826757

VMS Claims
92H/5W

# SUMMARY REPORT

# GEOLOGY AND SOIL GEOCHEMICAL ANOMALIES ON THE VMS 1-6 CLAIMS CHEHALIS LAKE SOUTHWESTERN B.C.

New Westminster Mining Division
N.T.S. 92F/5W
Latitude: 49° 28' N
Longitude: 121° 59' W

Owners: Barbara Thomae and Gary Benvenuto

Report by: Gary Benvenuto
231 Sea Avenue North
Burnaby, B.C. V5B 1K6
Phone: (604) 291 8772

Date: May 27, 1991

Cotter

NTS

231 Sea Ave North
Burnaby, B.C. V5B 1K6

June 4, 1991

RECEIVED
JUN 4 1991
Ans'd ..........

Mr. Ian Pirie
Minnova Inc.
311 Water Street, 3rd Floor
Vancouver, B.C. V6B 1B8

Dear Ian:

The attached report is a summary of the geochemical soil anomalies and geology on my VMS 1-6 claims located just east of Chehalis Lake. The claims are 16 km north of your optioned Seneca deposit and cover a complex series of Cu, Pb and Zn soil anomalies over a portion of the Harrison Lake Formation volcanics that appears to resemble that at the Seneca.

I would like to sell a 100% interest in the VMS 1-6 claims for a single cash settlement, and retain a small N.S.R.

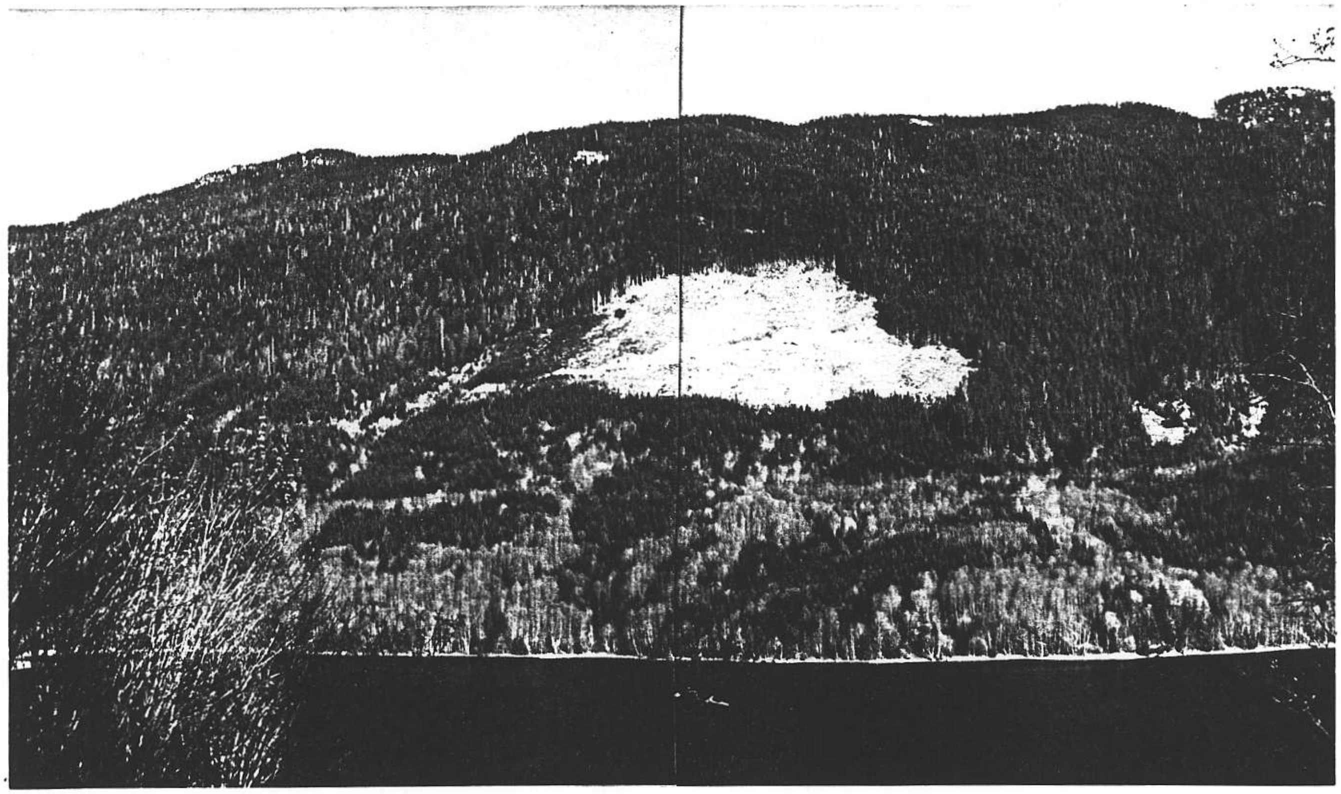
Please contact me (at 291 8772) if you have any questions concerning the claims, and notify me at your earliest convenience whether your company is interested in taking a closer look at them. I would appreciate the return of my report when it is no longer needed.

Thank you very much for considering my submission.

Sincerely,

Gary Benvenuto

Gary Benvenuto



Area of the VMS 1-6 claims looking east across the north end of Chehalis Lake to the westerly flanks of Mount Downing (extreme right) and Mount McRae (4 cm from left). Top Creek is apparent in upper right quarter of photograph. Road 90 is marked by a line of alder trees 2 cm up from the lake shore. The claims cover several large Cu, Pb and Zn soil anomalies over the Harrison Lake Formation volcanics, 16 km north of the Seneca deposit of volcanogenic polymetallic massive sulphides.

## TABLE OF CONTENTS



## LIST OF FIGURES

# SUMMARY REPORT: GEOLOGY AND SOIL GEOCHEMICAL ANOMALIES ON THE VMS 1-6 CLAIMS, CHEHALIS LAKE ,SOUTHWESTERN B.C.

## INTRODUCTION

The VMS 1-6 claims were staked in 1991 to cover a large, complex, copper, lead and zinc soil anomaly over a succession of Harrison Lake Formation volcanics that appear to resemble those hosting the Seneca Kuroko-type polymetallic volcanogenic massive sulphide deposit of sphalerite-pyrite-chalcopyrite-gold-silver. The Seneca deposit is 16 km south of the claims and being actively explored by Minnova Ltd.

### Location (N.T.S.: 92H/5W; New Westminster Mining Division)

The VMS claims are located about 85 air-km east-northeast of Vancouver, in southwestern British Columbia (Fig. 1). The claims are 200 m east of the northeastern end of Chehalis Lake, and on the westerly flank of Mount McRae of the Coastal Mountains (Fig. 3).

### Access

The claims area is a 2.3 hour drive from Vancouver as follows (Figs. 1 and 2): 1.3 hours, or about 100 km easterly along Highway No.7 (Lougheed Highway) to Harrison Mills, then northeasterly along Morris Valley Road (to Hemlock ski hill) 450 m to stop sign, then northerly along "Elbow Lake" (active logging) road about 14 km to intersection (at Statlu Creek), then east, then northerly along "Chehalis" main road 17 km to a bridge (with a washed out approach) across the Chehalis River, 700 m north of Chehalis Lake. It is a 600 m walk along the main road to the east to the intersection of Road 90, then southerly 1,155 m to an early 1980's logging road that accesses the central part of the VMS 3 claim. Access to the western part of the VMS 1 claim is along Road 90 which is overgrown south of the intersection at 1,155 m. The western part of the VMS 5 claim is accessed by an overgrown road branching from the road into the VMS 3 claim.

The washed out approach to the bridge across the Chehalis River north of Chehalis Lake is due for repair in late summer, 1991, according to a B.C. Forestry official. The Road 90 is washed out at 830 m south of its intersection with Chehalis Main road (Fig. 6), but could be repaired with several shovels.

The VMS claims are also accessible from the west via the road along the west side of Harrison Lake and the Mystery Creek road, which connects to Chehalis Main road (Fig. 2). This route apparently takes about 0.5 hour longer than the access up the Chehalis River valley, but saves about 1.4 km of walking on logging roads accessible from the east but not the west.

### Geography

The VMS claims cover the lower part of the westerly flank of Mount McRae (elevation of 1,527 m) (Fig. 3). The elevations range from 300 to 400 m along the western part of the claims to 800 to 1,000 m along the eastern part. The slope dips on the average 30° to the west but 40° in the VMS 4 and 6 claims. The northern claims (VMS 5 and 6) cover the deeply incised, west-draining (but mostly dry) "McRae" creek, and the southwestern claim (VMS 1) covers the very deeply incised, northwest draining "Top" creek.

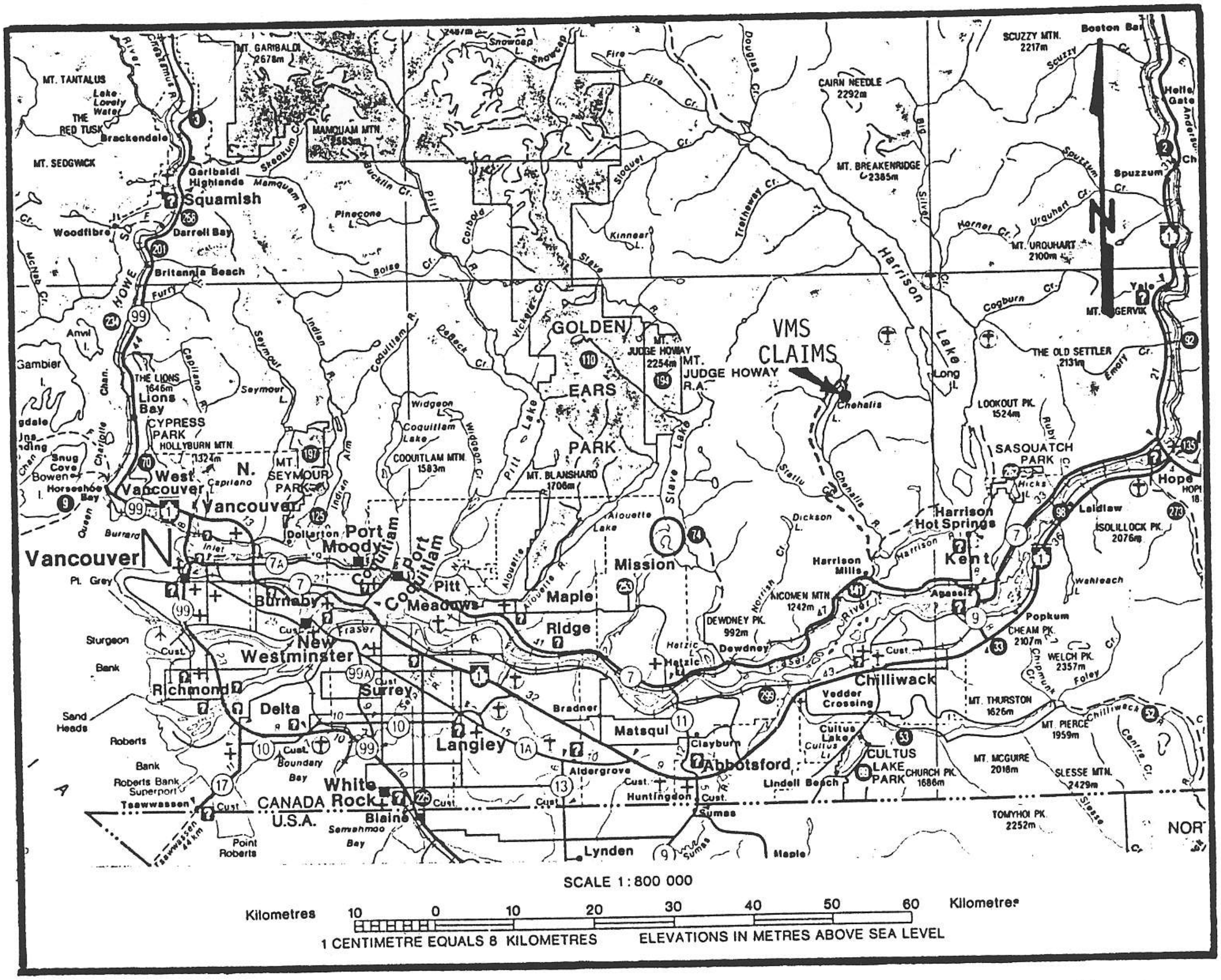



FIGURE 1: Location of the VMS 1-6 claims relative to Vancouver and Hope, southwestern British Columbia.

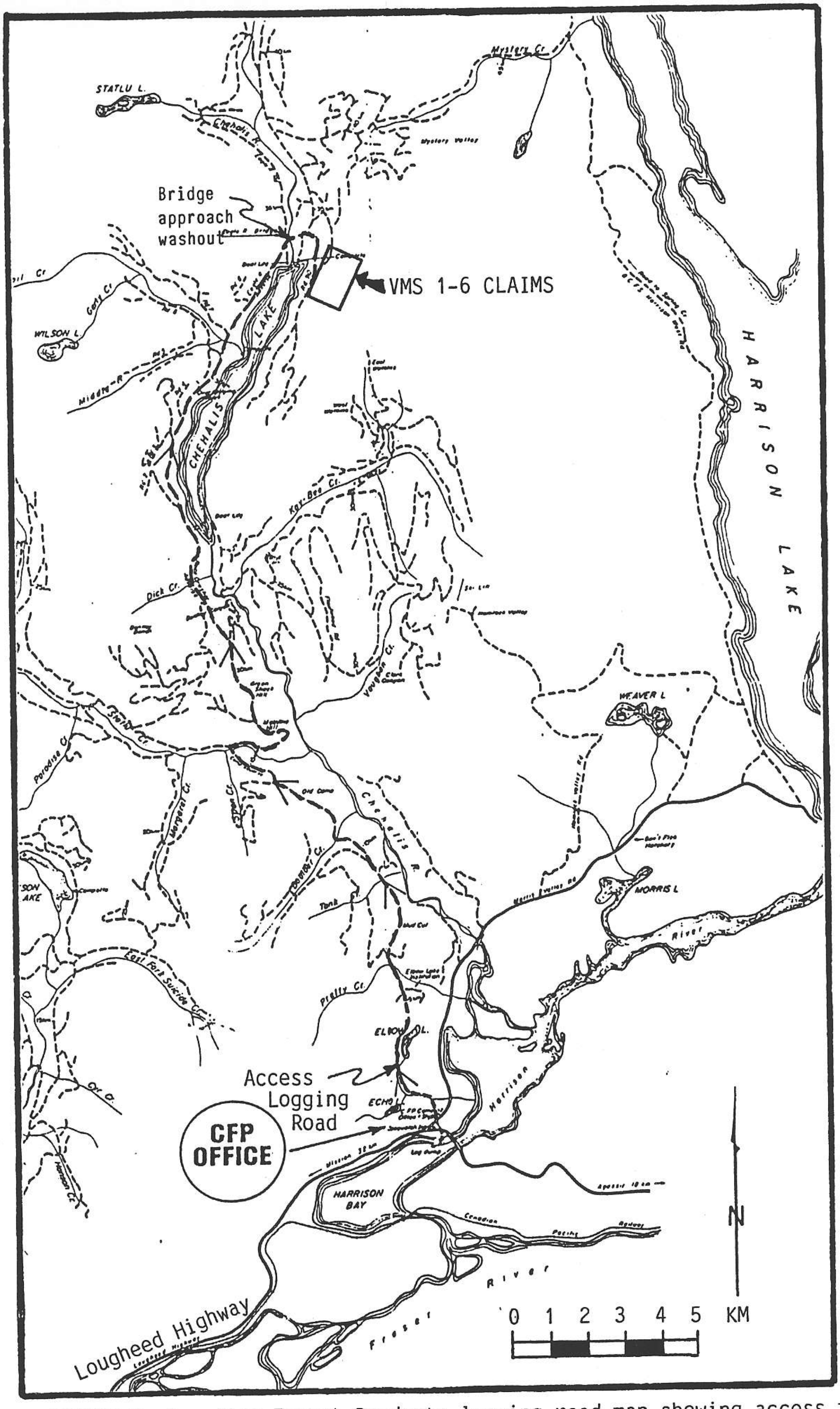



FIGURE 2: Canadian Forest Products logging road map showing access to the VMS 1-6 claims from the Lougheed Highway, at Harrison Mills. Claims may also be accessed from the road along the west side of Harrison Lake and the Mystery Creek road.

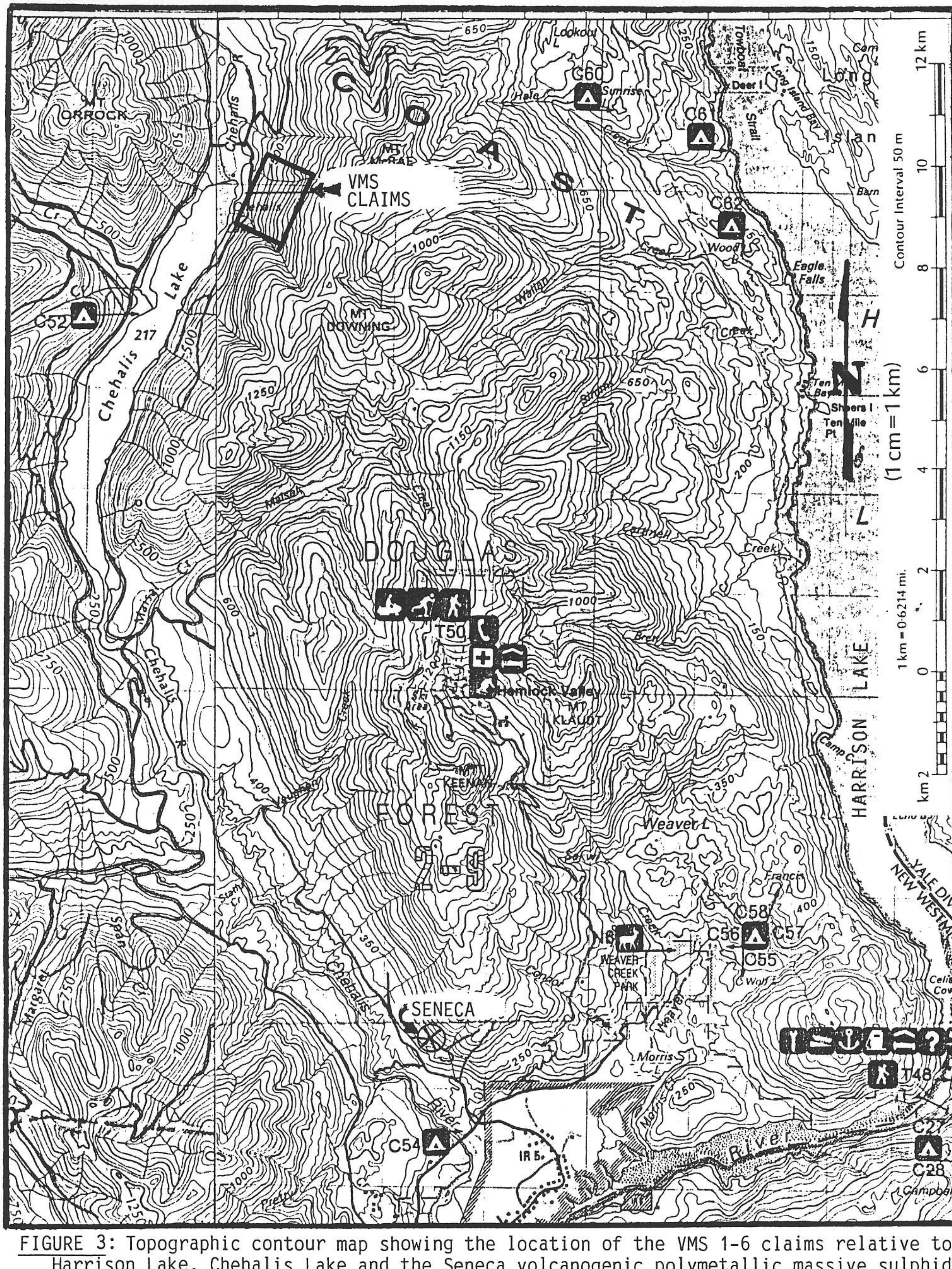



FIGURE 3: Topographic contour map showing the location of the VMS 1-6 claims relative to Harrison Lake, Chehalis Lake and the Seneca volcanogenic polymetallic massive sulphide currently under exploration by Minnova Inc. The Seneca deposit has reserves of 1,660,500 tons grading 3.57% Zn, 0.63% Cu, 0.024 oz/ton Au and 1.2 oz/ton Ag.

With the exception of a small, about 7 or 8 year-old logging slash in the VMS 3 claim, the claims and area are thickly forested with hemlock, balsam, Douglas firs and cedar trees. The forest within the claims is mature with little or no underbrush, except for the immature, second-growth forest with areas of thick undergrowth in the western part of the VMS 5 claim.

### Bedrock Exposures

Most of the western half of the VMS claims (No. 1, 3 and 5) appears to be covered with extensive overburden. A few exposures of bedrock occur in road cuts along the old logging roads within and just west of the claims (Road 90), which suggests the thickness of overburden is relatively variable. Bedrock exposures appear to be common in the eastern half of the claims or above an elevation of about 600 m. This elevation may correspond to the westerly and basal(?) contact of a unit of competent rhyolitic flows. Outcrops at this elevation tend to have low relief or no relief and are rubbly. All have extensive moss and lichen cover.

Bedrock exposures are very common along the steep banks of Top Creek through the southwest corner of the claims. However, many are cliff-forming and poorly accessible.

### Claims Information

The VMS 1-6 claims are two-post claims staked by me (registered owner) on April 20 and May 10, 1991. The claims comprise six units and cover an area of 1 km by 1.5 km. The location line for the claims forms the eastern boundary of the VMS 1, 3 and 5 claims and western boundary of the VMS 2, 4 and 6 claims, and trends 025° (Fig. 4). The claims data are as follows:

| CLAIM NAME | NO. UNITS | RECORD NO. | DATE STAKED | EXPIRY DATE |
|---|---|---|---|---|
| VMS 1 | 1 | 4211(4) | April 20, 1991 | April 20, 1992 |
| VMS 2 | 1 | 4212(4) | April 20, 1991 | April 20, 1992 |
| VMS 3 | 1 | 4213(4) | April 20, 1991 | April 20, 1992 |
| VMS 4 | 1 | 4214(4) | April 20, 1991 | April 20, 1992 |
| VMS 5 | 1 | 4234(5) | May 10, 1991 | May 10, 1992 |
| VMS 6 | 1 | 4235(5) | May 10, 1991 | May 10, 1992 |

### Economic Geology Setting

The VMS claims were staked because their potential for hosting a Kuroko type, volcanogenic massive sulphide deposit similar or analogous to the Seneca deposit 16 km to the south (Fig. 3), warrants testing.

The Seneca deposit is estimated to contain 1,660,500 tons grading 3.57% Zn, 0.63% Cu, 0.024 oz/ton Au and 1.2 oz/ton Ag (Vancouver Stockwatch, May 9, 1991). It comprises discontinuous lenses of massive sphalerite-pyrite-chalcopyrite with a siliceous matrix locally with barite. They occur within pyritic rhyolite lithic and lapilli tuffs with intercalated, thin bands of laminated meta-argillite and andesitic lapilli tuff of the Middle Jurassic, Harrison Lake Formation. The lenses are intimately associated with lenses of rhyolite lapilli tuff and a distinctive clastic rock with lapilli of bleached rhyolite in a fine-grained, black, somewhat friable matrix of meta-argillite. Together with thin rhyolitic and andesitic flows that overlie the rhyolitic tuffs, the unit which hosts the deposit is 61 m thick. The unit is overlain and underlain

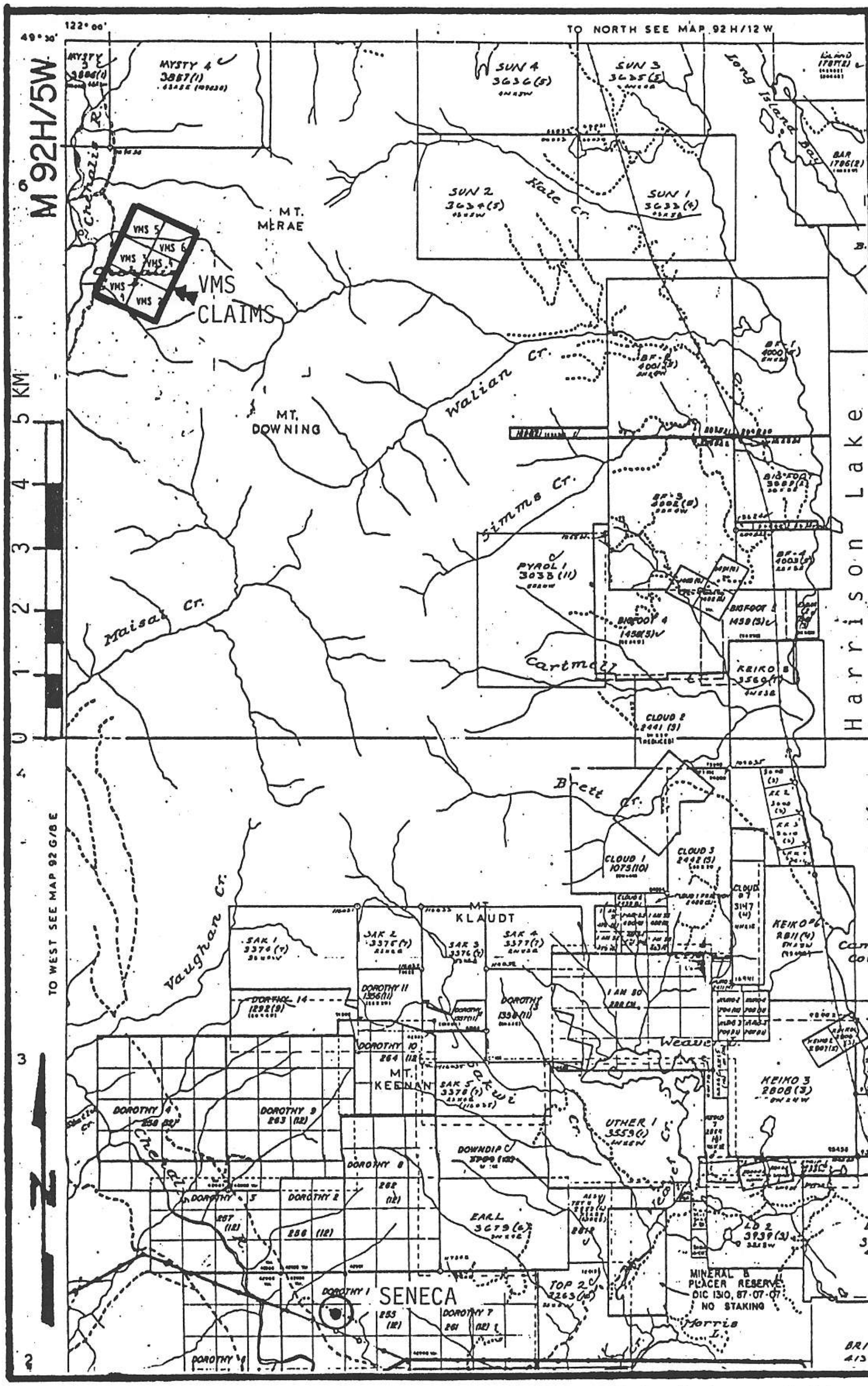



FIGURE 4: Claims map showing location of VMS 1-6 claims relative to the Seneca volcanogenic polymetallic massive sulphide deposit and Harrison Lake.

by units of thick, massive, feldspar porphyritic flows (Thompson, 1972). Strong argillic to chloritic alteration is associated with the mineralized succession, which dips 15 to 20° southeasterly (Garratt, 1988).

Minnova Inc. commenced a 3,000 m drill program in May, 1991, to test the down-dip and strike-projections of the Seneca deposit and several other targets, optioned from International Curator Resources Ltd. (50%) and Chevron Canada Resources Ltd. (50%).

Regional Geology

The claims are located near the northwestern margin of an up to 18 km wide belt of north to northwest-trending, complexly interdigitating, heterolithic volcanic flows, volcaniclastics and epiclastic rocks of the Middle Jurassic Harrison Lake Formation. These form the western part of the Cascade Fold Belt, which is bounded to the west by the Coast Plutonic Complex.

Texturally, the Harrison Lake volcanics vary from (Thompson, 1972):

a.) massive, thick (dacite) flows, thin and discontinuous (rhyolite and andesite) flows,

b.) pyroclastic rocks including lapilli tuff and lesser agglomerates, crystal or crystal-lithic tuff which are locally bedded,

c.) "secondary pyroclastics" of massive, chaotic and lenticular beds of agglomerate interlayered with bedded tuffs and lapilli tuffs, sandstone, shale, carbonaceous limestone and local andesitic and dacitic flows, and

d.) an "epiclastic succession" along the west shore of Harrison Lake, of andesite-chert conglomerate, greywacke, and argillite with interbeds of carbonaceous limestone and chert.

The compositions of the calc-alkaline, generally porphyritic (feldspar ±quartz) flows include, in approximate order of abundance: dacite, rhyolite ("low K"), andesite and basalt (Thompson, 1972). Thompson (1972) indicates that the volcanics have undergone "little or no regional metamorphism". More likely, however, the volcanics are extensively altered to sub-greenschist metamorphic facies minerals.

Reconnaissance-scale mapping of the Harrison Lake Formation by Thompson (1972) in the area 10 to 20 south of the VMS claims indicates that the generally massive volcanics are folded into broad open domes. There, minor folds are rare and no penetrative structural fabric such as schistosity or cleavage, affects the rocks.

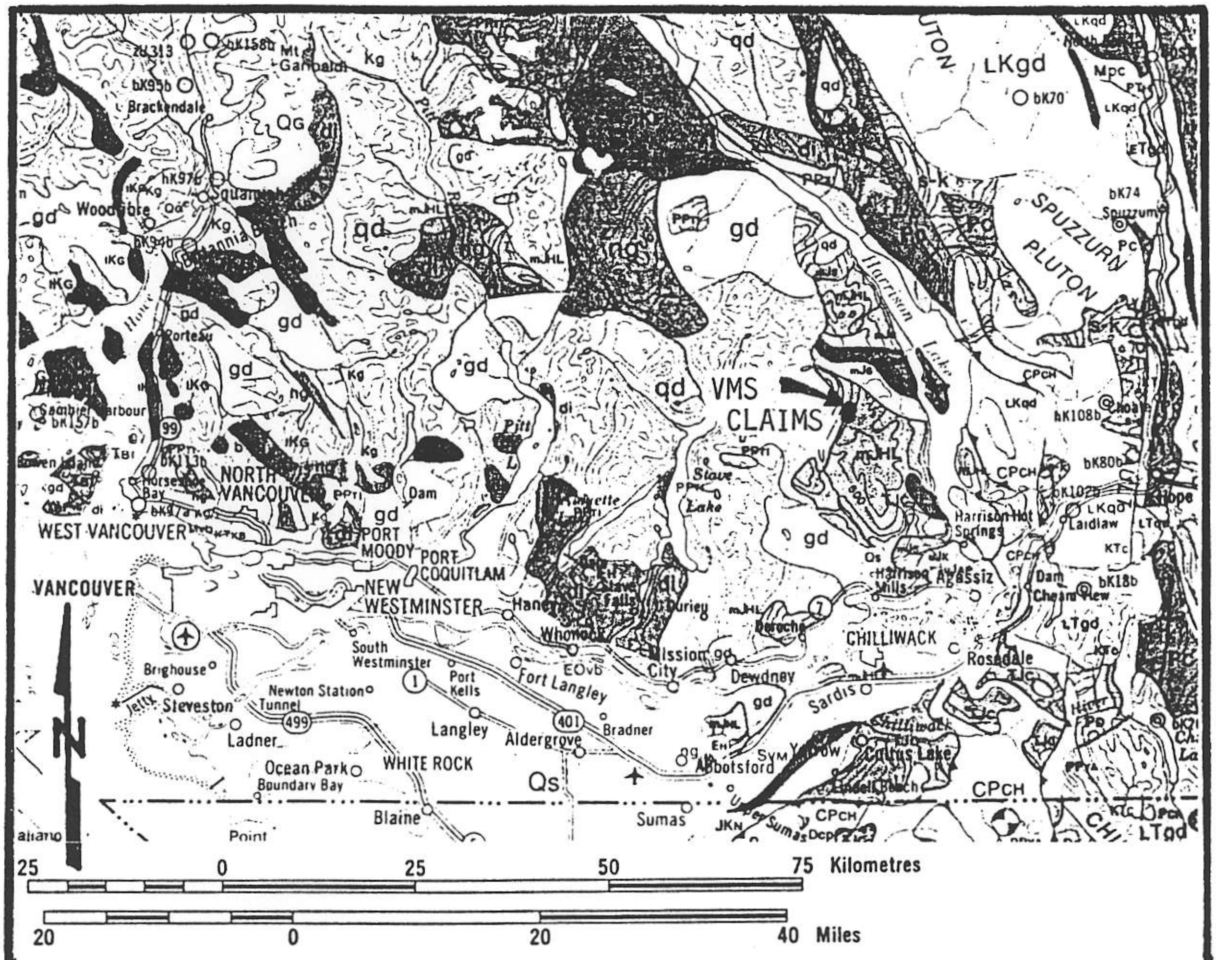
Exploration History

In 1971, Cominco Ltd. staked 25 claims (Top 1-25) to cover an area of anomalous stream silt samples (Nichols, 1972) (Note: Cominco also optioned the Seneca property in 1971). Between August 24 and September 12, 1971, Cominco Ltd. conducted the following surveys:

1. A geologic mapping survey within the claims which covered an area of about 1.6 km by 2.5 km.

2. 18 silt samples were collected primarily along Top Creek (elevations of 610 to 914 m (2000 to 3000 ft)) and "McRae" Creek (through VMS 5 and 6); the samples were analyzed for Cu, Pb and Zn.

3. 61 soil samples were collected in a 310 by 1,175 m area between Top and "McRae" Creeks and between the elevation contours of 762 and 914 m (2,500 and 3,000 ft). The survey appears to cover the




LEGEND:

Intrusive Rocks:

LTgd: Late Tertiary granodiorite.
LKgd: Late Cretaceous granodiorite.

Coast Plutonic Complex (Cretaceous):
gd: granodiorite.
qd: quartz diorite.

IKBP: Lower Cretaceous, Brokenback Hill and Peninsula Fms.: tuff, agglomerate, sandstone, pelite.
mJS: Middle Jurassic, Billhook Creek Fm., Mysterious Creek Fm. and Echo Island Fm.: tuff, sandstone, pelite, minor agglomerate.
mJHL: Middle Jurassic, Harrison Lake Fm.: rhyolitic to andesitic flow, tuffs, lapilli tuffs, minor argillite and chert.

FIGURE 5: Location of the VMS 1-6 claims in the Middle Jurassic Harrison Lake Formation shown on a regional geology map (Map 1386A, 1979)

northerly strike projection of an interval of silt samples with anomalous Pb and Zn along Top Creek. This area is now covered by south-central VMS 6 and central VMS 4 and eastern VMS 2 claims (Fig.7). The soil samples were taken at a vertical elevation spacing of 30.5 m (100 ft, or about 43 to 82 m horizontal) along 11 lines trending about 295°. They were analyzed for Cu, Pb, Zn and Ag.

4. 125 rock chip samples from outcrops were collected along eight southeast-trending lines across the claim group, at 304 m (1,000 ft) intervals. They were analyzed for mercury.

Between July 12 and October 31, 1974, Chevron Standard Ltd. contracted Stokes Exploration Management Company Ltd. to conduct surveys on a grid in the Top 1-37 and Kazar 1-4 claims (Culbert, 1974). The grid was centred on Top Creek, covered an area of about 2.1 by 2.8 km and comprised 24 lines, 152 m apart (500 ft) trending 105°. Unfortunately, the maps showing survey results along the grid are surface maps (surface distances plotted, not slope-corrected horizontal distances) and show few topographic features. Therefore, anomalies detected along the grid lines cannot be accurately located on a topographic map. The VMS 1-6 claims are located in the northwest part of the grid.

The surveys conducted by Stokes Exploration included the following:

1. Geologic mapping was conducted along all grid lines and numerous rock samples were collected for potassium staining (see below, Geology section).

2. 615 soil samples were collected at a spacing of 61 by 152 m (200 by 500 ft; surface distance) and analyzed for Cu, Pb, Zn and Ag.

3. A magnetometer survey with measurements taken at spacings of 30.4 by 152 m (100 by 500 ft).

It is interesting to note that Chevron conducted detailed geologic mapping, geochemical soil sampling, I.P. and Crone shootback EM surveys on their Ku 1-47 claims between 1973 and 1977 (Assessment Reports 4838, 5322, 5755 and 6499). These claims were located immediately north and west of the VMS 1-6 claims. In addition, Chevron drilled four short holes (in 1977) but submitted drill logs with no discussion and no assays for assessment work (AR 6499).

In 1982, Long Lac Mineral Exploration Ltd. staked 50 claim-units (Rain 1-3 claims) to cover silt samples with anomalous Zn and Cu and chalcopyrite-bearing float near the north end of Chehalis Lake (Turna, 1982). The VMS 1-6 claims now cover the northwestern part of the area of Lac's lapsed claims. Lac contracted for the production of a 1:5,000 scale topographic base map with 20 m contour intervals, and covering an area of 3.5 (north-south) by 4 km. Lac's surveys included the following:

1. Collection of 419 soil and 38 silt samples which were analyzed for Cu, Pb and Zn. The soil samples were taken at 100 m intervals along topographic contours at 100 m elevation intervals (generally about 100 to 225 m apart horizontally). Extra soil samples were collected where the rocks appeared significantly mineralized or the initial soil sampling detected an anomalous area. Most samples were collected in an area of 1.2 km (northeast-southwest) by 3.4 km, and extending southeasterly from the shore of Chehalis Lake. The area is centred approximately on Top Creek. The accuracy of the sample locations on the topographic map is uncertain.

The soil sampling survey covered all of the area of the VMS 1-6 claims with the exception of the southerly 60% of the VMS 3 claim and the northwest corners of the VMS 1 and 6 claims (areas covered by claims and fractional claims not owned by Lac). Figures 6 and 7 incorporate the analyses from the Chevron survey (Culbert, 1974) for these areas.

2. 111 selected grab rock samples were collected along the soil sample lines and analyzed for Cu, Pb, Zn and Ag (and Au for selected samples).

3. Prospecting was conducted along creeks, roads and soil sample lines. Follow-up prospecting was done in most areas of significantly anomalous soil samples.

## Results of Previous Exploration

### Cu, Pb and Zn Soil Anomalies

#### Distribution

The soil sample surveys conducted by Cominco, Standard Oil and Lac delineated a series of irregular and complex anomalies of weakly to strongly anomalous zinc, weakly to moderately anomalous lead and weakly anomalous copper in an area of about 930 m by 1,100 m. These anomalies are now covered by the VMS 1-6 claims (Figs. 6 and 7). The large zinc anomaly on the VMS 1, 3 and 5 claims, is open to the west because the area was not sampled.

Unfortunately, it is not possible to accurately superimpose the soil sample analyses from the three surveys on one map because of the inaccuracies inherent in the plotting of individual maps. Even the results of the small survey conducted by Cominco cannot be integrated with those of the Lac survey because of significant differences between the location of topographic contours on Cominco's base map with those on Lac's base map.

The series of complex anomalies delineated by Lac's reconnaissance-scale sampling, are defined by:

- 25 soil samples with anomalous Cu, ranging from 80 to 475 ppm.
- 22 soil samples with anomalous Pb, ranging from 40 to 710 ppm.
- 58 soil samples with anomalous Zn, ranging from 200 to 1,630 ppm.

Turna (1982) noted that anomalous Cu either occurs in the same sample with anomalous Zn or without other anomalous metals, but not with anomalous Pb. Furthermore, anomalous Pb occurs with anomalous Zn or by itself. However, it is difficult to analyze the modes of occurrence of the base metals because the certificates of analyses are not included in any of the reports on soil sampling.

In a general sense, a series of smaller areas of anomalous Cu, Pb and Zn are elongated along a northeast to east-northeast trend but form part of a larger anomalous area trending north-northeast, parallel to the surface trace of the lithologic units. The complexity of the distribution of the anomalies may result from a combination of factors, including:

1. The inaccuracies in plotted sample locations.
2. Irregular downslope dispersal of anomalous metals.
3. Anomalous base metals distributed along a series of east-northeast trending faults and shear zones.
4. Bias inherent in contouring analyses of samples collected on a grid with the north-northeast spacing (100 m; parallel

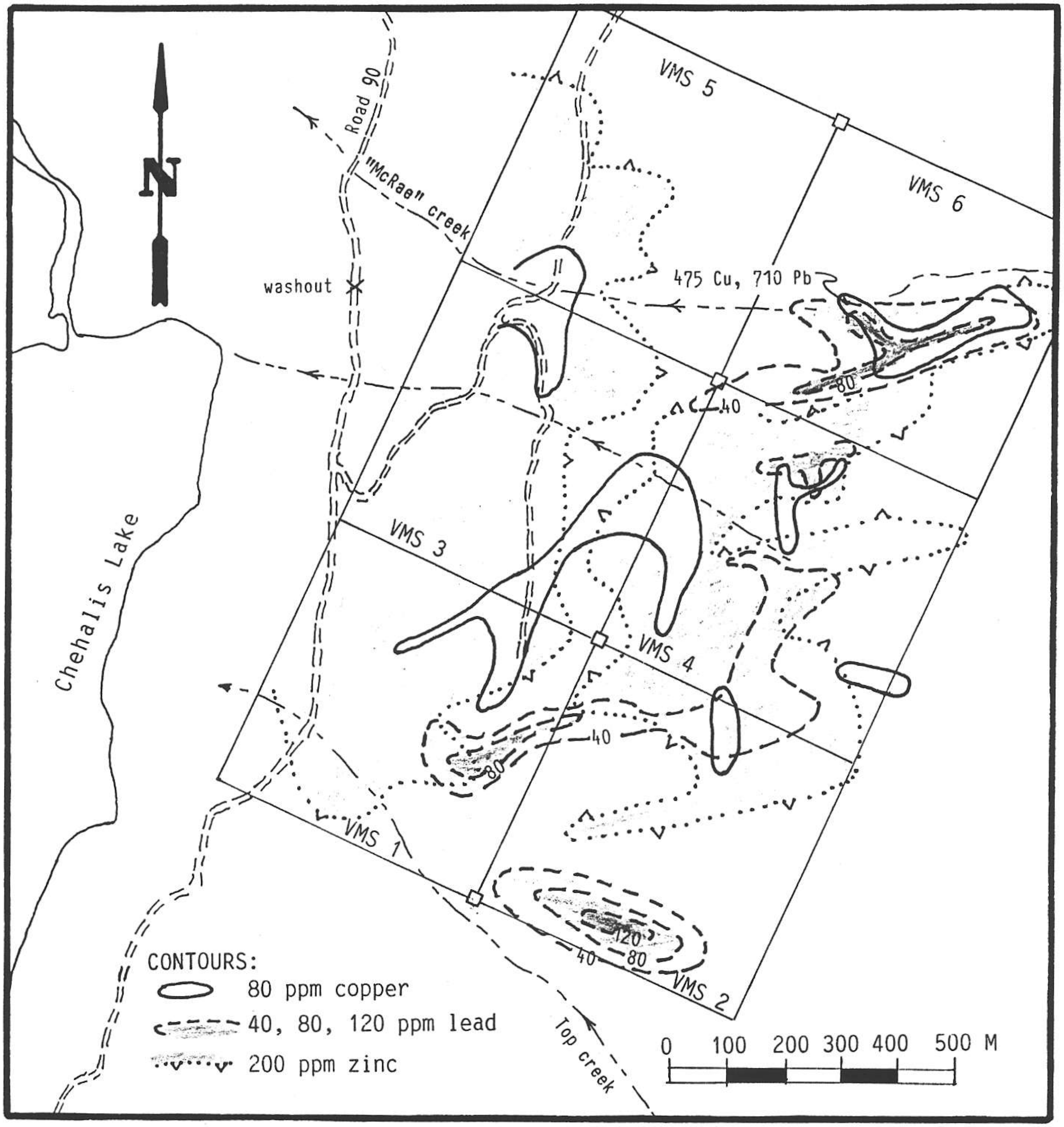



FIGURE 6 : Contoured anomalous copper, lead and zinc concentrations in soil samples collected along topographic contours by Long Lac Mineral Exploration in 1982 (Figs. 4 and 5, A.R. #10,771), at intervals of about 100 m by 150 m.

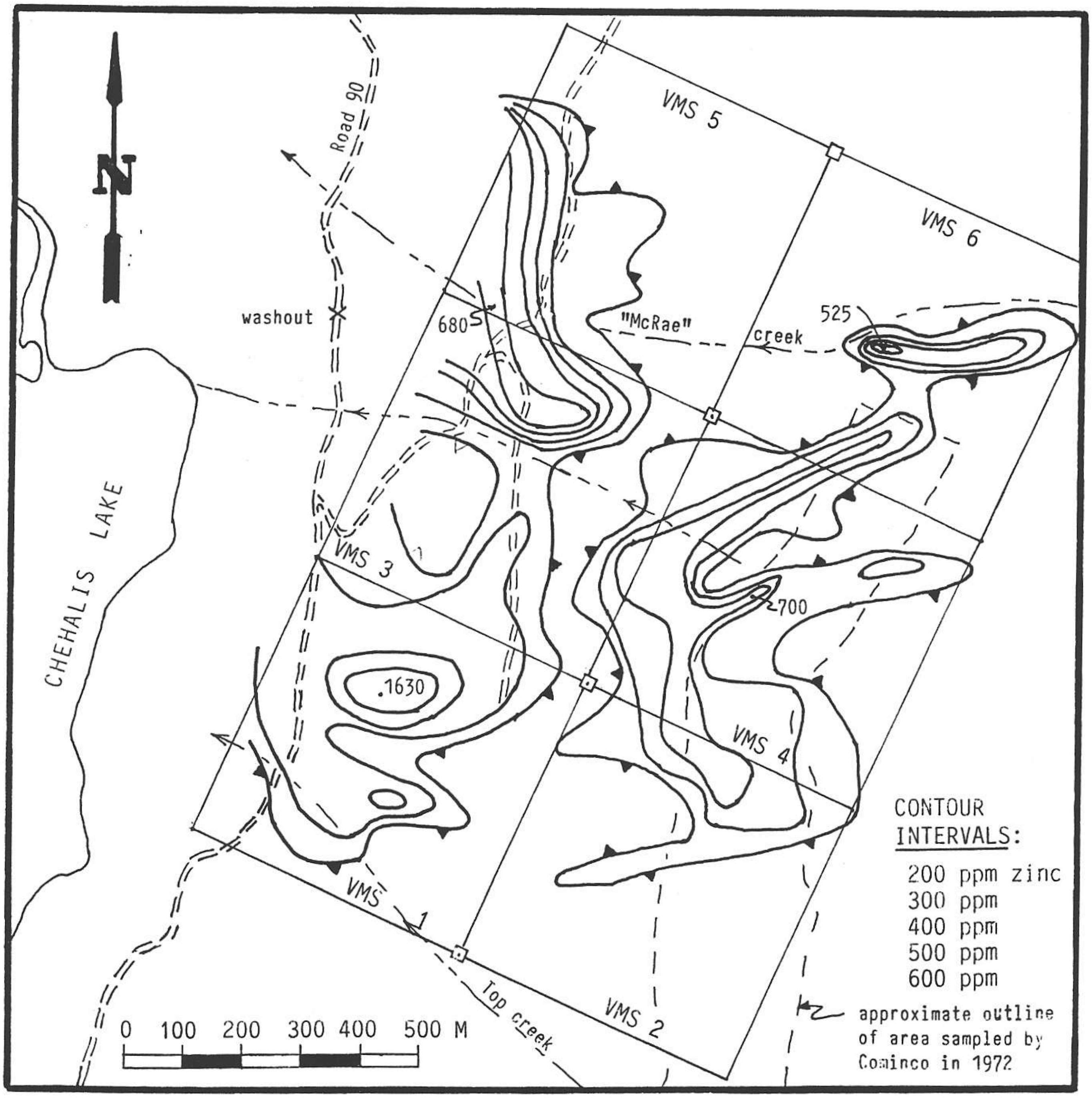



FIGURE 7 : Contoured anomalous zinc concentrations in soil samples collected by Long Lac Mineral Exploration in 1982 (Figure 6, A.R. #10,771), at approximately 100 m by 150 m intervals (contour sampling). Highest zinc concentrations are shown for four main anomalies.

to trace of lithogic units) generally significantly less than the east-southeast spacing (125 to 175 m). This is suggested by the fact that the contours for anomalous base metals from Chevron's soils sample grid trend northerly and north-northeasterly rather than east-northeasterly. Chevron's grid spacing was 61 m east-southeast and 152 m north-northeast.

Sources

The area of the westerly Zn soil anomaly in the VMS 1, 3 and 5 claims is covered by extensive overburden. Nichols' geologic map (1972), indicates this area is inferred to be underlain by predominately rhyolitic flows (Fig. 8). The Zn, Pb and Cu soil anomalies in the eastern VMS 1 and 3, and VMS 2, 4 and 6 claims are underlain by dacitic tuffs (to the west) and bedded dacitic and rhyolitic tuffs with acid sills(?) (to the east).

Turna (1982) prospected the areas of all significant anomalies and concluded that their source was base metal mineralization along fractures and veinlets within either:

1. pyritic fault zones or
2. pyritic "quartz eye dykes" and/or proximate volcanic wall rocks.

However, his samples of fault zones and dykes in the areas of the soil anomalies, contained low background base metal concentrations, with one exception, and do not substantiate that these are the primary sources for the soil anomalies. The exception is a "2 m wide pyritic rhyolite dyke" that strikes north in the northwest corner of the VMS 3 claim and contained up to 625 ppm Zn and 120 ppm Cu. It does not seem likely, however, that a such a narrow dyke is the source of the anomalous Zn and Cu in soils because of the large size of the anomaly (greater than 150 by 500 m).

Three rock samples collected by Turna (1982) in a fault zone marked by "McRae" creek contained either anomalous Zn, or anomalous Pb or anomalous Cu. These samples, however, were taken in a broad area between areas of anomalous soil samples. Culbert (1974) located a 0.75 by 3.0 m area with veinlets of massive galena and chalcopyrite up to 3.8 cm thick, at an elevation of 701 m on Top Creek (about 170 m southwest of the VMS 2 claim). These veinlets occur in sheared latite or rhyodacite lapilli tuff with quartz, pyrrhotite and calcite (Culbert, 1974, p.9). However, there are no soil anomalies proximate to this area, apart from those along the creek itself.

## GEOLOGY: PROPERTY AND AREA

The VMS claims and Mount Downing and Mount McRae areas are underlain by rhyolitic to andesitic flows and tuffs of the Middle Jurassic age Harrison Lake Formation (Nichols, 1972, and Turna, 1982). Well bedded, graded cherty tuffs and black, cherty argillite, "chaotic, multilithic breccias" (Culbert, 1974) locally form intervals within the flows and tuffs.

The three geologic mappers of the area offer three, distinctly different interpretations of the structure of the Harrison volcanics (see Structure section below).

The volcanic rocks are cut by poorly distinct dykes of predominately andesite(?) and secondarily sub-volcanic (Turna, 1982) quartz porphyritic, latite dacite (Culbert, 1974). A prominent, northeast-trending quartz diorite to augite diorite dyke occurs 250 to 500 m southeast of the VMS claims (Fig. 9). A prominent, easterly

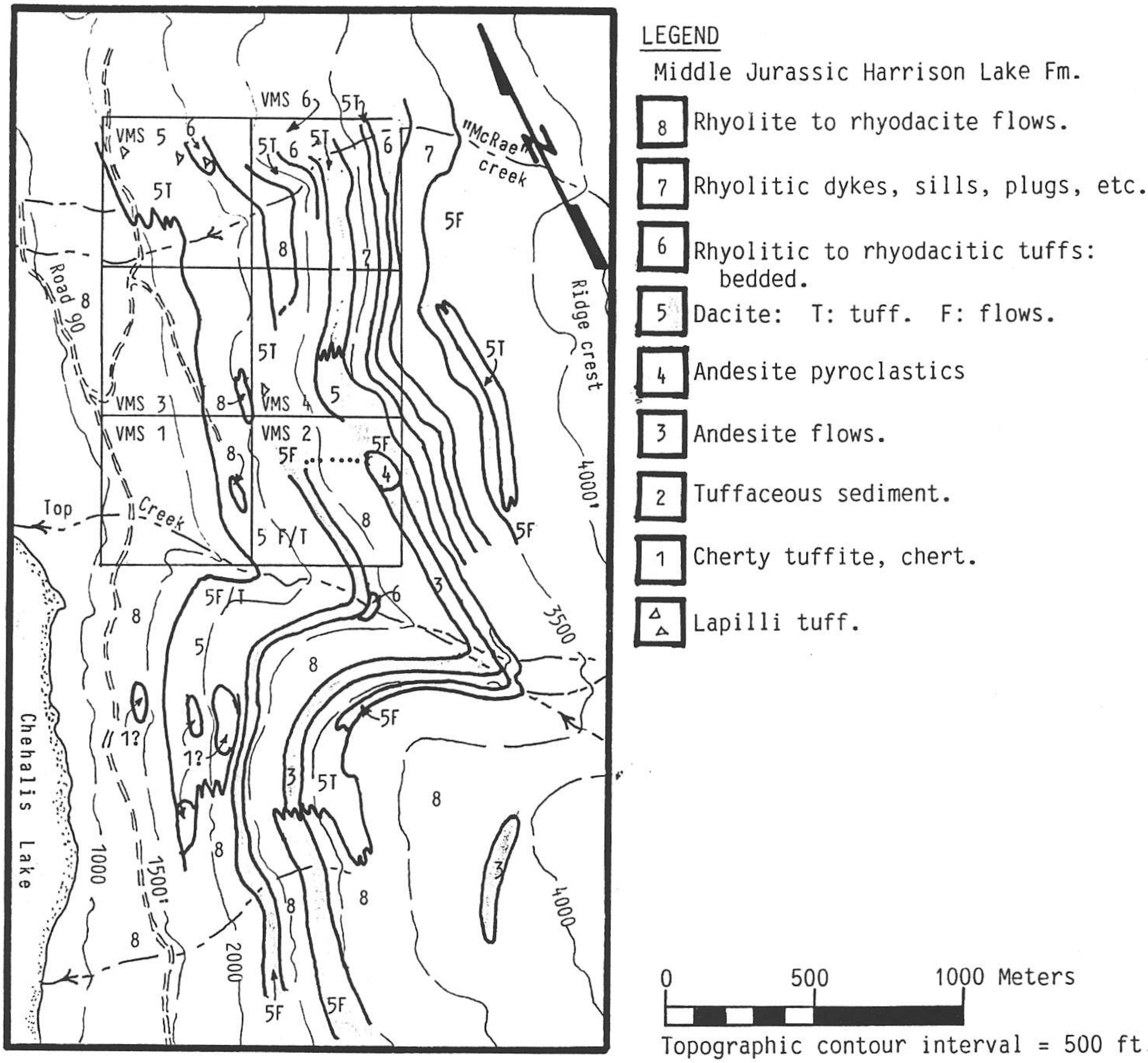



FIGURE 8: Geology of the area of the now lapsed Top 1-25 claims by Nichols (1972) of Cominco Ltd. The VMS 1-6 claims are also shown on this topographic base map. Note that all lithologic unit contacts on Nichols' original map are dashed or dotted. The assessment report copy was poorly legible (original coloured) and designation of several units is uncertain.

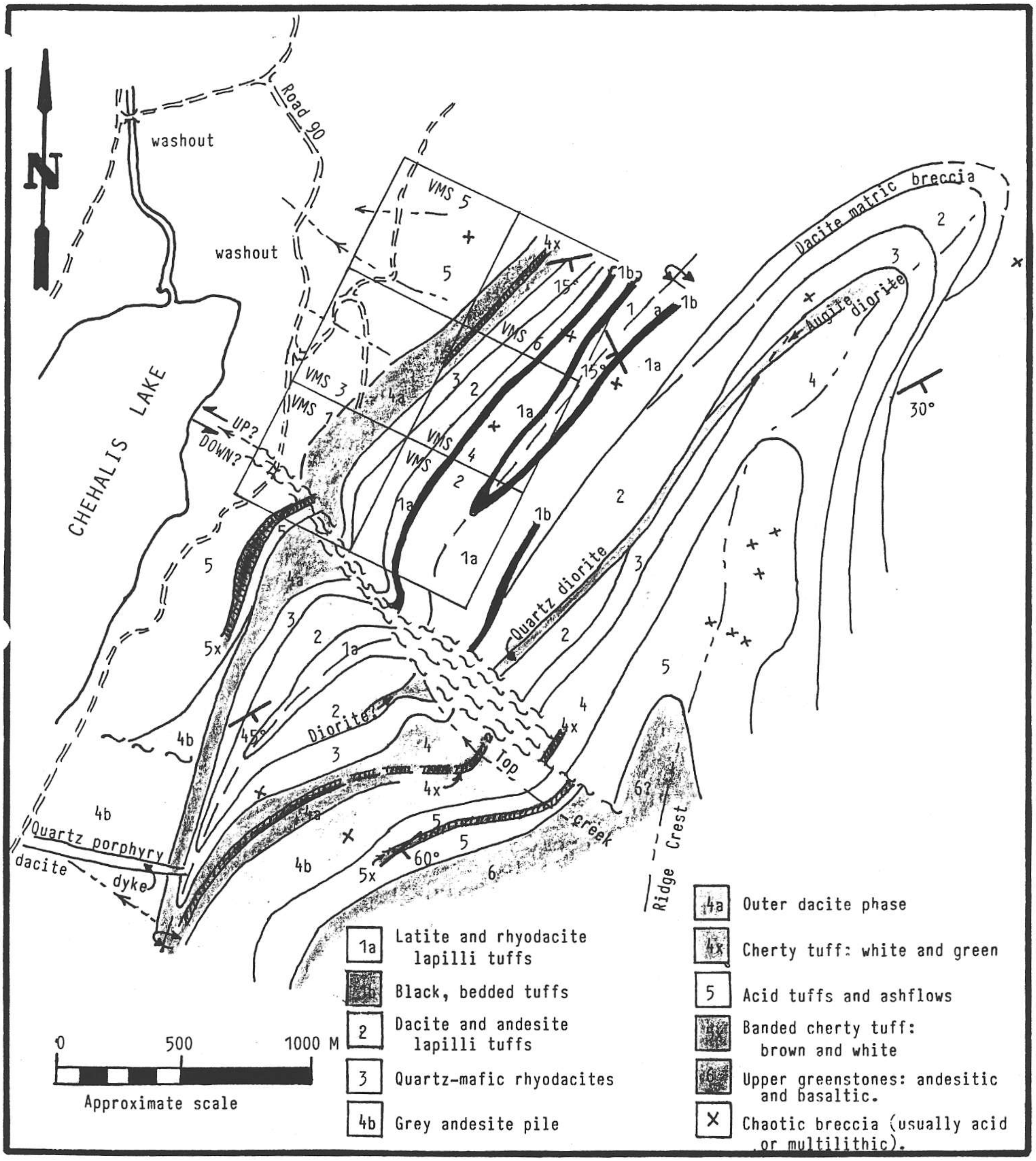



FIGURE 9: Highly schematic geologic map of the VMS 1-4 claims and area modified from Figure 3 of Assessment Report #5307 by R.R. Culbert of Stokes Exploration Management Co. Ltd. for Chevron Ltd., 1974. Culbert interpreted structure as a gently southwest-plunging recumbent anticline with southeast-dipping limbs. Note that closure of contacts in southeast half of area apparently due to trend of ridge relative to dip of units. The map is not corrected for changes in slope.

trending quartz porphyry dacite dyke is located about 1.5 km southwest of the claims.

### Lithologic Succession

Although the structural interpretations offered by Culbert (1974) (Fig. 9) and Nichols (1972) (Fig. 8) differ widely, their representations of the generalized lithologic succession of Harrison Lake Formation volcanics in the area of the VMS claims are analogous, overall. Nichols, however, suggests that facies transitions commonly occur between units of dacite tuffs and rhyolite flows.

Nichols indicates that the succession from an elevation of 1070 m to 275 m consists of the following units, from youngest to oldest:

**Bedded Andesitic to Rhyolitic Tuffs:** A 215 m or more, thick, flat lying unit of thickly to very thinly interbedded, light grey, rhyolitic tuff and darker grey dacitic to andesitic tuffs. Pyrite forms fine disseminations throughout the unit. Very locally, dark grey to grey-green, amygdaloidal andesite flows and olive green to dark grey andesitic tuffs occur within(?) this unit.

Nichols' geology map (see Fig. 8) indicates that this bedded tuff unit contains two sills(?) of acidic rock, about 70 m (upper) and 62 m (lower) thick and 53 m apart. His map also indicates that in the area north of Top creek, the tuff unit is overlain by more than 75 m of dacitic flows with a subunit of dacitic tuff. Furthermore, in the area about 340 m northeast of Top creek, there appears to be a poorly delineated transition from predominately tuffs to the north, to predominately rhyolitic flows to the south. The rhyolitic flow unit contains two subunits of amygdaloidal andesitic flows and several subunits of dacitic tuff and dacitic flows.

**Dacite Flows and Tuffs:** This unit is 305 m thick. The dacitic flows are light green and feldspar porphyritic. They locally contain clots of variably chlorite-altered biotite and hornblende. Minor disseminated pyrite occurs locally in the flows. Very locally the flows display an imperfectly developed columnar jointing.

The subunits of tuffs very locally comprise crystal tuffs and lapilli tuffs. Dark grey to black, massive, cherty tuffite (meta-cherty argillite(?)) with minor to abundant disseminated pyrite, forms another subunit at an elevation of 610 m in the area about 410 to 615 m southwest of Top Creek (and of the VMS claims). Culbert (1974), however, indicates on his geologic map (Fig. 9) that there are also two, "6 to 27 m wide", isoclinally folded and repeated subunits of "black bedded tuff" within acid tuffs north of Top Creek. The southwesternmost part of Culbert's meta-cherty argillite(?) subunits may be located in the VMS 2 and 4 claims. These subunits comprise important exploration horizons because the Seneca massive sulphide deposit occurs, at least in part, at the interface between rhyolitic lithic tuff and meta-argillite with rhyolite fragments (Thompson, 1972, p 113).

**Rhyolite Flows:** A more than 275 m thick unit of flows that range from rhyolite to rhyodacite. In general the flows are light green and comprise feldspar and locally quartz phenocrysts in a fine grained groundmass. Very locally, the unit contains subunits of rhyolitic tuffs, lapilli tuffs or light and dark green banded cherty tuffs. Culbert (1974) found that the rhyolites of this unit that are exposed along Top creek in the southwest corner of the VMS 1 claim, are quartz-pyrite-potassium altered.

Culbert's (1974) interpretation of the succession (Fig. 9) is based on mapping along twenty-four, southeasterly trending lines 500 feet apart and "extensive sampling" and potassium staining of rocks along these lines. Culbert divided the lithologies on the basis of potassium content ("the most mappable characteristic") and secondarily colour, as follows:

*Latite:* highly potassic groundmass.

*Rhyodacite:* faint potassic staining of groundmass. Some potassic alteration possible.

*Dacite:* without visible potassium staining and light coloured.

*Andesite:* without visible potassium staining and dark coloured. Some may be basaltic in composition.

It is unfortunate that Culbert lumped the "highly potassic" latite together with weakly potassic rhyodacite in his unit 1a, as he may have located a zone of potassic alteration related to a massive sulphide deposit.

**Structure**

Three interpretations of the structure of the Harrison Lake volcanics have been offered, one for each of the three previous workers in the area. Chronologically, they are as follows:

Nichols (1972) wrote that a limited number of bedding attitude measurements indicate the lithologic succession is essentially flat lying. This is consistent with the manner in which he shows the distribution of the various units on his geology map: unit contacts generally subparallel topographic contours. This is also consistent with Thompson's (1972) characterization of the structure of the Harrison Lake volcanics in the area 10 to 20 km to the south, as broad and open domes with bedding generally dipping about 10 to 25°.

Culbert (1974) concluded that the strusture of the Harrison Lake volcanics in the area covered by the VMS claims, comprises a moderately to gently southeast-dipping, gently southwest-plunging recumbent anticline. (The tight closure of unit contacts in the area to the east of his recumbent fold is a result of the intersection of gently south-dipping units with a steep-flanked north-northeast trending ridge.) His conclusion is based on the "considerable symmetry" of the succession, the apparent fact that units pinch out to the south, and four observations of graded bedding.

It appears, however, more reasonable to conclude that the units "pinch out to the south" because of lateral facies transitions as indicated by Nichols' (1972) map and Thompson's (1972) work in the Seneca deposit area. Furthermore, Culbert's suggested recumbent fold is not consistent with the structure mapped by Thompson (1972) to the south.

Top Creek Fault Zone: A major fault zone trending southeasterly up Top Creek was mapped by Culbert (1974). The distribution of the units on opposite sides of the fault, as shown on his schematic geology map, can be explained by oblique slip net displacement along the fault. That is, the northeast wall is up and to the northwest relative to the southwest wall. The net displacement vector would be about parallel with the dip direction of the axial plane of the recumbent anticline.

Perhaps as a strong indication of the high degree of interpretation incorporated on his geology map, Culbert suggests that the Top Creek fault may have large scale displacement along it and juxtapose entirely different units.

Contrary to Culbert's interpretation, Nichols' (1972) geology map indicates that all lithologic unit contacts are continuous across Top Creek (which was traversed and sampled), and that the creek is not a locus of shearing. During staking of the VMS 1 and 2 claims we noted, however, that moderately but inhomogeneously sheareb rocks are exposed along the creek. Furthermore, Turna (1982) noted that the creek follows a vertically dipping fault zone marked by an increase in pyrite and a "higher mineral content in fault gouge and breccia, and veinlets" which contain anomalous Cu, Pb, Zn , Au or Ag.

Turna (1982) reported that the Harrison volcanics generally strike northwest and dip moderately to the northeast, but did not include a geologic map witb his assessment report. This interpretation sharply contrasts with that of Nichols' (1972) generally flat dipping succession and of Culbert's (1974) northeasterly striking shallow to moderately southeasterly dipping succession.

An additional complication in interpreting the structure of the Harrison volcanics arises from the fact that Arscott's (1973) detailed geologic map of the old Ku claims, in the area 0.9 to 3 km north of the VMS 5 and 6 claims, shows lithologic units striking easterly to east-southeasterly and dipping generally 20 to 60°N to NNE. The easterly strike is at a high angle to the north-northeasterly strike of units on the VMS claims and area (Nichols, 1972 and Culbert, 1974).

**SUMMARY**

The VMS 1-6 claims cover a complex series of copper, lead and zinc soil geochemical anomalies (to 475 ppm Cu, 710 ppm Pb and 1630 ppm Zn), within an area greater than 930 m by 1,100 m. The locations of the 1972, 1974, and 1982 survey anomalies are poorly constrained because of the relatively broad spacing of the samples (61 x 152 m to 100 x 225 m) and poor geographic controls on the location of grid lines. Overall, a zinc anomaly in the VMS 1, 3 and 5 claims, is flanked to the east by an irregular series of copper, lead and zinc anomalies in the eastern VMS 1 and 3 claims and VMS 2, 4 and 6 claims. Both trend northeasterly parallel to the lithologic unit strike in this area. However, the copper-lead-zinc anomaly detected by Long Lac, comprises what appears to be a series of smaller en echelon anomalies elongated along a east-northeast trend whereas Chevron's anomalies are elongated northerly and northeasterly.

The most reasonable interpretation of the lithologic succession covered by the claims and area is offered by Nichols (1972). That is of three main, flat-lying units comprising, from youngest to oldest:

1. More than 215 m of bedded andesitic to rhyolitic tuff with two major siliceous sills(?). To the southwest of the VMS 4 claim, rhyolitic flows predominate.
2. 305 m of dacitic flows with interflow subunits of dacitic tuff or meta-cherty argillite.

3. More than 275 m of rhyolitic flows with minor subunits of rhyolitic tuff, lapilli tuff and cherty tuff.

Three, "6 to 27 m wide" subunits of meta-cherty argillite(?) within rhyolitic tuffs may be located in the VMS 2 and 4 claims (Culbert, 1974). These subunits comprise important exploration horizons because the Seneca massive sulphide deposit occurs, at least in part, at the interface between rhyolitic tuff and meta-argillite with rhyolite fragments (Thompson, 1972).

The zinc soil anomaly is located in an area of extensive overburden inferred to be underlain by rhyolitic flows (Nichols, 1972). The Zn, Pb and Cu soil anomalies to the east are underlain by dacitic tuffs (to the west) and bedded dacitic and rhyolitic tuffs with siliceous sills(?) (to the east).

After prospecting the soil anomaly areas, Turna (1982) concluded that their source was base metal mineralization along fractures and veinlets within either pyritic fault zones or pyritic "quartz eye dykes" and wall rocks. His rock samples of these contained low background base metal concentrations, with one exception (rhyolite dyke with anomalous Cu and Zn), and do not substantiate that these are the primary source for the soil anomalies.

The relatively unexplored Cu-Pb-Zn soil anomalies on the VMS 1-6 claims occur over lithologies that appear to resemble those hosting the Seneca volcanogenic massive sulphide (sphalerite-chalcopyrite-silver-gold) deposit 16 km the south. The areas of the anomalies warrant detailed and comprehensive exploration for massive sulphides. It is not reasenable to determine their economic potential based on prospecting in areas of moderate to extensive overburden, as the three previous workers presumed. Nor do the occurrences of base metals in veinlets in pyritic shear zones and rhyolitic dykes documented by Lac Minerals and Chevron, preclude the occurrence of stratabound massive sulphides. These occurrences, rather, may be interpreted as positive indicators of a polymetallic massive sulphide environment.

## RECOMMENDATIONS FOR ADDITIONAL EXPLORATION

1. A detailsd geochemical soil sampling survey over the area of the Cu-Pb-Zn soil anomaly covered by the VMS 1-6 claims is warranted. The survey area would be about 1.5 x 1.45 km (surface distances); at a spacing of 25 x 50 m, about 1,830 samples would be collected. The purpose is to locate and delineate the anomalies with a much greater precision than previous surveys and form the basis for the successive preliminary stages of exploration to delineate drill targets, which might include:

2. Detailed prospecting and geologic mapping in the area of all significant soil sample anomalies.

3. Detailed geophysical surveys, preferably I.P.-resistivity and magnetometer, over all significant soil and rock geochemical anomalies.

4. Trenching of all significant I.P. and/or resistivity anomalies with associated geochemical soil/rock anomalies, especially those that appear to have a stratabound bedrock source.

## REFERENCES

Arscott, D., 1973:
Preliminary Geochemical and Geological Surveys, Ku Claims, for Chevron Standard Ltd., December 20, 1973, B.C. Assessment Report #4838.

Culbert, R.R., 1974:
Geological, Geochemical and Geophysical Report on the Top Group Chehalis Lake, B.C., by Stokes Exploration Management Co. Ltd., for Chevron Standard Ltd., Oct. 31, 1974, B.C. Assessment Report #5307, 19 pp and 5 maps.

Garratt, G.L., 1988:
Agassiz-Weaver property, 092H; summary description for International Curator Resources, Exploration in B.C., 1988, p C98.

Nichols, R.F., 1972:
Geological and Geochemical Report on the Top 1-12, 14-25 and 1 Fr. Claims Situated at the Northeast End of Chehalis Lake in the New Westminster Mining Division, for Cominco Ltd., B.C., January 6, 1972, Assessment Report #3491, 10 pp and 8 maps.

Roddick, J.A., Muller, J.E. and Okulitch, A.V., 1979:
Geology of the Fraser River Map Sheet (N.T.S. 92), G.S.C. Map 1386A, compiled by Roddick, Muller and Okulitch; 1:1,000,000 scale.

Thompson, R.I., 1972:
Harrison, Lucky Jim [Seneca] (No. 140, Fig. B), B.C. Dept. of Mines & Pet. Res., G.E.M., 1972, pp 102-114.

Turna, R., 1982:
Geochemical Assessment Report on the Rain Group, Chehalis Lake Area, for Long Lac Mineral Exploration Ltd., November 10, 1982, Assessment Report #10,771, 27 pp and 5 maps.

APPENDIX

CERTIFICATE OF QUALIFICATIONS

I, Gary L. Benvenuto of the City of Burnaby, hereby certify that:

1. I am a consulting geologist with an office and residence at 231 North Sea Avenue, Burnaby, B.C., V5B 1K6

2. I graduated with a BSc. degree in geology from California State University at Los Angeles, California in 1972, and with a PhD. degree in geology from Queen's University at Kingston, Ontario in 1978.

3. I am a fellow member of the Geological Association of Canada.

4. I practised exploration geology with Cominco Ltd. from May to October, 1979, and with Westmin Resources Ltd. from January, 1980 to April, 1985, and have practised as a consulting exploration geologist from May, 1985 to present.

5. This summary report is based on a review of assessment reports and B.C. government publications, and property visits on April 20 and May 10, 1991.

Date: June 3, 1991
Burnaby, B.C.

Gary Benvenuto