

PRELIMINARY GEOLOGICAL AND GEOCHEMICAL  
REPORT ON THE  
HL CLAIM GROUP



WATSON LAKE MINING DISTRICT, Y.T.  
N.T.S. 105-B/6

Latitude 60°17'N; Longitude 131°20'W

FOR

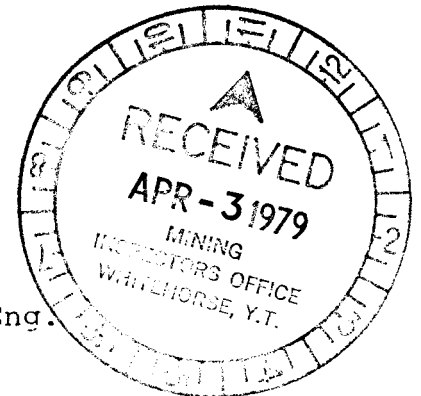
SWIFT RIVER RESOURCES LTD.



By

Carl G. Verley, B.Sc.,  
Geologist

Supervised by: M. H. Sanguinetti, P.Eng.

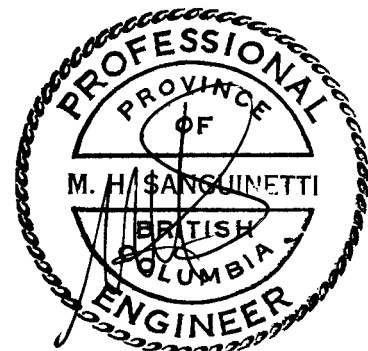


CORDILLERAN ENGINEERING  
1418 - 355 Burrard Street  
Vancouver, B.C. V6C 2G8

MARCH, 1979 090451

CLAIMS: HL 1-48 .. YA33483 - YA33530  
HL 49-52 .. YA35485 - YA35488

WORK PERIOD: August 31 - September 12, 1978



This report has been examined by the Geological Evaluation Unit and is recommended to the Commissioner to be considered as representation work in the amount of \$ 13,000.00

A. DeBicki  
acting Resident Geologist or  
Resident Mining Engineer

Considered as representation work under  
Section 50 (2) of the Quartz Mining Act.

B. R. BAXTER  
Supervising Mining Recorder  
Commissioner of Yukon Territory

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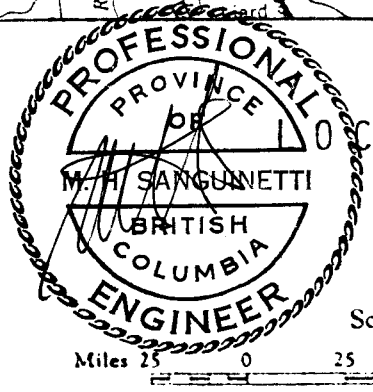
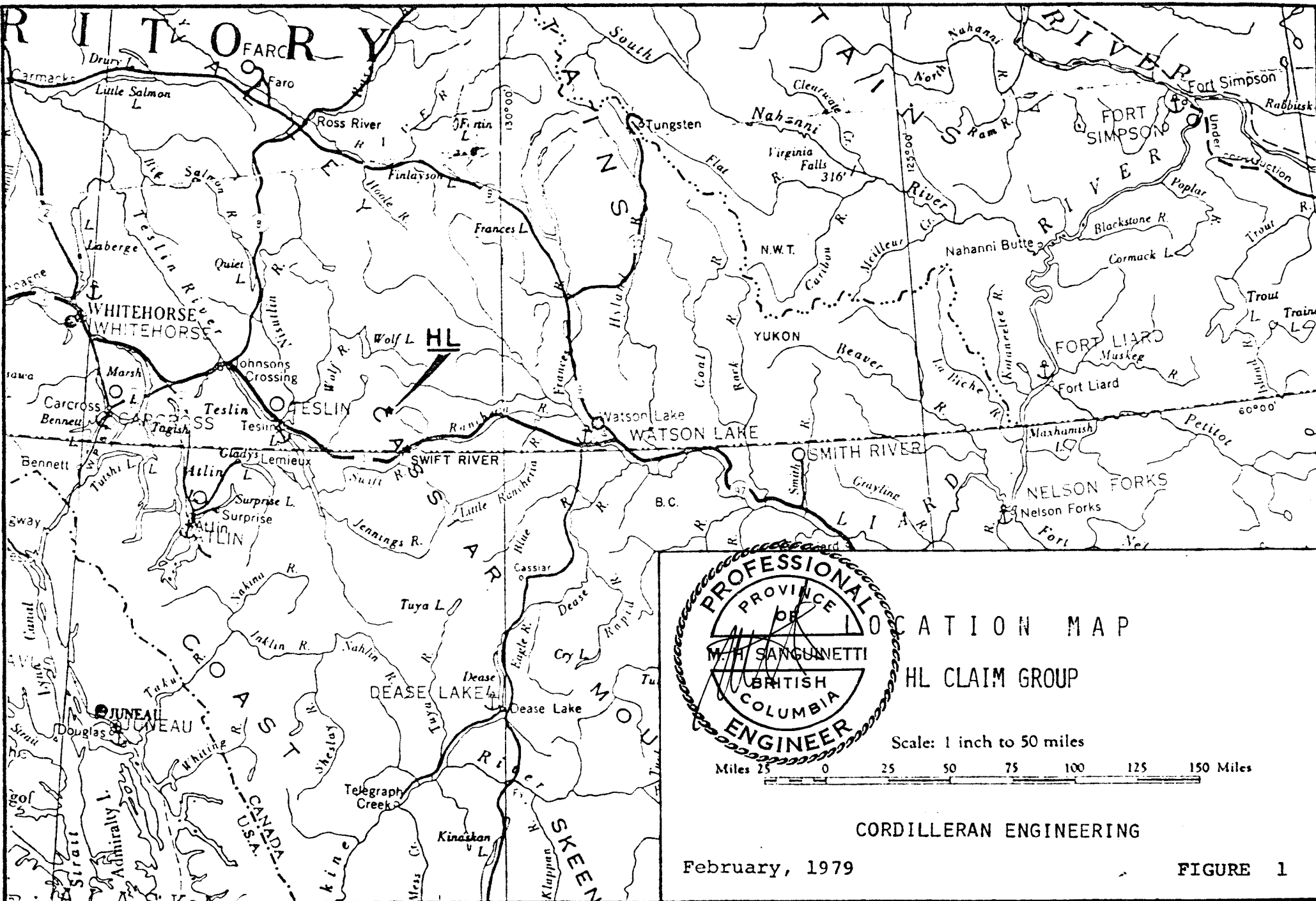
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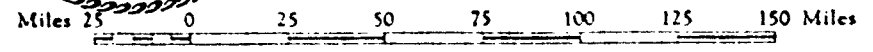
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PROVINCE OF LOCATION MAP  
 M. A. SANGUINETTI  
 BRITISH COLUMBIA  
 ENGINEER  
 HL CLAIM GROUP

Scale: 1 inch to 50 miles



CORDILLERAN ENGINEERING

February, 1979

FIGURE 1

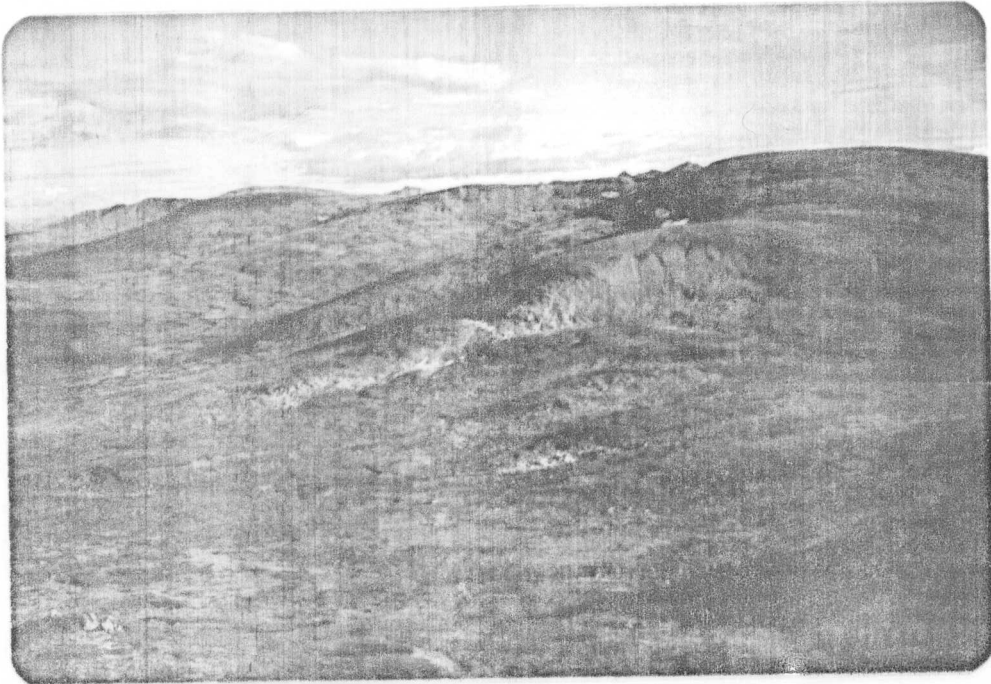


FIGURE 2: HL property, view looking southeast.

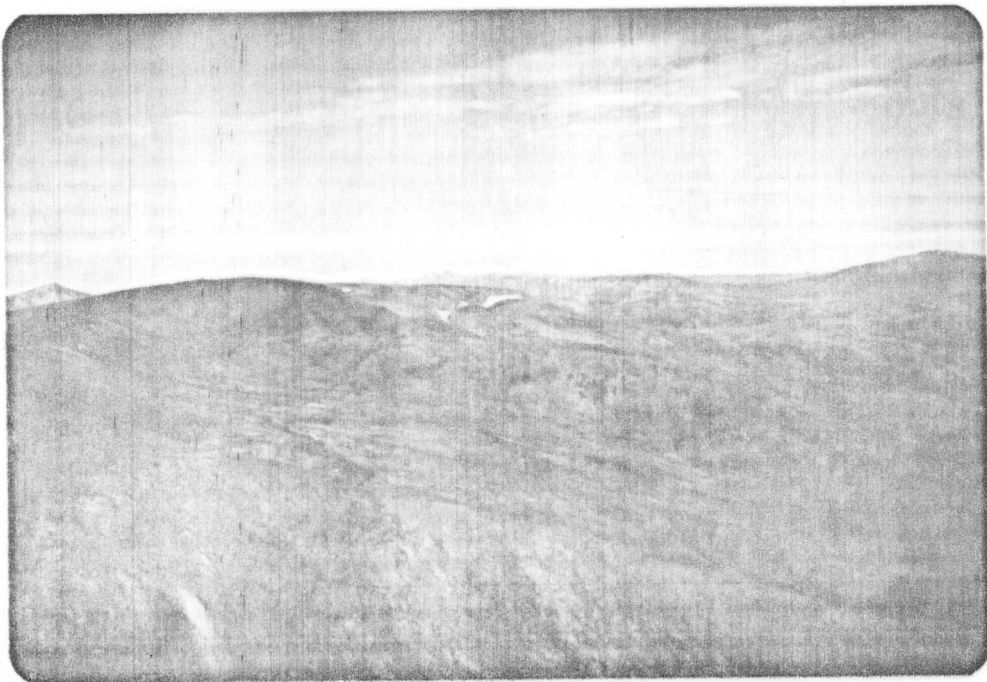


FIGURE 3: HL property, view looking northwest.

## INTRODUCTION

The HL group (52 claims) is located in the Watson Lake Mining District (N.T.S. 106-B/6), 34 kilometres (21 miles) north-northeast of Swift River, Y.T. The claims are situated at latitude 60°17'N and longitude 131°20'W and lie 11 kilometres (7 miles) from road end at Crescent Lake.

Initially staked to protect tungsten geochemical anomalies, forty-eight claims (Appendix "A") were acquired for Swift River Resources Ltd. by Cordilleran Engineering in June of 1978; four claims were added to the original block in September, 1978. Title to the claims is held by Cordilleran Engineering Limited.

The property is underlain by Lower Cambrian and earlier(?) metasediments with minor metavolcanics(?). In contact with the metasediments, on the east side of the group, is the Cassiar Batholith. Tungsten mineralization occurs as scheelite disseminated in the metasediments. Vein and skarn-

type mineralization are also found in the sequence.

A program of geological mapping, sampling and reconnaissance soil geochemistry was conducted during the period August 31 to September 12, 1978. Expenditures for this exploration program exceeded \$17,000.

This report has been written to comply with regulations governing the acceptance of geological and geochemical surveys as assessment work.

## H I S T O R Y

Extensive exploration work has been conducted in the vicinity of the HL since the mid 1940's. The BOM and ATOM groups (16 km, 10 mi. south of the HL) were located in 1946 by Hudson Bay Mining and Smelting Company for lead, zinc and silver in skarns. The Bastille claim (23 km, 14 mi. northeast of the HL) was acquired by Great Northern Exploration Company Ltd. in 1947 for zinc, lead and silver in skarn and veins. Minor tungsten and molybdenum are reported on this property which was restaked as the MID group in 1971 by the Wolf Lake Joint Venture (Rayrock Mines Limited, Ashland Oil Canada Limited and Canadian Industrial Gas and Oil Ltd.) and subsequently allowed to lapse. Intensive exploration has been conducted in the region immediately south and southwest of the HL in search for Mo, W, Sn during the past three seasons.

On the HL property skarn bands have been trenched

by previous exploration companies.

# G E O L O G Y

(Plate 1)

## GENERAL

The HL group lies in the northern Cassiar Mountains of the Omineca Crystalline belt. The property lies in a narrow northwesterly trending slice of Lower Cambrian and earlier(?) metasediments (G.S.C. Map 10-1960). The Cassiar Batholith (mainly quartz monzonite to granodiorite) is in contact with the Lower Cambrian on the northeast. An apparently conformable sequence of lower Paleozoic sediments and volcanics form the presumably downdropped, southwest contact of the Lower Cambrian slice along the Ram Creek fault.

Physiographically the property is situated in very subdued alpine topography. Straddling a rounded ridge, elevations on the group range from just over 4,500 feet

to approximately 5,700 feet above sea level. Outcrop is not more than 10 percent, but abundant rubble crop and talus are exposed.

## LITHOLOGIES

(Figure 4)

Preliminary mapping of the HL group has subdivided the Lower Cambrian into 5 units and the Cassiar Batholith into 2 phases. Brief descriptions of these follow. A petrographic report of specimens from the Lower Cambrian sequence (E5) is appended (Appendix "C"). This work was conducted by Miss Joanne Nelson, an associate of Vancouver Petrographics.

### LOWER CAMBRIAN AND EARLIER(?)

#### UNIT E1:

A sequence of thin-bedded medium crystalline grey argillaceous limestone grades down into thick-bedded to massive medium crystalline light grey limestone in the north corner of the property. This unit is in contact with the Cassiar Batholith, but appears to pinch out into Unit E2 to the south. Skarn bands consisting mainly of garnet and diopside(?) occur along the upper contact of this unit. Scheelite is found on fracture surfaces and in quartz veins cutting the limestone

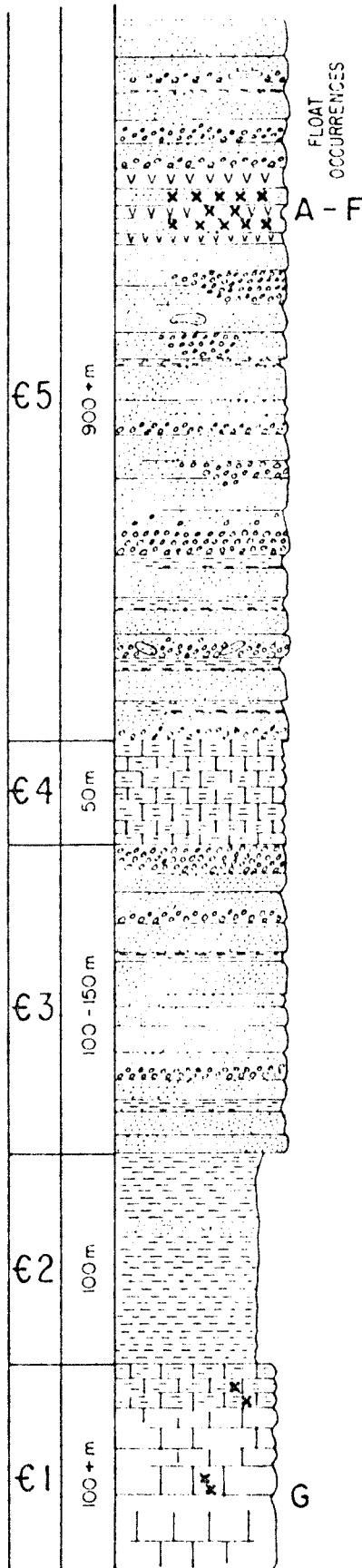
# HYPOTHETICAL, PRE-METAMORPHIC STRATIGRAPHY

## LOWER CAMBRIAN AND EARLIER (?) SECTION

### HL PROPERTY

SCALE 1:3333

LOWER CAMBRIAN and EARLIER (?)



#### UNIT €5:

RELICT SEDIMENTARY STRUCTURES: BEDDING, CROSS-BEDDING, GRADED BEDDING, PEBBLE CONGLOMERATES, SHALE RIP-UP CLASTS, CHANNEL FILL DEPOSITS, INDICATE THIS SEQUENCE CONSISTED PREDOMINATELY OF QUARTZ PEBBLE CONGLOMERATES AND SANDSTONES. BASIC VOLCANICS (V) ARE INFERRED FROM BASIC SCHISTS TO COMPOSE APPROXIMATELY 5 PERCENT OF THE SECTION ALONG WITH POSSIBLE ANDESITES AND VOLCANICLASTIC SEDIMENTS. SCHEELITE OCCURS DISSEMINATED IN THE SEDIMENTS, ANDESITES (?) AND LESS COMMONLY IN THE BASIC SCHISTS (A,B,C,D,E, F SHOWINGS).

#### UNIT €4:

LIMESTONE THIN-BEDDED, DARK TO MEDIUM GREY, MEDIUM CRYSTALLINE AND ARGILLACEOUS THE BASE OF THIS UNIT GRADES INTO A DISTINCTIVE QUARTZ-PEBBLE CONGLOMERATE CEMENTED WITH CARBONATE.

#### UNIT €3:

QUARTZ-PEBBLE CONGLOMERATE AND SANDSTONES, SIMILAR TO UNIT €5, BUT APPARENTLY LACKING BASIC VOLCANICS (BASIC SCHISTS).

#### UNIT €2:

PREDOMINANTLY FINE-GRAINED PELITIC ROCKS WITH LESSER PSAMMITIC ROCKS.

#### UNIT €1:

LIMESTONE: THIN-BEDDED, MEDIUM CRYSTALLINE, GREY, ARGILLACEOUS LIMESTONES GRADE DOWN INTO MASSIVE MEDIUM TO COARSE CRYSTALLINE LIGHT GREY LIMESTONE. SKARN IS DEVELOPED AT CONTACTS WITH THE CASSIAR BATHOLITH. SCHEELITE OCCURS ON FRACTURE SURFACES AND IN QUARTZ VEINS CUTTING THE SKARN.

GEOLOGY - Lithologies (cont'd)

and skarn. Disseminated scheelite in the skarn bands is rare and presently appears to be of lower tenor.

UNIT E2:

This unit consists of fine-grained andalusite-plagioclase-quartz schists which contain biotite and muscovite. Grain size and bedded character suggest these rocks are predominantly metapelites with lesser intercalated metapsammitic rocks. Present thickness of this unit is in the order of 100 metres.

UNIT E3:

Fine-to medium-grained biotite-muscovite-quartz-plagioclase schists form the bulk of Unit E3. Relict bedding and minor intercalated metapelites indicate the sedimentary origin of E3.

UNIT E4:

Thin-bedded, dark to medium grey, medium crystalline argillaceous limestones form a sequence approximately 50 metres thick. The base of this unit grades into a distinct quartz-pebble conglomerate in which clasts are cemented with calcite.

UNIT E5:

Unit E5 hosts the disseminated scheelite mineralization on the HL. The bulk of the package consists of biotite-muscovite-quartz-plagioclase schists. Variations in mica content (1 to 40%) give the rock a variably developed schistosity. Relict sedimentary structures are well preserved (Photographs, Appendix "B") suggesting original rock-types to have been quartz-pebble conglomerates, sandstones (greywackes?) and shales. Basic schists (actinolite/hornblende-plagioclase

GEOLOGY - Lithologies (cont'd)

schists) form approximately 5 percent of Unit E5. The basic schists are intercalated with the metapsammitic rocks and vary from 15 cm to 60 cm in thickness. It is believed the basic schists are metabasalts. Commonly adjacent to the basic schists are moderately well foliated rocks which contain siliceous layers (quartz and epidote) and aggregates of amphibole (actinolite and/or hornblende) varying from 3 to 10 mm in diameter, flattened parallel to foliation. These rocks are thought to have originally been volcanoclastic sandstones and tuffs, amphibole aggregates being fragments derived from basic volcanics, siliceous layers being the products of volcanic exhalations. Scheelite occurs in metapsammitic and volcanoclastic rocks. Quartz vein-hosted mineralization is common but vein density is low. At least 900 metres of Unit E5 occur on the property.

LOWER CRETACEOUS - Cassiar Batholith:Quartz Monzonite Kqm:

Coarse-grained, biotite quartz monzonite lies in contact with the Lower Cambrian strata on the northeast side of the property. The quartz monzonite has a well developed, wide spaced blocky jointing and generally appears foliated.

Leucocratic Phase Kl:

A pale grey, fine-to medium-grained porphyritic intrusive (quartz monzonite?) occurs in the north part of the claim group as a border phase to the main quartz-monzonite body. The groundmass has a sugary texture and contains accessory biotite and muscovite. Locally small pegmatitic zones occur in this rock.

GEOLOGY - Lithologies (cont'd)TERTIARY(?)Quartz porphyry Tqp:

A dyke of fine-grained quartz porphyry intrudes Unit €5 in the south part of the property. The dyke reaches a width of approximately 25 metres and is traceable over 100 metres. Small (1 to 2 mm) bipyramidal quartz phenocrysts are set in a fine-grained pale grey groundmass with accessory pyrite.

## STRUCTURE

The Lower Cambrian package on the HL is folded into a northwesterly trending syncline. Minor folds are locally developed in the metasediments. Talus fragments exhibiting isoclinal folds indicate the intensity of deformation. (Figure 12, Appendix "B"). Petrographic evidence suggests at least two stages of deformation.

A major fault, the Ram Creek fault, is inferred to lie immediately southwest of the claim group. This fault has moved the Lower Cambrian section upward adjacent to Lower Paleozoic sediments and metavolcanics. A fault is inferred to occur

GEOLOGY - Structure (cont'd)

between the Cassiar Batholith and Lower Cambrian package (G.S.C. Map 10-1960), but no evidence for this fault could be found on the property. The effect of faulting within the sequences on the claims is not apparent.

## G E O C H E M I S T R Y

(Plate 2)

STREAM SEDIMENTS:

Initial stream sediment sampling that defined the tungsten anomalies now covered by the HL claims was conducted during the 1977 field season. The streams that flow from the northeast side of the property drain the mineralized float areas and have gentle slopes; are 1 to 2.5 metres in width, containing adequate silt for sampling purposes. The southwest side of the property has moderate to steep slopes and streams are dry in the higher reaches after run-off.

Heavy mineral concentrates were taken during the 1978 season from the northeast drainages. Known occurrences of mineralized float correlate well with the stream sediment results.

SOILS:

Four reconnaissance soil lines aggregating 54,400 feet were sampled on the HL group to determine soil response to mineralization. A total of 184 samples were collected at 200 and 400 foot spacings. Soils on the property are poorly developed, consisting of a rocky alpine profile. At many sites adequate soils were difficult to obtain. Line control was by chain and compass; stations were marked at 200 foot intervals.

Samples collected were placed in numbered kraft bags and the sample sites were marked with plastic flagging. The samples were dried, sieved to the -80 mesh fraction, and shipped to the North Vancouver laboratory of Bondar Clegg and Company, Limited for analysis for tungsten.

The analytical method consisted of basic fusion, leaching, reduction with stannous chloride, complexing with ammonium thiocyanate and extraction by carbon tetrachloride. The concentration of tungsten was then measured by colourimetry.

Results of the sampling indicate subtle anomalies exist and are spatially related to most of the float occurrences presently identified. Values in soils range from 2 to 21 ppm W, with strongly anomalous samples being greater than 16 ppm.

The soil results are of the same order of magnitude as stream sediment values and indicate that tungsten is not liberated into streams or soils. This is probably caused by several factors. The host rock is resistant to weathering, therefore does not liberate abundant scheelite into the soils. Scheelite itself is resistant to weathering. The poor soil development limits the amount of clay available for tungsten to be adsorbed to, and limits the amount of this material available to streams draining the property.

The pulps of seven soil samples from soil lines on the HL property were rerun for tin and gold. The results of these analyses, which follow, indicate that these particular samples are not anomalous in tin or gold.

<u>GRID LOCATION</u>	<u>Sn</u> <u>ppm</u>	<u>Au</u> <u>ppb</u>	<u>W</u> <u>ppm</u>
35N - 24E	3	<5	18
40N - 104E	<1	<5	10
- 106E	3	<5	4
- 108E	2	5	4
45N - 24E	<1	<5	20
- 28E	1	<5	20
- 60E	<1	<5	18

## MINERALIZATION

Scheelite is presently the mineral of economic interest on the HL group. It has three modes of occurrences; disseminated in regionally metamorphosed rocks; in quartz veins and on fracture surfaces; and, rarely, disseminated in contact metamorphic skarn.

At the G occurrence scheelite is found in quartz carbonate veins and on fracture surfaces in float and cutting limestone and skarn over an area of 500 square metres. The limestone (E1) is in contact with a leucocratic phase of the Cassiar Batholith (K1). Skarn development in the limestone appears to be most well developed in the upper (stratigraphically), thin-bedded section of this unit. Scheelite disseminated in skarn is rare. Trenches across the skarn indicate other parties have investigated this occurrence.

At the A, B, C, D, E and F float occurrences scheelite occurs in quartzose foliated rocks which have tentatively been identified as metapsammites and metatuffs or metavolcaniclastic rocks. Mineralization occurs sporadically along strike over a distance of 3000 metres and appears to be limited to a narrow stratigraphic interval of approximately 100 metres in thickness. The showings are approximately 600 metres from the intrusive contact.

Scheelite is found in tabular aggregates (up to 4 mm long) interstitial to silicate grains and parallel foliation. The euhedral scheelite grains are complexly zoned and are associated with pyrrhotite, quartz, plagioclase, epidote, garnet and sphene. Genetic relations between scheelite and other minerals are not clear. A reaction involving actinolite and plagioclase to form scheelite has been suggested, but there is little evidence to support this assertion.

Assays of representative chips from mineralized boulders at the A, B, C and D occurrences range from 0.59%  $WO_3$  to 2.54%  $WO_3$  (Table I). High grade (1%+  $WO_3$ ) mineralization is confined to areas of talus covering 3 to 5 metres. The restricted nature of the high grade talus suggests that this material has not been transported far from a bedrock

TABLE I                      A S S A Y   T A B L E

<u>Sample Number</u>	<u>Description*</u>	<u>WO<sub>3</sub></u> <u>%</u>	<u>Sn</u> <u>ppm</u>	<u>Au</u> <u>ppb</u>	<u>Ag</u> <u>ppm</u>	<u>Cu</u> <u>ppm</u>	<u>Mo</u> <u>ppm</u>	<u>Bi</u> <u>ppm</u>	<u>U</u> <u>ppm</u>
13786	<u>A Showing:</u> representative chips from mineralized float boulders	2.54	140	5	0.2	14	2	<1	0.8
13787	<u>B Showing:</u> representative chips from mineralized float boulders	1.20	32	5	0.2	26	3	<1	1.0
13788	<u>C Showing:</u> representative chips from mineralized float boulders	1.24	44	10	0.2	29	2	3	0.6
13789	<u>Between B-C Showings:</u> mineralized talus chips	0.52	32	15	0.2	20	2	<1	0.8
13790	<u>D Showing:</u> chip from mineralized talus boulder	0.24	23	10	0.2	19	3	<1	1.0
13791	<u>D Showing:</u> representative chips from mineralized talus	1.86	118	15	0.2	22	4	<1	1.0
13792	<u>D Showing:</u> chips from large mineralized float boulder	0.95	44	50	0.2	154	3	30	1.0
13793	<u>D Showing:</u> representative chips from mineralized float boulders	0.59	46	5	0.2	23	3	<1	0.6
13794	East Cirque - talus chip thought to contain powellite	0.08	3	<5	0.2	26	4	<1	0.8
13795	<u>A Showing:</u> selected mineralized float specimen (equivalent to thin section HL 24)	1.08	5	1550	0.8	50	5	<1	0.6
13796	<u>B Showing:</u> selected mineralized float specimen (equivalent to thin section HL 25)	3.07	40	700	0.4	40	3	<1	0.6

\*All samples are of metasediments

source. Boulders up to 60 cm across containing disseminated scheelite throughout have been located at the A float occurrence. Although no assays have been reported from the E and F float occurrences mineralization is similar to that at A, B, C and D, but is not as concentrated in the talus as at the latter showings.

## S U M M A R Y   A N D   C O N C L U S I O N S

In excess of \$17,000 has been expended to conduct preliminary geological and geochemical investigations on the HL #1-52 claim block, Watson Lake Mining District, Y.T.

Geological mapping was completed and a reconstructed stratigraphic section drawn. The claims cover Lower Cambrian and earlier(?) metasediments with minor metavolcanics(?). The Cassiar Batholith-metasediment contact lies to the east side of the group. Tungsten mineralization occurs as disseminations in metasediments, in veins and in skarns within the metamorphic sequence. Assay results of grab samples from mineralized float range from 0.08 to 3.07%  $WO_3$ .

A total of 54,400 feet of line were chained and flagged and 184 geochemical soil samples collected at 200 and 400 foot spacings. All samples were analyzed for tungsten.

Results of the sampling indicate subtle anomalies existing which are spatially related to most of the mineralized float occurrences presently identified.

Tungsten mineralization located to date on the HL claim group, both in float and in place, is economically significant; continued evaluation is warranted.

Respectfully submitted

CORDILLERAN ENGINEERING

*Carl G. Verley*

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Geologist



*M. H. Sanguinetti*  
M. H. Sanguinetti, P.Eng.

March, 1979  
Vancouver, B.C.

APPENDIX "A"

CLAIM MAP

LOCATION PLAN

HL # 1-52 MINERAL CLAIMS

HIDDEN LAKE AREA, NTS 105 B-6, YUKON TERRITORY

WATSON LAKE MINING DISTRICT

DATE OF RECORD: HL # 1-48: JUNE 30, 1978

HL # 49-52: SEPT. 14, 1978

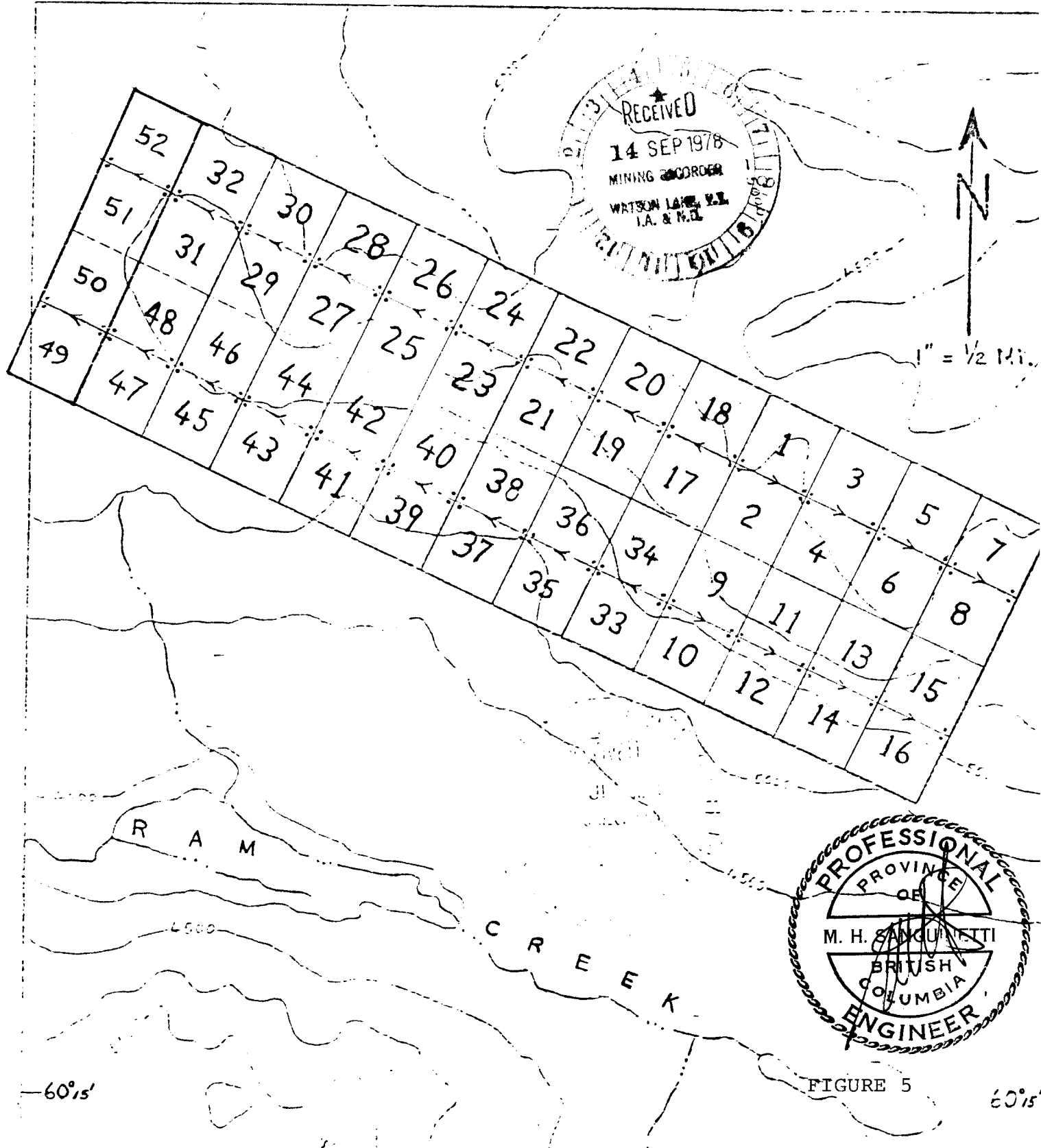


FIGURE 5

-60°15'

60°15'

APPENDIX "B"

FIGURES 6 TO 13

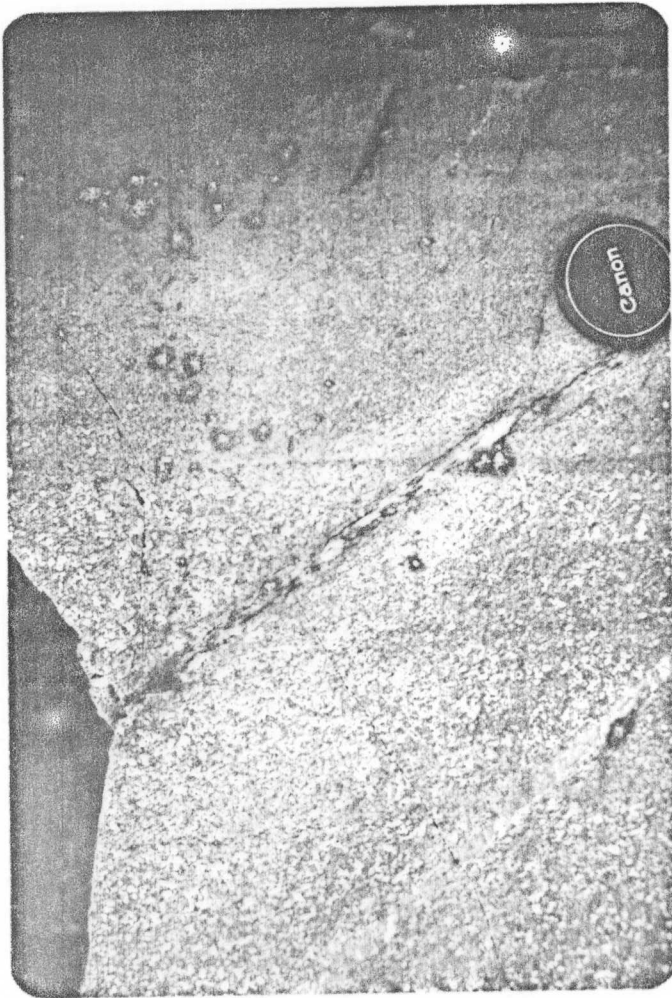


FIGURE 6:

Meta-quartz-pebble  
conglomerate grading  
into metapsammite.

(Unit e5)

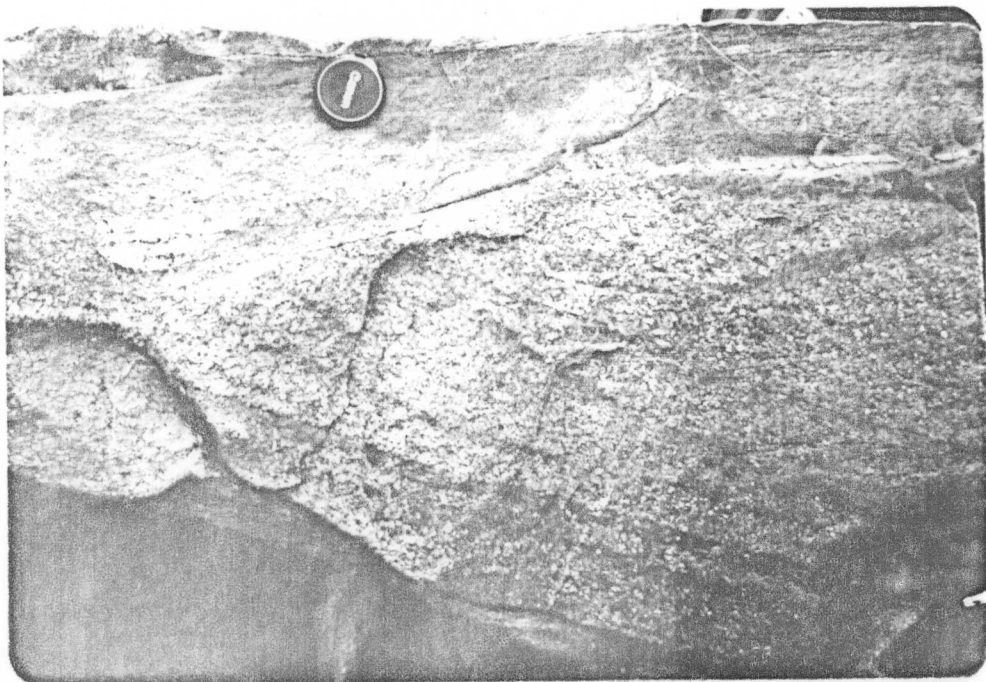


FIGURE 7: Metapsammite layer overlying channel  
filling of meta-quartz-pebble conglomerate.  
(Unit e5)



FIGURE 8: Shale rip-up clasts in meta-quartz pebble conglomerate (Unit E5).

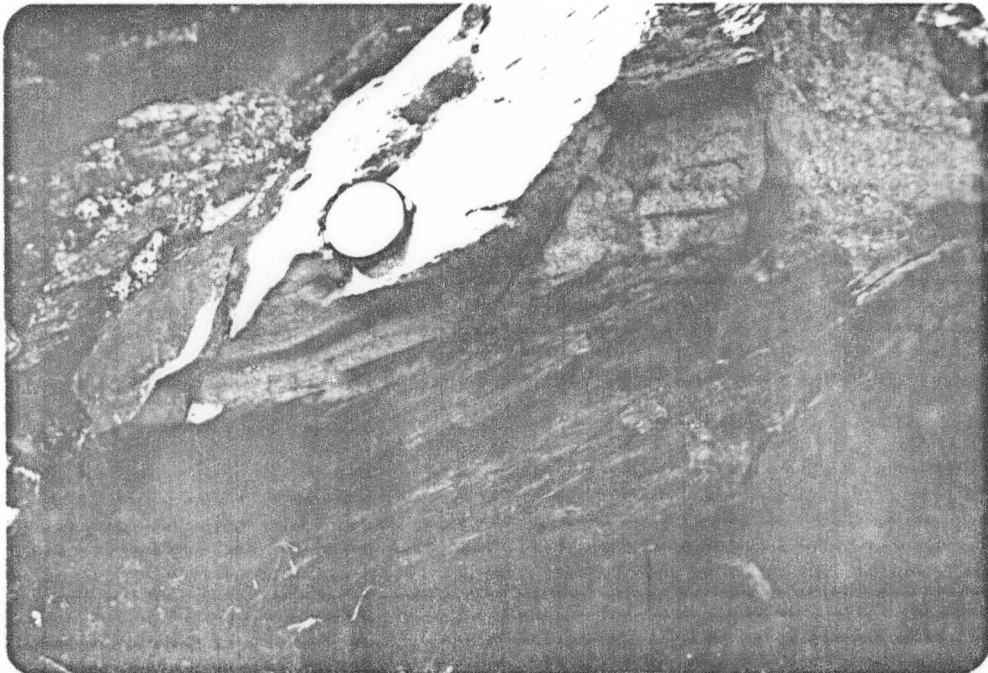


FIGURE 9: Metapelitic bed overlain by metapsammitic rocks (Unit E5).

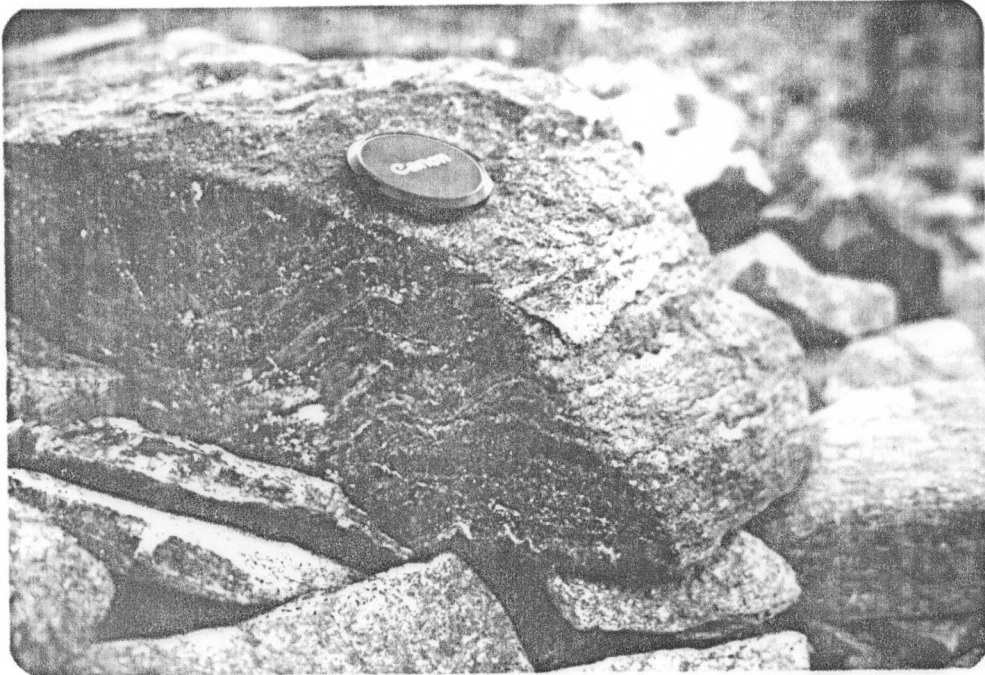


FIGURE 10: Basic schist (Unit E5).

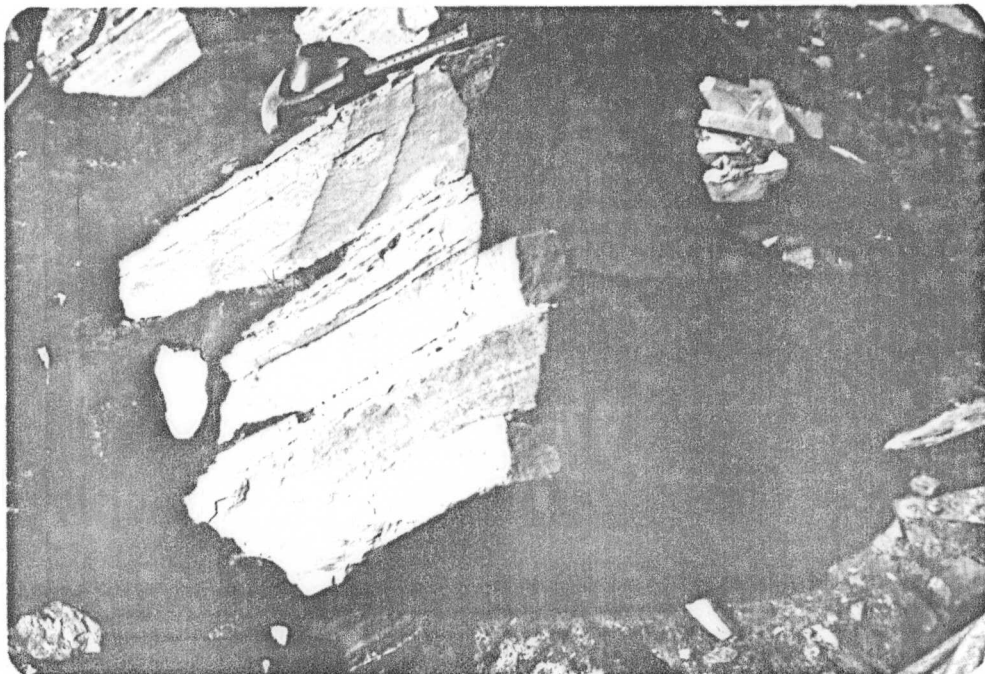


FIGURE 11: Basic schist layer between metasammitic layers (Unit E5).

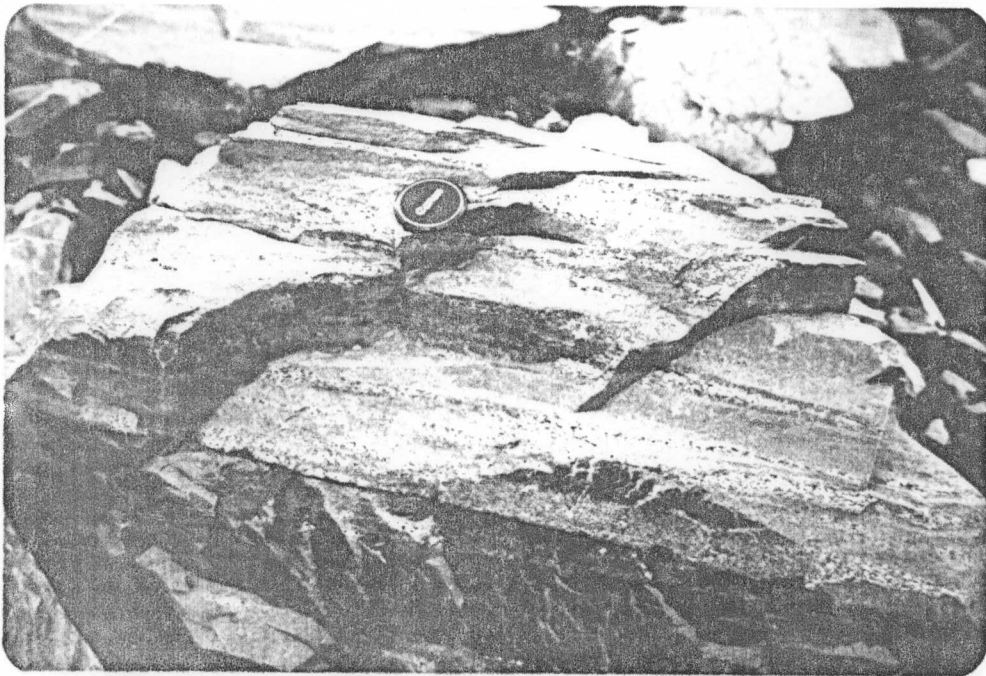


FIGURE 12: Metapsammitic rock with siliceous layers (tuffaceous?) containing amphibolite porphyroblasts (Unit €5).

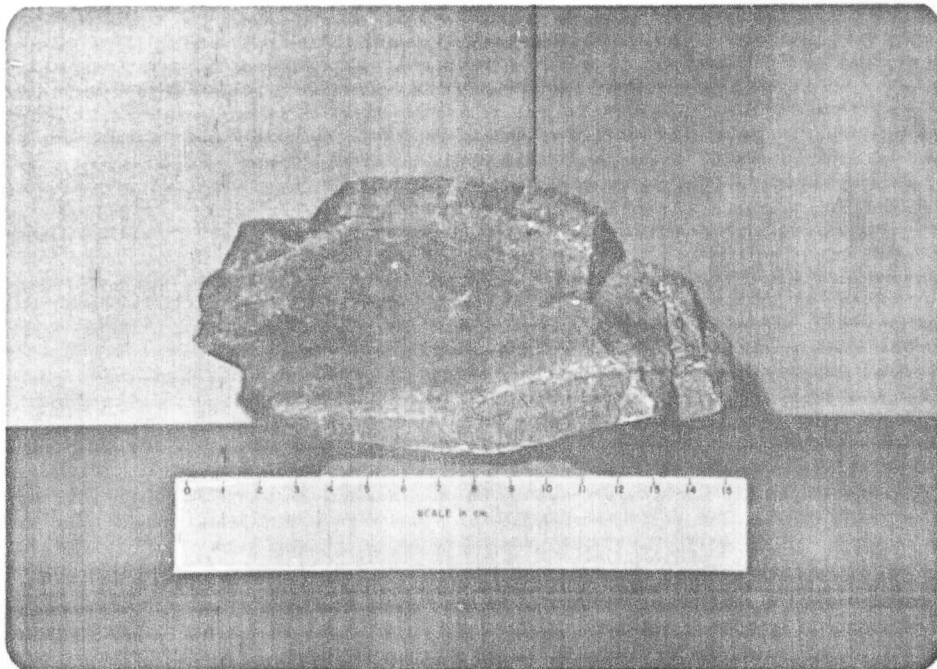


FIGURE 13: Isoclinal fold in metapsammitic rock. Note lighter coloured siliceous layer (tuff?), Unit €5.

APPENDIX "C"

PETROGRAPHIC REPORT



# Vancouver Petrographics Ltd.

JAMES VINNELL, Manager  
 JOHN G. PAYNE, Ph. D., Geologist

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 8887 NASH STREET  
 FORT LANGLEY, B.C.  
 VOX 1J0

PHONE (604) 533-1155

Report for: Mr. Carl Verley  
 Cordilleran Engineering  
 Suite: Swift River Resources HL9-HL31  
 By: J.Nelson

## Summary

The metamorphic samples in this suite fall into several categories based on inferred parentage. The first category is relatively well-established. Samples HL9, HL26, and HL31 are psammitic-pelitic. They contain the assemblage quartz-plagioclase-biotite-muscovite and, in the case of HL9, andalusite. Quartz and plagioclase are relict clasts, although quartz is strongly recrystallized. They are typical of metamorphosed grits and interlayered sandstones-shales.

The second category includes metaigneous and possibly metamorphosed epiclastic rocks. Except for the three listed above, the samples in this suite contain calcium-bearing mafic phases in preference to biotite: amphibole, epidote, and sphene. This mineralogy is typical of metamorphosed rocks of igneous and epiclastic origin. Subdivision of this category into metaplutonics, metavolcanics, metatuffs, and sediments was in many cases difficult due to extensive metamorphic recrystallization.

HL12, HL13 and HL23 have been classified as metavolcanics because of their mineralogy ( actinolite-plagioclase-quartz ) and, in HL12, an inferred amygdaloidal texture.

HL22 shows a compositional layering which is likelier to have been original than gneissic in origin. It thus may be a tuff or finely bedded epiclastic sediment.

HL24 and HL25 contain abundant quartz with subordinate plagioclase and minor mafics. Because of their low biotite contents they were grouped with the igneous samples; however they are even-textured and fairly coarse grained and may be metaarkoses.

HL11 and HL16 strongly resemble each other. Both are relatively coarse grained and foliated without a gneissic fabric. Their mineralogy is consistent with either an andesitic or intermediate plutonic parent.

I regard the pelitic-psammitic and metaigneous categories as discrete and somewhat incompatible. Is it possible that they are in tectonic contact?

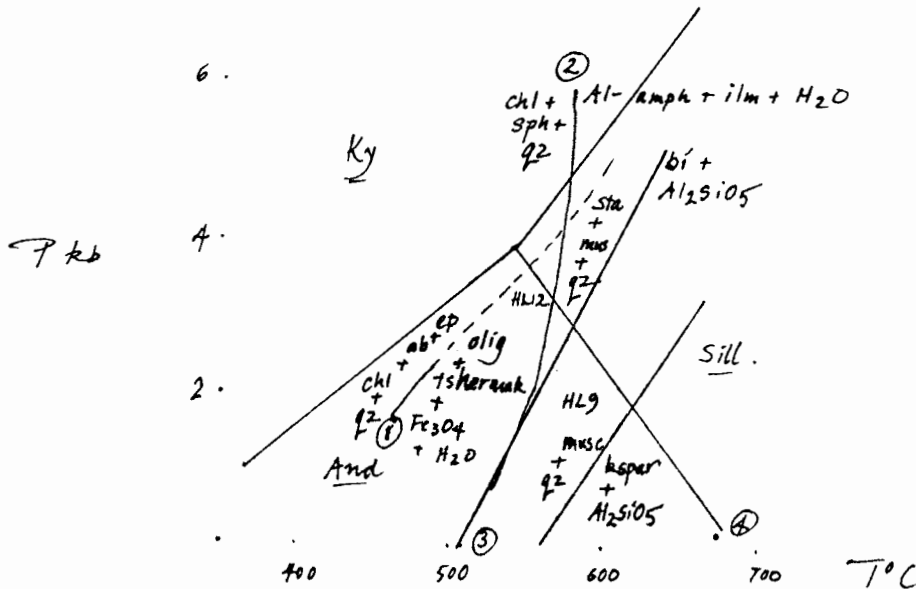
Metamorphic grade: Assemblages in both pelitic (HL9) and mafic rocks are indicative of moderate pressures and temperatures. Constraints derived from a) andalusite-biotite-muscovite-quartz in HL9 and b) calcic plagioclase-actinolite-chlorite in HL12 are  $P \leq 3.5$  kb and  $T \approx 550^\circ\text{C}$ . ( See Figure 1 below ).

Postkinematic growth is common; many samples have a weak directional fabric or none at all. This is suggestive of contact metamorphism.

Scheelite occurs accompanied by pyrrhotite. All the scheelite-bearing rocks contain abundant calcic phases, plagioclase, epidote, actinolite, garnet, and sphene. Scheelite can be found in association with all of them. The most notable sphene texture is its enclosure of euhedral silicates which are otherwise anhedral ( see HL25 ). Pyrrhotite and scheelite are in contact in perhaps half the cases observed. Both are characteristically interstitial.

Figure 1.

P-T conditions for HL9 and HL12



- ① and ② from Lim 1974 Am. J. Sci. p 613
- ③ from Winkler, Petrogenesis of Metamorphic Rocks 1974
- Aluminosilicate triple point after Holdaway.

① and ② depend on  $P_{\text{H}_2\text{O}}$  and  $f_{\text{O}_2}$  (positions shown are for  $\text{QFM}$  buffer)  
 ③ is the chlorite-out curve; ① is the chlorite, epidote decreasing curve with plagioclase replacing albite

## HL9 Layered andalusite-plagioclase-quartz schist

Two stages of deformation are shown by the fabrics in this sample: first, the biotite-muscovite foliation, F1, parallel to the compositional layering ( bedding ); and second the crenulation cleavage, F2, which cuts across and deforms F1. The andalusite porphyroblasts are "rotated" and the kinked mica trains bend around them. Andalusite crystallization must have preceded and/or accompanied the second deformation.

The compositional layering is probably an original bedding feature. The outside layers in the section are mostly composed of quartz with a biotite foliation. The inner layer, predominantly muscovite with lesser biotite, contains the largest andalusite porphyroblasts. This contrast between silica and alumina enrichment suggests an interbedded sandstone/shale. Scattered grains of zircon and tourmaline within the quartz-rich layers are probably original heavy detrital minerals.

The metamorphic assemblage andalusite-biotite-muscovite-quartz forms at pressures less than 35 kb and temperatures around 550-600°C. If andalusite formed during contact metamorphism the rocks represented by this sample underwent deformation during and/or after intrusion ( see above ).

Chlorite replacing biotite and fine-grained white mica surrounding andalusite indicate a later retrograde event.

## Mode

Quartz	35
Muscovite	30
Biotite	15
Andalusite	10
Chlorite	4
Plagioclase (An25)	5
Opagues	1
Zircon, Tourmaline	<1

Quartz grains are polygonal with straight to slightly curving grain boundaries. Grain size is fairly uniform, averaging .2 mm diameter.

Muscovite has two habits. The first is as plates oriented in the F1 foliation and forming polygonal arcs around the F2 kinks. The second is as fine-grained aggregates surrounding and replacing andalusite.

Biotite is the predominant mica in the quartz-rich psammitic layers. It is generally oriented within the F1 foliation there. The kinks are not as apparent as in the pelitic middle layer. Andalusite forms porphyroblasts throughout the section. The largest, in the pelitic layer, are up to 4 mm across. They contain abundant mica, quartz and opaque inclusions. These generally exhibit a planar orientation. One porphyroblast contains a kink defined by inclusions.

Chlorite sporadically mimics biotite. Plagioclase occurs as anhedral grains in the psammitic layer, as large or larger than the quartz. Opaques are scattered throughout the section. Some are partly composed of very dark sphene. Textures suggest that it is replacing the opaque mineral which it accompanies, possibly ilmenite. One aggregate of cubes may be magnetite. Tabular opaques are aligned parallel to the F1 foliation.

#### HL11 Metaandesite? Metagranodiorite?

The igneous origin of this sample is fairly certain based on its mineralogy, quartz-plagioclase-amphibole. Its original grain size is unknown, thus the uncertainty as to an intrusive or extrusive parent. There is some suggestion of an original coarse grain size ( see quartz ).

No compositional layering which might constitute evidence for a tuffaceous parent is present.

#### Mode

Quartz	55
Plagioclase (An50)	22
Hornblende	20
Opaques	3
Sphene	<1
Zircon, apatite, epidote, white mica	<1

Quartz grains generally have sutured borders. They commonly form clumps 2 mm across, partly surrounded by hornblende. These may have originally been single grains recrystallized under stress. All quartz grains show undulatory extinction. Plagioclase porphyroblasts ( or original large grains ) are sieve-textured due to abundant quartz inclusions. Some have approximately euhedral outlines. Skeletal and small anhedral plagioclase grains are also common. Heavy sericitization is developed in places; all plagioclases are dusty in appearance. Some grains show slight normal zoning. Opaques tend to irregular outlines. They are intergrown with the hornblende. Hornblende forms sprays which tend to be elongated parallel to the foliation. Grains are acicular to lath-shaped, some with prismatic terminations. By contrast to the amphiboles in the other samples ( except HL16 ) this hornblende is strongly blue-green to yellow-green pleochroic. Sphene occurs as discrete grains scattered throughout the section. Apatite, zircon and epidote occur as scattered grains accompanying hornblende. Zircons, some metamict, have produced pleochroic haloes in the amphibole.

## HL12 Metabasalt

This sample has a distinctive fabric dominated by whorls and festoons of radiating acicular pale amphibole that encircle round aggregates of coarse interlocking plagioclase. These aggregates may be either amygdules or relict phenocrysts. The former is more likely. It is common to see in volcanics which have been upgraded from greenschist and subgreenschist to amphibolite facies, plagioclase in amygdules which has developed at the expense of epidote+quartz.

The coexistence of calcic plagioclase, chlorite and pale actinolitic amphibole is, according to experimental studies, confined to low pressures ( less than 3.5 kb ). It represents a stage transitional between greenschist and amphibolite facies. The temperature for this transition is around 500-550°C. The lack of a directional fabric in this sample is consistent with contact, rather than regional metamorphism.

## Mode

Actinolite	45
Plagioclase (An60)	40
Chlorite	5
Opagues	4
White mica	5
Zoisite	1
Sphene	<1
Apatite	<1

Actinolite is very pale green with the typical acicular habit, although a few laths are also present.

Plagioclase patches, rounded in outline and approximately 1 mm in diameter, consist of coarse interlocking grains. They make up a large part of the section. Most plagioclase grains are heavily sericitized. All are crammed with fine amphibole needles.

Chlorite is very pale green and forms sheaves patchily distributed throughout the section. It appears to be in textural equilibrium with the other phases : it is not a later retrograde mineral.

White mica is in places intergrown with the amphibole. It occurs as masses of small irregular grains.

Zoisite forms relatively coarse, euhedral but spotty saussurite in some plagioclase grains.

Sphene rims opaques and forms clusters of small round grains. In one case a partial replacement of sphene by amphibole is suggested.

Opagues in trains tend to lie between whorls of actinolite and between actinolite and plagioclase.

## HL13 Biotite-actinolite schist ( Metaandesite? )

The mineralogy of this sample, biotite-actinolite-plagioclase-quartz, suggests that it had an intermediate volcanic parent. Except for the late biotite porphyroblasts it remains relatively fine grained. However, no trace of original texture remains. One 2 mm long lath-shaped aggregate of matted actinolite may be a relict hornblende phenocryst or porphyroblast.

Biotite plates are crudely aligned. Actinolite orientation is poor. This suggests metamorphism under static conditions. Is this sample close enough to the intrusion to have experienced potassium metasomatism which would account for the late spectacular biotite growth?

## Mode

Biotite	40
Actinolite	35
Plagioclase (An30)	15
Quartz	5
Sphene	3
Apatite	2
Muscovite	<1
Zircon,Allanite	<1

Biotite as large plates dominates the fabric of the sample. It cuts across and surrounds actinolite, suggesting later development. A few biotites have inclusion-rich cores. Actinolite forms mattes of laths with ragged terminations. It is intergrown with as well as surrounded by biotite. Plagioclase is anhedral. Most grains are sericitized. The presence of white mica probably accounts for the faint yellow stain seen on the sample block. Quartz grains are polygonal and form an equilibrium texture with plagioclase. Sphene grains are uncharacteristically coarse, up to 1 mm across. They are anhedral and interstitial to amphibole. They also intergrow with biotite in places. Apatite occurs as very small euhedral prisms, unusually abundant. One long apatite prism cores an amphibole. Zircon and scarce pleochroic allanite generate pleochroic haloes in biotite.

## HL16 Metagranodiorite (?)

Although coarse grained relative to the other samples in this suite, HL16 lacks compositional banding and thus cannot be called a gneiss. It resembles HL11 but is coarser grained. If its present grain size reflects an original texture it may be a metaplutonic rock.

The crossing quartz veins in the section are due to expansion rather than replacement. Dilation of one has offset the other. A rough quartz-elongation foliation crosses the veins and

is continuous with the matrix foliation.

#### Mode

Quartz	50
Plagioclase(An40)	25
Hornblende	15
Sericite	5
Sphene	3
Opaques	1
Epidote	1
Chlorite	<1
Zircon,Apatite	<1

Quartz grains have irregular to sutured boundaries. They tend to be elongated/flattened parallel to the foliation but not conspicuously crystallographically aligned.

Plagioclase is heavily sericitized. This may explain the yellow tint in the stained block. Plagioclase crystals are sieve-textured due to abundant quartz inclusions.

Hornblende, like that in HL11, is blue-green to yellow green pleochroic. It forms sprays of acicular and lath-shaped crystals elongated in the plane of foliation. A few skeletal crystals are also present. The growth-pattern of the sprays suggests that they are post kinematic and mimetic.

Sphene occurs as large scattered anhedral grains as well as clusters of small grains intergrown with hornblende.

Epidote in large zoned grains is also intergrown with hornblende.

Opaques are enclosed by hornblende. There are scattered opaque grains throughout the section.

Zircons are euhedral and zoned.

#### HL22 Layered quartz-epidote-actinolite-biotite schist ( Metatuff? )

The hand sample for HL22 contains a fold with parallel limbs, defined by a color transition from a light core to a darker exterior. In thin section this color transition corresponds to a variation in the dominant mafic mineral, with epidote in the light portion, biotite in the dark portion, and actinolite in a thin transition between the two. Quartz is ubiquitous.

Assuming the layering to have been original, this could have been a silica-rich or silicified tuff, or a fine volcanic sediment.

Mode	Quartz	70	Sphene	2
	Epidote	13	Biotite	1
	Amphibole	10	Scheelite	<1
	Carbonate	1	Sericite	<1
	Plagioclase	3	Chlorite	<1
			Apatite,Zircon	<1
			Opaques	<1

Quartz forms a granoblastic fabric with slightly uneven grain boundaries.

Epidote tends to be subhedral with well-developed concentric zoning. Some crystals are twinned. Epidotes are elongated commonly. Actinolite is anhedral to acicular and pale green in color. It forms sprays elongated in form but not always in orientation parallel to the foliation.

Plagioclase forms large polygonal sieve-textured crystals containing abundant quartz; and smaller round grains. Some are sericitized.

Sphene occurs as small round grains included in epidote and amphibole. It also associated with epidote as large anhedral grains interstitial to quartz. In a few cases it is euhedral. Biotite, brown in color, forms trains of small plates which define the foliation in the darker layer.

Carbonate, high in relief and thus probably siderite, replaces amphibole and epidote in ragged aggregates. It may weather out to cause the narrow holes which parallel the foliation near the transition from light to dark in the hand sample.

Scheelite is erratically distributed in the hand sample. Most grains are in the lighter, quartz-epidote layer. In the thin section, a few small grains of slight green-brown pleochroism and high relief were tentatively identified as scheelite. They form aggregates with epidote, amphibole, and sphene. One grain of scheelite occurs in the biotite layer in hand sample; none were observed in that part of the thin section.

Apatite, zircon and opaques concentrate as discrete grains in the amphibole sprays.

#### HL23 Quartz-Actinolite-Plagioclase hornfels

The foliation in this sample is faint. A few indistinct kinks with polygonal arcs of quartz are present. The unoriented growth of amphibole is consistent with contact metamorphism.

Scheelite and the opaque mineral ( probably pyrrhotite ) have similar habits. They both are interstitial to and enclose the silicate minerals, quartz, plagioclase and amphibole. This texture shows that they formed late in the crystallization sequence. They do not have a strong tendency to occur together. In a few cases scheelite encloses pyrrhotite. A reaction relationship involving actinolite and plagioclase in the formation of scheelite seems likely.

The mineralogy is suggestive of a volcanic parent.

Mode	Quartz	42
	Actinolite	30
	Plagioclase (An60)	20
	Scheelite	3
	Pyrrhotite	5
	Carbonate	<1
	Clinozoisite	<1
	White mica	<1
	Apatite	<1

Quartz is bimodal with abundant segregations of coarser grains. It forms a granoblastic fabric with slightly uneven grain boundaries.

Actinolite occurs as radiating acicular crystals and laths with ragged terminations. It is pale blue-green pleochroic except where its color is intensified by small pleochroic haloes.

Plagioclase tends to be fine grained. Some of the larger grains are slightly normal zoned. The bending of twins was observed in a few cases, indicating minor post-crystallization strain.

Scheelite forms large anhedral-interstitial grains to 4 mm long. They are complexly zoned. In many cases scheelite includes other phases : anhedral to prismatic quartz, euhedral plagioclase, actinolite, pyrrhotite, and in one grain apatite. Irregular scheelite margins penetrate into actinolite aggregates, a possible reaction texture.

Pyrrhotite forms irregular interstitial grains throughout the section. It seems in some places to be replacing actinolite.

#### HL24 Quartz-plagioclase-garnet schist : Metagrit?

This sample may have a gritstone parent. Quartz forms polycrystalline lenses parallel to the foliation which by analogy with HL26 may be relict clasts.

#### Mode

Quartz	60
Plagioclase (An50-60)	25
Biotite	3
Garnet	2
Pyrrhotite	5
Scheelite	1
Actinolite	1
Chlorite	1
Epidote	<1
Sphene	2
Hematite	<1
Pyrite	<1

Quartz grains have sutured borders. Lensoid aggregates bounded by plagioclase concentrations may be original clasts.

Plagioclase grains range in size from .05 to 1 mm. The larger ones are sieve textured and partly sericitized. Lacework internal fabrics may be the result of partial albitization. Sphene and pyrrhotite grow within plagioclase.

Biotite forms elongate clumps of radiating crystals which may be in part post-kinematic.

Garnets are sparse. They occur as discrete sieve-textured porphyroblasts accompanied in some cases by scheelite and pyrrhotite.

Pyrrhotite grains are anhedral-interstitial to skeletal. Pyrrhotite rims sphene, actinolite and epidote.

Scheelite occurs as anhedral grains interstitial to other phases. It has no preferred association. It can be seen in biotite, intergrown with garnet, and in the quartz-plagioclase matrix. It includes euhedral quartz and plagioclase in one case.

Pyrrhotite inclusions in scheelite are fairly common. One scheelite-garnet aggregate is overgrown and replaced by pyrrhotite.

Actinolite in fibrous skeletal grains associates with epidote. Chlorite sheaves are probably secondary after biotite.

Sphene, anhedral to euhedral, is ubiquitous.

A few grains of pyrite form straight grain boundaries with pyrrhotite. One irregular red hematite grain is probably a replacement of pyrrhotite.

#### HL25 Quartz-plagioclase schist : Metasandstone?

This sample shows the best development of scheelite textures. Scheelite encloses anhedral to perfectly euhedral plagioclase and quartz. It encloses but is also in places rimmed by pyrrhotite.

#### Mode

Quartz	50
Plagioclase (An60)	38
Scheelite	5
Pyrrhotite	4
Biotite	3
Sphene	<1
Chlorite	<1
Apatite, Zircon	<1
Pyrite, Hematite	<1

Quartz forms a granoblastic fabric with irregular to sutured borders. Its grain size varies from band to band, from .02 to 1 mm diameter.

Plagioclase grains are anhedral except where enclosed by scheelite. They commonly exhibit delicate oscillatory zoning. This type of zoning is unusual in metamorphic rocks. Could this sample have been taken close enough to the intrusion for chemical equilibrium between magma and country rock to have obtained? Some plagioclase grains are sieve-textured, ranging up to 1 mm long. Sericitization is patchy.

Scheelite forms elongate complexly zoned grains. They are anhedral and interstitial to the silicate phases. Some but not all are in contact with pyrrhotite. Within them oscillatory-zoned plagioclase, quartz, and biotite show euhedral outlines. Pyrrhotite occurs inside, intergrown with, and as partial rims on scheelite. Preferred scheelite associations seem to be with plagioclase and pyrrhotite.

Pyrrhotite grains are irregular and interstitial to the silicate phases. They are elongate parallel to the foliation. A few pyrite grains form straight boundaries with pyrrhotite.

One pyrrhotite grain is rimmed with specular hematite which interdigitates with the enclosed pyrrhotite.  
 Biotite plates are for the most part aligned in the foliation.  
 Some sheaves depart from preferred orientation.  
 Chlorite is minor, replacing biotite.  
 Scattered grains of zircon and apatite are present.

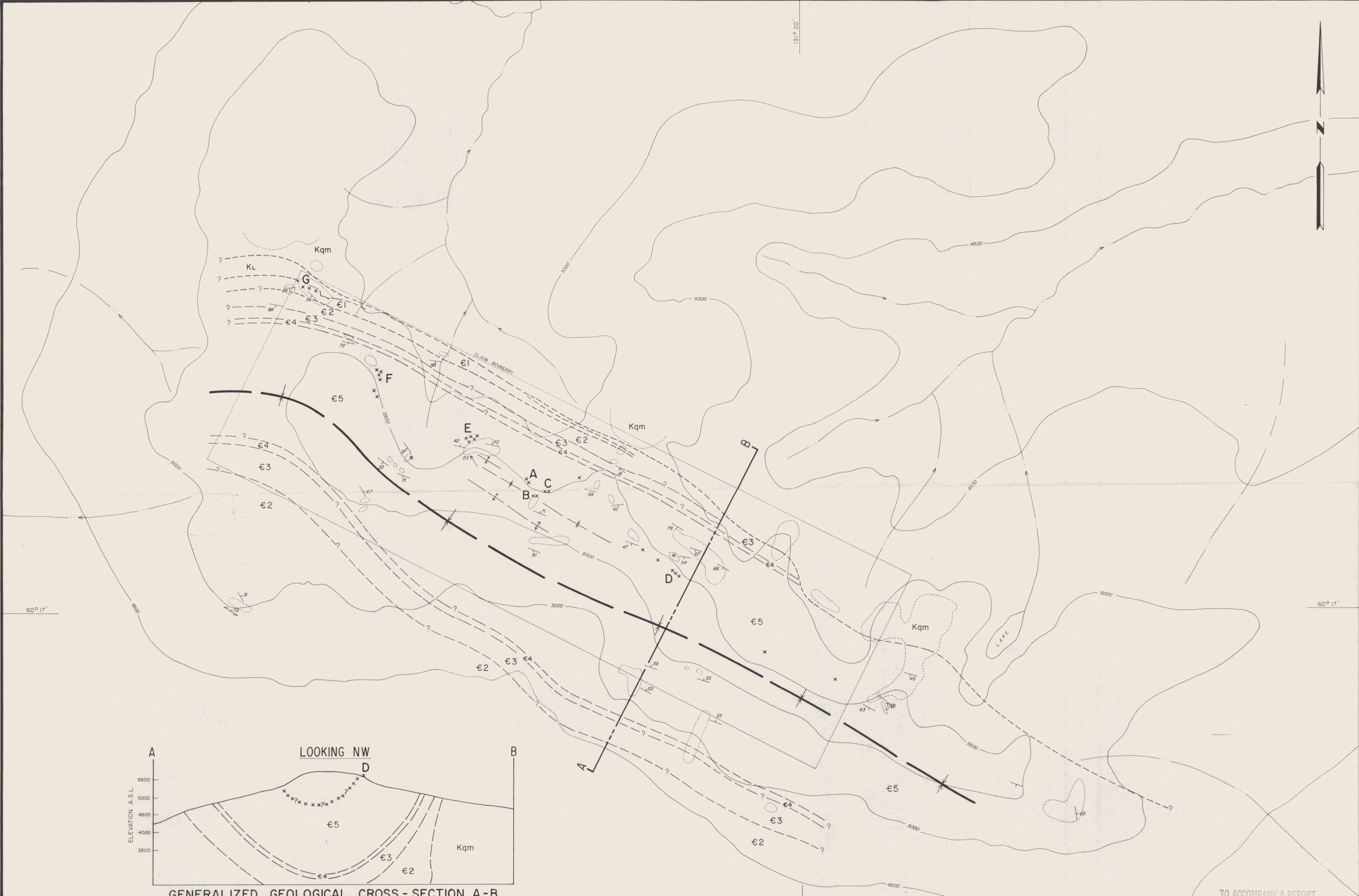
#### HL26 Metagritstone

This sample strongly resembles the metamorphosed grits of the Late Precambrian Windermere. The blue opaline quartz is particularly characteristic. The mature mineral suite and the general large size of the clasts is consistent with derivation from a plutonic-metamorphic ( probably cratonic ) terrane, rather than from a volcanic source region.

#### Mode

Quartz	65
Plagioclase (An25)	20
Biotite	10
Muscovite	2
Kspar(?)	2
Chlorite	<1
Hornblende, opaques, zircon, apatite	1

Quartz forms large lensoid aggregates with sutured grain boundaries. These are probably original clasts which have been recrystallized to finer material under strain.  
 Plagioclase clasts are rounded. They tend to lie with their long axes in the plane of foliation. They have not recrystallized to polygrain aggregates as has quartz. They contain quartz and occasional plates of muscovite. Some have internal lacework fabrics possibly due to partial albitization. Sericitization is common. Kspar was not identified in the section, although bright yellow stains in the block indicate the presence of minor amounts.  
 Biotite in trains of small plates defines the foliation, which bends around the original clasts. It is altered in some places to chlorite.  
 Muscovite accompanies biotite. A few large plates are present. Detrital hornblende, zircon, apatite and recrystallized opaques tend to associate with the interclast biotite trains.



**LEGEND:**

**TERTIARY (?)**

**Tqp** QUARTZ PORPHYRY DYKE. FINE - GRAINED, PALE GREY PORPHYRY WITH SMALL (1 - 2mm) BIPYRAMIDAL QUARTZ PHENOCRYSTS.

**LOWER CRETACEOUS - CASSIAR BATHOLITH**

**KL** LEUCOCRATIC PHASE. PALE GREY, FINE - TO MEDIUM - GRAINED PORPHYRITIC INTRUSIVE. POKILOITIC FELDSPAR PHENOCRYSTS (UP TO 15mm) OCCUR IN A SUGARY - TEXTURED GROUNDMASS WITH BIOTITE AND MUSCOVITE. LOCALLY PEGMATITIC.

**Kqm** COARSE - GRAINED, BIOTITE - QUARTZ MONZONITE WITH SMOKY QUARTZ. WEAKLY FOLIATED WITH WIDE SPACED BLOCKY JOINTING.

**LOWER CAMBRIAN AND EARLIER (?)**

**€5** PREDOMINANTLY BIOTITE - MUSCOVITE - QUARTZ - PLAGIOCLASE SCHISTS WITH VARIABLY DEVELOPED SCHISTOSITY. RELICT SEDIMENTARY STRUCTURES INDICATE THE ORIGINAL SEQUENCE CONSISTED OF QUARTZ - PEBBLE CONGLOMERATES AND SANDSTONES. BASIC SCHISTS (META - BASALTS?), META - ANDESITES (?) AND POSSIBLE VOLCANICLASTIC ROCKS COMPOSE APPROXIMATELY 5 PERCENT OF THE SECTION. SCHEELITE OCCURS DISSEMINATED IN THE METASEDIMENTS, META - ANDESITES (?) AND LESS COMMONLY IN THE BASIC SCHISTS. (A, B, C, D, E, F SHOWINGS). A THICKNESS OF 900 METRES IS ESTIMATED TO OCCUR ON THE PROPERTY.

**€4** LIMESTONE. THIN - BEDDED, DARK TO MEDIUM GREY, MEDIUM CRYSTALLINE AND ARGILLACEOUS. THE BASE OF THIS UNIT GRADES INTO A DISTINCTIVE META - QUARTZ - PEBBLE CONGLOMERATE CEMENTED WITH CARBONATE. APPROXIMATELY 50 METRES THICK.

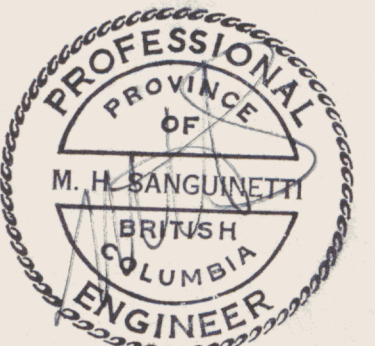
**€3** BIOTITE - MUSCOVITE - QUARTZ - PLAGIOCLASE SCHISTS. SIMILAR TO UNIT €5, BUT LACKING BASIC SCHISTS. 100 - 150 METRES THICK.

**€2** ANDALUSITE - MICA - QUARTZ - PLAGIOCLASE SCHISTS. FINE - GRAINED, PREDOMINANTLY METAPELITES WITH LESSER METAPSAMMATIC ROCKS. 100+ METRES ARE EXPOSED ON THE CLAIM GROUP.

**€1** LIMESTONE. THIN - BEDDED, MEDIUM CRYSTALLINE, GREY, ARGILLACEOUS LIMESTONES GRADE DOWN INTO MASSIVE, MEDIUM TO COARSE CRYSTALLINE LIGHT GREY LIMESTONE. SKARN BANDS CONSISTING MAINLY OF GARNET AND DIOPSIDE (?) OCCUR ALONG THE UPPER CONTACT. SCHEELITE OCCURS ON FRACTURE SURFACES AND IN QUARTZ VEINS CUTTING THE LIMESTONE AND SKARN (G SHOWING). 100 METRES ARE EXPOSED.

- OUTCROP
- - - INFERRED LITHOLOGIC CONTACT
- ↘ 30° STRIKE AND DIP OF BEDDING
- ↘ 20° STRIKE AND DIP OF CLEAVAGE IN METAPELITES
- +— MAJOR SYNCLINE
- +— SYNCLINE
- +— MINOR ANTICLINE
- ↘ 40° TREND AND PLUNGE OF MINOR FOLDS
- × A SCHEELITE MINERALIZATION (PRIMARY FLOAT)

**NOTE:** MAGNETIC DECLINATION: 35° EAST.  
CONTOUR INTERVAL 500 FEET.  
TOPOGRAPHY FROM DEPT. OF NORTHERN AFFAIRS AND NAT. RESOURCES CLAIM MAP 105 B/6.

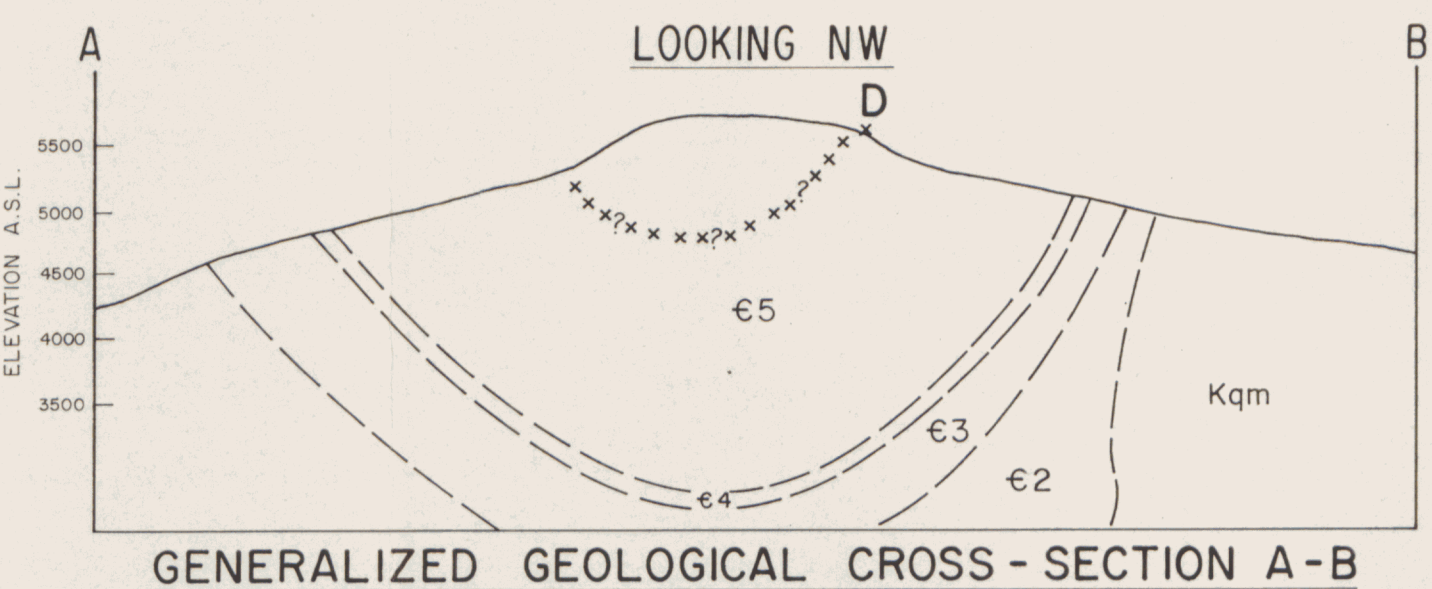


SWIFT RIVER RESOURCES LTD.  
HL CLAIM GROUP  
**GEOLOGY**

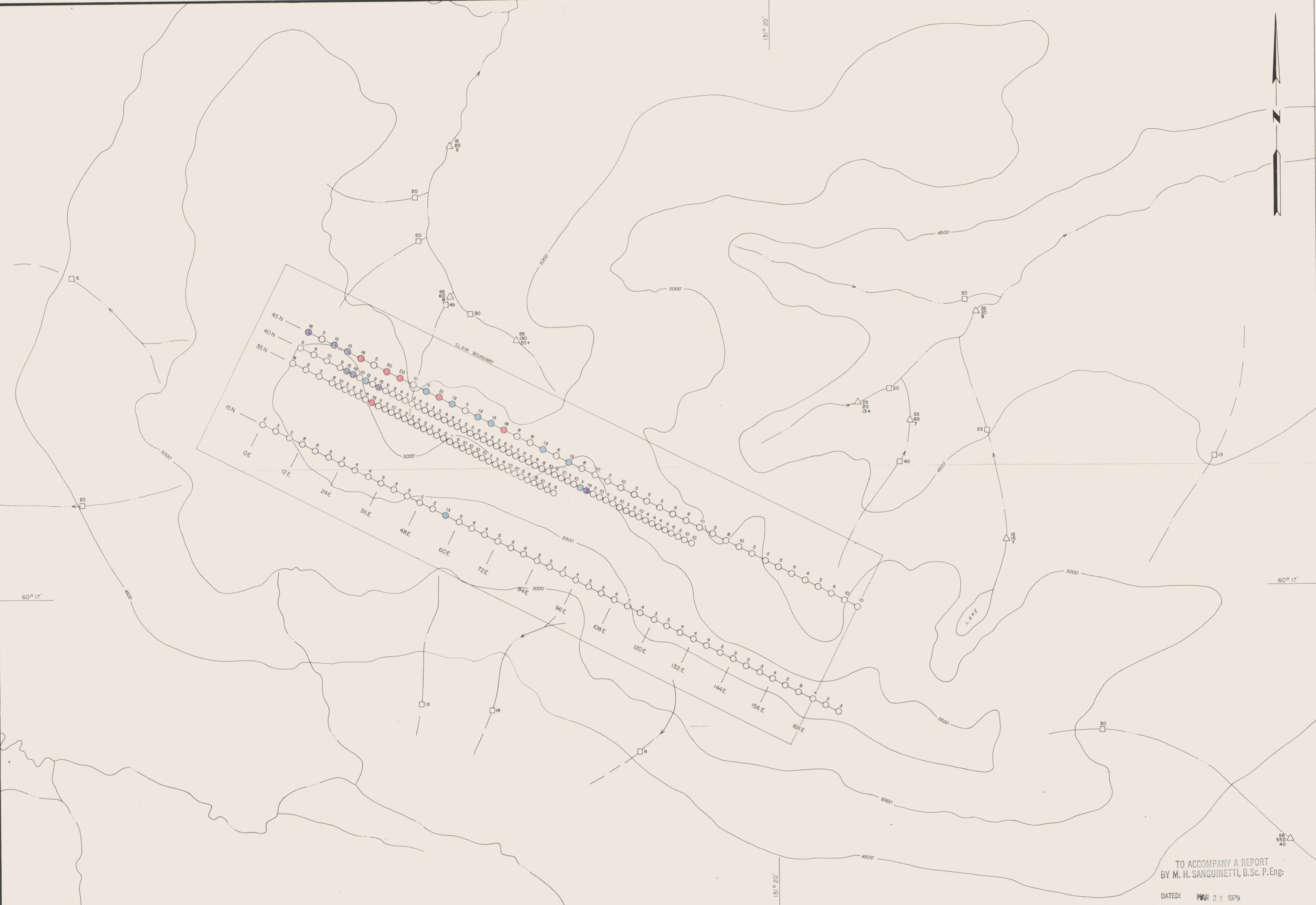
WOLF LAKE MAP AREA, N.T.S. 105 B/6  
WATSON LAKE MINING DISTRICT, YUKON TERRITORY  
SCALE  
500 0 500 1000 METRES  
1500 0 1500 3000 FEET

TO ACCOMPANY A REPORT  
BY M. H. SANGUINETTI, B.Sc. P. Eng.

DATED: MAR 21 1979



GENERALIZED GEOLOGICAL CROSS - SECTION A - B



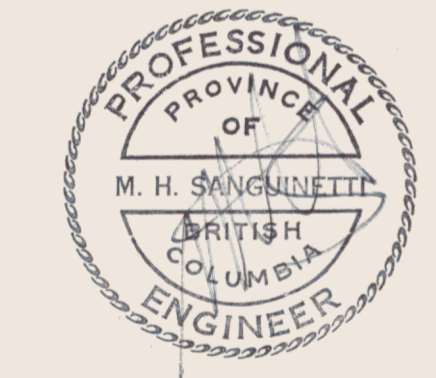
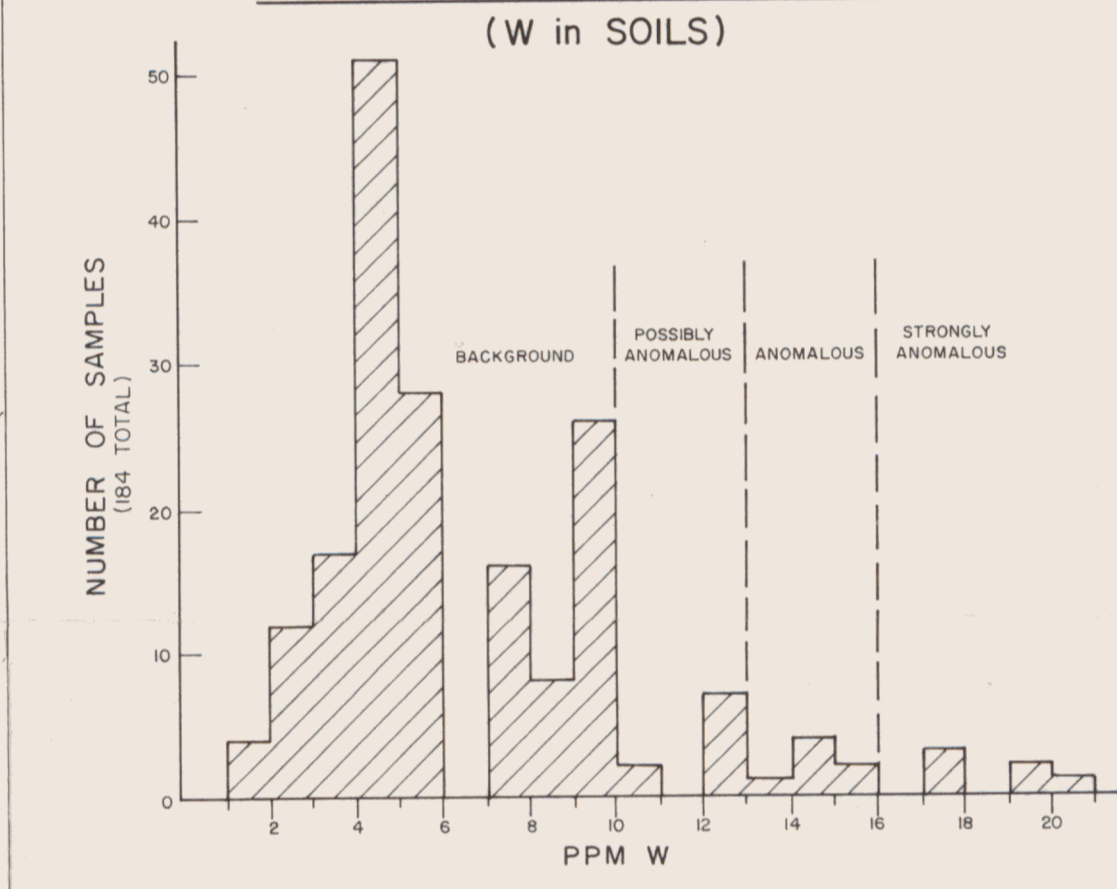
**EXPLANATION:**

- SOIL, SAMPLE INTERVAL 120 m (400 ft.) and 60 m (200 ft.)
- NORMAL (TUNGSTEN)
- △<sup>W</sup> HEAVY MINERAL CONCENTRATE } STREAM SEDIMENTS  
   Au    Sn                                    W, Sn in ppm, Au in ppb

**TUNGSTEN CONTENT OF SOILS (ppm)**

- BACKGROUND . . . . . 0 to 10
- POSSIBLY ANOMALOUS . . . . . 11 to 13
- ANOMALOUS . . . . . 14 to 16
- STRONGLY ANOMALOUS . . . . . 17 +

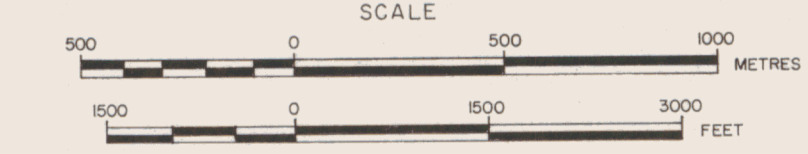
**TUNGSTEN FREQUENCY DISTRIBUTION**



NOTE: MAGNETIC DECLINATION: 35° EAST.  
 CONTOUR INTERVAL 500 FEET.  
 TOPOGRAPHY FROM DEPT. OF NORTHERN AFFAIRS AND NAT. RESOURCES CLAIM MAP 105 B/6.

**SWIFT RIVER RESOURCES LTD.**  
**HL CLAIM GROUP**  
**GEOCHEMICAL SAMPLING**

WOLF LAKE MAP AREA, N.T.S. 105 B/6  
 WATSON LAKE MINING DISTRICT, YUKON TERRITORY



TO ACCOMPANY A REPORT  
 BY M. H. SANGUINETTI, B.Sc. P.Eng.

DATED: FEB 21 1979

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