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PETROGRAPHIC DESCRIPTIONS

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Vancouver Petrographics Ltd.

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Samples: DDH-3 88', 142'
DDH-4 19', 35.5'

Summary:

The samples are dominantly of intermediate to mafic plutonic and hypabyssal rocks, with one sample containing a contact between these units and an aphanitic latite. Most of the rocks are altered and veined. Summaries of individual samples are below.

DDH-3 88' altered diorite (plagioclase-hornblende), medium to coarse grained. Hornblende mainly altered to actinolite. Veins dominated by plagioclase with a core of actinolite-calcite-(pyrite-Ti-oxide). Smaller vein of actinolite-plagioclase, and numerous veinlets of chlorite.

DDH-3 142' contact between strongly altered and recrystallized quartz diorite (only plagioclase recrystallized and altered) and aphanitic latite. Chlorite was introduced during recrystallization into both rocks. In the latite, some chlorite-rich patches appear to be replaced mafic phenocrysts. The rock contains veinlets of pyrite-chlorite-(plagioclase-quartz).

DDH-4 19' altered porphyritic gabbro-diabase, with clinopyroxene and minor plagioclase phenocrysts in a groundmass dominated by plagioclase and lesser actinolite and calcite. Clinopyroxene is altered completely to a variety of aggregates of calcite, chlorite, and actinolite. The rock contains a fragment of leucocratic quartz diorite? and is cut by two sets of veins, a major set dominated by calcite-(quartz-plagioclase), and a less abundant set dominated by quartz-(chlorite).

DDH-4 35.5' fine grained diorite dominated by plagioclase and actinolite, cut by major veins of plagioclase-chlorite-calcite-(quartz), and minor veinlets of calcite-(pyrite).

John G. Payne

Petrographic Analysis Summary

Sample #	Grid Location	Type of Sample	Classification
S-AA-2	A Grid 3+50N 4+00W	Outcrop	Altered (actinolite-quartz) volcanic (dacite)
85 AA DDH-1(49m)	A Grid 3+45N 4+00W	Diamond Drill Core	Tuff beccia (silicified)
85 AA DDH-2(16m)	A Grid 3+45N 3+50W	Diamond Drill Core	Fine grained graywacke
85 AA DDH-2(27m)	A Grid 3+45N 3+50W	Diamond Drill Core	Altered tuff
85 AA DDH-3(12m)	A Grid 0+50S 1+50E	Diamond Drill Core	Andesite
85 AA DDH-3(22.6m)	A Grid 0+50S 1+50E	Diamond Drill Core	Brecciated altered tuff (carbonatized)
85 AA DDH-3(26.9m)	A Grid 0+50S 1+50E	Diamond Drill Core	Altered diorite cut by several vein types
85 AA DDH-3(34.2m)	A Grid 0+50S 1+50E	Diamond Drill Core	Amphibolized intrusive? Altered tuff?
85 AA DDH-3(43.3m)	A Grid 0+50S 1+50E	Diamond Drill Core	Contact quartz diorite - latite
85 AA DDH-4(5.8m)	A Grid 0+47S 3+43E	Diamond Drill Core	Altered porphyritic gabbro with quartz-calcite veins
85 AA DDH-4(10.8m)	A Grid 0+47S 3+43E	Diamond Drill Core	Fine grained diorite cut by plagioclase-calcite-chlorite-quartz veins
85 AA DDH-4(17.5m)	A Grid 0+47S 3+43E	Diamond Drill Core	Fine grained diorite
S-AB-1	B Grid 4+75N 1+75E	~~Diamond Drill Core~~ Sample.	Altered (actinolite-quartz) volcanic

Sample AA DDH-1 49.0m (Slide 85-167X) TUFF BRECCIA

Estimated mode

Plagioclase	32
Quartz	14
Chlorite	32
Amphibole	18
Biotite	2
Rutile	1
Carbonate	trace
Epidote	trace
Sericite	trace
Pyrite	1

This is a heterogenous, strongly altered rock displaying obscure fragmental features.

The slide can readily be seen to consist of two main components - one distinctly green and the other more colourless. The green phase forms ragged, streaked-out fragments in the other, and there are areas of intimately admixed lensoid patches of the two components.

The light coloured material consists dominantly of an ill-defined anhedral granular aggregate of plagioclase, felsite and lesser quartz granules on the scale 0.05 - 0.2mm. It is intimately pervaded intergranularly, and within the grains, by very fine-grained chlorite.

The green material appears to be similar but with a much higher content of chlorite and the felsite barely distinguishable as interstitial remnants. Intergrown acicular amphibole, as non-oriented meshworks, is often abundant, together with scattered small flecks of biotite. Sometimes the amphibole-rich material forms cores to distinct fragments of the green phase, surrounded by rims of more chloritic composition. Some of the chloritic/amphibolitic fragments are speckled with small, rounded or elongate inclusions of quartzo-feldspathic material.

The rock is permeated throughout by irregular veinlets and pockets of quartz, presumably indicative of a phase of silicification - possibly diagenetic. Some of the quartzose pockets have intergrown flaky chlorite, green biotite, sulfides and occasional traces of carbonate. Sulfides also occur as sparse, randomly disseminated grains without associated silicates. The sulfides include pyrite and chalcopyrite.

The chaotic character of this breccia is suggestive of soft sediment slumping in intercalated felsitic and chloritic tuffs. The amphibolitization probably represents a subsequent (thermal?) episode.

Sample AA DDH-2 16.00m (Slide 85-168X) FINE-GRAINED GRAYWACKE

Estimated mode

Plagioclase	30
Quartz	26
Chlorite	30
Amphibole	8
Epidote	1
Carbonate	trace
Opaques	5

This is a rather even-grained, homogenous rock which exhibits a fine-grained graywacke-like texture.

It is composed of abundant angular to sub-rounded quartz grains and clasts of microgranular quartz and/or plagioclase, 0.05 - 0.2mm in size, set in a matrix of fine-grained felted chlorite and felsitic material. Accessory amounts of a fine-grained acicular amphibole form randomly oriented needles and incipient prismatic porphyroblasts through the matrix (and locally penetrating the quartz grains). Scattered tiny granules of epidote are another disseminated component.

The outlines of the coarser quartz and feldspar grains and aggregate patches are somewhat diffuse, as if through incipient replacement by the chloritic matrix.

The texture of this rock is somewhat enigmatic. The homogeneity and lack of layering or distinguishable fragments gives it a fine-grained igneous/volcanic look, but the pronounced microbreccia texture of gritty, dominantly quartzose grains in a fine-grained matrix favours its classification as a graywacke.

The rock contains a relatively high content of very fine-grained opaques. These include some recognizable pyrite but are probably mainly oxides. They exhibit an unusual and distinctive mode of occurrence as spidery, wispy networks and short, sinuous stylolite-like threads. Sometimes these include small discrete granules up to 0.05mm in size. This structure bears only a partial relation to the grain structure of the host, sometimes partially following around the outlines of the clasts but generally seeming independent of them. The sulfide threads and specks tend to define a weak sub-parallel foliation.

The lack of any apparent fracture control or of any associated concentrations of alteration type minerals suggests that the opaques are of a primary or diagenetic origin.

Sample AA DDH-2 27.28m (Slide 85-169X) ALTERED TUFF ?

Estimated mode

Plagioclase	30
Quartz	25
Amphibole	22
Chlorite	16
Epidote	2
Carbonate	2
Opaques	3

This rock is made up of a rather homogenous fine-grained, mafic-rich matrix which is host to prominent, augen-like segregations of quartz.

The matrix is composed of very fine-grained chlorite (possibly with intergrown felsite) within which is developed a meshwork of tiny acicular amphibole needles. Also present are some slender plagioclase laths and abundant small rounded/equant pools of microgranular quartz and felsitic plagioclase.

The fabric of the matrix shows a weak but distinct foliation (produced by weak preferred orientation of amphibole needles, strong parallelism of the scattered plagioclase laths and a tendency for the small quartz/feldspar clumps to occur in elongate clusters). This is emphasized by the distribution of fine-grained opaques which form spidery dendritic clusters, elongated in the direction of the foliation. Locally they form stylolite-like wisps and sinuous networks.

Although sub-concordant with the foliation, the opaque clusters and streaks seem to bear no consistent relation to the grain fabric of the matrix.

The opaques are very fine-grained and little more can be said about them in the absence of a polished surface for reflected light examination. As far as can be seen from the cut-off chip, however, they probably consist mainly of chalcopyrite and magnetite.

The prominent augen-like masses in this rock (which, in general, also show a conformity to the overall foliation) are composed essentially of anhedral mosaic aggregates of quartz of grain size 0.1 - 1.0mm. Some of them also contain intergrown coarse-grained carbonate, sheaf-like prismatic epidote, pockets of felted chlorite, and crystals of sericitized plagioclase.

The origin of these segregations is unclear. Sometimes they form clearly defined rounded or elongate patches reminiscent of amygdules. Elsewhere, however, they show more diffuse contacts, with gradational envelopes of fine-grained silicification in the surrounding matrix. In some cases they are linked by distinct veinlets of quartz, suggesting that they are centres of introduced silicification.

The rock itself is, overall, of obscure origin. The texture of the matrix looks volcanic-igneous, in which case the foliation may be a flow feature. However, it also looks somewhat recrystallized (the amphibole could be a superimposed feature) and the foliaiton could be partly deformational. Alternatively - and perhaps most likely overall - the foliation may follow original layering in a tuff in which the quartzose augen are fragments or coarse silty intercalations.

Sample AA DDH-3 12.00m (Slide 85-170X) ANDESITE

Estimated mode

Plagioclase	80
Amphibole	16
Carbonate	1
Sphene	1
Sericite	trace
Chlorite	trace
Epidote	trace
Opaques	2

This rock is composed essentially of a meshwork-textured aggregate of unaltered plagioclase, mainly in the size range 0.02 - 0.2mm. Euhedral to subhedral lath-like grains form a mesh to interstitial finer-grained felsitic plagioclase. A few coarser semi-phenocrysts ranging up to 0.5mm or more are also present, sometimes in clumps.

The scattered coarser grain clusters are lightly dusted with sericite but, for the most part, the plagioclase is fresh and unaltered.

The principal accessory is a pale olive coloured amphibole which forms small acicular crystals intimately intergrown with the plagioclase meshwork, as well as scattered, coarser, subhedral, phenocryst-like grains (sometimes clumped with the coarsest plagioclase).

Minor accessory sphene occurs as disseminated granules, and rims to small grains of oxides.

The amphibole is presumably mostly of primary origin (though some of the coarser grains have inclusions of plagioclase and look a little ragged and porphyroblastic). However, it also shows some wispy, irregular, veinlike concentrations, sometimes with associated sulfides and carbonate. These probably represent incipient alteration/recrystallization controlled by micro-fracturing.

Rare isolated granular pockets of epidote also occur.

The distribution of sulfides (mainly pyrite) is clearly fracture-controlled.

Sample AA DDH-3 22.65m (Slide 85-171X) BRECCIATED ALTERED TUFF (?)

Estimated mode

Carbonate	50
Sericite	14
Plagioclase) Felsite)	25
Quartz	10
Secondary amphibole(?)	1
Opaques	trace

This is a rock of enigmatic character.

As can be clearly seen from the cut-off chip it is, in part, a breccia. One end of the slide shows angular, matching fragments, 0.5 - 8.0mm in size, with a minor veinlet-type cementing phase.

The rock in this area appears to be a sericitized felsite heavily and pervasively permeated by fine-grained carbonate. Irregular diffuse-margined patches of quartz occur within this material and look like unreplaced remnants.

The cementing veinlet phase is carbonate and an olive green felted mineral which may be a type of amphibole. The latter sometimes forms rims and networks outlining microbrecciated areas of sparry carbonate (calcite) within the cementing phase.

This obviously brecciated zone is in contact with an area of similar but more homogenous rock which, however,lacks quartz. This makes up the central part of the slide and consists, apparently, of very fine-grained, partially sericitized felsite, densely and evenly pervaded by carbonate. The latter shows a peculiar sheaf-like, semi-fibrous habit. It may be either pseudomorphous after another mineral (amphibole/) or in a state of incipient recrystallization to this other mineral.

This area may simply be a large clast in the same crackle-type breccia referred to earlier. It is cut by occasional hair-line veinlets of the felted amphibole-like mineral.

It appears to show a sharp contact with the material making up the far end of the slide, which consists of patches of a granular quartzo-feldspathic rock separated by sub-opaque carbonate. This is also probably a breccia structure. The fragment material looks almost like a fine graywacke or crystal tuff - consisting of close-packed, small (0.02 - 0.2mm) clasts or crystals of quartz and plagioclase in a carbonate/sericite matrix. Locally the matrix is essentially lacking and the aggregates look volcanic in origin (lithic clasts?). The carbonate in this area often shows pellety, streaky features suggesting that it may be pseudomorphous after vitric or vitroclastic material.

The whole rock is obscured in detail by the strong pervasive carbonatization. The carbonate is non-reactive to dilute acid and is probably dolomitic.

The rock is probably an altered pyroclastic which has been brecciated.

(26.9 m)
DDH-3 88' Altered Diorite cut by several vein types

The rock is a medium to coarse grained diorite in which plagioclase is slightly altered to dusty sericite-epidote, and hornblende is variably altered to actinolite. A few hornblende grains are relatively fresh, and most are altered completely. Veins include a large composite vein dominated by plagioclase with a core of actinolite-calcite-(pyrite), a smaller vein dominated by acicular actinolite and lesser plagioclase, and numerous narrow chlorite-rich veinlets. Calcite-pyrite forms a few irregular replacement patches.

plagioclase	50-55%
hornblende/actinolite	35-40
calcite	0.2
pyrite	minor
ilmenite	0.1
Ti-oxide	0.1
veins	
1. plagioclase with core of actinolite-calcite-(pyrite)	4- 5%
2. actinolite-(plagioclase)	0.5
3. chlorite	½- 1

Plagioclase forms anhedral, equant grains averaging 1-1.5 mm in size. These are altered slightly to moderately to dusty to extremely fine grained sericite, epidote, and actinolite. Actinolite forms tiny acicular grains in some plagioclase grains.

Hornblende forms anhedral to subhedral grains averaging 0.7-1 mm in size. A few grains are relatively fresh, and are light brownish green in color with weak pleochrism. Many grains are altered to pseudomorphs of very pale green actinolite. More intense alteration and recrystallization produces subparallel to irregular aggregates of fibrous to acicular actinolite.

Calcite forms irregular interstitial patches averaging 0.1-0.2 mm across. A few larger patches up to 07. mm across contain very irregular intergrowths of very fine to extremely fine grained pyrite?.

Ilmenite forms scattered anhedral, equant to elongated grains from 0.05-0.15 mm in average size. A few have thin, partial rims of Ti-oxide. Ti-oxide/leucoxene forms disseminated, extremely fine grained patches, mainly less than 0.05 mm in size.

The rock is cut by a main vein 1-1.3 mm in width, dominated by anhedral, fine to locally medium grained plagioclase, with an irregular core zone averaging 0.1-0.2 mm in width consisting of extremely fine to very fine grained calcite and actinolite. Pyrite forms very irregular inclusions in some calcite patches (as in the host rock). Ti-oxide forms a cluster of elongated prismatic grains up to 0.5 mm in length. The original grains are altered completely to extremely fine grained aggregates of two phases, one colorless with high relief (rutile) and the other semiopaque to opaque (leucoxene).

In one corner is a vein up to 0.5 mm wide dominated by very fine grained, commonly acicular actinolite, with lesser anhedral, equant plagioclase of similar grain size.

The rock is cut by numerous wispy seams averaging 0.01-0.03 mm in width of very fine grained chlorite.

Sample AA DDH-3 34.20m (Slide 85-172X) AMPHIBOLITIZED INTRUSIVE (?)
ALTERED TUFF?

Estimated mode

Plagioclase	37
Quartz	20
Amphibole	20
Chlorite	12
Carbonate	8
Opaques	3

This sample consists of a quartzo-feldspathic rock of uncertain origin which has been strongly altered in a rather distinctive fashion.

What appears to be the primary texture consists of rather coarse subhedral to irregular shaped grains of quartz, 0.3 - 3.0mm in size, set in a matrix of plagioclase. The textural relationships are partly of sub-graphic type, and have the aspect of an intrusive. The character of the plagioclase, however, is strange. Instead of the discrete grains one might expect, it exhibits an obscure internal structure of patchy felsitic (or pseudo-felsitic?), type, sometimes microgranular, sometimes almost feathery. It is possibly a cryptic form of granophyre. Alternatively (though less likely) the quartz may be a form of silicification within a coarse-grained lithic tuff. The rock could also be extensively recrystallized, though no features of deformation are apparent.

The plagioclase is lightly dusted throughout with minute speckles of carbonate.

The rock is pervaded by radiate clusters, irregular meshwork patches and sub-parallel vein -like concentrations of pale-green, weakly pleochroic amphibole. This forms fibrous masses grading to acicular prismatic grains up to 1mm long. The more dispersed, finer-grained amphibole forms sheafs and rosettes often controlled by quartz/plagioclase contacts, but also as inclusions within quartz.

In parts of the slide ampbibole is rare and its place appears to be taken by chlorite. This forms rather well-segregated irregular masses and pockets of fine-grained felted material. This locally acts as matrix to meshwork of fine acicular amphibole and the latter mineral sometimes appears to be developing from chlorite.

Carbonate is an associate of some of the coarser segregations of amphibole. It occurs as interstitial pockets or as matrix to meshworks of amphibole needles.

Well-crystallized (twinned) plagioclase occurs in association with some of the vein-like amphibolitized zones.

Opaques (mainly pyrite) are patchily concentrated in the amphibolitic zones - in an intimately intergrown interstitial relation to the silicate meshworks. Disseminated anhedral grains of pyrite are also seen in the non-amphibolitized rock, sometimes associated with chlorite.

A proportion of the opaques exhibit the sinuous thread-like form seen in some of the other rocks of the suite. These may be largely rutile or Fe/Ti oxides (which are also seen as small skeletal/lattice growths).

(43.3m)

DDH-3 142' Contact: Quartz Diorite and Latite; Veins of Pyrite-Chlorite

The sample is at the contact of a medium to coarse grained quartz diorite and an extremely fine grained latite. The quartz diorite is strongly recrystallized (plagioclase but not quartz) and replaced by chlorite. The latite contains patches of chlorite, which may be replacements of hornblende phenocrysts. Veinlets in both rocks are dominated by pyrite and chlorite.

quartz diorite

plagioclase	55-60%
chlorite	10-12
quartz	25-30
ilmenite/leucoxene	1-1½
calcite	trace

Plagioclase forms anhedral grains from 0.7-2 mm in size. It is recrystallized strongly to very fine or extremely fine grained aggregates of equant, anhedral grains. The latter have been slightly to strongly replaced by chlorite, which is intimately intergrown with recrystallized plagioclase.

Quartz forms medium to locally coarse grains which show moderately strained extinction. They are fractured, with fractures filled by extremely fine grained plagioclase-chlorite.

Ilmenite/leucoxene forms ragged, equant grains up to 0.3 mm in size. These are corroded and replaced by extremely fine grained recrystallized plagioclase-chlorite.

Calcite forms scattered, extremely fine grained patches of irregular outline.

latite

plagioclase	70-75%	
chlorite	15-20	(groundmass)
chlorite patches	7- 8	
Ti-oxide	trace	
apatite	trace	
hematite?	trace	

The latite is dominated by extremely fine grained aggregates of plagioclase, with minor to moderately abundant intimately intergrown chlorite flakes of similar size. Chlorite is more abundant near late pyrite-chlorite veinlets. Scattered through the rock are patches up to 1.3 mm in size dominated by extremely fine to very fine grained chlorite. Some of these have subhedral outlines suggesting that they represent altered hornblende phenocrysts. However, some contain minor to moderately abundant intergrown plagioclase (as in the groundmass), suggesting that they formed by replacement of the groundmass. Scattered through the groundmass are irregular patches averaging 0.05-0.1 mm in size of plagioclase, probably formed by recrystallization.

Ti-oxide forms disseminated extremely fine grains.

Apatite forms a very few ragged prismatic grains up to 0.1 mm long.

Hematite? forms one euhedral pseudomorph 0.2 mm across. It is deep red-brown in color and isotropic. The original grain may have been pyrite.

veinlets

The rock is cut by numerous veinlets less than 0.2 mm wide. Most are dominated by patches of pyrite, with much less plagioclase, quartz, and brownish green chlorite. These grade laterally into thin seams of light green chlorite. A few lensy veinlets are dominated by quartz with much less plagioclase and/or chlorite.

(5.8m)

DDH-4 19' Altered Porphyritic Gabbro/Diabase; Calcite-Quartz veins

The rock contains medium to very coarser phenocrysts of clinopyroxene and minor plagioclase is a groundmass dominated by lathy plagioclase with interstitial actinolite and calcite. Clinopyroxene phenocrysts are altered to chlorite, actinolite, and calcite in a variety of textures. The rock is cut by two sets of veins, one dominated by quartz with lesser chlorite, and the other dominated by calcite with lesser quartz and plagioclase. The rock contains a fragment? of leucocratic quartz diorite?.

phenocrysts	
clinopyroxene	15-17%
plagioclase	1- 2
groundmass	
plagioclase	50-55
actinolite	15-17
calcite	5- 7
opaque	0.3
pyrite/hematite	trace
fragment	
quartz diorite?	2- 3
veins	
1) quartz-(chlorite)	1½- 2
2) calcite-quartz-(plagioclase)	7- 8

Clinopyroxene forms euhedral to subhedral phenocrysts up to several mm across. They are altered completely. Large phenocrysts generally are altered to fine to very fine grained aggregates of chlorite. Some of these contain cores rich in calcite with minor ragged actinolite grains. Others have thin rims of actinolite surrounding cores of chlorite. A few contain minor Ti-oxide as disseminated, extremely fine grained irregular patches. One contains irregular patches of quartz and actinolite surrounded by chlorite. Smaller phenocrysts (less than 1.5 mm) are dominated by pseudomorphic actinolite, with only minor chlorite or calcite.

Plagioclase forms one large phenocrysts over 2 mm across. It is irregularly replaced by patches of quartz of very fine to fine grain size. Smaller plagioclase phenocrysts are prismatic and up to 0.8 mm long; they are relatively fresh.

The groundmass is dominated by lathy plagioclase grains averaging 0.2-0.5 mm in length. Interstitial to these are subhedral to anhedral garins of actinolite up to 0.3 mm in size, and very fine grained patches and seams of calcite. Calcite and actinolite probably are secondary after primary clinopyroxene. Calcite probably is in part secondary after actinolite (Some patches in the rock contain only actinolite after clinopyroxene, and in other patches the only material interstitial to plagioclase is calcite.

Opaque forms anhedral grains and clusters from 0.1-0.6 mm in size. The mineral probably is ilmenite, possibly altered to leucoxene.

A very few subhedral to euhedral grains of pyrite are up to 0.1 mm across. They are altered completely to dark red-brown hematite pseudomorphs.

The rock contains an irregular patch (inclusion?) at one end of the section. The patch is dominated by very fine grained, equant, slightly interlocking plagioclase, with muc hess interstitial quartz, and also contains a few patches of fine to medium grained quartz.

The rock is cut by veins up to 0.6 mm wide of very fine to fine grained quartz with patches of extremely fine grained chlorite.

A larger, more irrgeular vein or replacement zone consists of very fine to fine grained calcite with lesser very fine grained quartz, and a few patches of very fine grained plagioclase. The hand sample contains several similar calcite-(quartz) veins up to 1.5 mm in width.

Note: Two thin sections were prepared; they have slightly different features. The description is of the section with the large calcite-rich vein.

(10.8 m)
DDH-4 35.5' Fine Grained Diorite cut by Plagioclase-Calcite-Chlorite-(Quartz) Veins

The rock is a uniform, fine grained diorite dominated by plagioclase and actinolite, with minor Ti-oxide/ilmenite, chlorite, and calcite patches. It is cut by two large veins dominated by earlier extremely fine grained plagioclase and chlorite and later coarser grained calcite-chlorite-(quartz).

plagioclase	50-55%
actinolite	30-35
calcite	2- 3
chlorite	1½-2
Ti-oxide	1- 1½
veins	
plagioclase-calcite-chlorite-(quartz)	7- 8%
calcite-opaque (pyrite?)	minor

Plagioclase forms a few prismatic phenocrysts up to 1 mm in size, and more abundant ones from 0.4-0.6 mm in length. The latter grade down into groundmass plagioclase, which consists of lathy, prismatic, and equant grains averaging 0.1-0.3 mm in size. Plagioclase is slightly altered to extremely fine grained sericite, chlorite, and actinolite.

Actinolite forms ragged prismatic grains averaging 0.1-0.5 mm in size, with a very few over 0.7 mm in length. Color is pale to light green and pleochroism is weak.

Calcite forms very irregular patches of extremely fine grain size; patches are up to 0.2 mm in size.

Chlorite forms interstitial patches up to 0.2 mm in size of extremely fine grained aggregates of equant flakes averaging 0.02 mm in grain size.

Ti-oxide and ilmenite occur in ragged patches from 0.02-0.05 mm in size. Patches commonly have tiny opaque (ilmenite/leucoxene) cores surrounded by high-relief Ti-oxide. Probably original ilmenite grains are replaced by Ti-oxides.

The rock is cut by two parallel veins from 1 to 3 mm wide. These consist of two main assemblages. Earlier, extremely fine grained aggregates are dominated by plagioclase with lesser interstitial chlorite. Plagioclase is equant and slightly interlocking. Later semas parallel to vein walls, and mainly in the core of veins consist of very fine grained calcite, with patches of chlorite and minor interstitial quartz. In one vein, some of the plagioclase near this core is moderately to strongly altered to extremely fine grained sericite and very fine grained sericite/muscovite.

Wispy stringers up to 0.03 mm in width consist of calcite with scattered patches up to 0.07 mm in size of opaque, probably pyrite. These veinlets cut the rock and the earlier plagioclase-rich veins.

Sample AA DDH-4 17.52m (Slide 85-173X) FINE-GRAINED DIORITE

Estimated mode

Plagioclase	50
Amphibole	42
Chlorite	1
Epidote	4
Carbonate	3
Sphene	trace
Opaques	trace

This is a fresh, evenly granular, medium to fine-grained rock composed essentially of intergrown plagioclase and amphibole.

The plagioclase forms an interlocking meshwork of subhedral, prismatic grains, 0.2 - 0.6mm in size. It is fresh and sometimes shows well-developed twinning. Observation of extinction angles indicates a composition in the andesine range. Scattered interstitial pockets of fine-grained felsitic or feathery textured plagioclase are also seen.

The amphibole is a rather pale coloured, olive to blue-green pleochroic variety which forms subhedral prismatic to anhedral grains of similar size to the plagioclase. It appears to be a primary constituent and exhibits an interstitial/interpenetrating textural intergrowth with the plagioclase. The amphibole tends to concentrate in clumps.

Epidote occurs as rather evenly distributed small fine-grained clusters, mainly as an alteration of plagioclase, but occasionally within amphibole.

Carbonate forms sparsely disseminated irregular flecks and intergrowths with the epidote, but is concentrated mainly as thin veinlets and linear replacement zones.

Sphene occurs as sparse scattered granules. Opaques are rare. They appear to be Fe/Ti oxides.

A Grid
3+50N 4+00W

S-AA-2: ALTERED (ACTINOLITE-QUARTZ) VOLCANIC (DACITE ?).

This sample originally consisted mainly of an aggregate of fine shapeless to lath-like plagicolase grains, intergrown with some quartz. Pervasive alteration has resulted in the formation of quartz patches within the mass of plagioclase. Perhaps all the quartz (certainly most of it) has been introduced which would place the rock in the andesite classification field. Actinolite and opaques (pyrite, judging from hand specimen) are intergrown with the quartz. Minerals are:

plagioclase	37%
quartz	32
actinolite	20
opaque (pyrite)	6
chlorite	4
epidote	1

Plagioclase forms shapeless to lath-like interlocking grains 0.05 to 0.3mm in size which are intergrown with some fine quartz. Extremely fine chlorite occurs between the plagioclase grains and is partly replacing them. The chlorite is concentrated in irregularly shaped patches up to 1mm in size where it forms a mass of flakes 0.05 to 0.1mm in size. In places rounded epidote grains less than 0.05mm in size occur in clusters within the plagioclase.

Quartz forms irregulalrly shaped to subrounded grains 0.1 to 0.6mm in size which occur in partly interconnected patches up to a few millimeters in size which have replaced the plagioclase. Small remnants of the plagioclase occur within the quartz patches. Sometimes there are small prismatic epidote grains within the quartz. There is also a veinlet of quartz about 1mm wide where the quartz is intergrown with tabular plagioclase grains about 0.3mm in size. Contacts with the rock are not sharp.

The quartz is associated with actinolite and pyrite (identified in hand specimen). The actinolite forms ragged acicular grains 0.05 to 0.3mm in length which occur in aggregates and clusters replacing the plagioclase around the quartz patches and are also intergrown with and included within the quartz grains. Small radiating clusters occur within the plagioclase away from the quartz patches. Very fine actinolite grains are included in the quartz and plagioclase in the veinlet.

The pyrite forms cubic to rounded grains 0.05 to 0.5mm in size. The larger ones usually occur in small aggregates which are intergrown with quartz; actinolite clusters around these and is sometimes intergrown with the pyrite. These actinolites are usually much broader than the more typical acicular grains. The smaller pyrite grains are disseminated throughout the plagioclase part of the rock.

B Grid
4+75N 1+75E

S-AB-1: ALTERED (ACTINOLITE - QUARTZ) VOLCANIC.

This sample originally consisted of a mass of fine plagioclase grains and was probabaly an andesite. Pervasive silicification has resulted in the formation of a partly interconnected patchy network of quartz within the mass of plagioclase. Actinolite is intergrown with the quartz and also occurs in patches within the volcanic parts of the rock. Further alteration (authigenic?) has resulted in bleaching and staining of the amphibole by limonite; this is associated with fine carbonate and chlorite. Minerals are:

plagioclase	35%	
actinolite	35	
quartz	30	
Fe-Ti oxide	minor	
chlorite	minor	
sericite	minor	
calcite	trace	
opaque	trace	(altering to limonite)

Plagioclase forms a mass of subrounded grains about 0.03mm in size. There are vague outlines of larger grains up to 0.2mm in size suggesting that the fine plagioclase has been recrystallised from these during the alteration. Extremely fine Fe-Ti oxides are disseminated within the plagioclase. In places there are very fine flakes of sericite within the plagioclase.

Alteration has resulted in the formation of a closely spaced, partly interconnected patchy network of quartz and actinolite within the plagioclase. The quartz forms subrounded to irregularly shaped grains 0.05 to 0.3mm in size. Interconnected patches may be a few millimeters in size; isolated ones are much smaller. In the larger patches actinolite occurs in a network amongst the quartz grains. It forms fine feathery or acicular grains up to 0.2mm in length which are growing into the quartz. The fine network of actinolite is continuous into the volcanic parts of the rock and it also occurs in patches within the plagioclase where it forms grains up to 1mm in length. Sericite in the plagioclase tends to occur near the actinolitic patches.

The actinolite has been bleached and stained a light brown colour by limonite; the green colour is preserved in the core of the patches. The limonite is derived from cubic opaque grains (altered pyrite??) up to 0.1mm in size which occur scattered about the patchy network of actinolite. Bleaching is probably due to the addition of calcite and chlorite which have been introduced along very thin fractures. Small chlorite patches are sometimes intergrown with the actinolite and very fine chlorite occurs in thin discontinuous vein-like patches within the plagioclase. Calcite also forms very fine grains occuring in thin vein-like patches in the plagioclase or in places it occurs as fine specks. Some of the actinolites have been pseudomorphically replaced by fine calcite.

Cu	123 p.p.m	Sb	34 p.p.m
Pb	236 p.p.m	Au	6 p.p.b.
Zn	521 p.p.m		
As	13 p.p.m		
Ag	0.-		

Harris
EXPLORATION
SERVICES

MINERALOGY AND GEOCHEMISTRY

534 ELLIS STREET, NORTH VANCOUVER, B.C., CANADA V7H 2G6 TELEPHONE (604) 929-5867

Job #85-59

October 10th, 1985

Report for: Rad Peshalj,
Imperial Metals Corp.,
1300-409 Granville St.,
Vancouver, B.C.
V6C 1T2

Samples:

7 core samples from Project 4114. The rocks were prepared as standard thin sections. Corresponding sample and slide numbers are as shown below:

Sample No.	Slide No.
AA DDH-1 49.0m	85-167X
AA DDH-2 16.00m	85-168X
AA DDH-2 27.28m	85-169X
AA DDH-3 12.00m	85-170X
AA DDH-3 22.65m	85-171X
AA DDH-3 34.20m	85-172X
AA DDH-4 17.52	85-173X

Summary:

This is a rather diverse suite including several rocks of obscure type.

Two samples readily identifiable are 170X, a fresh, non-porphyritic, plagioclase-rich andesite; and 173X, a plagioclase-amphibole rock classified as a fine-grained diorite.

The majority of the rocks exhibit features which suggest a probable tuffaceous or volcaniclastic origin. 168X appears to be a fine-grained graywacke; 169X is tentatively identified as an andesitic tuff with quartzose segregations; 167X may be a slumped melange of andesitic and felsic tuffs; and 171X is an intensely carbonated and sericitized breccia of possible tuffaceous character.

A notable feature of all these rocks, except the last, is the presence of fine-grained acicular amphibole. This appears to have developed from chlorite, possibly in response to thermal metamorphism.

The remaining rock of the suite, 172X, is of uncertain affinities: it was initially felt to be an altered intrusive but may be related to the tuffs. It contains acicular amphiboles similar to those characterising the latter group, as well as fine-grained opaques of a distinctive textural type also observed in 168X and 169X.

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Report for: **J. William Morton,**
Eastfield Resources Ltd.,
110 - 325 Howe Street,
VANCOUVER, B.C., V6C 1Z7

Invoice 7015
December 1987

Samples: 87-1-1 158', 87-1-2 13', 87-1-3 24', 87-1-5 130'

Summary:

The samples are of a metamorphosed hypabyssal suite of diorite-andesite composition. Hornblende is altered completely, mainly to one or more of actinolite, chlorite, and calcite. Plagioclase generally is fresh to altered slightly. Phenocrysts of plagioclase and hornblende are ubiquitous but not abundant.

Veins are common, and are dominated by one or more of calcite, chlorite, quartz, plagioclase, actinolite, and epidote.

87-1-1 158' diorite, moderately abundant phenocrysts of hornblende and lesser plagioclase; groundmass of plagioclase and actinolite; large vein of tremolite/actinolite with hornblende phenocrysts.

87-1-2 13' diorite-andesite, phenocrysts of hornblende in groundmass of plagioclase with lesser chlorite and much less epidote and calcite; veins of calcite.

87-1-3 24' contact: meta-andesite (cut by chlorite-quartz-plagioclase-(calcite) veins; epidote-chlorite vein on contact with meta-basalt (cut by veins of calcite-chlorite-quartz)

87-1-5 130' diorite-andesite, minor hornblende phenocrysts in groundmass of plagioclase-actinolite; veins of quartz-(chlorite-opaque).

John G. Payne

87-1-1 158' **Metamorphosed Hypabyssal Diorite cut by Actinolite-rich Vein**

The rock contains phenocrysts of plagioclase and hornblende in a very fine to fine grained groundmass of plagioclase and actinolite. Plagioclase is altered slightly to moderately to epidote, chlorite, sericite, and calcite, whereas hornblende is altered completely to actinolite-chlorite. The rock is cut by a vein up to a few mm wide of extremely fine grained actinolite with clusters of altered hornblende phenocrysts.

phenocrysts		vein	
plagioclase	4- 5%	hornblende phenocrysts	2- 3
hornblende	7- 8	tremolite/actinolite	
groundmass		groundmass	8-10
plagioclase	30-35	border zone	2- 3
actinolite	35-40	amygdule(?)	
epidote	1- 2	calcite-quartz	0.3
Ti-oxide/ilmenite	0.3	late veinlets	
opaque(pyrite?)	minor	calcite	trace

Plagioclase forms anhedral, stubby to locally slender prismatic phenocrysts averaging 0.7-1.2 mm in size. It is altered slightly to moderately to patchy zones of extremely fine grained chlorite, epidote, sericite, and calcite, with each alteration mineral generally occupying a separate part of the phenocryst.

Hornblende forms prismatic phenocrysts up to 3 mm in length. It is altered completely to pseudomorphic to fibrous, pale to light green actinolite. Many grains contain patches of very fine grained chlorite in cores of grains, surrounded by wispy fibrous rims of actinolite. Some phenocrysts are dominated by chlorite with disseminated grains of tremolite, some of which are in optical continuity and may represent relic pseudomorphs after hornblende.

The groundmass is dominated by very fine to fine grained, anhedral plagioclase intergrown with ragged prismatic to fibrous, pale green actinolite. Epidote forms anhedral patches averaging 0.03-0.15 mm in size of extremely fine to very fine grained aggregates, probably after plagioclase. A very few larger patches are up to 0.8 mm across. Opaque (pyrite?) forms a few equant, subhedral grains up to 0.05 mm in size. Ti-oxide forms irregular, extremely fine grained patches averaging 0.02-0.04 mm in size. Some of these contain cores up to 0.01 mm in size of ilmenite.

The rock contains a patch up to 1.5 mm in size of an intimate intergrowth of very fine grained quartz and interstitial calcite and epidote.

The vein is dominated by extremely fine grained, unoriented grains of tremolite/actinolite, with 2-3% disseminated, fibrous to prismatic grains up to 0.08 mm long. A few clusters up to 1.7 mm across consist of subhedral to euhedral hornblende phenocrysts up to 1.2 mm long. These are replaced completely by very fine grained chlorite. Ti-oxide is concentrated along borders of phenocrysts as extremely fine grained aggregates, and also is scattered thru the groundmass. The vein is bordered by a zone from 0.05-0.5 mm in width of coarser grained tremolite/actinolite in subparallel orientation parallel to the vein wall. The border zone appears to have slightly higher birefringence than the main vein.

Late wispy veinlets up to 0.02 mm wide consist of very fine grained calcite.

87-1-2 13' Hypabyssal Diorite/Andesite cut by Calcite Veins

The rock contains phenocrysts of hornblende and minor ones of plagioclase in a groundmass dominated by plagioclase with lesser chlorite, epidote, and calcite. Groundmass texture is diabasic, with minor late-stage intergrowths of plagioclase-quartz.

phenocrysts	
hornblende	4- 5%
plagioclase	0.5
groundmass	
plagioclase	65-70
chlorite	12-15
epidote	7- 8
calcite	3- 4
quartz	1
pyrite	0.1
veins	
calcite	1- 2

Hornblende forms subhedral to euhedral, prismatic grains up to 0.7 mm in length. Some are replaced by fibrous to feathery aggregates of tremolite with minor to very abundant disseminated, irregular patches of calcite. Others are replaced completely by single grains or aggregates of a few grains of calcite.

Plagioclase forms a few prismatic phenocrysts from 1-1.5 mm in average length and a few clusters of similar grains up to 2 mm across. Albite twins commonly are very discontinuous. Alteration is slight to patches of calcite.

Plagioclase in the groundmass ranges from prismatic to lathy grains up to 0.5 mm in length to anhedral, interstitial grains averaging 0.1-0.2 mm in size. Scattered through much of the groundmass are irregular, tiny, interstitial patches consisting of extremely fine grained plagioclase intergrown with lesser quartz.

Chlorite forms interstitial patches of extremely fine to very fine grained aggregates.

Calcite forms very irregular patches up to 0.15 mm in size, mainly associated with chlorite.

Epidote forms irregular patches of very fine grained aggregates, commonly interstitial to plagioclase and intergrown with calcite. It also forms scattered equant to prismatic grains from 0.2-0.7 mm in size. A very few larger patches up to 2 mm across consists of radiating elongate prismatic grains of epidote intergrown with irregular, very fine grained calcite.

Pyrite forms irregular to skeletal aggregates from 0.05-0.2 mm in size. Individual grains range from anhedral to euhedral in shape and average 0.02-0.03 mm in size.

Calcite forms somewhat discontinuous fracture-filling to replacement veins up to 0.5 mm wide of very fine to fine grains.

87-1-3 24' **Contact: Meta-andesite (cut by chlorite-quartz-plagioclase veins) and Porphyritic Meta-basalt(?) (cut by calcite-[chlorite-quartz] vein); Epidote-chlorite vein on contact**

meta-andesite

Plagioclase and hornblende form minor phenocrysts in a groundmass of very fine grained plagioclase and actinolite.

phenocrysts		
plagioclase	minor	
hornblende	minor	
groundmass		
plagioclase	70-75%	
actinolite	25-30	
epidote	1	
ilmenite/Ti-oxide	1	
amygdule		
calcite-quartz-rich	0.5	
vein		
chlorite-quartz-plagioclase-(calcite)		3-5%
quartz-(plagioclase)		0.5

Plagioclase forms a few subhedral to anhedral, prismatic phenocrysts up to 0.7 mm long. Albite twins are poorly and discontinuously developed.

Hornblende forms a few prismatic phenocrysts up to 1 mm long. It is replaced by pale green actinolite as ragged pseudomorphs and fibrous aggregates.

The groundmass is dominated by anhedral, interlocking plagioclase grains averaging 0.03-0.1 mm in size, with much less lathy plagioclase grains from 0.1-0.2 mm in length. These are intimately intergrown with ragged prismatic grains of actinolite averaging 0.05-0.15 mm in size.

Epidote forms irregular, extremely fine grained patches up to 0.05 mm in size.

Ti-oxide containing tiny relic cores of ilmenite forms irregular patches up to 0.1 mm in size.

One subrounded patch up to 1.7 mm across consists of an intergrowth of fine to very fine grained quartz and calcite, with a few clusters of prismatic epidote grains up to 0.5 mm in grain length. Chlorite is concentrated with extremely fine to very fine grained quartz, mainly towards the rim of the patch. Minor minerals are actinolite as a ragged prismatic grain 0.1 mm in length, and pyrite as two equant subhedral grains, largely replaced by hematite. Associated with the patch is a vein up to 0.2 mm wide composed of very fine grained quartz and minor plagioclase.

The rock is also cut by two veins up to 0.6 mm wide of very fine grained quartz and plagioclase, and extremely fine grained chlorite, with a few patches of calcite. Along the centerline of one of these veins is a late, irregular veinlet averaging 0.05 mm wide of calcite. The other vein has a similar but much finer and more discontinuous veinlet of calcite.

border vein

Along the border of the two rock types is a vein from 0.5-1.2 mm in width dominated by very fine grained patches of epidote, and extremely fine grained patches of chlorite, with much less calcite, mainly in patches intergrown with epidote.

meta-basalt

Amphibole phenocrysts occur in a groundmass of actinolite and lesser plagioclase.

phenocrysts	
hornblende	5- 7%
plagioclase	1
groundmass	
actinolite	50-55
plagioclase	35-40
Ti-oxide	0.1
pyrite	minor
veins	
calcite-chlorite-quartz	1-2%

Hornblende forms subhedral to anhedral prismatic phenocrysts up to 1.5 mm in length. They are replaced by variable aggregates of actinolite and chlorite. Actinolite commonly is fibrous. A few phenocrysts contain minor actinolite/hornblende relics surrounded by chlorite. Other grains are altered completely to chlorite, with very minor fibrous to prismatic actinolite.

Plagioclase forms a very few subhedral phenocrysts and clusters of a few phenocrysts up to 0.8 mm in size.

The groundmass consists of very fine grained, ragged prismatic to equant grains of pale green actinolite, with interstitial, very fine grained, anhedral plagioclase. Textures are similar to those in the meta-andesite, but the actinolite/plagioclase ratio is much higher in the meta-basalt.

Ti-oxide forms anhedral patches up to 0.1 mm in size.

Pyrite forms scattered anhedral grains up to 0.13 mm in size. It is altered to hematite.

The meta-basalt is cut by a vein from 0.1-0. 3 mm in width of calcite with patches of chlorite and of quartz.

87-1-5 130' **Altered Hypabyssal Diorite-Andesite**

The rock contains a few phenocrysts of altered hornblende in a fine grained groundmass dominated by plagioclase and altered hornblende. It is cut by a vein of quartz-(chlorite) with a weakly developed epidote halo.

phenocrysts	
hornblende	1- 2%
groundmass	
plagioclase	40-45
actinolite	40-45
chlorite	7- 8
quartz	1- 2
opaque	0.1
epidote	0.5
veins	
quartz-(chlorite-opaque)	2- 3%

Hornblende forms a few anhedral to subhedral, prismatic phenocrysts from 0.5-0.8 mm in size. It is replaced by pseudomorphic actinolite.

Plagioclase forms anhedral to subhedral prismatic to equant grains averaging 0.2-0.7 mm in size. These are altered in irregular patches to extremely fine grained chlorite, and elsewhere are altered to or intergrown intimately with very fine grained patches of quartz.

Hornblende in the groundmass forms ragged to subhedral prismatic grains averaging 0.05-0.15 mm in length.

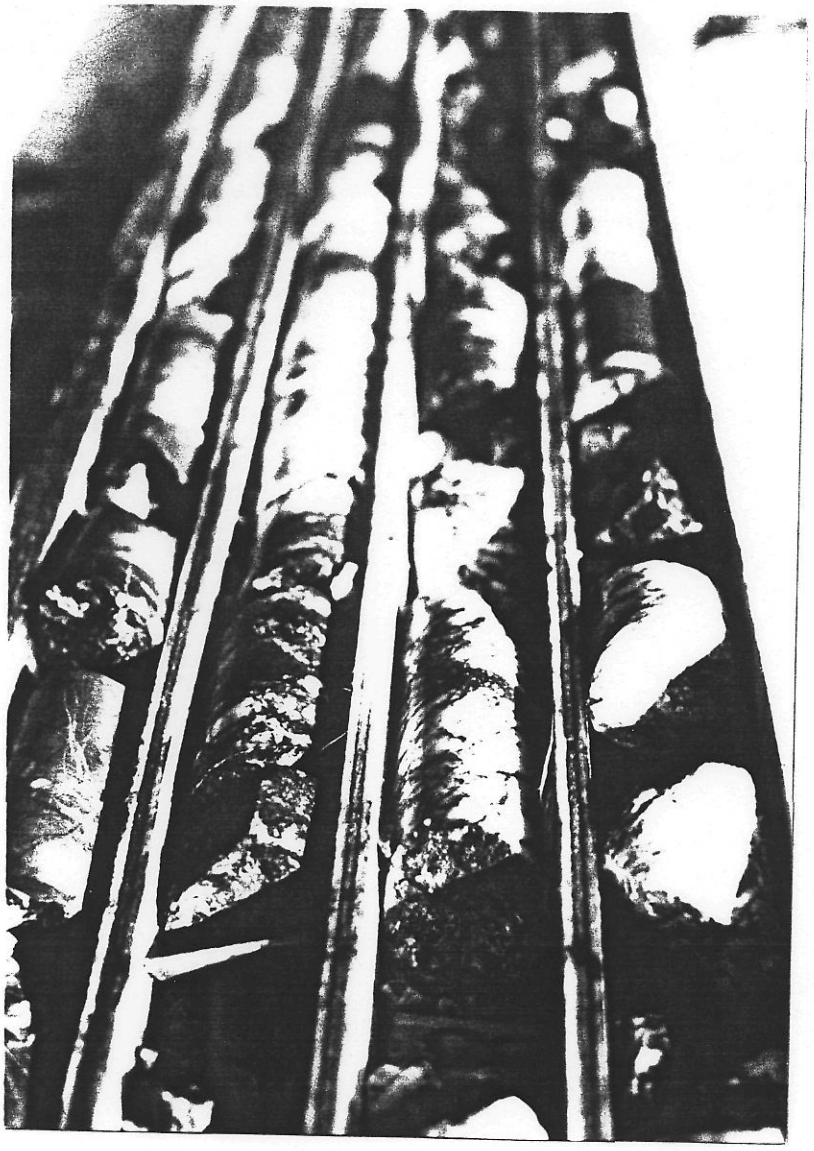
Chlorite forms irregular, extremely fine grained patches, in part interstitial to plagioclase.

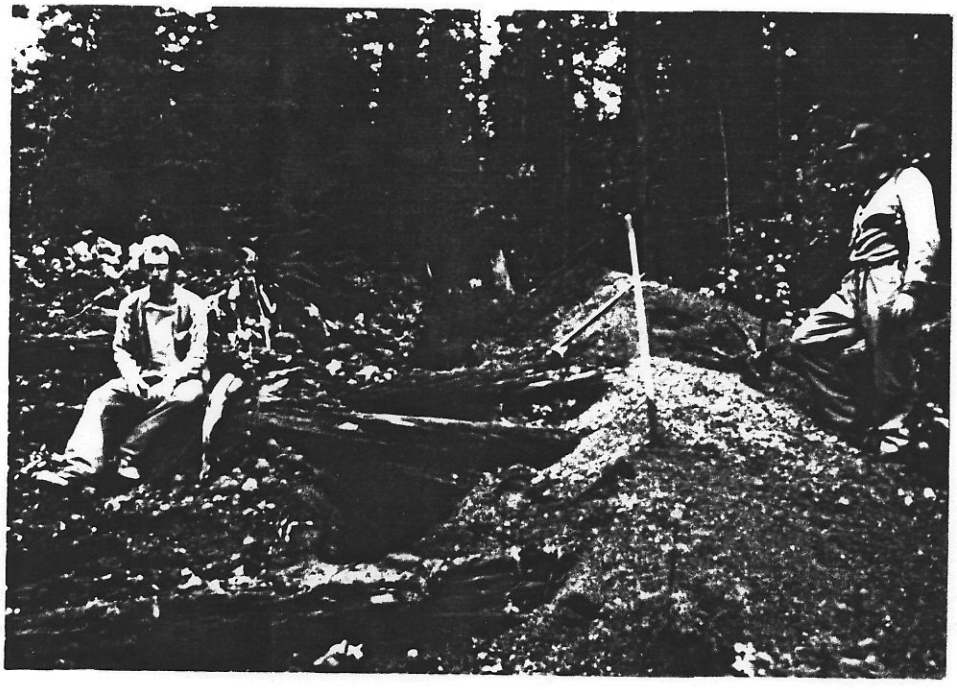
Quartz forms a few patches up to 1 mm across of very fine grained aggregates averaging 0.05-0.07 mm in grain size. Associated with some of the larger patches are irregular opaque (pyrite?) grains averaging 0.02-0.05 mm in size.

Opaque also occurs as concentrations of anhedral grains averaging 0.01-0.03 mm in size associated with amphibole.

Epidote forms a very few anhedral grains up to 0.1 mm in size.

The rock is cut by a vein up to 1.2 mm wide of fine to very fine grained quartz, with interstitial chlorite and minor patches of extremely fine grained opaque. In a zone up to 1.5 mm wide outwards from the vein, the rock contains extremely fine grained, irregular, commonly skeletal patches of epidote. The rock also is cut by a very few discontinuous, fine grained quartz veinlets up to 0.1 mm in width.





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Invoice #7031

December 30th, 1987

Report for: G.L. Garratt,
Eastfield Resources Ltd.,
110-325 Howe St.,
Vancouver, B.C.
V6C 1Z7

Samples:

4 rock samples for preparation as polished thin sections, and petrographic examination.

Samples are designated B7-1-3 82' and 91' and 1-TR-A 1 and 2.

Summary:

Three of these samples are composed predominantly of arsenopyrite. This occurs in intimate intergrowth with siliceous gangue (plus a little carbonate in B7-1-3 82'). Accessory constituents are pyrite, ranging from trace to relatively abundant, and minor chalcopyrite.

The remaining sample (B7-1-3 91') is different. It contains very little arsenopyrite, and the dominant sulfide is very fine-grained, partially gel-type pyrite. The gangue is mixed quartz and carbonate. This sample is unique in the suite in containing notable amounts of tetrahedrite associated with the accessory chalcopyrite.

The textural style of all the samples is characterized by fine-grain size and intimate intergrowths. Other than the tetrahedrite in one sample, no obvious source of elevated Au or Ag values was found.

Individual petrographic descriptions are attached.

J.F. Harris Ph.D.

Sample 1-TR-A-2

Estimated mode

Quartz	8
Scorodite	8
Arsenopyrite	56
Pyrite	27
Chalcopyrite	1
Limonite	trace

This is a similar type of sample to the previous one, consisting predominantly of arsenopyrite with a quartz gangue. Accessory pyrite is more abundant than in TR-A-1, and the arsenopyrite is more extensively altered (no doubt reflecting the effects of weathering in surface material).

The arsenopyrite occurs as patches of rather coarse-grained anhedral mosaic which are intimately microbrecciated and cemented throughout by a delicate hair-line network of secondary products (scorodite) and quartz. Some coarser veinlets of these minerals also occur, and much of the arsenopyrite is in the form of ragged remnants showing strong marginal replacement by the cementing phases. The quartz forms pockets throughout, commonly fringed by scorodite.

Pyrite is relatively common and occurs as 'sandy' clusters of euhedral grains 0.01 - 0.4mm in size. These are sometimes in a matrix of compact arsenopyrite, but are often cemented by scorodite (after arsenopyrite). Pyrite deposition appears to overlap that of arsenopyrite, and it is sometimes seen filling fractures in that mineral.

Chalcopyrite is minor and typically fine-grained. It forms scattered small clumps and streaks, 0.02 - 0.2mm in size, associated with pockets of gangue, or as veinlets (sometimes with intergrown pyrite) in the arsenopyrite.

The mineralogy is basically simple and no source of Au or Ag values was found.

The scorodite-type alteration mineral in this slide exhibits optical properties gradational to those of the component denoted as prehnite in the previous slide. This material is most likely all a mixture of fibrous secondary arsenates derived from the arsenopyrite.

Sample B7-1-3 82'

Estimated mode

Quartz	11
Carbonate	4
Arsenopyrite	85
Pyrite	trace

This sample consists predominantly of a compact, anhedral aggregate of monomineralic arsenopyrite. The grains making up this massive sulfide mosaic range from 0.1 - 1.0mm in size.

Angular pockets within the massive sulfide are filled by anhedral granular quartz with accessory carbonate. The arsenopyrite bordering these pockets shows partial development of crystal faces.

The same gangue minerals (intergrown quartz and carbonate) fill a delicate network of hairline microfractures which, in part, follow the sulfide grain boundaries.

Pyrite occurs as rare, individual, tiny grains within the arsenopyrite matrix and as occasional segments to gangue-filled micro-veinlets. No other sulfides were seen.

The arsenopyrite is fresh.

Sample B7-1-3 91'

Estimated mode

Quartz	20
Carbonate	12
Sericite	trace
Pyrite	54
Melnicovite) Marcasite)	12
Chalcopyrite	1
Tetrahedrite	1
Arsenopyrite	trace
Scorodite	trace
Pyrrhotite	trace

This sample consists essentially of more or less massive fine-grained pyrite intimately intergrown with quartz-carbonate gangue.

For the most part the pyrite forms a compact granular aggregate of grain size 10 - 50 microns. Where free crystal growth has developed, in and around gangue-filled pockets, grain size ranges up to 200 microns. Within the already fine-grained pyrite aggregate there are patchy, streaky or colloform zones of a minutely fine-grained form of pyrite, of the type sometimes referred to as melnicovite or gel-pyrite. This is of grain size 1 - 10 microns, and includes a proportion of intimately intergrown marcasite and iron oxides. It sometimes shows intimate intergrowth with carbonate. It may be a form of altered pyrrhotite, although no recognizable remnants of that mineral survive within it. Traces of pyrrhotite are occasionally seen as inclusions within coarser pyrite grains.

In contrast to the previous sample, arsenopyrite is rare - being confined to occasional individual subhedra in a veinlike zone of gangue. Traces of the derived secondary mineral, scorodite, are seen in one or two instances, cementing pyrite aggregates.

Chalcopyrite and tetrahedrite are notable accessories. They occur, in part, as micron-sized flecks and threads interstitial and intergranular to the massive pyrite aggregate. The major proportion, however, is in the form of irregular segregations, 0.1 - 1.0mm or more in size, mostly associated with the larger pockets of gangue. The chalcopyrite and tetrahedrite are often intimately associated, but are also seen as discrete segregations.

The massive pyrite is intimately pervaded by carbonate gangue, which fills the natural interstitial porosity of the microgranular aggregate. Carbonate also forms some coarser pockets and veniform bodies. The most extensive gangue pockets are made up predominantly of quartz. The carbonate locally shows strong reactivity with dilute acid, but for the most part is unaffected; it thus appears to be a mixture of calcite and dolomite.

It appears probable that tetrahedrite is the Ag-carrier in this material. Physical separation with acceptable grades and recoveries will be difficult to achieve by conventional means in such a fine-grained intergrowth. Bio-hydro-metallurgical methods may prove appropriate.