810141

88·09·09

Gregg:

- I've enclosed a brief summary of our work.

- There is a large load of samples for ACME (2 page summary).

- There are 6 bags of samples for Vancouver Pet.; these should be shipped air freight (Gelco - services 5).

- I talked to Kresho and we decided I should complete the Faro Underground report myself (Ted is busy next week, and is on holidays the following; THOUGH he has done most of the work!)

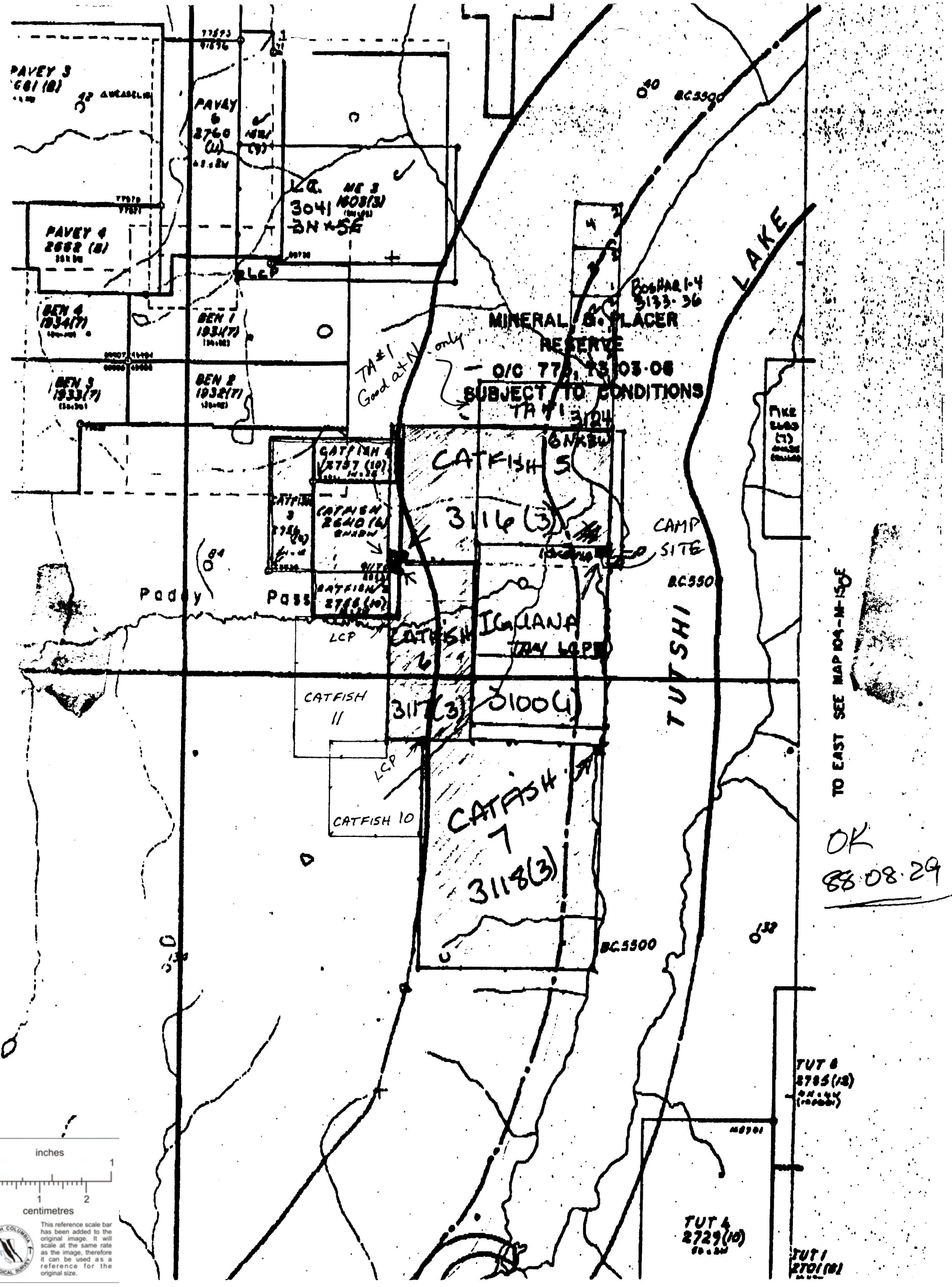
- The Catfish report will be worked on immediately, BUT Van. Pet. is about 3 weeks behind now (the sooner the samples are out, the better) and the geochem will probably be about two weeks

I've gone to Atlin to record the two new claims, hopefully I'll see you this afternoon.

OK

Bob

- could you send to me that write-ups by A-C on the Venice Mine, reference only.


PAVEY 3
PAVEY 6
2760
PAVEY 4
2662
ME 3
1603(3)
LG.
3041
3N+5E
BEN 4
1934(7)
BEN 1
1931(7)
BEN 3
1933(7)
BEN 2
1932(7)
LCP
MINERAL & PLACER
RESERVE
O/C 779, 73.03.06
SUBJECT TO CONDITIONS
TA#1
Good at N. only
TA#1 3124
6N+8W
CATFISH 4
2737 (10)
CATFISH 3
CATFISH
2640
CATFISH
2736 (10)
CATFISH 5
3116(3)
CAMP
SITE
BC5500
Boshar 1-4
3133-36
Paddy Pass
IGUANA
CATFISH
6
3117(3)
3100(4)
CATFISH
11
CATFISH 10
CATFISH
7
3118(3)
TUTSHI
LAKE
PIKE
TO EAST SEE MAP 104-M-15E
OK
88.08.29
TUT 6
2785(12)
TUT 4
2729(10)
TUT 1
2701(10)
inches
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centimetres
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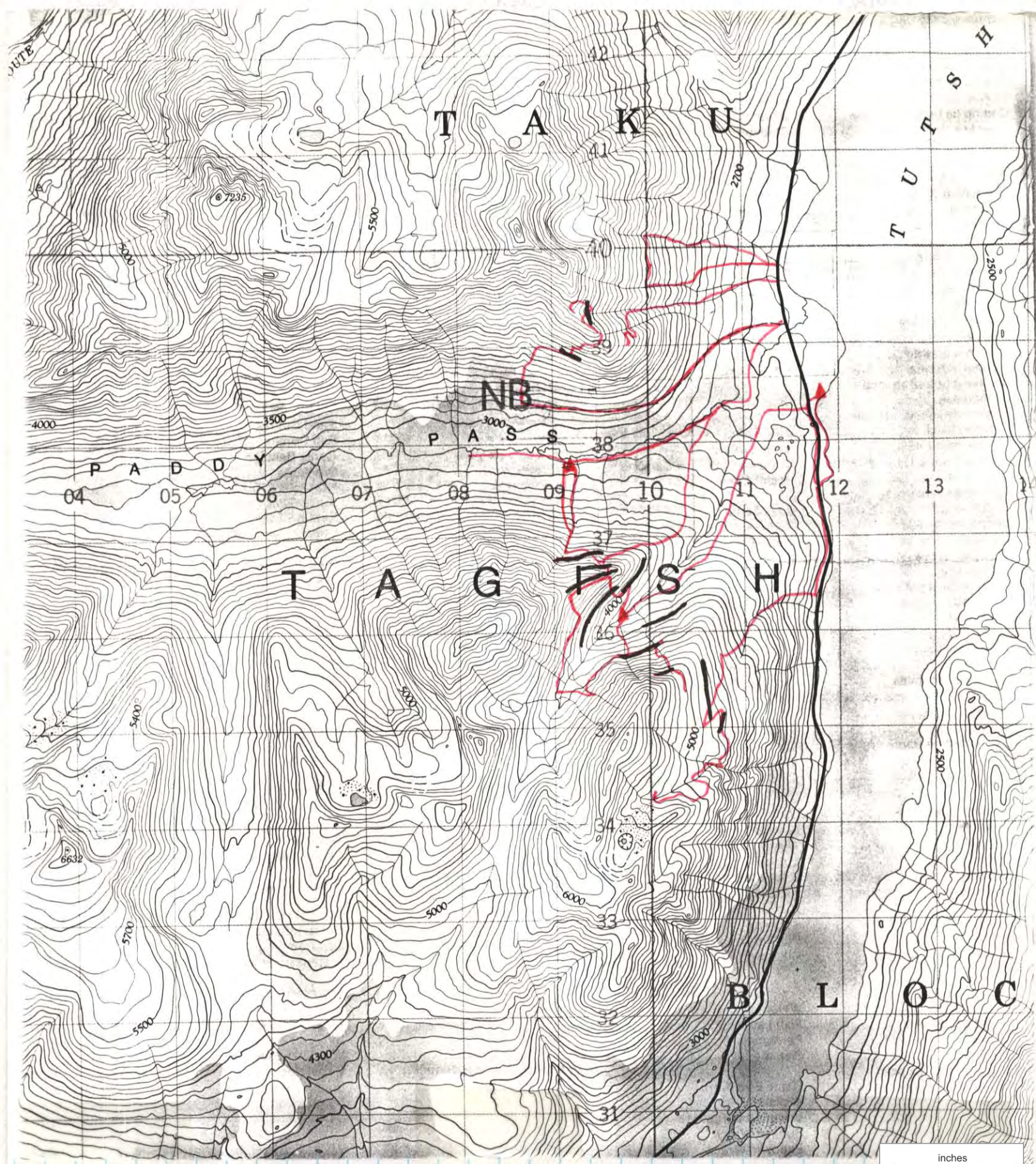
BRITISH COLUMBIA GEOLOGICAL SURVEY



— Traverse locations & camp sites (▲)

Detail soil sample lines —

inches
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centimetres

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R.J. Morris, 1988

Legend to accompany Geologic Map.

intrusives ; including Coast intrusions (K) (Cretaceous, Upper Cretaceous), Mesozoic intrusions (M) and Paleozoic ? to Triassic intrusions (PT)

tuffs
conglomerate
} Middle to Upper Jurassic

Inklin Fm. ; Lower Jurassic (argillite)

Stuhini Group ; Upper Triassic (tuffs)

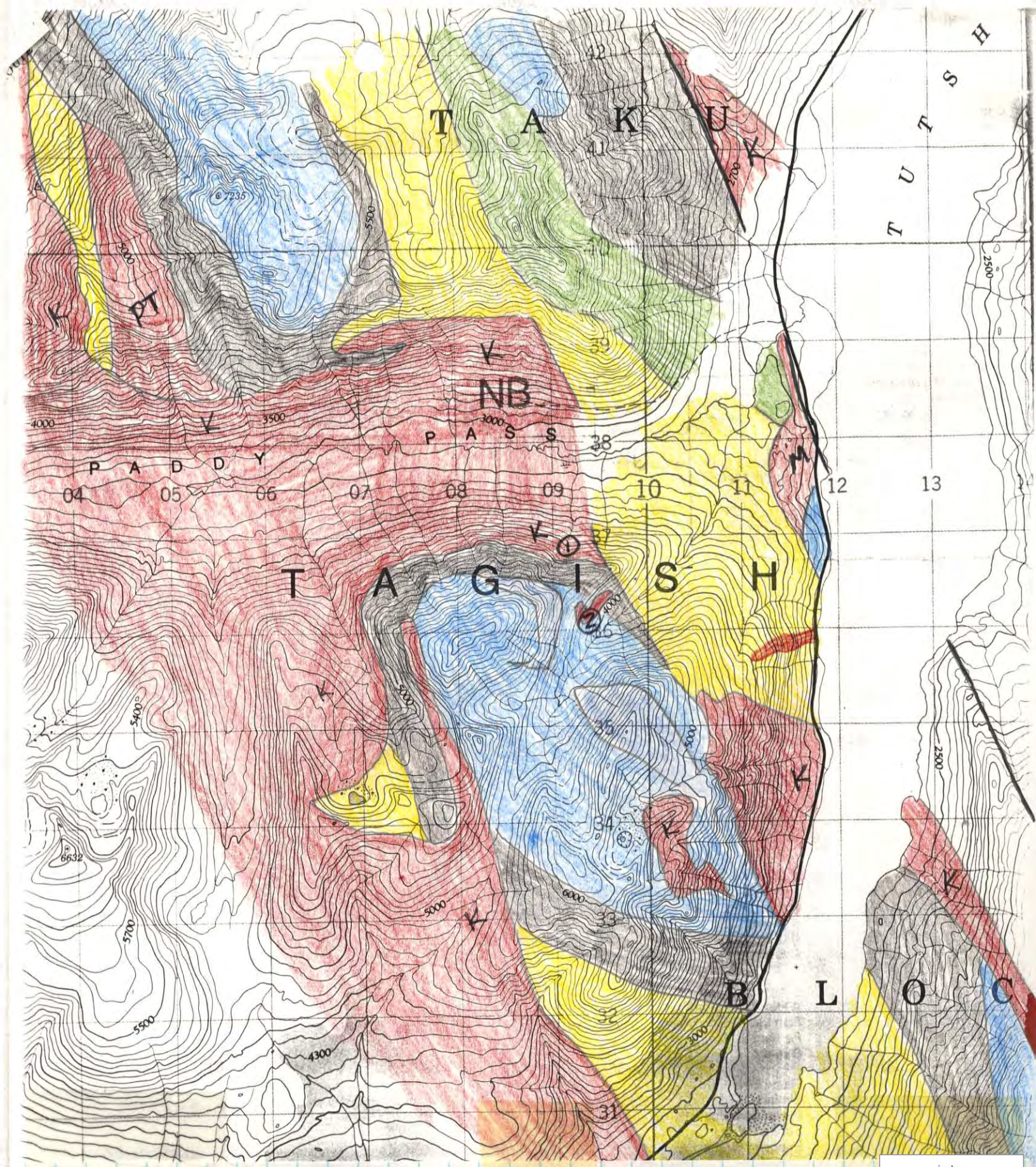
Boundary Ranges metamorphics ; Paleozoic to Proterozoic ?
(meta-seds + volcs.)

I feel that his map is very good with only our "Middle ridge" missing some detail. Several adjustments and additions have been made, including:

1 - the granite is moved up to ~4500' on the north slope of middle ridge (MR).

2 - a deformed granite body is added to the southeast slope of MR.

3 - I feel the "Zone", our target, on MR is the chilled margin of the granite body. It has intruded a structural break (indicated by the linear trend) and has in turn been deformed and invaded ~~by~~ mineralizing solutions.
(fractured) (Qz + As + Au ?)



adapted from: "Geology of the Tatshi Lake Area"
by: Mihalynuk & Rouse, 1988

inches
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R.J. Morris, 1988

Gregg: Regarding trenching, south middle ridge. Sept 1/89
Solid Asp veinlets occur parallel the primary and secondary joint sets, approximately 75/080, 70/300. Most are 1-15mm thick and 100% Asp. These thin veinlets are easily weathered at surface and only visible after the trenching was completed. A similar veinlet was seen and sampled in the PPd unit, sample # 15477, 686 ppb. Trenching results look very encouraging with mineralization occurring along a significant number of joint sets. The following page briefly tables the Asp or QV occurences listing the measured distance from the south end of trench #1, the vein width and type of mineralization. I expect assays will warrant further work that may include drilling.

Similar results occur in trench #2 (both in the aplite zone). Trench #3 in the PPd unit has almost none of the thin Asp veinlets along joints as seen in the aplite. (The aplite is significantly jointed relative the PPd unit).

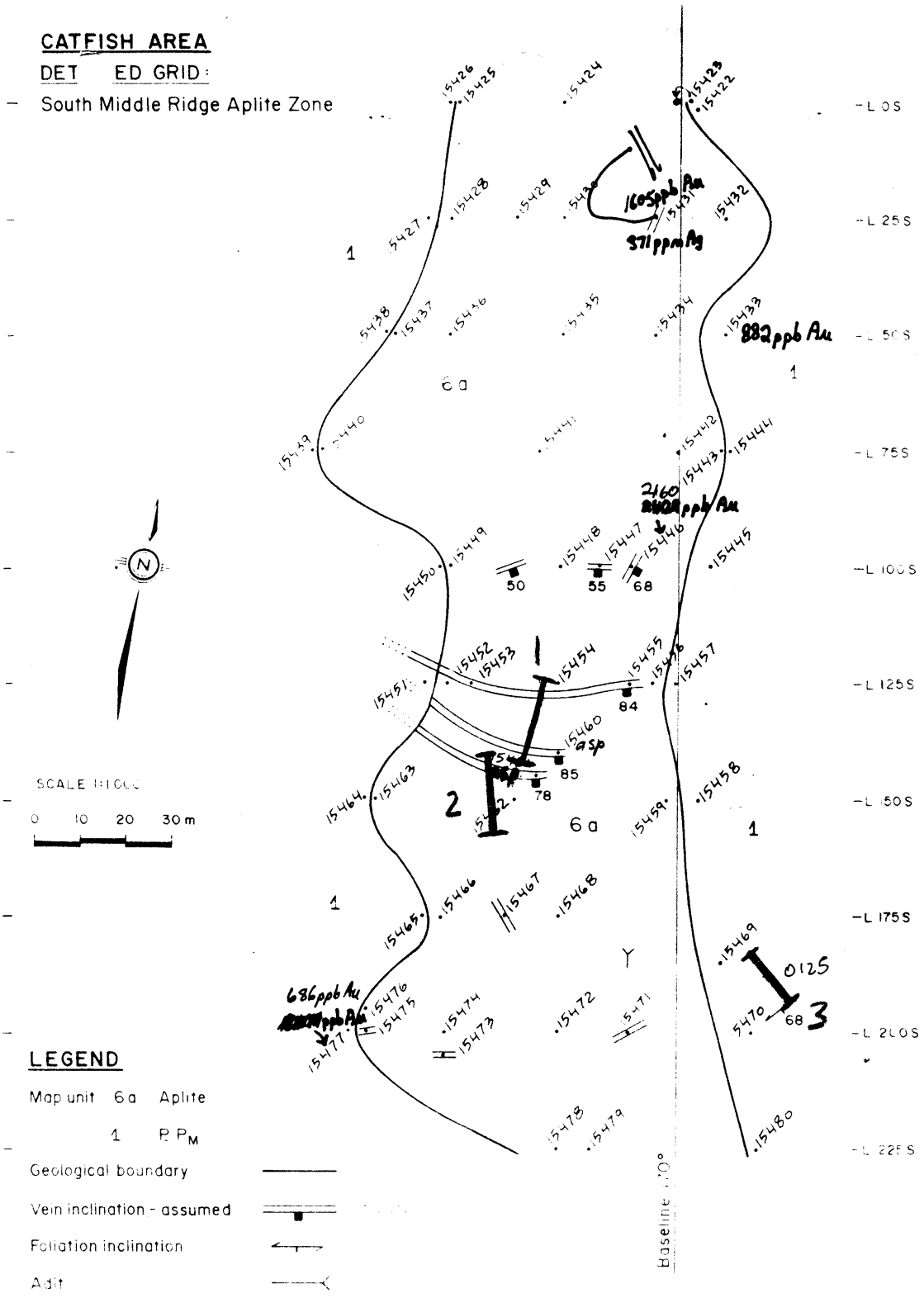
Example of veining in trench #1 with measurement from south end. Similar results in trench #2.

At: 30 cm — 1mm Asp vein
38 cm — 1mm ✓
90 cm — 1-2mm ✓
110 cm — 7mm ✓
150 cm — 4mm ✓
174 cm — 1mm Py
197 cm — Q-Asp 22mm
280 cm — 16mm Asp
310 cm — 9 cm 50% Asp
325 cm — QV 15mm
370 cm — QV 15mm w cgr Asp
375 cm — QV 15mm
400-470 cm — QV 20% Asp, <1% Py
490 cm — 2mm Asp
520 cm — 5mm ✓
560 cm — 6mm ✓
610 cm — 140mm ✓
650 cm — 6mm ✓
700 cm — QV 10mm 5% Asp
750 cm — 4mm Asp
800 cm — 5mm Asp
845 cm — QV + tr Asp
870-950 cm — QV with 3% vcgr euhedral Asp, minor Asp veinlets + tr cgr Py.
990 cm — 16mm Asp
1050 cm — 3mm Asp

CATFISH AREA

DET ED GRID:

South Middle Ridge Aplite Zone



SCALE 1:1000

0 10 20 30 m

LEGEND

Map unit 6a Aplite

1 $P_1 P_M$

Geological boundary

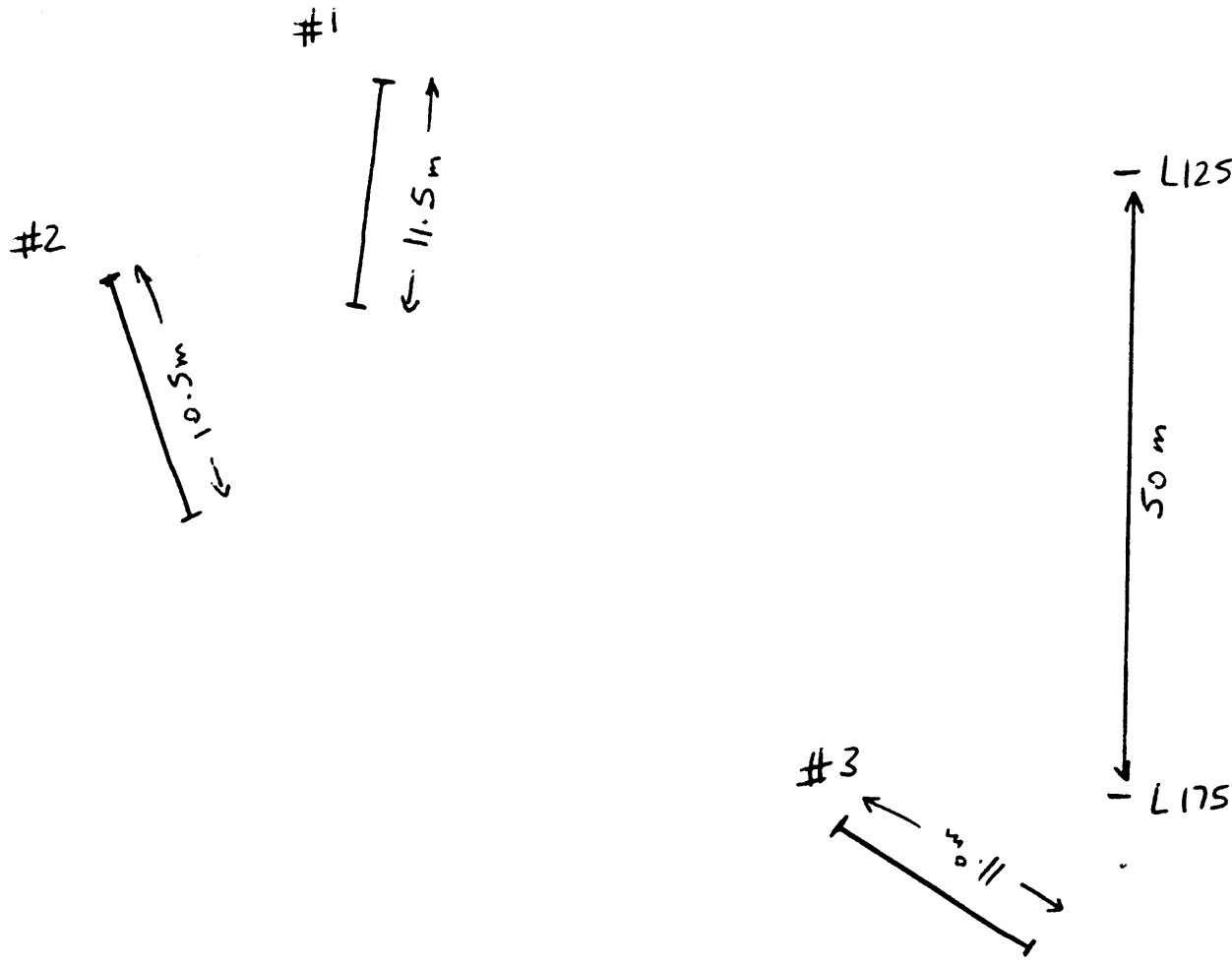
Vein inclination - assumed

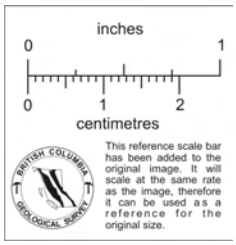
Foliation inclination

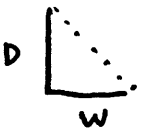
Adit

Approximate trench locations

South Middle Ridge Aplite Zone
Approximate Trench Positions - 3)
Completed Trenches



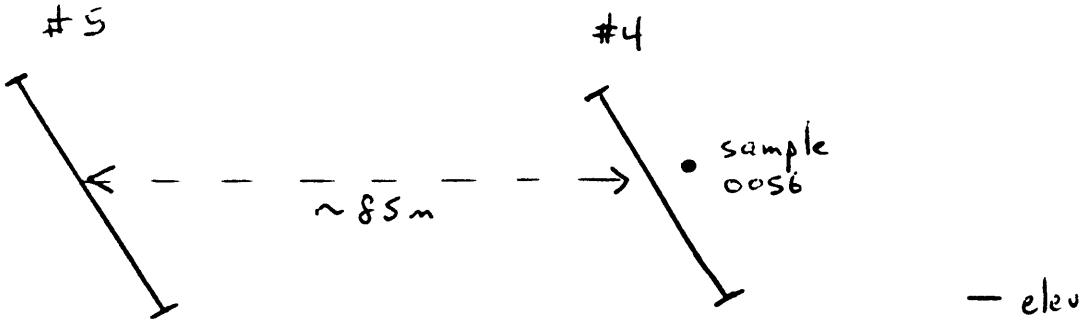


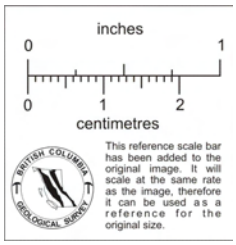
	Length	Width	Depth	X-section
# 1	11.5m	1m	1.5m	
# 2	10.5m	1m	1.5m	
# 3	11.0m	1m	2.5m	

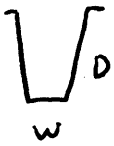
North Middle Ridge Aplite Zone

Approximate Trench Positions (2)

Work in Progress





Estimated :	Length	width	Depth	x-section
#4	11m	1m	2m	
#5	11m	1m	2m	

Copy to: R.J.Mc[illegible]is, Fernie, B.C.

Vancouver Petrographics Ltd.

JAMES VINNELL, Manager
JOHN G. PAYNE, Ph.D. Geologist
A.L. LITTLEJOHN, M.Sc. Geologist
JEFF HARRIS, Ph.D. Geologist

P.O. BOX 39
8887 NASH STREET
FORT LANGLEY, B.C.
VOX 1JO

PHONE (604) 888-1323

Report for: Greg Jilson,
Curragh Resources Inc.,
117 Industrial Rd.,
Whitehorse,
Yukon,
Y1A 2T8

Invoice 7649

October 7th, 1988

Samples:

31 rock samples, submitted by Bob Morris, for sectioning and petrographic description.

Samples are all suffixed "P" and consist of numbers 1 - 13, 15 - 30, 67 and 98.

Samples 1, 5, 7, 8, 11, 21, 23, 25 and 67 were prepared as polished thin sections to allow observation of opaques; the remainder were prepared as conventional thin sections.

Summary:

The rocks of this suite can be classified in four main categories, corresponding to those used for the field identifications given in the covering letter: i.e. intrusives, volcanics, tuffs and sediments.

Although the presence of these four groups is confirmed, the petrographic study - not surprisingly - reveals a fair degree of mis-classification in the assigned field names, especially as regards the last three groups. Identification of a few samples is uncertain, even with benefit of the microscopic data.

1. INTRUSIVES

a) Medium grained, porphyritic.

i) Granite porphyry (major proportions of quartz, plagioclase and K-feldspar). Samples 19, 28.

ii) Monzonite porphyry (K-feldspar > plagioclase; quartz minor). Samples 17, 26.

iii) Diorite porphyry (mainly plagioclase; quartz and K-spar minor). Sample 6.

b) Fine-grained, virtually non-porphyritic

i) Aplite (abundant quartz and K-spar; accessory plagioclase). Samples 3, 11, 12, 29.

ii) Latite-Trachyte (K-spar ≫ plagioclase; quartz minor). Samples 7, 13.

The coarser, abundantly porphyritic rocks (Group 1a) have textures typical of minor intrusives, such as marginal phases or satellite plugs associated with batholiths.

The finer, non-porphyritic rocks (Group 1b) have homogenous textures characteristic of dykes or chilled margin phases.

2. VOLCANICS

a) Andesitic

i) Mafic-poor (mainly plagioclase and sericite). Samples 1, 18, 20.

ii) Mafic-rich (include major biotite, chlorite, or hornblende). Samples 5, 9, 25.

b) Rhyolite(?)

Quartz-rich, with plagioclase and/or sericite. Samples 2, 98.

The samples classified as volcanics are a somewhat diverse group. They are fine-grained and sometimes porphyritic. They lack fragmental features which might indicate a pyroclastic origin, and are typically non-foliated. They mostly show strong pervasive alteration (to sericite, biotite and secondary amphibole, and - in the rhyolites - quartz). The andesites often contain notable amounts of finely disseminated sulfides.

3. TUFFS

Samples 4, 15.

Tuffs are much less common in the suite than the field naming suggests. The above two rocks are unquestionably andesitic lapilli-tuffs, consisting of abundant, vari-sized lithic clasts and plagioclase crystals in a fine biotitic matrix. They are non-foliated and show well-preserved primary textures.

4. SEDIMENTS

a) Unmetamorphosed

i) Wacke. Sample 23

ii) Carbonaceous mudstone. Sample 22

iii) Hematitic chert. Sample 16

b) Foliated

i) 'Sheared wacke'. Samples 8, 21, 27.

ii) Siliceous sediments. Samples 24, 30.

iii) Amphibolite. Sample 10.

This is a varied group, some of which are of ambiguous character.

Those of sub-group a) are unequivocal and, like the majority of rocks of the suite, show a notable lack of regional metamorphic features. Sub-group b) includes all the rocks of the suite having more or less strongly foliated fabrics - in part of recrystallized and/or cataclastic aspect.

The 'sheared wackes' are of quartzo-feldspathic composition, and could be of felsic volcaniclastic affinities. Sample 27P differs from the first two in lacking K-feldspar and having chlorite (rather than sericite and/or biotite) as the principal accessory.

Sub-group b) ii comprises siliceous sediments, poor in feldspar. It includes a possible impure meta-chert and a dolomitic quartzite.

The remaining sample (10P) is quartz-free, and has the mineralogy of an amphibolite (plagioclase-hornblende), but a similar meta-clastic fabric to group b) i. It could be a metacalcareous arkose or, more likely, a recrystallized andesitic crystal tuff.

Individual petrographic descriptions are attached

SPECIFIC QUERIES:

Sample	Field name	Comment
1P	Hornfelsed(?) sediment	This is an altered andesite. The biotite could be of hornfelsic origin. It may well be related to the tuffs, 4 and 15. The other samples you list are not tuffs.
2P	Altered volcanic	This is a silicified rhyolite. It is of totally different composition to the tuffs (which are andesitic).
3P	Rhyolite dyke	Actually quartz-latite composition: has textural characteristics of an aplite. Yes, similar to 11P, 12P (and also 29P).
4P	Tuff, in contact with 3P	Yes: this is an andesite lapilli-tuff.
5P	Meta-sediment	Not a metasediment. This is a mafic-rich andesite - altered, but not obviously metamorphosed (except possibly in a thermal sense).
6P	Diorite dyke	Yes: this is a diorite porphyry
7P	Rhyolite dyke	Not of rhyolitic composition. This is the quartz-poor type of fine-grained felsic rock (latite/ trachyte). i.e. different composition to 11P, 12P (more similar to 13P).
8P	Metasediment	Yes: this is one of the sheared wackes.
9P	Meta-basalt	One of the mafic-rich andesites: could be basaltic. Somewhat similar to 5P (though 5P contains no amphibole), but unrelated to 8P.
10P	Metasediment	This is a foliated, crypto-clastic amphibolite - possibly metasedimentary or a meta-andesitic tuff.
11P	Rhyolite dyke	See comment for 3P.
12P	Rhyolite dyke	See comment for 3P.

13P	Rhyolite dyke	Different composition to 11P, 12P. Quartz-free, K-rich: trachyte. More similar to 7P.
14P	No sample	
15P	Tuff	Yes: this is an andesite lapilli tuff. The biotitic composition of the matrix (as in 4P) could be a hornfelsic effect.
16P	Tuff	No: this is a chert, composed almost entirely of quartz. Red stain is hematitic.
17P	Tuff	No: this is a porphyritic latite or monzonite, texturally intermediate between 7P and 26P. Unrelated to 15P (though possibly intrudes it?)
18P	Tuff	No: this is one of the mafic-poor andesites. It has a high content of sulfides (pyrrhotite with traces of pyrite, marcasite and sphalerite). No obvious source of Sb: could be undetected traces of tetrahedrite.
19P	Granite	Yes: granite porphyry. Not altered or metamorphosed. Texture more typical of minor satellite plug than of 'normal' (batholithic) Coast Intrusives.
20P	Tuff	No: this is another altered andesite, without fragmental features. It is similar to 18P, but strongly sericitized. It is unrelated to 22P (carbonaceous mudstone).
21P	Metavolcanic	Probably not. This is one of the 'sheared wackes'. Could be felsic volcaniclastic.
22P	Black argillite	Yes: carbonaceous silty mudstone. Appears essentially unmetamorphosed No relation to 1P, 20P (andesites).
23P	Rhyolite dyke	No: this is totally unlike the other 'rhyolite dyke' samples (aplites, trachytes). It is a non-foliated, argillaceous wacke with mudstone intercalations.

24P	Metavolcanic	No: this is a foliated siliceous rock with plagioclase-sericite segregations: possibly an impure meta-chert.
25P	Metavolcanic	Yes: volcanic, mafic-rich - essentially an amphibolite, possibly meta-basaltic. Compositionally and texturally unlike 21P.
26P	Granite	Not strictly. This is a quartz-poor porphyry of monzonitic composition. Similar composition to 7P, 17P rather than to 19P or 26P.
27P	Metavolcanic	No: strongly foliated, wacke-textured. Probably related to 8P, 21P. Could be volcaniclastic.
28P	Granite	Yes: granite porphyry. Similar to 19P, but not to 28P (low quartz). Yes: compositionally similar to 11P, 12P, 29P: these could be fine-grained equivalents.
29P	Rhyolite dyke	Yes: aplite. Could be fine equivalent of 28P; similar to 10P, 11P.
30P	Metavolcanic	No: this is a metasediment of calcareous quartzitic type. Yes, could be related to 27P, 21P.
67P	Quartz vein	Yes: mainly homogenous arsenopyrite No gold seen.
98P	Rhyolite dyke	Quartz-sericite rock. Could be a silicified form of the fine-grained (aplitic) intrusives - though no K-spar. No actual sulfides in slide. Saw some scorodite, after arsenopyrite; this is presumably the 'green yellow stain'.

J.F. Harris Ph.D.

(phone: (604) 929-5867)

Sample 1P **ALTERED ANDESITE**

Estimated mode

Plagioclase	68
K-feldspar	1
Quartz	2
Sericite	15
Phlogopite	10
Tourmaline	trace
Apatite	trace
Rutile	trace
Pyrite	4
Pyrrhotite	trace

This is a fine-grained, altered rock of volcanic affinities.

It consists predominantly of an even, minutely fine-grained matrix of felsitic plagioclase, strongly pervasively dusted with micron-sized sericite.

Scattered throughout this matrix are diffuse, wispy to more distinct, sub-prismatic patches of slightly coarser felsite and/or felted micas, the latter often being a pale brown variety of apparent phlogopitic composition.

These features range in size from about 0.2 - 2.0mm, and appear to represent totally altered phenocrysts. They exhibit a partial preferred orientation which may represent a primary flow feature.

A common variant of the altered phenocrysts consists of prismatic forms defined by micron-sized opaque dust and/or clusters of tiny subhedral pyrite grains, locally with minor interstitial pyrrhotite. Others consist of felted phlogopite with diffuse patches of microgranular quartz and/or sulfides.

Accessories are tiny, randomly distributed euhedra of apatite, and scattered, tiny subhedra or acicular sheafs of green tourmaline.

The rock contains no recognizable lithic fragments, and the fabric - of scattered, discrete, sub-oriented, sub-prismatic patches in a homogenous felsitic matrix - is more suggestive of origin as a porphyritic flow than a tuff.

Sample 2P **ALTERED RHYOLITE**

Estimated mode

Plagioclase	37
K-feldspar	4
Quartz	42
Sericite	5
Phlogopite	10
Sub-opaque dust	2

This is a rock of similar general texture to the previous sample, but of notably different mineralogy. It is an altered volcanic of strongly siliceous composition, possibly gradational in character with 98P.

It consists predominantly of a matrix of brownish, turbid, cryptocrystalline, feldspathic material, strongly pervaded by microgranular quartz of grain size 20 - 50 microns.

The abundance and grain size of the quartz varies in a diffusely patchy manner, and it is often possible to recognize a pseudomorphed, pellety/cuspate fabric typical of a glassy rhyolite.

Scattered, more or less discrete, clumpy concentrations of coarser quartz, with intergrown meshwork flakes of sericite and pale brown phlogopitic mica, probably represent replaced phenocrysts. Finer grained sericite occurs as a pervasive dusting of the cryptocrystalline feldspathic glass matrix, and, together with phlogopite, forms small, random, diffuse wisps and patches delineating relict vitric features.

The cryptocrystalline felsite component appears to represent original glass. It is partially potassic in composition (see stained cut-off block) and is often impregnated by micron-sized, brownish, sub-opaque material (leucoxene?). This clearly distinguishes it, in thin section, from the superimposed pervasive silicification (probably of late magmatic/deuteric origin).

This rock is an altered, sparsely porphyritic, glassy rhyolite. There is no petrographic evidence to indicate that it is a tuff.

Sample 3P **APLITE**

Estimated mode

Plagioclase	20
K-feldspar	46
Quartz	30
Sericite	3
Limonite	1

This is an evenly microgranular rock of essentially identical type to several others of the suite (e.g. 29P, 22P etc.).

It consists of an anhedral mosaic of quartz, of grain size 0.1 - 0.3mm, within which are developed abundant smaller sub-prismatic grains, and coalescent grain clusters, of K-feldspar and lesser plagioclase. The feldspars are essentially fresh. The resultant texture can be described as saccharoidal, locally grading to micro-graphic.

Rare microphenocrysts of quartz and plagioclase, 0.5 - 2.0mm in size, are seen.

Mafics are sparse, as in all the rocks of this type, and consist of scrappy grains of sericite, often impregnated with limonite. These may represent altered biotite.

The rock is of granitic composition and has the texture of a minor intrusive (dyke rock). It is probably an aplite.

Sample 4P **ANDESITE LAPILLI TUFF**

Estimated mode

Plagioclase	30
Sericite	36
Biotitic(?) matrix	30
Chlorite	trace
Epidote	2
Apatite	trace
Tourmaline	trace
Rutile)	2
Leucoxene)	

This is one of the few samples of the suite to show undisputable fragmental character.

It is a strongly altered rock, apparently devoid of quartz and probably of andesitic composition.

It consists of abundant, angular, lithic fragments, 0.1 - 20.0mm or more in size, set in a fine-grained brown matrix or interstitial phase.

The fragments are almost all of similar type, being composed of felsitic plagioclase, showing strong, rather even, pervasive sericitization. The larger fragments contain more or less abundant remnant phenocrysts of plagioclase together with tiny accessory euhedra of apatite, and, in a few cases, fine-grained opaques.

Some of the plagioclase phenocrysts, and rare disaggregated plagioclase crystal clasts, show pervasive fine-grained epidotization as well as sericitization.

A few clasts of different, chlorite-rich composition are also present.

Fragment shapes are typically irregular and of 'torn-off' appearance. The larger, strongly porphyritic clasts often show a tendency for flow-orientation of the constituent phenocrysts.

The matrix appears to be of felsite, and is probably made up of progressively tinier clasts, grading to cryptocrystalline volcanic dust. It is clearly differentiated from the sericitized clasts by its high content of micron-sized, brown, felted material which is tentatively identified as a form of biotite. Wisps and flecks of rutile and leucoxene are an accessory component.

Traces of tourmaline are seen, as sporadic tiny clusters.

No bedding is recognizable, but there is a weak tendency for alignment of the clasts, and this rock may be a form of pyroclastic flow.

Sample 5P **ALTERED ANDESITE**

Estimated mode

Plagioclase	34
Quartz	8
Biotite	28
Chlorite	28
Apatite	trace
Ilmenite	trace
Pyrrhotite	2
Chalcopyrite	trace

This is a pervasively altered rock whose primary features are largely obscured. It is unquestionably of volcanic origin, but it is debatable whether it is a fragmental or a normal, sparsely porphyritic flow.

It consists predominantly of a matrix of felsitic plagioclase, of grain size 5 - 20 microns, intimately intergrown with abundant, chlorite and pale brown biotite, as tiny, random flakes and felted, meshwork aggregates.

The dominant biotite/chlorite component locally concentrates as small, sub-prismatic clumps which may be pseudomorphs.

The commonest heterogeneities are diffuse clumps of more coarsely granular, blocky material which may include some plagioclase but appears to be mainly quartz. This is of grain size 0.05 - 0.2mm, and occurs as clusters and aggregated mosaic patches.

These granular clumps (siliceous replacements? altered phenocrysts? fragments?) show varying contents of intergranular and cross-cutting chlorite and biotite, and have diffuse margins suggestive of partial assimilation by the fine groundmass. They often contain obscure ghost textures defined by minute acicular inclusions.

A few definite, discrete, rounded to subhedral phenocrysts of quartz, 0.5 - 1.0mm in size, are also seen.

The rock contains fine-grained pyrrhotite, with traces of intergrown chalcopyrite and secondary pyrite. The sulfides form patches of meshwork impregnation of the chlorite/biotite felsite, and locally concentrate as sub-prismatic clumps, sometimes associated with granular quartz.

This sample is tentatively classified as an altered andesite.

Sample 6P **DIORITE PORPHYRY**

Estimated mode

Plagioclase	75
K-feldspar	2
Quartz	trace
Sericite	2
Biotite	18
Hornblende	3
Apatite	trace
Rutile	trace

This is a porphyry of somewhat similar macroscopic appearance to 19P and 28P. However, it differs compositionally from those samples in being essentially devoid of quartz and K-feldspar. It also contains a slightly higher proportion of mafics. The rock is composed essentially of plagioclase.

Euhedral phenocrysts of plagioclase, 0.5 - 7.0mm in size, make up about 40% of the rock. These show partial twinning and appear to be of oligoclase composition. They are generally fresh but for an occasional slight dusting of very fine-grained sericite.

The groundmass is of distinctive texture. It appears to consist of a diffuse, anhedral, equigranular aggregate of plagioclase, on the scale 0.2 - 0.4mm, upon which is superimposed a meshwork/microlitic to felsitic fabric on the scale 10 - 100 microns. This composite texture may have formed by the devitrification of an original glassy matrix. Minor pockets of K-spar and rare quartz are also seen as groundmass components.

Mafics are of distinctive type. They appear to be largely of secondary character, consisting of minutely felted aggregates of red-brown biotite and lesser pale green, fibrous amphibole. These occur as abundant, sub-prismatic to irregular clumps and as tiny wisps and shreds throughout the groundmass. Sometimes the amphibole appears to develop peripherally to cores of biotite.

In part the secondary biotite/hornblende aggregates show pseudomorphic outlines suggestive of derivation from original euhedral amphibole phenocrysts.

Rutile occurs as diffuse flecks associated with the mafics. Apatite is seen as tiny, randomly disseminated, individual euhedra.

This rock is of dioritic composition and has the texture of a minor intrusive.

Sample 7P **LATITE**

Estimated mode

Plagioclase	21
K-feldspar	70
Quartz	4
Sericite	2
Amphibole	trace
Carbonate	3
Pyrrhotite	trace

This is a member of the quartz-poor sub-group of fine-grained potassic rocks (like 13P).

In thin section it is found to exhibit a texture very similar to that of the groundmass of the diorite porphyry, 9P. This consists of a somewhat diffuse, equigranular mosaic, of grain size 0.1 - 0.4mm, upon which is superimposed a random meshwork fabric of tiny prismatic grains. The base mosaic shows shadowy extinction, and sometimes appears to approach fibrous/radiate character.

This assemblage appears to be composed largely of K-feldspar, though the stained cut-off block indicates that there is also a significant proportion of finely intergrown plagioclase. Quartz is also present as a minor constituent, recognizable as scattered, small patches which seem to be gradational to the feldspar matrix. The feldspars are fresh and clear.

Accessories are random, rather evenly distributed, tiny flecks and wisps of minutely fine-grained carbonate and shreds of sericite. These tend to be intergranular to the coarser mosaic fabric.

The rock contains very rare, tiny microphenocrysts of plagioclase and some small, pockety, amygdule-like segregations composed of various proportions of plagioclase, granular quartz, pale acicular amphibole and fine-grained pyrrhotite.

This rock has the mineralogical proportions of a latite. As with 13P, it exhibits no diagnostic textural features to indicate whether it is a flow or a dyke rock. The incipient banding of more and less potassic composition, apparent in the stained block, is not recognizable in the thin section.

Sample 8P **SHEARED WACKE**

Estimated mode

Quartz	24
Plagioclase	20
K-feldspar	20
Sericite	15
Phlogopite	20
Chlorite	1
Apatite	trace
Rutile	trace
Pyrite	trace
Altered pyrrhotite	trace

This sample is an irregularly foliated, partially recrystallized quartzo-feldspathic rock of distinctive, possibly cataclastic texture.

It consists predominantly of an aggregate of quartz, plagioclase and K-feldspar, as sub-equant grains 0.1 - 0.5mm in size. The fabric is often mosaic-like and presumably granoblastic.

Quartz is often segregated as lenses and laminae of crenulate-margined, vari-granular mosiac. The feldspars generally show simpler grain shapes, sometimes partially flattened.

The granular feldspars are fresh and water-clear, and hence difficult to distinguish from the quartz, except by virtue of occasional twinning. Some quartz is probably present as an intergrown component of the feldspar mosaics.

A proportion of much finer-grained felsitic material (plagioclase and/or K-spar) is present throughout, as interstitial pockets and networks. This is commonly somewhat sericitized.

The rock contains abundant sericite and pale brown phlogopite. These form strongly oriented, relatively coarse, semi-connected flakes and discontinuous schlieren, interspersed with laminae and apparent sheared slices and/or augen of the granular, quartzitic mosaic. The micas also occur as substantial lenses of fine felted texture in their own right, and in dispersed fashion throughout as intergranular networks and wisps.

Opaques are sparse. They consist mainly of disseminated flecks and granules of rutile. Rare, tiny grains of partially oxidized pyrrhotite, and one or two tiny euhedra of pyrite are also seen.

This rock is of apparent metasedimentary origin, and is tentatively classified as a sheared feldspathic wacke.

Sample 9P **ANDESITE(?)**

Estimated mode

Plagioclase	37
K-feldspar	8
Quartz	6
Biotite	18
Chlorite	trace
Amphibole?	24
Carbonate	6
Sphene)	1
Rutile)	

This is a volcanic rock of distinctive type. It is composed essentially of fine-grained plagioclase and abundant altered mafics, but contains a few percent of phenocrysts which, somewhat surprisingly, are quartz.

The quartz phenocrysts are of rounded to sub-polygonal form and 0.5 - 1.0mm in size. Sometimes they occur as small, coalescent clumps.

The groundmass is a rather diffuse-margined, sub-trachytic aggregate of prismatic feldspars, 0.02 - 0 1mm in size, with rare sub-phenocrysts to 0.2mm. The feldspar is predominantly plagioclase but, as is apparent from the patchy stain developed on the cut-off block, includes a proportion of intergrown K-feldspar. Scattered, tiny interstitial flecks of quartz are also seen in the groundmass. The feldspars are fresh.

Mafics are notably abundant, but appear to be entirely of secondary type. They consist of felted aggregates of pale brown biotite, and very fine-grained, fibrous/acicular masses of probable pale amphibole - often with intimately intergrown carbonate.

The fine-grained mafic aggregates form semi-coalescent, sub-prismatic patches, 0.1 - 1.0mm in size, which are apparently pseudomorphs of primary subhedral mafics of unknown type - most probably hornblende or pyroxene. The same secondary-type mafics form diffuse, fine-grained permeations throughout the microlitic plagioclase matrix.

Tiny specks of rutile and sphene are the remaining constituent.

The rock is cut by occasional hairline veinlets of carbonate.

Classification of this rock is difficult as the plagioclase composition is indeterminate. The abundance of mafics could indicate a composition as mafic as basalt, though the content of quartz and K-spar is atypical. Possibly it is a specialized form of andesite.

Sample 10P **META-ARKOSE? (AMPHIBOLITE)**

Estimated mode

Plagioclase	60
K-feldspar	trace
Hornblende	32
Biotite	2
Sericite	3
Epidote	2
Sphene)	1
Rutile)	

This is a rock of simple mineralogy, composed essentially of plagioclase and hornblende.

The plagioclase occurs as abundant, individual, equant, rounded to sub-prismatic grains, 0.05 - 0.3mm in size, or aggregate mosaic clumps of such grains.

Generally the plagioclase is clear and unaltered, and has the aspect of a partially recrystallized arkose. Rarely it shows a light dusting of sericite.

Sericite also occurs locally as an intergranular network, possibly representing remnants of a pervasively altered felsitic matrix.

The other main component is green hornblende, as very fine-grained, fibrous/felted aggregates, locally grading to prismatic clumps. The hornblende forms an intimately pervasive, intergranular phase, and concentrates as abundant irregular pockets and networks.

Minor proportions of fine-grained biotite, granular epidote and flecks and granules of rutile and sphene are associated with the hornblende.

A weak preferred orientation is apparent in the reticulate distribution of the hornblende matrix or cementing phase, and the elongation of clumps and individual grains of plagioclase.

The nature of this rock is obscure. The fabric has a distinctly metasedimentary aspect, but the mineralogy is atypical. The hornblende may be a metamorphic development from an original limey matrix in an arkosic wacke - though the total absence of quartz is atypical. Alternatively, this could be a partially recrystallized andesitic crystal tuff. The mixture of individual, discrete plagioclase grains and aggregate clumps suggests a partial cataclastic element in its formation.

Sample 11P **APLITE**

Estimated mode

Quartz	33
K-feldspar	45
Plagioclase	20
Sericite	2
Rutile	trace

This sample is essentially identical, in composition and texture, to 3P and the other rocks of the suite classified as aplites.

It consists of an equigranular mosaic of anhedral quartz, of grain size 0.1 - 0.3mm, which acts as a matrix to abundant small subhedral/prismatic grains of K-feldspar and plagioclase. The latter sometimes coalesce as irregular interlocking clusters.

This rock shows occasional clumps and elongate segregations of coarser quartz and plagioclase, of grain size to 0.5mm, and is cut by rare hairline veinlets of these minerals. It also contains a few individual euhedral microphenocrysts of quartz, to 1.0mm in size.

Accessories are scattered, small, ragged grains of sericite with flecks of rutile and ferruginous material - possibly representing altered biotite.

Sample 12P **APLITE**

Estimated mode

Quartz	30
Plagioclase	20
K-feldspar	47
Biotite	3

This rock is closely similar to the previous sample (q.v.) and is one of several such essentially identical rocks in the suite.

It consists of an evenly microgranular intergrowth of anhedral quartz, K-feldspar and plagioclase, in the grain size range 0.05 - 0.3mm. Grain boundaries are sharply defined, and the texture is an interlocking, saccharoidal aggregate. Feldspars are fresh and clear throughout.

Sparsely scattered microphenocrysts of quartz and plagioclase, 0.5 - 2.0mm in size, are present, as in the other aplite samples.

This particular example of the aplite lithotype differs from most others in that the accessory biotite - as randomly scattered, irregular flakes, 0.1 - 0.5mm in size - is mainly fresh.

Sample 13P **TRACHYTE**

Estimated mode

K-feldspar	84
Plagioclase	8
Quartz	1
Sericite	4
Carbonate	3
Epidote	trace
Rutile	trace

This is another fine-grained, K-rich rock. Though superficially similar to the aplites, such as 11P and 12P, it is seen, in thin section, to be of significantly different type.

The principal distinguishing feature is the paucity of plagioclase and virtual absence of quartz. It closely resembles 7P, but has a slightly higher K-spar/plagioclase ratio.

The rock is composed essentially of K-feldspar. This forms a felsitic aggregate, of grain size 10 - 50 microns, within which are developed relatively abundant coarser grains (to 0.2mm), showing a radiate or eutectoid/micrographic internal texture.

Rare, tiny pockets and elongate clumps of quartz are seen, and the stained cut-off block indicates the presence of a minor proportion of intergrown plagioclase (etched white).

Accessories are diffuse flecks and pockets of sericite and minutely fine-grained carbonate. Rare microgranular epidote is a possible additional trace component.

This rock has the mineralogical composition of a trachyte. It shows no flow textures or other features diagnostic of extrusive origin; however, its very fine grain size and sub-spherulitic texture seem atypical of an intrusive.

Sample 15P **ANDESITE TUFF**

Estimated mode

Plagioclase	77
Quartz	trace
Sericite	5
Biotite	15
Epidote	1
Rutile)	2
Opaques)	

This is another of the relatively few undoubted tuffs of the suite. It is similar, in many respects, to sample 4P, though the clasts tend to be a little smaller (mostly in the range 0.2 - 3.0mm) and include a higher proportion of crystal vs lithic fragments. Also, this rock lacks the weak tendency for flow orientation seen in 4P.

Clasts are of various felsitic, meshwork-textured and strongly porphyritic andesites, and derived disaggregated plagioclase crystal clasts. The felsitic groundmass material and the plagioclase crystals show pervasive fine-grained sericitization to a greater or lesser degree. Plagioclase phenocrysts and clasts occasionally show pervasive epidotization.

Lithic clasts are sub-equant in shape and often ragged. The slide includes one rather ill-defined lithic clast to 10mm in size.

The clasts are randomly packed, with the smallest ones (down to 0.05mm or less) filling interstitially between the coarser ones. The whole aggregate is set in an evenly distributed matrix or cement of cryptocrystalline felsite, strongly pervaded by minutely fine-grained, felted biotite.

Minor flecks granules and micron-sized dust of rutile and opaques occur both within some clasts and in the matrix.

A few lithic clasts show diffuse wisps of biotitization - suggesting that this mineral is of post depositional, possibly metamorphic origin.

Sample 16P **HEMATITIC CHERT**

Estimated mode

Chert	92
Sericite	1
Carbonate	3
Secondary biotite(?)	1
Barite	trace
Hematite	3

Macroscopically, this sample is an aphanitic red rock, structureless but for an obscure mottling, cut by a micro-stockwork of veinlets and hairline fractures.

In thin section, it is found to be a chert, consisting of an even, interlocking aggregate of quartz, of grain size 5 - 20 microns.

The overall red colour is apparently due to sub-microscopic hematite, which is recognizable as an even dispersion of opaque dust throughout.

Partial redistribution and segregation of the hematitic pigmentation is seen. Some hairline fractures and quartz veinlets show 'de-hematization', with expulsion of opaques from the immediate fracture, and concentration as diffuse marginal envelopes.

The hematitic dust tends to aggregate as tiny, disseminated, acicular forms up to 200 microns in length. These have a pseudomorphous appearance, but are often quite diffuse. They may represent a process of incomplete diffusive crystal growth in a ferruginous silica gel medium. Locally, hematitic segregations are in the form of clusters of pellety or ovoid forms.

The veinlets are principally of quartz and carbonate. Minor accessories in the veinlet phase are sericite, a brown mineral which may be a form of biotite (or possibly just Fe-stained sericite), and barite - which forms segments alternating with carbonate in some of the thinnest, hairline veinlets.

Sample 17P **MONZONITE PORPHYRY**

Estimated mode

Plagioclase	18
K-feldspar	67
Quartz	2
Sericite	9
Carbonate	1
Biotite	3
Chlorite	trace
Rutile	trace

This is another of the quartz-poor type of felsic igneous rocks of the suite. Samples 7P and 26P are of similar composition.

It is noticeably porphyritic, and phenocrysts constitute approximately 10% of the rock. They are mainly of euhedral plagioclase, 0.5 - 3.0mm in size. Rare, rounded to amoeboid quartz phenocrysts are also seen.

The plagioclase phenocrysts typically show a rather even, mild to moderate, pervasive dusting of minutely fine-grained sericite and carbonate.

The groundmass is a somewhat diffuse-margined, blocky, microgranular aggregate of grain size 0.02 - 0.1mm, composed of anhedral K-feldspar with intergrown subhedral plagioclase and possibly a little very fine-grained quartz. The K-feldspar shows occasional incipient development of the feathery, granophyric texture characterising sample 26P.

Accessories consist of small, irregular to sub-prismatic patches of felted, secondary-type brown biotite with inclusions of rutile and opaques. Tiny intergranular wisps of minutely fine-grained sericite are dispersed throughout the groundmass.

Rare pseudomorphs (sericite-rutile-carbonate) of mafic phenocrysts are also seen.

The rock has the composition of a latite. Its sparsely porphyritic texture could be that of a flow or a minor intrusive.

Sample 18P **ALTERED ANDESITE**

Estimated mode

Plagioclase	85
Sericite	10
Rutile	1
Pyrrhotite	4
Pyrite	trace
Marcasite	trace
Sphalerite	trace

This is an andesitic volcanic of somewhat similar type to sample 1P, but with primary phenocrysts better preserved. It also lacks the phlogopitic biotite component of that sample.

It is notably lacking in mafics, and consists largely of plagioclase, in the form of abundant, randomly oriented phenocrysts in a felsitic groundmass.

The phenocrysts are mainly 0.1 - 1.0mm in size (rarely to 3.0mm), and are subhedral, prismatic in shape. They are often clumped. The groundmass is of grain size 5 - 20 microns.

Both phenocrysts and groundmass are more or less strongly altered.

Phenocrysts are patchily turbid and sometimes show wispy and dusty sericitization. They are typically rather ill-defined, and tend to merge with the groundmass - in part by virtue of actual peripheral or core replacement/assimilation by groundmass felsite, and in part because of the overlap of pervasive groundmass seritization into the phenocrysts.

The groundmass is strongly pervaded by minutely wispy, reticulate sericite. The latter shows a weak preferred orientation throughout the whole rock, and may have developed under conditions of mild regional metamorphism.

The rock contains rather abundant disseminated pyrrhotite and traces of other sulfides. The pyrrhotite occurs as clusters of tiny irregular granules, commonly (though not exclusively) concentrated within plagioclase phenocrysts and small altered mafic phenocrysts composed of sericite and reticulate rutile. Its distribution appears to be without structural control.

Sample 19P **GRANITE PORPHYRY**

Estimated mode

Quartz	20
Plagioclase	25
K-feldspar	45
Sericite	5
Chlorite	trace
Carbonate	5
Rutile	trace

This is a prominently porphyritic rock consisting of abundant euhedral phenocrysts of quartz and plagioclase, and occasional K-feldspar, 0.5 - 5.0mm in size, in a microgranular groundmass composed largely of K-feldspar. Phenocrysts make up about 50% of the rock.

The plagioclase phenocrysts seldom show good twinning, but are tentatively classified as of oligoclase composition. They are mostly turbid and show weak to moderate pervasive alteration to very fine-grained sericite. Occasionally they show patchy replacement by carbonate.

A few glomerophenocrysts are seen. These are composed of clusters of small, prismatic plagioclase crystals, sometimes with a few included grains of altered mafics.

Mafics are minor. They appear to have originated as biotite, in the form of individual euhedral grains, 0.2 - 1.0mm in size. They are now totally pseudomorphed by lamellar intergrowths of sericite, carbonate and rutile.

The groundmass consists of an interlocking aggregate of anhedral to subhedral K-feldspar, with lesser intergrown quartz and plagioclase. It is of grain size 0.02 - 0.2mm. A herringbone-textured, eutectoid variant (a form of granophyre) is very common - particularly (though not exclusively) as fringes to the larger quartz phenocrysts. This is clearly a product of the rapid, simultaneous crystallization of the groundmass phases.

The groundmass feldspar is typically fresh.

Carbonate occurs as scattered, random pockets and rare hairline veinlets, as does felted chlorite.

Sample 20P **SERICITIZED ANDESITE**

Estimated mode

Plagioclase	20
Sericite	72
Quartz	trace
Apatite	trace
Opaques	8

This is an intensely altered rock which now consists essentially of a minutely felted mass of compact sericite, of grain size 1 - 10 microns. Minor proportions of remnant plagioclase are sometimes diffusely recognizable within the sericite mass, as are pseudomorphous textures clearly indicating that the latter represents the almost total alteration of a sub-trachytic, minutely microlitic to glassy volcanic groundmass.

Scattered relict phenocrysts are recognizable as clumps of prismatic forms, 0.3 - 2.0mm in size, composed of slightly coarser felted sericite.

Quartz, as tiny grains and microgranular pockets associated with the altered phenocrysts, and apatite as rare relict euhedra, are trace accessories.

The other principal constituent(s) are fine-grained opaques. These occur rather evenly dusted throughout, as individual, minute granules, 5 - 15 microns in size. These commonly show clustering, and tend to aggregate as small, sub-prismatic patches, clearly pseudomorphing micro-phenocrysts (original mafics?). Some of the coarser sericitized phenocrysts - assumed to have been mainly plagioclase - are also more or less strongly impregnated by the fine-grained opaques. The denser concentrations of the latter are recognizable in the cut-off block as pyrrhotite, though some rutile or Fe-Ti oxides are probably also present.

The rock appears to be a pervasively sericitized volcanic, probably of andesitic composition. It shows no sign of structural deformation or metamorphic recrystallization.

Sample 21P **SHEARED FELDSPATHIC WACKE**

Estimated mode

Quartz	27
Plagioclase	43
K-feldspar	10
Sericite	14
Biotite	3
Chlorite	3
Amphibole	trace
Carbonate	trace
Apatite	trace
Rutile	trace
Magnetite	trace

This is a strongly foliated, quartzo-feldspathic rock of similar type to sample 8P.

It consists essentially of a recrystallized mosaic of anhedral, locally flattened grains of quartz and plagioclase, 0.02 - 0.1mm in size. The stained cut-off block indicates that a proportion of the feldspar (largely untwinned) is of potassic composition.

The rock exhibits a strongly foliated, platy, deformational fabric, whereby thin laminar and micro-lenticular slices of the quartzo-feldspathic aggregate are separated by semi-continuous schlieren of well-oriented sericite flakes, and by flattened reticulate networks of fine-grained, felted/fibrous, green biotite and chlorite. The latter also forms partial intergranular wisps within the quartz-feldspar.

Occasional clusters of acicular amphibole are seen, and may be present as an incipient development in some of the diffuse biotite/chlorite schlieren.

Local crumpling of the foliation is common. Some clumpy, augen-like segregations of coarser plagioclase may be of micro-structural (remobilized) origin, or may represent recrystallized primary, clastic features.

The rock is tentatively classified as a sheared feldspathic wacke. Alternatively, it could be of meta-intrusive or felsic volcaniclastic origin.

Sample 22P **CARBONACEOUS MUDSTONE**

Estimated mode

Quartz	6
Sericite)	94
Carbonaceous pigmentation)	

This is a minutely fine-grained, black rock which, in thin section, is clearly revealed as a silty carbonaceous mudstone.

It consists of a foliated matrix of minutely fine-grained sericite, strongly and evenly impregnated by sub-microscopic black pigmentation - almost certainly of carbonaceous character. For the most part, this renders the matrix essentially opaque to transmitted light.

The lensy features seen on the etched cut-off block are areas of less intense carbonaceous impregnation, in which the cryptocrystalline sericitic composition of the matrix is clearly recognizable.

The rock contains a minor silt-sized component of individual, sub-angular quartz grains, 10 - 100 microns in size. These occur evenly scattered throughout, together with tiny lenticles and flakes of carbon-free sericite.

The more elongate silty particles show a consistent preferred orientation which defines a distinct, undisturbed foliation. The sedimentary origin of this rock is unquestionable.

Sample 23P **WACKE, WITH MUDSTONE INTERCALATIONS**

Estimated mode

Quartz	20
Plagioclase	22
K-feldspar	trace
Sericite	49
Biotite	5
Tourmaline	trace
Rutile	1
Pyrrhotite	2
Pyrite	1
Marcasite	trace

This is a rock of distinctive textural type not seen elsewhere in the suite. It is clearly of sedimentary origin and shows the typical, poorly sorted, vari-granular fabric of a rather fine-grained wacke.

Unlike other rocks of related type in the suite, it is non-foliated and shows little or no recrystallization or metamorphic effects. Original clastic textures and sedimentary structures are perfectly preserved.

It consists of angular to sub-rounded, individual grains of quartz, 0.05 - 0.5mm in size, randomly scattered through an abundant matrix of minutely felted sericite. Much of the latter is distinguishable, on close examination, as almost totally sericitized felsitic lithic clasts of a similar size range to the quartz. Occasional remnants of crystalline plagioclase are also seen, representing original feldspathic sand grains.

Brown biotite, as diffuse fine-grained, felted wisps and clumps, is a common accessory. It may represent the alteration of more mafic lithic clasts. Acicular tourmaline, as sheafs of tiny needles, is a common trace associate.

The presence of biotite may indicate some degree of thermal metamorhpism, but the totally non-foliated fabric indicates a total lack of dynamic effects.

The rock shows a central zone of heterogenous intermingling with a much finer sericitic mudstone, devoid of sandy clasts. This incorporates torn-off fragments of the coarser sandy phase, and probably represents the effect of slump-type, soft sediment deformation.

Finely disseminated sulfides (pyrrhotite and pyrite) are widespread in the coarser wacke. They form minute flecks, 10 - 20 microns in size, commonly aggregating as small clumps. They are often (though not exclusively) associated with the biotite and tourmaline.

Sample 24P **BRECCIATED IMPURE META-CHERT(?)**

Estimated mode

Quartz	65
Plagioclase	12
K-feldspar	2
Sericite	17
Biotite	1
Amphibole	3
Chlorite	trace
Carbonate	trace
Sphene	trace

This is a rock of highly siliceous composition and uncertain origin.

It is composed predominantly of a fine-grained, crenulate-margined, strain-polarized aggregate of anhedral quartz, of grain size 10 - 150 microns. This has the aspect of a quartzite, showing extensive intergranular granulation/recrystallization, or is possibly a recrystallized chert.

The quartz aggregate shows a weak laminar structure defined by sub-parallel wisps and flecks of sericite, fibrous/acicular green amphibole and more or less sericitized felsite (plagioclase and minor K-spar). Similar wisps also cement a local micro-fragmented fabric.

The same constituents form relatively extensive, discordant, irregular veniform to pockety masses which appear to follow a coarser fracture pattern and may represent remobilized (soft-sediment/diapiric?) tuffaceous intercalations. These segregations are composed primarily of rather coarse foliaceous sericite, and sericitized and biotitized feldspar.

The slide includes a hairline veinlet of chlorite which cuts both the chert matrix and the sericitized segregation.

Sample 25P **META-BASALT**

Estimated mode

Plagioclase	18
K-feldspar	trace
Amphibole	55
Sericite	22
Epidote	3
Carbonate	trace
Apatite	trace
Sphene)	1
Rutile)	
Pyrite	1

This is a fine-grained, streakily foliated to clumpy-textured rock of quartz-free, mafic rich composition. It is clearly of volcanic affinity.

It consists predominantly of amphibole. This ranges from minutely fine-grained, pale-coloured or sub-opaque, felted aggregates, to compact masses of sub-oriented, tiny, prismatic grains, to 0.1mm in size, showing the typical green colour of hornblende.

Cryptocrystalline to granular epidote is a common minor accessory intergrown with the amphibole. Epidote also forms rare hairline veinlets. Rutile and sphene form sub-oriented needles and granules.

The other main constituents are sericite and plagioclase. The sericite typically occurs as groups of small (0.1 - 0.2mm), discrete, sub-equant to rounded patches of fine-felted material, scattered through the hornblende aggregate. These have the appearance of pseudomorphs or altered amygdules.

Sericite also locally forms a matrix or interstitial phase to densely disseminated amphibole needles.

The sericite most likely represents an altered form of primary, possibly felsitic, plagioclase. However, the rock also contains a component of essentially fresh plagioclase, as clumps of subhedral prismatic grains, 0.5 - 3.0mm in size. These are often twinned, and have the composition of labradorite, confirming the intermediate to mafic character of the rock.

Possibly these fresh plagioclase clumps represent remnant phenocrysts, whereas the totally sericitized material is original groundmass?

Pyrite occurs as a few segregated clumps of skeletal, poikilitic euhedra, heavily sieved with matrix silicate inclusions.

Sample 25P cont.

The rock shows streakily banded textural variations, chiefly defined by the grain size and colour of the amphibole and the proportion of intergrown sericite. The coarser amphibole zones show an oriented grain fabric.

There is no specific evidence for tuffaceous origin, and this rock is tentatively classified as a weakly sheared, possibly flow banded, meta-basalt.

Sample 26P **MONZONITE PORPHYRY**

Estimated mode

Quartz	3
Plagioclase	26
K-feldspar) Granophyre)	65
Biotite	4
Amphibole	trace
Sericite	1
Sphene) Rutile)	1

This is a potassic granitoid of somewhat similar macroscopic appearance to the granite porphyries, 19P and 28P. However, it differs in having generally smaller and less abundant phenocrysts. In particular, the prominent euhedral quartz crystals of those samples are lacking.

Compositionally it equates to the fine-grained latite, 7P.

Phenocrysts make up about 30% of the rock. They consist mainly of plagioclase, as euhedral crystals, 0.5 - 2.0mm in size. These are fresh but for a patchy, brownish turbidity and a very light dusting of sericite. They have the composition of oligoclase.

Minor quartz phenocrysts are also seen. These are smaller (0.2 - 1.0mm) and range from equant/subhedral to amoeboid in shape. Occasional plagioclase phenocrysts have graphically intergrown quartz.

The groundmass is an equigranular, anhedral aggregate of K-feldspar, mainly in the range 0.05 - 0.2mm, but with some finer, felsitic patches. It typically shows a strong, feathery/eutectoid, internal texture which is a form of granophyre, and presumably includes a substantial proportion of intimately intergrown quartz and/or plagioclase. It closely resembles 19P in this respect. The rock may thus be more siliceous, overall, than the minor content of quartz phenocrysts suggests.

Mafics are sparse. They consist of small, scrappy patches and wisps of olive-coloured biotite. Much of this is a very fine-grained felted type, of secondary aspect, locally intergrown with minutely acicular amphibole. Small granules of sphene and diffuse, sub-opaque rutile/leucoxene are often associated with the mafic patches.

This rock is probably a minor intrusive of monzonite to quartz-monzonite composition.

Sample 27P **CHLORITIC WACKE**

Estimated mode

Quartz	22
Plagioclase	48
K-feldspar	trace
Chlorite	20
Sericite)	8
Biotite)	
Carbonate	trace
Apatite	trace
Rutile)	2
Sphene)	

This is a weakly foliated rock consisting predominantly of plagioclase and quartz as individual grains and microgranular clumps and lenses in a foliaceous matrix of chlorite.

Plagioclase occurs as individual, randomly oriented, stumpy subhedra, 0.2 - 0.7mm in size. These are fresh and clear and appear to represent crystal clasts. Quartz occurs as clumpy/lensy, microgranular aggregates of grain size 20 - 200 microns. Plagioclase grains - largely untwinned - are intergrown with the quartz in uncertain proportion.

Plagioclase also occurs as diffuse, granular mosaics often showing pervasive sericitization, and having the appearance of a devitrified glass. This material occurs as patches, 0.5 - 2.0mm in size, possibly representing remnant lithic clasts.

These quartzo-feldspathic components are intergranularly cemented by chlorite, which forms flaky pockets and irregular networks outlining the trains of plagioclase crystals and quartz aggregate lenses. The chlorite exhibits a general preferred orientation and defines an irregular 'lumpy' foliation.

Very fine-grained sericite and or biotite locally occurs intergrown with the chlorite, and pervasively permeates some fine felsitic patches (altered lithic clasts).

Flecks and wisps of sphene and rutile are closely associated with the chloritic interstitial phase.

The textural aspect of this rock is of a mildly sheared volcaniclastic or wacke, in which the chloritic matrix has been partially recrystallized, but the primary clastic outlines are still well preserved. It is probably of related type to the sericitic wackes 8P and 21P, but is of less potassic composition.

Sample 28P **GRANITE PORPHYRY**

Estimated mode

Quartz	33
Plagioclase	28
K-feldspar	38
Sericite	1
Biotite	trace
Jarosite	trace

This is a rock of similar general type to 19P, though differing in some particulars.

It is made up of phenocrysts of quartz, K-feldspar (microcline microperthite) and plagioclase, 0.5 - 5.0mm in size, in a finer grained groundmass.

The feldspar phenocrysts show pervasive mild turbidity and, in the case of plagioclase, are sometimes flecked with sericite.

Mafics are extremely sparse, being limited to rare, tiny grains of altered biotite. These are variably replaced by sericite, rutile and a brownish cryptocrystalline material which may be jarosite. The latter is also seen as rare hairline veinlets.

The groundmass is of distinctive texture. It consists of abundant, blocky, subhedral grains of microcline and minor plagioclase, 0.02 - 0.2mm in size, densely disseminated through a continuum of rather coarser, anhedral quartz. Locally this fabric approaches a graphic texture. The feathery eutectoid groundmass textures seen in 19P are not present here.

Like that sample, however, the rock is notably devoid of trace accessories or opaques. It is a typical siliceous, felsic porphyry of minor intrusive aspect.

Sample 29P **APLITE**

Estimated mode

Quartz	31
Plagioclase	18
K-feldspar	48
Sericite	2
Biotite	1
Rutile	trace
Limonite	trace

This sample is an evenly fine-grained igneous rock of strongly potassic composition (see stained cut-off block).

Its texture is essentially identical to that of the groundmass in sample 28P, and it is probably of related origin. It lacks coarse phenocrysts characterising the previous sample, and is evenly microgranular but for rare, euhedral, microphenocrysts of quartz, to 0.5mm in size.

It consists of K-feldspar, quartz and minor plagioclase in intimate intergrowth. The quartz forms an anhedral mosaic, of grain size 0.2mm, within which abundant, smaller (0.02 - 0.1mm) blocky, prismatic grains of feldspar are developed - often concentrating as clumpy segregations. Occasional areas of aggregated K-spar show incipient development of the feathery eutectoid texture seen in 19P.

Mafics are rare. They consist of scattered tiny flakes and shreds of biotite, sometimes altered to sericite and rutile. Diffuse flecks of limonite staining are also noted.

The composition of this rock is in the granite/rhyolite field. Its texture is atypical of an intrusive than granite or an extrusive rhyolite, and it is tentatively classified as an aplite.

Sample 30P

SHEARED METASEDIMENT (DOLOMITIC SILICEOUS WACKE)

Estimated mode

Quartz	48
K-feldspar	1
Sericite	28
Carbonate	20
Chlorite	3
Apatite	trace
Rutile	trace

This is a strongly foliated rock composed of a matrix of granular quartz with abundant schlieren and networks of intergrown sericite and carbonate.

The quartz is of grain size 0.02 - 0.1mm, and consists of a crenulate-margined aggregate of anhedral grains, 0.02 - 0.1mm in size. The grains are more or less flattened, strongly strained and partially recrystallized.

The fabric has the aspect of a sheared, fine-grained, impure quartzite.

Minor amounts of K-feldspar are present, as sporadic felsitic wisps and flecks, but the rock does not appear to contain plagioclase.

Sericite forms abundant, close-spaced, anastomosing wisps and semi-continuous, sinuous schlieren, made up of partially coalescent flakes to 0.3mm in length.

Minutely fine-grained carbonate (unreactive to dilute acid and probably dolomitic) forms irregular clumps and semi-continuous networks, partly intimately intergrown with the sericite, and partly independent of it: some of the larger carbonate clusters have intergrown very fine-grained chlorite.

This is a dynamically metamorphosed, impure (argillaceous/ dolomitic) quartzite or siliceous wacke.

Sample 67P **ARSENOPYRITE WITH VEIN QUARTZ**

Estimated mode

Quartz	26
Sericite	1
Scorodite	trace
Arsenopyrite	72
Marcasite	1
Mineral X	trace
Chalcopyrite	trace

This sample is a strongly mineralized rock consisting essentially of coarse-grained arsenopyrite with a quartz gangue.

The sulfides consist of homogenous, compact arsenopyrite, mainly of grain size 0.2 - 3.0mm. Grain size tends to be smaller at the peripheries of the sulfide masses, where the quartz gangue acts as an interstitial cement. Minor hairline veinlets and pockety segregations of quartz are seen throughout the coarse arsenopyrite clumps.

Accessories are minor. Marcasite and secondary pyrite (possibly after pyrrhotite) occur as small segments in some of the hairline quartz veins and interstitial pockets. Traces of chalcopyrite are sometimes also associated.

Mineral X is light grey and resembles tetrahedrite, but sometimes shows a weak birefringence. It may be a Pb-Sb sulfosalt. It occurs as rare, irregular pockets in quartz, peripheral to the arsenopyrite.

Rare flecks of scorodite (secondary Fe arsenate) are associated with some of the hairline quartz veinlets, or form threads in their own right.

The gangue is varigranular, anhedral, strained quartz of typical vein aspect. Minor sericite occurs as localized felted-textured pockets and discontinuous linear zones.

Sample 98P **SILICIFIED RHYOLITE(?)**

Estimated mode

Quartz	75
Sericite	24
Scorodite(?)	1

This is a rock of simple mineralogy but uncertain origin.

It consists essentially of quartz, as an equigranular, anhedral mosaic of grain size 0.1 - 0.3mm.

Sericite is the other constituent, occurring as clusters and networks of randomly oriented, tiny flakes, 0.02 - 0.05mm (rarely to 0.1mm) in size, evenly distributed throughout and mainly developed in the grain boundaries of the quartz mosaic.

The latter is unstrained, and sometimes shows traces of an apparent, more finely granular proto-texture in ghost form, defined by minute inclusions. It may, therefore, be of metasomatic origin, representing a totally silicified rock - possibly a rhyolite. Rare coarser quartz grains, to 2.0mm in size, clearly represent relict phenocrysts.

The rock is cut by occasional hairline veinlets (healed fractures) of quartz, and by irregular, anastomosing threads, small pockets, and tiny euhedral pseudomorphs of a brown, felted-textured mineral which appears to be the Fe-arsenate scorodite (the typical secondary breakdown product of arsenopyrite).

No sulfides are present in the slide, but the cut-off block includes a few tiny euhedral casts, one of which contains traces of arsenopyrite. It seems likely that these all represent the sites of original disseminated arsenopyrite, now leached out and/or plucked during slide preparation.

INTEROFFICE MEMORANDUM

TO: Gregg Jilson

FROM: Lee Pigage

DATE: May 24, 1988

SUBJECT: MAY 20, 1988 VISIT TO CATFISH CLAIMS, TUTSHI LAKE

Topography rises rapidly from Tutshi Lake to the mountains. Outcrop exposures are excellent on the upper steep mountain slopes. The lower slopes are extensively till covered with no outcrop. The till covered areas have a dense growth of alder. Soil sampling without cut lines in the alder will be difficult.

The recreation site on the lake would be a beautiful spot for a small tent camp. The road extending along the Paddy Creek valley would provide access to the area of interest. The road is not passable for a pickup truck without upgrading; it is passable for an ATV type vehicle.

During our walk along the Paddy Creek road, Cam and I only encountered a single rock type. Initial exposures consisted of a dark green, aphanitic greenstone containing minor green epidote clots. Metamorphic grade appears to be upper greenschist facies or lower amphibolite facies. Outcrops are massive with only an incipient, irregular, widely spaced fracture cleavage/joint system developed.

Farther to the south and west along the road, the greenstones contain a pervasive axial plane foliation. Compositional banding is subparallel to the foliation. Isoclinal folds are present locally. One outcrop contained a folded and foliated pale grey aplite/granite dyke. Systematic mapping would be required to indicate if the foliation was related to a major fault zone or simply developed on the margin of the greenstone unit.

Lee

Lee Pigage

/cb

Curragh Resources Inc.

117 Industrial Rd.
Whitehorse, Yukon Y1A 2T8
Tel: (403) 668-3578
Telex: 036 8359

1988 10 11

MEMORANDUM

TO: Kurt Forgaard

FROM: Gregg Jilson

RE: Catfish Update

Reconnaissance geological mapping was carried out over most of the Catfish claims to evaluate future exploration requirements. Along with the mapping many rock samples and soil samples were taken on irregularly spaced lines.

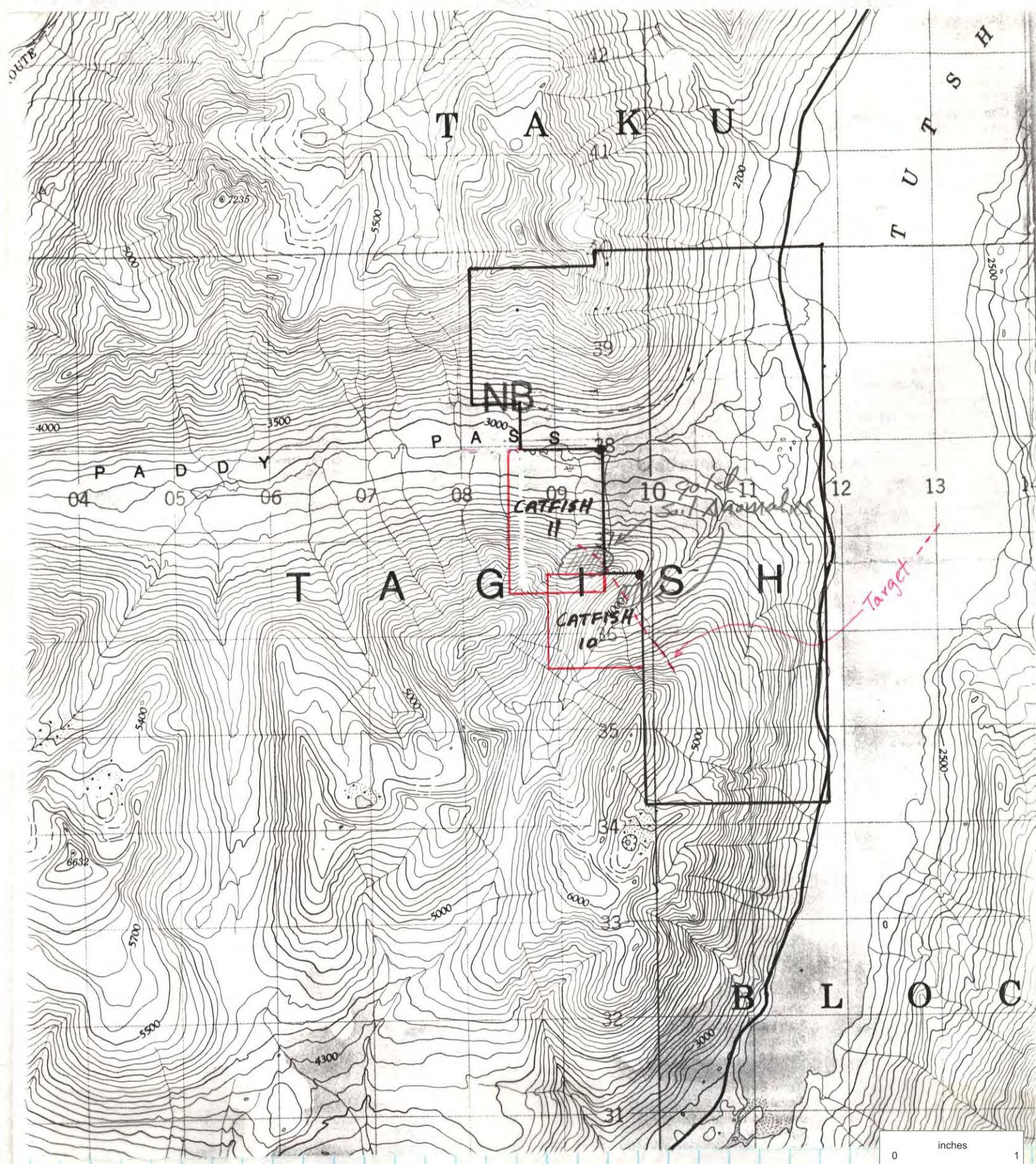
The geological mapping outlined a previously unknown fault 2 km long along which the metasedimentary and granitic rocks are strongly altered. Two small adits and some old trenches were found in the altered zone.

The soil sampling shows preliminary indications of a large and intense soil anomaly near the fault zone. On one side of a ridge cut by the fault there is a minimum 400 m x 400 m area (not closed off) with highly anomalous soils, many of which exceed 1000 ppb (1 gm/tonne). There is a similar intensity anomaly on the other side of the same ridge but its dimensions are not well known since there is only one line which is anomalous for 300 m.

This type of soil anomaly requires careful evaluation, it is definitely unusual.

Preliminary indications are that rock samples are not high in gold unless the sample is from a quartz vein, generally with arsenopyrite. Near the main structure one chip sample over 1.4 m assayed 1.12 oz/ton, another nearbyover 0.6 m assayed 1.38 oz/ton to 0.05 oz/ton Au with a few carrying up to 10 oz Ag. At present the altered zone around the veins has not been proved to be high in gold.

Several new claims units were staked to cover this zone as it was near the edge of the claim block (Catfish 10 and 11 on accompanying map).



CLAIM MAP

— existing claims

— claims added during this program
• L.C.P.

R.J. Morris 1988

INTEROFFICE MEMORANDUM

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DATE: May 24, 1988

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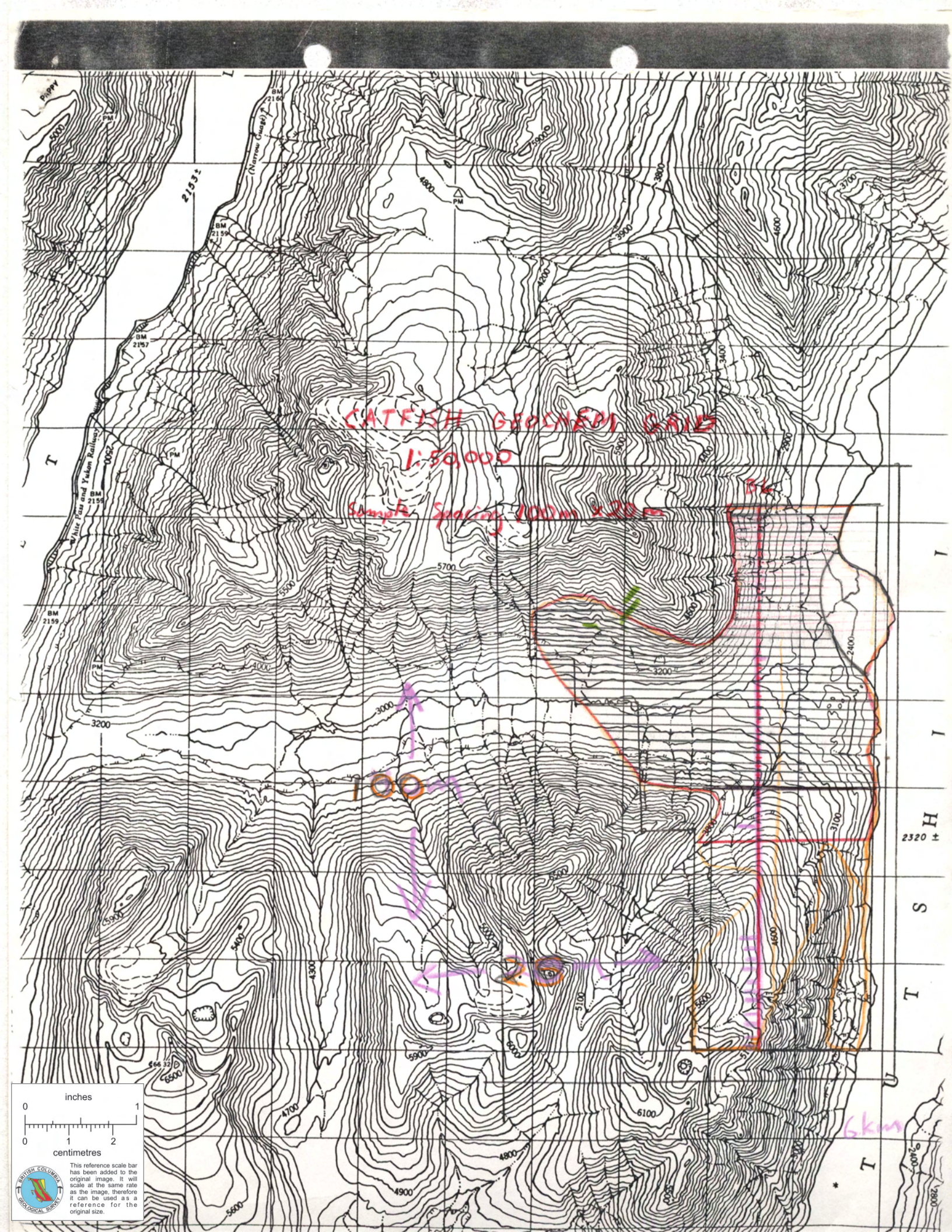
Lee

Lee Pigage

/cb


CATFISH GEOCHEM GRID
1:50,000
Sample Spacing 100m x 20m
100m
20m
6km
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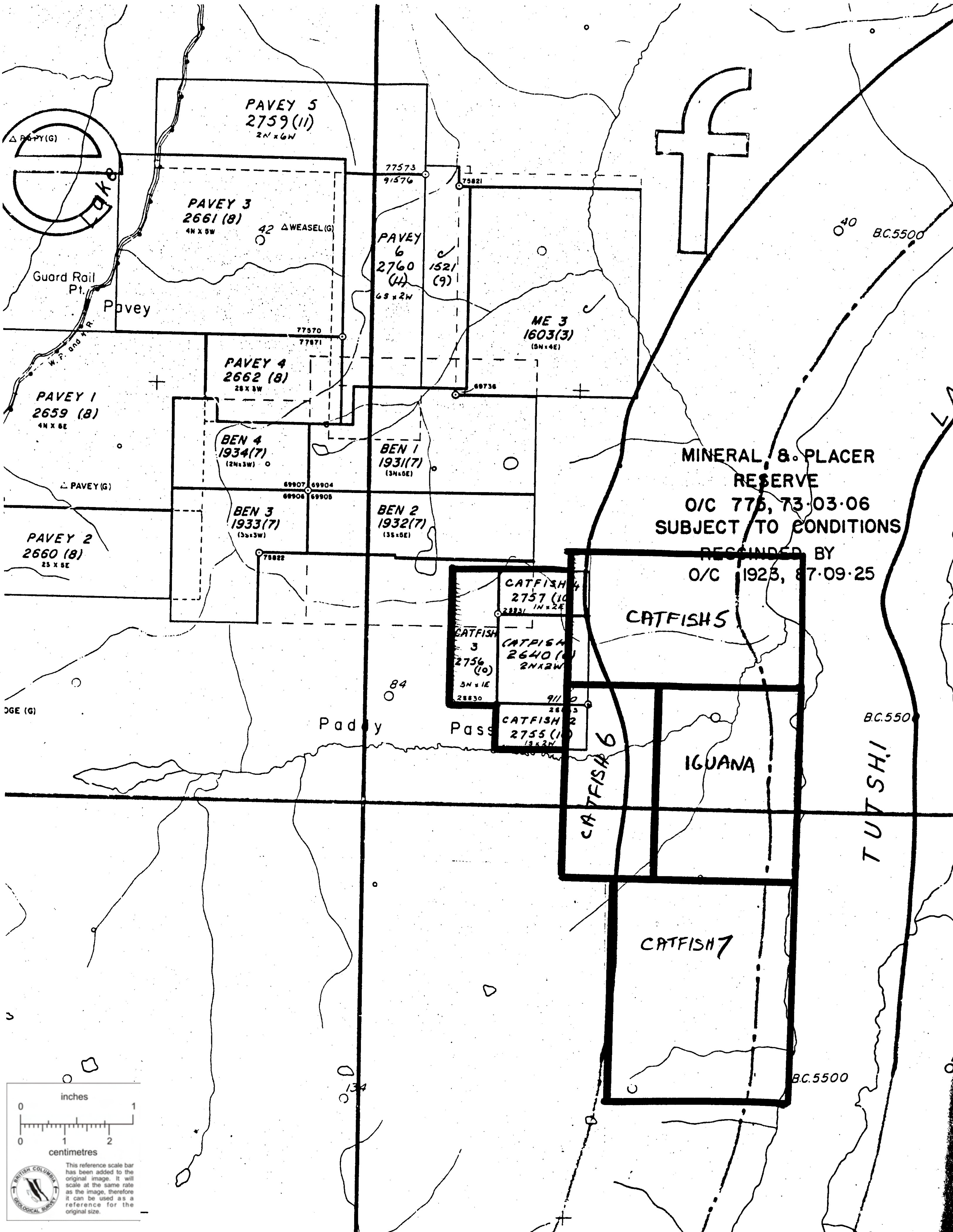
BRITISH COLUMBIA GEOLOGICAL SURVEY


PAVEY 5
2759 (11)
2N x 6W
PAVEY 3
2661 (8)
4N X 5W
42
WEASEL (G)
Guard Rail Pt.
Pavey
PAVEY 6
2760 (11)
6S x 2W
1521 (9)
77573
91576
75821
ME 3
1603 (3)
(5N x 4E)
77570
77871
PAVEY 4
2662 (8)
2S X 3W
69736
PAVEY 1
2659 (8)
4N X 6E
BEN 4
1934 (7)
(2N x 3W)
BEN 1
1931 (7)
(3N x 6E)
PAVEY (G)
69907
69904
69906
69905
BEN 3
1933 (7)
(3S x 3W)
BEN 2
1932 (7)
(3S x 6E)
PAVEY 2
2660 (8)
2S X 6E
75822
MINERAL & PLACER RESERVE
O/C 775, 73·03·06
SUBJECT TO CONDITIONS
RESCINDED BY
O/C 1923, 87·09·25
CATFISH 4
2757 (10)
1N x 2E
CATFISH 5
CATFISH 3
2756 (10)
3N x 1E
28830
CATFISH
2640 (10)
2N x 2W
84
Paddy Pass
CATFISH 2
2755 (10)
1S x 2W
B.C.5500
B.C.550
IGUANA
CATFISH 6
TUTSHI
CATFISH 7
134
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BRITISH COLUMBIA GEOLOGICAL SURVEY
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MEMORANDUM

TO: Kurt Forgaard

FROM: Gregg Jilson

DATE: February 9, 1988

RE: CATFISH CLAIMS, BC

~~This property has been brought to us by a geologist/prospector~~ on the claims pair. Very little work has been done other than preliminary geology and prospecting. An old adit 15 m. long was driven on the main vein. The results reveal an interesting environment which is definitely anomalous in gold content and has a signature characteristic of gold deposits.

(d) The best gold grab sample assay is 0.68 oz/ton; the best assay over a length of material is 0.069 oz/ton over 1.5 m. from the same vein as the grab.

(c) Mineralization is in NE trending veins in a northwest trending shear zone. Several veins are present but the best assays are from the "Main vein" which averages 1 m. wide and has been traced for 200 m. Other veins are obscured by snow.

(b) The property is associated with a northwest shear on the northeast edge of the Coast Plutonic complex. This environment is similar to a number of significant gold properties from Bralorne in BC to the Wheuton District in Yukon.

BC Department of Mines released a map at the Cordilleran roundup last week giving details of the geology of the area and silt geochemistry. There were several anomalies on streams around the property, one of the best anomalies on the map is from a stream near the property.

I think this is a good environment and a property worthy of more work. I recommend an option be taken and the property be enlarged. The vendors are asking $15,000; I suggest countering with $10,000 (they appear to be firm however). The property needs an additional 45 units. The vendors can look after the staking at a cost to us of around $800 and vehicle from Whitehorse and about 3 hours helicopter ($1,600).

In light of the recent geochemical results released and the geologic environment in the new maps I would say if we wait till spring this property will be gone.

Vancouver Petrographics Ltd.

JAMES VINNELL, Manager
JOHN G. PAYNE, Ph.D. Geologist
CRAIG LEITCH, Ph.D. Geologist
JEFF HARRIS, Ph.D. Geologist
KEN E. NORTHCOTE, Ph.D. Geologist

P.O. BOX 39
8080 GLOVER ROAD,
FORT LANGLEY, B.C.
V0X 1J0
PHONE (604) 888-1323
FAX. (604) 888-3642

Report for: James H. Davis,
Curragh Resources Inc.,
117 Industrial Road,
Whitehorse, Yukon,
Y1A 2T8

Invoice 8394

September 6th, 1989

Samples:

20 rock samples from the Catfish Project, for sectioning and petrographic study.

Samples are numbered as follows:

42	15359
0067	15405
0107	15408
0110	15410
0122	15411
0124	15413
0127	15421
0128	15730/S
0129	15731
0130	15733

Samples 0107, 0124, 0127, 0128 and 0129 were prepared as polished thin sections. The remainder were prepared as conventional thin sections.

Summary:

The rocks of this suite are of diverse character. They are generally non-foliated, and seem not to be regionally metamorphosed, though some of them show probable thermal effects. Alteration in the volcanic and pyroclastic rocks is predominantly to sericite and, in some cases, to secondary biotite.

4 main groups may be distinguished. Note that some uncertainty exists in the differentiation of intrusive volcanic or pyroclastic character.

a) Probable Minor Intrusives:

Samples 0110 and 0122 are porphyritic rocks of amphibole-rich composition. The first is extremely mafic, and best classified as a lamprophyre; the second is of related composition, but contains more plagioclase, and could be classed as a diorite porphyry.

Sample 15408 is a porphyry of andesitic composition. Mafic components show strong alteration to secondary biotite; plagioclase phenocrysts are fresh.

Sample 0107 is of quartzo-feldspathic (dacitic) composition. It shows strong, platy recrystallization, and may be a sheared porphyry. It contains disseminated pyrite.

b) Probable volcanics:

Sample 15421 is an andesite showing strong alteration to secondary biotite. It could be fragmental (autobrecciated?).

Samples 15731 and 15733 are porphyritic rhyodacites having sericitized K-spar phenocrysts in a groundmass of quartz and sericitized felsite - probably of original glassy character. They contain traces of tourmaline.

c) Probable pyroclastics:

Samples 0124, 15405, 15410, 15411 and 42 are quartz-poor, felsic to intermediate lithic tuffs, or lapilli tuffs, consisting largely of sericitized felsite or altered glass. 1510 contains fine-grained secondary biotite; 15411 shows pervasive tourmalinization; 42 is distinctive for the presence of coarse porphyroblasts of andalusite - possibly the effect of thermal metamorphism.

Sample 0130 may be a breccia of welded tuff fragments or an autobrecciated flow. It is distinct from the previous group in lacking sericite. It contains chlorite and a little epidote and amphibole, and may be of intermediate (andesitic) composition.

d) Sediments and metasediments:

Samples 15359 and 15413 are black carbonaceous siltstones or wackes; the latter sample is a possible slump breccia.

sample 15730/S is a typical greywacke of volcanic lithic clasts and quartz grains.

Samples 0127 and 0129 are magnesian marbles, showing more or less strong development of porphyroblastic tremolite - probably indicative of thermal metamorphism.

Samples 0067 and 0128 are of uncertain origin. They are granoblastic carbonate rocks with pockety segregations of chlorite (or possibly serpentine). The second sample has a similar carbonate composition (mixed calcite and ankerite) as the previous group, and contains accessory tremolite - suggesting a kinship with the tremolite marble group. In Sample 0062 the carbonate is entirely calcite. The morphology of the chlorite (serpentine) suggests the possibility that it may represent the total alteration of skarnic forsterite aggregates in a marble.

Individual petrographic descriptions and illustrative photomicrographs are attached.

J.F. Harris Ph.D.

(604) 929-5867

SAMPLE 42 **ALTERED ANDESITE (TUFF?)**

Estimated mode

Sericite	45
Chlorite	10
Plagioclase	18
Quartz	1
Andalusite(?)	18
Apatite	trace
Opaques	8

Macroscopically this is a speckled rock of apparent porphyritic aspect. The slide includes a small area of a fine-grained, streaky unit - in apparent bedded(?) contact with the speckled lithotype.

In thin section the rock is found to consist predominantly of minutely fine-grained sericite, as a non-foliated, felted aggregate of grain size 1 - 10 microns.

Accessory constituents are intimately intergrown chlorite, felsitic plagioclase and disseminated, sub-opaque and opaque material.

A diffuse, cryptofragmental or porphyritic texture, on a scale of 0.1 - 1.0mm, is defined by patchy variations in the proportions of intergrown chlorite and felsite in the sericite. The felsite may represent remnants of an original plagioclase-rich volcanic or tuff, now largely converted to sericite.

The disseminated opaques - as granules 5 - 20 microns in size, aggregating to equant grains of 100 microns or more - tend to form patchy clusters which locally emphasize the relict volcanic texture. They are probably mainly pyrrhotite.

Apatite is seen as occasional individual, tiny subhedra. Quartz forms a few tiny pockets and rare, fragment-like patches of chert-like aggregate.

The speckled appearance of the rock, on the macroscopic scale, is found to be the result of porphyroblastic development, in the form of diffuse to sharply prismatic areas, 0.2 - 1.5mm in size, of a moderate relief, low-birefringent mineral thought to be andalusite. In part, these are aggregates of minute granules, but locally they develop optical homogeneity.

The phase making up one end of the slide is of generally similar character to the dominant lithotype, except that it lacks andalusite porphyroblasts. It is also notably less sericitized, and is composed largely of felsite. Opaques in this area tend to segregate as sub-prismatic patches and rimming forms of pseudomorphous aspect.

Sample 42 cont.

The contact between the two phases is demarked by a streaky, foliated, sericite-rich zone.

The sample is an altered andesite - possibly a tuff.

The presence of andalusite porphyroblasts is suggestive of a thermal (contact metamorphic) overprint on the andesite, resulting from proximity to an intrusive body.

SAMPLE 0067 **SERPENTINE MARBLE**

Estimated mode

Serpentine	44
Chlorite	1
Carbonate	50
Sericite	3
Pyroxene	trace
Opaques	2

This rock is a streaky/pockety intergrowth of two main constituents - a carbonate and a fibrous-textured mineral having the aspect of serpentine.

X-ray diffraction checks show that the carbonate is entirely calcite. The identity of the other component remains uncertain; it gives a very subdued XRD response which, on balance, is a better match for serpentine than chlorite.

The calcite is in the form of an even, polygonal mosaic, of grain size 0.1 - 0.4mm.

The serpentine occurs as extensive, sharply defined, irregular patches of pseudo-crustified/cellular to spherulitic habit. Occasional inclusions of calcite are seen within the serpentine masses, and there is a tendency for mutual intergrowth in the contact zones. Serpentine also occurs as small, interstitial pockets within the carbonate mosaic.

Opaques occur as fine, duty disseminations and cellular networks in the serpentine, and as granular clusters in the carbonate - especially in association with some localized, elongate zones of rather coarse, well-formed sericite or muscovite flakes.

A single, small grain of fresh pyroxene was seen within carbonate.

The origin of this rock is obscure. It appears to be a marble. The serpentine could possibly be a pseudomorphic replacement (total alteration) of clumps of original skarnic forsterite, or some other magnesian silicate.

SAMPLE 0107 **SHEARED FELSIC PORPHYRY(?)**

Estimated mode

Plagioclase	56
Quartz	22
Sericite	17
Rutile	trace
Pyrite	5

This is a rock of distinctive, sinuously laminar texture.

It is composed principally of fresh plagioclase with accessory quartz. The fabric appears strongly recrystallized, and consists of an aggregate of more or less strongly elongate, crenulate-margined grains, 20 - 200 microns in size. Coarser, sub-prismatic (relict primary) plagioclase grains, to 1.0mm in size, occur as scattered individuals, generally oriented parallel to the marked foliation, and as augen-like, or blocky kernels within the finer, recrystallized felsite.

Quartz occurs in indeterminate accessory proportions throughout the recrystallized plagioclase matrix, and also concentrates as occasional irregular clumps and lenses.

Sericite mainly occurs in strikingly segregated manner, as slightly sinuous schlieren, 0.1 - 1.0mm in thickness, and spaced 0.3 - 2.0mm apart. These are composed of lines of well-crystallized flakes, grading to minutely foliated wisps. Minor amounts of sericite are also seen as small, discontinuous, intergranular wisps within the feldspathic matrix.

Pyrite - apparently without any associated accessory sulfides - occurs as strings of irregular/elongate to subhedral grains, 20 - 200 microns in size - locally aggregating to lenses of 2mm or more in length. These are closely associated with the micaceous schlieren, and show intimate textural intergrowth with the sericite flakes.

This rock is of uncertain origin. It is clearly of igneous ancestry, and may be an intensely sheared and extensively recrystallized dacite porphyry, or possibly a crystal tuff. The striking freshness of the plagioclase (having the composition of oligoclase) favours the former possibility.

The sulfides appear to have been sheared and recrystallized along with the matrix.

SAMPLE 0110 **LAMPROPHYRE(?)**

Estimated mode

Amphibole	82
Plagioclase	10
Epidote	3
K-feldspar	1
Carbonate	trace
Sphene)	3
Rutile)	
Opaques	1

This is a mafic igneous rock of prominently porphyritic texture.

Phenocrysts make up about 50% of the rock. They consist predominantly of sharply angular (equant/prismatic) masses of felted/fibrous, pale green to brownish amphibole, 0.3 - 3.0mm in size, sometimes with minor included epidote and opaques. These are clearly pseudomorphs after some original mafic silicate. No actual remnants of this survive, and distinctive crystal outlines are seldom seem; it most probably originated as hornblende.

Less abundant, generally smaller, elongate, prismatic phenocrysts of plagioclase are also seen. These tend to show rather diffuse outlines, and appear partially assimilated by the groundmass.

The latter consists largely of a minutely felted mass of colourless, acicular, secondary-type amphibole, as randomly oriented, interlocking needles, 10 - 100 microns in size. Tiny granules of sphene and/or rutile are evenly disseminated accessories in the groundmass, and there is probably also an interstitial low-birefringent component which may be felsitic plagioclase or glass.

Scattered prominent clumps of granular/radiate epidote, rimmed by, or intergrown with, fine-grained K-feldspar and traces of carbonate, have the appearance of amygdules. A few of these show more angular form, suggesting that they may, in fact, be a type of altered (feldspar?) phenocryst.

The slide is cut by a sharply demarked microfracture or fault showing slight lateral displacement.

This rock could be a form of altered porphyritic volcanic, but its strongly amphibolitic composition and textural features suggest that it is most likely a type of lamprophyre.

SAMPLE 0122 DIORITE PORPHYRY OR LAMPROPHYRE

Estimated mode

Amphibole	52
Plagioclase	32
K-feldspar	8
Sericite	3
Epidote	4
Sphene	trace
Opaques	1

This is a rock of somewhat similar composition to the previous sample (0110). However, it has a distinctly higher content of feldspar and lacks the extreme textural bimodality of the previous sample.

Phenocrysts make up a high proportion of the rock. They are of two main kinds. The coarsest (up to 6mm in size) are equant/angular, often 6-sided crystals, now totally pseudomorphed by felted/fibrous, secondary-type, green amphibole - often intergrown with accessory proportions of K-feldspar and epidote, and sometimes with fine-grained opaques. These pseudomorphs probably originated as euhedral hornblende.

The other type of phenocryst consists of elongate, prismatic grains of plagioclase, 0.2 - 2.0mm in size. These are generally more or less turbid as a result of pervasive alteration to minutely fine-grained sericite and clays. The feldspar prisms show a crudely tangential orientation around and between the coarser amphibole pseudomorphs.

A matrix or interstitial phase, composed of minutely felted amphibole with indeterminate proportions of felsitic plagioclase and minor specks of sphene or rutile, constitutes the remainder of the rock - occupying the spaces between the close-packed phenocrysts. The mineralogical similarity between the groundmass and the altered mafic phenocrysts, plus the turbid, indistinct nature of the plagioclase, gives the rock a very diffuse, ill-defined appearance in thin section.

The slide is cut by a network of hairline veinlets of fibrous amphibole (paler in colour and better crystallized than the groundmass amphibole).

This rock could be classified as a diorite porphyry or a type of lamprophyre.

SAMPLE 0124 **FELSIC TUFF**

Estimated mode

Plagioclase	40
Quartz	5
K-feldspar	2
Sericite	38
Chlorite	3
Carbonate	6
Sub-opaque dust	2
Pyrite	4

The cut-off block of this sample has the appearance of a coarse, matrix-less breccia in which the constituent fragments - of a fine-grained, porcellanous rock - are distinguished by various degrees and types of alteration. Fine-grained volcanic and/or pyroclastic textures are distinguishable within the coarse breccia fragments.

In thin section the rock is found to consist predominantly of cryptocrystalline felsite and sericite. The former constitutes a matrix to abundant vari-sized altered feldspar crystal clasts and lithic fragments. These are mainly in the size range 0.3 - 1.0mm, but a few lithic clasts, up to 5mm or more, are also present.

The crystal clasts are totally converted to minutely felted sericite, with minor wisps and patches of carbonate. A few equant crystal clasts of quartz are also seen.

The lithic clasts are also composed predominantly of minute fine-grained sericite and, in many cases, have the ragged, streaked-out appearance and crypto-pumiceous texture of original glass. A few of the coarser fragments are recognizably porphyritic, and contain small phenocrysts of quartz and partially unaltered plagioclase, sometimes in a devitrified mosaic-textured glass matrix.

The rock contains irregular pockety and wispy segregations of quartz, chlorite and K-feldspar (in various proportions). It is also distinguished by a substantial content of disseminated pyrite. The latter occurs randomly, without apparent structural control or consistent relation to fragments or matrix, as irregular to subhedral, sometimes poikilitic grains, 0.02 - 1.0mm in size, locally coalescing to irregular clumps. Sometimes the pyrite is associated with the quartz/chlorite pockets, but this is not a consistent feature.

SAMPLE 0127 **TREMOLITIZED MARBLE**

Estimated mode

Carbonate	72
Tremolite	27
Chlorite	1

This is an altered marble of simple composition.

The portion sectioned includes two distinct assemblages in apparent replacement contact.

About 40% of the slide consists of a homogenous, fine-grained carbonate aggregate, of grain size 20 - 150 microns. The remaining 60% is a skarn-like assemblage of fibrous/acicular tremolite, intimately intergrown, in sheaf-like, skeletal, porphyroblastic mode, with coarser, sparry-textured carbonate.

The tremolite-carbonate phase has apparent inclusions (unreplaced remnants?) of the fine-grained marble, and the latter is penetrated - at the irregular contact - by diffuse veniform apophyses of very fine-grained tremolite (presumably representing the first stages of an advancing replacement front).

XRD analysis shows the presence of major proportions of both calcite and ankerite. Judging from the relative reactivity to dilute acid in the cut-off block, the fine-grained aggregate is predominantly ankerite, and the coarser, invasive phase (with tremolite) is calcitic.

The only other constituent is chlorite, as a few radiate/fibrous-textured pockets and diffuse streaks within the altered marble close to the contact.

SAMPLE 0128 **CARBONATE-CHLORITE ROCK**

Estimated mode

Carbonate	58
Tremolite	8
Chlorite	28
Biotite	3
Talc(?)	1
Sphene) Rutile)	1
Pyrite	1
Pyrrhotite	trace
Chalcopyrite	trace

This is a heterogenous-textures rock of metasomatic aspect. It shows some similarities to Samples 0127 and 0067.

Macroscopic examination of the cu-off block, or the slide, reveals a pockety, concentrically-zoned distribution of several different phases, possibly suggestive of cementation and replacement of an original breccia.

The relationships of one phase to another are obscure. The principal constituents are as follows:

a) varigranular, micritic to coarsely recrystallized carbonate, locally strongly clouded with micron-sized opaque dust (mainly pyrrhotite, partly altered to Fe oxides) and/or speckled with individual euhedral pyrite grains, 0.02 - 0.3mm in size.

b) inclusion-free carbonate, with varying proportions of randomly intergrown, acicular tremolite. This phase contains rare individual specks of chalcopyrite.

c) felted chlorite, locally grading to pale brown biotite (phlogopite). Fine flecks and granules of rutile and sphene are a common accessory in this phase.

These three components occur as more or less sharply defined, concentric bands, in the order listed, and locally show complex intermingling.

Minor patches of possible felted talc are seen in the carbonate.

XRD analysis shows the presence of calcite and somewhat less abundant ankerite. By analogy with Sample 0129, the type a) carbonate is probably the ankerite, and the type b) carbonate is the calcite.

This rock is of uncertain origin, but is probably a form of altered marble (c.f. Sample 0067).

SAMPLE 0129 **MARBLE**

Estimated mode

Carbonate	84
Tremolite	16
Chlorite	trace
Rutile) Sphene)	trace
Pyrite	trace
Arsenopyrite	trace
Pyrrhotite	trace
Limonite	trace

This is another tremolite-bearing marble, clearly of related type to Sample 0127.

It consists predominantly of a rather homogenous, very fine-grained, anhedral aggregate of carbonate, of grain size 10 - 50 microns. XRD analyses show that this consists of a mixture of ankerite and somewhat less abundant calcite.

The micritic carbonate aggregate is traversed by a diffuse network of more or less abundant veniform and pockety zones of slightly coarser carbonate with intergrown, fine-grained acicular tremolite. One localized streaky segregation of felted chlorite was also seen. The veniform carbonate is reactive to dilute acid, and appears to be the calcite - the fine-grained matrix being ankeritic.

Rare elongate clumps of sparry, actinolite-free carbonate contain fine-grained disseminated sulfides (pyrite, arsenopyrite and pyrrhotite - partially oxidized).

SAMPLE 0130 **INTERMEDIATE TUFF**

Estimated mode

Plagioclase	68
Quartz	3
Chlorite	18
Epidote	2
Tremolite	3
Sphene) Leucoxene)	5
Pyrite	1

This is a fine-grained rock of uncertain origin. It has an ill-defined, patchy, cryptofragmental texture, and is probably a form of autobrecciated, devitrified, glassy volcanic or breccia of welded tuff.

It is made up essentially of minutely fine-grained felsitic plagioclase, of grain size 5 - 20 microns. This contains more or less abundant flecks and granules of accessory chlorite and sphene/ leucoxene (and possibly some cryptocrystalline epidote). The distribution of the accessories defines a small-scale, wispy foliation - resembling flow-banding or the texture of a welded tuffite.

A fragmental structure, on the scale 0.5 - 10.0mm or more, is distinguishable by virtue of differing directions of the wispy foliation in adjacent areas. The rock appears to be a breccia of close-packed, non-matching, angular fragments of the same rock type (autobreccia?).

Occasional angular clasts or pockets of cherty quartz are seen.

The rock is cut by a sparse network of hairline veinlets and streaky gash-like segregations of fibrous tremolite, and of felted chlorite.

Sporadic irregular clusters of fine-grained sulfides (apparently mainly pyrite) are also seen. These show no consistent relationship to the fragmental structure or the microfractures.

SAMPLE 15359 **BLACK ARGILLITE**

Estimated mode

Quartz	9
Plagioclase	6
Sericite	8
Sericitized felsite	44
Carbonaceous material	33
Pyrite	trace

This rock is a typical example of a fine-grained carbonaceous siltstone or argillite.

Its appearance in thin section is dominated by the abundant, pervasive opaque pigmentation. Under high magnification this can be seen to constitute a wispy, micro-foliated matrix, separating and wrapping around individual tiny clasts of more or less intensely sericitized felsite and of less abundant crystalline plagioclase, quartz and discrete sericite flakes.

The constituent clasts are in the size range 20 - 150 microns, and are equant/angular to somewhat elongate in form.

A few laminae or lenses of slightly coarser, carbon-poor sediment occur. These consist largely of quartz grains in a felted sericite matrix. There are also a few threadlike, concordant wisps of pyrite.

The rock is cut by a few oblique microshears which are the locus of redistribution and concentration of carbonaceous material.

Overall, this is a rather homogenous, undisturbed sediment, showing well-preserved, primary, clastic textures.

SAMPLE 15405 **SERICITIZED LITHIC TUFF**

Estimated mode

Fragments	
Sericite	54
Plagioclase	1
Apatite	trace
Matrix	
Chlorite) Cryptocrystalline material)	40
Sub-opaque dust	5

Low-power examination of the etched cut-off block clearly indicates the fragmental character of this rock. Sub-rounded to irregular-shaped, lithic clasts, up to lapilli of 8mm or more in size, make up >50% of the rock. The majority of these are of ragged, streaked-out, or ripped-off form - as in glass fragments still soft at the time of accumulation - and show a weak tendency for a preferred elongation.

In thin section these clasts are found to consist essentially of structureless, minutely felted sericite - almost certainly representing altered glass. Some exhibit pumiceous or shard-like fabrics. The fragments sometimes contain small feldspar phenocrysts which are also totally sericitized, and patches of low birefringent material which may be chloritic, whilst a few contain rare subhedral phenocrysts of fresh plagioclase, to 1mm in size. Tiny euhedral crystals of apatite are also seen.

The fragments are set in a featureless, cryptocrystalline, sub-opaque matrix. This is of similar appearance to the fragments, but of lower birefringence, and more or less densely dusted with micron-sized sub-opaque material. It possibly contains an indeterminate proportion of chlorite.

The sub-opaques (rutile) locally concentrate as rare, dense clusters of fragmental aspect.

SAMPLE 15408 **ALTERED ANDESITE PORPHYRY**

Estimated mode

Plagioclase	64
Sericite	2
Secondary biotite	28
Secondary amphibole(?)	2
Rutile)	4
Opaques)	

This is a rock of notably different type to any previous samples of the suite. It is a coarsely porphyritic volcanic or minor intrusive of probable andesitic composition, in which plagioclase phenocrysts are notably fresh, but mafics are totally altered - with development of a distinctive, red-brown, secondary-type biotite.

Phenocrysts make up 50 - 60% of the rock. They are of two kinds. The commonest consist of subhedral prismatic plagioclase crystals, 1 - 6mm or more in size. These are often well-twinned (indicating a composition of andesine) sometimes show fracturing and local granulation. They are generally fresh, but occasionally show veining and partial replacement by minutely felted sericite and/or secondary biotite.

The other phenocryst type is now totally converted to compact or diffuse masses of minutely felted, red-brown biotite. In a few cases, these show cores of similarly-textured, pale green, secondary-type amphibole.

These biotitized masses presumably represent original mafic phenocrysts, though their form is generally indistinct and sometimes streaked-out. This is possibly the result of a tendency for the original mafic phenocrysts to cluster, combined with more or less extensive dispersion and redistribution of the secondary biotite. This fills microfractures, and forms diffuse, pervasive replacements and microbreccia fillings in plagioclase phenocrysts and the groundmass.

The groundmass is a minutely fine-grained meshwork to sub-trachytic aggregate of felsitic and microlitic plagioclase, with interstitial altered mafics (now represented by red-brown biotite) and abundant, disseminated granules of rutile and opaques. Groundmass grain size is in the range 10 - 100 microns.

SAMPLE 15410 **LITHIC TUFF**

Estimated mode

Sericite	42
Felsite	35
Secondary biotite	20
Quartz	trace
K-feldspar	trace
Sub-opaque dust	3

This sample is unambiguuously identifiable as a felsic to intermediate lithic tuff. The etched cut-off block clearly reveals the presence of abundant, equant to somewhat elongate, ragged-shaped clasts, ranging up to lapilli of 8mm or more. The majority of the clasts are in the size range 0.2 - 2.0mm.

In thin section the clasts are found to be composed of more or less strongly sericitized, cryptocrystalline felsite. Some of the larger clasts are recognizably microporphyritic, with partially sericitized plagioclase phenocrysts to 0.5mm or more in size; others show streaky and pellety textures, and clearly originated as glass; and a few appear to be refragmented tuffs.

Clasts make up some 80% of the rock, and range down to 0.05mm or less in size, the smaller lithic detritus being packed interstitially between the coarser fragments.

A matrix phase - presumably representing finely comminuted glass dust - cements the whole aggregate. It is characterized by a high content of micron-sized opaques and sub-opaques, and of diffuse orange-brown biotite.

The same, minutely-felted, orange-brown biotite (similar to that seen in Sample 15408) is also seen as patches (altered mafics?) in some of the porphyritic clasts. Some smaller clasts are composed entirely of this material (biotitized glass?).

Rare, tiny clasts of quartz and chert, and a few individual crystal clasts of plagioclase, are also present.

The rock shows a weak foliation which clearly represents original bedding. It is remarkable for its clearly defined, primary fragmental features and lack of any apparent recrystallization.

SAMPLE 15411 **ALTERED LAPILLI TUFF**

Estimated mode

Sericite	80
Felsite	5
Chert?)	5
Albitite?)	
Chlorite	5
Tourmaline	2
Rutile)	3
Leucoxene)	
Limonite	trace

This is clearly another pyroclastic rock - though with less well defined fragment outlines than in the previous sample. The constituent clasts appear to be predominantly much larger than in 15410 - commonly being in the range 3 - 15mm or more. The majority of them display a streaky, flecked macroscopic texture.

In thin section the clasts are found to consist essentially of minutely felted sericite, with wisps and patches of similar-textured but lower birefringent material which may be of more felsitic and/or chloritic composition. The distribution of the more and less sericitic material within the clasts is a patchy/streaky contorted one, suggestive of original pumiceous, glassy character.

Wisps and irregular pockety concentrations of micron-sized opaque/ sub-opaque material occur throughout - probably mainly in an interclast relationship.

One large sub-rounded clast is composed of a microgranular mosaic of chert (or possibly albite), and similar material is also seen as small, diffuse shreds elsewhere in the slide.

Interclast contacts tend to be defined by local microshears, with oriented sericite and concentrations of chlorite and opaque dust.

A distinctive feature, not seen in previous samples, is the presence of pervasive tourmalinization. This is manifested as tiny, disseminated, acicular crystals, up to 0.1mm in length, often as radiate sheafs. The tourmaline needles are seen randomly within the body of the sericitized clasts, and tend, in particular, to concentrate in the shear-like interclast wisps.

SAMPLE 15413 SLUMP BRECCIA(?) OF CARBONACEOUS WACKE

Estimated mode

Sericite	28
Plagioclase) Felsite)	10
Quartz	8
Chlorite(?)	38
Carbonaceous matter	16

Macroscopic features indicate that this rock is another fragmental product. However, its overall black colour suggests carbonaceous character, which appears more consistent with a sedimentary rather than a pyroclastic origin. The cut-off block includes several coarse, angular fragments of a platy lithotype which has the aspect of a black shale, and suggests possible affinities with Sample 15359.

In thin section the rock is seen to be an aggregate of fragments of widely different sizes, ranging from 0.05 - 10.0mm or so.

Overall it has the appearance of a polylithic wacke composed of close-packed, angular to ovoid clasts of cryptocrystalline/felted sericite and chlorite, and/or felsitic material, plus notable amounts of mineral clasts of quartz and chert. These are set in a minimal matrix of chloritic material with varying proportions of pervasive opaque (carbonaceous?) dust.

Some of the larger clasts are of ragged shape and streaky/pellety texture, and clearly originated as glass.

The coarsely fragmental structure is defined by areas of the wacke lithotype showing different average grain size and proportions of opaque matter. Some of these are highly enriched in the latter component - the angular, shaly fragments referred to in the macroscopic description being essentially totally opaque, with pellety patches of felted chlorite.

The rock appears to be a melange - possibly of slump origin - of carbonaceous shale, volcanic wacke or tuff, and chert.

SAMPLE 15421 **ALTERED ANDESITE**

Estimated mode

Plagioclase	43
Chlorite	10
Secondary biotite	40
Quartz	3
Rutile) Leucoxene)	2
Carbonate	trace
Opaques	2

This sample does not show clearly defined features on the macroscopic scale. A possible cryptofragmental texture, defined by a network of irregular unetched wisps in the predominantly strongly etched matrix, is distinguishable in the cut-off block.

In thin section the rock is found to be distinguished by its high content of the red-brown, minutely felted, secondary-type biotite seen in some other samples of the suite (notably 15408).

More or less compact, aggregated, clumpy to diffuse areas of the fine-grained biotite alternate patchily, on a scale of 0.1 - 0.5mm, with a fine-grained volcanic material consisting of felsitic plagioclase, chlorite and micron-sized rutile/leucoxene and occasional recognizable plagioclase phenocrysts to 0.5mm in size.

The nature of this intergrowth is unclear. It may represent a fragmented andesitic volcanic, cemented and diffusely pervaded by the biotite. Alternatively, it could be a more or less homogenous volcanic in which the biotite patches and streaks represent totally altered pseudomorphs of semi-coalescent clumps of small mafic phenocrysts. Some diffuse dispersion of the secondary biotite may also have taken place.

Other constituents are quartz, as semi-continuous hairline veinlets, scattered tiny grains and small pockety segregations - presumably indicative of incipient silicification.

Opaques (apparently mainly pyrite or pyrrhotite) are sometimes associated with the diffuse threads of quartz, but most commonly show a distinctive mode of occurrence as dense clusters of tiny grains concentrated in discrete, rounded to sub-prismatic patches of minutely microgranular quartz. Traces of carbonate are sometimes intergrown, and one sulfide cluster is located within a patch composed totally of fine-grained carbonate. These features may represent centres of alteration, or could possibly be amygdules.

SAMPLE 15730/S **GREYWACKE**

Estimated mode

Plagioclase) Felsite)	62
K-feldspar	1
Quartz	16
Biotite	18
Rutile	2
Carbonaceous matter	1
Pyrrhotite	trace

This is an even-grained rock having the macroscopic appearance of a bedded clastic sediment.

This impression is confirmed in thin section, where the rock is seen to be a typical greywacke composed largely of volcanic lithic clasts.

The slide includes two bedded units in contact. In the coarser one the clasts range up to 0.5mm in size, whereas in the finer they are seldom more than 0.1mm. The two units are separated by a thin sinuous intercalation of carbonaceous siltstone.

In the (predominant) coarser wacke unit, the clasts are mainly composed of cryptocrystalline felsitic material. In some cases this may contain indeterminate proportions of intergrown chlorite. The felsitic clasts show varying degrees of pervasive alteration to minutely fine-grained, felted, orange-brown biotite. This also tends to concentrate as an interclast network, and, in redistributed form, as discordant streaks and microshears, often containing fine-grained pyrrhotite.

A proportion of the clasts are composed almost entirely of felted biotite, sometimes with disseminated granules of rutile; these presumably represent a somewhat more mafic form of altered aphanitic volcanic.

Quartz is a relatively prominent constituent, as individual angular to sub-rounded clasts, 0.0 - 0.5mm in size, and occasional microgranular lenses. The quartz clasts (and rare crystalline plagioclase clasts) are randomly and rather evenly scattered through the aggregate of close-packed, somewhat ill-defined, partially elongate lithic clasts.

The finer-grained siltstone unit is of similar mineralogy, but the shapes of individual lithic clasts are seldom distinguishable, and the rock consists of small quartz clasts scattered through a streaky, turbid, diffusely biotitized matrix of felsite. The latter appears to be of distinctly potassic composition (see stained cut-off block), compared with the dominant material of the coarser unit.

SAMPLE 15731 **ALTERED RHYODACITE**

Estimated mode

Plagioclase) Felsite)	45
Quartz	14
K-feldspar	5
Sericite	30
Biotite	6
Tourmaline	trace
Rutile	trace
Apatite	trace
Opaques	trace

The matrix texture of this rock, as revealed in thin section, somewhat resembles that of a fine-grained wacke - being an even, diffusely microgranular aggregate of quartz, plagioclase and sericitized felsite, on the scale 50 - 100 microns. However, this texture is also characteristic of the devitrified groundmass of many felsic volcanics. The presence of prominent, euhedral, phenocryst-like forms in the stained cut-off block favours the latter possibility.

The phenocrysts, 0.3 - 2.0mm in size, are composed of potassic feldspar - now strongly altered to patches and networks of minutely felted sericite.

The rock also contains smaller, sub-prismatic phenocrysts of felted, brown, secondary-type biotite - often with included fine-grained rutile or opaques. These are presumably pseudomorphs of some primary mafic silicate.

Secondary biotite also occurs, to a minor degree, in dispersed form throughout the matrix.

Tourmaline is a notable trace accessory, as sporadic small clumps and radiate sheafs. These are sometimes associated with biotite/ rutile patches (mafic pseudomorphs) or with sericitized glass remnants.

The rock includes some ragged, wispy patches of sericite, which appear to be xenoliths of altered pumiceous glass. Alternatively,they may represent undevitrified (possibly autobrecciated) remnants of the originally glassy matrix.

A weak tendency to preferred orientation is exhibited by the biotitized phenocrysts, sericitized glassy xenoliths and a few diffuse laminar quartzose zones. These are probably flow-related features in what is most likely an altered rhyolitic volcanic.

There is no direct evidence favouring a tuffaceous character for the rock.

SAMPLE 15733 **ALTERED RHYODACITE**

Estimated mode

K-feldspar	6
Sericite	22
Plagioclase) Felsite)	46
Biotite	8
Quartz	18
Tourmaline	trace
Apatite	trace
Opaques	trace

This is a macroscopically similar rock to the previous sample (compare the stained cut-off blocks).

The similarity is confirmed in thin section, where the rock is seen to consist predominantly of an equigranular matrix of diffusely sericitized felsite, evenly sprinkled with flecks and small elongate clumps of quartz, 20 - 150 microns in size.

A feature of the matrix, not seen in Sample 15731, is an abundance of tiny, fluidally-oriented, microlitic forms, apparently composed mainly of biotite.

The macroscopically prominent K-feldspar phenocrysts are 0.3 - 3.0mm in size, and show strong diffuse alteration to minutely felted sericite. A minor proportion of altered mafic phenocrysts is also present, now pseudomorphed by felted secondary biotite.

A few of the biotite clumps have intimately intergrown opaques and clusters of acicular green tourmaline.

Tiny elongate euhedra of apatite are a notable trace accessory.

A weak, flow-related, preferred orientation is apparent in the distribution of phenocrysts, and as streaky mineralogic segregations and a sub-trachytic microlitic fabric in the groundmass.

This rock appears to be a pervasively sericitized, porphyritic, felsic volcanic, having a devitrified glassy groundmass. It is of rhyodacite composition.

PHOTOMICROGRAPHS

All photos are by cross-polarized transmitted light, at a scale of 1cm = 0.17mm, except where otherwise stated.

a) INTRUSIVES

SAMPLE 0110: Neg. 157-8: Lamprophyre. Typical field, showing mafic phenocrysts pseudomorphed by secondary amphibole with opaque inclusions (grey-green and yellow-brown flaky masses; bottom left, bottom centre right); elongate prismatic feldspar phenocrysts (grey; lower centre, right); and clump of granular epidote (bright colours; centre) partially rimmed by K-feldspar (grey). Groundmass is composed largely of felted amphibole, low-birefringent cryptocrystalline material and sub-opaque granules.

SAMPLE 0122: Neg. 157-9: Lamprophyre. Majority of field consists of part of a large altered mafic phenocryst, pseudomorphed by fibrous secondary amphibole (yellow brown) with intergrown K-feldspar (grey) and opaque granules (black). Lower part of field includes turbid (saussuritized) prismatic plagioclase phenocrysts in a matrix of felted secondary amphibole.

SAMPLE 15408: Neg. 157-16: Andesite porphyry. Shows fresh plagioclase phenocrysts (grey, twinned) in a groundmass rich in secondary biotite (red-brown) and rutile/opaques, showing a sub-trachytic fabric of plagioclase microlites. Clumpy concentrations of red-brown felted biotite (at upper left and top right) are probably altered mafic phenocrysts.

SAMPLE 0107: Neg. 157-7: Sheared felsic porphyry. Shows strongly foliated (sheared) fabric consisting of schlieren of sericite (yellow-blue-green) in platy alternation with recrystallized/ granulated quartz and fresh plagioclase (white-grey). Field includes two relict plagioclase phenocrysts (upper left; centre bottom). Note concordant lens of pyrite grains (opaque, black).

b) VOLCANICS

SAMPLE 15421: Neg. 157-21: Biotitized andesite. Typical field showing patchy alternations of fine-grained andesite (grey, flecked areas e.g. top centre, bottom right) and concentrations of minutely felted biotite (orange brown). Note some diffuse pervasion of the andesite matrix areas by the fine-grained secondary biotite. Field also includes two amygdule-like patches of microgranular quartz (white-grey) with cores of aggregated pyrite granules (opaque, black).

SAMPLE 15731: Neg. 157-23: Rhyodacite. Typical field, showing matrix of sericitized felsite (speckled) with diffuse flecks and clumps of quartz (white-grey). Field includes a clump of brown biotite (upper right) probably representing an altered phenocryst. Minutely fine-grained brown biotite is also seen in dispersed form throughout the matrix.

SAMPLE 15733: Neg. 157-24: Rhyodacite. Similar quartz-flecked felsite matrix (devitrified glass) to 15731. Field includes parts o two diffusely sericitized K-feldspar phenocrysts (top right, bottom right). These are much less clearly defined in thin section than on the macroscopic scale. Brown area at upper left is a mafic phenocryst pseudomorphed by felted secondary biotite and opaque granules. Note smaller clumps and diffuse dustings of biotite throughout the matrix.

c) PYROCLASTICS

SAMPLE 42: Neg. 157-4: Altered tuff. Note relict fragmental or porphyritic textures (lighter patches and wisps) in matrix of minutely felted sericite dusted with micron-sized opaques. Field includes several of the prominent phenocryst-like forms which are thought to be porphyroblasts of andalusite. These are predominantly made up of aggregates of minute spongy granules which appear sub-opaque in thin section. Some better crystallized, more transparent patches are also present. Note how the andalusite prisms are clearly developing in situ in the matrix - the patchy fabric of which can still be distinguished within them

SAMPLE 15411: Neg. 157-18: Altered lapilli tuff. Shows large, altered glassy clasts with streaky/flecked pumiceous fabric defined by more sericitic (lighter coloured) and more chloritic (darker) material, and wisps of sub-opaque dust. Opaque material (probably mainly rutile) tends to concentrate interstitially to the clasts (e.g. centre, top).

SAMPLE 15411: Neg. 157-19: Plane polarized light: Scale 1cm = 85 microns. Higher magnification to show acicular tourmaline crystals (pale grey-green; some examples circled). Note concentration of tourmaline and opaques in crenulate microsheared zones demarking clast boundaries.

SAMPLE 15410: Neg. 157-17: Lithic tuff. Typical field showing sharply defined lithic clasts in a matrix loaded with fine-grained sub-opaques and secondary biotite (brownish). Clast at bottom right is recognizably porphyritic. Clast at top left is of sericitized felsite.

SAMPLE 15405: Neg. 157-15: Sericitized lithic tuff. Shows ill-defined fragmental textures in minutely fine-grained sericitic and/or chloritic felsite. Field includes some small, intensely sericitized clasts or phenocrysts (whitish) and a few tiny fresh feldspar grains (grey). Note general streaky appearance suggestive of original glassy character.

SAMPLE 0130: Neg. 157-13: Intermediate tuff. Shows coarse, angular fragmental, autobrecciated structure in cryptocrystalline felsite with abundant chlorite and sub-opaques (dark). Note weak, foliated fabric within the coarse fragments; this may be a relict welded tuff texture. Field includes a few flecks or pockets of quartz (white).

SAMPLE 0124: Neg. 157-10: Felsic tuff. Typical field, showing small sericitized clasts (lighter brownish grey) in matrix of felsite (speckled darker grey). Field includes individual grains and clumps of quartz (white; grey) and disseminated pyrite (opaque, black) - in part associated with a clump of quartz (top).

d) SEDIMENTS

SAMPLE 15359: Neg. 157-14: Black argillite. Typical field showing small grains of quartz and plagioclase (white, grey) and flakes of sericite (pink, blue), together with felsitic clasts (speckled, barely distinguishable from the dark background), set in a pervasive matrix of opaque, probably carbonaceous material (black). Note weak but distinct foliation.

SAMPLE 15413: Neg. 157-20: Breccia of carbonaceous wacke. Plane polarized light. Shows clasts of quartz or chert (white) and felsitic/chloritic material (darker, speckled) in a chloritic matrix more or less densely impregnated with opaque (carbonaceous?) matter. Note concentration of opaque material (left) separating coarse blocks of the carbonaceous wacke.

SAMPLE 15730/S: Neg. 157-22: Greywacke. Typical wacke of angular quartz grains (white, grey) and rather even-sized, close-packed felsitic lithic clasts (speckled). Note that many of the lithic clasts are more or less strongly enriched in minutely fine-grained felted brown biotite.

SAMPLE 0128: Neg. 157-12: Altered marble. Field shows banded/ crustified zones of minutely fine-grained brown carbonate with disseminated pyrite (bottom left); recrystallized, somewhat flattened mosaic of carbonate with acicular/skeletal tremolite (colours; centre); and fine-grained, felted chlorite (blue-black, with minor brownish biotite; upper right).

SAMPLE 0127: Neg. 157-11: Tremolitized marble. Shows remnant of original fine-grained ankeritic carbonate at bottom right, in contact with invasive phase of skeletal/bladed tremolite (bright colours) intergrown with coarser calcitic carbonate (tan colours).

SAMPLE 0067: Neg. 157-6: Altered marble. Shows part of pocket of fibrous, aggregate-textured serpentine (blue grey-black; right) in contact with coarse-grained mosaic aggregate of carbonate (brownish to pale pastel colours) with elongate flakes of muscovite (green, orange, blue-violet). Note minor pockets of serpentine in the carbonate near the contact, and occasional tiny flecks of carbonate in the main serpentine area.

Curragh Resources Inc.

117 Industrial Rd.
Whitehorse, Yukon Y1A 2T8
Tel: (403) 668-3578
Telex: 036 8359

1988 09 15

Mr. Bob Morris
Morris Geological Co. Ltd.
Mineral and Coal Exploration & Mining
P.O. Box 1364
Fernie, B.C.
VOB 1M0

Dear Bob:

I enclose a copy of your first set of analytical results. Page 4 looks fairly interesting, I assume these are your rock samples. Why don't you give me a call if there is anything that you feel is of unusual interest that you would like to discuss. Sorry I missed you on your way through Whitehorse. Thanks for the info you left. The second batch of samples have been shipped to Acme and the rocks shipped to Vancouver Petrographics.

Yours very truly,

CURRAGH RESOURCES INC.

Gregg Jilson
Vice President, Exploration

Encl.

88.09.18

Gregg:

I included a preliminary sample location map as well as sample description notes for your information.

Please note, in detail the sample locations are not great! This is in part due to the distortion and poor elevation control in the map and my plotting (to a lesser degree). The air photo blow-ups will allow me to transfere locations more accurately BUT more important, they will be the final record of locations (if the property continues, an orthophoto & survey control system should be completed and data from the blow-ups can go directly onto the orthos & then to map.)

My schedule is:

Sept 22-26 - S. Econ. Geol. N. Cordillera field trip, Sandspit, Stewart, Smithers

Sept 27 - Oct ? - EIM, Fernie (604.423.4531)

I hope to have lots done prior to these so that by the time air photos are blown-up, Acme is finished & Van. Petro. is finished I will be able to put final touches to it (?!)

Yours truly,

Bob.

P.S.
- I enjoyed the work, thanks for the opportunity.

NOTES

C8R - Catfish, 1988, R.J. Morris
C8N - " , " , Nick "

C8R 12 - sequential number

C8R 12 R - rock sample
L - soil "
S - silt " (stream sediment)

Sample Duplicates

C8N 26 - 30
42 - 45
71 - 75
92 - 100
118 - 130
144 - 152
159 - 165
175 - 187
192 - 197
217 - 227
238 - 248

C8R 34 - 36
48 - 50

C8R sample location & description

1 R	N. mountain, E. side	float	6 ppb Au	
2 R	middle ridge	"	2 ppb Au	
3 L	" "	soil below sulfur stain	NS	
4 R	" "	vein in rhyolite (S. side)	2420 ppb	42980 ppm As, 20.9 Ag
5 R	" "	" " " (N. ")	16690 ppb	42779 As, 32.2 Ag
6 R	lake shore	float	136 ppb Au	
7 R	" "	"	195	
8 R	" "	"	13	
9 R	" "	"	112	
10 R	S. mountain	vein, high grade (10 cm)	13210 ppb Au	351.4 Ag
11 R	N. "	volc. + abn Py	1320 ppb	
12 R	N "	trench above adit; high grade,	6720 picked sample	110.9 Ag, same site as C8R 5
13 R	N "	old adit; high grade,	~~730~~ 6720	~~105.5 Ag~~
14 R	N. "	" " ; FW sample over ~1.5 m,	1660 ppb chips	
15 R	" "	W " " ; float, Mo in granite	35	
16 R	" "	" " " " , stibnite? in Qz vein	3720	325.2 Ag
17 R	N. "	E side ~~near granite contact~~ rusty gully; alt. zone	~2 m	163 ppb Au
18 R	N. "	E side, rusty gully; rust "	~3 m	49
19 R	" "	" " ; " "	~2 m	56
20 R	" "	" " ; " "	~1 m	81
21 R	" "	" " ; " "	~2.5 m	20
22 R	" "	" " ; siltstone, abn Py		350 ppb
23 R	" "	" " ; " " "		11 ppb
24 R	S. "	volc, float		6 ppb.
25 R	" "	siltst. + Py + silver min? (float)		6 ppb
26 R	" "	volc + Py		15 ppb
27 R	" "	vein, alt ~1m		11 ppb
28 R	" "	contact with granite, massive Py		222 ppb
29 R	" "	" " " , black alt.		28 ppb
30 → 53 L	" "	Soil line		
54 → 57 R	middle ridge, below adits	float	.024 .072 .020 .053	oz/t
58 R	" " , lower adit	vein 2-3 cm	.002	oz/t
59 R	" " " "	host	32 ppb	
60 R	" " " "	vein 3 cm	.028	oz/t
61 R	" " " "	rhyolite	92 ppb	
62 R	" " (above) " "	vein 10 cm	0.157	oz/t
63 R	" " " " "	float	525 ppb	
64 R	" " (10 m SW) " "	vein ~1m	345 ppb	
65 R	" " ; middle "	" 3 cm	360 ppb	
66 R	" " " "	" 85 cm (chips)	0.124	oz/t

67 R - middle ridge, middle adit ; vein 85 cm (float) 0.038 opt
68, 69 L - " " , " " ; soils
70 R - " " , top trenches ; high grade grabs 0.092 opt
71 L - S. mountain ; soil
72 R - " " ; rusty tuff? 7 ppb
73 R - " " ; " , float 9 ppb
74 R - middle ridge ; calc-sil., skarn?, float 845 ppb
75 R - middle ridge ; rusty tuff 10 ppb
76 → 78 L - " " ; soil samples, below rusty tuff
79, 80 L - " " ; " " , " granite
81 R - " " ; greisson?, float 2 ppb
82 R - " " ; altered sed. 8 ppb
83, 84 L - " " ; soils on zone
85 R - " " ; N. side ; alt. zone 245 ppb
86 R - " " ; " " ; rusty " 15 ppb
87 R - " " ; " " ; chips over 4.2 m, rusty zone .001
88 R - " " ; " " ; " " 1.6 m, vein .051
} old trench
89 → 95 L - " " ; " " ; soil samples level with trench
96 R - " " ; " " ; alt. zone .007
97 R - " " ; " " ; Qz vein in FW 1.2 m 26 ppb.
98 R - " " ; " " ; host + As 38 ppb
99 R - " " ; " " ; 60 cm vein 1.38 oz/t
100 R - " " ; " " ; 140 " " 1.12 oz/t
101 R - " " ; " " ; 100 " " 1220 ppb
102 L - " " ; " " ; soil in rusty zone
103 R - " " ; " " ; vein in granite 355 ppb
104 S - Paddy Pass cr. - 1 km above middle ridge
105 S - " " " - in canyon near bottom

88.08.27

Greg:

A few notes in case we don't cross paths for a while! These are preliminary, "Frank" impressions:

① the adit on the north mountain is in a quartz vein, which is weakly mineralized. You have to be very selective to obtain good results (hopefully my results confirm this).

② there is a major shear on the middle ridge and south mountain. In both places it is up to 100' wide with ~~lots~~ many veins and associated alteration + arsenopyrite. Also there are two old adits and some blasted trenches.

- to date we've done a quick run over the middle ridge and down the north side (Paddy Pass side) & collected several nice samples. (we got snowed on so I'm not real happy with my coverage)
- we completed a day on the south ridge and quickly looked over the SE edge (not strikingly promising). We mapped, and soil sampled our way into the south creek.

TO DO - I still want to trace the shear to the SE into the granite (Monday) above Tutshi Lake.

TO DO - Trace the shear to the NW above the "Paddy Cr." granite where there is a visible shear (?) - break (?)

- STAKE more claims to the west; #1 = a 2W × 4N claim; #2 = a 1E × 2S claim; ?#3 (±) = a 2W × 3N claim (dependent on the above.)

TO DO - We'll spend approx. 1 week doing detail around the shear as it crosses the middle ridge.

" - check out rust zone in drainage © to the east of adit #1

- I think the old road was put in to look for Mo in the granite (there is some in assoc. Qz veins). It was put in post '55 (our photo set) But is not accessible.

- ~~Your~~

- How about a new road crossing Paddy Pass Cr. ~2900' elev. and checking out the shear zone on both the N. and S. sides of the middle ridge!!

* If you get #4 & 5 assayed, ask to retain coarse reject + pulp
a) Fire assay Au + Ag
b) 30 element ICP

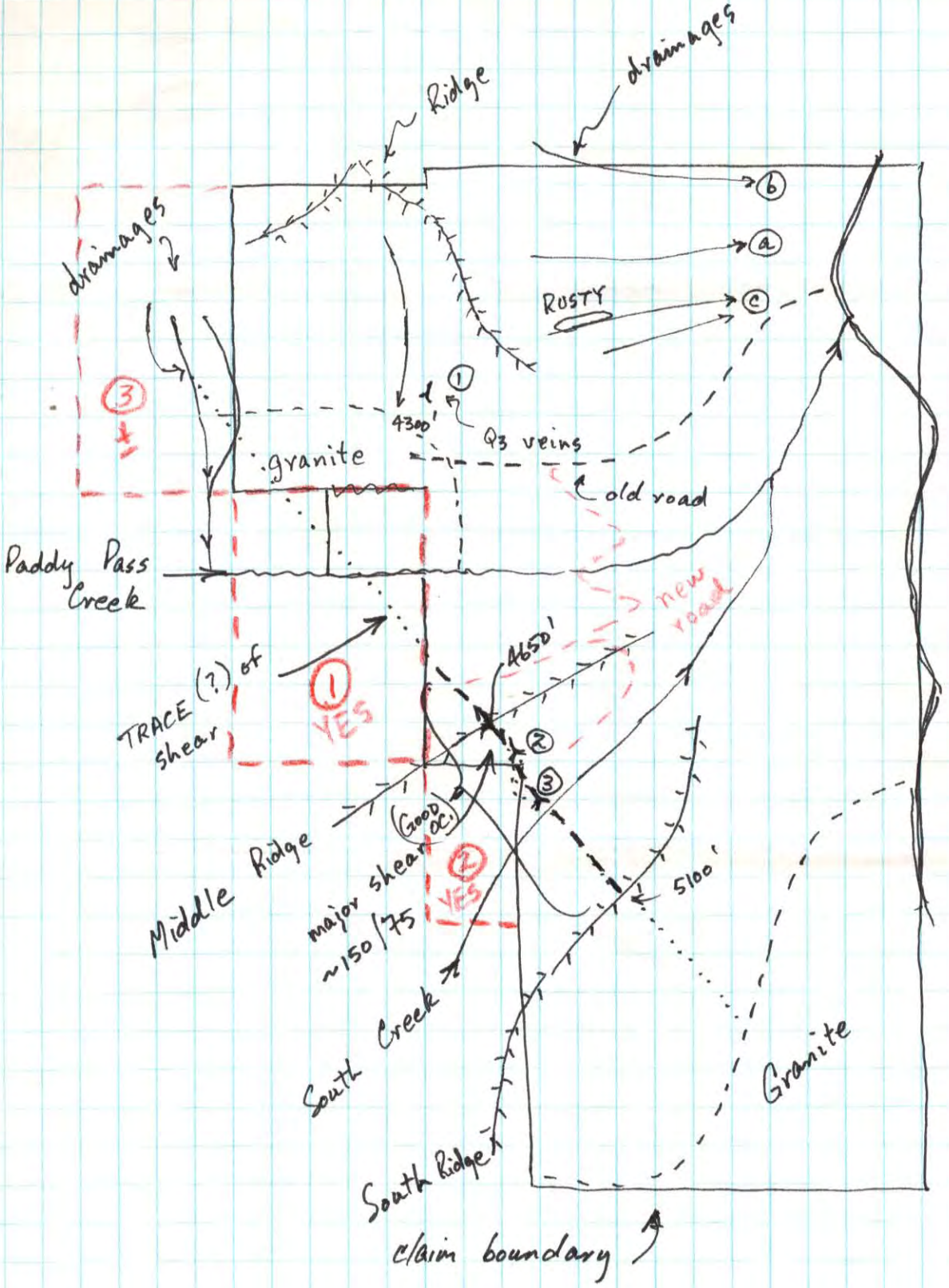
NEED - Frame Mining's Free Miners Cert. No. to stake more claims.

- $\$\frac{500}{\cancel{300}}$.- cash advance; Monday afternoon we'll be in town

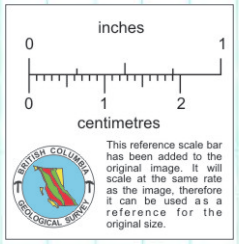
Thank,

Bob.

CATFISH CLAIMS



5h - Monday Aft



RJM.
88.08.27

Frame Mining Corp.

117 Industrial Road
Whitehorse, Yukon Y1A 2T8
Tel: (403) 668-3578 Telex: 036-8359 Fax: (403) 668-6518

March 12, 1990

Resource Data & Analysis Section
Geological Survey Branch
Room 121, 525 Superior Street
Victoria, British Columbia
V8V 1X4

Attention: Mr. T.E. Kalmins

Dear Mr. Kalmins:

RE: CATFISH GROUP ASSESSMENT WORK

Enclosed are two copies of a report on an I.P. Survey done on the Catfish Group in 1989. This survey was done in conjunction with other work previously submitted and is in excess of the allowed 10 years. A summary of the survey costs is also enclosed. I would like to have the value of the work credited to the PAC account of Frame Mining Corp., if this is possible.

If you require additional information, please do not hesitate to contact me.

Yours very truly,

CURRAGH RESOURCES INC.

Janet C. Nyberg
Exploration Coordinator

JCN*geb

Enclosures: I.P. Survey (2 copies)
Survey Cost Summary

Curragh Resources Inc.

117 Industrial Rd.
Whitehorse, Yukon Y1A 2T8
Tel: (403) 668-3578
Telex: 036 8359

February 15, 1990

Mr. Craig J.R. Hart
707 Cook Street
Whitehorse, Yukon
Y1A 2R7

Mr. H. Copland
Site 20, Box 109, R.R. #1
Whitehorse, Yukon
Y1A 4Z6

Dear Sirs:

RE: CATFISH MINERAL CLAIMS

We enclose one copy each of the geology and I.P. reports on work done on the Catfish Mineral Claims during 1989.

The work consisted of a much more detailed prospecting of the area to evaluate the possibility of large tonnage deposits and more carefully and critically apply soil geochemistry. More detailed geological mapping and a test induced polarization survey were carried out. Quartz veins were trenched on the Middle Ridge to evaluate grade in fresh exposure.

The results continue to indicate gold is present in quartz arsenopyrite veins to tenors of 1 oz/ton however, tonnage potential is highly limited. Intense soil geochemical anomalies from 1988 reconnaissance work were not duplicated although it is clear that widespread soil anomalies are present on Middle Ridge. There was considerable interest in establishing sources of gold other than quartz veins, however it appears conclusive that the apilite, though spatially associated with anomalous gold geochemistry, contains no gold itself.

Expenditures to date are tabulated below:

1988	Total Expenditures:	$ 45,206
1989	Total Expenditures:	$181,360
	Geological & Geochemical	$102,307
	Linecutting	$ 7,737
	I.P.	$ 39,042
	Road Rehabilitation	$ 3,225
	Trenching	$ 23,779
	Assessment Fees	$ 5,270
GRAND TOTAL ('88 & '89)		$**226,567**

. . . . . /2

All applicable work has been filed to the limits possible and the status of the claims is tabulated below:

Name	Units	Expiry Date
Catfish	4	01-05-2000
Catfish 2	2	10-30-1998
Catfish 3	3	10-30-1998
Catfish 4	2	10-30-1998
Catfish 5	15	03-04-2000
Catfish 6	8	03-04-2000
Catfish 7	20	03-04-2000
Catfish 10*	4	09-03-2000
Catfish 11*	6	09-06-2000
Iguana	12	01-05-2000

* not referenced in agreement; new staking

As you are aware metal prices are in decline, consequently our exploration budget will become more focused to high priority projects. Since the results of work on the Catfish Claims are not very encouraging, it appears that we will not be conducting an exploration program on this property during 1990. In light of this, and of our expenditures in excess of the work requirements to date, I propose that the work requirement for 1990 be deferred to 1991.

Please note that all required reclamation on this property has been completed. I trust you will find these reports in order.

Yours very truly,

CURRAGH RESOURCES INC.

Gregg A. Jilson
Vice-President, Exploration

GAJ*geb

Enclosures: J.H. Davis Geology Report dated December 3, 1989 + folder of maps
Peter E. Walcott & Assoc. Ltd. I.P. Report dated January, 1990

MEMORANDUM

TO: Kurt Forgaard

FROM: Gregg Jilson

DATE: February 9, 1988

RE: CATFISH CLAIMS, BC

This property has been brought to us by a local geologist/prospector pair. Very little work has been done other than preliminary geology and prospecting. An old adit 15 m. long was driven on the main vein. The results reveal an interesting environment which is definitely anomalous in gold content and has a signature characteristic of gold deposits.

The best gold grab sample assay is 0.68 oz/ton; the best assay over a length of material is 0.069 oz/ton over 1.5 m. from the same vein as the grab.

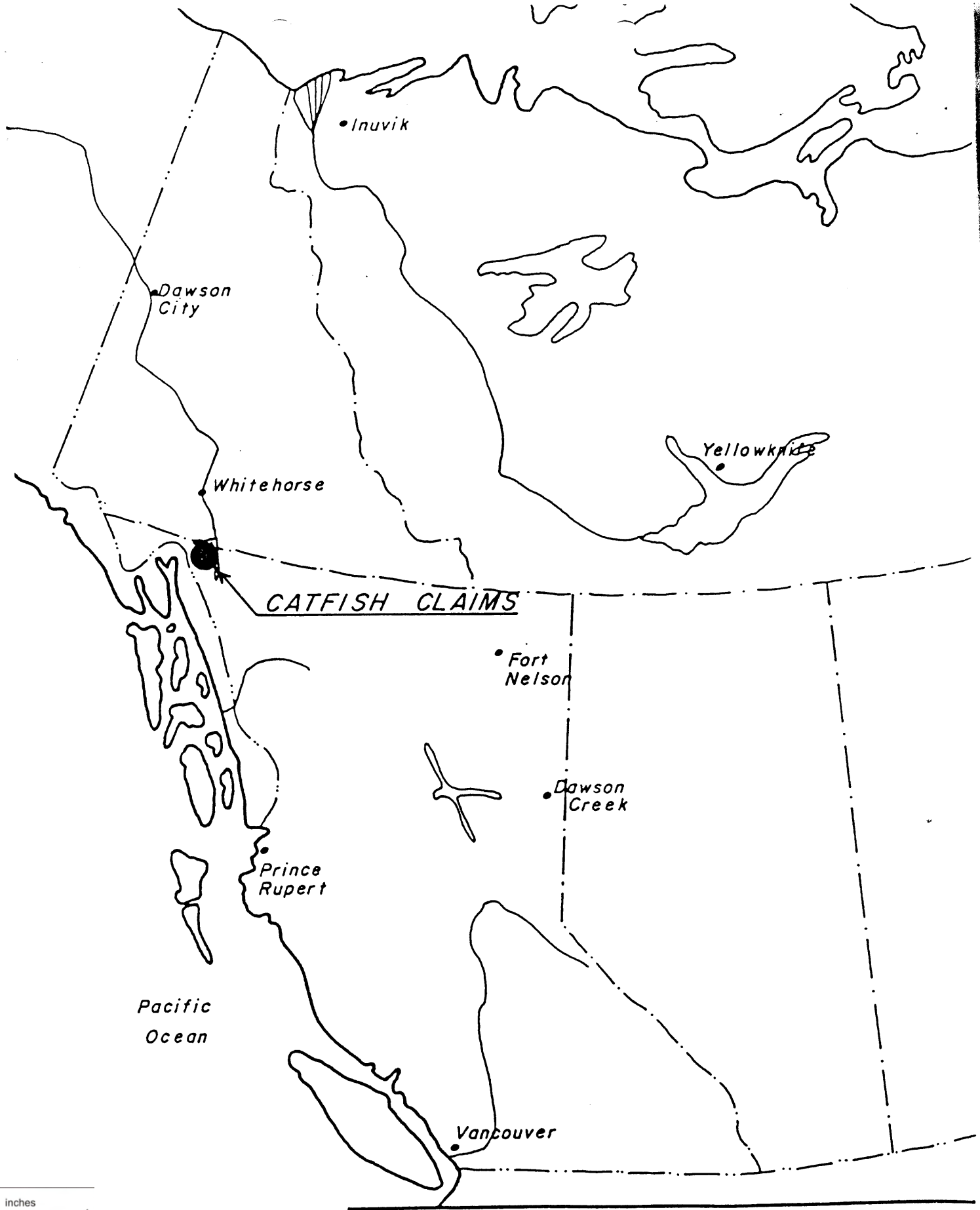
Mineralization is in NE trending veins in a northwest trending sheer zone. Several veins are present but the best assays are from the "Main vein" which averages 1 m. wide and has been traced for 200 m. Other veins are obscured by snow.

The property is associated with a northwest sheer on the northeast edge of the Coast Plutonic complex. This environment is similar to a number of significant gold properties from Bralorne in BC to the Wheuton District in Yukon.

BC Department of Mines released a map at the Cordilleran roundup last week giving details of the geology of the area and silt geochemistry. There were several anomalies on streams around the property, one of the best anomalies on the map is from a stream near the property.

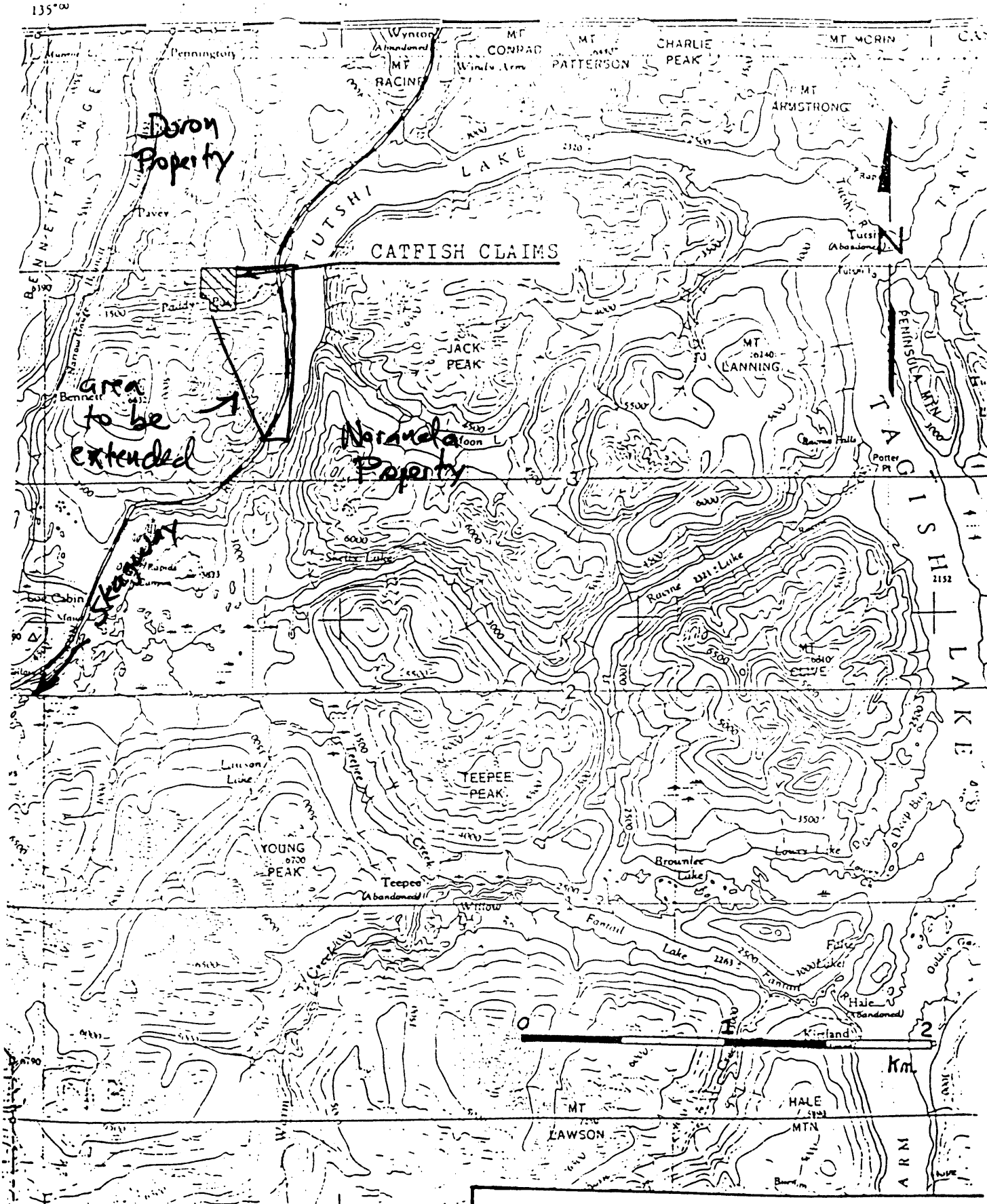
I think this is a good environment and a property worthy of more work. I recommend an option be taken and the property be enlarged. The vendors are asking $15,000; I suggest countering with $10,000 (they appear to be firm however). The property needs an additional 45 units. The vendors can look after the staking at a cost to us of around $800 and vehicle from Whitehorse and about 3 hours helicopter ($1,600).

In light of the recent geochemical results released and the geologic environment in the new maps I would say if we wait till spring this property will be gone.



LOCATION MAP Fig. 1

0 300 600 900 KM.



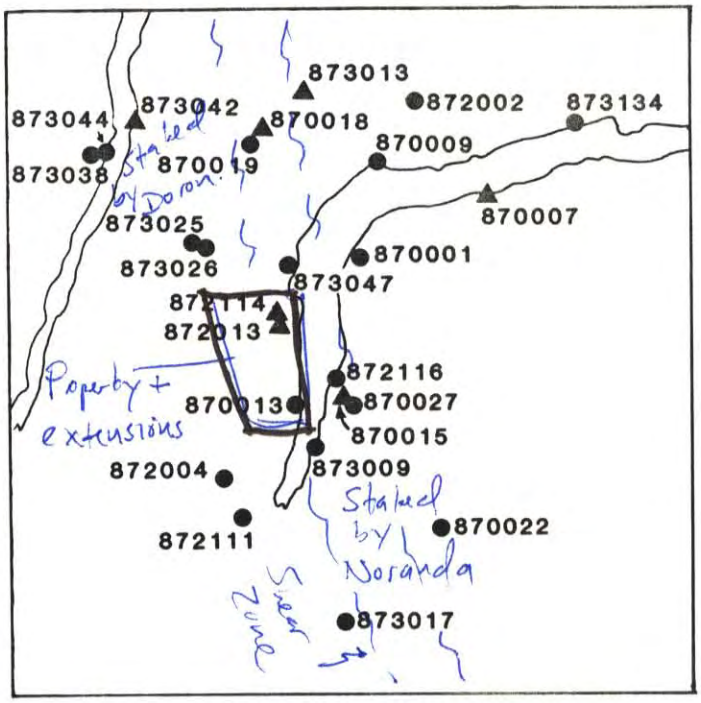
LOCATION MAP Fig.2

CATFISH CLAIMS

Atlin Mining Division NTS:104M/1
British Columbia

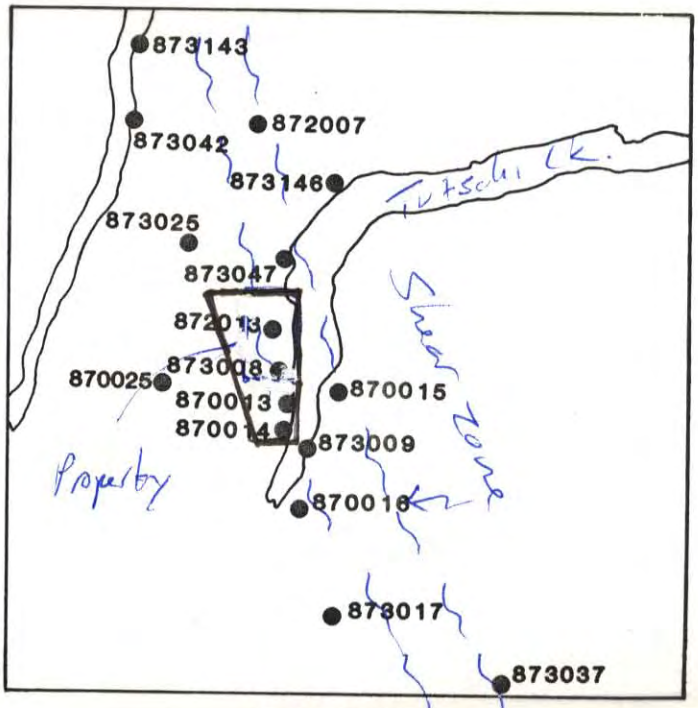
Scale 1:250,000 Jan. 1987

ANOMALOUS Au, Hg, and As DISTRIBUTION



● Au >19 < 80 ppb

▲ Au > 80 ppb



As >117ppm

1988 02 09

MEMORANDUM

TO: Whitehorse Staff

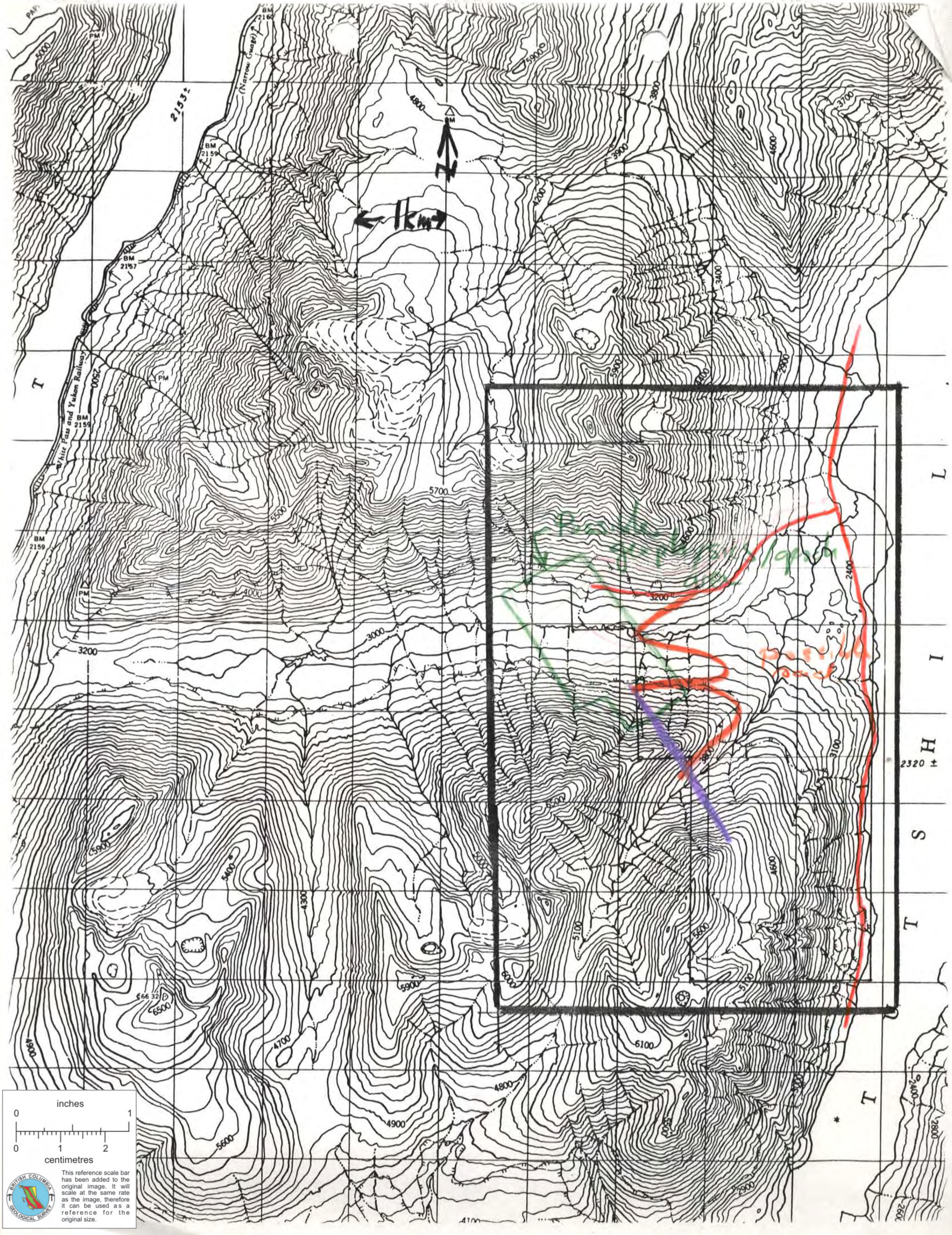
FROM: Harold Upton

On Friday 88-02-19
1. Cliff Frame
2. Marv Pelley
3. Bill Redrupt
4. Ralph Sultan
5. Jack Mitchell

and wives will arrive in Whitehorse on the 5:30 p.m. flight. Their itinerary will have them in Whitehorse until Sunday noon, Faro sunday evening - dinner Monday evening and mine visits either or both Monday and Tuesday.

The group will be using the Whitehorse office for meetings, etc. Please ensure that your office and desks are left in an orderly state.

Thank you for your cooperation.



inches
0 1
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centimetres

This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.

BRITISH COLUMBIA GEOLOGICAL SURVEY

Gregg: Assay results from the Nevel Mtn, Catfish Property show four rock samples greater than 500 ppb and one soil sample greater than 50 ppb as highlighted in red.

Rock Units 1 = PPM
2 = Stuhini
3 = Inklin
6 = granite or aplite

#0080 Qtz stockwork veining w up to 1% Mo
#0083 PPM
#0208 } both from second adit Q + PY + Asp (adit seen from helicop
#0209 }
S225

Contacts, defined ———
assumed — — —
outcrop boundary .....