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MINERAL RESOURCES DIVISION
Geological Survey Branch

TALC AND PYROPHYLLITE IN BRITISH COLUMBIA:

By M. MacLean

A contribution to the Canada/British Columbia Mineral Development Agreement, 1985–1990

OPEN FILE 1988-19

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VICTORIA
BRITISH COLUMBIA
CANADA

August 1987

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INTRODUCTION

At the present time there are no operating talc mines in British Columbia; all of the province`s talc is imported, mostly from Montana. In the past there has been intermittent small-scale production from four talc properties and three pyrophyllite properties.

In British Columbia the greatest demand for talc comes from the pulp and paper industry where it is used for pitch control, and as a filler for paper coating. The twenty-five pulp mills in the province and five mills in Alberta use as much as 2.3 tonnes of talc per day. Tens of thousands of tonnes of talc are required by the industry each year.

The geology of British Columbia offers potential for the discovery of a quality talc deposit. Generally, the highest purity talc is derived from deposits associated with magnesium carbonate rocks, and the talcs of lesser purity come from altered ultrabasic igneous rocks (Winkler, 1976). Most of the past British Columbia production has come from deposits hosted in schists, which tend to yield talc of the lowest quality. One of the producers, the View property west of Creston, is hosted in dolomite (Table 1). Two properties studied by the industry in recent years have identified talc meeting the pulp and paper industry standards.

TABLE 1
HISTORICAL PRODUCTION OF TALC AND PYROPHYLLITE

Name	Map No.	NTS	Years of Production	Tonnes
Eagle	T20	92E/5	1923	250
Lucky Jane	T23	92J/9	1917-1935	455
Gisby	T24	92H/13	pre-1923	(?)
View	T32	92F/2	1984	(?)
Kyoquot Sound	P1	92L/3	1910-1914, 1937	'several hundred'
Riverside	P2	92I/14	1950	82 (test)
Pyro Group	P3	92H/7	(?) <1958, 1972 ---> present	'small shipment' ~200 tonnes/year

There are many ultramafic belts in British Columbia (see map in pocket) which are ideal settings for a higher purity talc deposit. Other favourable host rocks which warrant exploration are also outlined on the map.

All past talc production has been from short-lived, low-tonnage operations; often a specific order would be filled, after which the property would be abandoned. Upgrading, by flotation or other processing, was not employed.

The number of known talc occurrences, together with favourable geology and laboratory research, indicates that talc meeting the industry's standards can be produced in British Columbia.

The intent of this publication is to aid prospectors and the industry in general in the discovery and development of a local talc resource to replace the present imported product. The report outlines the known occurrences of talc and pyrophyllite in British Columbia, and provides information and references that will be useful as guides to exploration.

PROPERTIES OF TALC AND PYROPHYLLITE

Talc is a soft, fissile and commonly pale-coloured mineral which is easily ground to a fine powder. It is a hydrous magnesium phyllo-silicate, with the chemical formula $Mg_3Si_4O_{10}(OH)_2$. Pure talc has a unique combination of properties; it is chemically inert, white coloured, non-abrasive, fine grained, and very soft (hardness of 1). In a natural setting however, talc is rarely found exhibiting all these characteristics simultaneously.

The theoretical composition of pure talc is 63.5 per cent SiO_2, 31.7 per cent MgO and 4.8 per cent water; these percentages seldomly if ever occur naturally, as impurities are generally present. The most common mineral impurities are chlorite, iron sulphides (usually pyrite), calcite, dolomite and magnesite, amphiboles and silica. Chemical impurities involve the replacement of magnesium in the crystal lattice by iron or manganese. Impurities affect the colour of the talc, which may range from apple green through greyish white to dark grey-green.

Pyrophyllite is a hydrous aluminum phyllo-silicate with the chemical formula $Al_2Si_4O_{10}(OH)_2$. The name 'pyrophyllite' is derived from the Greek meaning 'fire' and 'leaf' which describes the way it exfoliates when heated. Pyrophyllite is very similar to talc in appearance, it has the same pearly to greasy lustre and ranges in colour from white to apple green to grey or brown, and has a hardness of 1 to 2. The theoretical composition of pyrophyllite is 28.3 per cent Al_2O_3, 66.7 per cent SiO_2 and 5 per cent water. It may also contain excess aluminum, potassium (K_2O), and iron oxide (Fe_2O_3).

Talc and pyrophyllite both consist of alternating brucite and silicate layers, that is, octahedral sheets sandwiched between tetrahedral sheets which are joined by weak van der Waal's bonds (Figure 1). The layers are electrically neutral and hence the minerals are chemically inert. The weak bonding accounts for the excellent cleavage and greasy feel.

Pyrophyllite and talc can usually be distinguished by their geological setting and associated mineral assemblages. In the laboratory they are distinguished by moistening a fragment with cobalt-nitrate and heating intensely. Talc will turn to a pale violet colour while pyrophyllite will become blue (Hurlbut and Klein, 1977).

Talc in its massive compact form may be termed either 'steatite' or 'soapstone'. The original connotation of 'steatite' was a massive talc of high purity, but this definition is not always implied. 'Soapstone' is used to describe talc of carving quality which may be contaminated by carbonate and chlorite.

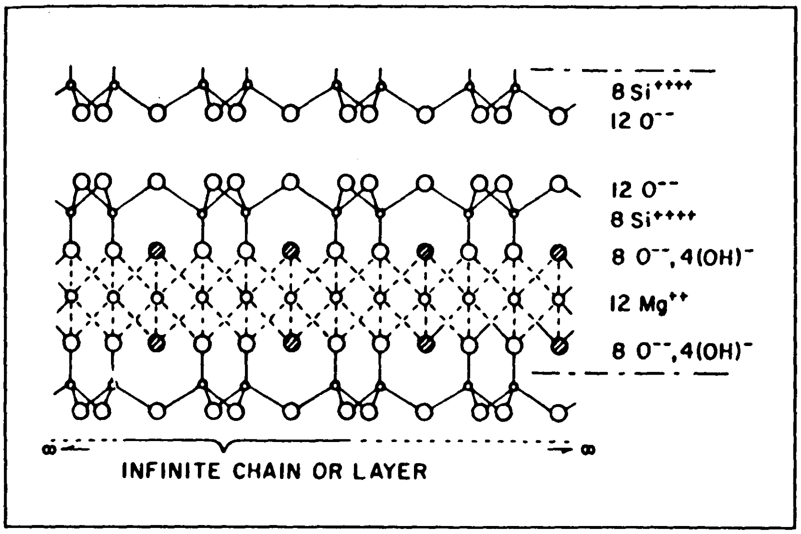


Figure 1. Theoretical structure of talc (after Gill, 1984)

Another type of talc ore is `hard talc', containing abundant tremolite, with anthophyllite, calcite, dolomite and serpentine. `Soft talc' implies platy foliated talc, the most common type. In industry, the name `talc' is used very generally to describe a wide range of mineral mixtures which may in fact contain very little talc.

SPECIFICATIONS - TALC

Each talc deposit is unique and the degree to which it must be processed depends on the end use of the product. The physical and chemical properties are tested and the importance or applicability of each test depends on the specifications of the consumer.

The physical properties considered when evaluating powdered talc are slip, grittiness, brightness, grain size, colour, specific gravity, adsorbtive abilities and reaction to heat.

Slip is the general smoothness or greasiness of the mineral, tested in powdered form.

The softness of talc allows it to be easily pulverized into a fine non-abrasive powder, which is useful as a duster or filler. Since it is chemically inert, it is used as a dilutant in drugs and cosmetics. Grittiness, that is, material larger than the grain size of the ground talc, causes abrasion. Grit may form due to contamination by quartz or aluminosilicate minerals. The `grittiness' is measured by the Valley Abrasion Test which indicates, in milligrams, the wear on a piece of wire testing cloth (Lefond, 1983).

The brightness of talc is a measure of reflectivity as compared to a pure magnesium oxide standard. It is also called the `GE' brightness, referring to the General Electric Company, which developed the instruments used in its measurement (Berg, 1979).

The grain size is measured by passing the powdered talc through standard wire screens, the most common size is 200 mesh. Mesh sizes are often quoted in specifications.

The colour is often important and is caused by impurities. Iron causes discolouration, which is most often undesirable, especially in filler applications in the paper industry. When powdered, the colour of talc usually lightens, therefore increased or repeated grinding may improve the measured brightness of the sample. Talc purity is determined through X-ray diffraction, which reveals the presence of talc as well as any other impurities.

The specific gravity of talc ranges from 2.55 to 2.78; this varies with the shape of the grains and with the amount of impurities. When finely powdered, talc exhibits colloidal properties and surface tension prevents it from settling, which may or may not be desirable. The platy surface of talc is hydrophobic but the edge surface is hydrophilic, allowing it to disperse easily in a hydrous system.

Talc has the ability to adsorb organic compounds, which is useful in controlling pitch that is released during the pulping process. The talc adheres to the pitch and prevents settling which damages machinery and stains the final paper product. Fine-grained talc is also used as an adsorbant in paints; it keeps the pigments mixed and its colloidal nature inhibits settling.

The reaction to heat is important for some talc uses, especially in the ceramics industry where talc's low shrinkage characteristics improve the dimensional stability of products during firing. Massive talc is renowned for its poor conductivity, and powdered talc is also used as a fire retardant or insulator. Impurities may destroy the ability of the talc to retain or resist heat and it may react by swelling.

SPECIFICATIONS - PYROPHYLLITE

Grading pyrophyllite depends, like talc, on the ore mineralogy and on the consumers' requirements.

Pyrophyllite is slightly harder than talc, 1 to 2 versus 1 on Moh's scale of hardness. It may be substituted for talc in many applications, but pyrophyllite is a much less common mineral in nature.

Massive, compact pyrophyllite is commonly used as a refractory and testing for this purpose involves firing at a range of temperatures to check the dilatancy properties. Refractory potential is measured using a Pyrometric Cone Equivalent (PCE) test. Cones made of material which fuses at a known temperature are fired along with a `cone' of the material being tested. By noting which cone deforms simultaneously with the sample, the fusion temperature of the sample is determined and the corresponding cone number is quoted. Cones range up to No. 38 which indicates a temperature of fusion of 1835°C (Klinefelter and Hamlin, 1957; Liles and Heystek, 1977). Foliated or micaceous pyrophyllite has a very low coefficient of thermal expansion and is often used in making ceramic tiles.

PROCESSING

Talc ore beneficiation involves either dry grinding or wet processing. Grinding requires ceramic machinery as opposed to the conventional steel rod and ball milling which causes discolouration and contamination of the talc. Wet processing involves froth-flotation and/or high-intensity magnetic separation which removes iron impurities. The talc is delaminated into the more useful form of discrete platelets, as in the process used for mica delamination. Flotation techniques are facilitated by the natural hydrophobicity of talc and collector agents are not required.

USES OF TALC AND PYROPHYLLITE

Talc may substitute for other minerals when they are unavailable, for example, if the talc is bright enough, it may may take the place of titanium oxide which is added to brighten paper. Talc is now widely used in place of asbestos for insulating purposes and very low grade talc is used in place of granular silica and dolomite in the roofing industry.

The best known application of talc is in talcum powder, which ironically, is the least important in terms of the size of the industry, because of the extremely high purity of talc required.

The most important uses for talc are in the pulp and paper, paint, and plastics industries. It is also used in the ceramic, roofing, rubber and pharmaceutical fields. The list of possible applications is almost endless; talc has been used in insecticides, crayons, as a bleaching agent, in floor waxes, lubricants, soaps and textiles, and as a polish for cereal grains and rice.

Talc specifications for the major industrial applications are summarized in Tables 2, 3 and 4.

THE MARKET

Statistics for 1986 show the pulp and paper industry in Canada used an increasing amount of talc, and predictions for 1987 indicate that demand from the plastics industry will increase. At present, Canadian talc comes from Quebec and Ontario, and pyrophyllite is mined on the Avalon Peninsula in Newfoundland.

The main markets for Canadian talc are in eastern Canada and in the northeastern United States. Canada also exports to Europe and Japan. Compared to the previous year, Canadian exports of talc increased 9.6 per cent in 1986, while pyrophyllite exports decreased by 23 per cent. The average unit value of talc increased 13 per cent, and prices of all grades of talc rose 5 per cent in 1986; the same trends are expected for 1987. The price of talc, as with many other industrial minerals, is very sensitive to local conditions and is negotiated between the producer and consumer within a certain generally established range. The rate will fluctuate according to processing methods, transportation costs, material quality and specifications. The range in Canadian dollars per short ton is:

35-70	.....	medium grade
95-160	.....	high grade
180-250	.....	highly beneficiated
1000+	.....	steatite blocks
30-40	.....	pyrophyllite (bulk materials)

(Source: Prud`homme, 1987)

TABLE 2
TALC IN PULP AND PAPER, PAINT AND PLASTICS INDUSTRIES

Industry		Desirable Properties of Talc and Properties Improved in Product		Talc Specifications	Minerals Which May Substitute for Talc
PULP & PAPER	PITCH CONTROL		talc adsorbs resin and keeps it dispersed in pulp	- close to 1 , finely pulverized, high purity, white colour	pyrophyllite
	PAPER FILLER	talc softness, chemical inertness, high reflectance, hydrophobicity, organophilic, particle shape		- max. particle size <20 (-200 mesh), 40 grades also used, fibrous, rather than foliated talc, grit free, white, little to no calcite - paper grades: ultrafine talc - GE brightness - 90-96%,	kaolin, calcite, carbonate, pyrophyllite
	COATING PIGMENT		good coverage, smooth printability	- preferred grades have Valley abrasion level <30 mg/3000 cycles; impure grades may be higher - particle size <10 , soft, grit free, ink accepting	
PAINTS (extender)		- talc decreases gloss, aids in adhesion, flow, hardness & 'hiding power' of paint - low specific gravity of talc allows it to remain in suspension		- low carbonate content - nearly white colour - at least 98.5% must pass through 325-mesh screen - foliated & fibrous varieties used - specific oil adsorption needed specifications are established by ASTM (American Society for Testing & Materials) #605-69(1976)	pyrophyllite
PLASTICS - polypropelene - nylon - polyester - thermoplastic resins - thermosets		- improves dimensional stability, chemical & heat resistivity - strength (impact & tensile) - good electrial insulator		- no Fe impurities or 'grit' - super fine grained: <8	mica, wollastonite, carbonate, pyrophyllite

Sources of Information for Tables 2, 3 and 4: Spence (1922), Harben (1978), Cornish (1983), Gill (1984), Clifton (1985), Prud'homme (1985) and Berg (1979).

TABLE 3
TALC AND PYROPHYLLITE IN CERAMIC AND REFRACTORY INDUSTRIES

Industry	Desirable Properties of Talc and Properties Improved in Product	Talc and Pyrophyllite Specifications	Minerals Which May Substitute

CERAMICS
- tiles
- earthenware
	- improves firing characteristics, translucency, strength & aids in crack-free glazing
	- permits time reduction in firing cycle
	- chloritic talc - used for earthenware for uniform dilation, fast firing and good adhesion of glaze to body
	- pyrophyllite - foliated variety used
	  - has low coefficient of thermal expansion
	  - high aluminum content aids in good dying and firing characteristics
	  - high mechanical strength & good resistance to crazing
	  - high sericite-pyrophyllite used as substitute for silica-feldspar mixtures - reduces crazing, shrinkage & warping of product
		- low Fe, Mn & other impurities
		- average grain size 6-14
		- 90-98% must pass through 325 mesh
		(Note: in Europe, Electroceramics use only nonlaminar, compact talc (steatite), free from chlorite)
		- pyrophyllite - grade -325 mesh
		  - minimum quartz & sericite impurities, foliated or micaceous variety
		  - low shrinkage necessary for products requiring standard precise size (i.e. tiles)
		  - for high frequency insulators uniform physical & chemical properties needed
		  - max. amounts tolerated:
		  CaO - 0.5%
		  Fe oxides - 1.5%
		  Al_2O_3 - 4%
			wollastonite

REFRACTORIES	- pyrophyllite used more than talc
	  - pyrophyllite expands on heating, counteracting plastic fraction shrinkage & has low thermal conductivity
	- steatite - not used alone much anymore but may be ground to mix with clay to produce synthetic cordierite for electric insulators
	- block steatite - ground to make synthetic lava (conversion to clinoenstatite & quartz)
		- pyrophyllite - compact, homogeneous (some crystalline or radiating varieties used)
		  - tested for refractories (see text (Introduction) re PCE testing)
		- steatite - fine grained, compact, soft, no cleavage or flaws, absent of grit, low iron content
			kyanite, andalusite, calcined bauxite

TABLE 4
TALC IN ROOFING AND PHARMACEUTICAL INDUSTRIES

Industry	Desirable Properties of Talc and Properties Improved in Product	Talc Specifications	Minerals Substituted for Talc
ROOFING - filler, coater	- weather resistant, prevents sticking (dusting), hydrophobic, good anti-caking characteristics, platy structure - protects asphalt, against uv radiation - prevents oil penetration or migration - increases fire resistance	- lowest quality talc used - often a mix of grit & coarse talc from talc mills as filling -150 mesh used for surface coating -40-80 mesh - may be impure as colour is not important	pyrophyllite, actinolite, low-grade asbestos, pyraliolite-rensselaerite (pyroxenes partially altered to talc), in Europe - mixed talc/sand used
PHARMACEUTICAL - filled in tablets - additive in medical pastes, creams, soaps - talcum powder	- softness, chemical inertness, hydrophobicity	- EXTREMELY high purity talcs used - very fine grained, no impurities, no grit - white colour - 'dry' slip characteristics	

In the world market, talc is usually only traded between neighbouring countries, as deposits are widespread and commonly developed; there are 30 talc-producing countries at the present time. Exceptions are steatite and very pure talc, which are very expensive and less common, and therefore may compete to a limited extent in world markets.

SOURCES OF INFORMATION

The properties described in this report were researched and without being examined firsthand in the field; any corrections or information regarding the deposits is welcome. In a few instances, samples were available which were analysed by the Ministry's laboratory with results included in this report. The main sources of information are personal communications, publications and property files of the Ministry of Energy, Mines and Petroleum Resources and the Geological Survey of Canada, company reports and graduate theses. The MINFILE system of the Ministry of Energy, Mines and Petroleum Resources is cross-referenced; data on each occurrence is accessible through the computer file.

Locations are plotted on a 1:2 000 000-scale map of British Columbia (in pocket), as well as on 1:50 000 National Topographic System map sheets, or on more detailed property maps when available. When only a claim name is given as a location, the centre of that claim is plotted. Sometimes only a general geographic location is available, or the showing may actually cover a large area; these factors affect the accuracy of the locations.

All quoted analyses are as originally published; reliability is uncertain, but those included are the most recent available.

The talc and pyrophyllite occurrences are categorized according to geological setting. Only those showings which have sufficient information have been written up; the rest are listed in the appendix. The appendix also includes properties in MINFILE which list talc as an associated or secondary mineral.

GEOLOGICAL SETTING

Talc and pyrophyllite are secondary minerals, formed as products of hydrothermal alteration during low grade regional metamorphism.

TALC

Talc forms as an alteration product of magnesium silicates such as olivine, pyroxenes and amphiboles, or by the reaction between magnesium and silica. Minerals commonly associated with talc are chlorite, dolomite, tremolite, anthophyllite, antigorite, serpentinite, magnesite, magnetite and chromite. The magnesium and silica required for the formation of talc may both be supplied by the host rock or the silica may come from hydrothermal solutions emanating from nearby acid intrusions or from adjacent siliceous beds.

The most common geological settings for talc formation are: (1) within regionally metamorphosed and/or hydrothermally altered ultramafic rocks, (2) in association with schists, generally chloritic, (3) with dolomite and magnesite, or (4) with mafic volcanics.

The talc deposits in British Columbia are classified in this report according to the host rock. A few deposits could be assigned to more than one category, particularly those described as schists, which are very likely sheared and completely altered serpentinite bodies, for example, the deposits near the Nahatlatch River, the J & J (T25) and Gisby (T24) properties. The complication of shearing is common as many occurrences are formed in fault zones.

Altered Ultramafic Rocks

The association with serpentinite and ultramafite is the most common setting for talc deposits. There are many very small talc occurrences of this type in the province and only the most promising are described in detail. The talc has formed as a result of low temperature alteration of magnesia-bearing minerals such as olivine, hypersthene, enstatite and augite. It is usually foliated and forms at considerable depths. Talc can form by direct metasomatism of ultramafic rock or serpentinites. Talc development not associated with serpentinization requires an especially open circulation system, through deformation and faulting. Talc is usually found at the margins of ultramafic bodies or within shear zones, and is usually associated with abundant carbonate.

Schists

Schists are the second most common host for talc alteration. Three of the four past producers in British Columbia are of this association. The schists vary widely in composition, they may be chloritic, quartz-sericite-graphite or low grade metamorphic mineral assemblages. The pre-metamorphosed sediments are the source of magnesia and silica.

Dolomite and Magnesite

Talc may form through direct alteration of dolomitic sedimentary rocks. Silica is provided by circulating hydrothermal solutions from nearby intrusions or from an adjacent quartzite bed. The reaction that takes place is as follows (Winkler, 1974):

3 dolomite + 4 quartz + water ---> talc + 3 calcite + 3 carbon dioxide

This alteration may have an intermediate phase of tremolite or another magnesium silicate and chlorite is commonly present.

Almost all the talc mined in Montana and in the Madoc district in Ontario is of this type, but it includes only 15 per cent of the known talc showings in British Columbia.

Mafic Volcanics

Talc is formed, especially along faults, as a result of magnesia-bearing solutions circulating through mafic volcanics. The Chu Chua (T38) is the only occurrence of this type in British Columbia.

PYROPHYLLITE

Pyrophyllite is a relatively rare mineral, found in association with acid volcanic rocks, as a hydrothermal or metasomatic alteration of feldspars in rhyolites, dacites and andesites. Associated minerals are kaolinite, alunite, quartz, sericite, montmorillonite, diaspore, corundum and less commonly, pyrite, chlorite, feldspar, hematite and magnetite.

The pyrophyllite mined near St. John's, Newfoundland is in hydrothermally altered, sheared rhyolite. The ore is found in shear zones near granitic contacts. Of the four British Columbia pyrophyllite showings, the largest, at Kyoqout Sound (P1), is hosted in dacitic to andesitic volcanics, with abundant associated alunite.

Some varieties of pyrophyllite found in other parts of the world are; in South Africa, wonderstone, with a hardness of 8, consisting of pyrophyllite, chloritoid, epidote and rutile; and in South Korea, a massive variety of pyrophyllite called agalmatolite is used for carving.

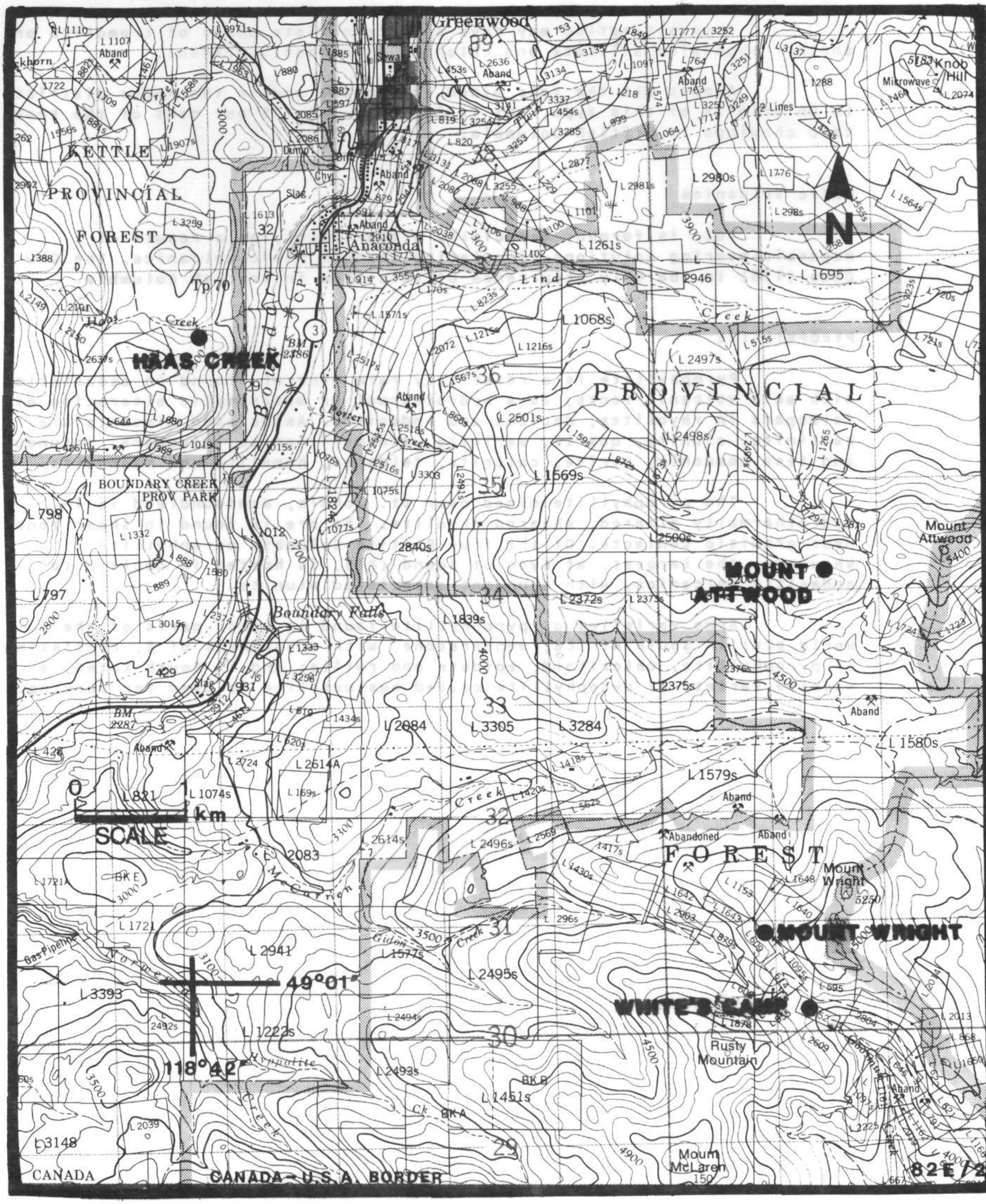


Figure 2. Talc locations in the Greenwood area, T1 .

OCCURRENCES ASSOCIATED WITH ULTRAMAFICS

Greenwood Area — T1

White's Camp (Goosmus Creek)

MINFILE: 082ESE038
NTS: 82E/2E
49°00'50", 118°37'20"
Elevation: 1380 metres

Soapstone is found at the headwaters of Goosmus Creek, known as `White's Camp', between Mount Wright and Rusty Mountain (Figure 2). The serpentinite in this area is intensely sheared and mottled dark and light green, locally altered to talc. Partially talc-altered ultramafite is also reported further east in Gibb's Creek (Little, 1983).

Mount Attwood

MINFILE: 082ESE221
NTS: 82E/2E
49°03'07", 118°37'20"
Elevation: 1575 metres

Talc is found southwest of Mount Attwood (Figure 2), on both sides of two large `knockers' of Permo-Carboniferous chert of the Knob Hill Group, which are contained within a Cretaceous ultramafite body. The talc forms a bluff 3 metres high and generally contains disseminated magnetite, but with streaks and lenses of pure talc 15 to 25 centimetres long (Church, 1986).

Haas Creek

MINFILE: 082ESE222
NTS: 82E/2E
49°04'20", 118°41'50"
Elevation: 990 metres

Talc is found on the south bank of Haas Creek (Figure 2), located about a kilometre north of the Skomac mine, 1.5 kilometres southwest of Greenwood. The talc is hosted in serpentinized ultrabasic rocks (Cretaceous) which form sills and irregular dyke-like masses along unconformable surfaces and in fault zones. The serpentinite intrudes the contact between `old diorite' (Triassic) and Permo-Carboniferous metavolcanics of the Attwood Group. The sheared marginal phases of the serpentinite are commonly altered to talc and talc-carbonate schist (Church, 1986).

Mount Wright

MINFILE: 082ESE223
NTS: 82E/2E
49°01'20", 118°37'25"
Elevation: 1425 metres

McCammon (1967) reported several occurrences of talc-carbonate alteration in `slips' in serpentine, outcropping on the southwest slope of Mount Wright (Figure 2). On the Mabel property, a trench cut through serpentinite exposed a distinctive blue massive talc (Church, 1970; personal communication, 1987).

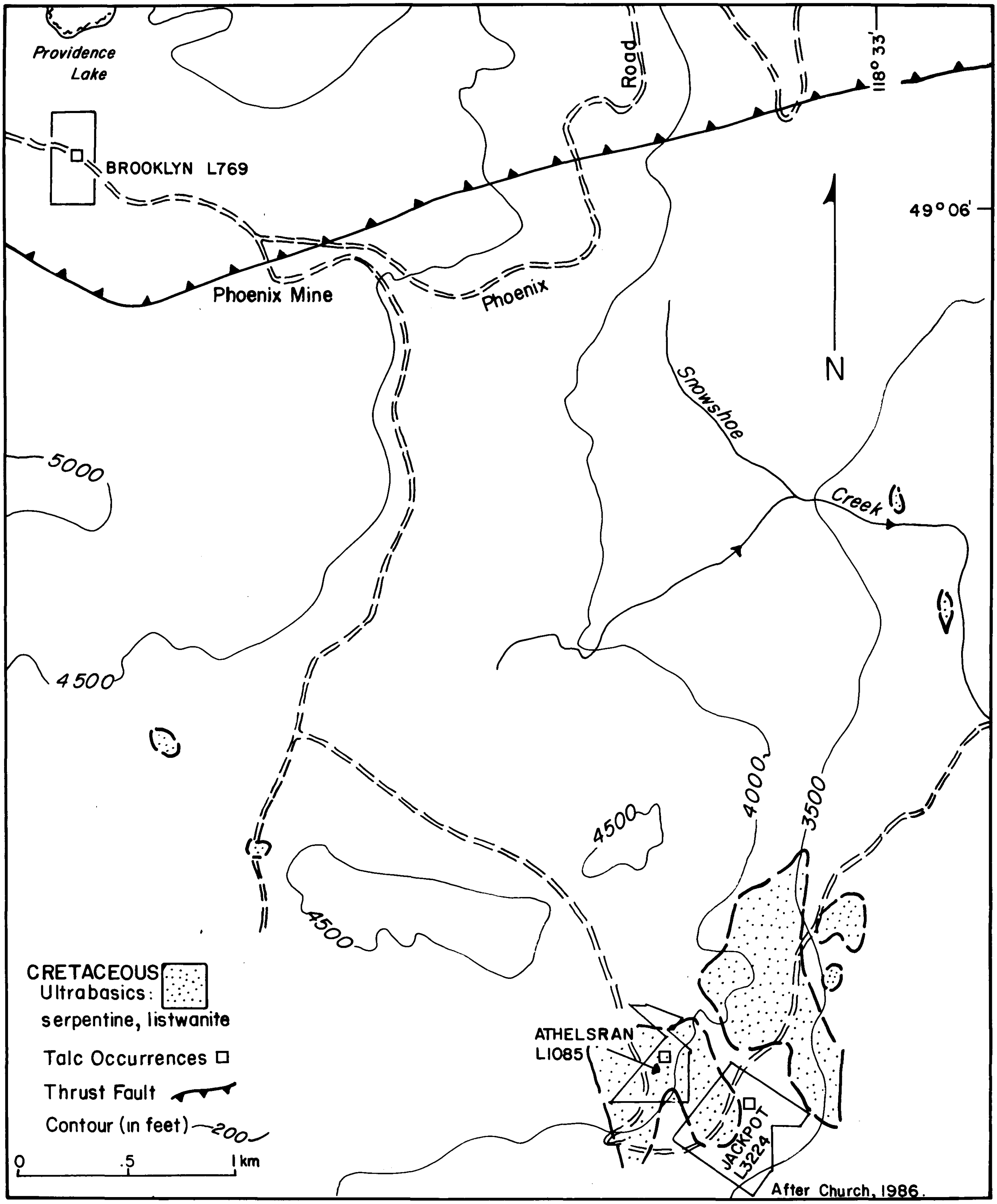


Figure 3. Location of talc near the Phoenix mine, T2 .

Phoenix T2

MINFILE: 082ESE013, -047
NTS: 82E/2E
49°06'36", 118°36'06"
Elevation: 1380 metres

Talc is associated with serpentinized ultrabasic rocks which are widely distributed in the area of Phoenix mine, east of Greenwood. The ultramafic rocks show massive and schistose phases; sheared margins are often altered to talc and talc-carbonate schist. The contacts with surrounding country rocks are intensely sheared. The ultrabasics are Late Mesozoic to Cretaceous in age, and intrude mainly Triassic Brooklyn Group volcaniclastics and sediments, and Cretaceous Greenwood granodiorite.

Talc is found north of the Phoenix pit, not exposed on surface but in drill holes on the Brooklyn claim (Figure 3). The talc occurs below a major thrust which separates Triassic Brooklyn Group rocks from basement rocks of the Knob Hill Group (Church, 1986; personal communication, 1987).

Talc-carbonate-altered serpentinites are also found at the Athelsran-Jackpot mine, located 8 kilometres southeast of Phoenix mine. Talc-carbonate schist is most prominent adjacent to bodies of younger quartz diorite and quartz feldspar porphyry intrusions. Talc-carbonate rocks are exposed over a maximum width of 170 metres from the top of the hill above the Athelsran adit to at least as far as the Jackpot adit (McNaughton, 1945). The talc-carbonate rocks have a greater carbonate content than those derived from serpentinites elsewhere in the area.

Asbestos Group T3

MINFILE: 082KNW075
NTS: 82K/13W
50°45'10", 117°56'
Elevation: 1260 metres

The Asbestos group property is located on the western slope of Mount Sproat, 38 kilometres south of Revelstoke (Figure 4). The asbestos deposit has been known since 1921, and a test shipment of asbestos fibre was made in 1928.

Talc and asbestos occur in a serpentine-altered ultrabasic dyke (peridotite or pyroxenite), 270 metres wide and 400 metres long, which strikes north and intrudes Precambrian Hamill Series grey quartzite, phyllite, slate and schist. The Hamill Series is stratigraphically overlain by quartzites, schists and limestones of the Lardeau Series. Between the Hamill and Lardeau rocks a limestone formation occurs, which is believed to be the stratigraphic equivalent of the Bradshaw limestone. The ultrabasic dyke intrudes just above this limestone unit; it is discordant with the metasediments near the workings, but becomes concordant to the northeast (Purdie, 1953).

The dyke forms two parallel bluffs; the western bluff exposes talc and serpentine in contact with limestones. To the southwest, the gradation can be seen from talc-actinolite schists to mixed schists to interbedded argillites and limestone. The eastern bluff-forming serpentine exposure is also in contact with metasediments, but is barren of talc.

In general, the dyke is mostly composed of serpentine in its central core, while the outer edges are altered to talc-carbonate schist; in narrow sections the serpentine is absent and the entire width is talc-

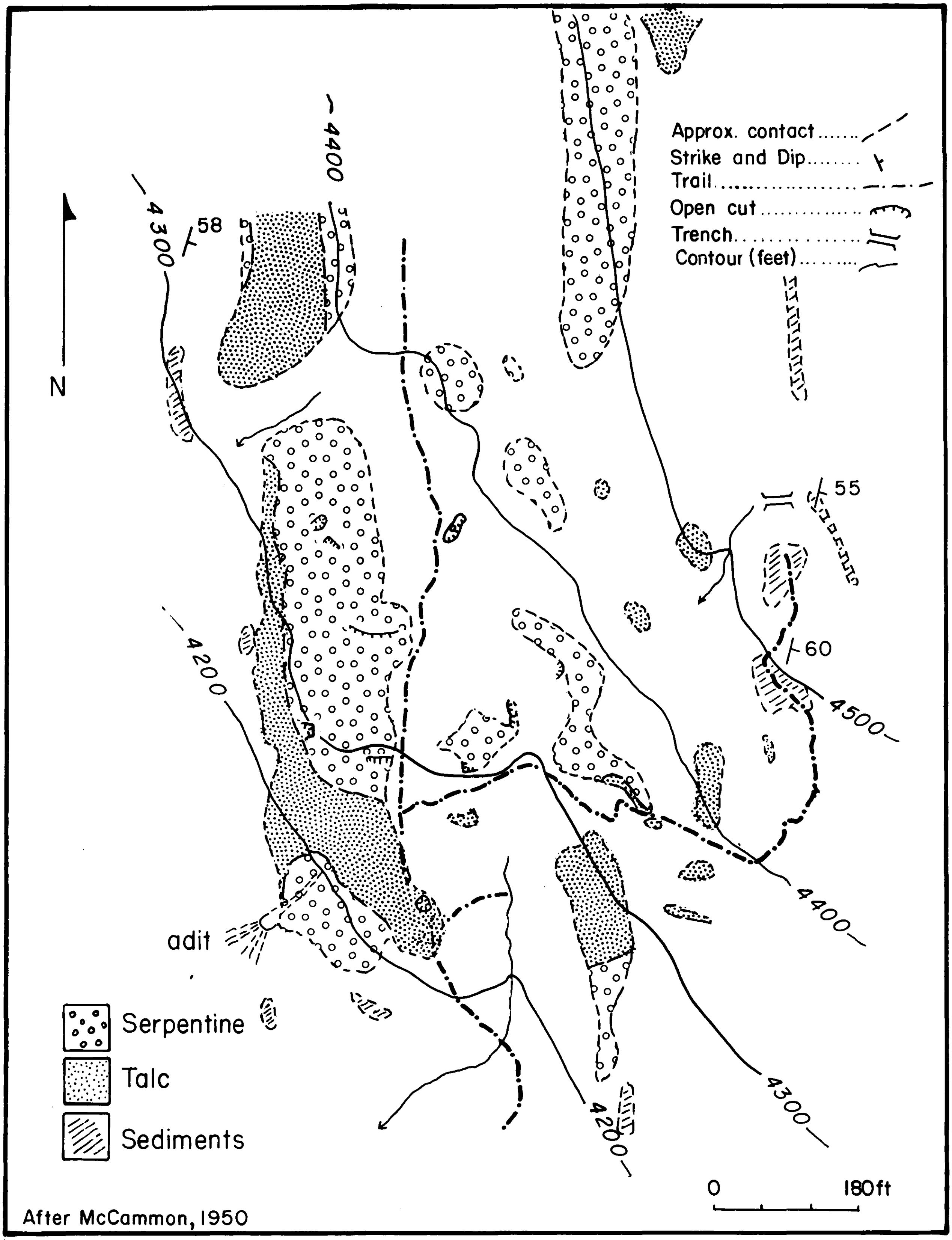


Figure 4. Geology of Asbestos group property, T3 .

schist. The serpentine portion is mostly composed of antigorite with magnetite and olivine remnants and minor calcite and chrysotile cross-fibre veinlets. The talc schist is greenish white to dark grey, and greyish white when pulverized. The talc contains many crystals and veinlets of magnesite, which are weathered out on the surface.

The largest zone of talc is at the bottom of a pit, 6 metres wide by 15 metres long by 1.8 metres deep, within grey talc schist. This talc is fine grained, micaceous and dark, and contains coarse-grained magnesite and granular magnetite (Wilson, 1926).

X-ray diffraction analysis of two grab samples by the Ministry of Energy, Mines and Petroleum Resources in 1986, showed the talc to be composed of 40 to 60 per cent talc, up to 25 per cent magnesite, 5 to 10 per cent chlorite, lesser amounts of magnetite and trace amphibole.

Highland Surprise (Phoenix Gold) — T4

MINFILE: 082KSW144
NTS: 82K/3E
50°03'42", 117°07'24"
Elevation: 1665 metres

The Highland Surprise property is located about 3.5 kilometres northeast of Retallack, on the west side of Lyle Creek, a tributary of Whitewater Creek (Figure 5).

The area is underlain by Kaslo Series volcanic rocks, mostly andesite and dacite which are chloritized. A serpentinite belt, about 300 metres wide, cuts through the Kaslo Series and on the Highland Surprise property the serpentinite is largely altered to talc and carbonate.

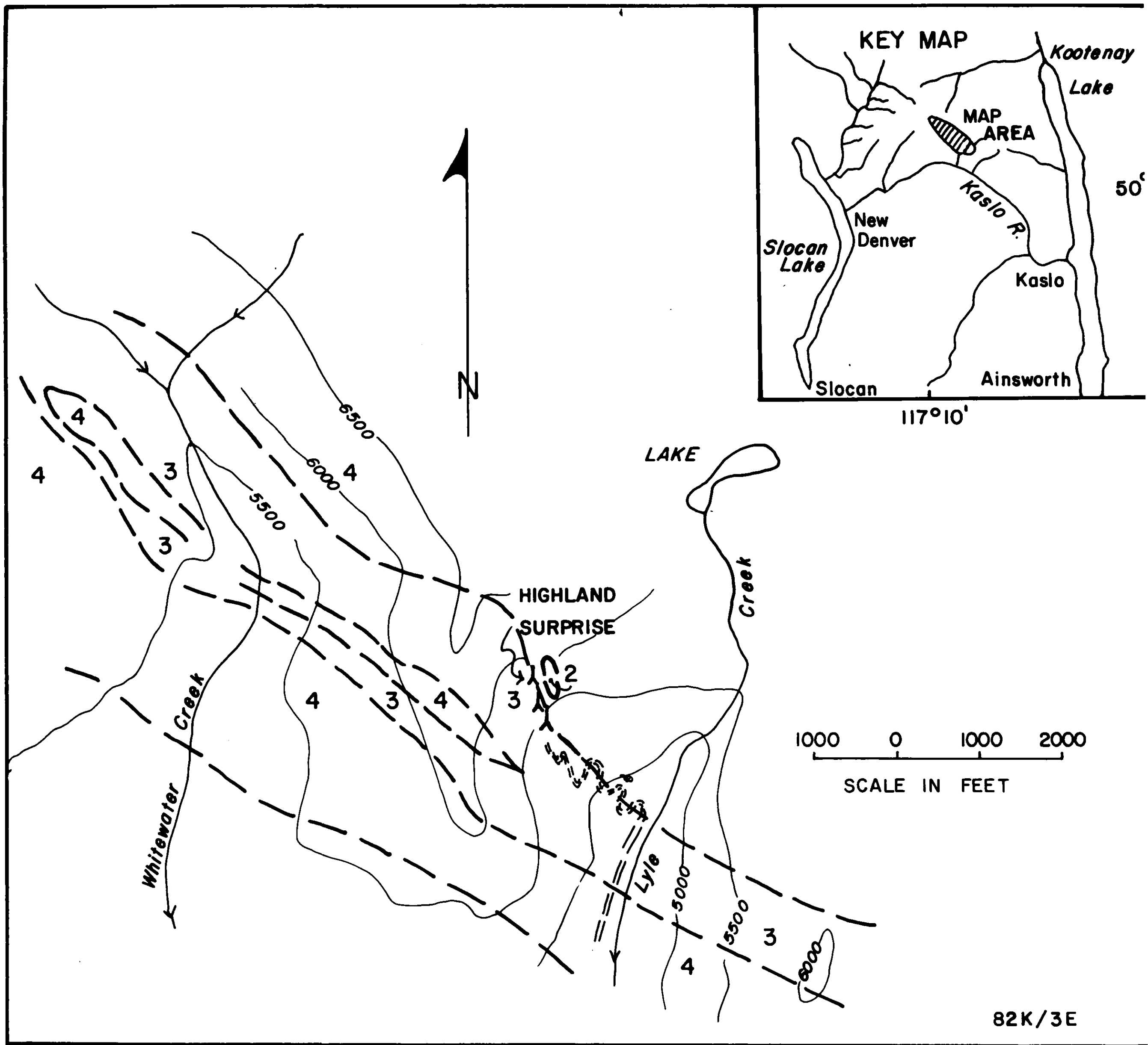
Cairnes (1934) reports "conspicuous amounts of talc" and mariposite developed on the property, where a large body of serpentine, located in the vicinity of the quartz veins, is largely altered to talc and brownish weathered (Ca-Mg-Fe) carbonate. The surrounding massive greenstones are altered to chlorite, serpentine, uralite, saussurite and albite. The alteration is believed to be related to the intrusion of the Mount Nelson batholith.

Chrome-Vanadium (Alocin, Vanadium) — T5

MINFILE: 082LSW056
NTS: 82L/4W
50°00'40", 119°52'06"
Elevation: 1440 metres

The Chrome-Vanadium group is located at the headwaters of the Nicola River, 27 kilometres west of the Kelowna bridge (Figure 6). The property is reached by vehicle via the Bear Lake logging road, then by a 19-kilometre trail to Eileen Lake. The claims have been worked for their chromite potential with which talc alteration is associated.

A belt of serpentinized dunite 180 metres wide and approximately 5.5 kilometres long strikes north-northwest from Cameo Lake in the south, to the north end of the property. The dunite is massive and dull green, weathering red or white. It is mainly composed of olivine with grains of magnetite and chromite, and short stringers (up to 6 millimetres wide) and lumps of pearly grey, semitransparent talc. Pyroxene and chlorite are associated minerals. The ultramafic body is steeply dipping and dyke-like, intruding slaty argillites and limestones



LEGEND

SLOCAN SERIES

| 1 | Slate, argillite, quartzite, limestone (in part fossiliferous), conglomerate, tuffaceous sediments.

KASLO SERIES

| 2 | DIORITE- Margins irregular and not defined.

| 3 | SERPENTINE- Dark green on freshest surfaces; pink, black, white, bright green, light grey on weathered surfaces.

| 4 | GREENSTONE- Massive and schistose. Flows, pyroclastics, and minor occurrences of sediments; all metamorphosed to make differentiation difficult. Predominantly dark green in colour and fine in grain.

Adit ⅄

Geological boundary

Contour (feet) 1000

Road

Trail

After Maconachie, 1940.

Figure 5. Geology of Highland Surprise property, T4 .

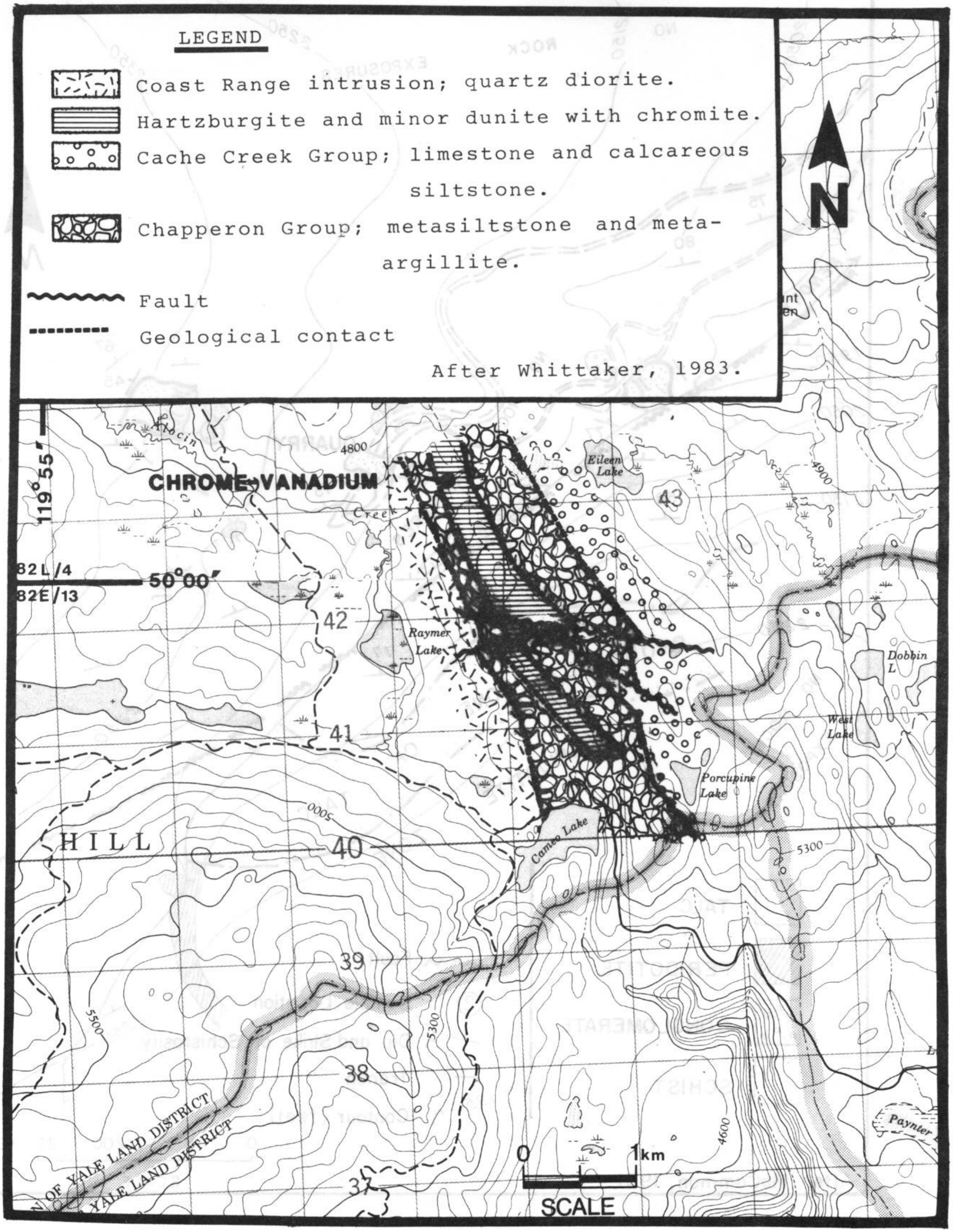


Figure 6. Geology near the Chrome-Vanadium property, T5 .

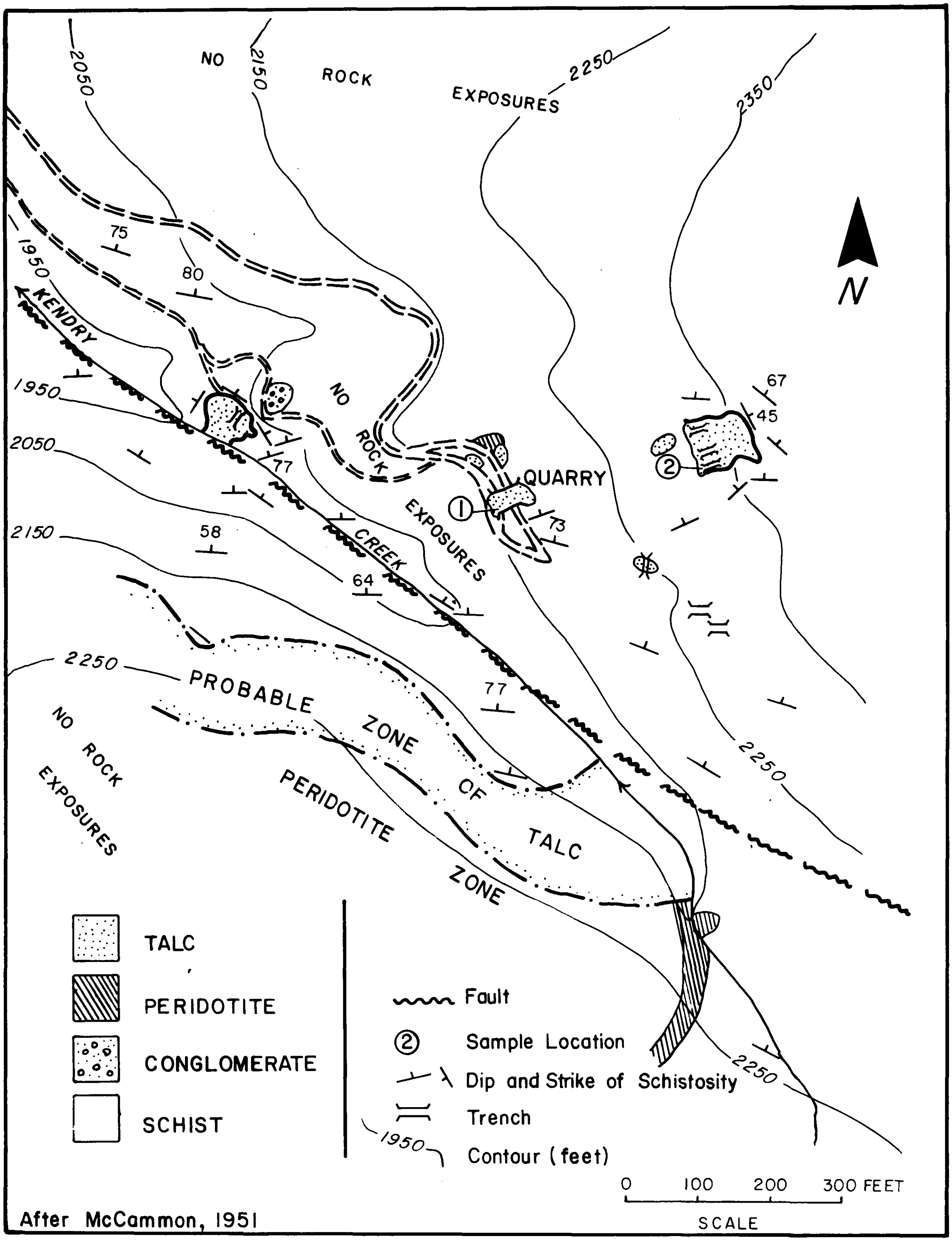


Figure 7. Geology of Barbara-Ann deposit, T6 .

between two granite stocks.

The ultramafics are part of the Windermere age(or younger) Old Dave intrusions; these cut the Archean metasediments of the Chapperon Group. Jurassic or younger dykes ranging from gabbro to quartz diorite and granodiorite in composition cut the Chapperon - Old Dave package.

Barbara-Ann
(Sonny)

T6
MINFILE: 082LSW063
NTS: 82L/6E
50^{o}, 119^{o}
Elevation: 595-715 metres

The Barbara-Ann deposit occurs on both sides of Kendry Creek, about 5 kilometres northeast of Armstrong, 1.6 kilometres east of where Highway 97 bends north towards Enderby (Figures 7 and 8). Workings consist of a small quarry and several test pits and trenches.

Talc is found in discontinuous lenses in a northwest-trending serpentinized peridotite sill which intrudes bluish grey quartz-mica schists. The schist, part of the Shuswap metamorphic complex, is associated with hornblende gneiss, limestone and minor conglomerate. Talc outcrops are mostly on the north side of Kendry Creek. Immediately adjacent to the north bank, talc is exposed which is badly sheared, iron stained and contains a large carbonate content. Rarely, white crystals of talc 5 centimetres long are developed, together with actinolite-tremolite grains.

About 50 metres above the creek, a 9 by 12 metre quarry exposes talc within schists. Fifteen metres northwest of the quarry, talc is seen grading into dark green altered peridotite. A sample taken across 4 metres at the base of the quarry (Figure 7, Location 1) contained 71 per cent talc, 14.5 per cent magnesite, 2.5 per cent calcite and 6.25 per cent magnetite (Minister of Mines, B.C., Annual Report, 1951).

About 60 metres above the quarry, a bluff-forming lens of strongly sheared, highly iron-stained talc, measuring 20 by 20 metres, pinches out to the east. Occasional white fibrous flakes of talc occur with carbonate crystals. A sample at the south end of the exposure (Figure 7, Location 2) is composed of 52.5 per cent talc, 34.5 per cent magnesite, 1.5 per cent calcite and 5.75 per cent magnetite (Minister of Mines, B.C., Annual Report, 1951).

On the south side of Kendry Creek, the 60-metre-thick serpentinized peridotite sill strikes northwest and dips steeply east, parallel to the schistosity in the enclosing rocks. The sill appears to terminate against Kendry Creek, which is probably a fault trace.

At the top of the sill, that is, the north end, the main mass of serpentinite (with grains of olivine, talc, magnetite and tremolite) grades into tan to green talc-carbonate alteration, which extends for about 200 metres along strike.

Detailed chemical analyses of two samples, by the Ministry of Energy, Mines and Petroleum Resources in 1951, are given below. When tested, they both yielded a buff-coloured powder. A trial shipment of 43 tons of talc was made in 1950.

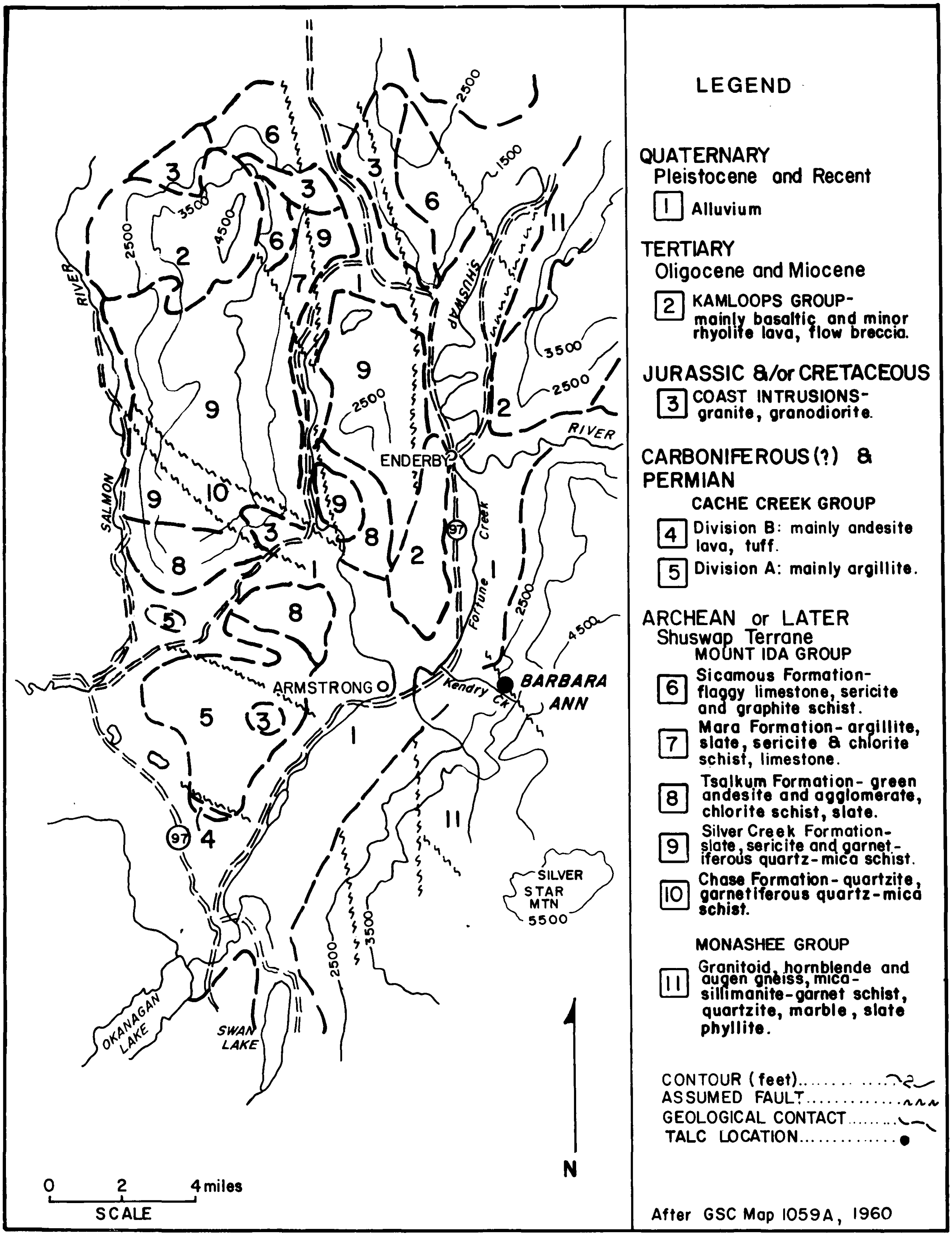


Figure 8. Regional geology of Barbara-Ann deposit, T6 .

Analyses of Samples from
Barbara-Ann Deposit
(per cent)

	1	2
CaO	1.34	0.88
MgO	29.23	33.14
CO_2	10.44	21.42
SiO_2	45.22	33.52
Fe (total) ..	4.50	4.23
Al_2O_3	1.32	0.32
H2O+	0.21	0.10
H2O-	4.52	3.22

Standard T7

MINFILE: 082M090
NTS: 82M/8E
51°23'05", 118°14'40"
Elevation: 2100 metres

The Standard property, on Standard Peak, is 41 kilometres north of Revelstoke in the Selkirk Mountains, northeast of the Columbia River (Figure 9). The property has been worked discontinuously since 1896 as a copper-silver-zinc-gold prospect.

Ultramafic pods lie within a metasedimentary phyllite unit, tentatively correlated with the Eocambrian Hamill Group (Høy, 1979). The pods, consisting of coarse-grained, brown-weathering talc-chlorite-serpentine-dolomite, are repeated as part of the Standard anticline. The anticline consists of metamorphosed volcanics and sediments; crystalline limestone, pyritic graphitic schists, grey sericite schists and hornblende-feldspar-chlorite schists.

Talc occurs mixed with carbonate and serpentine, sometimes with chrome-mica veining, along broad zones of alteration in greenstone. In the Nos. 2 and 3 adits 'pure', light green talc is reported to occur in shears in serpentine, together with a lesser amount of slip-fibre asbestos.

Monarch T8

MINFILE: 082M098
NTS: 82M/10E
51°40', 118°37'
Elevation: 600 metres

The Monarch showing is located near the mouth of Goldstream Creek on the east side of the Columbia River, 112 kilometres north of Revelstoke (Figure 10).

Exposures in three crosscut tunnels show graphitic and talc schists with serpentine layers. Several 'layers' of talcose material are reported. The rocks strike northwest and dip moderately northeast. At the No. 1 adit, 50 metres above the Columbia River, a 2.1-metre width of 'fair quality' talc is reported. Impurities include fine-grained magnetite. An analysis of this material yielded the following percentages (O'Grady, 1922):

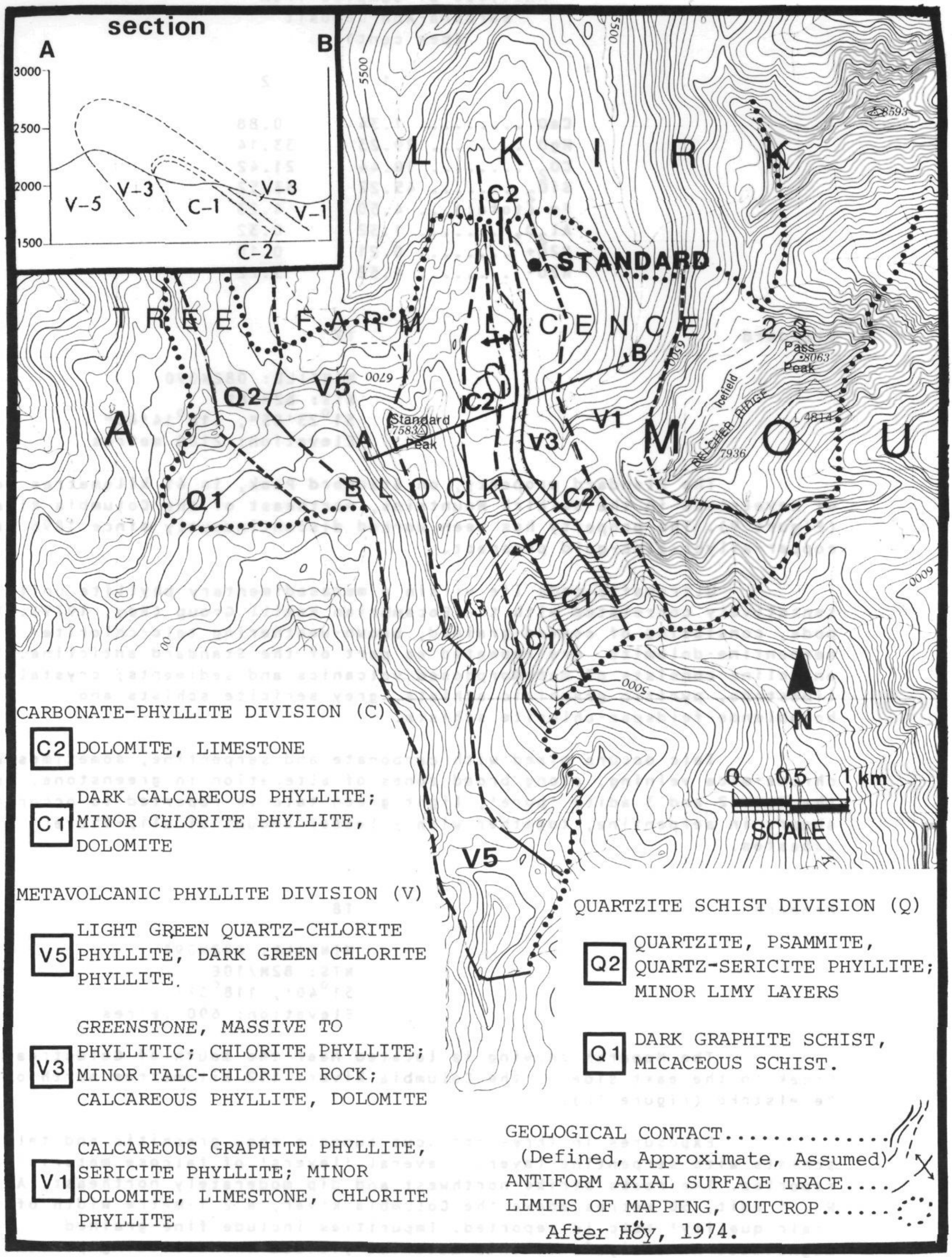


Figure 9. Geology of Standard Peak area, T7 .

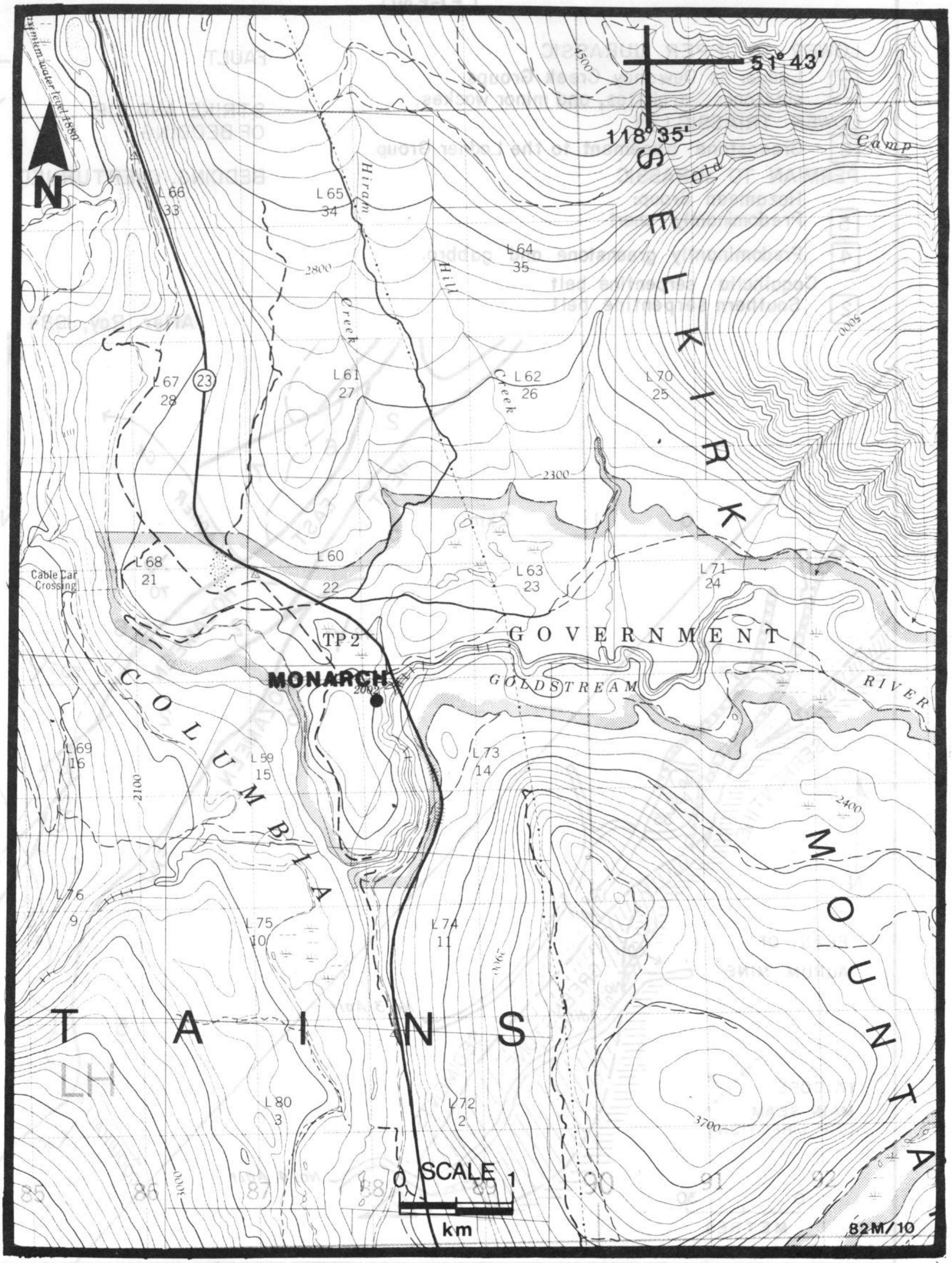


Figure 10. Location of Monarch showing, T8 .

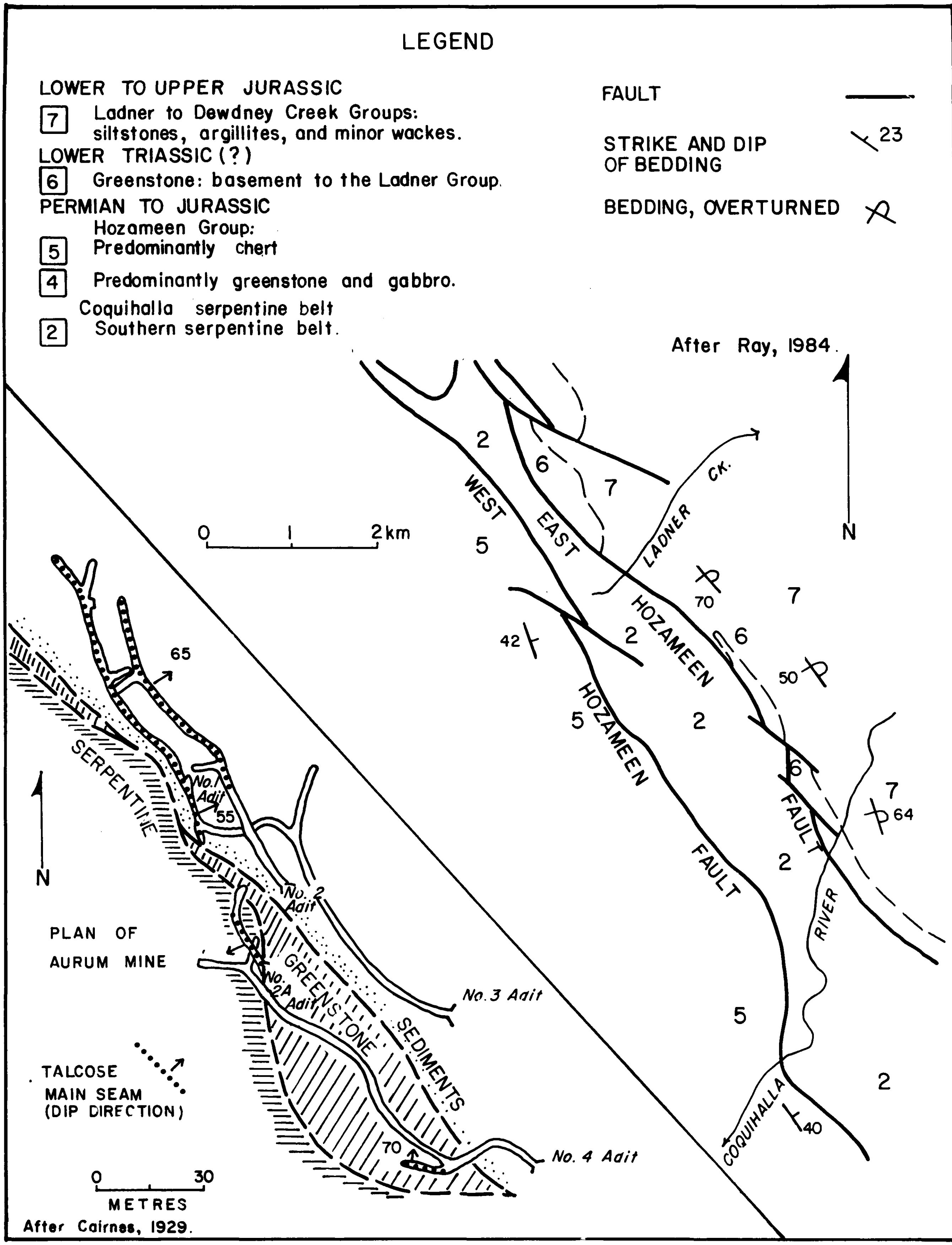


Figure 11. Geology of Aurum mine, T9 .

Silica	61.0
Fe-oxide	4.9
Alumina	0.6
Magnesia	32.0
Lime	trace
Loss on ignition ..	1.0

Similar material obtained from further within the same tunnel was analysed and found not to be composed of talc.

Aurum T9

MINFILE: 092HNW003
NTS: 92H/11W
49°30'22", 121°10'57"
Elevation: 1000 metres

The Aurum property is located on the south fork of Ladner Creek, about 17 kilometres northeast of Hope (Figure 11). A northwest-trending belt of serpentine, the southern portion of the Coquihalla serpentine belt, separates Permian to Jurassic cherts of the Hozameen Group to the northeast, and Lower to Upper Jurassic argillites and siltstones of the Ladner and Dewdney Creek groups to the southwest. The serpentine is strongly sheared and altered to talc over an average width of a few metres. The talc seam, which hosts gold orebodies, has been followed by many metres of underground workings.

The talc is mottled, mostly impure, foliated, light grey to dark green in colour and free of grit. It has a smooth greasy slip in powdered form. Impurities with the talc include sulphides, imperfectly altered serpentine and minor amounts of quartz and calcite.

Apparently soapstone production from this location was attempted in 1932.

Clover Leaf T10

MINFILE: 092HSW067
NTS: 92H/5E
49°21'30", 120°37'00"
Elevation: 60 metres

The Clover Leaf showing is on the southwest bank of Ruby Creek which drains southeast into the Fraser River, about 18 kilometres northeast of Agassiz (Figure 12). The area is mostly drift covered and exposures are poor.

The talc exposure is 10 metres thick with a strike length of 70 metres, contained within north-striking, steeply dipping chloritic phyllite. The talc is believed to be a completely altered ultramafic body, as many such bodies are seen nearby, including a bluff of pyroxenite north of the talc showing.

The talc is cream to dark greenish grey and weathers rust and green. The surface is highly fractured and slickensided, and the talc has a north-trending foliation. In thin section, the talc is seen to consist of 25 per cent tremolite-actinolite and 5 per cent magnetite. It yields an off white to grey powder.

The property has been drilled, first in 1964 and again in 1970. The later drilling intersected about 60 metres of talc in a hole dipping 33 degrees north, `possibly' along strike, indicating the depth of talc

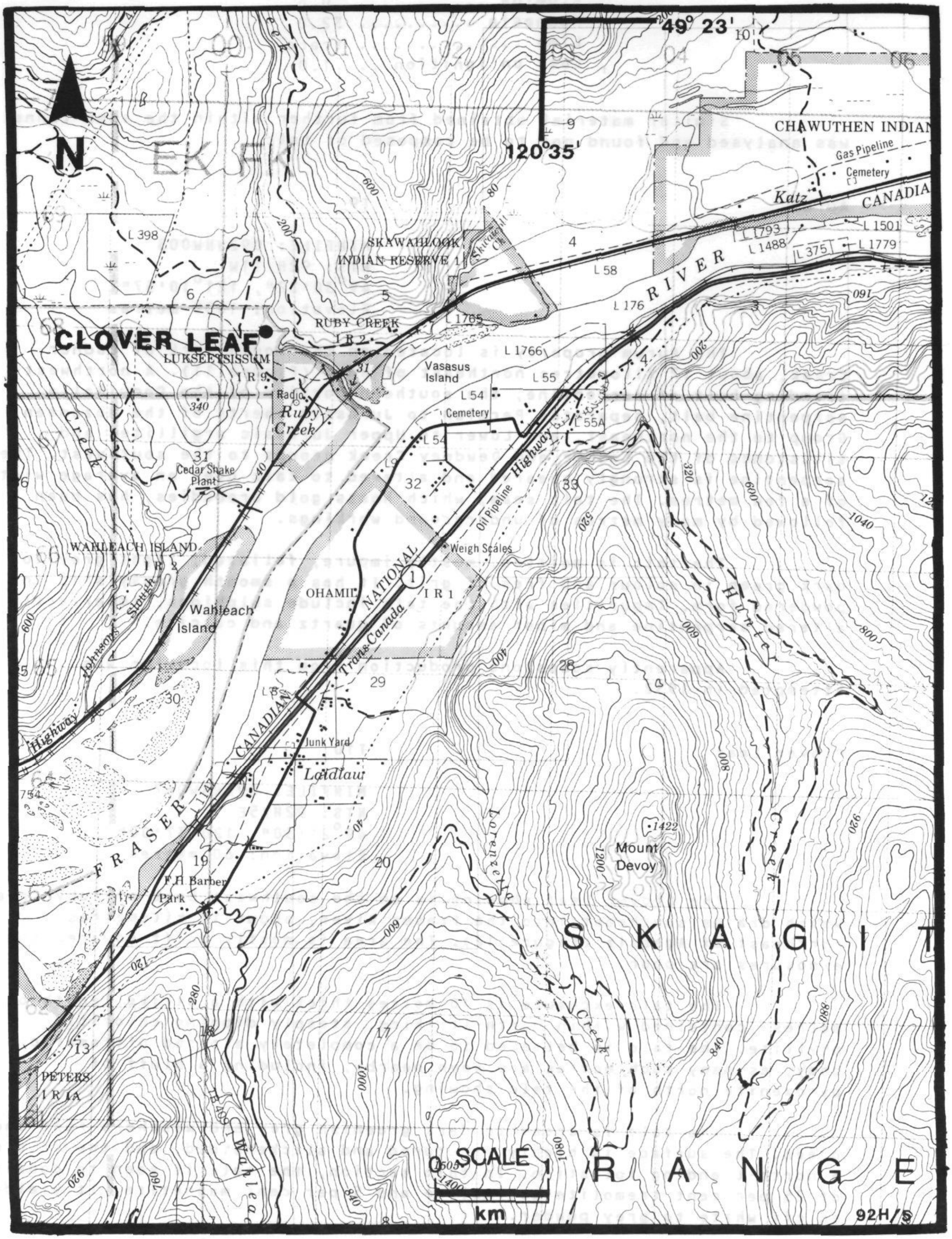


Figure 12. Location of Cloverleaf showing, T10 .

but not the true thickness (McCammon, 1974). Trenching and test pits have also been dug on the showing, dating to 1966.

H

T11

MINFILE: 092ISW064, 063
NTS: 92I/4E
$50^{\circ}03'$, $121^{\circ}37'$
Elevation: 1590-1650 metres

The H claims are located on a ridge west of the Fraser River, about 22 kilometres northwest of Boston Bar (Figures 13 and 14). Access is gained by crossing the Fraser River at Boston Bar to North Bend, then north to a road branching from near the confluence with the Nahatlatch River which leads to 1200 metres elevation. The claims are a further 6.5 kilometres northwest along the ridge.

The claims cover a 900-metre-wide serpentinized ultramafic body which trends northwest intruding phyllites; a band of phyllite is preserved within it. The ultramafics and metasediments are part of the Permian to Triassic Bridge River Complex (Monger and McMillan, 1984). The ultramafic rock is dark green to black and weathers buff to reddish brown. The rock is a fine grained, massive serpentinite with minor carbonate and 5 per cent magnetite.

Talc occurs in two zones, one on claims H-9, H-7 and G2 (MINFILE occurrence 092ISW063), and a less important showing to the south on H-16 and H-18 (MINFILE 092ISW064). The south talc zone lies within a shear; outrop in this area is scarce.

The northern zone is near a large lake and exposure on the surface shows a width of 90 metres with a strike length of 210 metres. The body strikes 110° and dips 55° south. The talc is pale green to white with a creamy buff-weathered surface and contains small quantities of disseminated magnetite. Thin sections show the rock to be composed of 50 per cent talc and 50 per cent carbonate and magnesite. Although strongly schistose in outcrop, the talc does not appear so in thin section.

Magnetometer work on the claims showed that very low values corresponded to phyllite bodies and talc was not detectable (Mark, 1974).

A laboratory examination of a bulk sample taken from the northern zone showed the talc to be very high grade, but the iron content makes it unsuitable for whitener or for a refractory base. The percentages given are: talc, 62; magnesite, 30; chlorite, 8; and Fe_2O_3, 5.8. The brightness factor is 63.1. The talc was suggested to be suitable as a low-grade filler (Chamberlain, 1973b).

Based on a 50-per-cent talc content, and a strike length of 210 metres in the northern zone, reserves are approximately 30 000 tonnes per vertical metre (Chamberlain, 1973a).

Work on the property in 1977 consisted of three trenches, totalling 29 metres in length.

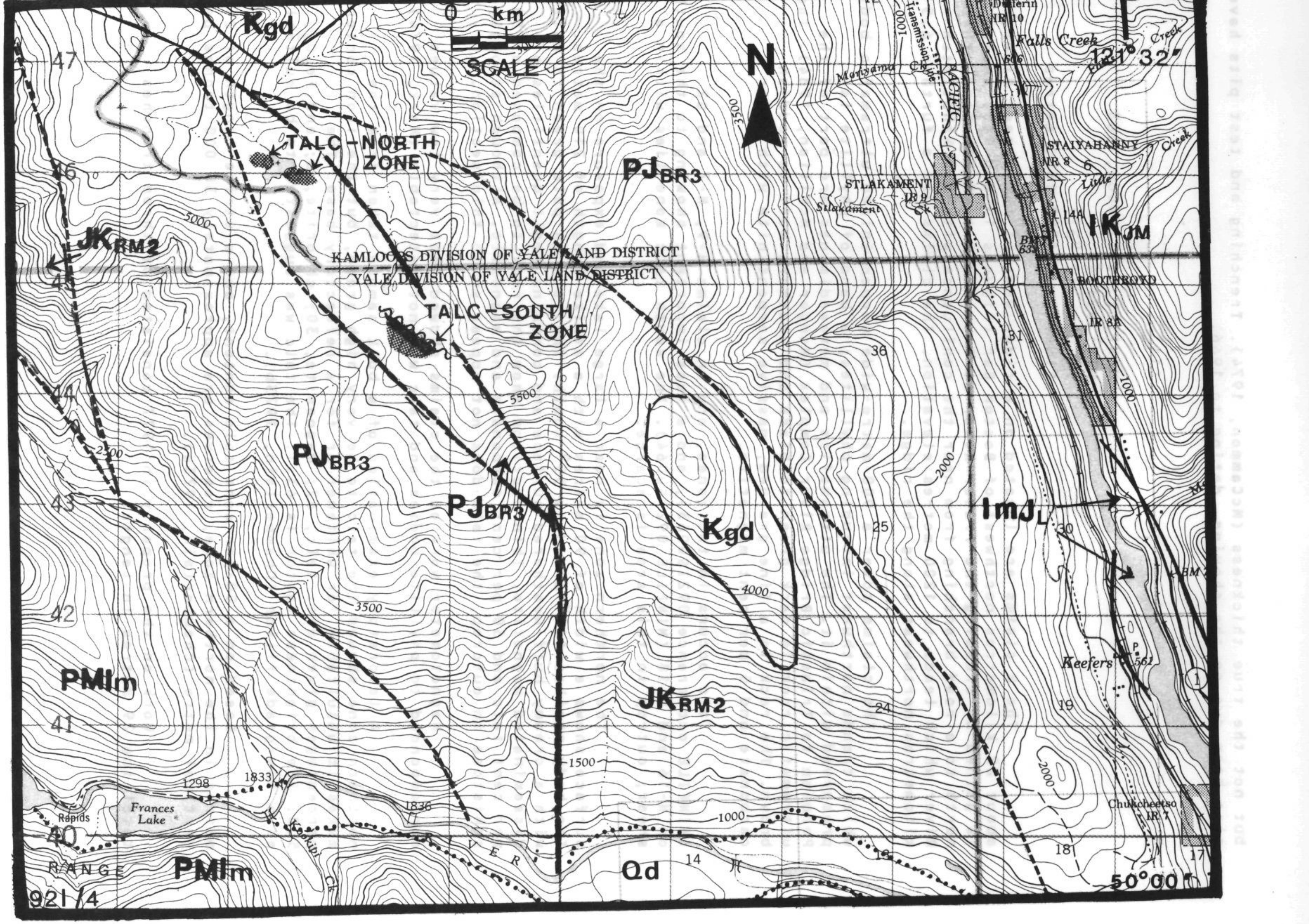


Figure 13. Geology of H claims, T11 .

LEGEND

Quaternary

Qd alluvium

Cretaceous

Kgd granodiorite, quartz monzonite, few or no included metamprphic rocks

Aptian & Albian & Older (?)

lK_{JM} Jackass Mountain Group
-sandstone, conglomerate from granitic and volcanic sources, shale.

Jurassic & Cretaceous
Neocomian &(?) Older

JK_{RM2} Relay Mountain Group
-phyllite, semischist, local conglomerate, foliated low-grade metamorphic equivalents of RM1 (argillite, siltstone, sandstone, and local conglomerate)

Sinemurian to Callovian

lmJ_{L} Ladner Group
-argillite, siltstone, sandstone and foliated low grade metamorphic equivalents.

Permian to Jurassic

PJ_{BR2} Bridge River Complex
-ultramafic rocks, mainly serpentinite.

PJ_{BR3} Bridge River Complex
-phyllite, quartzose phyllite, foliated greenstone, low grade greenschist facies metamorphosed equivalents of BR1 (radiolarian chert, argillite, basalt, pillow basalt, local carbonate, local gabbro), commonly well developed foliation.

SYMBOLS

Geological contact, approximate

Contact with alluvium

Fault

Talc deposit

Geology after Monger and McMillan, 1984, G.S.C. Open File Map 980.
Talc locations after Chamberlain, 1973.

Figure 14. Legend to accompany map, Figure 13 .

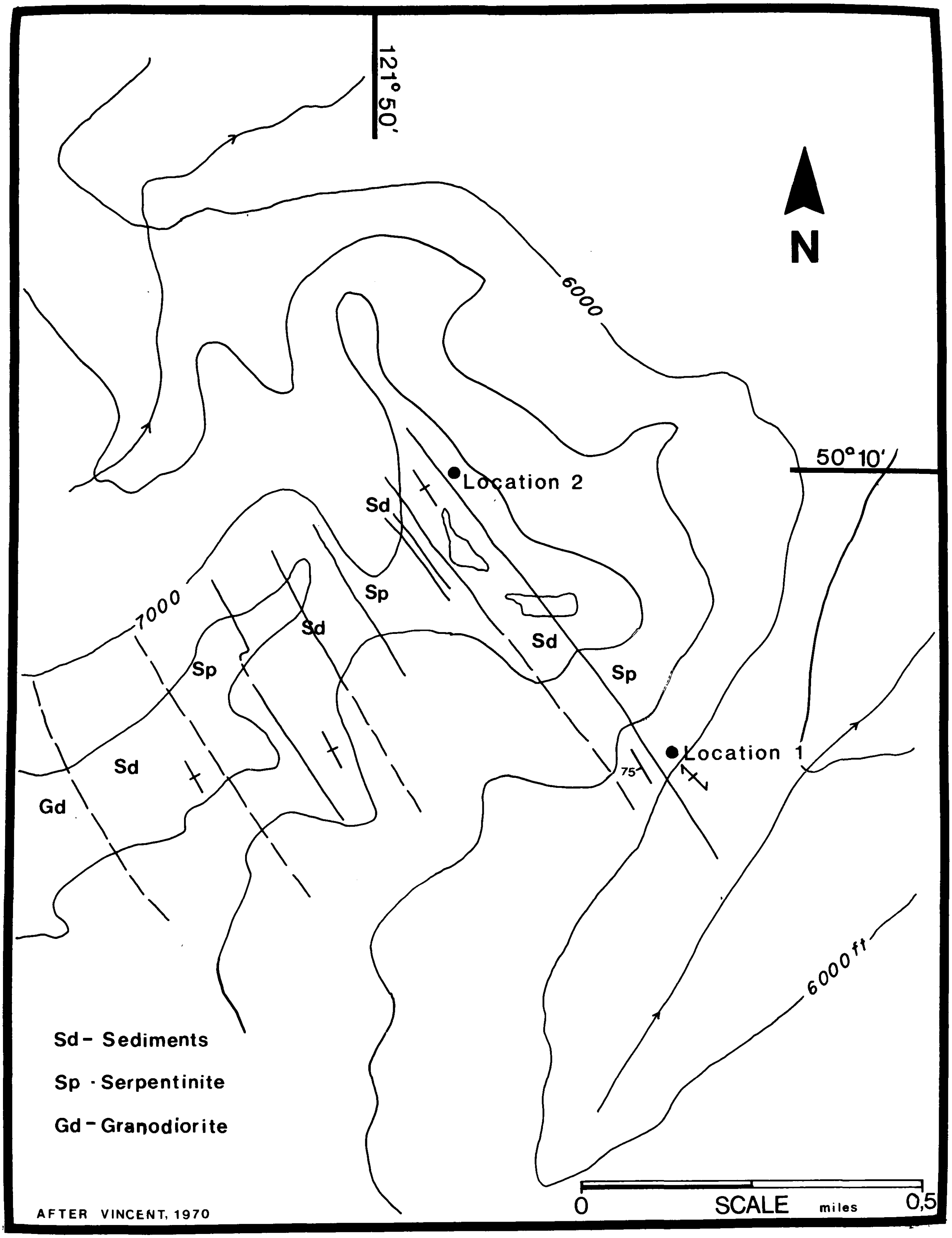


Figure 15. Geology of Rawhide claims, T12 .

Rawhide T12

MINFILE: 092ISW051, -052
NTS: 92I/4W
50°10', 121°50'
Elevation: 1950 metres

The Rawhide claims cover older asbestos and jade showings which occur in a serpentine belt, associated with cherty quartzite, argillite and graphitic and micaceous schists (Figure 15). Lenticular masses of tremolitic talc with carbonate are exposed in a small trench (Location 1). A pod of such material, 3 metres by 6.2 metres, lies concordant with the enclosing foliation.

Fibrous tremolite grades into white masses of talc and serpentine. The serpentine varies from blue-green to a light mottled buff to brown carbonate-rich combination of talc and serpentine. At Location 2, similar material is found in a few fractures in dark blue-black serpentinite.

Another talc showing is reported next to the old asbestos location. A 15 to 30-metre-wide zone is exposed over 120 metres and continues for several metres below the talus. A random grab sample contained about 95 per cent talc with associated tremolite (J.D. Carnahan, personal communication, 1987).

Cadwallader Creek T13

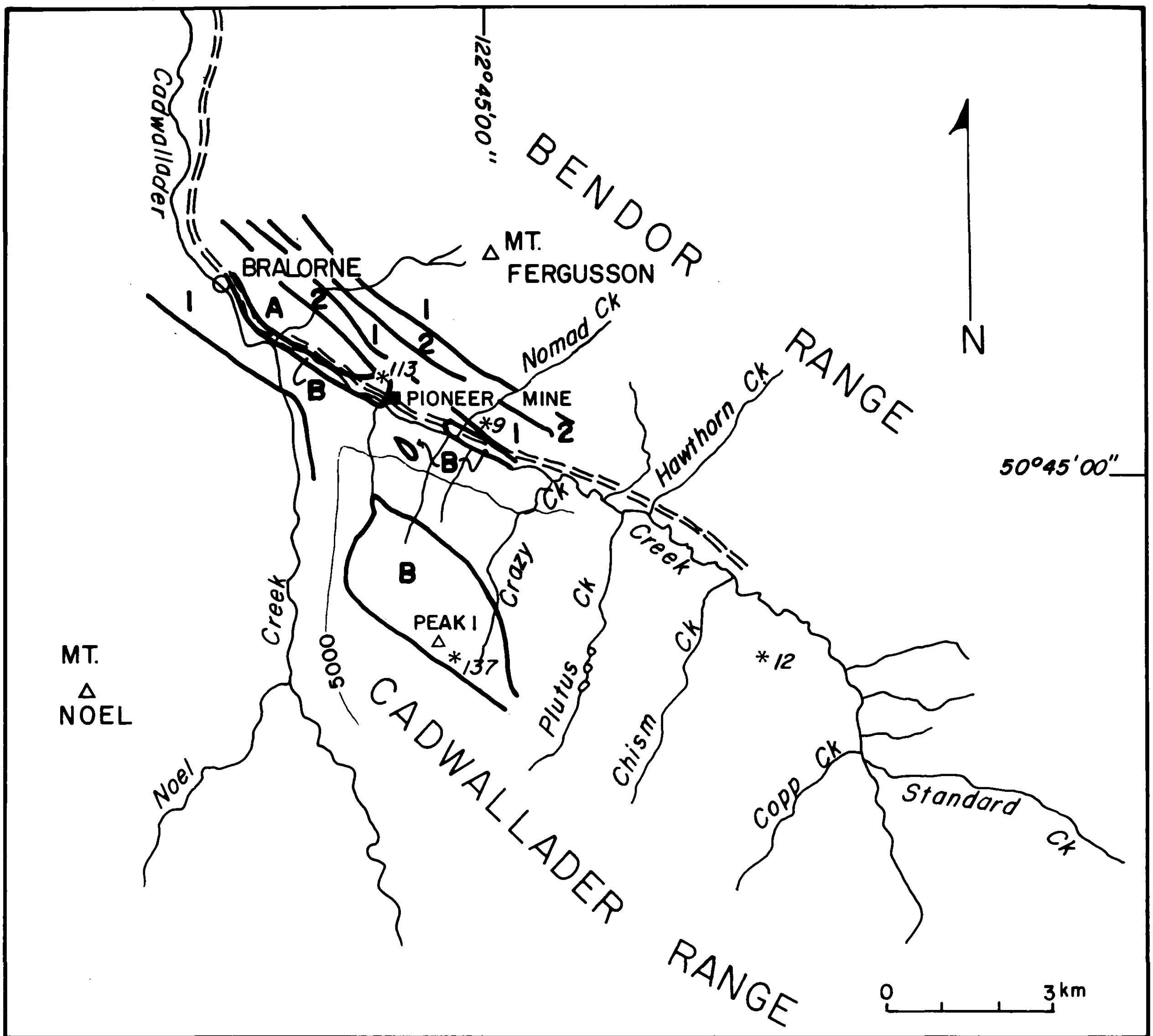
MINFILE: 092JNE009,
-012,-113,-137
NTS: 92J/15W
50°46', 122°46'
Elevation: ~1280 metres

Talc occurs as an alteration product within the serpentinite bodies of the Jurassic(?) President ultrabasic intrusions. The intrusions follow the Cadwallader fracture zone, trending northwest-southeast along Cadwallader Creek (Figure 16).

Talc is reported to be abundant in four locations; above the Pioneer mine (MINFILE 092JNE113), on the Red Hawk property (092JNE012), in a shaft on the Pioneer Extension claim (092JNE009) and on the ridge between the heads of Crazy and Plutus creeks (092JNE137).

Generally the talc is associated with approximately equal amounts of ankerite and contains serpentine, disseminated sulphides (mostly pyrite), magnetite and chromite. The colour varies from creamy white to dark reddish purple. The probable source of the altering hydrothermal solutions is the nearby Bralorne intrusions or, less likely, the Bendor batholith.

In the Pioneer Extension workings, a shaft cuts through 30 metres of highly talcose rock lying beneath an albitic dyke. Nodules of Bridge River chert and argillite are found within the talc bed. It has been suggested that this particular showing may not be derived from serpentinite, but directly from the metasediments. Magnesium necessary for this transformation could have been supplied from the nearby Bralorne gabbros and diorites or from late solutions emanating from the ultrabasic intrusions themselves. Analysis of the talc by the British Columbia Department of Mines (published in 1937) yielded the following (in per cent):



TRIASSIC

2 **Cadwallader Group**
Hurley Fm.
Noel Fm.
Pioneer Fm.

PALEOZOIC

1 Bralorne Group- mostly ribbon chert.

MESOZOIC

B Ultrabasic rocks- peridotite, serppentine.

PALEOZOIC

A Bralorne intrusions- amphibole, gabbro, diorite.

TALC OCCURRENCES
(by MINFILE Nos)

92JNE009	Pioneer Ext. (Au, Ag, Tc)
92JNE012	Red Hawk (Au, Tc)
92JNE113	Cadwallader Ck (Tc)
92JNE137	Crazy (Tc)

Road
Geological Contact
100 Contour (feet)
* Talc Occurrence

Modified from Church and MacLean, OF 1987-11 & Wright, 1974.

Figure 16. Geology and location of Cadwallader Creek showings, T13 .

Silica	58.40
Ferric Iron (+ minor alumina)	8.07
Magnesia	29.66
Water (by difference)	3.87

A 30-metre-wide zone of talc rock is also found on the north border of a serpentinite belt separating the altered ultramafics from soda granite. Albitite dykes intrude the talcose zones.

The Crazy Creek showing lies within what has been termed the Pioneer Ultramafite (Wright, 1974), an alpine-type peridotite body which is enclosed in lower greenschist facies sediments and volcanics of the Bridge River Group. Talc-carbonate alteration occurs along fault zones within the ultramafite which is highly serpentinized. A talc-magnesite-chlorite zone, ranging from a few metres to a few tens of metres wide, is developed near a fault and grades into serpentine north of `Peak 1' (Figure 16). The rock is strongly sheared and foliated, and consists of chlorite patches (replacing orthopyroxene) veined by calcite and dolomite in an extremely fine-grained matrix (0.01 millimetre) of talc-chlorite.

A talc-carbonate schist of variable width is developed between serpentinite and the contact with country rock. The talc zone is marked by either an abrupt shear zone or a gradational contact. There is a gradual increase of talc and talc-carbonate schist which contains 45 per cent magnesite in a matrix of fine-grained talc and minor chlorite.

St. John Talc
(Cayoosh Creek)

T14

MINFILE: 092JNE114
NTS: 92J/9E
50°39'10", 122°00'30"
Elevation: 480 metres

The St. John talc deposit is located on the Duffy Lake road which follows Cayoosh Creek from Pemberton to Lillooet. The workings are on both sides of the road, 9 kilometres from Lillooet (Figure 17).

In the upper workings, 30 metres above the road, two open cuts and strippings expose lenses of serpentinite and sheared soapstone measuring 2 by 0.75 metres. The serpentinite contains 2.5-centimetre nodules of soapstone.

The best, and largest, showing occurs 5 metres to the west where lenses of soapstone/serpentinite are 3 by 0.5 metres. Light green talc is located in the hangingwall of the serpentinite, in bands 0.5 metre long by 5 centimetres thick. The soapstone is mottled grey-green and peppered with crystals of rusty ankerite.

The workings 20 metres below the road are about 100 metres southwest across strike from the upper lenses. A large open cut contains a small amount of soapstone occurring with serpentinite in lenses parallel to the foliation in the enclosing rocks.

The host rock to all showings is ankeritic sericite schist; metasedimentary rocks of the Permo-Triassic Bridge River Group which lie in a band 100 metres wide striking northwest and dipping nearly vertical. Platy argillites lie conformably against the schist and are irregularly intruded by granite dykes.

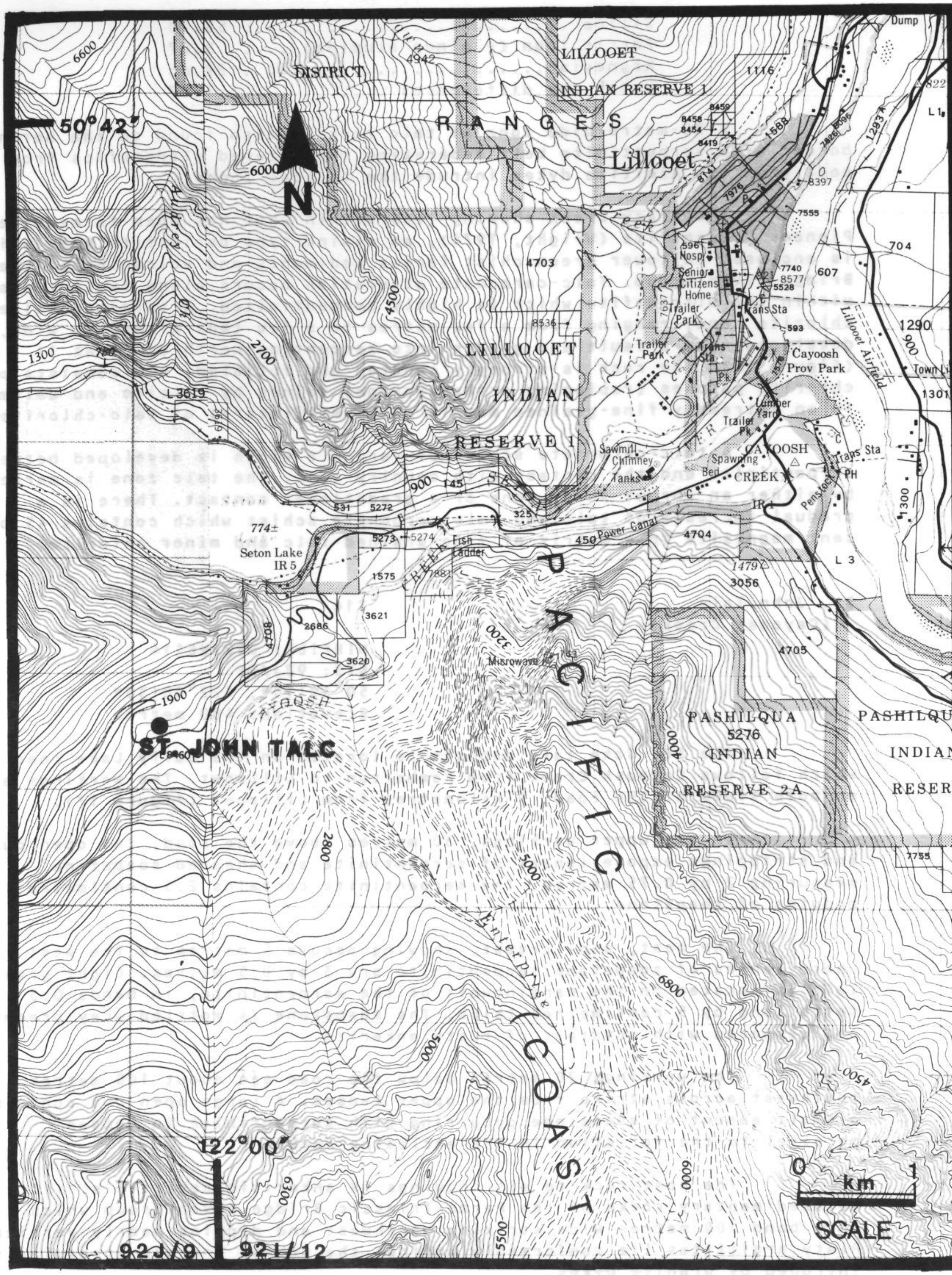


Figure 17. Location of St. John talc deposit, T14 .

Sovereign Creek (Wim, Wim-Ta, Tom)

T15

MINFILE: 093A013
NTS: 93A/13W
52°59'30", 121°53'30"
Elevation: 650-1350 metres

The Wim claims are situated near upper Sovereign Creek, on the right flank of Sovereign Mountain, about 36 kilometres southeast of Quesnel. The property is reached by turning off Highway 92 to follow the Barkerville road for 26 kilometres to the junction with the Swift River forestry road; the claims start at sign 1316, 10 kilometres along.

There are four talc showings; Dodo Creek, Creek 1, Creek 2, and Creek 3 north of the Swift Creek forestry road (Figure 18). All the showings are within 500 metres of the road, occurring along a strike length of 1 kilometre.

The talc is hosted by Mississippian to Permian(?) serpentinite and sheared ultramafic rocks of the Antler Formation, which are bounded on the southwest by Upper Triassic dolomite and phyllite. These rocks are thrust over the Mississippian (or Permian?) Ramos Creek succession of micaceous quartzite, phyllite, slate and limestone. Folding causes local bed repetition and thickening; the general trend of all rocks is northwest, with dips to the southwest. Talc occurs in altered serpentinized ultrabasics. It is found on the surface as discrete platy fragments (float) of talc-chlorite rock and in schistose talc-carbonate boulders.

The Dodo Creek showing is exposed for 30 metres along its length. Dark green serpentinized ultramafics contain 20 to 42 per cent light green to white talc blebs, ranging from very fine-grained to 1 centimetre long. The matrix contains mostly dolomite with lesser amounts of chlorite. Antigorite flakes (15 millimetres in length) are cut by reticulate talc and chrysotile veinlets.

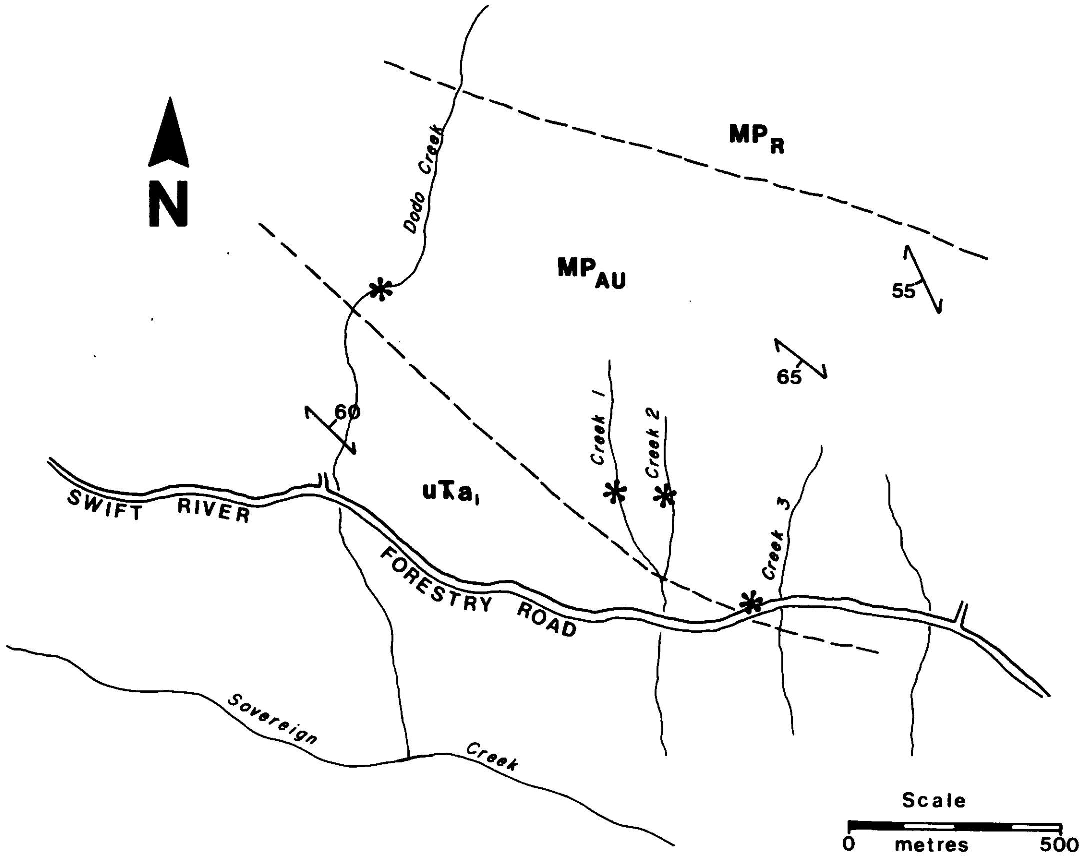
Drilling has indicated a higher grade talc schist (up to 95 per cent talc) which is associated with an albite syenite intrusion.

The Creek 1 and 2 showings are located 750 metres southeast of the Dodo Creek showing. Light green platy talc composed of 70 to 90 per cent talc and chlorite with minor disseminated pyrite and limonite is found in float. The fragments are angular, ranging in size from 30 to 60 centimetres; the size and shape suggest a close proximity to the source. Creek 2 contains coarser fragments than Creek 1, and some boulder-sized rocks of talcose material are found.

Another showing, just north of the Swift River forestry road on Creek 3, consists of several large boulders, up to 3 metres in diameter, of talc-carbonate schist. The boulders are mottled light green to light grey-brown and contain up to 85 per cent talc with associated carbonate (dolomite?) and minor limonite.

The four talc showings are aligned on a northwest trend for about 1255 metres, although outcrop is not continuous. An estimated 102 000 tonnes of talc ore are reported in the peridotites, based on six drill holes.

Four grab samples from the Sovereign Creek property were analysed by X-ray diffraction by the Ministry of Energy, Mines and Petroleum Resources laboratory in 1987; the results are as follows:



LEGEND

uTRa$_1$ phyllite, argillite, quartzite, schist, minor greenstone.

MP$_{AU}$ ANTLER FORMATION
-serpentinite, gabbro.

MP$_R$ RAMOS CREEK SUCCESSION
-quartzite, phyllite, slate, limestone.

SYMBOLS

65 foliation

road

geological contact

* TALC occurrence

After Trifaux, 1986.

Figure 18. Geology of Sovereign Creek showing, T15 .

Sample 1:
talc >> chlorite (10%) > dolomite > trace quartz and calcite (1-2%)

Sample 2:
talc >> dolomite (>10%) > chlorite (8%) >> trace quartz (1-2%)

Sample 3:
talc >> chlorite (20%) > dolomite (15%) >> minor quartz (5%)

Sample 4:
talc >> minor chlorite (5%), calcite (3%) and trace quartz (1-2%).

Ontario Research Foundation studies done for TRIFCO show the talc compares favourably with current marketable products. The peridotite talc rated 69.5 per cent brightness and the platy talc rated 74.5 per cent. Since the samples studied were weathered, the brightness, according to the authors of the report, would presumably improve with fresher material. Compared to a commercial product, the peridotite talc product was found to be more hydrophobic, but similar in density and pH (Trifaux, 1986).

Baptiste (Mount Sydney Williams) T16

MINFILE: 093K089
NTS: 93K/14W
54°51', 125°17'
Elevation: 750-1350 metres

Talc is associated with the Mount Sydney Williams ultramafic massif in the area between Trembleur Lake and Baptiste Creek, southwest of Mount Sydney Williams (Figure 19). The area is 85 kilometres northwest of Fort St. James.

The Mount Sydney Williams peridotite batholith is part of the Permian to Triassic Trembleur intrusions which include hartzburgite and dunite (which are 60 per cent serpentinized) and intrude Paleozoic cherts and argillites.

Carbonate, quartz and mariposite occur in zones of hydrothermal alteration along faults, shears and fractures. However soapstone bodies with talc and carbonate are massive and do not appear to be structurally controlled.

Two large masses of soapstone occur in the southern part of the stock. The surrounding rock is red, green and orange-weathered and contains elongate euhedral olivine crystals in a talc matrix; all the serpentine and pyroxene is completely replaced.

The borders of the ultramafic bodies, especially along serpentine and siliceous sediment contacts are altered to talc, chlorite-actinolite and tremolite. The talc and carbonate zones are greenish to buff with a greasy lustre. Average compositions are 60 per cent talc, 40 per cent ankerite with accessory magnetite, chromite and pyrite.

On the southeast face of Mount Sydney Williams, a 15 to 30-metre-wide talc-carbonate zone with minor actinolite crystals, marks the contact between serpentinite and peridotite, and siliceous sediments. The characteristic succession for steatitization is observed here; hornblende to actinolite/tremolite to chlorite to talc to carbonate (Armstrong, 1949).

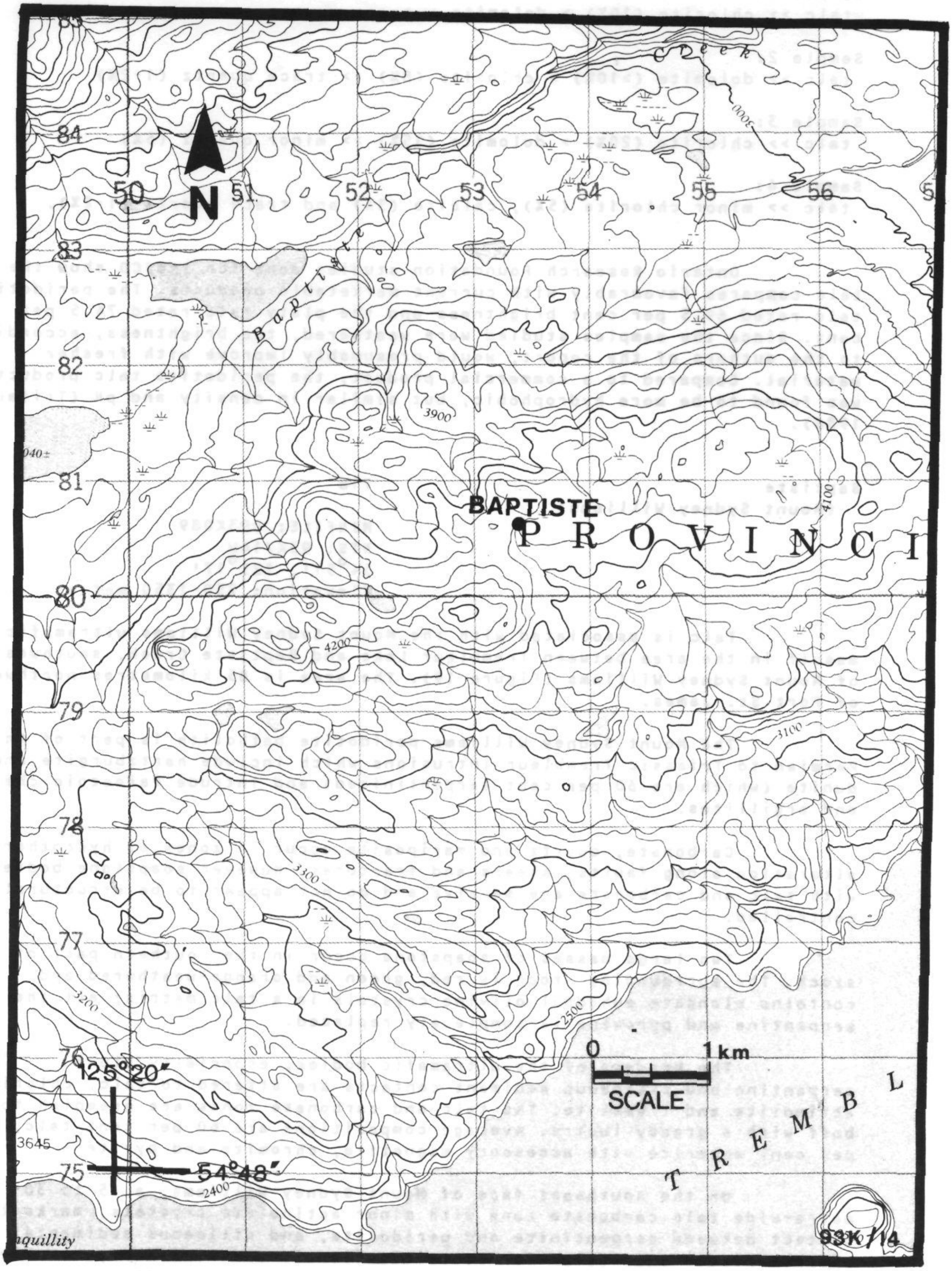
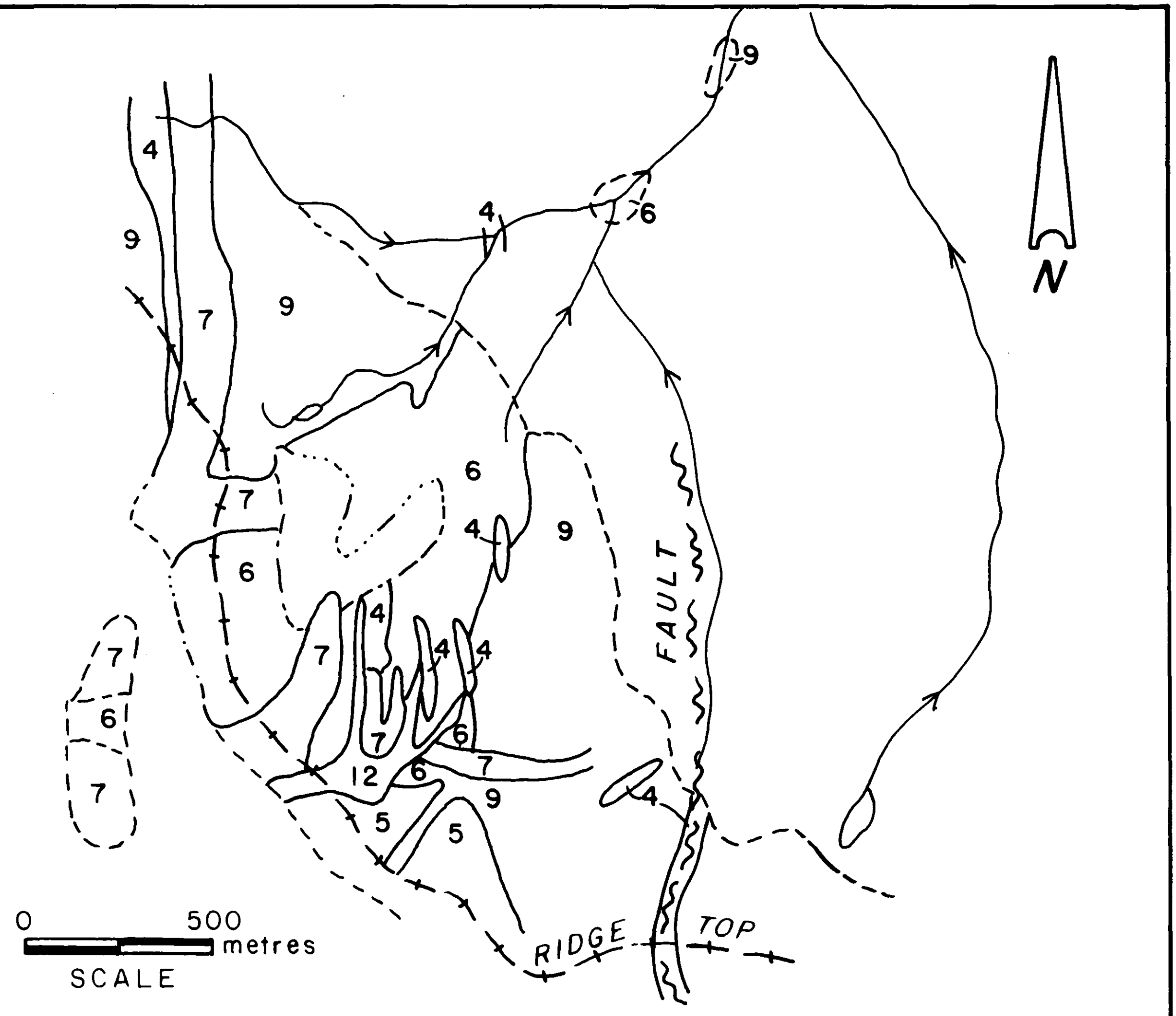


Figure 19. Location of Baptiste showing, T16 .



LEGEND

12 Fine to medium-grained felsite.

9 Dark greenstones with peridotite zones.

7 Serpentinite.

6 Talc-ankerite alteration zone.

5 Sheared and altered greenstone and ultrabasic rocks.

4 Quartz-carbonate-mariposite zones.

After Culbert, 1985.

Figure 20. Geology of Humphrey property, T17 .

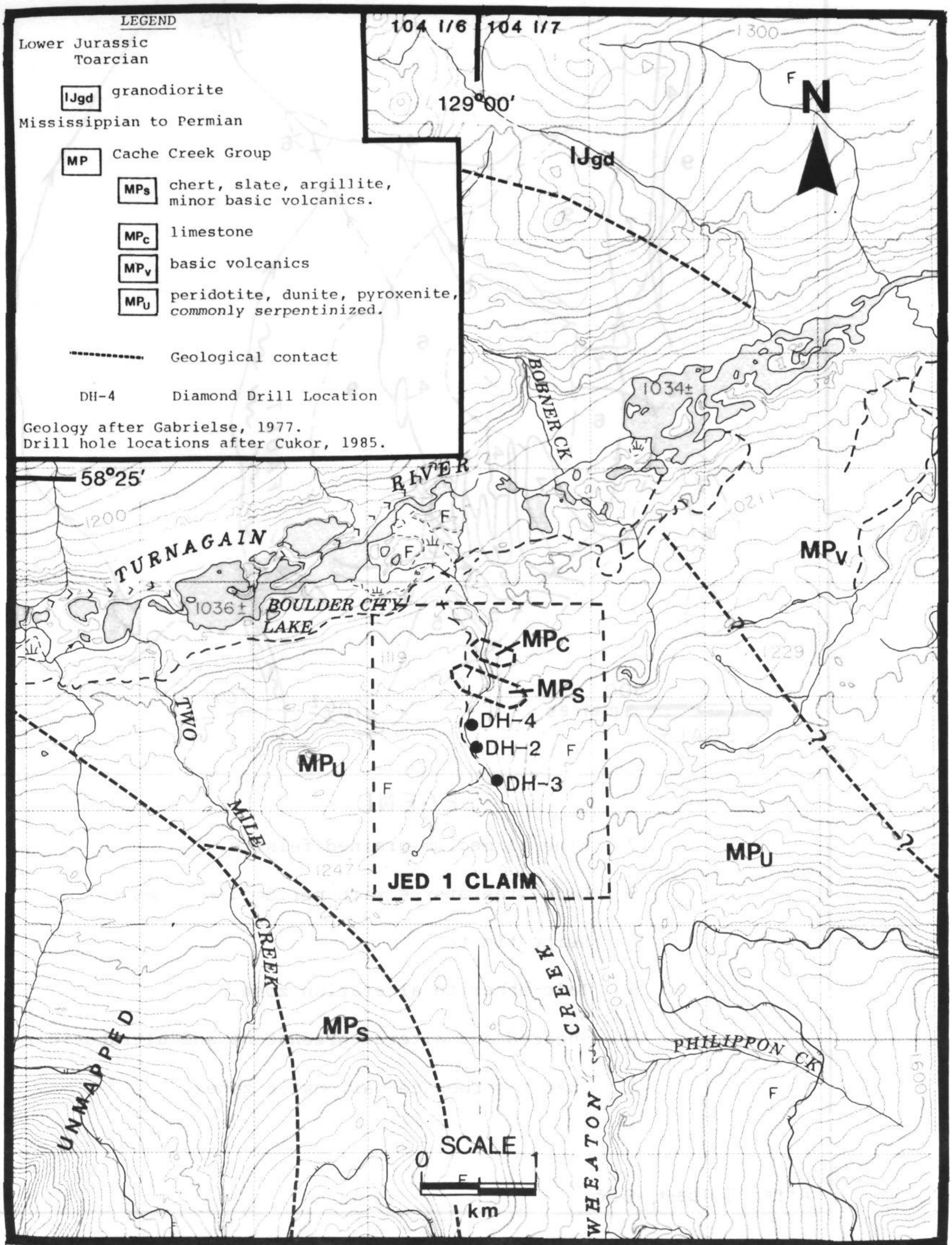


Figure 21. Geology of Jed property, T18 .

Humphrey T17

MINFILE: 093N195
NTS: 93N/12
$55^{o}37'$, $125^{o}43'$
Elevation: 1675 metres

The Humphrey property is located north of Humphrey Lake, about 22 kilometres northwest of Takla Landing.

A major structural feature, the Vital fault, trends north-south and dips east through the claims, dividing metasediments and greenstones of the Cache Creek Group to the east and serpentinites and ultramafics (peridotite and hartzburgite) to the west (Figure 20). The ultramafics are variably serpentinized with a considerable amount of talc-ankerite alteration. The alteration zones are cream to light brown with orangy brown-weathered zones of quartz-carbonate-mariposite. The zones are most prominent adjacent to the main fault.

Jed T18

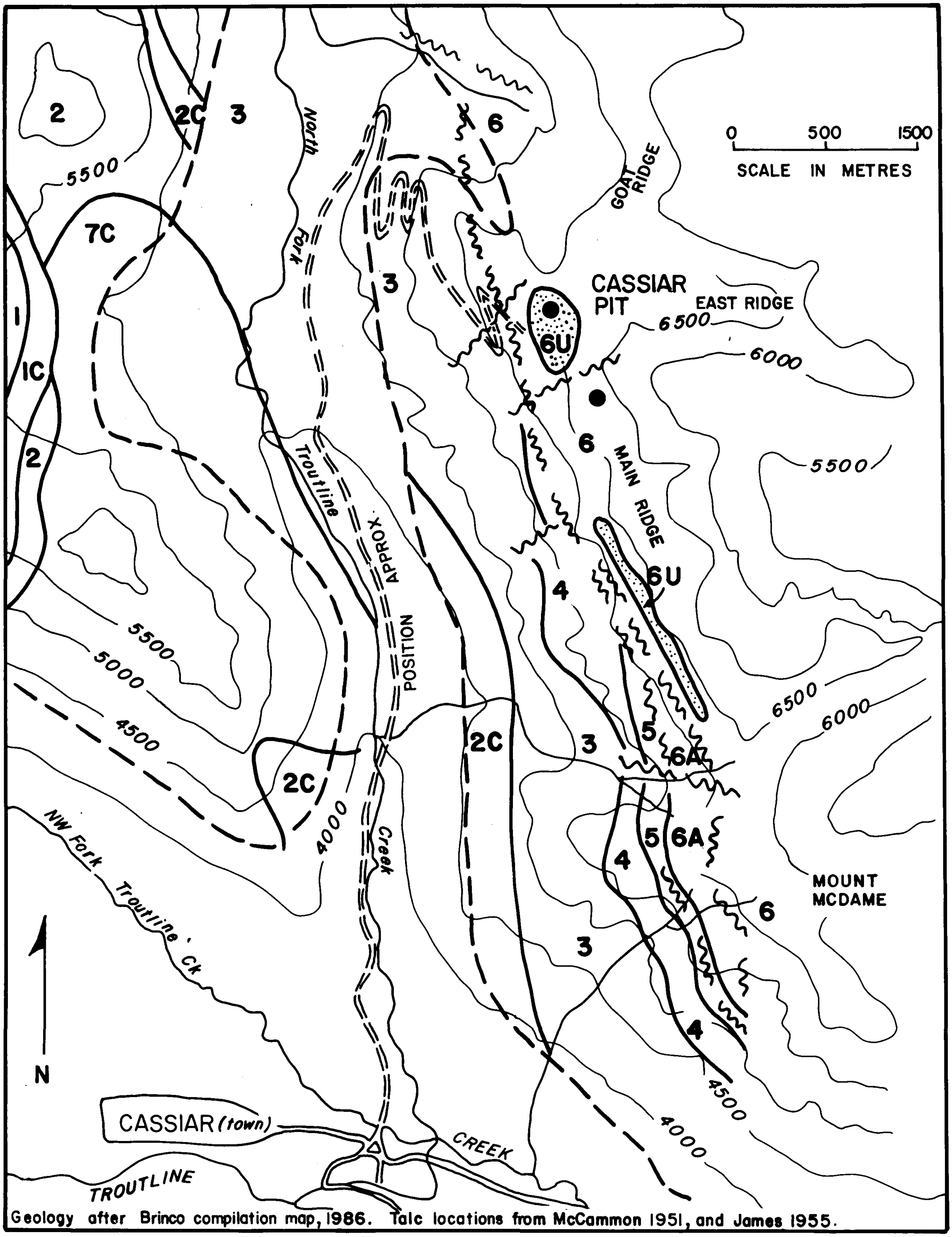
MINFILE: 104I097
NTS: 104I/6E, 7W
$58^{o}24'$, $129^{o}00'$
Elevation: 1130 metres

The Jed claim is in the valley of Wheaton Creek, just south of the Turnagain River, about 65 kilometres northeast of Dease Lake. Access is by a bulldozer road which leads off the Cassiar-Stewart road in the Tanzilla River valley. Substantial quantities of gold are reported to have been recovered from placer mining on Wheaton Creek.

The area is underlain by Mississippian to Permian ultramafics; peridotite, dunite and pyroxenite. Small areas of sediments (chert, slate, argillite, graphitic schist and limestone) occur on the Jed claim. North of the Turnagain River, Lower Jurassic (Toarcian) granodiorite intrudes the ultramafics (Figure 21).

The ultramafics are completely altered to dark green to black serpentinite with small grains of magnetite and minor, partially altered, pyroxene. Apparently `considerable amounts' of talc occur with these rocks.

Drilling in 1984 (for sulphides in quartz viens) intersected numerous talc zones. Drill hole 2 cut a graphitic schist with narrow serpentine and talc zones from 53 to 87 metres. In drill hole 3 a talc schist occurs from 5 to 38 metres, which is locally silicified and brecciated and has small concentrations and disseminations of amorphous mariposite. From 38 to 46 metres, narrow talc zones occur in graphitic schists. Drill hole 4 intersected talc schist with zones of serpentine from 39 to 57 metres (Cukor, 1985).



Geology after Brinco compilation map, 1986. Talc locations from McCammon 1951, and James 1955.

Figure 22. Geology in Cassiar Asbestos mine area, T19 .

CRETACEOUS AND TERTIARY

CASSIAR INTRUSIONS: Quartz monzonite, granodiorite, granite, pegmatite, porphyritic granite.

7C Contact stock (73 ma.)

CARBONIFEROUS AND PERMIAN

6U Serpentine, peridotite, dunite, pyroxenite, minor metamorphosed volcanic rocks.

DEVONIAN AND MISSISSIPPIAN

SYLVESTER GROUP:

6V Greenstone (andesite and basalt flows and tuff), chert tuffaceous chert, minor argillite and limestone.

6A Argillite, siltstone, greywacke, conglomerate.

6 Undifferentiated 6A and 6V.

DEVONIAN

MCDAME GROUP:

5 Black fetid dolomite and limestone.

ORDOVICIAN, SILURIAN AND (?) DEVONIAN

SANDPILE GROUP:

4 Dolomite, sandy dolomite, quartzite, siltstone, minor dolomite breccia.

CAMBRIAN AND ORDOVICIAN

KECHIKA GROUP:

3 Shale, calcareous shale, black shale, argillaceous limestone, conglomerate, slate, and calc-silicate hornfels

CAMBRIAN

ATAN GROUP:

2C Rosella Formation: limestone, dolomite, minor shale.

2 Boya Formation: quartzite, argillite, shale, slate, hornfels.

CAMBRIAN AND HADRYNIAN

GOOD HOPE GROUP:

1C Upper Carbonate Unit: limestone, dolomite, slate.

1 quartzite, grit, siltstone, limestone, dolomite, argillite hornfels, skarn. Includes 1C where not differentiated.

● Talc locations

Limit of exposure

Geological contact (assumed)

Fault

2500 Contours (in feet)

Figure 23. Legend to accompany map, Figure 22 .

Cassiar Asbestos Mine T19

MINFILE: 104P005
NTS: 104P/5W
59°19'06", 129°49'18"
Elevation: 2000 metres

Chrysotile asbestos is mined from the Cassiar orebody about 5 kilometres north of Cassiar. The serpentinite forms a lens-shaped body of Carboniferous to Permian serpentinite, peridotite, dunite, pyroxenite and minor metavolcanics. An ultramafic dyke strikes 015° and dips 45° east along the main ridge running south from the mine towards Mount McDame (Figures 22 and 23).

The ultramafic dykes and stocks intrude Devonian and Mississippian Sylvester Group sediments and volcanics. West of the dyke are slaty argillites, minor quartzite, a 130-metre-thick bed of siliceous dolomitic limestone and minor black limestone. To the east lie slates and volcanic flows. White talc is reported to occur at the junction of Goat Ridge and East Ridge in a 3-metre-wide band formed along both sides of a serpentinite band. The serpentinite is 15 metres wide, dark, shattered and slickensided parallel to the bedding in the enclosing slates (McCammon, 1951).

Talc is also reported to straddle the main ridge 3.5 kilometres northwest of Mount McDame (James, 1955).

Eagle — T20

(Past Producer)

MINFILE: 092B012
NTS: 92B/5E
48°29'24", 123°40'36"
Elevation: 300 metres

The Eagle deposit is about 30 kilometres northwest of Victoria, on Old Wolf Creek, west of the confluence with the Sooke River (Figures 24 and 25). In 1923, 250 tons of talc was mined and shipped to a plant in Sidney. Two small tunnels were driven into the west bank of Wolf Creek. A shaft was sunk 10.5 metres from the bank above, and a drift runs 19.5 metres. A mill was built in 1921 about 20 metres above the workings and later moved about a kilometre away.

The host rocks are Mesozoic Leech River slates and schists which strike nearly west and dip steeply northeast. The Leech River Formation is bounded by the Survey Mountain fault which follows Deception Gulch on the north, and by the Leech River fault which follows Leech River and Old Wolf Creek. The Eagle, as well as three other talc showings, lies on the Leech River fault (see Leech River Group-T22) and the Invereck property (T21) lies on the Survey Mountain fault.

The latest movement on the faults bounding the Leech River Group is dated at 38 to 42 million years; this date would also suggest a lower boundary to the age of the talc (N.W.D. Massey, personal communication, 1987).

Near the workings, the slates are black, carbonaceous and severely crushed and folded. Talc occurs in three narrow, lens-shaped bodies paralleling the schistosity in the slates.

A 2.1-metre-thick body outcrops in the top bank and widens to 4.5 metres thickness 12 metres below. Fifteen metres stratigraphically below the first showing, a 3 to 3.6-metre talc lens is enclosed in talcose slate and black, soft, slaty argillites. A third talc body, 2.1 metres thick, is exposed in the creek with another talc outcrop appearing on strike, 1.5 metres west.

The lenses are homogeneous and mottled grey with faint black specs (magnetite?). The talc is light greenish grey, granular, very friable and crushes to an off-white powder. The crude ore is 50 per cent talc and 38 per cent dolomite and calcite. Chemical analyses of two samples of this ore were made by the Mines Branch (Spence, 1940), yielding the following percentages:

	1	2
Silica	33.68	34.38
Ferrous oxide	4.97	4.59
Ferric oxide	nil	0.45
Alumina	1.65	0.83
Lime	15.32	8.68
Magnesia	22.88	26.94
Carbon dioxide	18.23	19.30
Water above 105°C	3.20	3.10
Total	99.93	98.27

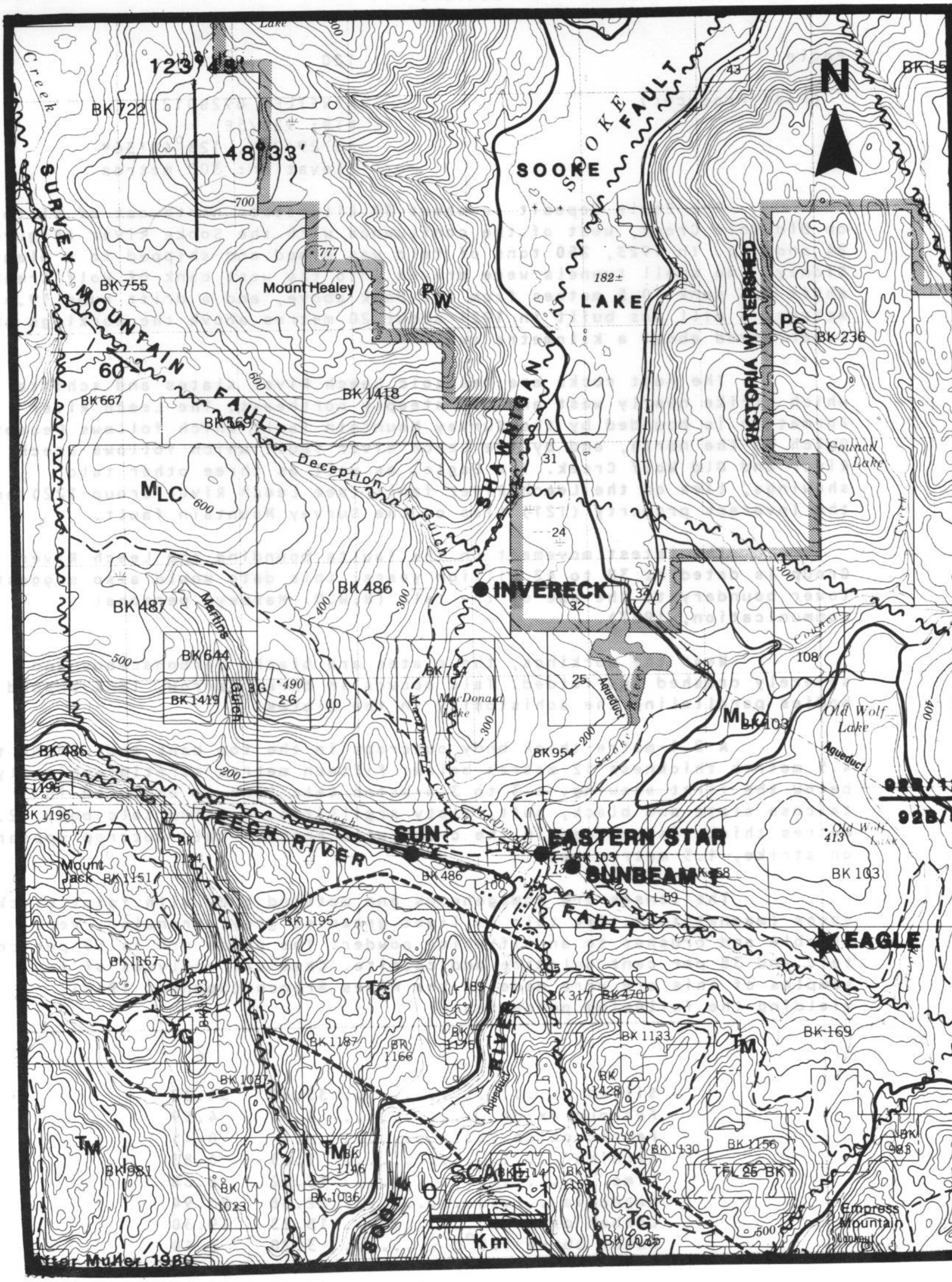


Figure 24. Geology and location of Eagle property, T20; Invereck property, T21; and Leech River showings, T22 .

LEGEND

Eocene and Older (?)

$\boxed{T_G}$ Catface intrusions: quartz diorite, agmatite.

$\boxed{T_M}$ Metchosin Volcanics: basalt.

Triassic to Cretaceous

$\boxed{M_{LC}}$ Leech River Formation:

chert-argillite unit, ribbon chert, cherty argillite, meta rhyolite, meta basalt, chlorite schist.

Lower Paleozoic or Younger (?)

$\boxed{P_C}$ Colquitz Gneiss: quartz-feldspar gneiss.

$\boxed{P_W}$ Wark Gneiss: massive and gneissic meta diorite, (meta gabbro, amphibolite).

After Muller, 1980

Figure 25. Legend to accompany map, Figure 24 .

Invereck T21
(Gold Bar)

MINFILE: 092B031
NTS: 92B/12W
$48^{\circ}31'$, $123^{\circ}43'$
Elevation: 180 metres

The Invereck showing is located in the steep-sided Deception Gulch, 1.3 kilometres west of the outlet of Sooke Lake. The property is just west (outside) the boundary of Greater Victoria's watershed which includes Sooke Lake. Gravel roads access the area from Victoria, about 50 kilometres to the southeast (Figures 24 and 25).

The talc occurs in shear zones in the Mesozoic Leech River Formation, which includes sandstone, chert, argillite and some volcanics, metamorphosed in places to graphitic quartz-sericite and staurolite-andalusite-garnet-biotite schists (Fairchild, 1979). Near the showing the rocks are mainly pelitic schists.

The talc appears to be structurally controlled as it occurs at the intersection of two major faults, the Survey Mountain fault that follows Deception Gulch, and the Shawnigan Lake fault that trends north-south through Sooke Lake. The Survey Mountain fault and the Leech River fault mark the north and south boundaries respectively, of the Leech River Group, and both host talc deposits (see T22 and T20). Potassium-argon dates of 38 to 42 million years give the date of latest movement on the faults bounding the Leech River Group. This age suggests a lower boundary to the time of talc formation (N.W.D. Massey, personal communication, 1987).

In Deception Gulch, a 5.4-metre talc bank is excavated and a sample was analysed by the Department of Mines in 1922 (numbers are percentages):

Al_2O_3	5.8
Fe	2.8
MgO	30.4
Lime	nil
Magnesite	16.0
Gold	trace
Heat loss @ 110° ..	nil
Heat loss @ `red heat'............	17.0

The Invereck deposit is reported to be very similar in appearance to the Eagle property (T20) (Minister of Mines, B.C., Annual Report, 1922).

Leech River Area T22

The Leech River area consists of three separate showings, all within a kilometre of the confluence of the Sooke River with the Leech River, where the abandoned settlement of Leechtown stood (Figures 24 and 25). Since information is sparse, and because of their close proximity, the showings are treated as one occurrence.

Eastern Star

MINFILE: 092B051
NTS: 92B/5E
$48^{\circ}29'45''$, $123^{\circ}42'36''$
Elevation: 160 metres

Location: at the confluence of McDonald Creek and Sooke River.

Sunbeam 1

MINFILE: 092B052
NTS: 92B/5E
48°29'42", 123°42'18"
Elevation: 160 metres

Location: 250 metres northeast of Leechtown, on Old Wolf Creek.

Sun

MINFILE: 092B053
NTS: 92B/5E
48°29'45", 123°43'30"
Elevation: 170 metres

Location: on the Leech River, 800 metres west of Leechtown.

All the Leech River showings lie on or close to the Leech River fault which separates Mesozoic Leech River metasediments from Tertiary Metchosin volcanics. The talc abundance in this area is probably related to the movement on the Leech River fault (N.W.D. Massey, personal communication, 1987). This is more fully discussed under the Invereck showing (T22). The setting of the Sun occurrence is similar to the Invereck, at the confluence of the Leech River and Shawnigan Lake faults. A former talc producer, the Eagle property, is also on the Leech River fault, about 2 kilometres east on Old Wolf Creek (see T20, and Figure 24).

The rivers in the vicinity were extensively worked in the past for placer gold, and all the properties have had some degree of work on them; short adits, open cuts, trenching and percussion drilling are reported.

Very little information is recorded on the talc deposits themselves. The talc occurs in shear zones within the Leech River Formation slates and schists. On the Eastern Star, a body of talc 2.3 metres long is reported, with the footwall unexposed (Minister of Mines, B.C., Annual Report, 1924).

Lucky Jane
(Lakeshore)

(Past Producer)

T23

MINFILE: 092JNE110
NTS: 92J/9W
50°35', 122°25'50"
Elevation: 360 metres

The Lucky Jane deposit is located on the west side of Anderson Lake on the British Columbia Railway about 800 metres south of McGillivray Creek (Figure 26). All the workings, including several short (longest 30 metres) tunnels, are close to the railway tracks.

The deposit was worked from 1917 to 1935 and produced approximately 455 tonnes of talc. The first operator was the Pacific Roofing Company, which shipped crude talc to Vancouver. In later years British Columbia Quarries Ltd. also made intermittent shipments (Spence, 1940).

A 5-kilometre-wide belt of sheared metasediments, chlorite slates, grey quartzites, schists and altered greenstones of the Permo-Triassic Bridge River Group is wedged between granodiorite of the

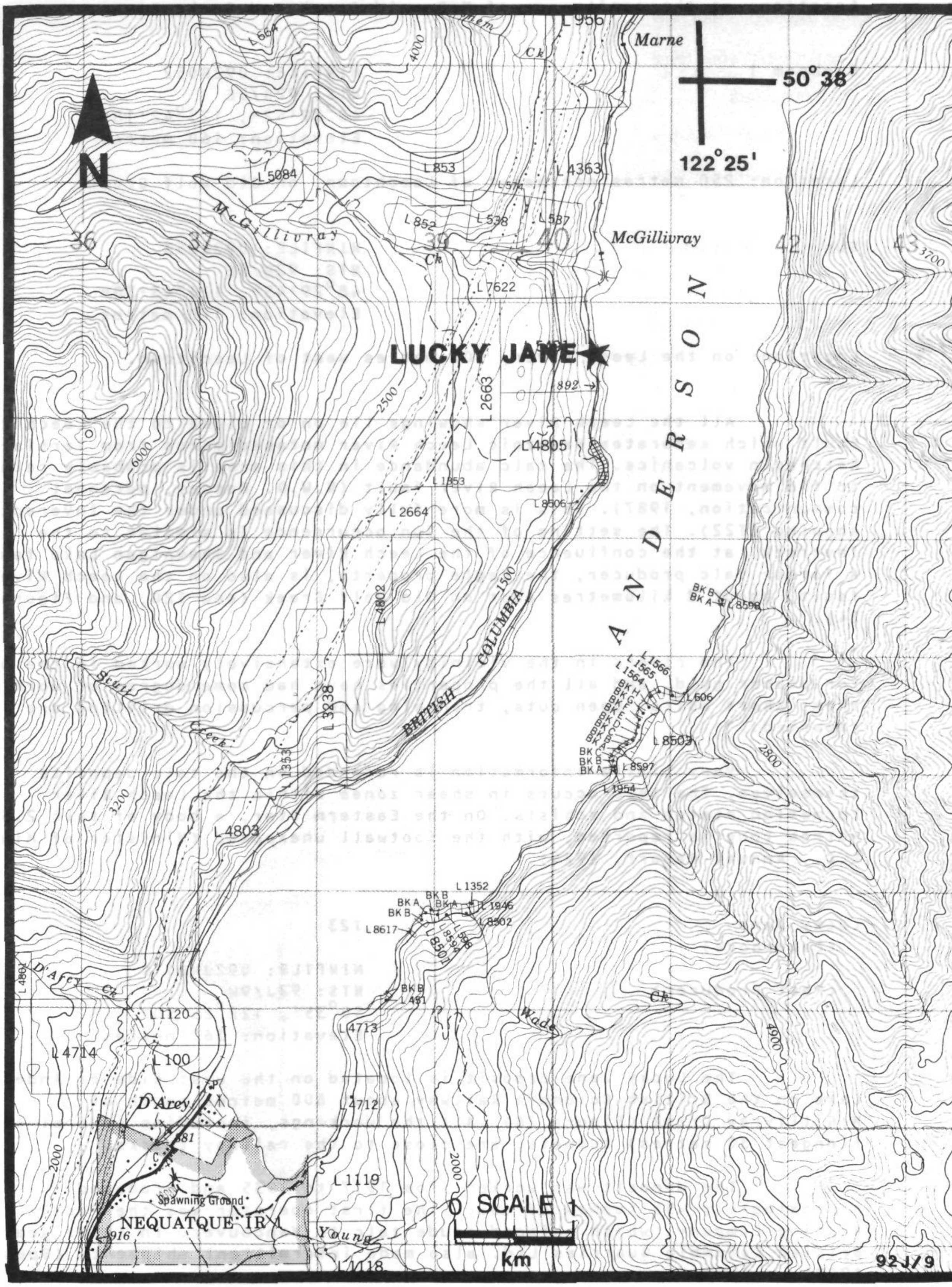


Figure 26. Location of Lucky Jane showing, T23 .

Cretaceous Coast Plutonic Complex on the north, and younger miarolitic granite on the south. Granodiorite dykes intruding the metasediment/volcanic package are sheared and gneissic; the foliation parallels talc-bearing shear zones in the greenstone which are abundant near the southern intrusive contact.

The talc occurs in bands up to 3 metres wide, or as narrow veins which pinch and swell, following erratic paths in the metasediments and greenstones. The talc is light greenish grey to dark green, highly sheared, soft, fissile and intensely slickensided. Impurities such as pyrite, magnetite and limonite occur in very small amounts, with a few veinlets of unaltered actinolite. The talc apparently yields a white powder with good slip. Analyses of two talc samples yielded the following percentages (Spence, 1940):

	1	2
Silica	57.62	58.06
Ferrous Oxide	5.31	4.91
Ferric Oxide	0.80	0.11
Alumina	2.46	2.25
Lime	0.10	trace
Magnesia	28.53	28.82
Carbon dioxide	nil	0.90
Water >105°C	4.75	5.46
Total	99.57	99.70

Gisby — T24

(Past Producer)

MINFILE: 092HNW002
NTS: 92H/13E
49°58'52", 121°30'55"
Elevation: 200 metres

The Gisby group of claims is located directly south of the Nahatlatch River, just west of the Fraser River (Figure 27). Access is by good logging roads originating in North Bend, about 10 kilometres to the south. Before 1920, the property was worked for silica and shipments were made to Vancouver. An adit was driven on the Gisby claim (Lot 1078), apparently in search of gold, which intersected a talc body. About 100 tons (approximately 91 tonnes) of talc was extracted from the workings up to 1923, with an average value of $20 per ton. Other adits are reported on the Salmon River claim (Lot 1077), but recent visits to the area found no such workings; they were probably covered during road construction (which has also provided some new exposures).

The best and most abundant talc is found on the Laura and Salmon River claims (Lots 1080 and 1077) immediately south of the Nahatlatch River, and this showing is plotted on the location map (Figure 28).

The host rocks are mixed metasediments of the Permian to Jurassic Bridge River Complex; mostly slaty argillite with minor quartzite interlayers, greywacke, calcareous bands and chlorite-carbonate schists. The sediments are highly sheared, contorted and quartz veined. Pods of ultramafic rock, mainly serpentinite, are common.

The Gisby adit was driven perpendicular to the enclosing slates, which dip nearly vertically. At 45 metres, a 1.5 to 2.4-metre-wide talc bed was exposed, bordered by 15 metres of talcose slate. On either side of the talc bed is more magnesia-rich talcose rock with much

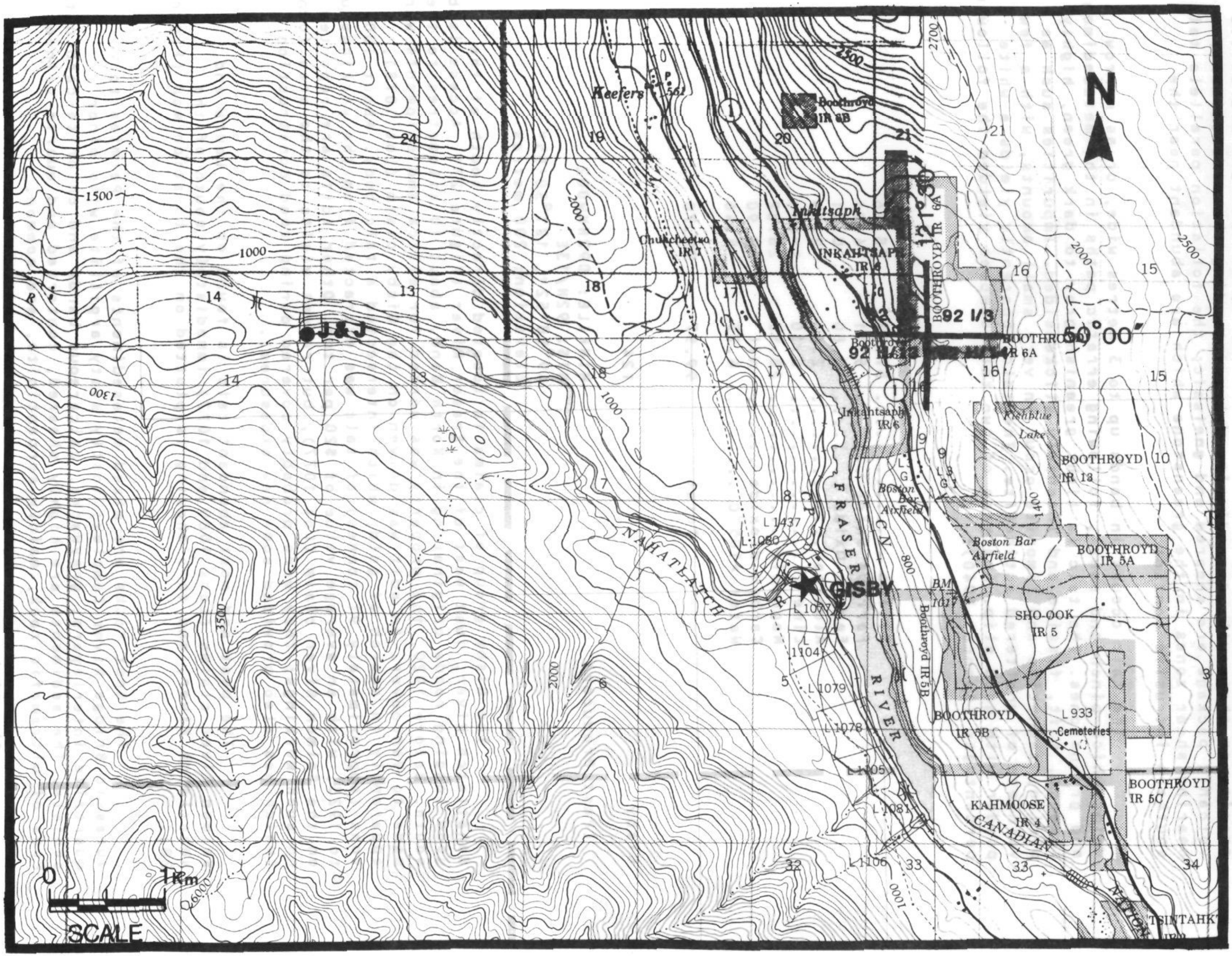


Figure 27. Location of Gisby (T24) and J & J (T25) properties .

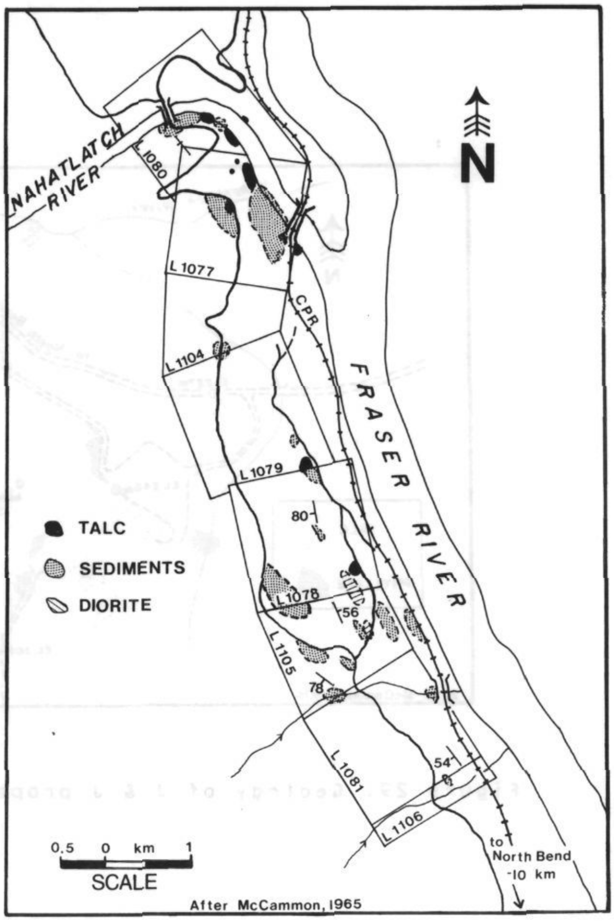


Figure 28. Geology of Gisby property, T24 .

quartz and calcite veining.

A talc bed is exposed southeast of the tunnel adjacent to the largest of two northwest-trending diorite bodies. The talc in this area contains a large percentage of carbonate; the host is sheared talc-carbonate schist mixed with pods of quartzite and argillite. In the tunnel however, the talc is reportedly much purer. It is light to dark olive green and translucent. Occasional quartz impurities are present as thin layers, but the talc grinds to a soft powder with no discernible grit. The talc breaks into irregular pieces with slickensided surfaces. An analysis of this material was made by the Mines Branch (Ottawa) in 1926 to yield the following (in per cent):

Silica	59.88
Ferrous oxide	4.54
Ferric oxide	nil
Alumina	1.18
Lime	0.10
Magnesia	29.51
CO_2	0.02
H_2O >105°C	4.73

The talc showings along the Nahatlatch River have an aggregate width of 100 to 150 metres. The talc is light green to pearly grey, massive to lightly laminated, with granular quartz and minor sulphide impurities. All the showings contain abundant carbonate, most of which is iron-rich magnesite. One bed, described as the "uppermost" showing, is distinctive in that it contains bright green chrome mica (Wilson, 1926).

The main showings are at the south abutment of the railway bridge on both sides of the railway, 180 metres upstream from the railway and another 45 metres upstream; here the talc is exposed in a 4.5-metre bank and is highly sheared.

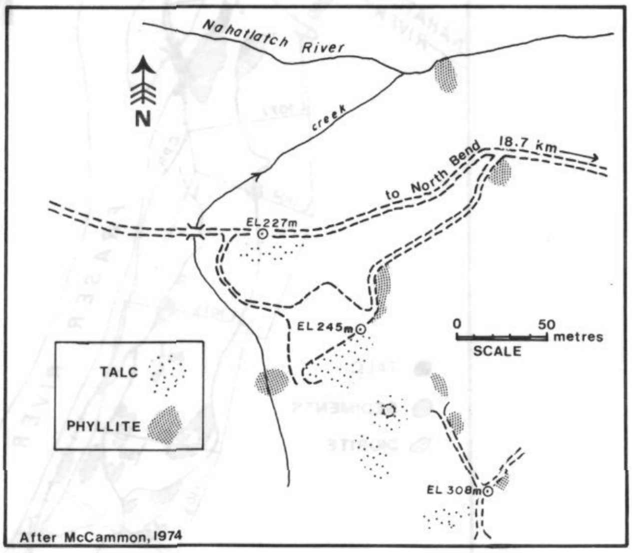


Figure 29. Geology of J & J property, T25 .

J & J T25

MINFILE: 092HNW047
NTS: 092H/13W
$49^{0}59'$, $121^{0}34'$
Elevation: 225-310 metres

The J & J claims are situated just south of the Nahatlatch River, approximately 19 kilometres, by logging road, north of North Bend (Figure 29).

The talc is found in a strongly schistose chloritic phyllite and graphitic to quartzose phyllite, probably part of the Permian to Jurassic Bridge River Complex. The rocks strike southeast and dip subvertically and are cut by many small serpentinized ultrabasic intrusions. To the southwest the phyllites are intruded by granodiorite of the Tertiary Scuzzy pluton.

The talc body ranges from 50 metres wide in the northern exposures to 10 metres wide in the southern exposures, and has a strike length of 500 metres.

The talc is platy and light to dark greyish green, weathering buff to brown. It is associated with carbonates (magnesite and some dolomite), chlorite, limonite and magnetite. Up to 5 per cent pyrite is visible mainly along fractures and also disseminated throughout the rock.

Thin sections show that the talc forms a fine-grained groundmass within which is enclosed larger (0.5-1.0 millimetre) grains or grain aggregates of carbonate (magnesite and dolomite). The talc is seen to be replacing chlorite (McCammon, 1974). Through X-ray analysis, there are no amphiboles (such as tremolite) or serpentines present. A high purity talc concentrate, obtained by simple crushing and flotation, measured a brightness of 85 to 90 per cent (Nevin, Sadlier-Brown and Goodbrand Ltd., 1987).

Chemical analysis (McCammon, 1974) of a chip sample over 36 metres, containing an estimated 50 per cent talc, gave the following percentage compositions:

MgO	35.1
SiO_2	37.5
H_2O (+900°)	4.26
CO_2	17.0
Fe_2O_3	6.75
Al_2O_3	1.29
CaO	0.62

Three holes drilled in 1978 had major talc intersections. In drill hole 1, 38 metres of talc (20 to 60 per cent) with magnesite, chlorite and pyrite were intersected at 22.5 metres depth. A 44-metre intercept beginning at 17 metres depth in drill hole 2, contains fracture fillings of 20 to 40 per cent talc with talc bands up to 2 centimetres wide. Drill hole 3 intersected 9 metres of talc alteration from 16 metres depth.

Drill core samples were analysed using a combination of chemical and X-ray diffraction techniques, revealing the following percentages:

	Talc	Chlorite	Dolomite	Magnesite
Drill Hole 1	57	25	3	9
Drill Hole 2	50	37	3	5
Drill Hole 3	55	27	5	8
Drill Hole 4	53	36	3	8
Drill Hole 5	60	25	4	8
Drill Hole 7	56	24	8	8

(Perston, 1979)

One calculation made by J. Sullivan in 1984 estimated a mineable 421 860 tonnes of impure talc (based on 2.9 specific gravity for talc) with a stripping ratio (open-pit methods) of 0.66:1.

Cawston T26

MINFILE: 082ESW155
NTS: 82E/4W
49°09'42", 119°43'40"
Elevation: 480 metres

Talc is found 1.2 kilometres southeast of the town of Cawston, 0.4 kilometre east of Highway 3 (Figure 30).

The schistose talc occurs in irregular patches, striking northwest and dipping southeast within chlorite schist, quartzite and greenstone of the Precambrian (possibly Devonian?) Kobau Group. The Kobau Group, which also contains marble beds, is highly deformed and exhibits low grade regional metamorphism (Okulitch, 1973).

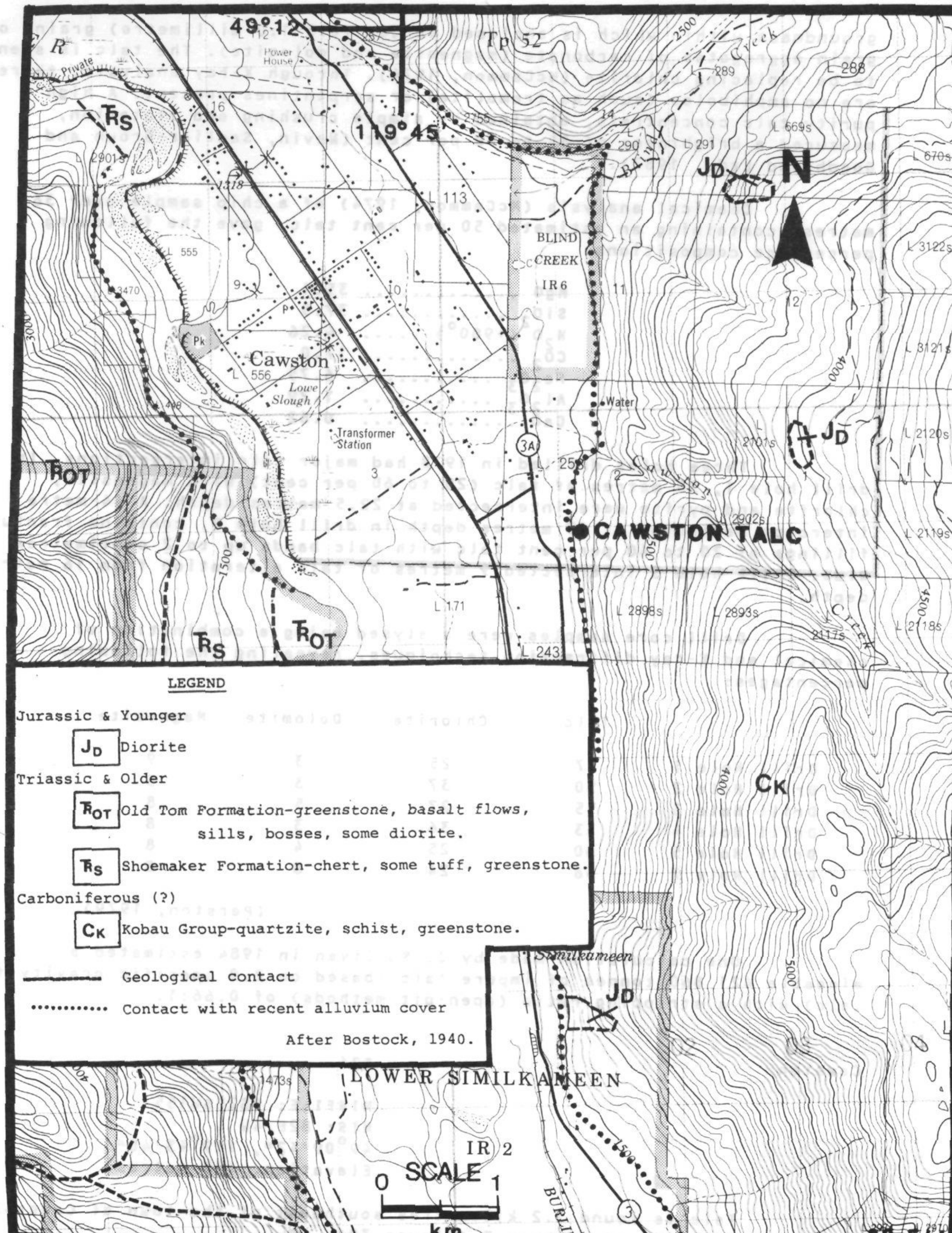


Figure 30. Regional geology and location of Cawston talc, T26 .

The talc is exposed in gulleys; generally the rock exposure is poor. One showing, 60 metres above the highway, is in a northwest-trending gulley where an open cut 6 metres wide has been dug for 7.5 metres. Talc schist occurs on both sides of a bed of chlorite schist. On the southwest side the widest exposure (3 metres) was sampled across the width, yielding the following percentages (McCammon, 1962):

SiO_2	52.77
Al_2O_3	1.35
CaO	4.17
MgO	21.92
CO_2	6.59
Fe	4.53
H_2O (105^o)	0.13
H_2O (>105^o)	5.64

When powdered, the talc is reported to be slightly gritty and a pale greenish white colour (McCammon, 1962).

A gulley located 30 metres to the west contains a 1.5-metre-wide talc schist zone, exposed along a length for 12 metres. The talc here is in chlorite schist with minor quartzite interbeds.

Between the above-mentioned gulleys is a small 3-metre open cut exposing another talc bed 1 metre thick. Another gulley 300 metres to the southwest and 110 metres higher up on the slope exposes 50 metres of talc.

Duncan Lake T27

MINFILE: 082KSE074
NTS: 82K/7W
$50^o24'20''$, $116^o56'50''$
Elevation: 735 metres

The showings are located 1.2 kilometres north of North Creek, on the east shore of Duncan Lake (Figure 31). Two talc zones exposed on the logging road, both approximately 5 metres wide, occur in a mica schist striking northwest and dipping 65 to 70^o east. The talc is reported to be hydrothermally leached and contaminated with 5 per cent iron and quartz(?) fragments.

A magnetometer survey identified three talc zones just above the road showings in a open clearing. The zones are approximately 10 metres thick and range from 20 to 70 metres in length; the extent of the zones has not been determined. The talc bodies are found both crosscutting and parallel to bedding.

The talc is hosted in pre-Mississippian metasediments of the Lardeau Series; mostly schists (chlorite-muscovite, biotite-muscovite, chlorite-feldspar) and micaceous quartzite. A band of northwest-trending Badshot-Mohican Formation marble, phyllite and muscovite-quartz schist separates the Lardeau Series from Lower Cambrian Hamill Group slates, phyllites and quartzite.

The talc has been collected by local people for carving, but apparently it is of inferior quality and has not been worked for several years (G.G. Addie, personal communication, 1987).

Silver Cup T28

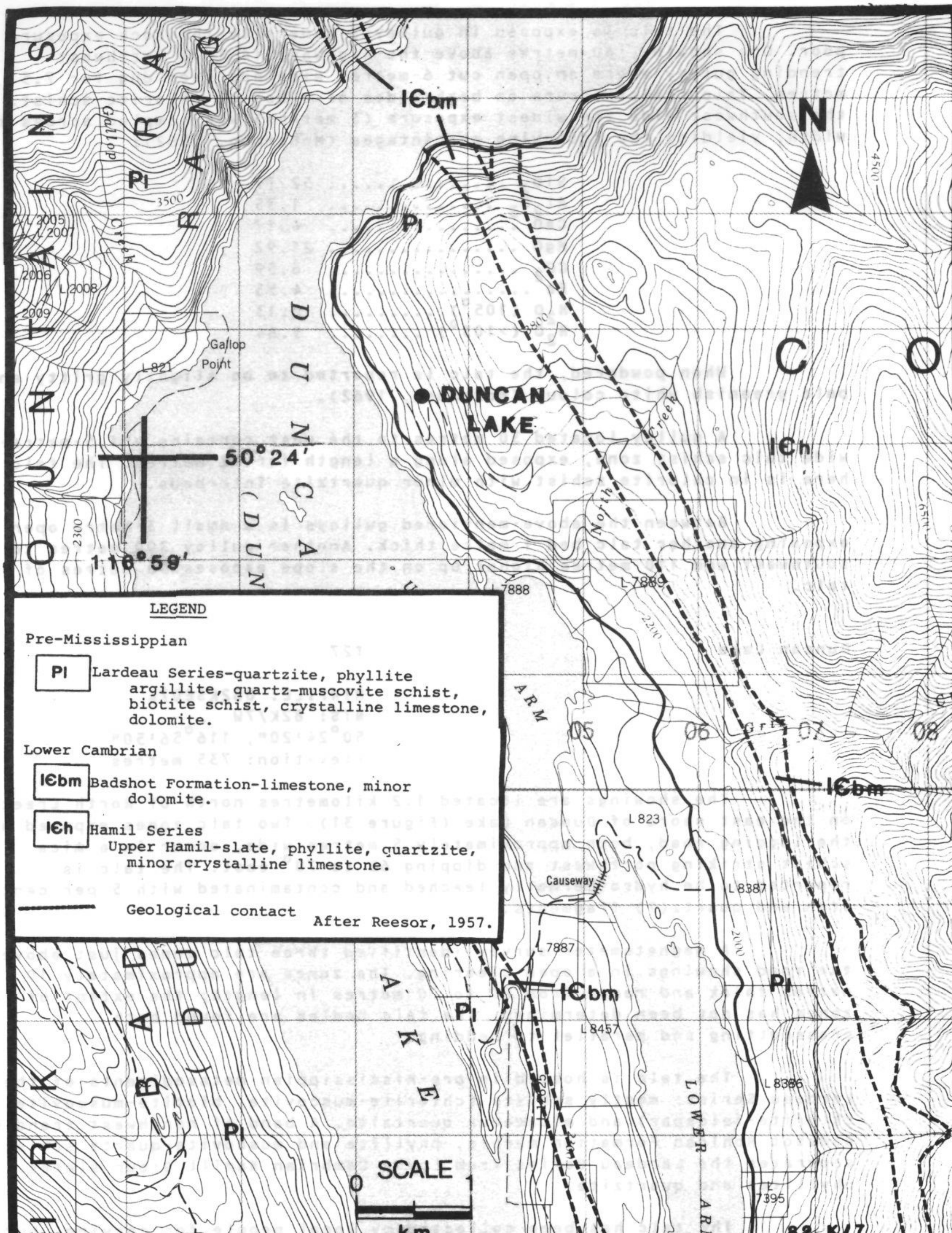


Figure 31. Regional geology and location of Duncan Lake showing, T27 .

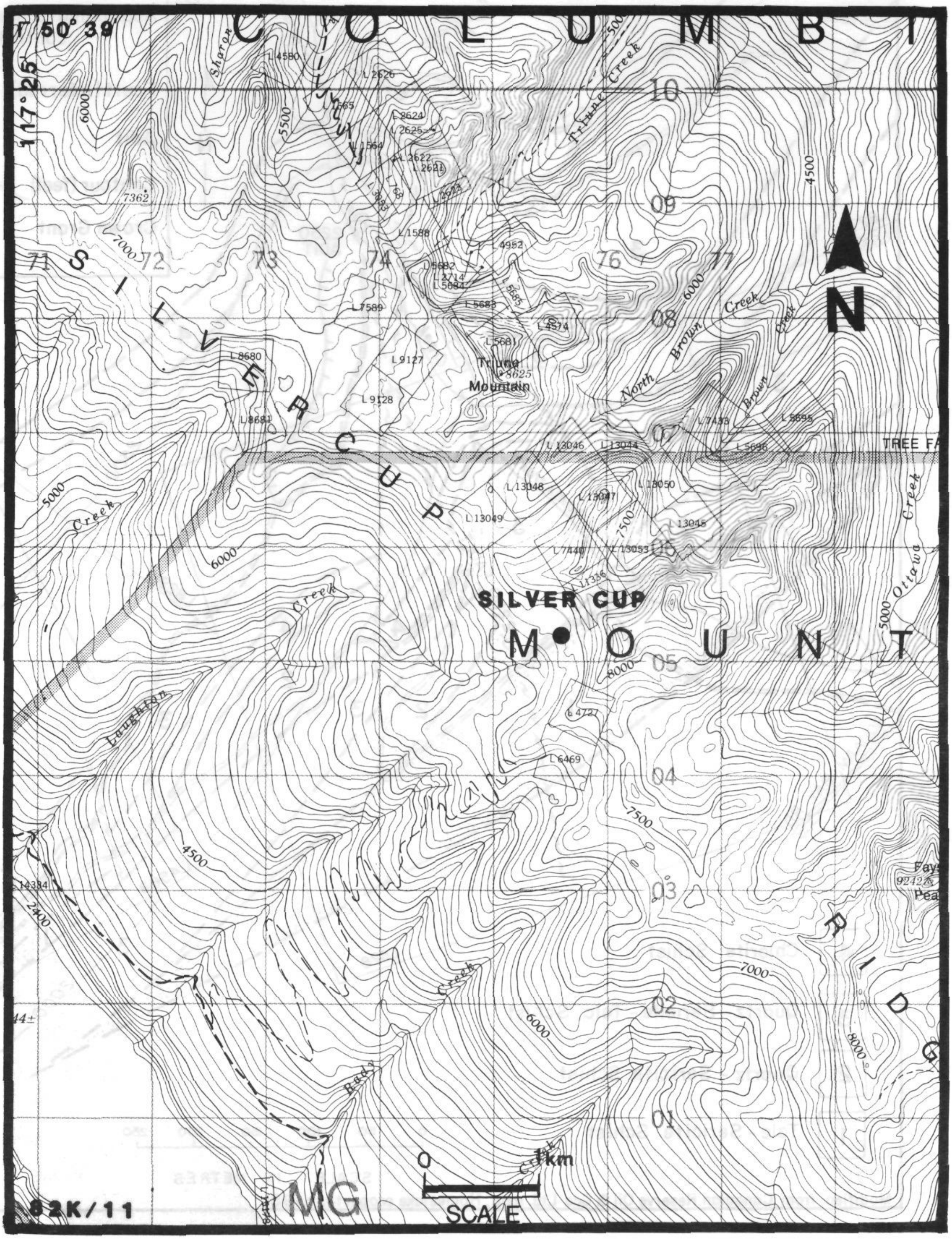


Figure 32. Location of Silver Cup showing, T28 .

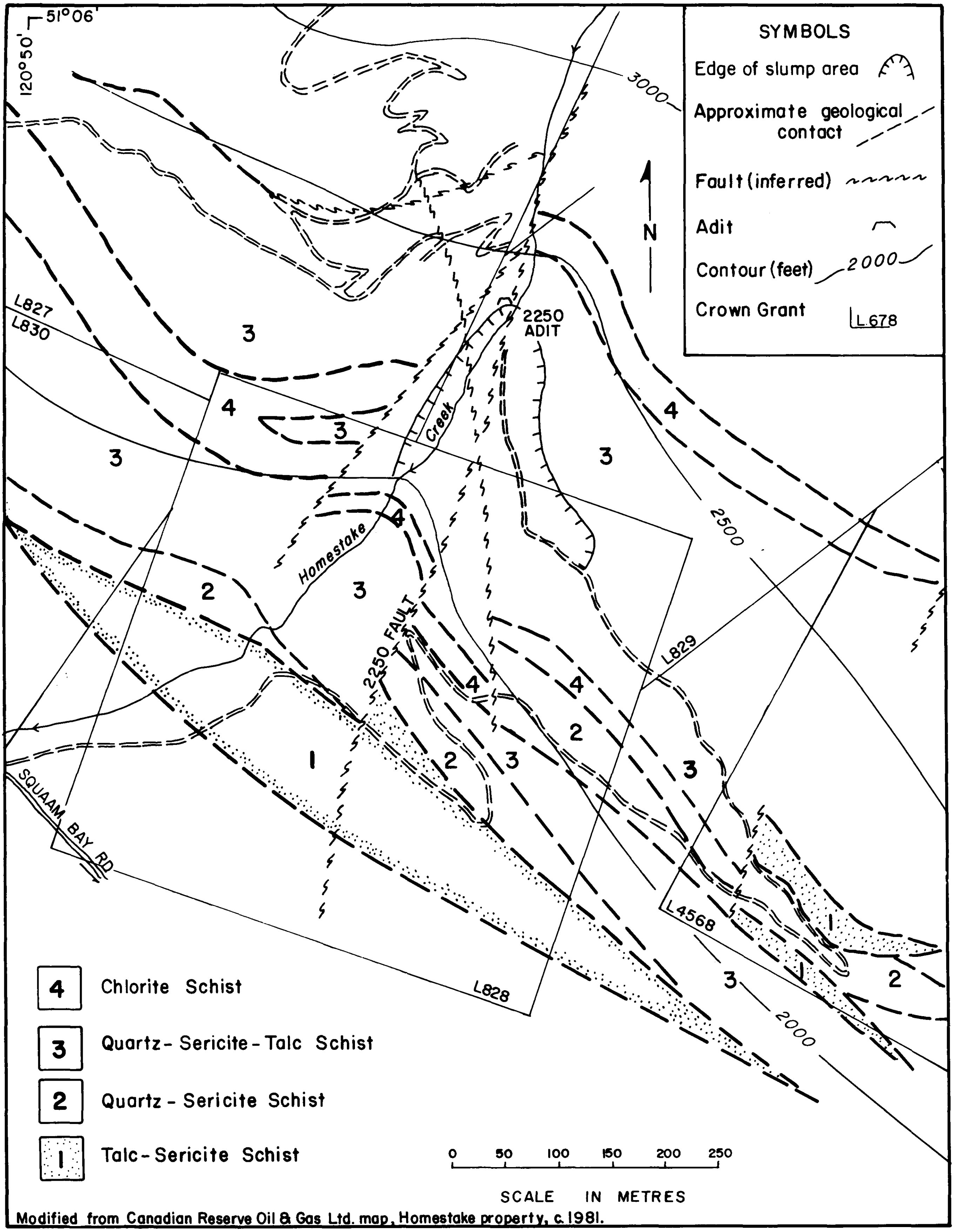


Figure 33. Geology of Homestake property, T29 .

MINFILE: 082KNW222
NTS: 82K/11W
50°36', 117°20'30"
Elevation: 1800 metres

The showing lies on Silver Cup Ridge, northeast of Trout Lake and about 50 kilometres northeast of Nakusp. The location is known within a kilometre accuracy (Figure 32).

A sample of pale green micaceous talc obtained in 1926(?) and several outcrops of rusty talc schist are reported. The talc is hosted in the Lardeau Series of the Late Cambrian Windermere Group, which consists of schist, phyllite, quartzite, slate and limestone.

Homestake T29

MINFILE: 082M025
NTS: 82M/4W
51°06'36", 119°49'36"
Elevation: 670 metres

The Homestake property, on Sinmax and Homestake creeks, is near the head of Squaam Bay on Adams Lake. From Kamloops one travels 50 kilometres north on Highway 5 to Louis Creek, then 30 kilometres on the Agate Bay road to Adams Lake.

The area is underlain by quartz-talc-sericite schists and phyllites of the Devonian-Mississippian Eagle Bay Assemblage which strikes northwest and dips moderately northeast (Figure 33). Bands of talc-sericite and quartz-talc-sericite up to 600 metres wide extend for up to 7 kilometres northwest from Squaam Bay.

The talc-sericite schist is fine grained, fissile and weathers yellow due to ferric sulphate coating. Nodules of augen-like quartz give the rock a mottled appearance (Z.D. Hora, personal communication, 1987). X-ray diffraction analyses in 1987, by the Ministry of Energy, Mines and Petroleum Resources, found talc to be a component in a number of samples of quartz-sericite schist.

Kirkup T30

MINFILE: 082M197
NTS: 82M/1W
51°00', 118°24'10"
Elevation: 1980 metres

The Kirkup Creek - Hiren Creek area is accessed by gravel road which follows the west side of Jordan River, then along the north side of Hiren Creek, then up Crazy Creek. The area is 6 kilometres northwest of Revelstoke (Figure 34).

The occurrence is on the south flank of the Frenchman's Cap gneiss dome in the Shuswap metamorphic complex. Gneiss, quartzite, schist, calc-silicate rocks, minor marble and argillite, are isoclinally folded with easterly trending structures (Daughtry, 1968). Folding and jointing are common, with fracture planes intruded by swarms of pegmatite and lamprophyre dykes (Forgeron, 1968).

A talc schist was sampled and analysed by X-ray diffraction in 1968, and found to contain talc and mica intergrown with chlorite.

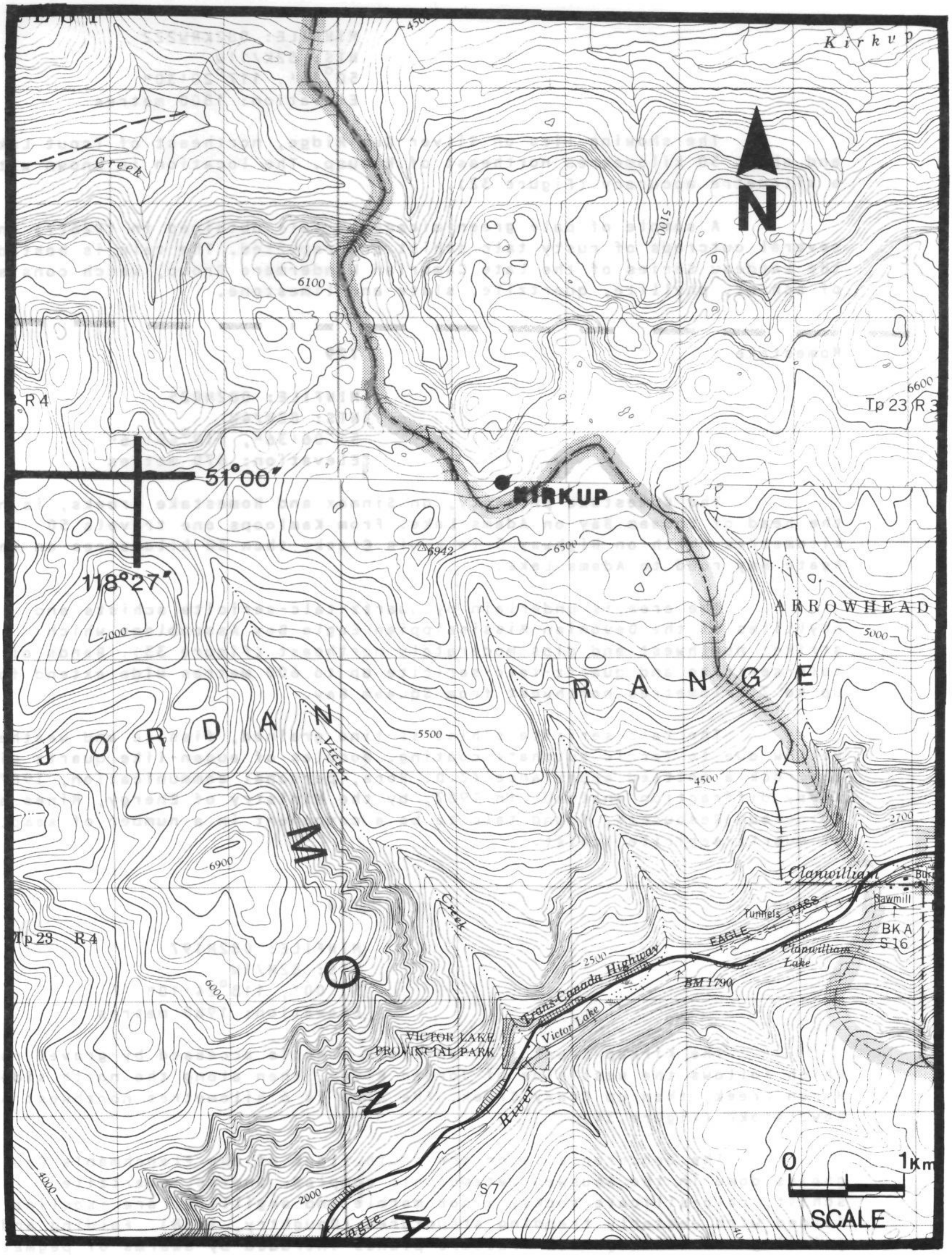


Figure 34. Location of Kirkup showing, T30 .

Accessory minerals are quartz, feldspar and sillimanite (Wilson, 1968).

A small bed of `nearly pure' talc is reported to occur within mixed gneisses, about 1 kilometre to the south.

Ironclad T31

MINFILE: 092B049
NTS: 92B/13E
48°51'36", 123°41'18"
Elevation: 150 metres

The Ironclad property is located north of Mount Richards, about 2 kilometres southwest of Crofton. Access is easily attained by roads from Crofton, or from the Westholm road to the west. The property has been previously worked for copper-zinc mineralization; there are several old adits and shafts in the area.

The area is underlain by metavolcanics of the Sicker Group and gabbros of the Karmutsen Formation (Vancouver Group), which are intruded by quartz-feldspar porphyries of the Late Devonian Saltspring intrusions (Figures 35 and 36). The Sicker Group is in unconformable contact with the Cretaceous Nanaimo Group to the north, and to the south the Sicker package is cut off by the northwest-trending Fulford thrust. A younger, left-lateral strike-slip fault, trending north-northeast, offsets the generally east-trending rocks on the west side off Mount Richards (Massey, et al., in preparation).

In the Mount Richards area, the Sicker Group consists of the older Nitinat Formation, the McLaughlin Ridge Formation felsic volcanics altered to quartz-sericite schist, and the Cameron Ridge Formation (Pennsylvanian) metasediments (Eastwood, 1980a; Massey, et al., in preparation).

Talc is found with sulphide mineralization in shear zones in the schists where they are cut by quartz feldspar porphyries. The talc is up to 1 metre thick and contains calcite and quartz as impurities.

An old shaft is reported to have intersected a 1-metre-thick band of talc at the 10-metre level (Allan, 1909).

Broken Pick, Oro Viejo T39

MINFILE: 082M2S4
NTS: 82M/10E
51°40', 118°35'
Elevation: 720m

This property is located north of confluence of Goldstream and Columbia Rivers, about 80 kilometres north of Revelstoke. Access is easily attained by Highway 23. The property has been recently prospected for high purity white dolomite. The area is underlain by Badshot Formation which, to the southeast dips under the overlying Lardeau Group of phyllites, slates and limestone.

Talc is found in lenses, pods and impregnations as part of an approximately 100 metre wide band of phyllites and slates which extends in a north-northwest direction over a length of at least 1500 metres. Outcrops with white steatite and occasionally greenish white crystalline talc are found in a highway cut 1800 metres south of the Goldstream River bridge, and along the bank of Goldstream and Columbia Rivers. (Komarechka, 1987)

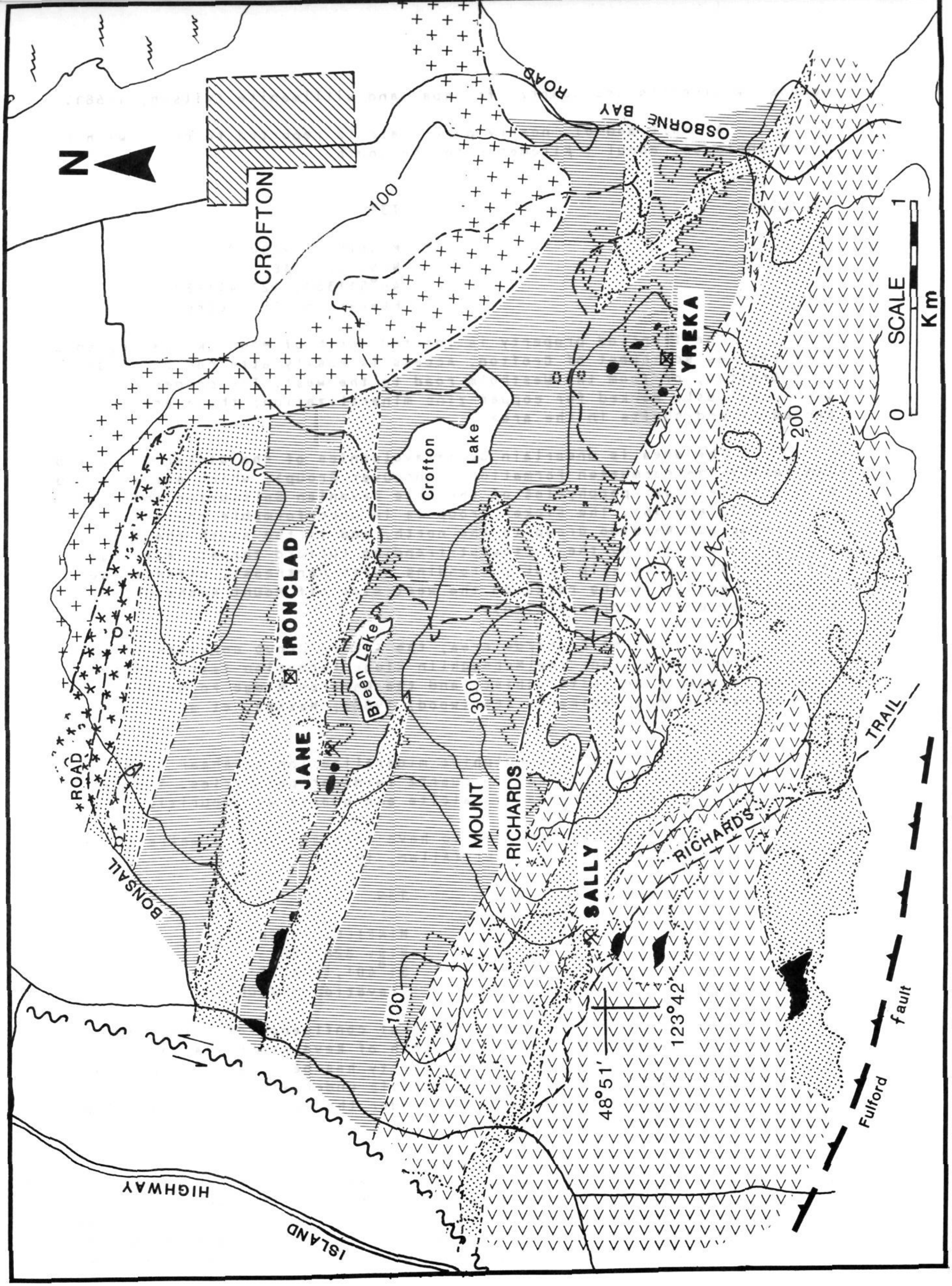


Figure 35. Geology of Mount Richards area and Ironclad showing, T31 .

LEGEND

Cretaceous

Nanaimo Group: sandstone, siltstone, shale, conglomerate, grit.

Lower Triassic

Vancouver Group

Karmutsen Formation: gabbros

Lower Devonian

Saltspring Intrusions: quartz feldspar porphyry.

Mississippian-Pennsylvanian to Middle Devonian

Sicker Group

Cameron River Formation: limestone, chert, argillite, sandstone.

McLaughlin Ridge Formation: rhyolite, andesite flows and breccias.

Nitinat Formation: basalts, andesites.

Symbols

Road, paved, secondary (gravel)

Outcrop area

Nanaimo contact

Other contacts

Fault with sense of movement

Thrust fault

Old Workings

Adit

Shaft

SOURCES

Massey, et. al., 1988; Eastwood, 1980; Sutherland Brown and Yorath, in prep.; Brandon, et. al., 1986.

Workings locations from Canadian Pacific Oil and Gas Limited, Company Report, 1969.

Figure 36. Legend to accompany map, Figure 35 .

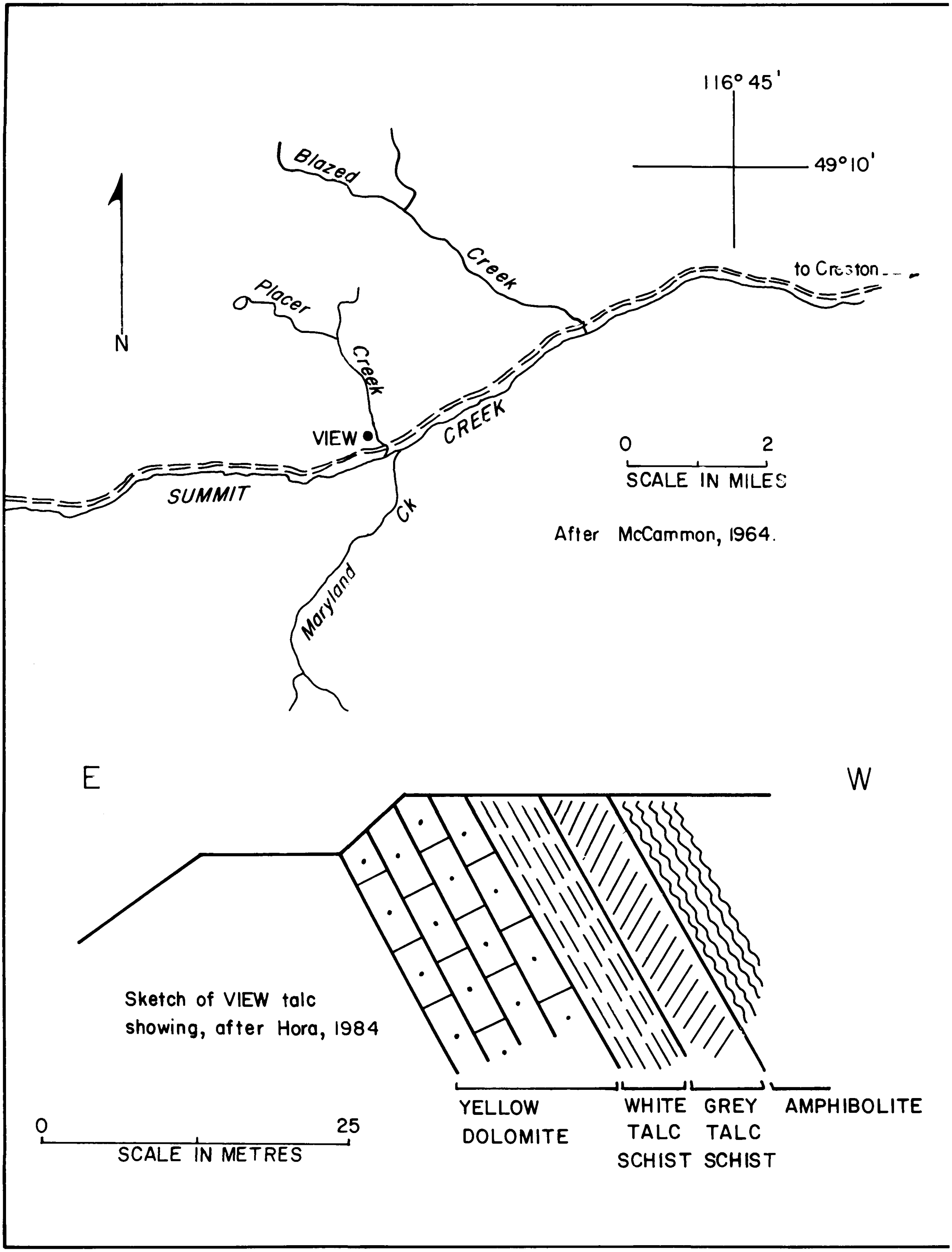


Figure 37. Sketch and location of View talc showings, T32 .

OCCURRENCES ASSOCIATED WITH DOLOMITE

View
(Summit Creek)
(Past Producer)

T32

MINFILE: 082FSE070
NTS: 82F/2W
49°06'48", 116°52'
Elevation: 1200 metres

The View showing is on the west side of Placer Creek, 0.5 kilometre above the confluence with Summit Creek. The claim is directly above the Salmo-Creston Highway, 32 kilometres west of Creston (Figure 37). Relatively low grade talc has been mined periodically from this deposit, most recently (1984) by the International Marble and Stone Company Ltd.

The main showing is near the top of a cleared area where bedrock is exposed through stripping for highway material. Talc is exposed in trenches up to 2 metres deep, over lengths of up to 50 metres (Z.D. Hora, personal communication, 1987). A shallow shaft is also reported, which intersected a small vein of high purity talc (D.F. Gunning, personal communication, 1987).

The host rocks are northeast-striking, steeply northwest-dipping dolomite, quartzite, argillite, sandy limestone, schist and amphibolite of the Dutch Creek Formation, part of the Upper Purcell Group (Precambrian).

The main talc seam occupies a sheared zone, partially replacing a 3-metre-thick bed of thinly banded siliceous dolomite. The surrounding rocks are impure dolomites and amphibolite. Talc is also exposed in a 3-metre-high bluff on Placer Creek, approximately on strike with the gravel pit, 180 metres to the northeast.

The talc, being relatively low grade, has found application as a filler and as a dusting component for ashphalt (Hora, 1984). X-ray diffraction analyses were run on samples by the Ministry of Energy, Mines and Petroleum Resources laboratory in 1987, and indicate the presence of, in decreasing order of abundance, talc, dolomite, muscovite and trace calcite.

HB
(Zincton, L. 12672)

T33

MINFILE: 082FSW004
NTS: 82F/3E
49°09'20", 117°11'55"
Elevation: 1220 metres

The HB mine is located on the west bank of Aspen Creek which drains south into Sheep Creek, about 10 kilometres southeast of Salmo. Secondary roads reach the claim from Highway 6, 4.5 kilometres to the west (Figure 38).

Talc is hosted in dolomite of the Reeves limestone member of the Lower Cambrian Laib Group. Dolomite forms lenses in the limestone; at the HB mine, massive, white to cream-coloured dolomite forms an oval-shaped zone plunging south, parallel to the strike of the limestone. The dolomite is coarse grained and silicified; diopside and tremolite are developed along the margins of quartz grains and blades of talc-altered tremolite are widely scattered.

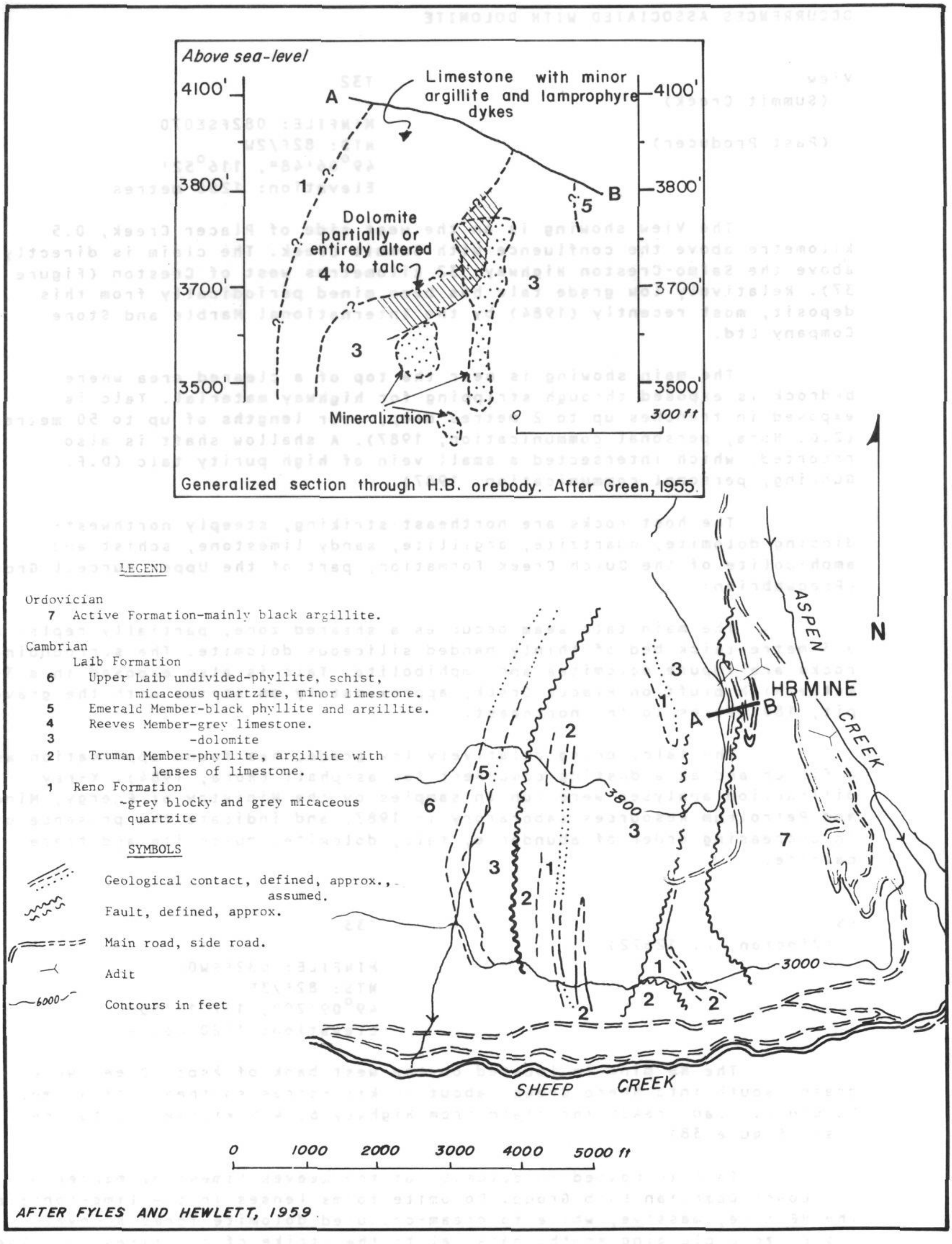


Figure 38. Geology of HB mine, T33 .

The talc is pre-sulphide mineralization; coarse sphalerite blebs replace carbonate grains between flakes and commonly contain numerous flakes of unreplaced talc (Green, 1954). Irvine (1957) reports an "appreciable amount of talc is found within the ore zones".

Green (1954, page 23) decribes the talc as follows: "Much of the dolomite in the vicinity of the west ore body has been altered to talc. The talcose zone lies above the west ore body in the section shown [Figure 38] and plunges at the same angle as the ore bodies. One part of the dolomite in the west ore body has been partly altered to talc. The talc is very fine grained, and the altered rock retains the texture of the `wispy banded' dolomite. No unaltered tremolite was observed in the talc zone, but thin sections showed some areas of talc with nearly parallel extinction, and these zones are believed to represent tremolite grains that have been so altered. Calcite is present in the altered rock and it is believed to have formed as an alteration product of the dolomite. The sulphides do not replace the talc, and masses of sphalerite commonly contain blades of fine-grained talc."

Massive dolomite is also found widely distributed on the Black Rock claims situated on both sides of Sheep Creek, as well as west of the HB mine, and in places on Lucky Boy Ridge on the south side of Sheep Creek.

Dolo T34

MINFILE: 082ESE200
NTS: 82E/2W
49°01'18", 118°57'48"
Elevation: 1020 metres

The Dolo property is south of Meyers Creek, 5.3 kilometres southeast of Rock Creek settlement and can be reached via roads from the Harpur Ranch (Figure 39). The property is quarried for dolomite; rock is crushed and ground in a plant in Rock Creek.

The dolomite occurs as a lens within Permian Anarchist Group greenstone, greywacke, limestone and paragneiss. The dolomite is fine grained and contains thin veinlets of quartz and traces of talc. Small bands of greenish to yellow talc, between 0.3 to 1.1 metres thick occur in a zone near the hangingwall contact of the dolomite. The orientation of the talc zone is 150°/30-50° west.

Illecillewaet T35

MINFILE: 082N063
NTS: 82N/4W
51°11'18", 117°45'54"
Elevation: 1200 metres

Steatite is found near the Canadian Pacific Railway (old line), about 400 metres west of the Illecillewaet station (Figure 40). An old mine is reported here but no detailed information is available.

A 1 by 5 metre pit is recorded exposing a shear zone in Lower Cambrian Lardeau Group slates and limestone (dolomite?). Talc is found in the shear zone and in outcrops extends over 600 metres. The talc is pale greenish grey to white, translucent, and mixed with pale green actinolite. An occurrence of steatite in dolomite is also reported about 10 kilometres west of the Illecillewaet showing, on Ross Peak.

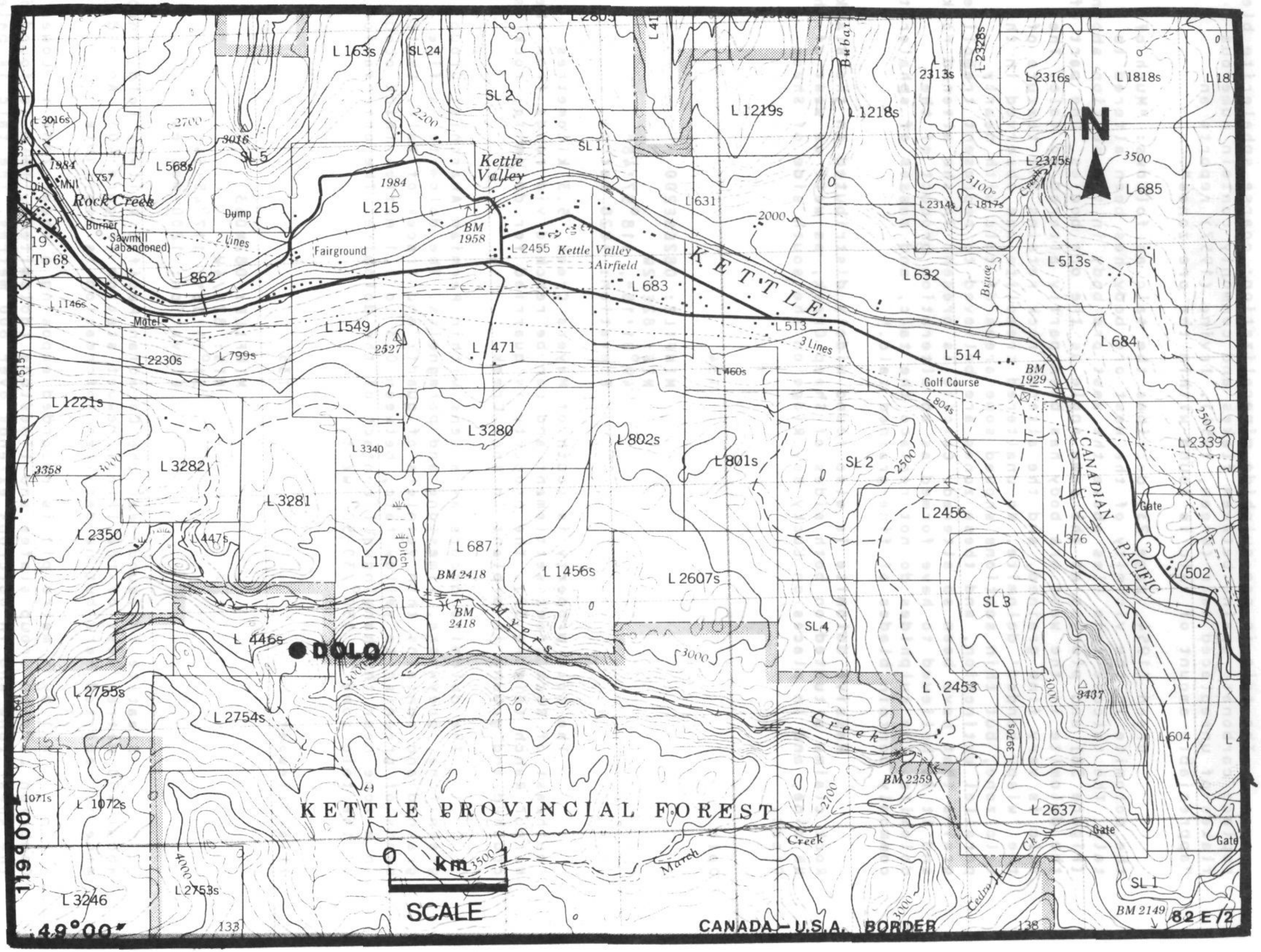


Figure 39. Location of Dolo property, T34 .

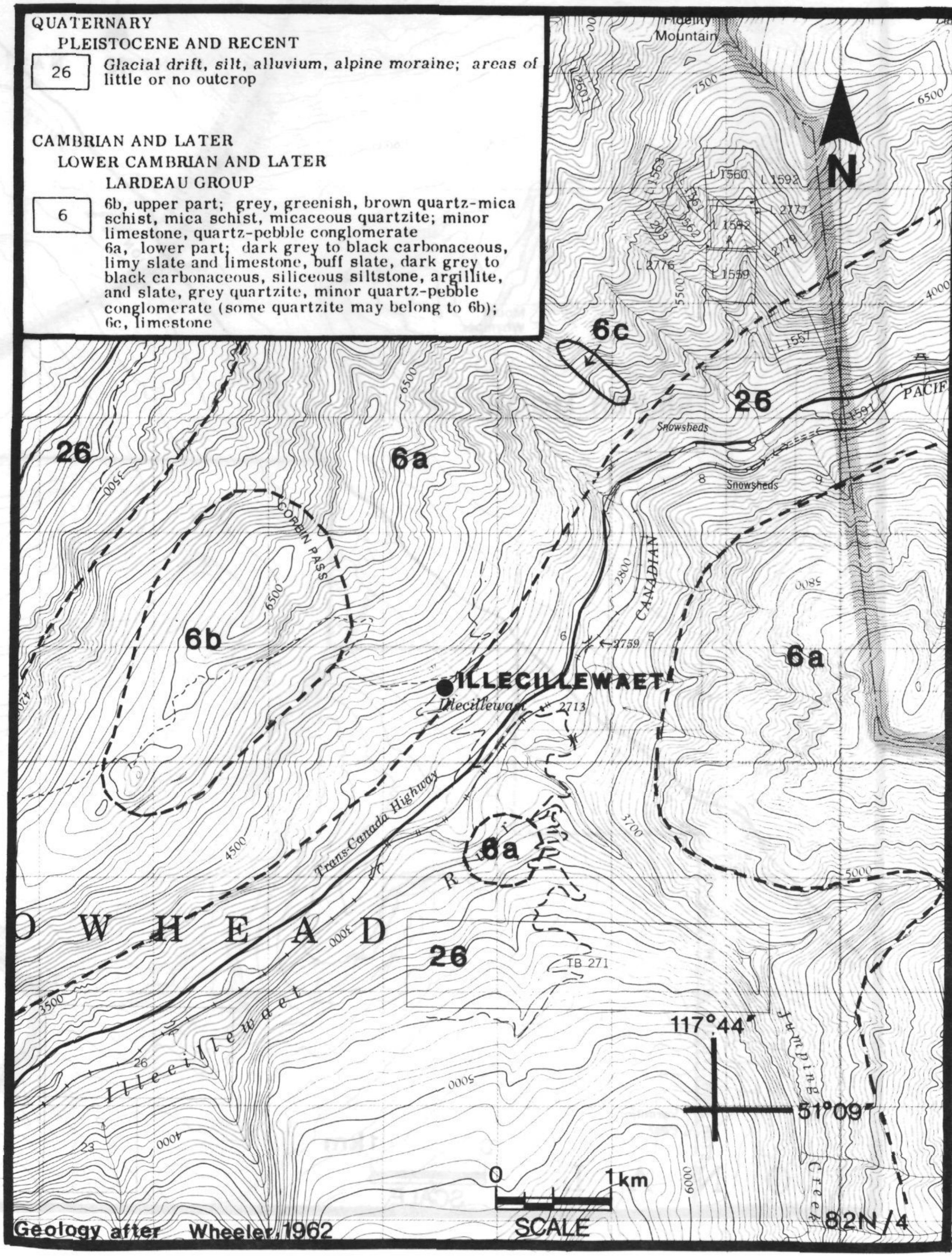


Figure 40. Geology and location of Illecillewaet showing, T35 .

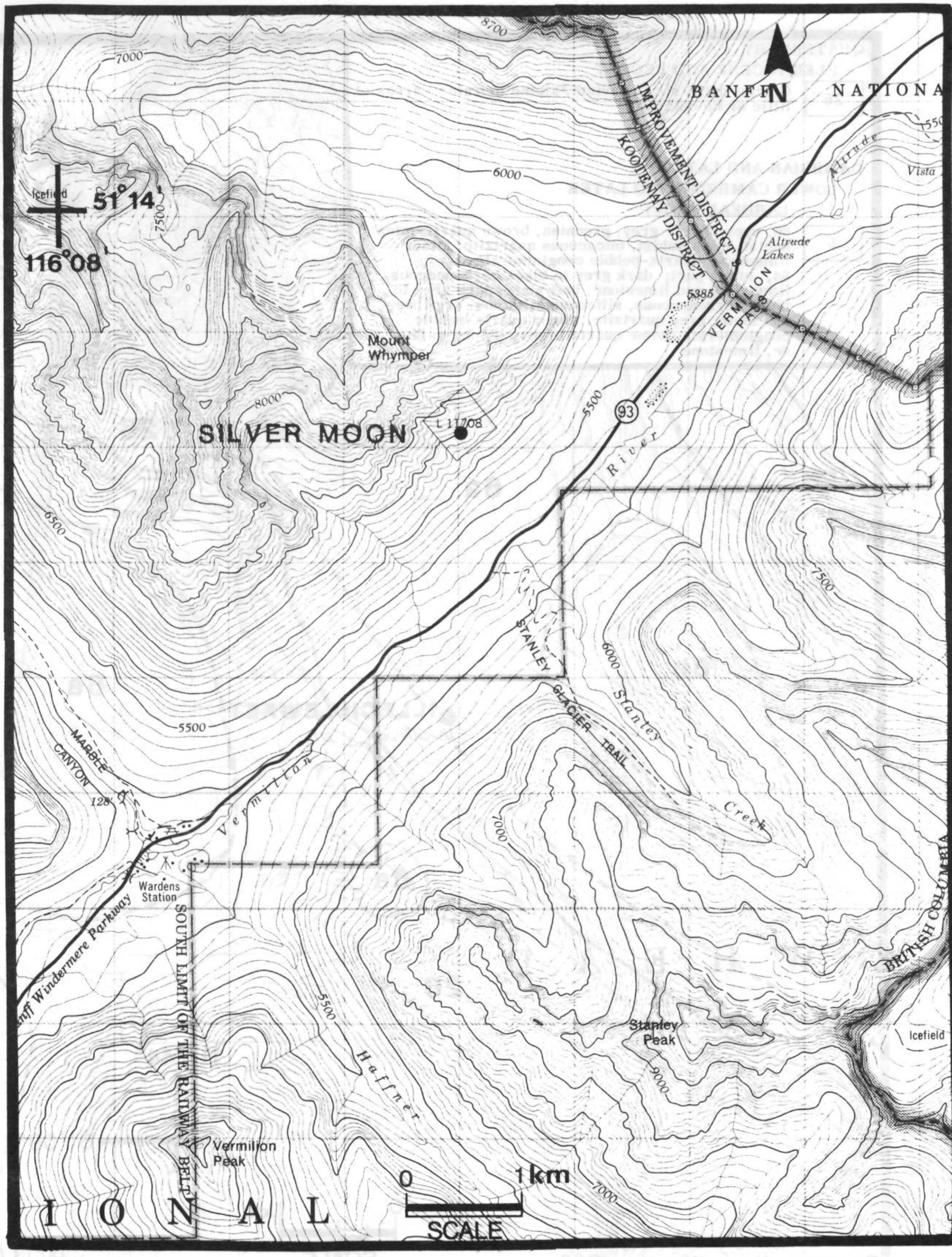


Figure 41. Location of Silver Moon showing, T36 .

Silver Moon
(L. 11708)

T36

MINFILE: 082N071
NTS: 82N/1E
51°13', 116°04'55"
Elevation: 1950 metres

The Silver Moon showing is on the southeast slope of Mount Whymper. The British Columbia/Alberta border is about 2 kilometres east at Vermillion Pass, and Banff lies 40 kilometres to the east on the Banff-Windermere Parkway (Figure 41). The property is within the boundaries of Kootenay National Park. The workings, located 300 metres above (north) the road, consist of a 10-metre tunnel and a few small pits along a series of outcrops.

The area is underlain by Lower Cambrian grey, bedded shallow-dipping dolomite. Talc appears to always occur within the same 5 to 6-metre-wide bed, which extends vertically for a maximum of 23 metres. The bed is not continuous but pinches and swells along its strike. The talc is mostly massive, dense, greenish grey to yellowish green, with pockets of fibrous material. The steatite is highly fractured, with a maximum block diameter of 0.6 metre, and is intergrown with coarsely crystalline dolomite and quartz. The iron and lime content is reported to be quite low, and the ore grinds to a 'good white powder' (Spence, 1940).

It has been suggested that nearby nepheline syenite intrusions are the source of the siliceous hydrothermal solutions causing the alteration (Wilson, 1926).

Gold Dollar

T37

MINFILE: 082O001
NTS: 82O/4
51°05', 115°54'
Elevation: 2400 metres

The Gold Dollar talc deposit lies just within British Columbia at the boundary of Kootenay National Park and Banff National Park (Figure 42). An Albertan talc deposit (Red Mountain) lies 0.8 kilometre to the west. The Gold Dollar claims are situated on a ridge between Mummy Lake (west) and Talc Lake (east). From 20 kilometres west of Banff, Alberta, a secondary road leads off Highway 1 and follows Redearth Creek, and from the mouth of Pharoah Creek a trail leads south into Redearth Pass and the above-mentioned lakes.

On the Gold Dollar claim, a 3-metre talc bed occurs on the shoulder of the ridge. It is massive and cross-jointed, with a fissile surface that breaks into 1.2-metre slabs. The unusual colour, ranging from bluish black to mottled cream and black, is due to the presence of finely disseminated amorphous carbon and abundant pyrite crystals.

The talc occurs in several beds, 0.3 to 1.5 metres thick, near the base of a flat-lying grey bedded dolomite formation 600 metres thick.

On the Red Mountain claim two short tunnels have been driven 60 metres apart. The most northwesterly outcrop on the property exposes a 3-metre-wide talc bed overlain by an iron-stained, massive, black and white talc body 20 metres thick, above which lies 600 metres of dolomite. The massive talc is badly shattered and produces only small blocks.

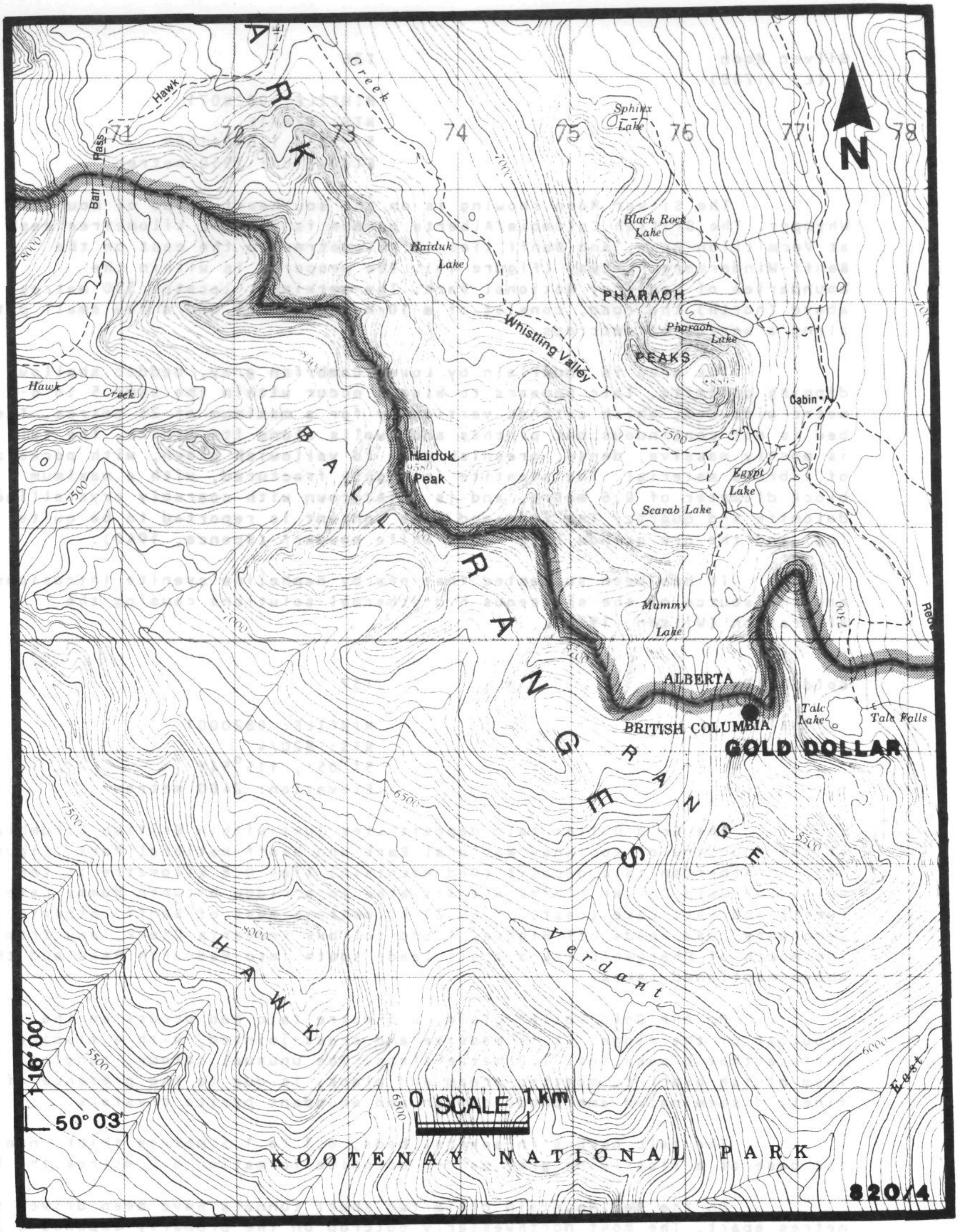


Figure 42. Location of Gold Dollar showing, T37 .

OCCURRENCES ASSOCIATED WITH MAFIC VOLCANICS

Chu Chua ('CC')

T38

MINFILE: 092P140
NTS: 92P/8E
51°23', 120°03'
Elevation: 1800 metres

The Chu Chua property is located 20 kilometres north-northeast of Barriere, on the ridge east of Chu Chua Mountain.

The host rocks are Mississippian Fennell Formation, thick massive to pillowed basalts with local pods and layers of cherty tuff and greywacke (Figures 43 and 44). The rocks strike north and dip steeply west. The regional metamorphism is lower greenschist facies and hydrothermal alteration products include epidote, zoisite, carbonate, chlorite and talc.

In the mineralized zones, siliceous, fine-grained fractured cherty tuff contains pyrite and magnetite with dark grey talc in breccia zones. Volcanic interlayers are bleached and altered to chlorite, carbonate and talc. Talc also occurs with quartz in veins cutting massive sulphide lenses. Magnetite lodes are veined with pyrite-chalcopyrite-talc and magnetite breccias are cemented either by talc alone or chalcopyrite-pyrite-chlorite.

Drilling in 1979 found talc in four holes. Drill hole 11 intersected a 3.6-metre thickness of magnetite-talc. Drill hole 12 had 4.2 metres of dark grey to black, coarse-textured talc-magnetite at 98.3 metres depth. Talc magnetite bands, 50 centimetres wide, occur in drill hole 14 from 174 to 193 metres, followed by a 7.5-metre band of the same material. In drill hole 21, a 3.5-metre zone was intersected, reported to be 95 per cent talc of a grey greeny yellow massive variety (Vollo, 1979).

In 1983, Pacific Cassiar Ltd. reported reserves of 180 000 tonnes of talc (George Cross Newsletter No. 123, 1983).

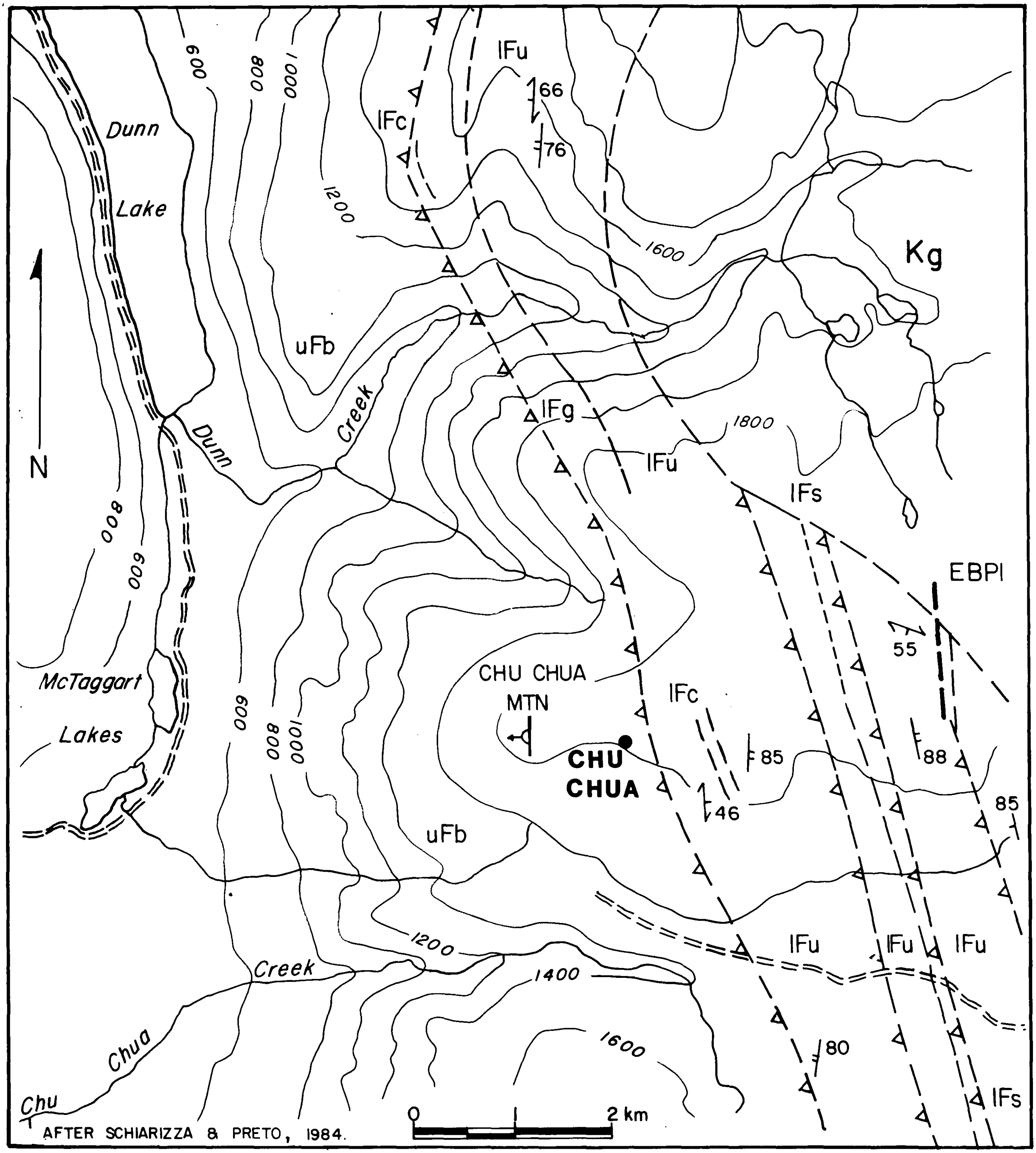


Figure 43. Geology of Chu Chua Mountain area, T38 .

LEGEND

DEVONIAN TO PERMIAN
FENNELL FORMATION

UPPER STRUCTURAL DIVISION

uFb	Grey and green pillowed and massive metabasalt; minor amounts of basaltic breccia, tuff, diabase, gabbro, chert.
uFc	Grey and green bedded chert.

LOWER STRUCTURAL DIVISION

lFc	Green and grey bedded chert, cherty argillite, slate and phyllite.
lFb	Grey and green pillowed and massive metabasalt; minor amounts of basaltic breccia and tuff.
lFg	Gabbro, diorite, diabase.
lFp	Light to medium grey quartz-feldspar porphyry rhyolite.
lFs	Light to dark grey sandstone, siltstone, slate, phyllite, and quartzite; minor amounts of limestone and chert; in places includes grey to green quartzose and feldspathic phyllite (metatuff).
lFcg	Intraformational conglomerate; clasts derived exclusively from Fennell Formation lithologies.
lFu	Undivided; mainly lFc, lFg, and lFb, but may include any or all of the above rock types.

DEVONO-MISSISSIPPIAN AND OLDER PARAUTOCHTHONOUS ROCKS (EBP to SDQ)
EAGLE BAY FORMATION

MISSISSIPPIAN

EBP	Dark grey phyllite and slate with interbedded siltstone, sandstone, and grit; minor amounts of conglomerate, limestone and metatuff; EBPl - limestone; EBPv metavolcanic breccia and tuff.

CRETACEOUS
BALDY BATHOLITH, RAFT BATHOLITH, AND RELATED ROCKS

Kg	Granite and granodiorite.

SYMBOLS

Geological contact...............
(approximate, assumed)
Bedding, top known...............
Bedding, top unkown, inclined....
Facing direction of pillowed
basalt, inclined.................
Synmetamorphic slaty cleavage,
schistosity, gneissosity ....

Early (pre folding and metamorphism) easterly directed thrust fault; teeth on upper plate: assumed.................
Fault, approximate..............
Topographical contour (metres).. 100

Figure 44. Legend to accompany map, Figure 43 .

KYOQUOT SOUND P1

(Past Producer)

MINFILE: 092L117, 072
NTS: 92L/3W
50°17', 127°17'
Elevation: 30-60 metres

Pyrophyllite is found on the shorelines of Kyoquot Sound at Easy Inlet. The showings are 13 kilometres northeast of the village of Kyoquot on the west coast of Vancouver Island, accessible by logging roads.

The host rocks are dacitic to andesitic fragmental flows of the Triassic to Lower Jurassic Bonanza Formation, which strike east and dip shallowly south. Quartz diorite porphyry and andesitic dykes intrude the volcanics, with pronounced alteration along the contact zones. Three types of alteration are present; quartz sericite, quartz alunite and quartz pyrophyllite (Figure 45).

Pyrophyllite is prominent at the north end of the peninsula east of Easy Inlet, on Lots 988 (Morris) and 989 (Deertrail), on Lots 826 (Monteith) and 830 (JH Hunter) to the southeast in a north-facing bay, and on the south shore of Easy Inlet (Figure 45).

The pyrophyllite ore is compact, dense and ranges from cream, white, pink or light grey to dark bluish grey when pyrite is present. Minor limonite imparts a yellow to reddish brown stain on the weathered surface. In thin section, the pyrophyllite flakes are about 0.01 millimetre in diameter; the ore is readily crushed to a fine smooth powder.

On the Monteith showing ("1"), the ore is pinkish white and contains 42 per cent pyrophyllite and 50 per cent quartz. On the Deertrail showing ("2"), the ore is white to grey and contains 71 per cent pyrophyllite and 20 per cent quartz. Chemical analyses of these two showings are as follows (in per cent):

	1	2
Silica	81.94	71.88
Aluminum	15.29	23.56
Ferric Oxide ...	0.11	0.14
Soda	0.40	0.36
Potash	0.50	0.43
H_2O >105°C	2.40	3.24

(Spence, 1940)

Small shipments of both pyrophyllite and alunite have been made from the area. Pyrophyllite was mined from a 2 by 2 by 4.5 metre adit on the Monteith claim at the head of Easy Inlet. Several hundred tonnes of quartz pyrophyllite rock were extracted between 1910 and 1914 by the British Columbia Pottery Company and shipped to its plant in Victoria. The ore was mixed with shale and used as a refractory for sewer pipes and fireproofing. It was also used as polishing powder, soap and cleanser.

Ries and Keele (1912) tested samples taken from the stockpiles at the Victoria plant, and found "it burns steel hard at cone 1, and shows good refractiveness; in fact, there are few more refractory clays thus far known in the western provinces." They also found it "entirely

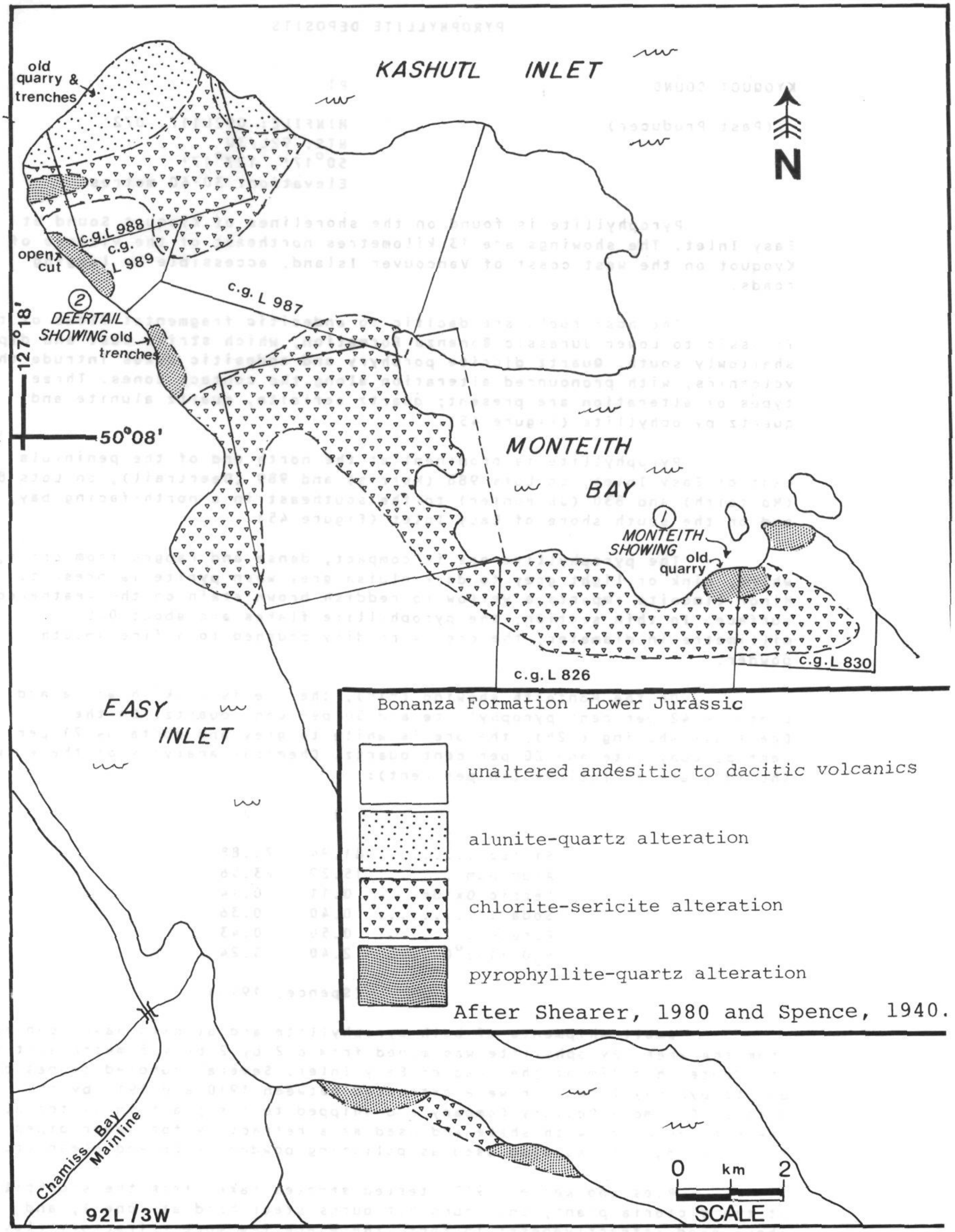


Figure 45. Geology of Kyoquot Sound showing, P1 .

unsuited" to replace foliated talc.

The deposit was examined late in World War II as a possible source of paper filler, and testing determined it to be a "highly satisfactory ingredient of whiteware batches for both slip-cast and dry process tiles, electric insulators and tableware" (Minister of Mines, B.C., Annual Report 1947, page 223).

In 1913, Clapp estimated 362,800 tons of pyrophyllite ore was contained in the 3 acres (12 140 square metres) on the Deertrail and Morris claims, and 90,000 tons on the 1-acre (4047 square metres) showing on the Montieth claim.

Drilling in 1983, by Falconbridge Limited, encountered mostly brecciated volcanics with strongly silicified zones of alunite and pyrophyllite mixed with varying proportions of quartz and abundant pyrite (Wilson, 1983).

RIVERSIDE
(SEMLIN)

(Past Producer)

P2

MINFILE: 092INW087
NTS: 92I/14E
50°47', 121°05'42"
Elevation: 430-504 metres

The Riverside deposit lies immediately south of the Canadian Pacific Railway tracks at Semlin Siding, 16 kilometres east of Ashcroft (Figure 46). The showing is in the gulley of a small creek in the south bank of the Thompson River. A quarry, 450 metres south of the railway tracks, joins two deep open cuts.

The host rock is Upper Triassic rhyolite porphyry which is schistose, greenish grey and contains quartz, orthoclase and minor albite in a fine-grained groundmass.

Pyrophyllite occurs with quartz, calcite and minor pyrite as wallrock alteration along a shear zone in the rhyolite porphyry. The pyrophyllite is stained yellow with small selenite crystals. In the quarry, the pyrophyllite is light grey to white but very iron stained.

An 82-tonne test shipment was reportedly sent to a grinding plant in Lethbridge, Alberta in 1950. Grinding tests done by the Bureau of Mines in Ottawa in 1948 found that if impurities are removed prior to grinding, the product obtained is suitable for ceramics or as a filler (McCammon, 1951).

PYRO GROUP

(Past Producer)

P3

MINFILE: 092HSE131
NTS: 92H/7E
49°29'36", 120°37'30"
Elevation: 1050 metres

The main showing of the Pyro group is on a logging road 3.8 kilometres east of Coalmont, approximately 5 kilometres northwest of Princeton (Figure 47). Work reported in 1973 consisted of 375 metres of trenching and 30 square metres of stripping.

The host rocks are volcanics of the Upper Triassic Nicola Group. The showing appears to be related to a major fault zone. The ore is a mixture of quartz and pyrophyllite with scattered grains of pyrite.

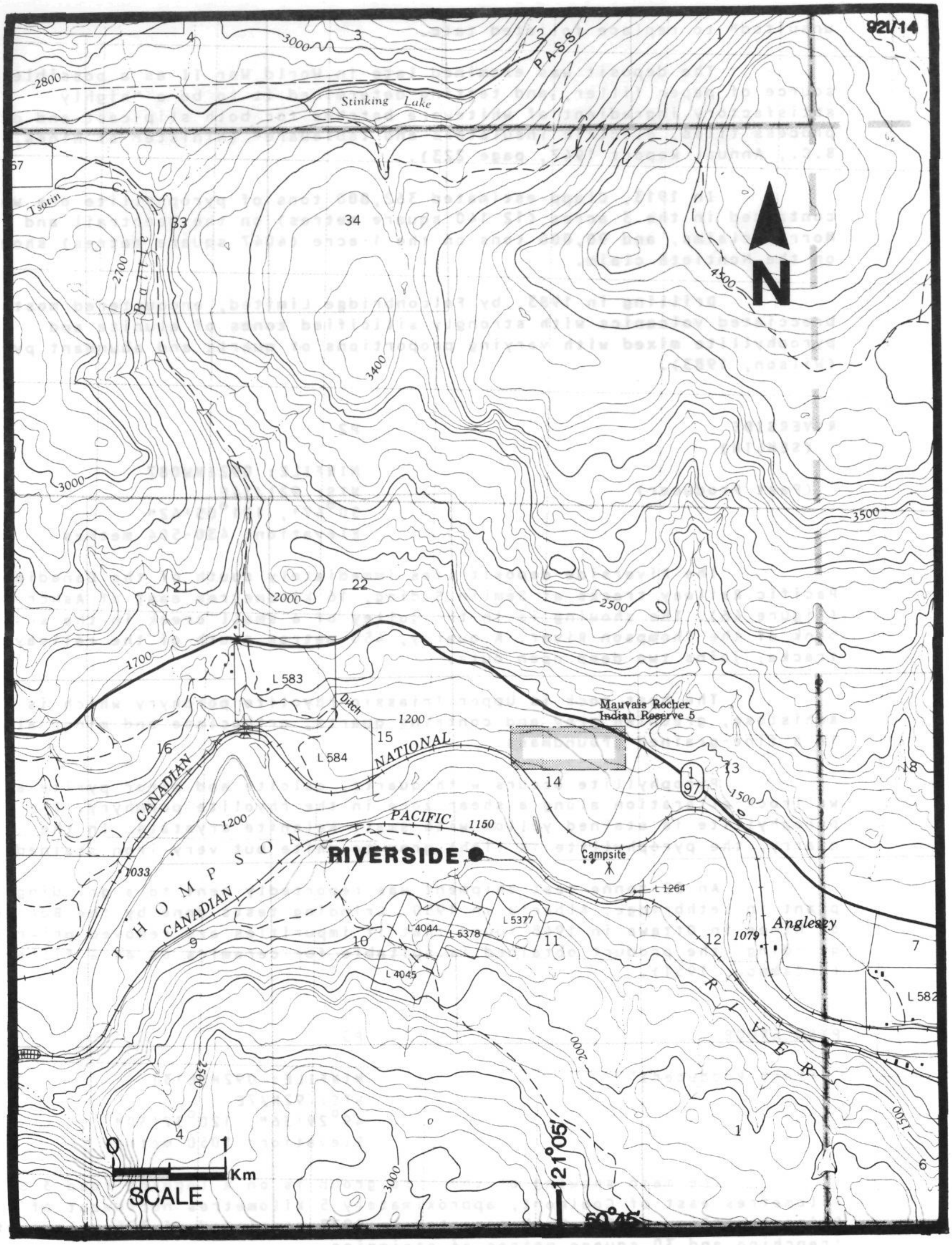


Figure 46. Location of Riverside deposit, P2 .

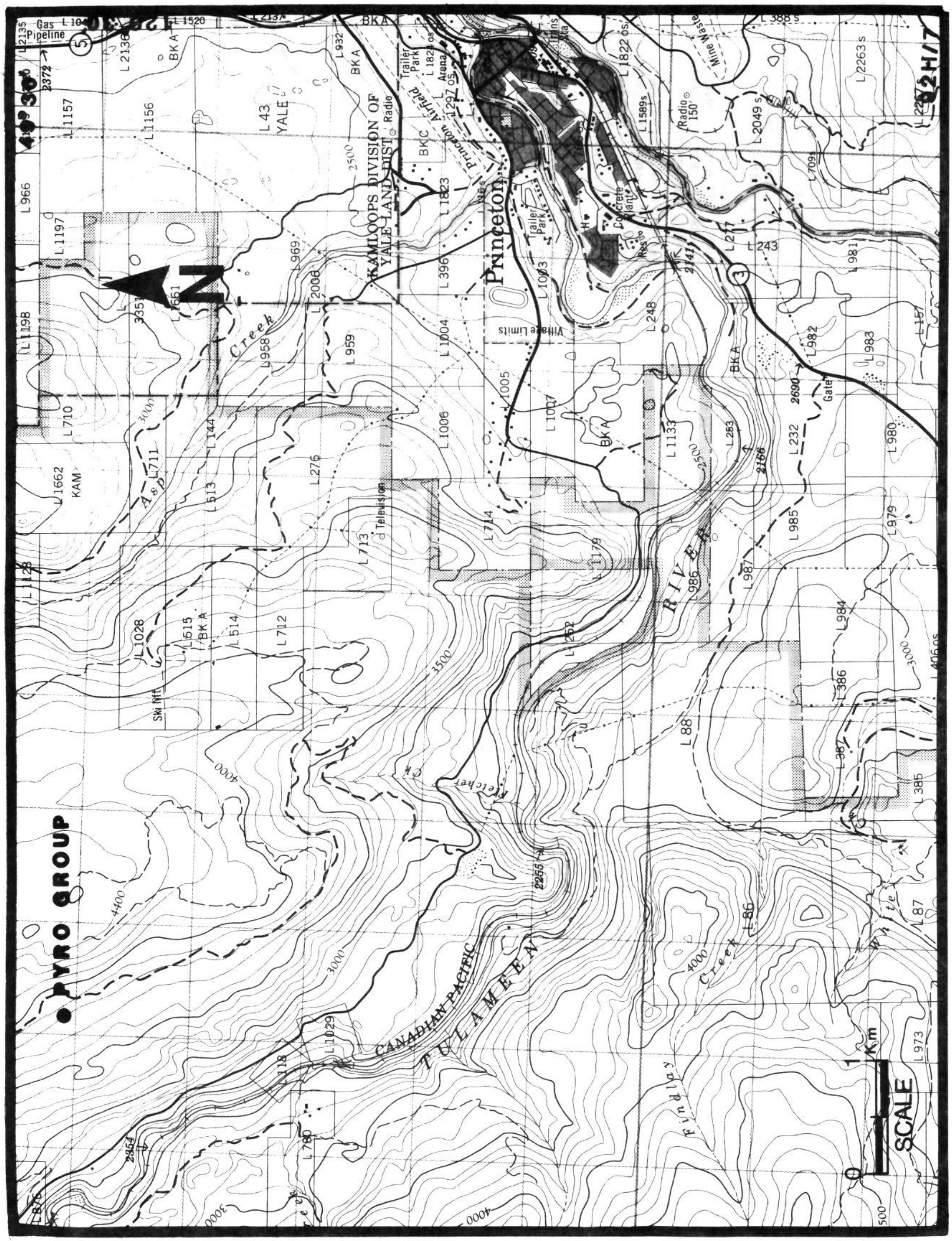


Figure 47. Location of Pyro group, P3 .

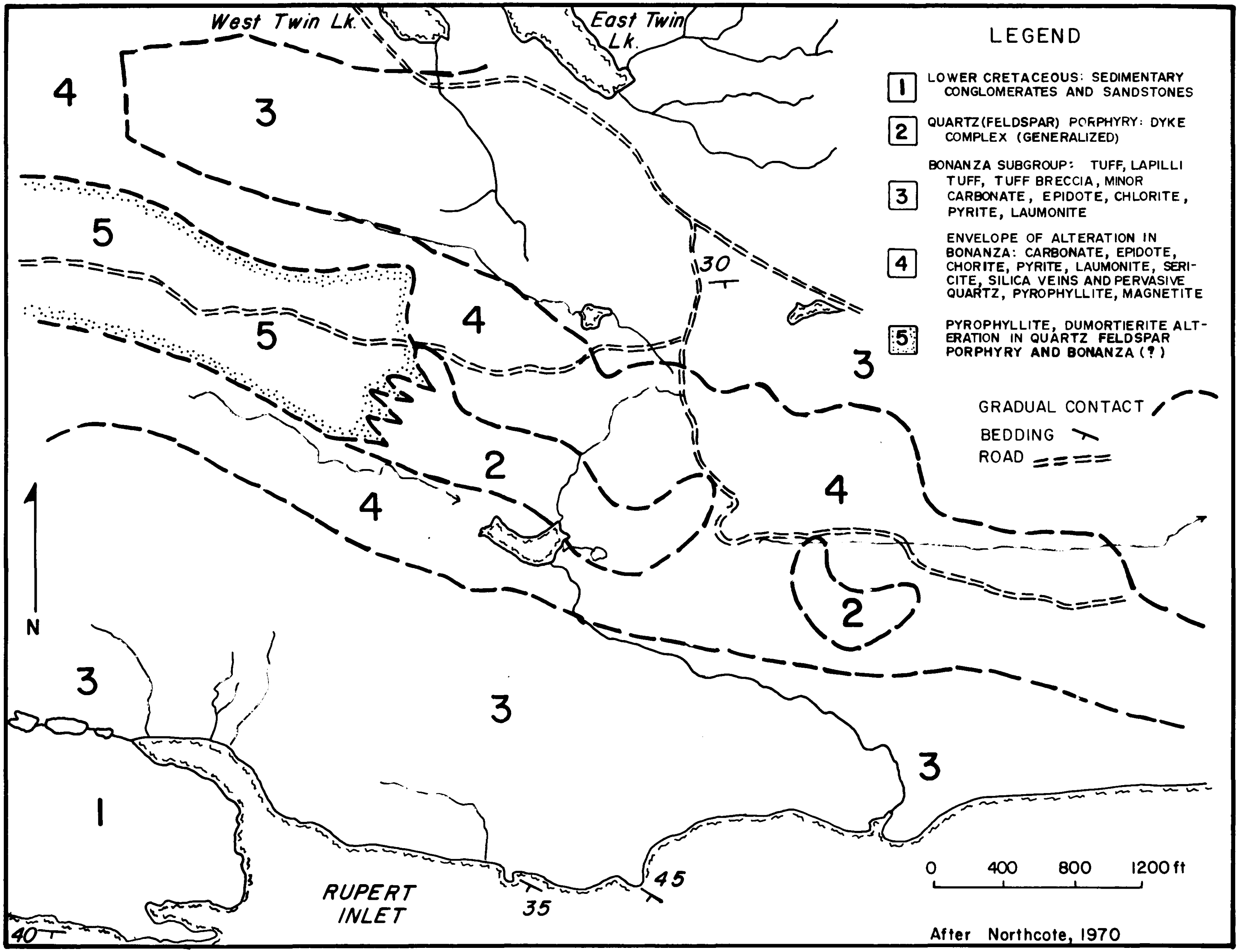


Figure 48. Geology of Island Copper deposit, P4 .

Shears and fracture faces are filled with quartz and fine-grained powdery pyrophyllite.

A grab sample of the ore was taken from the centre of the strippings where the rock is more light grey-white coloured, surrounded by brown-stained material. The results were (in per cent):

Silica	80.96
Alumina ...	13.24
Iron	0.13

Apparently a small shipment was made from this deposit but no further information is given (McCammon, 1958).

Since 1972, pyrophyllite from this property has been used by Clayburn Industries Limited of Abbotsford for manufacturing refractory products, at a rate of approximately 200 tonnes a year. The material is stockpiled on the minesite and in Princeton, and is shipped to the Abbotsford plant whenever there is a demand for it.

ISLAND COPPER
(BAY NO. 74)

P4

MINFILE: 092L138
NTS: 92L/11W
$50^{\circ}37'$, $127^{\circ}29'30''$
Elevation: SL-150 metres

Island Copper is a porphyry copper-molybdenum deposit located on the north side of Rupert Inlet, about 6.5 kilometres east of Coal Harbour and 19 kilometres south of Port Hardy, by road.

The host rocks are brecciated, hydrothermally altered andesitic to basaltic lapilli tuff and tuff-breccia of the lower Bonanza Subgroup. A northwest-trending quartz feldspar porphyry dyke swarm cuts the volcanics, which strikes northwest and dip southwest (Figure 48).

At the western edge of the deposit, a dyke is overlain by an intensely altered breccia zone up to 150 metres wide and 1000 metres long. The zone is massive greyish tan pyrophyllite, quartz and kaolin, speckled with bright blue dumortierite. The zone appears brecciated and has a coarse, gritty texture. The alteration is due to siliceous differentiates of the quartz feldspar porphyry system permeating brecciated rocks; the brecciation and alteration are inferred to be synchronous with the brecciation and emplacement of the dykes (Northcote, 1970).

A chip sample across a 15-metre exposure on the east end of the zone was analysed by the Ministry of Energy, Mines and Petroleum Resources in 1968, yielding the following percentages:

SiO_2	83.18
Al_2O_3	13.36
H_2O >$105^{\circ}C$ ...	2.78

Spectrographic analysis indicates the presence of iron, titanium and 0.5 per cent boron.

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APPENDIX 1
MINOR TALC OCCURRENCES

MINFILE No.	Name	Latitude	Longitude	Description
		Associated with Ultramafics		
082ESE216	Last Chance (L. 753)	49.05.40	118.38.18	talc in altered shear zone with carbonate in an ultrabasic intrusion
082KNE014	Jab	50.48.19	116.21.30	talc with serpentine as slickensided 'films' separating thin layers of magnesite
082KNW224	Upper Arrow Talc	50.44.00	117.48.24	30-cm light greenish white impure talc seam in serpentine
082LNE001	JS			
092HSW097	Steven	49.27.	121.15.	talc associated with serpentine along contact with chert
092HNW042	NI	49.30.54	121.38.36	schistose talc with tremolite and chlorite in serpentine
092HNW063	Old Settler Mtn.	49.32.	121.39.00	schistose talc found in serpentine
092JNE015	Standard (L. 1940)	50.41.22	122.36.10	talc in altered and sheared serpentinite - President utrabasic intrusions
092JNE045	Lucky Strike (L. 6828)	50.58.55	122.51.50	talc in altered serpentinite with quartz, carbonate and mariposite
092JNE063	Hell Creek	50.49.30	122.16.15	0.3-m talc zone bordering nephrite deposit
092JNE064	4-Ton (L. 2085)	50.54.10	122.30.46	talc and chlorite schist with serpentinized Shulaps ultrabasics
092JNE065	Greenbay (L. 2084)	50.54.12	122.31.10	talc and chlorite schist with serpentinized Shulaps ultrabasics
092JNE092	Olympic	50.53.35	122.44.30	talc and mariposite with sulphides in listwanites (quartz-carbonate zones)
092JNE099	Shulaps Range	50.54.50	122.32.35	talc in altered serpentinite zone surrounding chromite deposit
092JNE100	Taylor Basin	51.00.00	122.52.00	talc with serpentinite in sheared dunite hosting nickel occurrence
092JNE104	Moon Creek Asbestos	50.45.20	122.01.10	talc associated with asbestos in serpentinized peridotite
092JNE111	Jim Creek	50.56.55	122.33.15	schistose talc with nephrite in serpentinite
104M 022	Laverdiere	59.13.25	134.07.10	talc as alteration and gangue with serpentinite, chlorite, epidote and tremolite
104P 084	McDame	59.19.20	129.48.50	McDame ultramafics - sheared talcy soapstone, tremolite, zoisite and epidote

Associated with Schists

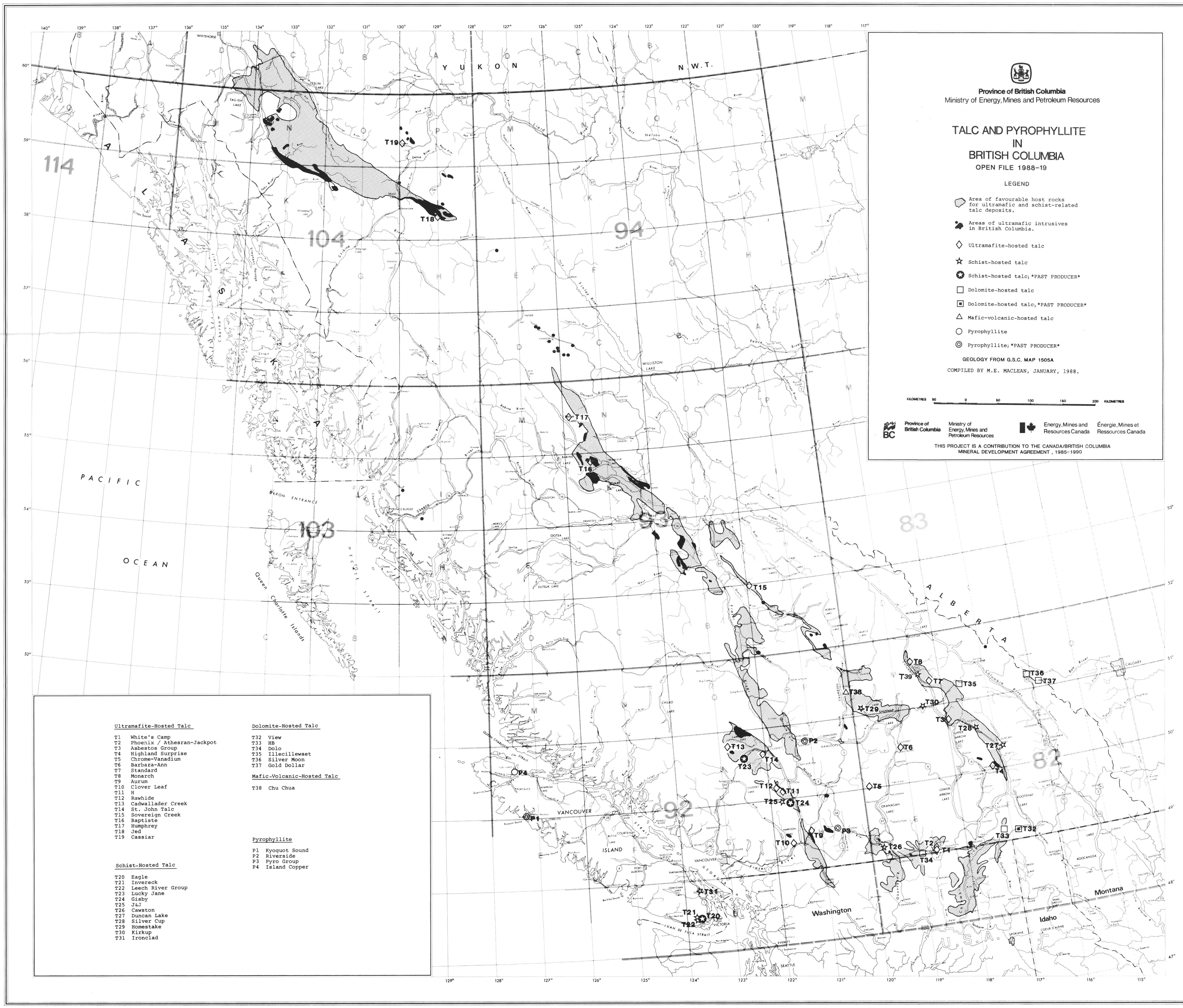
082GSW010	Ramshorn	49.15.20	115.06.00	talcose (chlorite?) gouge (2 cm) along one side of quartz vein
082M149	Bend	51.38.40	118.32.30	20-cm-thick quartz-talc-tremolite-garnet schist
114P 064	Low Herbert	59.21.45	136.31.00	mineralization hosted in sericite, talc and chlorite-altered schistose metavolcanics

Associated with Dolomite

082FSW001	Aspen (L. 12471)	49.11.08	117.11.15	'upper' zinc-bearing dolostone breccia; talc in gangue with calcite, dolomite, olivine and serpentine
082KNE015	Topaz Lake	50.49.38	116.24.01	talc in minute shears in magnesite-bearing Mt. Nelson dolomite
104O 032	Gunnar Berg	59.59.20	130.23.30	talc as alteration with wollastonite and chlorite in mineralized skarn deposit

Others

092JNE008	Holland (L. 7258, 7079)	50.45.40	122.45.50	talc with sulphides in quartz-calcite veins infilling fissures in greenstone and quartzite
092JNE016	Short O'Bacon (L. 7509)	50.46.40	122.50.25	shear zone in Pioneer greenstone; rock is talcose with mariposite and pyrite
092JNE030	Wayside Mine (L. 3036)	50.52.35	122.49.40	talc as alteration product with siderite, mariposite, sericite and chlorite in mineralized shear zone
104M 001	Gridiron	59.56.00	134.56.20	talc and quartz gangue in mineralized shear zone in Yukon Group hornfelsed metaseds



Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources
TALC AND PYROPHYLLITE IN BRITISH COLUMBIA
OPEN FILE 1988-19
LEGEND
Area of favourable host rocks for ultramafic and schist-related talc deposits.
Areas of ultramafic intrusives in British Columbia.
Ultramafite-hosted talc
Schist-hosted talc
Schist-hosted talc; *PAST PRODUCER*
Dolomite-hosted talc
Dolomite-hosted talc; *PAST PRODUCER*
Mafic-volcanic-hosted talc
Pyrophyllite
Pyrophyllite; *PAST PRODUCER*
GEOLOGY FROM G.S.C. MAP 1505A
COMPILED BY M.E. MACLEAN, JANUARY, 1988.
KILOMETRES 50 0 50 100 150 200 KILOMETRES
Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources
Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada
THIS PROJECT IS A CONTRIBUTION TO THE CANADA/BRITISH COLUMBIA MINERAL DEVELOPMENT AGREEMENT, 1985-1990
Ultramafite-Hosted Talc
T1 White's Camp
T2 Phoenix / Athesran-Jackpot
T3 Asbestos Group
T4 Highland Surprise
T5 Chrome-Vanadium
T6 Barbara-Ann
T7 Standard
T8 Monarch
T9 Aurum
T10 Clover Leaf
T11 H
T12 Rawhide
T13 Cadwallader Creek
T14 St. John Talc
T15 Sovereign Creek
T16 Baptiste
T17 Humphrey
T18 Jed
T19 Cassiar
Schist-Hosted Talc
T20 Eagle
T21 Invereck
T22 Leech River Group
T23 Lucky Jane
T24 Gisby
T25 J&J
T26 Cawston
T27 Duncan Lake
T28 Silver Cup
T29 Homestake
T30 Kirkup
T31 Ironclad
Dolomite-Hosted Talc
T32 View
T33 HB
T34 Dolo
T35 Illecillewaet
T36 Silver Moon
T37 Gold Dollar
Mafic-Volcanic-Hosted Talc
T38 Chu Chua
Pyrophyllite
P1 Kyoquot Sound
P2 Riverside
P3 Pyro Group
P4 Island Copper
YUKON
N.W.T.
ALBERTA
PACIFIC OCEAN
Queen Charlotte Islands
VANCOUVER
VICTORIA
Washington
Montana
Idaho
U.S.A.
114
104
94
103
93
83
92
82