with dolomite-muscovite. A few patches of sphalerite up to 2 mm in size are interstitial to subhedral to euhedral prismatic grains of quartz up to 1 mm in size. Some sphalerite grains contain minor exsolution lenses of chalcopyrite.

Galena forms a grain Ø.5 mm across associated with sphalerite, and much smaller grains nearby intergrown with quartz, chalcopyrite.

Chalcopyrite forms a few grains up to Ø.Ø3 mm in size outside pyrite or sphalerite.

Sample 02-97 Altered Felsic Breccia: Groundmass of Quartz-Calcite-(Pyrite-Chlorite-Sericite)

The rock contains fragments up to a few cm across of a wide variety of felsic rock types in a patchy groundmass dominated by quartz and calcite with lesser pyrite and minor sericite and chlorite. Some fragments were replaced partly by quartz, and their outlines were obliterated.

fragments	
porphyritic latite	20-25%
non-porphyritic latite	25-30
porphyritic dacite	1
chert	1- 2
groundmass and replacement	
quartz	25-30
calcite	12-15
pyrite	3- 4
K-feldspar	2- 3
sericite	1- 2
chlorite	1- 2
muscovite	minor

The porphyritic latite contains 10-15% phenocrysts of plagioclase from 0.2-0.8 mm in size and lesser ones of hornblende up to 1.7 mm in size and Ti-oxide up to 0.5 mm across. Plagioclase is altered completely to extremely fine grained sericite, in part with patches of calcite. Hornblende is altered completely to extremely fine grained aggregates of quartz-(sericite-chlorite) or sericite with patches of chlorite and rims of calcite. Both contain minor patches of Ti-oxide and inclusions of apatite. Ti-oxide patches probably are secondary after ilmenite. Apatite forms a few euhedral phenocrysts up to 0.25 mm in length. The groundmass is dominated by extremely fine grained plagioclase with disseminated patches of Ti-oxide and of calcite, and minor apatite and Ti-oxide.

A few fragments up to 1.7 mm in size of non-porphyritic latite/dacite are dominated by very fine grained plagioclase altered strongly to extremely fine grained calcite and much less sericite, with abundant disseminated, ragged patches of Ti-oxide.

Many fragments of non-porphyritic latite are dominated by extremely fine grained sericite, with scattered porphyroblasts of dolomite and minor muscovite, and irregular patches of chlorite. A few fragments contain pyrite porphyroblasts from 0.7-1.5 mm in size; many of these have thin partial rims of carbonate. A few fragments contain much more abundant patches of carbonate and of chlorite; some of these contain ragged porphyroblasts of carbonate up to 0.7 mm across. A few fragments contain minor phenocrysts of biotite replaced by muscovite-(Ti-oxide). Other similar ones are less strongly altered, and contain groundmass plagioclase averaging 0.02-0.05 mm in size altered moderately to sericite.

One fragment contains a subangular phenocryst of quartz 0.8 mm across in a groundmass dominated by plagioclase-quartz averaging 0.01-0.03 mm in grain size.

In one fragment replaced moderately by quartz, apatite is concentrated in an irregular lens 1.2 mm long as anhedral, fractured grains up to 0.3 mm in size.

One chert fragment 1.7 mm long consists of extremely fine grained, interlocking grains of quartz, with moderately abundant cryptocrystalline to very fine grained patches of ankerite and a few subhedral to euhedral grains of pyrite up to 0.15 mm in size.

(continued)

Several fragments, especially in one corner of the section contain moderately abundant K-feldspar, in part concentrated along borders of fragments. K-feldspar probably is largely of secondary origin, associated with the breccia matrix.

The groundmass is dominated by aggregates of quartz averaging Ø.Ø2-Ø.Ø3 mm in grain size with minor interstitial patches of extremely fine grained sericite and calcite. A few patches up to Ø.7 mm across consist of quartz grains averaging Ø.Ø7-Ø.15 mm in size with minor calcite and pyrite.

Some patches up to a few mm across are dominated by calcite grains averaging Ø.Ø3-Ø.1 mm in size, with a few grains up to Ø.3 mm across. Pyrite forms anhedral to subhedral grains averaging Ø.Ø5-Ø.2 mm in size, with a few up to Ø.5 mm across, mainly associated with calcite.

Chlorite forms irregular, very fine grained patches bordering calcite-rich patches. Muscovite forms scattered flakes averaging Ø.Ø5-Ø.1 mm long in calcite-rich patches.

A few fragments each are cut by a discontinuous veinlet up to Ø.Ø8 mm wide of calcite.

Sample Ø2-218.7 — Deformed Porphyritic Diorite; Actinolite/Tremolite Veinlets

The rock is dominated by medium grained plagioclase grains in a groundmass of very fine grained plagioclase and actinolite/tremolite, with minor Ti-oxide. The rock was deformed moderately; much of the groundmass may be granulated fragments of original coarser grains. Veinlets are of actinolite/tremolite as in the groundmass.

megacrysts	
plagioclase	35-4Ø%
groundmass	
plagioclase	25-3Ø
actinolite/tremolite	25-3Ø
Ti-oxide	1- 2
opaque	Ø.3
lens	
prehnite(?)	Ø.7
veinlets	
actinolite	2- 3

Plagioclase forms anhedral to subhedral grains averaging Ø.5-1.2 mm in size. Composition is in the andesine range. Some grains are strained moderately and deformed slightly. Alteration is slight to moderate to extremely fine grained sericite with minor concentrations of actinolite/tremolite and a very few patches of epidote.

The groundmass is patchy and dominated by zones rich in very fine grained plagioclase, and others dominated by extremely fine to very fine grained actinolite/tremolite. Actinolite/tremolite is pale to light green.

Ti-oxide and opaque (ilmenite?) form clusters up to Ø.6 mm in size of grains averaging Ø.Ø1-Ø.Ø2 mm in size. Most are intergrown with minor to abundant extremely fine grained plagioclase and/or actinolite/tremolite.

Apatite forms equant, anhedral grains averaging Ø.Ø2-Ø.Ø3 mm in size, with a few irregular grains up to Ø.1 mm in size.

A lens 1.7 mm long by Ø.6 mm wide consists of anhedral, prismatic grains averaging Ø.1-Ø.4 mm long of prehnite(?).

The rock is cut by several fractures, some of which are filled partly by wispy, in part braided veinlets up to Ø.1 mm wide of cryptocrystalline to very fine grained, prismatic actinolite/tremolite grains.

Sample Ø3-49 **Altered Slightly Porphyritic Andesite Flow: Veins of Calcite-(Quartz-Pyrite) and of Sericite, and Veinlets of Quartz**

The rock contains plagioclase and minor hornblende(?) phenocrysts in a groundmass of unoriented, very fine to fine grained, lathy plagioclase grains and interstitial patches of calcite with much less chlorite and opaque. Plagioclase is altered slightly to moderately to sericite-calcite. Abundant veins and veinlets are of calcite-(quartz-pyrite-chlorite), in part with halos of sericite. A few diffuse veins are of sericite-(opaque), and a few veinlets are of quartz.

phenocrysts					
plagioclase	4- 5%				
groundmass					
plagioclase	6Ø-65				
calcite	17-2Ø				
chlorite	2- 3				
opaque	2- 3				
veins and veinlets					
1) calcite	4- 5	2) sericite	3- 4%	3) quartz	Ø.3%
quartz	1- 2	opaque	minor		
pyrite	Ø.3				

Plagioclase phenocrysts are subhedral and equant, and up to 1.7 mm in size. Alteration is moderate to extremely fine grained sericite and minor patches and veinlets of calcite.

A lensy patch up to 1.5 mm in long may be an altered hornblende phenocryst; it is altered completely to very fine to extremely fine grain chlorite, calcite and quartz, with moderately abundant disseminated patches of opaque.

In the groundmass, plagioclase forms anhedral to subhedral lathy to equant grains averaging Ø.1-Ø.2 mm in length, with a few up to Ø.5 mm long. Interstitial to these are patches of anhedral plagioclase averaging Ø.Ø2-Ø.Ø5 mm in grain size. Alteration is slight at one end and grades to moderate to strong at the other to extremely fine grained sericite and carbonate.

Interstitial to plagioclase are patches of extremely fine grained calcite, opaque and lesser chlorite.

Apatite forms a few irregular grains up to Ø.2 mm in size.

Veins up to 1.2 mm wide are dominated by very fine to fine grained calcite, with patches of very fine grained quartz, and minor patches and lenses of very fine grained chlorite. In some veins, very fine grained quartz occurs along borders, and medium to coarse grained calcite occurs in the cores. Pyrite forms a few lenses and patches averaging Ø.1-Ø.3 mm in size, with a few up to Ø.8 mm long. Some veins have halos up to Ø.1 mm wide on either side of the vein of extremely fine grained sericite.

A few veins with diffuse borders averaging Ø.5 mm wide are dominated by extremely fine grained sericite with minor dusty to extremely fine grained, disseminated opaque.

A few veinlets averaging Ø.Ø2-Ø.Ø5 mm in width are dominated by very fine grained quartz.

Sample Ø3-73 Altered Metamorphosed Andesite with Seams of Sericite-Pyrite, Lenses of Albite, and Veins of Calcite-Pyrite-(Opaque)

The rock is a slightly porphyritic andesite which was metamorphosed and recrystallized. Plagioclase was altered to calcite, sericite, and minor epidote. Mafic minerals were altered to sericite/biotite-Ti-oxide. Early lenses are of albite; later (?) seams are of sericite-opaque, and later veinlets are of calcite and/or pyrite.

phenocrysts	
plagioclase	5- 7%
hornblende(?)	1- 2
groundmass	
plagioclase	35-4Ø
calcite	17-2Ø
sericite	12-15
epidote	1
mica	8-1Ø
opaque	2- 3
seams	
sericite-opaque	2- 3
veinlets	
1) albite	1- 2
2) calcite	2- 3
pyrite	Ø.7
quartz	Ø.1

Plagioclase forms anhedral to subhedral prismatic to equant phenocrysts averaging Ø.5-1.2 mm in size. These are set in a groundmass dominated by plagioclase averaging Ø.Ø5-Ø.15 mm in size, with lesser biotite(?) averaging Ø.Ø3-Ø.1 mm in size. Plagioclase is altered slightly to locally strongly to extremely fine grained calcite and sericite, with local patches up to Ø.7 mm in size of ragged very fine to fine epidote grains.

A few phenocrysts of hornblende(?) are altered completely to sericite, with or without moderately abundant, disseminated, irregular patches of opaque.

In the groundmass, mafic grains (possibly originally hornblende or biotite) are altered to pale to medium brown, sericite/biotite. Many grains contain moderately abundant, cryptocrystalline Ti-oxide inclusions, which give the grains an apparent pleochroism from light brown to nearly opaque.

Opaque forms anhedral patches averaging Ø.Ø3-Ø.Ø7 mm in size.

The rock is altered in a few irregular seams up to Ø.3 mm wide of extremely fine grained, pale brown sericite/biotite.

Lenses up to 2 mm long and Ø.5 mm wide consist of fine to very fine grained, slightly interlocking, prismatic grains of unaltered plagioclase, probably albite-oligoclase. Interstitial to plagioclase in some patches is minor extremely fine grained calcite.

Veins up to 1.3 mm wide are dominated by very fine to locally medium grained calcite with minor to moderately abundant clusters of very fine grained opaque (pyrite?). Medium to locally coarse grained calcite occurs in the cores of veins. One vein contains minor quartz along borders of the vein, and patches of pyrite enclosed in calcite in the core. Pyrite forms a few veinlets up to a few mm long and Ø.3 mm wide.

Sample Ø3-81 Late Andesite Dike; Fragments of Andesite; Calcite Veinlets

A late andesite dike with a border zone characterized by radiating aggregates of plagioclase contains fragments of slightly porphyritic andesite replaced moderately by calcite-quartz patches and veinlets. Calcite-(opaque) forms a few discontinuous veinlets in both the fragments and the dike.

andesite	17-2Ø%	dike	78-8Ø%
phenocrysts		phenocrysts	
plagioclase	1- 2	plagioclase	1
hornblende	2- 3	groundmass	
groundmass	8-1Ø	plagioclase	55-6Ø
replacement		calcite	17-2Ø
calcite	3- 4	opaque	1- 2
quartz	1- 2	Ti-oxide	1
late veins		chlorite	Ø.3
calcite	1		

The andesite contains phenocrysts of plagioclase and hornblende(?) averaging Ø.8-1.2 mm in size. Plagioclase is altered moderately to extremely fine grained sericite and patches of dolomite. Hornblende(?) is altered completely to very fine grained, aggregates of subparallel flakes of sericite, with minor to moderately abundant lenses of opaque. The groundmass contains plagioclase and much less biotite averaging Ø.Ø7-Ø.15 mm in size, with local concentrations of dolomite/ankerite patches and minor interstitial patches of quartz grains averaging Ø.Ø2-Ø.Ø5 mm in size. Biotite is altered to pseudomorphic muscovite and minor chlorite, with moderately abundant dusty limonite.

Calcite and lesser quartz form irregular, fine to very fine grained replacement patches up to 2 mm across.

A border zone of the dike up to 1.5 mm wide is characterized by subradiating to sheaf-like clusters of acicular plagioclase grains averaging Ø.15-Ø.2 mm in diameter or length. Interstitial to plagioclase grains in the clusters are cryptocrystalline trains and patches of Ti-oxide. A patch a few mm across along the border is replaced by an aggregate of calcite grains averaging Ø.Ø5-Ø.1 mm in grain size with much less patches of a pale yellowish green mineral with low birefringence (possibly chlorite); much of the original subradiating plagioclase texture is preserved.

Away from the border, the dike contains laths of plagioclase averaging Ø.1-Ø.15 mm in length, in part showing a subradiating texture, and enclosed in a groundmass of extremely fine grained, anhedral, equant plagioclase. A few clusters of subhedral to anhedral, prismatic phenocrysts of plagioclase up to Ø.6 mm long are altered completely to calcite. Interstitial to plagioclase grains is abundant dusty Ti-oxide as in the border zone. Calcite forms irregular replacement patches averaging Ø.Ø5-Ø.15 mm in size. A few spheroidal patches up to Ø.5 mm across appear to be original aggregates of equant plagioclase grains averaging Ø.1 mm in size replaced completely by calcite with minor pyrite. Opaque (pyrite?) forms disseminated, subhedral grains averaging Ø.Ø2-Ø.Ø3 mm in size, and a few irregular clusters of similar grains up to Ø.8 mm across. Light yellow-green chlorite forms a few spheroidal patches up to Ø.Ø5 mm across of extremely fine grained aggregates.

A few late, discontinuous veinlets of very fine grained calcite average Ø.Ø5-Ø.2 mm in width. Many of them are cut off or offset along late fractures.

Sample Ø3-88 **Altered Andesite Tuff; Calcite-Pyrite-(Quartz) Vein**

The rock is strongly altered, and many of the original textures are destroyed. It contains plagioclase and lesser hornblende and biotite phenocrysts and dacite fragments in a groundmass dominated by sericite and calcite, with lesser quartz and chlorite. It is cut by a vein up to a several mm wide of calcite with a border zone up to a few mm wide of pyrite and minor quartz.

fragments				
plagioclase phenocrysts		1Ø-12%		
hornblende(?)		2- 3		
altered dacite(?) fragments		1- 2		
biotite		Ø.3		
groundmass				
sericite	3Ø-35			
calcite	25-3Ø	vein		
quartz	7- 8		calcite	8-1Ø
chlorite	4- 5		pyrite	4- 5
pyrite	3- 4		quartz	Ø.5
Ti-oxide	1- 1.5		chlorite	minor
apatite	Ø.3			

Patches averaging Ø.2-Ø.7 mm in size and locally up to 1.7 mm in size consist of aggregates of extremely fine grained sericite; subhedral outlines of some suggest that they were plagioclase phenocrysts.

Several patches up to 1 mm in size of very fine to fine grained quartz with minor to moderately abundant calcite and opaque may represent altered hornblende phenocrysts. Other similar patches may be of replacement origin.

Two altered dacite(?) fragments up to 1.8 mm across consist of an aggregate of very fine grained, slightly to moderately interlocking quartz, with much less sericite as interstitial patches and disseminations of extremely fine grains. One fragment is of dacite dominated by equant, slightly interlocking plagioclase grains averaging Ø.Ø1-Ø.Ø2 mm in size with scattered patches of calcite and minor disseminated Ti-oxide/opaque.

Biotite (altered completely to pseudomorphic muscovite and Ti-oxide) forms a few flakes averaging Ø.15-Ø.2 m min length.

The groundmass is dominated by extremely fine grained sericite containing disseminated Ti-oxide grains averaging Ø.ØØ5-Ø.Ø1 mm in size. Calcite forms irregular patches averaging Ø.Ø5-Ø.5 mm in size of very fine to extremely fine grains. Quartz forms disseminated grains and clusters of a few grains averaging Ø.Ø5-Ø.15 mm in grain size. Chlorite forms patches up to Ø.3 mm in size of very fine to extremely fine grained, pale green aggregates.

Pyrite forms disseminated subhedral to euhedral grains averaging Ø.1-Ø.5 mm in size, and local porphyroblastic grains up to 1.5 mm in size. The latter contain moderately abundant irregular inclusions of quartz and less commonly sericite.

Ti-oxide forms anhedral patches up to Ø.3 mm in size of cryptocrystalline aggregates, probably after original ilmenite. Apatite forms a few anhedral, equant grains averaging Ø.1-Ø.3 mm in size.

The vein is dominated by very fine grained, moderately strained, interlocking calcite grains, generally containing abundant dusty opaque inclusions. On the borders are zones up to 2 mm wide of subhedral to euhedral pyrite grains averaging Ø.3-1 mm in size. Quartz occurs locally on the border of the vein adjacent to pyrite as very fine grained aggregates, intergrown with minor irregular very fin to fine grains of calcite. Chlorite forms minor interstitial patches of unoriented to radiating grains up to Ø.Ø5 mm long.

Sample Ø3-89.7 **Breccia: Fragments of Diorite, much less Andesite(?), and minor other Types with Veins of Calcite-Quartz-K-feldspar-(Pyrite-Chlorite)**

The sample contains abundant fragments of a fine to medium grained, mainly leucocratic diorite, a few of andesite and one of each of several other types. The groundmass is granulated and partly recrystallized and altered aggregates of these rock types. A vein up to 2 mm wide and a few smaller lenses and veinlets are dominated by calcite, K-feldspar, and quartz, with a few patches of pyrite and minor chlorite.

fragments		
diorite	4Ø-45%	
andesite	7- 8	
other types	7- 8	
groundmass	3Ø-35	
veins, etc.		
calcite-quartz- K-feldspar-(pyrite-chlorite)		7- 8

Diorite fragments are dominated by fine to medium grained, slightly interlocking plagioclase grains, with minor to moderately abundant very fine grained plagioclase and scattered patches of ilmenite-leucoxene. Plagioclase is altered slightly to locally strongly to patches of calcite and disseminated sericite. A few fragments are dominated by relatively fresh plagioclase, with a few replacement patches and veinlets of extremely fine grained calcite and/or biotite. One fragment contains two flakes up to 1.3 mm long of biotite, altered completely to pseudomorphic chlorite and abundant Ti-oxide. Another fragment contains moderately abundant similar biotite flakes up to Ø.15 mm in size. One fragment is a hornblende(?) grain 1.7 mm across. It is altered completely to patchy, very fine grained aggregates of calcite, chlorite, and lesser opaque. Quartz forms scattered, interstitial patches averaging Ø.2-Ø.5 mm in size of grains averaging Ø.Ø5-Ø.Ø7 mm in size, in pat intergrown with plagioclase of similar grain size. Apatite forms disseminated grains averaging Ø.Ø4-Ø.Ø8 mm in size, with a few up to Ø.12 mm long. Pyrite forms replacement patches and lenses of very fine grains.

One fragment a few mm across is a very fine to extremely fine grained meta-andesite dominated by plagioclase and sericite with lesser chlorite and Ti-oxide/opaque. Another one of meta-andesite contains lathy plagioclase grains up to Ø.3 mm in length and equant plagioclase grains averaging Ø.Ø3-Ø.1 mm in size in an extremely fine grained groundmass dominated by chlorite and Ti-oxide, with scattered clusters of opaque.

One fragment is of a plagioclase-(biotite) porphyritic dacite. Plagioclase forms phenocrysts (2Ø-25%) averaging Ø.3-Ø.8 mm in size. Mafic phenocrysts (hornblende biotite) are altered completely to extremely fine grained aggregates of biotite-(pyrite-quartz), and hornblende phenocryst is altered to extremely fine to very fine grained biotite-quartz-calcite. Opaque forms a rectangular patch Ø.3 mm across consisting of extremely fine, equant grains. The groundmass is plagioclase and quartz averaging Ø.Ø1-Ø.Ø3 mm in grain size, with minor disseminated calcite, opaque, and apatite.

One fragment is a very fine grained aggregate of plagioclase and biotite with lesser calcite and Ti-oxide. Biotite is pleochroic from pale to light brown. Another fragment(?) 1.7 mm across is dominated by extreme fine grained biotite with abundant disseminated patches and veinlets up to Ø.15 mm across of opaque, with or without minor chlorite.

(continued)

The groundmass is dominated by slightly to moderately interlocking, very fine to extremely fine grained plagioclase, with moderately abundant patches of very fine to extremely fine grained calcite, chlorite, and opaque. It commonly contains scattered, fragments averaging Ø.Ø3-Ø.Ø8 mm in size, mainly of plagioclase.

In the main vein, calcite, quartz, and K-feldspar form anhedral grains averaging Ø.5-1 mm in size. Quartz commonly has subhedral to euhedral terminations against calcite. Pyrite forms a few anhedral patches up to 1.7 mm long. Chlorite forms subradiating to parallel aggregates of flakes averaging Ø.Ø5-Ø.1 mm in size. A smaller lens is dominated by fine grained calcite with minor interstitial quartz, and with pyrite and locally chlorite concentrated near the border of the lens. A veinlet up to Ø.Ø3 mm wide consists of K-feldspar, quartz, calcite, and minor sericite, and locally has a moderately well developed alteration halo of extremely fine grained sericite.

Sample Ø3-91.5 Altered Felsic Breccia: Groundmass Quartz-Sphalerite-Pyrite-Dolomite-(Sericite)

fragments	
latite (minor phenocrysts)	3Ø-35%
porphyritic latite	2Ø-25
porphyritic dacite	1
groundmass	
quartz	3Ø-35
sphalerite	4- 5
pyrite	2- 3
dolomite/ankerite	2- 3
sericite	1

Fragments of latite are dominated by extremely fine grained sericite. A few contain one or two ragged phenocrysts of biotite (replaced by pseudomorphic muscovite and ragged patches of Ti-oxide) up to 1.2 mm long. In one fragment, two biotite phenocrysts are replaced by a network of thick Ti-oxide lenses along crystallographic directions in the biotite, with interstitial patches of extremely fine grained, unoriented sericite and patches of very fine grained muscovite, mainly near margins of the phenocrysts. One fragment contains a zone up to 1.5 mm across of very fine grained, unoriented muscovite flakes intergrown with about the same amount of irregular ankerite grains. A few contain replacement patches and veinlike zones of dolomite with or without pyrite. Pyrite forms anhedral grains averaging Ø.Ø5-Ø.4 mm in size, and commonly is surrounded by very fine grained dolomite. A few fragments contain anhedral to subhedral porphyroblasts of pyrite up to 1 mm in size. Some similar fragments are replaced moderately to strongly by patches of very fine grained to fine grained, in part porphyroblastic ankerite/dolomite. A few contain equant, subhedral grains of apatite up to Ø.3 mm across, and prismatic grains up to Ø.4 mm long. One contains an irregular grain 1.4 mm long. A few contain clusters of fractured apatite grains associated with patches of Ti-oxide. One contains a patch 1.3 mm long dominated by Ti-oxide with minor interstitial, extremely fine grained sericite. One contains a wispy, discontinuous veinlet of Ti-oxide averaging Ø.Ø2-Ø.Ø3 mm wide.

Some fragments of porphyritic latite are similar to the above type, and contain subhedral, prismatic phenocrysts of plagioclase or hornblende up to 1.5 mm in size. The phenocrysts are altered completely to aggregates of extremely fine grained sericite-carbonate or of quartz averaging Ø.Ø5-Ø.1 mm in grain size with abundant patches of dolomite/ankerite of similar size and minor sericite flakes. A few fragments of porphyritic latite contain subhedral plagioclase phenocrysts from Ø.2-1 mm in size, minor equant ones of biotite up to Ø.4 mm across and minor angular ones of quartz up to Ø.1 mm in size in a groundmass of extremely fine grained plagioclase, colored light brown by dusty inclusions. In these, plagioclase phenocrysts are altered to extremely fine grained sericite, locally with moderately abundant dolomite, and biotite is altered to aggregates of very fine grained muscovite.

One fragment 1.3 mm across contains a subangular phenocryst of quartz up to Ø.3 mm across and a few up to Ø.2 mm across of plagioclase altered to sericite in a groundmass of extremely fine grained plagioclase stained brown by dusty opaque/semiopaque inclusions. A second fragment of similar size has the same groundmass but no phenocrysts.

(continued)

In the groundmass, quartz commonly forms aggregates of slightly interlocking grains averaging Ø.Ø2-Ø.Ø5 mm in size. Intergrown with these are minor to moderately abundant disseminated grains and patches of extremely fine grained sericite and carbonate. Coarser grained patches of quartz (up to Ø.5 mm in grain size) commonly are intergrown with sulfides; in a few of these, quartz grains have subhedral to euhedral terminations against sphalerite.

Sphalerite forms patches up to a few mm across of anhedral grains with a medium red-brown color. Pyrite forms anhedral grains up to Ø.8 mm in size associated with sphalerite.

Dolomite/ankerite forms anhedral grains up to Ø.1 mm in size intergrown with sulfides.

One sericite-rich fragment is cut by a veinlet Ø.5 mm wide of very fine to locally fine grained quartz-dolomite-sphalerite-(pyrite) as in the groundmass.

Sample 03-92.3 Altered Porphyritic Andesite; Pyrite-Quartz Vein

The rock contains phenocrysts of plagioclase, lesser ones of hornblende, and minor ones of quartz and apatite in an extremely fine grained groundmass dominated by plagioclase and much less sericite and ankerite, and minor quartz and Ti-oxide. Pyrite is concentrated in a band up to a few mm wide. At one end is a vein up to a few mm wide dominated by pyrite and quartz.

phenocrysts			
plagioclase	25-30%	vein	
hornblende	5- 7	pyrite	3- 4%
quartz	1	quartz	1- 2
apatite	minor	sericite	0.1
groundmass		-- -- -- --	-- -- -- --
plagioclase	50-55		
sericite	5- 7	opaque	1.5-2
ankerite	2- 3	Ti-oxide	0.5
quartz	0.3	apatite	0.1

Plagioclase forms subhedral to euhedral prismatic phenocrysts averaging 0.2-1.2 mm in length, with a few up to 2 mm long. They are altered completely to extremely fine grained sericite, with scattered, locally prominent, commonly irregular patches of very fine grained ankerite. A few contain minor replacement patches of very fine to extremely fine grained quartz as in the groundmass.

Hornblende(?) forms subhedral, elongate to stubby prismatic phenocrysts from 0.5-1.5 mm in length. It is altered completely to ankerite. Some grains have moderately abundant Ti-oxide/opaque concentrated near their margins. A few contain moderately abundant inclusions of apatite, and a few contain patches of extremely fine grained sericite intergrown with ankerite.

Quartz forms one phenocryst 1.5 mm across; in detail, it has irregular borders against the groundmass.

Apatite forms a few subhedral to euhedral prismatic grains up to 0.2 mm long. In the groundmass it forms subhedral prismatic grains averaging 0.05-0.07 mm long.

The groundmass is dominated by plagioclase grains averaging 0.02-0.03 mm in size, with moderately abundant extremely fine grained sericite, probably formed by alteration of plagioclase. A few prismatic plagioclase grains average 0.07-0.15 mm in length. Like the coarser phenocrysts, these are altered completely to sericite. Ankerite forms patches up to 0.5 mm in size of very fine grained aggregates. Quartz occurs in patches up to 0.3 mm in size of extremely fine to very fine grained aggregates.

Ti-oxide forms scattered patches averaging 0.07-0.15 mm in size, with a few from 0.2-0.5 mm across. These consist of boxworks of Ti-oxide with interstitial patches of sericite, and probably are secondary after sphene and/or ilmenite. Disseminated, extremely fine grained Ti-oxide is concentrated in certain patches in the groundmass.

Pyrite forms equant subhedral disseminated grains averaging 0.1-0.5 mm in size. It is concentrated in a band up to a few mm across, in which it forms 7-8%, and clusters of a few grains.

At one edge of the section is a vein 0.5 mm wide dominated by very fine grained quartz, with scattered clusters of pyrite and interstitial patches of extremely fine grained sericite. Quartz commonly forms subhedral, prismatic grains oriented perpendicular to the walls of the vein. Adjacent to it, and grading into it is a zone up to 2 mm wide of anhedral to euhedral pyrite grains averaging 0.1-0.5 mm in size.

Sample Ø3-95.8 Altered Diorite; Replacement Patches of Quartz-Pyrite; Veins of Quartz-(Chlorite-Pyrite-Sphalerite)

The sample is a medium to coarse grained diorite dominated by plagioclase with much less biotite, ilmenite, and apatite. Plagioclase is altered complete to sericite, and original textures are destroyed. Biotite is replaced by muscovite-Ti-oxide, and ilmenite by leucoxene/Ti-oxide. Replacement patches of quartz-pyrite-sericite may in part be after hornblende. Veins up to 1.5 mm wide are of quartz with lesser patches of each of chlorite, pyrite, and sphalerite.

plagioclase	7Ø-75%
apatite	4- 5
biotite	1- 2
ilmenite	2- 3
replacement	
quartz	1Ø-12
pyrite	2- 3
sericite	1
veins	
quartz	2- 3
pyrite	1
chlorite	1
sphalerite	Ø.3
veinlets	
quartz	minor

Plagioclase is altered completely to sericite, and original grain borders were obliterated. Original grain size probably was coarse to medium.

Apatite forms subhedral to euhedral, equant to prismatic grains averaging Ø.1-Ø.4 mm in size, with a few up to Ø.6 mm long. It commonly occurs in clusters associated with Ti-oxide.

Biotite forms ragged flakes up to 1.2 mm in size, commonly associated with ilmenite and apatite. It is altered completely to pseudomorphic muscovite which is recrystallized partly to extremely fine grained sericite. Some grains also contain abundant dusty Ti-oxide along cleavage planes. Some biotite phenocrysts contain abundant inclusions of apatite.

Ilmenite forms patches up to 1.5 mm in size, commonly in cores of mafic patches, and surrounded by biotite and/or apatite. It is altered to extremely fine grained leucoxene/Ti-oxide with minor interstitial sericite.

Replacement patches up to a few mm across consist of aggregates dominated by very fine to fine grained quartz with minor to moderately abundant interstitial and disseminated flakes and patches of sericite. Some of the patches have outlines suggesting they may have formed by replacement of hornblende. Patches of quartz up to Ø.2 mm in size may be interstitial to plagioclase. Pyrite forms porphyroblasts from Ø.5-1.5 mm in size in the rock and finer grains and clusters associated with replacement patches of quartz.

A few veins up to 1 mm wide are dominated by fine to medium grained quartz, with patches dominated by pyrite, chlorite, or sphalerite. Chlorite forms a few patches up to 1 mm in size of subradiating aggregates. Sphalerite forms patches up to 1 mm long in a vein, in part associated with a large patch of chlorite and in part interstitial to quartz. Veinlets averaging Ø.Ø2-Ø.Ø5 mm wide are dominated by quartz.

Sample 03-95.8 (polished TS) **Altered Diorite replaced by Quartz-Chlorite; Vein of Quartz-Sphalerite-Pyrite-Chlorite**

The rock is a strongly altered diorite as in the thin section, with less abundant apatite, ilmenite, and biotite. It is replaced irregular patches by very fine grained quartz. Veins consist of medium to locally coarse grained quartz, with lesser sphalerite, pyrite, and chlorite.

plagioclase	35-40%	veins	
apatite	2- 3	quartz	10-12%
ilmenite	1- 2	sphalerite	5- 7
biotite	0.5	pyrite	3- 4
replacement patches in diorite		chlorite	3- 4
quartz	3- 4	galena	minor
pyrite	0.5	chalcopyrite	trace
replacement patches		Mineral X	trace
quartz	2- 3		
chlorite	1		
pyrite	1		
sericite	minor		
sphalerite	minor		

Plagioclase is altered strongly to completely to extremely fine grained sericite, in part oriented parallel to c-axes of plagioclase grains. Textures suggest that original plagioclase grains were coarse.

Apatite, ilmenite and biotite occur in clusters up to a few mm across. Apatite forms subhedral to euhedral grains averaging 0.1-0.5 mm in size, with a few elongate prismatic grains up to 1 mm in length. Ilmenite forms equant patches averaging 0.2-0.6 mm in size. Alteration is to leucoxene and Ti-oxide, with moderately abundant interstitial quartz. Biotite forms ragged flakes averaging 0.1-0.2 mm in size; it is altered completely to pseudomorphic muscovite with minor Ti-oxide.

The rock contains replacement patches up to 2 mm across of very fine grained quartz with much less extremely fine grained sericite. These are similar to early replacement patches in the thin section, and some may be after original hornblende.

Replacement patches up to 1.5 mm in size along borders of veins consists of very fine grained aggregates of quartz and chlorite, and locally quartz and sericite. Some of these patches also contain disseminated, irregular grains of sphalerite. Pyrite forms disseminated, anhedral to subhedral grains averaging 0.1-0.5 mm in size, in part associated with mafic clusters.

Veins up to 1.5 mm wide are dominated by fine to medium grained quartz, in part anhedral and in part prismatic. Sphalerite forms patches up to a few mm across of anhedral grains, commonly interstitial in part to subhedral to euhedral quartz. Sphalerite is deep brownish red in color. It contains minor anhedral inclusions of chalcopyrite up to 0.05 mm in size and of pyrrhotite averaging 0.01-0.02 mm in size. One inclusion 0.06 mm long consists of galena, chalcopyrite, and Mineral X. The last forms an elongate grain 0.015 long, and has a pale cream color and high reflectivity. It may be native bismuth or electrum. Pyrite forms aggregates of euhedral to subhedral grains averaging 0.1-0.5 mm in size, with a few up to 2.5 mm across. A few pyrite grains contain inclusions from 0.01-0.1 mm in size of galena and lesser sphalerite. A few large pyrite grains contain exsolution(?) lenses of Fe-oxide. Associated with one inclusion of galena are a few grains up to 0.002 mm in size of Mineral X. Chlorite forms patches of very fine to locally fine grained flakes. Chalcopyrite forms grains up to 0.07 mm in size in quartz.

Sample Ø3-1Ø1.3 **Breccia: Fragments of Diorite and Andesite; with Matrix of Quartz-Pyrite-Sphalerite**

Fragments of diorite and lesser ones of porphyritic and non-porphyritic andesite are up to 2 cm across. The diorite is coarse grained and dominated by plagioclase, with much less biotite, apatite, and ilmenite. It is altered strongly, with plagioclase replaced by sericite, and biotite by muscovite-(Ti-oxide). Some of the andesite fragments contain phenocrysts of plagioclase and minor biotite (both altered completely) in as groundmass of plagioclase-sericite. Other andesite fragments are non-porphyritic. The breccia matrix and minor replacement zones in fragments is dominated by quartz and pyrite with lesser sphalerite. The matrix occurs in veinlike zones between fragments.

fragments			matrix	
1) diorite	(4Ø-45%)		quartz	12-15%
plagioclase		4Ø-45%	pyrite	8-1Ø
biotite		2- 3	sphalerite	2- 3
apatite		1- 2	galena	trace
ilmenite		1- 2	chalcopyrite	trace
quartz		4- 5		
2) andesite		2Ø-25		

In the diorite, plagioclase forms anhedral grains up to 2 mm in size. It is replaced completely by extremely fine grained sericite, and original textures are obliterated.

Biotite, apatite, and ilmenite commonly occur in clusters up to a few mm across. Biotite forms interstitial grains up to 1.5 mm in size. It is replaced completely by pseudomorphic muscovite with Ti-oxide concentrated along cleavage planes. Apatite forms subhedral grains averaging Ø.1-Ø.5 mm in size. Equant patches averaging Ø.2-Ø.5 mm in size contain networks of Ti-oxide with interstitial patches of quartz and/or sericite.

Irregular patches of very fine grained quartz in the diorite are probably largely of replacement origin; some of these are intergrown with much less sericite.

The largest fragment and a few small ones are of altered andesite. The large fragment contains phenocrysts of plagioclase from Ø.8-1.5 mm in size and minor ragged flakes of biotite up to Ø.7 mm long in a very fine to extremely fine grained groundmass dominated by plagioclase and sericite, with lesser quartz, and minor disseminated Ti-oxide and pyrite. Some fragments are dominated by quartz and sericite, with minor disseminated Ti-oxide. One is dominated by quartz with lesser sericite (after plagioclase), and biotite. Biotite forms ragged flakes averaging Ø.Ø3-Ø.Ø5 mm in size, and is altered to muscovite with moderately abundant dusty limonite.

In the breccia matrix, quartz forms aggregates of anhedral to subhedral grains averaging Ø.2-1.2 mm in size. Finer grains quartz grades into replacement patches in the fragments.

Pyrite forms aggregates of anhedral to subhedral grains averaging Ø.2-1.5 mm in size. Pyrite is slightly to locally moderately anisotropic, suggesting gradation to the marcasite texture and possibly a low temperature of formation. Locally it contains minor inclusions of chalcopyrite and of galena averaging Ø.Ø1-Ø.Ø15 mm in size. Sphalerite forms grains averaging Ø.2-1 mm in size, mainly associated with, and in part interstitial to pyrite. Galena and lesser chalcopyrite form minor inclusions up to Ø.Ø5 mm in size in sphalerite.

Sample 03-107.5 Breccia: Strongly Altered Fragments in Matrix of Quartz-Dolomite-(Pyrite-Chlorite- K-feldspar)

The rock contains angular to irregular fragments of a few rock types, all strongly altered to sericite in a patchy groundmass of very fine to fine grained quartz and dolomite.

fragments		groundmass	
andesite (?)	40-45%	quartz	25-30%
diorite	5- 7	dolomite	17-20
andesite/dacite	2- 3	pyrite	2- 3
K-feldspar-rich	0.5	chlorite	1- 2
		K-feldspar	1

Many fragments of altered andesite(?) are dominated by extremely fine grained sericite. Many of these also contain irregular, very fine to extremely fine grained patches of dolomite, of quartz, and of chlorite, and minor disseminated, in part porphyroblastic pyrite grains, locally up to 0.6 mm across.

A few fragments contain minor plagioclase phenocrysts (altered to sericite) in an extremely fine grained groundmass of plagioclase-sericite-quartz with minor Ti-oxide and opaque. One andesite/dacite fragment is non-porphyritic, and is dominated by very fine to extremely fine grained, equant plagioclase, with moderately abundant replacement patches of extremely fine grained dolomite, scattered patches of quartz and of chlorite, and minor disseminated Ti-oxide/opaque.

A few fragments are of altered diorite. Many of these are dominated by extremely fine to very fine grained sericite, which shows no signs of original textures of plagioclase. Diorite fragments contain one or more of the following: moderately abundant, subhedral apatite grains averaging 0.2-0.5 mm in size; equant flakes of biotite averaging 0.3-0.6 mm in size (with a few up to 2.5 mm across) altered completely to muscovite-(Ti-oxide), locally with rims of chlorite; irregular interstitial patches of chlorite up to 0.7 mm in size; replacement patches of dolomite up to 0.2 mm in size; and patches of pyrite up to 0.7 mm in size. One less altered diorite fragment contains fine to medium plagioclase grains moderately altered to sericite and minor dolomite, with minor very fine grained apatite, opaque, and quartz.

One fragment is dominated by equant, slightly interlocking plagioclase averaging 0.05-0.15 mm in grain size and altered slightly to sericite, with a few patches up to 0.25 mm in size of chlorite and lesser ones of dolomite.

Minor fragments averaging 0.3-0.7 mm in size consist of very fine to fine grained K-feldspar with abundant opaque inclusions.

In the breccia matrix quartz forms aggregates of two main types. An earlier stage consists of slightly interlocking grains averaging 0.03-0.05 mm in size, with minor to locally moderately abundant interstitial patches extremely fine grained sericite. Late-formed quartz forms aggregates of anhedral to locally subhedral grains averaging 0.1-0.3 mm in grain size. Dolomite forms patches up to a few mm across of grains averaging 0.1-0.2 mm in size. In some patches, dolomite grains are strained moderately. Pyrite forms grains and clusters of grains averaging 0.05-0.2 mm in size, with a few over 0.5 mm across, commonly associated with dolomite. Chlorite forms very fine grained aggregates, mainly along borders of matrix and fragments. K-feldspar forms very fine grained patches, whose distribution is best seen in the stained offcut block.

Sample Ø4-148.5 **Breccia: Diorite and Minor Andesite Fragments; Groundmass of Granulated Host Rocks and Calcite-Pyrite Replacement Patches**

Fragments up to a few mm across are dominated by medium to coarse grained diorite, with fewer ones of a few types of andesite. These are set in a groundmass of granulated fragments of diorite with replacement patches of calcite-pyrite and minor quartz.

fragments		groundmass	
diorite	35-4Ø%	rock flour, fragments	35-4Ø%
andesite	3- 4	calcite	17-2Ø
		opaque(pyrite?)	2- 3
		quartz	Ø.5

In the diorite, plagioclase forms anhedral to subhedral grains up to a few mm across. Many are fractured and slightly deformed. Alteration ranges from minor to strong to extremely fine grained sericite and much less calcite. Some grains are cut by veinlets of calcite and sericite. Others are cut by veinlets up to Ø.3 mm wide of extremely fine grained opaque (pyrite?), with interstitial, extremely fine grained chlorite, sericite, and calcite.

Biotite (8-1Ø%) is concentrated in clusters up to a few mm across of ragged flakes averaging Ø.3-Ø.5 mm in size, with a few over 2 mm across. Alteration is to pseudomorphic muscovite or extreme fine to very fine grained sericite, with or without moderately abundant lenses of dusty Ti-oxide parallel to cleavage.

Apatite (2-3%) forms anhedral grains averaging Ø.12-Ø.5 mm in size, with a few up to Ø.7 mm long. Many coarser grains are fractured strongly. Apatite is most abundant with biotite clusters.

Opaque (leucoxene/Ti-oxide/ilmenite) (2-3%) forms ragged patches up to 2 mm in size, commonly associated with biotite. Opaque (pyrite?) (Ø.5%) forms irregular disseminated patches averaging Ø.1-Ø.5 mm in size.

A few fragments up to 2 mm in size consist of very fine grained diorite/andesite dominated by equant plagioclase grains averaging Ø.1 mm in size, with interstitial patches of very fine grained biotite and ragged clusters of pyrite.

One andesite fragment up to 4 mm across is dominated by unoriented plagioclase laths averaging Ø.1-Ø.2 mm in length, with abundant interstitial patches of Ti-oxide, opaque, and biotite averaging Ø.Ø5-Ø.1 mm in size. Other patches may be extremely fine grained fragments of andesite or may be granulated groundmass; they are altered variably to sericite, calcite, and opaque.

The groundmass is very variable in composition. Parts consist of strongly granulated rock fragments, with minor fragments over Ø.1 mm in size surrounded by extremely fine grained material, probably dominated by plagioclase. Some patches are replaced by very fine grained quartz with lesser sericite and biotite. Other patches dominated by sericite and/or biotite may represent altered groundmass material. Calcite forms irregular replacement patches up to a few mm across of moderately interlocking grains averaging Ø.5-1 mm in size. Biotite forms extremely fine grained aggregates in irregular patches. Its texture suggests that it was formed during contact metasomatism.

A replacement patch up to several mm across is dominated by fine to medium grained, interlocking calcite grains, with abundant disseminated pyrite? grains averaging Ø.Ø4-Ø.Ø7 mm in size. Quartz forms scattered patches of extremely fine to very fine grains, commonly concentrated near the border of the replacement patch.

Sample Ø4-216.5 **Breccia with Matrix of Pyrite-Quartz-Dolomite-Pyrrhotite-Sphalerite-Chlorite-(Sericite) with Trace Electrum and Argentite**

The section is mainly of the matrix, and only minor fragments are present; these may not be representative of the sample as a whole. Also, fragment are altered strongly. They are of andesite/dacite and minor diorite. The matrix is dominated by pyrite and quartz, with lesser pyrrhotite, dolomite, and sphalerite, minor chlorite and trace electrum and argentite.

fragments			
andesite/dacite	5- 7%		
diorite(?)	1- 2		
matrix			
pyrite	4Ø-45	sphalerite	3- 4%
quartz	2Ø-25	chalcopyrite	1
ankerite	1Ø-12	galena	trace
pyrrhotite	5- 7	electrum	trace
chlorite	2- 3	argentite	trace
sericite	1		

Andesite and dacite fragments are up to 1.5 mm in size. Andesite fragments consist of very fine grained plagioclase intergrown with lesser chlorite, and with patches of sericite and of ankerite. Dacite fragments are dominated by very fine grained plagioclase altered slightly to strongly to sericite. One fragment is dominated by extremely fine grained chlorite with lesser sericite with minor Ti-oxide. A few fragments up to Ø.3 mm in size are dominated by Ti-oxide with lesser sericite. Fragments are surrounded by and replaced partly by fine to very fine grained quartz, with minor patches of extremely fine grained sericite.

In another part of the rock, one fragment(?) contains several grains of apatite up to Ø.4 mm in size surrounded by extremely fine to very fine grained chlorite-ankerite-quartz. This probably is a strongly altered fragment of diorite.

The vein contains patches rich in pyrite and others rich in quartz.

Sulfide-rich patches are dominated by pyrite and lesser sphalerite and pyrrhotite. Pyrite forms subhedral to anhedral grains averaging Ø.2-2 mm in size. Finer grained zones are dominated by subhedral to euhedral pyrite with interstitial pyrrhotite, chalcopyrite, and ankerite. A few coarser pyrite grains contain minor inclusions of chalcopyrite and pyrrhotite and trace inclusions of galena averaging Ø.Ø2-Ø.Ø5 mm in size. A few pyrite grains contain abundant, extremely fine grained, exsolution lenses of Fe-oxide(?).

Pyrrhotite forms irregular patches of fine to medium grains, in part interstitial to pyrite and averaging Ø.3-1 mm min size. Much of the pyrrhotite is altered moderately to strongly to pyrite/marcasite, which commonly shows spheroidal textures. Less altered patches are altered along grain borders and fractures to extremely fine grained pyrite/marcasite.

Deep brownish red sphalerite forms patches up to 3 mm in size intergrown with pyrite, and much smaller patches interstitial to pyrite. Some of the latter contain minor exsolution blebs of chalcopyrite.

Chalcopyrite forms anhedral patches averaging Ø.Ø7-Ø.25 mm in size, with a few from Ø.3-1 mm in size associated with pyrrhotite in interstitial patches in pyrite.

Electrum forms a few inclusions in pyrite averaging Ø.Ø1-Ø.Ø2 mm in size, in part intergrown with galena. It is light yellow in color, indicating a moderate silver content (15-2Ø%). Argentite occurs alone or with electrum as grains up to Ø.Ø2 mm long in a few inclusions and one fracture in pyrite.

Interstitial to sulfides are fine to medium grained patches up to a few mm across dominated by ankerite with much less quartz, chlorite, and sericite. Some ankerite patches have a subradiating texture.

Quartz forms anhedral to euhedral grains, with euhedral terminations common against ankerite grains.

Interstitial to pyrite, chlorite forms patches of unoriented, slightly radiating flakes averaging Ø.Ø3-Ø.Ø5 mm in size, and a few subradiating clusters up to Ø.3 mm across. It also forms radiating aggregates averaging Ø.2 mm in diameter in ankerite, and clusters of much finer ones in a few quartz grains. A few patches of medium grained ankerite contain abundant inclusions of very fine grained chlorite.

Sericite forms clusters of subradiating aggregates averaging Ø.Ø5-Ø.25 mm in diameter.

Quartz-rich patches range from fine to coarse grained. A few interstitial patches up to Ø.3 mm in size contain radiating aggregates of carbonate, which show sharp concentric growth zones from cores of ankerite/siderite to outer zones of calcite. Sphalerite forms minor interstitial grains up to Ø.3 mm in size.

Sample 04-236 Altered Porphyritic Dacite Flow or Intrusion

The rock contains phenocrysts of plagioclase, biotite and quartz in a very fine grained groundmass dominated by plagioclase with scattered patches of quartz, and disseminated grains and clusters of pyrite. Alteration of plagioclase ranges from moderate to complete to sericite-dolomite/ankerite. Biotite is replaced completely by muscovite-dolomite-Ti-oxide. A discontinuous veinlet is of dolomite.

phenocrysts		veinlet	
plagioclase	7- 8%	dolomite	1%
biotite	2- 3		
quartz	1- 2		
groundmass			
plagioclase	25-30		
sericite/muscovite	35-40		
dolomite/ankerite	17-20		
quartz	3- 4		
pyrite	4- 5		
K-feldspar	1- 2		
Ti-oxide	1		
apatite	minor		
zircon	trace		

Plagioclase forms subhedral prismatic phenocrysts from 0.5-1.5 mm in size. Most are altered strongly to completely to sericite with or without minor to abundant carbonate, and a few (at one end of the section) are altered only moderately to strongly to sericite.

Biotite forms slender flakes averaging 0.3-1 mm in length. It is altered completely to pseudomorphic muscovite with moderately abundant patches of Ti-oxide and lenses and patches of dolomite.

Quartz forms anhedral phenocrysts averaging 0.1-0.3 mm in size, and a few irregular ones from 0.5-0.8 mm in size with strongly resorbed borders against the groundmass.

The groundmass is dominated by anhedral, slightly interlocking plagioclase grains averaging 0.05-0.15 mm in size. Alteration to extremely fine grained sericite flakes and patches of ankerite and/or dolomite ranges in intensity from moderate at one end to complete at the other end of the section.

Quartz forms interstitial patches from 0.2-1 mm in size of very fine to locally fine grained aggregates, in part intergrown intimately with groundmass plagioclase. Textures grade into those of the phenocrysts.

K-feldspar is concentrated slightly in bands up to a few mm wide as aggregates of very fine grains surrounding quartz phenocrysts and intergrown intimately with groundmass quartz patches. Its distribution is shown in the stained offcut block.

Pyrite forms subhedral to euhedral grains and clusters averaging 0.05-0.3 mm in grain size, with clusters up to 1.7 mm in size.

Ti-oxide forms patches averaging 0.1-0.3 mm in size of extremely fine grained aggregates, probably after original ilmenite.

Apatite forms subhedral to euhedral, slender prismatic grains averaging 0.05-0.2 mm in length.

Zircon forms a few equant grains up to 0.05 mm in size, mainly associated with Ti-oxide, and a euhedral elongate prismatic grain 0.1 mm long.

A wispy, discontinuous veinlet up to 0.08 mm wide is of very fine grained dolomite.

Sample Ø4-24Ø.5 **Heterolithic Felsic Volcanic Breccia; Quartz-Calcite-Pyrite-(Sericite-Chlorite) Groundmass**

The rock contains subangular to subrounded fragments of a variety of rock types in a patchy groundmass of very fine grained calcite and quartz, with disseminated grains and clusters of pyrite, and minor sericite and chlorite. Fragments are of plagioclase aggregates, porphyritic and non-porphyritic latite/dacite, and a few exotic types including diorite, biotite-phlogopite-calcite and hypabyssal andesite.

fragments	
plagioclase	1Ø-12%
porphyritic latite/dacite	3Ø-35
biotite-phlogopite-calcite-pyrite-Ti-oxide-apatite	7- 8
diorite	5- 7
hypabyssal andesite	2- 3
other	4- 5
groundmass	
quartz	15-17
calcite	12-15
pyrite	2- 3
sericite	1- 2
chlorite	Ø.3

Plagioclase forms phenocrysts and clusters of phenocrysts up to 2 mm in size. Some of these are fresh, and others (probably of a different origin) are altered moderately to extremely fine grained sericite. Several contain inclusions of acicular to prismatic apatite from Ø.Ø5-Ø.3 mm in length. A few plagioclase crystals are deformed slightly to moderately, with slight offset and warping of albite twins along fractures. Several fragments consist of fine to very fine grained aggregates of plagioclase, altered slightly to sericite.

A wide variety of textures are present in fragments of dacite/latite. Some fragments contain plagioclase phenocrysts up to 1 mm in size surrounded by a groundmass of very fine grained plagioclase and quartz. In some of these, plagioclase is altered strongly to completely to sericite. Other fragments contain plagioclase and minor biotite phenocrysts from Ø.2-Ø.7 mm in size in an extremely fine grained groundmass of plagioclase and lesser quartz. Some contain minor to moderately abundant K-feldspar in the groundmass. Pyrite and Ti-oxide form disseminated grains and patches in amounts ranging from trace to locally moderately abundant.

A few fragments up to several mm across contain scattered phenocrysts of biotite up to Ø.7 mm in size in a groundmass dominated by extreme fine grained, pale brown phlogopite/sericite. Some fragments contain moderately abundant patches of very fine grained calcite. Others contain moderately abundant disseminated patches of pyrite and lesser ones of Ti-oxide. Apatite forms scattered subhedral grains averaging Ø.Ø5-Ø.15 mm in size.

One large fragment of diorite consists of coarse grained plagioclase with scattered clusters of chlorite-Ti-oxide (after biotite) averaging Ø.5-Ø.8 mm in size, and clusters of apatite averaging Ø.3-Ø.5 mm in grain size. Altered biotite grains contain networks of Ti-oxide grains along crystallographic directions, with interstitial aggregates of very fine grained chlorite.

One fragment is dominated by plagioclase and lesser muscovite (after biotite) grains averaging Ø.Ø5-Ø.1 mm in size, with moderately abundant apatite and opaque grains of similar size, and minor calcite.

(continued)

One fragment contains a ragged phenocryst 1.3 mm across of quartz in an extremely fine grained groundmass of plagioclase, with minor disseminated sericite and patches of calcite.

One fragment is dominated by extremely fine grained sericite with minor disseminated Ti-oxide spots and scattered patches up to 0.5 mm in size of very fine grained chlorite a few of which also contain a pyrite grain up to 0.5 mm in size.

A few fragments of hypabyssal andesite(?) up to 1 mm across consist of aggregates of very fine grained plagioclase, with interstitial patches of chlorite and of calcite, and disseminated grains and clusters of Ti-oxide.

A few fragments up to 0.7 mm across are dominated by Ti-oxide intergrown intimately with very fine grained patches of calcite and of chlorite.

The breccia matrix is patchy, in part dominated by equant calcite grains averaging 0.03-0.07 mm in size, and in part dominated by quartz grains averaging 0.05-0.1 mm in size. Some coarser grained patches contain intergrowths of calcite and quartz with pyrite. Muscovite forms disseminated flakes in calcite averaging 0.07-0.15 mm in length. Pyrite forms disseminated, equant, anhedral to subhedral grains averaging 0.01-0.05 mm in size, mainly in calcite, and a few coarser grains averaging 0.5-1 mm in size.

Sample Ø4-253 Altered Breccia; Vein of Quartz-Pyrite-Pyrrhotite-Sphalerite-Calcite with trace Electrum, Argentite, and Native Silver(?)

The rock contains strongly altered fragments up to a few mm across of a few rock types, many of which are altered and replaced by quartz. It is replaced by a fine to locally coarse grained vein of quartz-pyrite with lesser pyrrhotite, sphalerite, and calcite and a trace of electrum and argentite, and possibly native silver.

fragments	
sericite-rich	1Ø-12%
sericite-(biotite)	3- 4
porphyritic dacite	minor
replacement patches	
quartz-rich	1Ø-12
chlorite-(quartz)	3- 4
vein	
quartz	35-4Ø
pyrite	17-2Ø
sphalerite	4- 5
pyrrhotite	4- 5
calcite	3- 4
chalcopyrite	Ø.1
galena	trace
native silver(?)	trace
argentite	trace
electrum	trace
arsenopyrite	trace

Some fragments are dominated by extremely fine grained sericite showing no relic primary textures. Other sericite-rich fragments contain moderately abundant flakes of biotite averaging Ø.1-Ø.2 mm in size. Biotite is replaced by pseudomorphic muscovite with abundant dusty Ti-oxide. Apatite forms several anhedral grains averaging Ø.2-Ø.4 mm in size. Minor minerals include calcite and disseminated pyrite.

One fragment contains a few subrounded phenocrysts of quartz up to Ø.25 mm across in an extremely fine grained groundmass of plagioclase with minor patches of ankerite.

Some replacement patches up to a few mm across are dominated by very fine grained quartz, with interstitial patches of extremely fine grained chlorite, minor patches of extremely fine grained sericite, and minor disseminated apatite. One of these contains a relic quartz phenocryst Ø.3 mm in size. Other replacement patches consist of very fine grained chlorite with lesser quartz and calcite; these generally border the vein and contain abundant fine to medium grains of pyrite. Gradations in texture and composition exist between different types of replacement patches.

In the vein, quartz forms aggregates of very fine to medium and locally coarse grains. Locally against calcite these have euhedral terminations.

Pyrite forms disseminated clusters of anhedral to subhedral grains averaging Ø.1-Ø.5 mm in size, with a few grains up to Ø.9 mm in size. Grains commonly contain irregular inclusions of non-reflective minerals, and a few also contain minor inclusions up to Ø.Ø7 mm in size of pyrrhotite.

Sphalerite forms anhedral patches up to a few mm in size, concentrated in a veinlike zone up to 2 mm wide in the center of the section. A few grains contain minor exsolution(?) inclusions of pyrrhotite.

Pyrrhotite forms patches averaging Ø.1-Ø.5 mm in size, with a few at one side of the section up to 1.5 mm across. Much of it is altered to secondary pyrite/marcasite with poorly developed colloform textures.

Calcite forms interstitial fine to locally coarse grains, interstitial to quartz and sulfides.

Chalcopyrite forms a few lenses and patches up to Ø.18 mm long in fractures in pyrite.

Galena forms a few inclusions up to Ø.Ø8 mm in size in pyrite.

One inclusion Ø.1 mm long in pyrite consists of equal amounts of galena and an isotropic silvery-white mineral with high reflectivity (native silver ?) with minor pyrrhotite. A second inclusion Ø.Ø6 mm across consists of galena, pyrrhotite, minor pale yellow electrum, and minor argentite. One veinlet in pyrite contains a lens Ø.1 mm long of electrum and argentite.

Arsenopyrite forms a few subhedral to euhedral inclusion of pyrite averaging Ø.Ø2-Ø.Ø3 mm in size.

Sample 1Ø-77 Chert; Vein of Quartz-Calcite-Sphalerite-Mineral X-Galena-Tetrahedrite-Chalcopyrite-(Electrum)

An extremely fine grained chert is cut by numerous quartz veinlets and by a major vein dominated by quartz and calcite, with lesser chlorite and patches of sulfides and sulfosalts dominated by sphalerite, galena, Mineral X, chalcopyrite, and tetrahedrite. Minor electrum is intergrown with sulfides. The sample is through the vein zone and contains patches of host rock along one side.

host rock		
chert	15-17%	(of section, much higher in sample)
dolomite	Ø.2	
pyrite	minor	
galena	trace	
veinlets		
quartz	1- 2	
chlorite	Ø.3	
dolomite	Ø.2	
main vein		
quartz	3Ø-35	
calcite	3Ø-35	
chlorite	5- 7	
sphalerite	3- 4	
Mineral X	4- 5	
galena	3- 4	
chalcopyrite	Ø.7	
tetrahedrite	Ø.4	
pyrite	Ø.3	
arsenopyrite	trace	
electrum	trace	

The host rock is dominated by slightly interlocking grains of quartz averaging Ø.Ø1-Ø.Ø15 mm in size, with a few patches up to Ø.2 mm across of grains averaging Ø.Ø15-Ø.Ø3 mm across. Dolomite forms disseminated patches averaging Ø.Ø3-Ø.Ø5 mm in size. Pyrite and galena each forms disseminated, euhedral to subhedral grains averaging Ø.Ø2-Ø.Ø3 mm in size.

Early veinlets averaging Ø.Ø3-Ø.15 mm wide are dominated by very fine grained quartz, with much less dolomite and chlorite. Larger veinlets (averaging Ø.3-Ø.6 mm wide) probably are related in origin to the main vein into which they merge. These are dominated by quartz with much lesser patches of chlorite and of dolomite.

The main vein is dominated by fine to medium grained quartz and calcite, which commonly show a patchy distribution. Commonly calcite and sulfides are interstitial to quartz, and quartz shows subhedral to euhedral crystal faces against them.

Chlorite forms patches up to 1.5 mm across of extremely fine to very fine grained aggregates showing subparallel to subradiating textures. Locally, very fine grained, subradiating patches of chlorite contain moderately abundant galena intergrown along grain borders.

Sphalerite (deep brownish red) forms anhedral patches averaging Ø.7-2 mm in size. A few patches contain moderately abundant exsolution lenses and blebs of chalcopyrite.

Galena occurs in anhedral patches up to a few mm across, mainly interstitial to quartz, in which it is intergrown with fine grained Mineral X or less commonly with very fine grained tetrahedrite.

(continued)

Mineral X forms patches up to 1 mm in size, and very fine to fine grained, submosaic intergrowths with galena up to a few mm across. In a few patches, broad cores of fine to medium grained Mineral X are rimmed by an intimate intergrowth of tetrahedrite and galena, which in turn commonly is bordered by patches of chalcopyrite. Mineral X has the following properties: hardness slightly greater than galena, reflectivity slightly lower than galena, slight bireflectance, strong anisotropism with no distinct colors. The mineral which comes closest to these properties is boulangerite, but its hardness is reported as equal to or less than that of galena.

Chalcopyrite forms a few patches to 1 mm in size in calcite, and patches up to 2 mm across bordering patches of Mineral X-galena-tetrahedrite.

Galena forms anhedral patches up to a few mm across. It commonly is intergrown intimately with very fine grained patches of Mineral X. Bordering these patches, galena commonly is intergrown intimately with extreme fine to very fine grained, subradiating to radiating aggregates of chlorite.

A few patches averaging 0.2-0.3 mm in size contain intimate intergrowths of Mineral X and tetrahedrite, intergrown more coarsely with galena, chalcopyrite and sphalerite, the last containing abundant exsolution blebs and lenses of chalcopyrite.

Pyrite forms disseminated, subhedral grains averaging 0.1-0.2 mm in size, and patches of anhedral to subhedral grains from 0.3-0.8 mm in size intergrown with sulfides.

Arsenopyrite forms scattered, subhedral grains averaging 0.05-0.1 mm in size enclosed in patches of galena-Mineral X.

Electrum (?) forms a few grain averaging 0.03-0.08 mm in size in patches of galena, Mineral X, and tetrahedrite, and along borders of these patches with calcite. Two grains 0.02-0.025 mm in size and a few much smaller ones occur on and near the border of a pyrite grain and Mineral X. Electrum(?) has a pale cream to pale yellow color, high reflectivity, and is much softer than galena.

Hematite forms a cluster of largely subparallel, thin plates up to 0.2 mm in length in a grain of quartz.

Sample 11-101 **Fragments of Porphyritic (Quartz) Rhyolite in Groundmass of Porphyritic Dacite; Exotic Chert-Opaque-Epidote Fragment; Patch of Calcite-Pyrite-(Chlorite)**

The sample contains subrounded fragments up to several cm across of porphyritic rhyolite containing quartz and K-feldspar phenocrysts in an extremely fine to very fine grained groundmass dominated by K-feldspar, with patches of calcite. Fragments are set in a groundmass of slightly porphyritic dacite with quartz phenocrysts and calcite patches in a groundmass dominated by plagioclase. One exotic fragment is of an opaque-rich chert with unusual acicular porphyroblasts of epidote(?). A replacement patch up to a few cm long is dominated by calcite and bordered by pyrite with minor chlorite.

Rhyolite (60-65%)

phenocrysts	
quartz	4- 5%
K-feldspar	1- 2
fragments	
plagioclase aggregates	3- 4
groundmass	
K-feldspar-(plagioclase-quartz)	50-55
calcite	2- 3
pyrite	0.1
replacement patches	
quartz-(chlorite-calcite)	0.3
veinlets	
quartz	0.1
calcite	0.1

In the rhyolite, quartz forms subrounded phenocrysts averaging 0.2-1 mm in size, with a few clusters up to 2 mm across. K-feldspar forms subhedral phenocrysts up to 1.7 mm in size. It is altered moderately to patches of calcite, and locally lesser pyrite and minor epidote. Plagioclase occurs in patches up to 1.5 mm in size of anhedral, equant grains averaging 0.2-0.7 mm in size. These are replaced slightly to strongly by calcite, and locally by chlorite and tremolite. The groundmass is an extremely fine grained aggregate dominated by K-feldspar with much less plagioclase and quartz, and with minor irregular, replacement patches of dolomite. Pyrite forms disseminated, subhedral to euhedral grains averaging 0.03-0.15 mm in size. It contains a few replacement patches up to 1 mm across of very fine grained quartz with lesser calcite and chlorite. The rhyolite cut by a few veinlets up to 0.02 mm wide of quartz, and up to 0.05 mm wide of calcite. Some of the latter are associated with replacement patches of calcite.

Dacite 25-30%

phenocrysts	
quartz	1- 2%
groundmass	
plagioclase-quartz-(K-feldspar)	17-20
calcite	4- 5
chlorite	2- 3
pyrite	0.2
apatite	trace

Quartz phenocrysts are as in the rhyolite, but generally smaller, averaging 0.1-0.2 mm in size. The groundmass averages 0.02-0.03 mm in grain size and is dominated by plagioclase with lesser quartz and minor K-feldspar. Calcite forms irregular replacement patches averaging 0.2-1 mm in size. Chlorite forms patches averaging 0.1-0.2 mm in size of very fine grained flakes. Apatite forms a few anhedral grains averaging 0.05-0.07 mm in size.

Exotic Fragment (2- 3%)

The rock contains an exotic fragment up to several mm across (in the second thin section). It contains spheroidal patches of extremely fine grained quartz enclosed in a groundmass of cryptocrystalline quartz(?) with abundant dusty opaque. Epidote forms elongate, prismatic to acicular grains up to 1 mm in length in random orientation. Pyrite forms scattered subhedral to euhedral grains averaging 0.1-0.3 mm in size. Epidote and pyrite form similar porphyroblasts in the surrounding dacite.

Replacement Patch (5- 7%)

calcite	3- 4
pyrite	1- 2
chlorite	1- 2

The replacement patch contains a core of submosaic to irregular calcite grains averaging 0.1-0.25 mm in grain size. It is bordered by a zone up to 1 mm wide dominated by very fine to fine grained pyrite intergrown with lesser patches of very fine grained chlorite. Some pyrite patches extend into the core of the zone. Outside the pyrite-rich zone is an irregular replacement(?) zone up to 1 mm wide dominated by very fine grained chlorite.

Sample 11-135.6 **Layered Lithic Sandstone, Pebble Breccia; Replacement Patches of Pyrite-(Tremolite), Quartz-Sericite and Pyrite-Calcite-Quartz-(Tremolite)**

The rock contains three main layers, an upper one of a medium lithic sandstone dominated by fragments from 0.7-1.5 mm in size in a sparse groundmass, a middle one several mm thick of fine lithic sandstone, and a lower one of pebble breccia with fragments of chert up to a few cm across in an extremely fine grained groundmass. Replacement by pyrite is common in cherty fragments in the pebble breccia and in the groundmass of the medium lithic sandstone. A replacement patch up to a few mm across in the pebble breccia consists of sericite and quartz, and a smaller one consists of pyrite rimming a core of calcite-quartz-(tremolite).

Pebble Breccia

This contains fragments up to a few cm across (average 1-5 mm) of a few types of chert. These range from cryptocrystalline varieties with abundant dusty opaque and minor quartz veinlets to extremely fine grained varieties relatively free of dusty opaque. Disseminated calcite patches occur in several fragments.

The largest fragment in the section contains a layer of each type. At one end of this fragment is a layer or replacement zone up to 1 mm wide dominated by very fine grained pyrite. A few patches up to 0.3 mm in size in the large fragment consist of intergrowths of pyrite with lesser tremolite. The finer grained chert layer contains a fossil 0.22 mm in diameter, which appears to be a cross-section of a rugose coral.

Several fragments contain replacement patches up to a few mm across dominated by fine to locally medium grained, anhedral to subhedral pyrite, with inclusions and interstitial patches of prismatic to acicular tremolite.

The groundmass is extremely fine to very fine grained and dominated by feldspars and quartz. It contains porphyroblasts up to 1.5 mm in size of pyrite with lesser intergrown tremolite (as in the chert fragments). A few patches up to 0.2 mm in size are dominated by dusty opaque.

A replacement patch up to 1.3 cm across is dominated by patches of extremely fine to very fine grained sericite, and others of fine to medium grained quartz. Pyrite forms scattered grains and clusters, mainly in quartz.

A second replacement patch up to 3.5 mm across contains an outer zone dominated by pyrite-(tremolite) and a core dominated by quartz, calcite, and tremolite, with minor disseminated pyrite.

Fine Lithic Sandstone

In this layer, fragments are diffuse and in large part similar in composition to the groundmass, which is dominated by extremely fine grained feldspars and quartz. Chert forms fragments averaging 0.2-0.5 mm in size. Quartz forms several grains averaging 0.1-0.3 mm in size. Moderately abundant fragments up to 0.15 mm in size consist of extremely fine grained aggregates of Ti-oxide. Replacement patches are similar to some of those in the pebble breccia, being dominated by pyrite with less tremolite, and minor calcite and chlorite.

Coarse Lithic Sandstone

This layer contains fragments averaging 1-2 mm in size of a variety of rock types, many of which are similar to fragment types in the pebble breccia. Most important types include the following:

1) a few varieties of chert (including some rich in dusty opaque),
2) quartz phenocrysts/crystals up to 1 mm in size,
3) very fine grained aggregates dominated by quartz with lesser dolomite and minor pyrite,
4) very fine to fine grained aggregates of quartz, in part recrystallized in patches to extreme fine grained aggregates,

The groundmass is as in the other layers, being dominated by feldspars and quartz.

Replacement patches are abundant, and dominated by porphyroblastic pyrite grains averaging Ø.5-1 mm in size. Generally intergrown with these are elongate prismatic grains of tremolite. A few patches consist of pyrite intergrown with chlorite. Tremolite also forms a few replacement patches averaging Ø.2-Ø.6 mm in size of elongate, in part subradiating grains. One chert fragment is replaced by an irregular patch up to Ø.4 mm across of subparallel, stubby prismatic grains of tremolite.

Sample 11-243 **Chert/(Andesite)-Fragment Pebble Breccia with Groundmass Dominated by Calcite-(Quartz-Pyrite); Veinlets of Calcite-Quartz-Gypsum**

The sample contains angular to subangular fragments of a few main and exotic rock types averaging 1-3 mm in size, with moderately abundant fragments from 5-15 mm in size. Fragments are dominated by several varieties of chert, with much lesser ones of at least two types of andesite, deformed diorite(?), and opaque-rich, and minor ones of quartz grains and aggregates. The groundmass is dominated by calcite with lesser quartz, minor pyrite and a trace of tremolite

fragments		veinlets	
chert	65-70%	calcite-quartz-gypsum	0.2%
andesite	7- 8		
diorite	4- 5		
quartz aggregates	0.7		
apatite	trace		
groundmass			
calcite	12-15		
quartz	3- 4		
pyrite	1- 2		
tremolite	0.1		

Chert fragments are of two main types, with gradation between types and variations within types. Some are relatively free of opaque, and are dominated by slightly interlocking grains averaging 0.01-0.02 mm in grain size. Others contain abundant to moderately abundant opaque; these generally are cryptocrystalline. A few of the latter type contain disseminated, spheroidal patches of clear quartz averaging 0.05-0.08 mm in size. Some fragments also contain minor to moderately abundant K-feldspar in the groundmass (identified only in stained offcut block). Many are cut by veinlets and veins up to 0.3 mm in width of very fine grained quartz, with or without patches of calcite. A few are replaced by clusters up to 1 mm in size of subhedral to euhedral pyrite grains averaging 0.1-0.4 mm in size. Several fragments up to 1.7 mm in size and possibly related in origin to the above types, are dominated by extremely fine grained opaque, with minor interstitial cryptocrystalline quartz. One elongate fragment 2 mm long is of very fine grained, submosaic quartz.

Several fragments up to 3 mm in size contain very fine to locally fine grained plagioclase phenocrysts in a groundmass of extremely fine grained plagioclase. A few andesite fragments up to 3 mm in size are of extremely fine grained andesite containing minor lathy plagioclase grains up to 0.05 mm long in a groundmass of plagioclase with minor to moderately abundant sericite and Ti-oxide.

A few fragments are of deformed diorite, dominated by fine to medium grained plagioclase in a groundmass of granulated plagioclase; alteration is slight to moderate in patches to calcite. One apatite fragment 0.3 mm across probably came from the diorite.

Interstitial patches up to a few mm across are dominated by fine to locally medium grained calcite. Quartz forms patches up to 1.5 mm in size of very fine grained aggregates. Pyrite forms scattered subhedral to euhedral grains up to 1.5 mm in size. Tremolite forms clusters of a few subparallel, prismatic grains up to 0.2 mm in length, mainly on borders of calcite patches.

Late veinlets up to 0.05 mm wide are of calcite, quartz, and gypsum.

APPENDIX IX

PETER READ CONSULTING REPORT

ABSTRACT

The Trophy Property straddles the south fork of the Scud River in the Liard Mining District, northwestern British Columbia (104G/3W). On the east side of the Scud an area including the Ptarmigan, Hummingbird, Bear Pass, QBO and QBS showings was geologically mapped at 1:5,000-scale, and on the west side of the Scud an area 6 kilometres long that covers a thrust fault system and spatially related veins was mapped at 1:10,000. The stratified rocks of both areas include massive Permian limestone, dark grey Middle Triassic argillite and chert, and Middle and(?) Upper Triassic volcanics of the Stuhini Group. To the east of the Scud these units are subvertical or overturned to the east and young eastward, and on the west the units are strongly overturned to the west, young to the west and are cut by east dipping thrust faults. On the east side of the Scud, the Middle Triassic Hickman Pluton intrudes volcanics of the Stuhini Group, and on the west side an Early(?) Jurassic granodiorite stock intrudes Middle Triassic sediments and volcanics, but lies thrust faulted against the Permian.

The mineralized showings on the east side of the Scud are spatially related to a north-northeasterly trending quartz monzonite-rhyolite intrusive complex. The Ptarmigan showing is a 400 x 250 m, northerly elongate, altered and mineralized breccia body composed of angular to rounded clasts of all bounding rock types including probable Eocene rhyolite clasts. The QBS-Bear Pass breccia is a 300 x 125 m northerly elongate sparsely altered and mineralized breccia body of mono- to heterolithic breccias containing fragments of all bounding rock units. The presence of rare steeply dipping layers, fragments of all bounding rock units, of which many are truncated by the breccia bodies in plane, near complete restriction of sulphide (pyrite-sphalerite-galena) mineralization and alteration to the breccia bodies, rounding of some fragments and open-spacing filling around clasts in strongly altered zones favours a

breccia pipe origin for both of these breccia bodies. On the west side of the Scud, southwesterly dipping veins containing pyrite, chalcopyrite, sphalerite, galena, quartz and calcite lie close to the thrust fault system.

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TROPHY PROPERTY OF CONTINENTAL GOLD CORPORATION, LIARD MINING DISTRICT, NORTHWESTERN BRITISH COLUMBIA (104G/3W)

1. INTRODUCTION:

This report is based on ten days of fieldwork on the Trophy Property in the period July 15 to 26, 1988. The property covers 72 square kilometres south from the Scud River to north of Sphaler Creek and to as far west as Galore Creek. The fieldwork involved 1:5,000- and 1:10,000-scale geological mapping in two areas. Six days were spent on the east side of Scud River near the Ptarmigan (Cirque), Bear Pass, Hummingbird, QBO and QBS showings (57°10', 131°17'), and four days were devoted to mapping a thrust fault system and related veining on the west side of Scud River from a lake locally known as "Trench Lake" southwards towards the Copper Canyon property (57°10', 131°21').

2. PTARMIGAN, HUMMINGBIRD, BEAR PASS, QBS AND QBO SHOWINGS:

Permian limestone, Middle Triassic argillite and chert, Middle and Upper(?) Triassic volcanics and an Early Jurassic(?) or Eocene quartz monzonite-rhyolite dike complex and two associated breccia pipes host sulphide-carbonate-quartz mineralization. The host rocks are described in order of decreasing age prior to a discussion of the structure.

(a) Permian: A massive light grey to white crystalline limestone which here and there contains crinoidal and bryozoan debris. Close to the quartz monzonite-rhyolite complex the marble is whitened, contains locally developed andradite, epidote, diopside and tremolite skarns, and is sugary textured as a result of recrystallization. Four macrofossil and microfossil collections were submitted to the Geological Survey of Canada for identification (Appendix A).

(b) Middle Triassic: Dark grey siliceous and/or limy argillite, ribbon chert, and minor lenticular grey silty limestone compose a succession ranging in thickness from a few metres to more than 100 metres. Within the map area, unidentifiable bivalves occur in limy argillite. Because of the poor macrofossil preservation, five samples were collected for conodonts and submitted to M.J. Orchard of the Geological Survey of Canada (Appendix A).

(c) Stuhini Group: Within the map area, only the lower part of the group has been examined. On the ridge between the Ptarmigan and Hummingbird showings, a cream weathering plagiphyric rhyodacite(?) lapilli tuff dominates. To the east and southeast of the Ptarmigan, the volcanic rocks are intruded by the Hickman Pluton. Because the Hickman Pluton is radiometrically dated by the K-Ar method at 221±8 and 229±6 Ma on biotite and hornblende respectively (Holbeck, 1988, p. 35), these volcanic rocks of the Stuhini Group must be Middle Triassic. Although Middle Triassic augite porphyry flows and volcaniclastic rocks are extensive to the north near the Grand Canyon of the Stikine (Read, 1983 and 1984), rhyodacite, such as occurs in the present map area, is unknown. Because the volcanics are unbedded within the map area, their thickness is unknown but probably exceeds 500 metres.

(d) Hickman Pluton: The pluton includes medium grained biotite hornblende quartz diorite and granodiorite, and coarse grained monzonite and syenite. All rocks contain chloritized and sericitized mafic minerals and common chlorite-epidote-quartz-feldspar filled joints and shears. The alteration of the pluton is a result of low grade regional metamorphism which has affected all but the core of the pluton. Except for a two-kilometre long faulted portion of the southwestern contact of the pluton, within the map area the remainder of the pluton appears to intrude the volcanics of the Stuhini Group.

(e) Early Jurassic(?) or Eocene Intrusions: Quartz monzonite, and sparse quartz or plagioclase phenocryst bearing rhyodacite and rhyolite dikes, and aphanitic dikes of similar composition comprise a 250 metre wide and 800 metre long zone that trends north-northeasterly. The medium grained (1-2 mm) equigranular quartz monzonite contains 15% biotite and a few per cent hornblende. A minor porphyritic variant has a few per cent of 4 mm poikiolitic biotite phenocrysts. Because the composition of the complex and its north-northeasterly orientation are similar to those of radiometrically dated Eocene intrusions (47.7± 1.7 Ma, Panteleyev (1976)) included by Panteleyev (1975) in his unit 6, I considered an Eocene age more probable for the intrusive complex than an Early Jurassic age.

(f) Breccia: The mineralization of the Ptarmigan, Bear Pass and QBS showings lies in a breccia of uncertain origin. The Ptarmigan breccia consists mainly of angular fragments ranging from 2 to 20 cm composed of altered Hickman Pluton with no mafic minerals preserved, unaltered pluton, plagiphyric rhyodacite and andesite clasts from the Stuhini, and red quartz-plagioclase prophyry fragments of unknown stratigraphic correlation. Core from drill holes TR88-2 and TR88-3 contain fragments of quartz-eye rhyolite which are lithologically similar to the rhyolite and rhyodacite dikes of the intrusive complex south of the Hummingbird. The breccia is mainly clast supported with tuff filling the interstices. Where the breccia is strongly altered, the interstices are filled with iron-bearing carbonate, pyrite, calcite, quartz, sphalerite and galena which locally show open space filling textures. In the strongly altered zones, some of the clasts are subrounded. The breccia underlies a northerly trending elliptical area 400 by 250 metres.

The straight, faulted contact of Hickman Pluton is embayed next to the breccia. The contact between the breccia, rich in plutonic clasts, and the pluton shows a steep southwesterly dip in an exposure on the northeast corner of the breccia body. These relations indicate that the breccia is younger than the pluton. On the western side of the breccia, an easterly striking chert terminates against the breccia implying that the breccia is younger than the chert. Rare layering within the breccia dips steeply.

QBS-Bear Pass breccia varies from monolithic to heterolithic. The northern and eastern margins of the area underlain by breccia are mainly chert breccia. Grey-green volcanic clasts dominate the northern half away from the margins. The southern portion consists of volcanics, limestone, chert, and minor white rhyolite and quartz-eye rhyolite clasts. The southwestern margin contains large blocks of white massive Permian(?) limestone up to 50 metres on edge. The breccia underlies a northerly elongate area 300 metres long by 125 metres wide. In contrast to the Ptarmigan breccia, QBS breccia is sparsely altered and mineralized.

The foregoing obervations and relations suggest at least two possible modes of origin for the breccia:

1. Debris Flow: The Ptarmigan breccia represents a debris flow which is younger than the Hickman Pluton, and because the Stuhini Group is intruded by the pluton, also younger than the Stuhini Group. Because both breccia bodies contain fragments of the quartz-eye rhyolite lithologically similar to that of the Early Jurassic(?) or Eocene intrusions, they are at least Early Jurassic or more probably of Eocene age. The elliptical shaped breccia bodies must be younger than all surrounding rocks including the intrusions. These relations would be consistent with a shallow breccia body lying unconformably on a basement composed of Hickman Pluton, Middle Triassic and Stuhini Group for the Ptarmigan breccia, and on Middle Triassic, Stuhini Group, and Early Jurassic(?) or Eocene for the QBS-Bear Pass breccia.

2. Breccia Pipes: The Ptarmigan breccia represents a pipe which is younger than the Hickman Pluton, Middle Triassic sediments and Stuhini Group. Fragments of all bounding rocks including the Early Jurassic(?) or Eocene quartz-eye rhyolite are represented as clasts in the pipe. Rare steeply dipping layering suggests that the Ptarmigan breccia pipe should extend subvertically to depth. The nearly complete restriction of alteration to the breccia, rounding of some of the fragments and open-space filling around highly altered fragments result from the streaming of fluids

through the pipe, milling the fragments and removing the fines around the clasts in the zones of highest flow where the fluids most intensely altered the rock.

Of the two suggested origins, a breccia pipe is favoured because it better explains the nearly complete restriction of alteration and mineralization to the pipe, the rounding of some fragments, open-space filling textures in the most intensely altered zones, and presence of quartz-eye rhyolite clasts. The pipes should be subvertical, particularly if they are Eocene in age, and in distinction to a debris flow, extend to a significantly greater depth.

3. STRATIGRAPHY ON THE WEST SIDE OF THE SCUD:

Permian limestone, Middle Triassic argillite and chert, Middle and Upper(?) Triassic Stuhini volcanics and an Early Jurassic(?) quartz monzonite underlie the mapped area on the west side of the Scud. Of these rocks the volcanics host quartz-calcite-iron carbonate-pyrite-chalcopyrite-galena-sphalerite veins. As many of these rocks units have been described under 2, only additional characteristics follow.

(a) Stuhini Group: Near and south of "Trench Lake" grey-green plagiphyric lapilli tuff and minor tuff are juxtaposed against Middle Triassic sediments. Towards the south, sparsely amygdaloidal augite porphyry basalt flows with augite phenocrysts ranging from 2-5 mm in length form the western host rocks of a pluton that intervenes between the Stuhini Group and Middle Triassic sediments. Locally the flows are weakly maroon. Within the map area, the Stuhini is volcanic and unbedded, but to the west B. Augsten has found fossiliferous sediments. Among these sediments, which Souther (1972) mapped as undifferentiated Triassic sedimentary and volcanic rocks, is a conglomerate which contains potash feldspar syenite clasts typical of the Early Jurassic Galore Creek stock (B. Augsten, oral comm., July 25, 1988). This observation suggests that Souther has accidentally included some Lower Jurassic sediments in his undifferentiate Upper Triassic unit.

(b) Early Jurassic(?) stock: Intruded along the Stuhini-Middle Triassic sediment boundary is a 3.5 km long stock. A thrust fault lies along the middle portion of the eastern boundary of the stock and sets Permian limestone or Middle Triassic argillite onto it. Elsewhere the unfaulted boundary intrudes Middle Triassic argillite and volcanics of the Stuhini Group. The stock is compositionally variable with most of it being a medium grained, equigranular biotite hornblende granodiorite or quartz monzonite with minor hornblende syenite. Within the map area, the southernmost valley bottom north of an extensive glacier is underlain by medium grained, equigranular hornblende diorite. South of the map area, the stock may continue as the mineralized syenite that outcrops in the Copper Canyon showing.

4. STRUCTURE:

The two mapped areas on the east and west sides of the south Scud River involve Permian and Middle and Upper Triassic rocks. On the east side, up to 100 metres of Middle Triassic argillite intervenes between the Permian limestone and Triassic volcanics for 4 of the 4.5 kilometres mapped. The rock units are infolded along southeasterly plunging axes with the incompetent Permian and Middle Triassic rocks involved in isoclinal folds, and the competent Triassic volcanics in probable open folds. The difference in fold styles results in some disharmonic folding within the Middle Triassic. Only the southernmost 0.5 kilometres of the Permo-Triassic boundary lacks Middle Triassic argillite and may be a fault. This possible fault may extend northward and form the western boundary of the Ptarmigan breccia pipe. In the Permian and Middle Triassic rocks, steep to westerly dipping bedding indicates that the section is subvertical to overturned.

The southwestern boundary of Hickman Pluton is faulted along the southeasternmost two kilometres. Northwest of the Ptarmigan breccia pipe, the exposed fault dips about 25°SW, but towards the pipe the dip steepens to over 60°SW. The fault zone contains a 0.5 to 1 metre thickness of fault gouge and brecciated rock. The magnitude and direction of fault displacement are unknown, but the fault has eliminated any fine grained marginal phase of the pluton and contact metamorphic zone in its wallrocks. On the south side of Scotch Glacier, where the contact is unfaulted, both exist. The fault zone passes through the breccia pipe but shows no mappable displacement of the margin. A fault displacement which removes the marginal zone of the Hickman but apparently does not displace the breccia pipe implies two periods of fault movement with a significant pre-pipe motion followed by a negligible post-pipe displacement. The pre-pipe faulting and proximity of the rhyolite-quartz monzonite complex probably controlled the location of the Ptarmigan breccia pipe.

The QBS-Bear Pass breccia pipe crosses an anticline-syncline pair in the disharmonically folded Middle Triassic at the north end of the rhyolite-quartz monzonite complex. Proximity to the intrusive complex and the disharmonically folded nature of the Middle Triassic probably controlled emplacement of the pipe.

Steeply dipping joints, fractures, dikes and veins commonly have a strike in the range 010° to 035°. Because the boundaries of the breccia pipes are poorly defined due to lack of outcrop, the elliptical plan view of the breccia pipes may also be elongate within this range.

On the west side of the south fork of Scud River, the Permian limestone, Middle Triassic argillite, Triassic volcanics, and Early Jurassic(?) granodiorite are involved in an east-dipping thrust and reverse fault system. The stratified rocks, excluding the unbedded Triassic volcanics of unknown orientation, have a moderate eastward dip, but the rock units young westward. The contacts between rock units are mainly planar and faulted. Although the incompetent Middle Triassic argillite is intensely folded, the contact between it and the Permian limestone is knife-sharp and planar. Because the Middle Triassic is faulted against adjacent units, it is locally absent between the Permian limestone and the Triassic volcanics. Although Souther (1972) showed the

Middle Triassic-Permian contact unfaulted, detailed mapping along this contact shows that it is faulted for nearly its entire length. A northerly oriented granodiorite sill lies across the Triassic argillite-volcanic contact. Its eastern contact is faulted against limestone or argillite for most its length except for the northern and southern ends which lie within the Triassic volcanics. The western plutonic contact intrudes Triassic volcanics along its entire length. At the north end of the map area, near a lake locally called "Trench Lake", the major fault in the system appears to veer to the northwest and strike towards an unfaulted Early Jurassic granodiorite pluton, radiometrically dated at 182 Ma (Allen et al., 1976), which must intrude the fault. In this area, the contact between Permian limestone and greenstone of uncertain volcanic or hypabyssal intrusive origin is highly irregular and folded, which indicates that the limestone contact is locally unfaulted. North of "Trench Lake" geological mapping near the 1200 m level shows that the granodiorite intrudes the Permian limestone. Although Souther (1972) showed the fault system ending at the southern contact of the granodiorite pluton, it may extend to the west of the pluton and continue along the Permo-Triassic boundary which west of Galore Creek has a significant thickness of rusty weathering Middle Triassic(?) argillite on the boundary according to D. Brown (BCMEM&PR, oral comm., July 26, 1988).

Numerous southwesterly dipping veins, which contain quartz, calcite, pyrite, chalcopyrite, galena and sphalerite, lie within and close to the thrust fault system for 5.5 kilometres southward from "Trench Lake". These veins and rusty carbonate altered shears cut all rocks including the granodiorite. Their proximity to the thrust fault system implies that it may have played a role in the development of the southwesterly dipping fractures and shears which the veins occupy.

5. RECOMMENDATIONS:

1. Because the main mineralized areas, Ptarmigan, Hummingbird, Bear Pass, QBS and QBO are spatially related to features which I think are assuredly breccia pipes and a probable Eocene quartz monzonite-rhyolite complex, similar geological settings should be sought.

2. Because the geological setting is subvolcanic, the geology of the property needs to be sufficiently unravelled to identify this setting.

3. Because a breccia pipe setting developed during the Early Jurassic and again in the Eocene, it is most important to radiometrically date the quartz monzonite-rhyolite complex immediately south of Hummingbird.

4. Because the mineralization of the Ptarmigan breccia is quartz-calcite-iron carbonate-pyrite-sphalerite-galena-gold and is unlike the Early Jurassic potash feldspar-biotite-garnet-pyrite-chalcopyrite-magnetite-hematite±sphalerite±galena assemblage with very minor gold at Galore Creek, an Eocene age should be considered possible and all known Eocene intrusions should be prospected, particularly those intrusions included by Panteleyev (1975) as unit 6.

5. Panteleyev's (1975) unit 5 may include suitable prospecting targets but they are not described as subvolcanic and they do not have the north-northeasterly elogation direction of the intrusions included in unit 6.

REFERENCES:

Allen, D.G., Panteleyev, A., and Armstrong, A.T. (1976):
Galore Creek; in Porphyry Deposits of the Canadian Cordillera, Canadian Institute of Mining and Metallurgy, Special Volume 15, p. 402-414.

Holbeck, P. (1988):
Stikine Assemblage; draft of an unpublished MSc. thesis, University of British Columbia, Vancouver, B.C.

Panteleyev, A. (1975):
Galore Creek Map-Area (104G/3W, 4E); in Geological Fieldwork 1974, British Columbia Department of Mines and Petroleum Resources, p. 59-62.

_______ (1976):
Galore Creek Map-Area (104G/3W, 4E); in Geological Fieldwork 1975, British Columbia Department of Mines and Petroleum Resources, p. 79-81.

Read, P.B. (1983):
Geology Classy Creek (104J/2E, and Stikine Canyon (104J/1W) British Columbia; Geological Survey of Canada, Open File 940.

_____ (1984):
Geology, Klastline River (104G/16E), Ealue Lake (104H/13W), Cake Hill (104I/4W), and Stikine Canyon (104J/1E), British Columbia; Geological Survey of Canada, Open File 1080.

Souther, J.G. (1972):
Telegraph Creek Map-Area, British Columbia; Geological Survey of Canada, Paper 71-44, 38 p.

APPENDIX A: PALEONTOLOGY

Unnamed Permian Unit

GEOLOGICAL SURVEY OF CANADA

Project:	Telegraph Creek Map Area	**NTS Sheet:**	104G/3
Field No.:	R88-5F **Map No.:**	**GSC Loc. No.:**	C-159955
UTM Coordinates:	UP0361285mE	**Latitude:**	57°10'32"
	UP6338820mN	**Longitude:**	131°17'40"
Station:	L20	**Notebook:**	88-1, p. 54
Collector:	P.B. Read	**Identified By:**	

Location: At 1355 m elevation, 8.5 km at 147° from the junction of the north and south forks of the Scud River, northwestern British Columbia

Rock Unit: Unnamed Permian Unit 3 (Souther, GSC, Paper 71-44)

Lithology: Medium grey crinoidal limestone

Fauna:

Remarks:

C.A.I.:

Age:

GEOLOGICAL SURVEY OF CANADA

Project:	Telegraph Creek Map Area	**NTS Sheet:**	104G/3
Field No.:	R88-7F **Map No.:**	**GSC Loc. No.:**	C-159957
UTM Coordinates:	UP0358350mE	**Latitude:**	57°10'15"
	UP6338385mN	**Longitude:**	131°20'33"
Station:	B5q	**Notebook:**	88-1, p. 66
Collector:	P.B. Read	**Identified By:**	

Location: At 1440 m elevation, 7.75 km at 167° from the junction of the north and south forks of the Scud River, northwestern British Columbia.

Rock Unit: Unnamed Permian, Unit 3 (Souther, GSC, Paper 71-44)

Lithology: Medium grey limestone

Fauna:

Remarks:

C.A.I.:

Age:

GEOLOGICAL SURVEY OF CANADA

Project:	Telegraph Creek Map Area	**NTS Sheet:**	104G/3
Field No.:	R88-8F **Map No.:**	**GSC Loc. No.:**	C-159958
UTM Coordinates:	UP0358870mE	**Latitude:**	57°08'08"
	UP6334435mN	**Longitude:**	131°19'54"
Station:		**Notebook:**	
Collector:	P.B. Read	**Identified By:**	

Location: At 2025 m elevation, 11.8 km at 169° from the junction of the north and south forks of the Scud River, northwestern British Columbia.

Rock Unit: Unnamed Permian, Unit 3 (Souther, GSC, Paper 71-44)

Lithology: Massive light grey limestone

Fauna:

Remarks:

C.A.I.:

Age:

Unnamed Middle Triassic Unit

GEOLOGICAL SURVEY OF CANADA

Project: Telegraph Creek Map Area
NTS Sheet: 104G/3
Field No.: R88-1F **Map No.:**
GSC Loc. No.: C-159951
UTM Coordinates: UP0362130mE
UP6337910mN
Latitude: 57°10'03"
Longitude: 131°16'47"
Station: F1
Notebook: 88-1, p.51
Collector: P.B. Read
Identified By:

Location: At 1615 m elevation, 9.5 km at 142° from the junction of the north and south forks of the Scud River, northwestern British Columbia.

Rock Unit: Unnamed Middle Triassic

Lithology: Bleached chert

Fauna:

Remarks:

C.A.I.:

Age:

GEOLOGICAL SURVEY OF CANADA

Project:	Telegraph Creek Map Area	**NTS Sheet:**	104G/3
Field No.:	R88-2F **Map No.:**	**GSC Loc. No.:**	C-159952
UTM Coordinates:	UP0361750mE	**Latitude:**	57°10'06"
	UP6338015mN	**Longitude:**	131°17'10"
Station:	F2	**Notebook:**	88-1, p. 51
Collector:	P.B. Read	**Identified By:**	

Location: At 1630 m elevation, 9.4 km at 148° from the junction of the north and south forks of the Scud River, northwestern British Columbia.

Rock Unit: Unnamed Middle Triassic

Lithology: Light grey limestone

Fauna:

Remarks:

C.A.I.:

Age:

GEOLOGICAL SURVEY OF CANADA

Project:	Telegraph Creek Map Area	**NTS Sheet:**	104G/3
Field No.:	R88-3F **Map No.:**	**GSC Loc. No.:**	C-159953
UTM Coordinates:	UP0361370mE	**Latitude:**	57°10'23"
	UP6338550mN	**Longitude:**	131°17'34"
Station:	L14	**Notebook:**	88-1, p. 51
Collector:	P.B. Read	**Identified By:**	

Location: At 1435 m elevation, 8.7 km at 148° from the junction of the north and south forks of the Scud River, northwestern British Columbia.

Rock Unit: Unnamed Middle Triassic

Lithology: Dark grey silty limestone

Fauna:

Remarks:

C.A.I.:

Age:

GEOLOGICAL SURVEY OF CANADA

Project:	Telegraph Creek Map Area	**NTS Sheet:**	104G/3
Field No.:	R88-4F **Map No.:**	**GSC Loc. No.:**	C-159954
UTM Coordinates:	UP0361020mE UP6339070mN	**Latitude:**	57°10'40"
		Longitude:	131°17'56"
Station:	L19e	**Notebook:**	88-1, p. 53
Collector:	P.B. Read	**Identified By:**	

Location: At 1195 m elevation, 8.1 km at 148° from the junction of the north and south forks of the Scud River, northwestern British Columbia.

Rock Unit: Unnamed Middle Triassic

Lithology: Dark grey calcareous siltstone

Fauna:

Remarks:

C.A.I.:

Age:

GEOLOGICAL SURVEY OF CANADA

Project:	Telegraph Creek Map Area	**NTS Sheet:**	104G/3
Field No.:	R88-6F **Map No.:**	**GSC Loc. No.:**	C-159956
UTM Coordinates:	UP0356925mE UP6342006mN	**Latitude:** **Longitude:**	57°12'11" 131°22'05"
Station:	B1	**Notebook:**	88-1, p. 58
Collector:	P.B. Read	**Identified By:**	

Location: At 1420 m, 3.95 km at 177° from the junction of the north and south forks of the Scud River, northwestern British Columbia.

Rock Unit: Unnamed Middle Triassic

Lithology: Dark grey silty limestone

Fauna:

Remarks:

C.A.I.:

Age:

Stuhini Group

GEOLOGICAL SURVEY OF CANADA

Project:	Telegraph Creek Map Area	**NTS Sheet:**	104G/3
Field No.:	R88-9F **Map No.:**	**GSC Loc. No.:**	C-159959
UTM Coordinates:	UP0356382mE	**Latitude:**	57°10'01"
	UP6338000mN	**Longitude:**	131°22'30"
Station:		**Notebook:**	
Collector:	P.B. Read	**Identified By:**	

Location: At 1867 m elevation, 7.75 km at 152° from the junction of Galore Creek and Scud River, northwestern British Columbia.

Rock Unit: Undifferentiated Triassic rocks, Unit 9 (Souther, GSC, Paper 71-44)

Lithology: Grey-green siltstone and tufffaceous wacke

Fauna:

Remarks:

C.A.I.:

Age:

APPENDIX B: PANTELEYEV (1975 & 1976)

LEGEND

QUATERNARY
PLEISTOCENE AND RECENT

Glacial deposits, recent alluvium and colluvium; few if any outcrops

JURASSIC(?) OR EOCENE
EARLY JURASSIC(?) OR EOCENE

915 Monolithic chert, or volcanic breccia; heterolithic chert, volcanic, plutonic, limestone and rhyolite breccia

929 Sparse plagioclase and quartz-eye rhyolite and rhyodacite, aphanitic rhyolite and rhyodacite

918 Hornblende biotite quartz monzonite and granodiorite

JURASSIC(?)
EARLY JURASSIC?

921 Biotite hornblende granodiorite, quartz monzonite, hornblende syenite, hornblende diorite

TRIASSIC
MIDDLE TRIASSIC
HICKMAN PLUTON

925 Chloritized biotite hornblende quartz diorite, diorite, monzodiorite and hornblende syenite

MIDDLE AND(?) UPPER TRIASSIC
STUHINI GROUP

910 Medium to dark grey-green, locally maroon augite porphyry flows

909 Cream weathering, light to medium grey-green feldsparphyric tuff and lapilli tuff

MIDDLE TRIASSIC

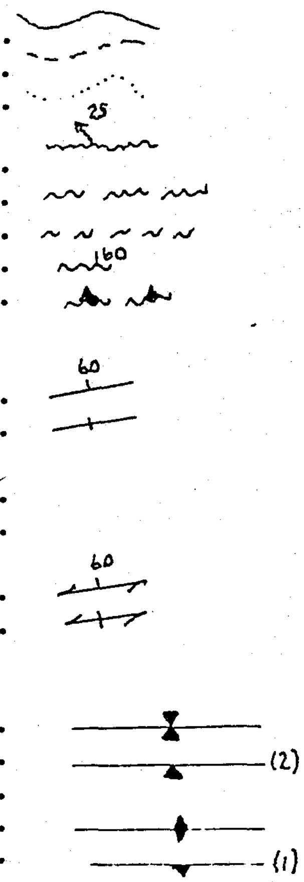
967 Medium to dark grey argillite, siliceous argillite, chert; minor silty grey limestone lenses

920 Light grey limestone and skarn

PERMIAN
EARLY PERMIAN?

902 Massive light grey to white limestone

Geological boundary	(defined		
	(approximate		
	(assumed		
Fault	(defined, with slickensides		
	(approximate		
	(assumed		
	(dip of fault plane inclined		
	(thrust fault, teeth on upper plate		
Bedding	(inclined		
	(vertical		
Flow layering	(inclined		
	(vertical		
Foliation	(inclined		
	(vertical		
Trace of axial surface	(syncline or	(upright (phase determined)	
	(synform	(inclined (phase undetermined)	
	(beneath bedrock units		
	(anticline or	(upright (phase undetermined)	
	(antiform	(inclined (phase determined)	



Geology, Geotex Consultants Limited: P. B. Read, July 16-25, 1988

GALORE CREEK MAP-AREA

(104G/3W, 4E)

By A. Panteleyev

Geological mapping at a scale of 1:31,680 (1 inch equals one-half mile) initiated in 1973 was continued in 1974 (*see* Fig. 15). Base maps are Sphaler Creek (104G/3W) and Flood Glacier (104G/4E), 100-foot contour preliminary maps available from the Surveys and Mapping Branch, Department of Lands, Forests, and Water Resources, Victoria. These maps are especially suited for reconnaissance mapping as they are derived from and match the scale of recent (1965) air photographs.

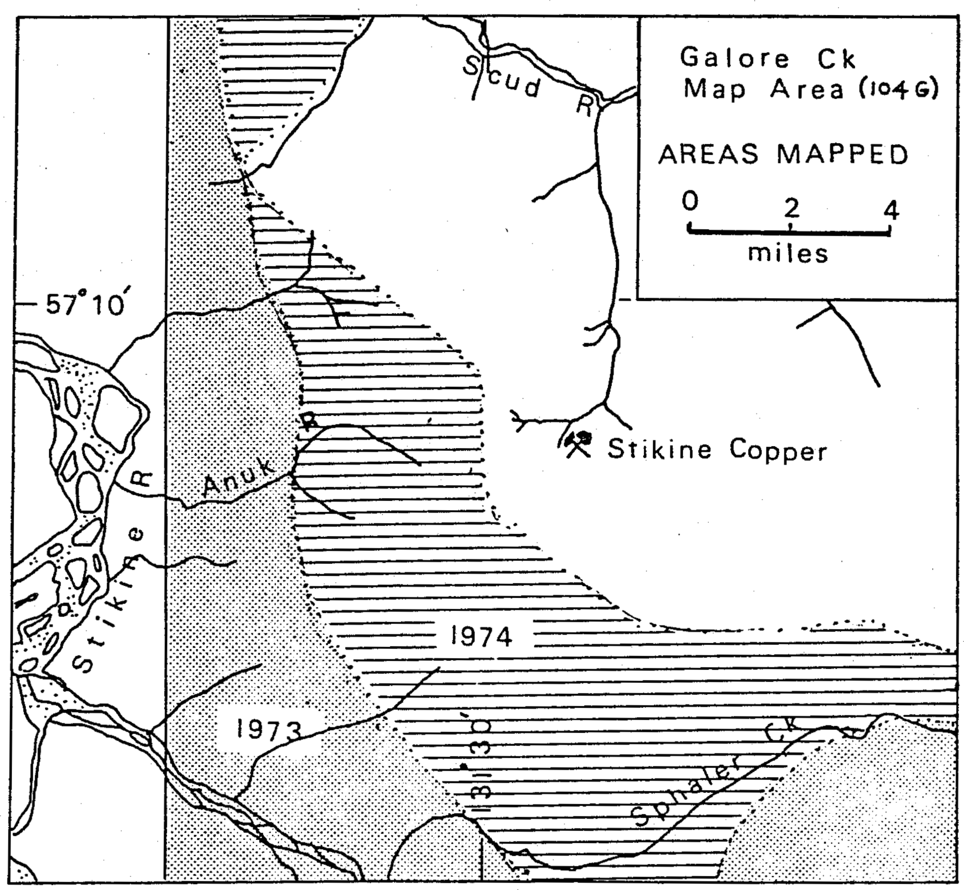


Figure 15. Location of mapping, Galore Creek area.

Regional mapping is being done in order to evaluate ore potential of known showings and to predict undiscovered resource capability of the map-area. Mapping during 1973 was concerned mainly with intrusive rocks along the western and extreme southeastern map

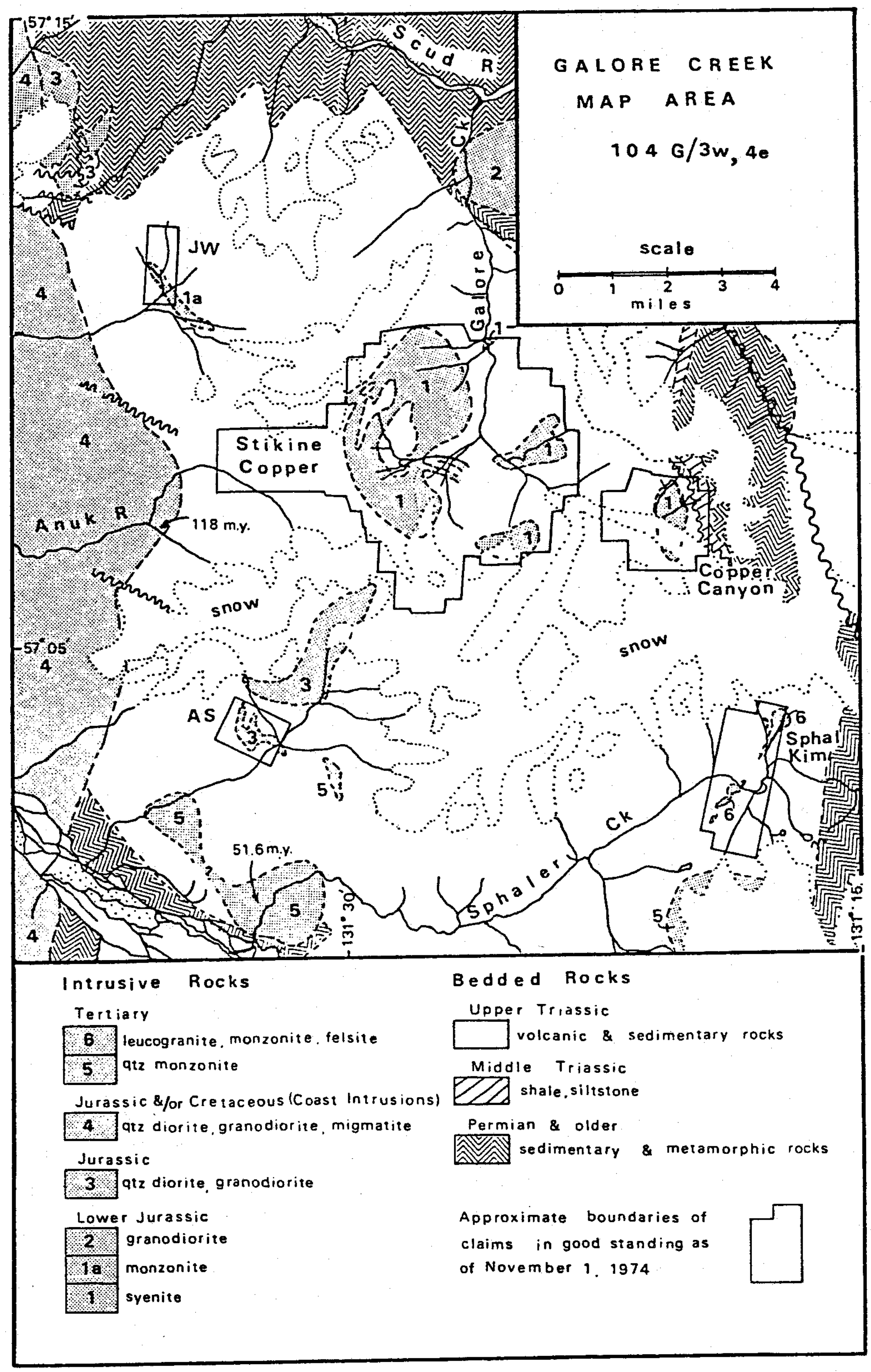


Figure 16. Generalized geology, Galore Creek map-area.

boundaries. Intrusive contacts were located and contact relations with country rocks, age of intrusions, and relation to mineralization were investigated. Mapping during 1974 established a stratigraphic framework for the area by defining major stratigraphic units and structures. Petrology and chemistry of volcanic rocks from a number of measured sections are currently being investigated.

Regional mapping is being done in conjunction with detailed investigation of the Galore Creek deposits of Stikine Copper Limited (*see* GEM, 1972, 1973). These and further studies will determine the validity of the suggestion that syenite porphyries and related mineralization are coeval and cogenetic with intruded volcanic rocks in Galore Creek map-area.

Work to date is summarized on Figure 16. The area of highest economic potential consists of alkalic intrusive and Upper Triassic volcanic rocks and is outlined in the centre of the map-area. To the west are intrusive rocks of the Coast Plutonic Complex and to the southwest, north, and east are Paleozoic rocks. South of Sphaler Creek, glaciers and large snowfields form an effective southern boundary for the map-area.

Ages of intrusive rocks shown on Figure 16 are tentative. They are based on six published and two new K-Ar dates. Alkalic rocks of map units 1 and 1a are associated with copper mineralization and contain hydrothermal biotites ranging in age from 174 to 198 m.y. Medium to coarse-grained granodiorite of unit 2 has an apparent age of 182 m.y. These earlier published dates are summarized elsewhere (Panteleyev, 1973). Map unit 3 consists of fine to medium-grained hornblende quartz diorite or granodiorite. Intrusive contacts are sheared and the rocks are commonly hydrothermally altered. Epidote, chlorite, quartz veining, and small amounts of pyrite as well as traces of chalcopyrite are common. Map unit 4 represents rocks of the Coast Plutonic Complex. These rocks display a variety of rock types and textures ranging from massive, coarse-grained leucogranite to foliated hornblendite. Rocks of unit 4 in Galore Creek map-area are commonly weakly to noticeably foliated, medium-grained hornblende and hornblende biotite granodiorite. Biotite from a weakly foliated, fine-grained hornblende biotite quartz diorite collected from Anuk River yielded a K-Ar date of 118±5 m.y. (Lower Cretaceous).

Rocks of map unit 5 are little altered, medium-grained, pink to grey biotite quartz monzonite or granodiorite. The intrusions form a number of small stocks satellitic to Coast Plutonic rocks along the southwest and south map boundaries. They are considerably younger than Coast Plutonic rocks, as biotite from a quartz monzonite stock at the mouth of Sphaler Creek yielded a K-Ar date of 51.6±1.6 m.y. (Eocene). Unit 6 comprises a number of small subvolcanic stocks, dykes, and possibly intrusive breccia bodies. The rocks are mainly leucocratic porphyritic to felsitic rocks tentatively called monzonite. Minor hornblende-bearing phases may approach quartz monzonite in composition. Some pyrite and chalcopyrite are associated with these rocks as disseminations and fracture fillings in breccia zones. Significant bornite and some molybdenite have also been noted.

Structural relationships between Paleozoic, Middle Triassic, and Upper Triassic bedded rocks will be investigated by further field work and Upper Triassic rocks will be subdivided as petrologic and analytical data become available.

PROPERTY EXAMINATIONS

Two areas of exploration activity representing the bulk of exploration expenditure in the Liard Mining Division were examined in some detail. These are the RED/SUS, CHRIS claim groups 10 miles southeast of Iskut (Eddontenajon) (104H) and the SMRB/JEFF groups on a southeast fork of Kutcho Creek, about 12 miles south-southeast of Rainbow Lakes (104I).

Reports are forthcoming in *Geology, Exploration, and Mining in British Columbia, 1974.* Further field work is planned in 1975 for Kutcho-Tucho Creek areas in the vicinity of SMRB/JEFF claim groups.

REFERENCES

Panteleyev, A. (1972): GC, Hab, Buy (Stikine Copper), *B.C. Dept. of Mines & Pet. Res.,* GEM, 1972, pp. 520-526; 1973, in press.

Souther, J. G. (1972): Telegraph Creek Map-area, British Columbia, *Geol. Surv., Canada,* Paper 71-44, 38 pp.

GALORE CREEK MAP—AREA
(104G/3W, 4E)

By A. Panteleyev

INTRODUCTION

Regional mapping in an area surrounding the Galore Creek copper deposits of Stikine Copper Limited was initiated in 1973 and concluded in 1975. Approximately 647 square kilometres (250 square miles) centred on a mineralized syenite complex was mapped at a scale of 1:31 680 (1 inch to ½ mile). The purpose of this mapping project is to describe the regional setting of the Galore Creek deposits, estimate resource potential in the map-area, and to assess the role and relative importance of intrusions, volcanic rocks, and structures (mainly breccias and faults) in localizing mineralized zones.

Rock specimens from 360 locations were collected and four fossil collections made. To date, 39 rocks (8 intrusive, 31 volcanic) have been analysed to determine major oxide and minor element contents. Twenty additional volcanic rocks will be analysed during 1976. Two new K-Ar ages have been determined in addition to the two reported earlier (*Geological Fieldwork,* 1974, p. 61).

GEOLOGY

Stratigraphy of Upper Triassic rocks has been mapped in detail. Bedded rocks have been divided into three major map units, all of regional extent (Fig. 13). Oldest rocks are pyroxene-bearing flows and flow breccias of basalt or basaltic andesite composition that form massive outcrops, commonly with indistinct bedding. Youngest rocks are well layered, lithic and crystal tuffs, tuffaceous sedimentary rocks, and subordinate flow rocks. Tuffs and interbedded tuffaceous sedimentary rocks have highly variable clast sizes ranging from boulder breccia to dust tuff with lapilli tuffs most prevalent. Tuffaceous rocks range in composition from pyroxene basalt to orthoclase crystal trachyte. Intercalated flows are basalt and, locally, pseudoleucite phonolites. The third map unit is discontinuous and is locally present between the two main map units. Rocks in this map unit are feldspar porphyry flows, flow breccias, and lenses of fine-grained sedimentary rocks and epiclastic rocks containing feldspar porphyry clasts.

Strata are folded into large, open structures that form a series of linked anticlines and synclines with east-west or northwesterly trending axes. A second generation of smaller upright isoclinal to box-like folds with north-northwesterly trending axes transect the larger structures. At least two zones up to 200 metres wide of sheared cataclastic rocks have been mapped for distances of 3 kilometres. Northwesterly and north-south-trending

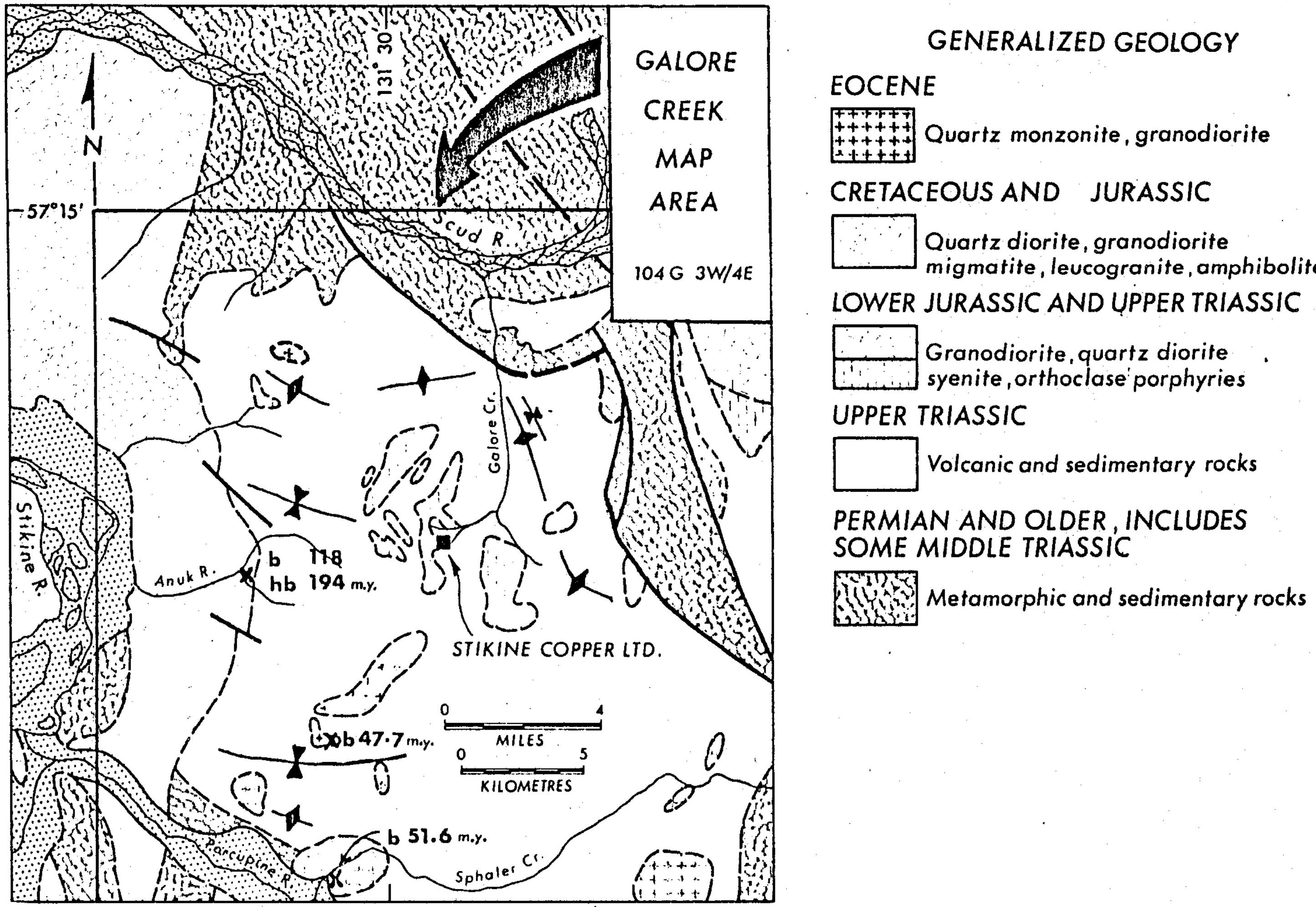


Figure 13. Generalized geology, Galore Creek map-area.

normal faults in the northern part of Galore Creek map-area and reverse faults in the east, define boundaries between Upper Triassic rocks and Middle Triassic sedimentary rocks and Paleozoic sedimentary and metamorphic rocks.

In Galore Creek basin, regional northwesterly stratigraphic and structural trends are disrupted by north-northeasterly trending breccia zones, syenite (orthoclase porphyry) intrusions, and tightly folded strata cut by numerous faults. Five major types of syenite intrusions are now recognized. The intrusions form a series of dykes, sheets, and at least two stocks, the smaller of which might be a volcanic neck. Breccias of many types are present; the most widespread is associated with dyke swarms and contains porphyritic syenite fragments in an andesite matrix mineralized with magnetite and rare sulphide minerals.

Two new K-Ar age determinations have been made. A 194 million year date was obtained from a hornblende collected from a quartz diorite phase of the Coast Plutonic Complex. This date provides a discordant pair of ages for this part of the Coast Plutonic Complex (hornblende 194±5 m.y., biotite 118±5 m.y., *Geological Fieldwork,* 1974, p. 61). A 47.7±1.7 million year date from fine-grained biotite associated with pyritic mineralization in a granodiorite stock at Split Creek indicates that mineralization as well as intrusion of small barren quartz monzonite stocks (52.6±1.6 m.y., *Geological Fieldwork,* 1974, p. 61) took place during Eocene time.

A simplified geological map of Galore Creek map-area is shown on Figure 13.

Figure 13. Generalized geology, Galore Creek map-area.

APPENDIX X

STATEMENT OF QUALIFICATIONS

STATEMENT OF QUALIFICATIONS

I, SILVIA M. HEINRICH, of #1 - 2247 West 7th Avenue, in the City of Vancouver, British Columbia , do hereby certify that:

1. I am currently employed as Senior Project Geologist by Continental Gold Corp. with offices at 1020 - 800 West Pender Street, Vancouver, B.C.

2. I graduated from Queen's University in Geology, having obtained my Master of Science in 1988 and from the University of Massachusetts, having obtained my bachelor of Science in 1980.

3. I have worked in the field of mineral exploration in B.C. and Manitoba.

4. This report is based in part on my personal observations of the property.

Silvia M. Heinrich, MSc.
Senior Project Geologist
CONTINENTAL GOLD CORP.

VANCOUVER, B.C.

STATEMENT OF QUALIFICATIONS

I, Greg Dawson, of 1008 Beach Avenue, in the City of Vancouver, British Columbia, do hereby certify that:

1. I am currently employed as geologist by Continental Gold Corp. with offices at 1020 - 800 West Pender Street, Vancouver, B.C.

2. I graduated from the University of British Columbia in Geology, having obtained my Bachelor of Science in 1986.

3. I have worked in the field of mineral exploration in B.C., Manitoba and the Northwest Territories since 1976.

4. This report is based in part of my personal observations of the property.

Greg Dawson, B.Sc.
Senior Exploration Geologist
Continental Gold Corp.

Vancouver, B.C.

STATEMENT OF QUALIFICATIONS

I, BERNHARDT E.K. AUGSTEN, of 214 - 144 West 4th Street, of the City of North Vancouver, British Columbia do hereby certify that:

1. I am currently employed as Senior Exploration Geologist by Continental Gold Corp. offices at #1020 - 800 West Pender Street, Vancouver, B.C.

2. I graduated from Carleton University in geology, having obtained my Honours Bachelor of Science in 1985.

3. I have worked in the field of mineral exploration in B.C., Manitoba, Ontario and Quebec.

4. The foregoing report is based on:
   (a) A study of all available company and government reports.
   (b) My examination of the property during the period June 16 to September 23, 1988.

Bernhardt E.K. Augsten, B.Sc.
Senior Exploration Geologist
CONTINENTAL GOLD CORP.

Vancouver, B.C.

APPENDIX XI

COST STATEMENT

Since such a large number of claims were involved in the 1988 exploration program, it was considered easiest to partition expenses on the basis of man days worked and samples collected per claim.

The first major subdivision is made between the drilling and mapping program on the Trophy 1-4 claims, and the mapping and sampling program on the 44 claims surrounding the Trophy group. The 60/40% Trophy 1-4 versus regional split of expenditures was based on the following proportions.

Man days worked on Trophy 1-4	791
Man days worked on regional program	535
Total	1,326
Percent of days spent on Trophy 1-4	**59.6%**
Percent of days spent on regional	**40.4%**

Rock & core samples collected on Trophy 1-4	1,605
Rock samples collected on regional program	894
Total	2,499
Percent of samples collected on Trophy 1-4	**64.2%**
Percent of samples collected on regional program	**35.8**

These percentages yield the following cost breakdown.

TABLE XI - 1

COST BREAKDOWN BETWEEN THE TROPHY 1-4 MAPPING AND DRILLING PROGRAM AND THE REGIONAL MAPPING AND SAMPLING PROGRAM

	Trophy 1-4	Regional
Labour	$ 99,990.00	$ 64,700.00
Support Portion	14,616.00	9,744.00
Benefit Portion	11,238.85	7,492.56
Fixed Wing	48,111.89	32,074.59
Helicopter	135,938.56	90,625.71
Fuel	32,748.07	21,832.04
Geochemistry*	35,209.00	18,845.52
Drill	328,810.27	N/A
Groceries	18,040.99	12,027.32
Freight and Express	17,509.15	11,672.76
Equipment rental	7,448.48	4,965.66
Hotel and Travel	3,186.55	2,124.36
Field and Camp Supplies	48,150.25	32,100.17
Consulting	4,995.00	3,330.00
Drafting	12,144.78	8,096.52
Report Writing, Copying, etc.	4,800.00	3,200.00
TOTAL	$ 822,937.84	$ 322,831.21

*Based on the actual number of samples collected.

The same principle was used to determine the costs to be applied to each claim (see Table XI-2).

TABLE XI - 2

COST BREAKDOWN AND WORK DISTRIBUTION FOR REGIONAL MAPPING AND PROSPECTING PROGRAM

Claim	Man Days	Samples	Proportional Cost*
Bear 1	5	26	$ 9,039.30
Bear 2	2	15	3,712.69
Catto 1	5	9	8,680.94
Catto 2	4	23	7,277.82
Glacier 1	13	90	23,974.37
Glacier 2	7	33	12,583.35
Glacier 3	11	68	20,114.12
Glacier 4	11	57	19,882.24
Glacier 5	12	61	21,664.81
Glacier 6	6	53	11,306.70
Glacier 7	14	8	23,944.08
Glacier 8	13	69	23,531.69
Glacier 9	6	26	10,737.54
Glacier 10	2	5	3,501.89
Glacier 11	1	10	1,909.04
Glacier 12	10	43	17,888.88
Scotch 1	3	1	5,115.81
Scotch 2	2	9	3,586.20
Scotch 3	1	3	1,761.48
Scotch 4	0	0	0
Scotch 5	4	7	6,940.54
Scotch 6	7	70	13,363.31
Scotch 7	2	14	3,691.61
Scotch 8	2	6	3,522.97
Scotch 9	1	1	1,719.32
Scotch 10	2	3	3,459.73
Scotch 11	0	0	0
Scotch 12	11	71	20,177.36
Saddle 1	0	0	0
Saddle 2	1	2	1,740.40
Saddle 3	0	0	0
Saddle 4	1	6	1,824.72
Saddle 5	0	0	0
Saddle 6	2	15	3,712.68
Saddle 7	4	6	6,919.46
Saddle 8	1	4	1,782.56
Saddle 9	1	0	1,698.24
Saddle 10	3	15	540.93
Saddle 11	1	7	1,845.80
Saddle 12	0	0	0
Saddle 13	2	0	3,396.49
Saddle 14	5	53	9,608.46
Saddle 15	0	0	0
Camp 1	1	5	1,803.64
TOTAL	**179**	**894**	**$ 322,831.15**

*Cost was determined by the proportion of days worked per claim to the total days worked, and the cost per sample collected.

TROPHY GOLD PROJECT
1988 Cost Statement

LABOUR

Regional Crew

B. Augsten	June 1 to November 15, 1988 144.5 days @ $140/day	$ 20,230.00
B. Mezei	May 29 to September 28, 1988 102 days @ $130/day	13,260.00
P. Barratt	June 2 to September 25 109 days @ $130/day	14,170.00
L. Brommeland	June 1 to August 26, 1988 86 days @ $90/day	7,740.00
K. May	May 16 to August 26, 1988 93 days at $100/day	9,300.00
	Sub-total	$ 64,700.00

Camp Support

J. Falkliner	Cook June 1 to September 22, 1988 113 days @ $131/day	$ 14,795.00
M. Ball	Cook's Assistant June 20 to August 19, 1988 54 days @ $90/day	4,860.00
I. Fredricks	Cook's Assistant July 26 to Aug 4, 1988 10 days @ $90/day	900.00
D. McTague	Cook August 5 to August 11, 1988 5 days @ $130/day	655.00
B. Van Barneveld	Cook's Assistant August 20 to September 9, 1988 21 days @ $90/day	1,890.00
T. Kyle	Cook's Assistant September 8 to September 21, 1988 14 days @ $90/day	1,260.00
	Sub-total	$ 24,360.00

Drill Support

D. Forster	Geologist June 1 to October 30, 1988 5 months @ $3,850/month	$ 19,250.00
G. Dawson	Geologist June 1 to November 15, 1988 142 days @ $140/dayd	19,880.00
B. Lane	Geologist June 1 to September 13, 1988 93 days @ $140/day	13,020.00
S. Heinrich	Geologist June 1 to November 15, 1988 103 days @ $140/day	14,420.00
S. Martin	Core Splitter June 1 to August 26, 1988 82 days @ $90/day	7,380.00
R. Hunter	Core Splitter June 15 to September 13, 1988 91 days @ $90/day	8,190.00
J. McGregor	Core Splitter August 24 - September 25, 1988 33 days @ $100/day	3,300.00
D. Fennings	Technician June 1 to July 27, 1988 52.5 days @ $150/day	7,875.00
G. McKenzie	Technician June 10 to July 27, 1988 44.5 days @ $150/day	$ 6,675.00
	Sub-total	$ 99,990.00
	TOTAL WAGES	$ 189,050.00
	Employer Share Benefits, Holidays, Etc.	$ 18,731.41
	TOTAL	$ 207,781.41

AIR SUPPORT

Fixed Wing

Flywest Air Ltd., Dease Lake, B.C.	$ 19,465.00
B.C. Yukon Air Ltd., Dease Lake, B.C.	1,700.00
Trans-Provincial Airlines, Terrace, B.C.	33,981.48
Ken Borek Air Ltd., Dawson Creek, B.C.	25,040.00
Sub-total	$ 80,186.48

Helicopter

Vancouver Island Helicopters	
500D, 350.5 hours @ $485/hour	$ 169,979.26
Bell 204, 30.3 hours @ $1,125/hour	34,087.50
Bell 205, 7.6 hours @ $1,426.87/hour	10,844.25
Northern Mountain Helicopters	
Bell 206, 2.5 hours @ $613.26/hour	1,533.13
Bell 204, 5.2 hours @ $1,632.28/hour	10,120.14
Trans North Air	
Bell 206, 3 hours @ $600/hour	1,800.00
Sub-total	$ 226,564.28
TOTAL AIR SUPPORT	$ 306,750.76

FUEL

Diesel, 21,502 litres @ $0.40 - 1/2 litre	$ 8,704.35
Regular gas, 416 litres @ $0.48 - 1/100/litre	199.93
Propane, 1,090 litres @ $2.10/litre	2,285.15
Jet fuel, 67,280 litres @ $0.73/litre	30,808.38
Aviation gas, 9,316 litres @ $0.74/litre	12,582.30
TOTAL	$ 54,580.11

GEOCHEMISTRY

2,499 rock and core samples @ $21.08/sample (cost includes shipping) Analysis included one or all of the following: 30 element ICP, Au, Ag fire assay	$ 52,678.92
181 soil samples @ $7.60/sample analyzed for Au & Ag	1,375.60
TOTAL	$ 54,054.52

DRILL

2,833.90 m @ $116.03 inclusive Contractor: Coates Enterprises, Richmond, B.C.	$ 328,810.27

GROCERIES

June 13 to September 22, 1988 1,467 man days @ $20.50/day	$ 30,068.31

FREIGHT AND EXPEDITING

Dease Lake Expediters	$ 7,646.59
North Arm Expediters	236.61
Blacks Expediting	94.65
Canadian Airlines International	1,598.55
Bandstra Trucking Ltd.	3,379.78
Gilmac Trucking Ltd.	1,852.01
Lindsays Trucking Ltd.	1,695.92
Central Mountain Air Ltd.	12,677.80
Sub-total	$ 29,181.91

EQUIPMENT RENTAL

Generator, 4.1 mo. @ $938.10/mo.	$ 3,842.33
Rock Drill, 4 mo. @ $318.00/mo.	1,272.00
Transit, 4 mo. @ $302.10/mo.	1,208.40
Radios, 6 x 3 mo. @ $185.50/mo.	2,782.50

VEHICLE RENTAL

Ford Van, 3 mo. @ $1,102.97/mo.	3,308.91
Sub-total	$ 12,414.14

HOTEL AND TRAVEL EXPENSES

HOTEL AND TRAVEL EXPENSES	$ 5,310.91

CONSULTING SERVICES

Geoterex Consulting Ltd. 15 days @ $395/day	$	5,925.00
Don Francis Ltd. 6 days @ 400/day		2,400.00
Sub-total	$	8,325.00

FIELD, CAMP AND OFFICE SUPPLIES

Lumber, construction, plumbing and electrical supplies	$	13,316.18
Tents, frames, all field and safety gear, fridge, freezer, stoves, tent heaters, cots, etc.		50,457.45
Sub-total	$	50,588.63

MISCELLANEOUS EQUIPMENT

Blasting materials	$	1,324.70
Rock saw		2,794.64
Hand held radios		2,747.10
Chain saw		724.21
Wajax pump & hoses		3,955.43
Drill steel		728.81
Core boxes		4,202.00
Sub-total	$	80,250.42

DRAFTING SERVICES

1:10,000 and 1:20,000 scale maps for the project area	$	20,241.30

OFFICE AND OVERHEAD

Postage, telephone, radio licence, secretarial etc.	$	8,000.00
GRAND TOTAL	$	1,145,769.06