# Industrial Minerals Studies

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Geological Fieldwork 1989

# PERLITE AND VERMICULITE OCCURRENCES IN BRITISH COLUMBIA

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*KEYWORDS:* Industrial minerals, perlite, vermiculite, Frenier, Francois Lake, Nechako River, Port Clements, Joseph Lake, Sowchea Creek.

## INTRODUCTION

The term "perlite" applies to hydrated volcanic glass of rhyolitic composition which, when heated to temperatures as low as 510°C, will expand to form a white, porous, light-weight material. In its expanded form, perlite is used primarily as an insulating aggregate in plaster and concrete, as a loose-fill insulation, in horticultural applications and as a filtering agent. Generally perlite is thought to form by the secondary hydration of obsidian. Combined water in perlite exists in two forms, molecular and as hydroxyl ion, with the ratio of one to the other varying with location. Deposits are restricted to volcanic belts ranging in age from Tertiary to Quaternary. Commercial deposits of perlite have a variety of textures grading from pumiceous to obsidian, which appear to be related to depth of burial.

"Vermiculite" is a micaceous mineral that rapidly expands on heating, to produce a low density material. Like perlite, vermiculite swells when heated, with individual flakes expanding up to 30 times – a process called exfoliation. If heated in an oxidizing atmosphere vermiculite turns dull grey or tan but if heated in a reducing atmosphere the product is bronze or gold. These light-weight commercially valuable products are commonly used in construction, agriculture or

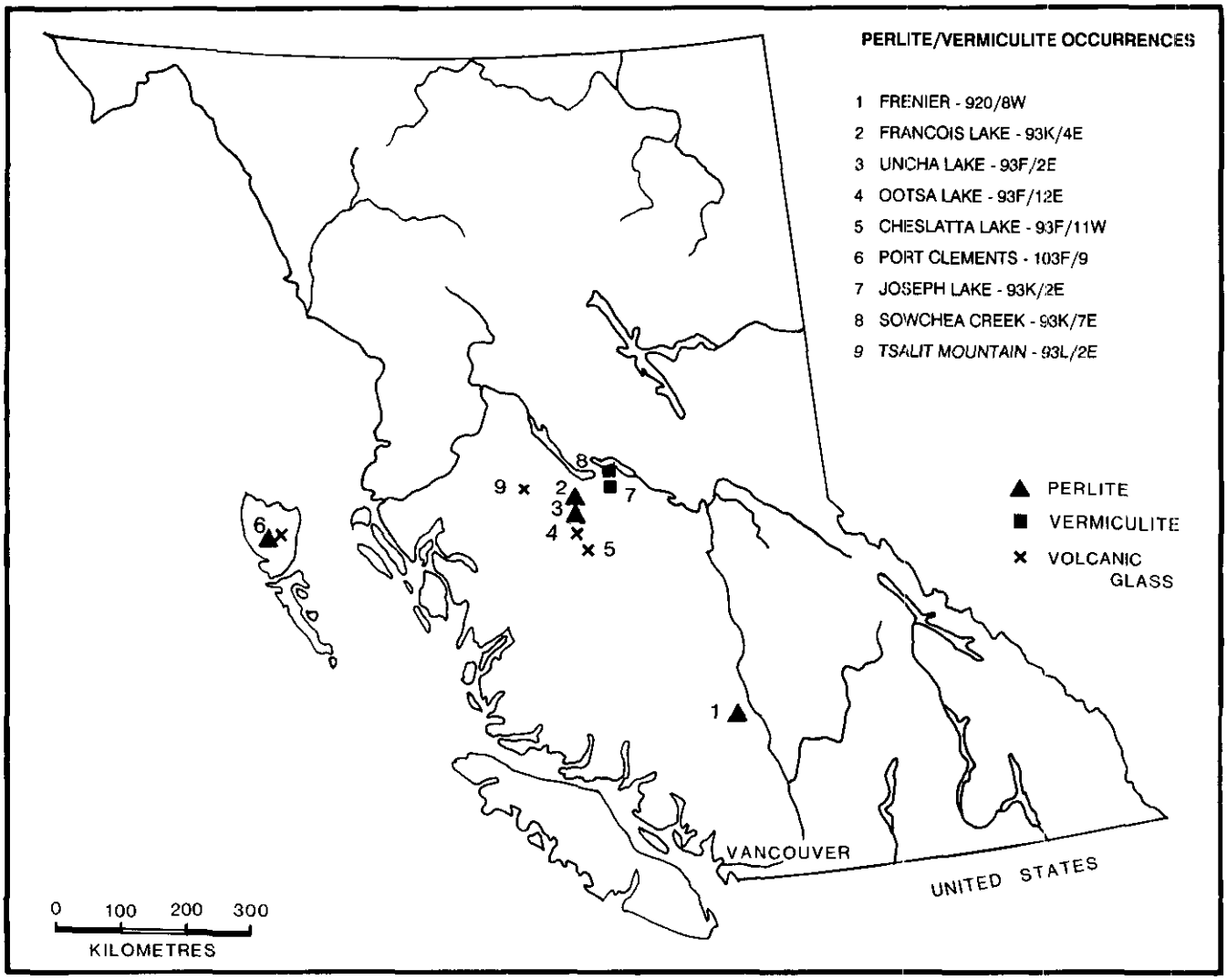
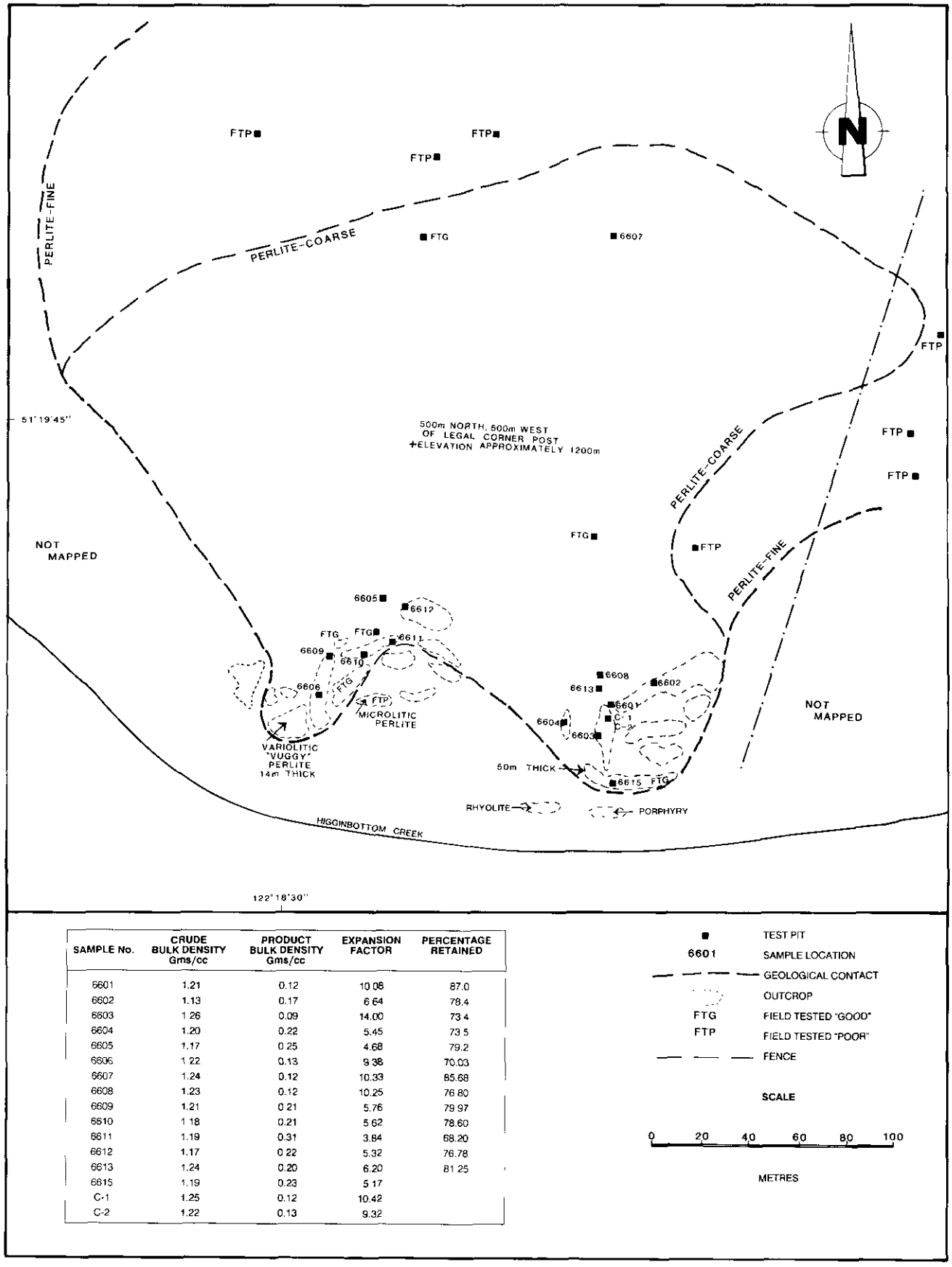



Figure 5-1-1. Locations of perlite/vermiculite occurrences in British Columbia.




| SAMPLE No. | CRUDE BULK DENSITY Gms/cc | PRODUCT BULK DENSITY Gms/cc | EXPANSION FACTOR | PERCENTAGE RETAINED |
|---|---|---|---|---|
| 6601 | 1.21 | 0.12 | 10 08 | 87.0 |
| 6602 | 1.13 | 0.17 | 6 64 | 78.4 |
| 6603 | 1 26 | 0.09 | 14.00 | 73 4 |
| 6604 | 1.20 | 0.22 | 5.45 | 73 5 |
| 6605 | 1.17 | 0 25 | 4.68 | 79.2 |
| 6606 | 1 22 | 0.13 | 9 38 | 70.03 |
| 6607 | 1.24 | 0.12 | 10.33 | 85.68 |
| 6608 | 1.23 | 0.12 | 10.25 | 76 80 |
| 6609 | 1.21 | 0 21 | 5.76 | 79 97 |
| 6610 | 1 18 | 0.21 | 5 62 | 78.60 |
| 6611 | 1.19 | 0.31 | 3.84 | 68.20 |
| 6612 | 1.17 | 0 22 | 5.32 | 76.78 |
| 6613 | 1.24 | 0.20 | 6.20 | 81 25 |
| 6615 | 1.19 | 0.23 | 5 17 | |
| C-1 | 1.25 | 0.12 | 10.42 | |
| C-2 | 1.22 | 0.13 | 9.32 | |



Figure 5-1-2. Frenier perlite deposit located 60 kilometres northwest of Clinton, B.C. (92O/08W); adapted from Horne, 1983.

for horticultural applications. To be commercially viable, vermiculite deposits must contain flake material larger than 65 mesh with the recovery greater than 20 per cent by volume. Vermiculite is usually mined from altered basic intrusive rocks or ultramafic layered metamorphic rocks. Biotite is the most common parent mineral.

At present, all perlite and vermiculite products used in British Columbia are imported from the United States. As a first step to assess the potential to develop local production, a study of known occurrences was undertaken. Of ten known perlite occurrences in the province, only three had partial geological descriptions. Three vermiculite occurrences with a sizeable tonnage potential were reported in 1987 and 1988 but only one has a report in the Ministry's files. A systematic, "grassroots" evaluation of six volcanic glass (perlite) deposits and two vermiculite occurrences was carried out during 1989 (Figure 5-1-1). Sites were selected on the basis of their accessibility to established transportation networks, production record (if any) and geological setting. In most instances the geological, physical and chemical characteristics of each site were unknown.

This report describes these occurrences and their physical characteristics and, where possible, evaluates their potential as a commercial source of perlite or vermiculite. All sites are accessible by road. Representative samples collected at each site were heated using a hand-held propane torch. This simple test is effective in determining whether the material is expandable.

Preliminary results indicate five perlite occurrences contain expandable material (Frenier, Francois Lake, Uncha Lake, Blackwater Creek, Gold Creek) and material from both vermiculite showings swells when heated (Fraser Lake, Fort St. James). Laboratory and process testing of bulk samples are required to assess whether the occurrences contain material which meets industry specifications, and to compare the quality of perlite from individual locations.

## PERLITE OCCURRENCES

### FRENIER DEPOSIT (MINFILE 92O 072)

The Empire Valley perlite deposit was discovered by Lawrence Frenier in 1949. It is located approximately 60 kilometres northwest of Clinton at 1200 metres elevation on the eastern slope of Blackdome Mountain. The property, developed by Aurun Mines Limited and named after the prospector who discovered it, saw production from 1983 through 1985 producing 1000, 2000 and 3000 tonnes respectively. Crude perlite was shipped by truck, initially to the company's pilot-plant in Aldergrove, B.C., and later to its processing facility in Surrey where the expanded product was marketed under the tradename Aurolite. The mine has been inactive since 1986 because of transportation difficulties resulting from an old, low-capacity bridge across the Fraser River. Various industry sources indicate that the quality of Frenier perlite is far superior to any imported rock.

#### GEOLOGY

Volcanic rocks at the site are assigned to the Eocene Kamloops Group and consist of devitrified rhyolite tuff, vesicular rhyolite flows, rhyolite crystal tuff, perlite and volcanic breccia with clasts of varied composition (Green and Trupia, 1989). In outcrop the perlite is a homogeneous, light grey, glassy rock, crosscut by veins of opalline silica and pitchstone. When heated using a hand-held propane torch, crushed perlite expands rapidly to many times its original size, similar to heated corn kernels.

The deposit consists of a flat-lying flow of volcanic glass with occasional shards of glass welded together to form tuff. Flow direction has not been established but the deposit is massive, appears domed, and exhibits perlitic (onion skin) textures.

#### RESERVES

The shape of the orebody is illustrated in Figure 5-1-2. The deposit has been divided into "coarse" and "fine" perlite with inferred reserves calculated by Aurun Mines Limited of 3.8 million tonnes, using an average thickness of 30 metres and a specific gravity of 2.3. There is possiblity that the estimated resource reported by the company can be increased.

### FRANCOIS LAKE PROSPECT (MINFILE 93K 001)

First reported by G.M. Dawson in 1876 and staked in 1948 by N.B. Davis of Ottawa, Ontario, the Francois Lake perlite showing was sold to Western Gypsum Products Limited of Winnipeg a year later. In 1953 this company produced 1100 tonnes of perlite from a quarry located on the north shore of Francois Lake approximately 22 kilometres south of the town of Burns Lake. The mineral was processed at the company plant in Calgary, but its eventual use and value are not known. The quarry has not been worked since that time.

#### GEOLOGY

The Francois Lake perlite occurs in a package of rocks considered to be Eocene to Oligocene and possibly Paleocene in age, consisting of rhyolite, dacite and associated tuffs and breccias minor andesite, basalt and conglomerate (Tipper, 1963).

Volcanic glass crops out at four separate sites (Figure 5-1-3) and is medium grey on weathered surfaces but dark grey to black on freshly exposed outcrops. Commonly, exposed perlite crumbles into marble-sized angular pellets. When heated with a hand-held propane torch, perlite from Sites A and B expands a similar amount to that tested at the Frenier deposit. At Sites C and D, however, tested volcanic glass did not expand.

Perlite beds at Site A strike northeast and dip 15° to 35° northwest. The rock exhibits typical onion-skin texture with radiating fractures perpendicular to strike. In places it is brecciated and siliceous with pronounced flow banding and, in all locations, perlite beds sit in sharp contact with cherty rhyolite both above and below exposed outcrop. At the lakeshore, perlite is exposed in a 2-metre bed over 15 metres. Twenty metres away from the shore much of the overburden was removed during quarry development and a small stockpile remains, but fresh outcrop is not exposed.

At Site B, 300 metres north of the lake, perlite is exposed intermittently for 110 metres along an access road. At the

north end of the roadcut, fresh perlite is exposed continuously for 50 metres. The 15-metre-thick bed strikes northeast dipping 30° northwest and lies on coarse, grey tuff and under 10 metres of unconsolidated silty overburden.

Volcanic glass crops out at two sites 300 metres north of Site B (Site C). It is medium grey in colour, but unlike rock at Sites A and B, contains hard, dense, spherulitic aggregates up to 2 centimetres in diameter. No other rock types are exposed at this site but small outcrops of rhyolite occur to the west.

At Site D, 100 metres northeast of Site C, a trench 24 metres long and 1.5 to 2 metres deep exposes volcanic glass striking northwest and dipping 20° southwest. Grey to brown cherty rhyolite crops out immediately east of the exposed perlite and white rhyolite crops out to the west.

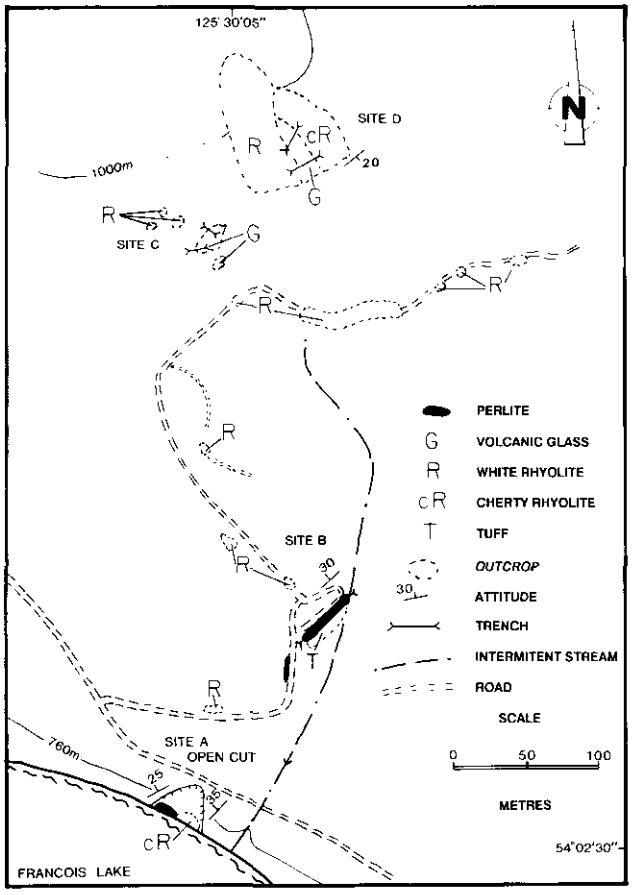



Figure 5-1-3. Francois Lake perlite prospect 22 kilometres south of Burns Lake (93K/04E); adapted in part after McCammon (1949).

## Nechako River Area Perlite/ Volcanic Glass Occurrences

The Uncha Lake (perlite), Cheslatta and Ootsa Lakes (volcanic glass) occurrences are in a volcanic package mapped by Tipper (1963), as Paleocene (?), Eocene and Oligocene Ootsa Lake Group, consisting of rhyolite, dacite and associated tuffs and breccias, minor andesite, basalt and conglomerate. A brief description of each occurrence follows:

### UNCHA LAKE PROSPECT (MINFILE 93F 026)

Originally staked in 1953 by C.S. Powney and J. Rasmussen of Fort St. James and their associates, the Uncha Lake perlite prospect has been explored by trenching and limited laboratory processing tests. The property is located 40 kilometres south of the town of Burns Lake on the northwest slope of Dayeezcha Mountain between 975 and 1125 metres elevation. British Columbia Minister of Mines reports indicate that in 1955 Technical Mines Consultants Limited exposed six mineable perlite layers along a zone 850 metres long and 500 metres wide. The company reported the layers are "irregular in width and attitude, lying interbedded in a folded series of rhyolites striking generally northeast and dipping about 70° to the southeast". James (1955) reports the maximum exposed width of at least two layers exceeds 45 metres, and that in some places interbedded rhyolite is sufficiently narrow to permit practical open-pit mining of two or more layers from one pit. Currently the property is inactive and the old trenches are partially filled. Past company records are not available so the following description is based on field observations only.

### Geology

Figure 5-1-4 shows the rock types mapped at the perlite prospect and their distribution. A description of each follows:

**Perlite** is intercalated with light to dark grey porphyritic and sometimes cherty rhyolites and ranges in colour from brown to medium grey to black to pale green. It often has a good pearly lustre but when exposed for periods of time tends to break down into 2 to 3-centimetre subangular fragments. Uncha Lake perlite expands when heated with a hand-held propane torch although not as rapidly as samples from the Frenier deposit.

Perlite is exposed in trenches south of the access road but not enough bedrock is exposed to determine whether these occurrences represent a single unit. Significantly, fresh, medium grey perlite is exposed along a ridge west of the trenched area. Structural information is limited but exposures in trenches indicate the host rhyolite strikes northeast and dips steeply southwest.

**Rhyolite,** in sharp contact with perlite, ranges from white to dark grey in colour. Both white and grey varieties contain 1 to 7-centimetre bands of darker "cherty" quartz (chalcedony?) or patches, up to 3 centimetres across, of light green silica possibly indicative of hydrothermal alteration. Rhyolite is occasionally porphyritic with 1 to 5-centimetre rectangular phenocrysts of potassium feldspar in a fine-grained matrix. Near the southern end of the access road siliceous angular fragments, 5 to 7 centimetres across, are observed in rhyolite.

### OOTSA LAKE SHOWING (MINFILE 93F 028)

Three kilometres southeast of False Hill and 800 metres north of Intata Reach, at 975 metres elevation, a 2 to 3-metre bed of volcanic glass/chert is exposed along the side of a hill

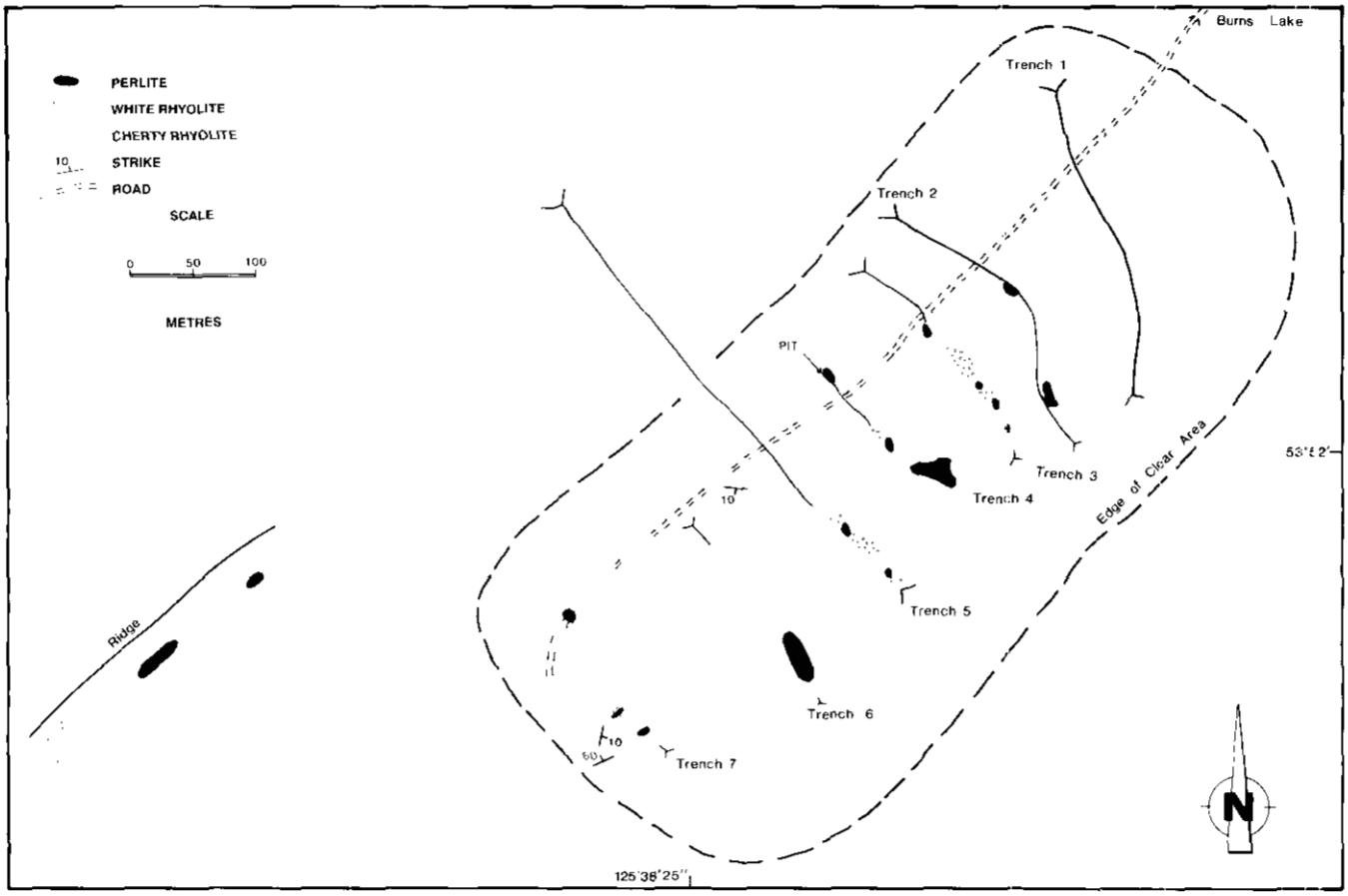



Figure 5-1-4. Uncha Lake perlite prospect located 40 kilometres south of Burns Lake (93F/13E).

for 250 metres (Figure 5-1-5). The bed strikes northeast, dipping variably 35° to 70° northwest, in pale to medium green cherty rhyolite. Commonly, 4 to 6-centimetre beds of pale green chert alternate with beds of dark grey to black volcanic glass. The bed splits into two separate seams approximately one-third of the way along its length. When heated with a hand-held propane torch the rock "explodes" without apparent swelling.

### CHESLATTA LAKE OCCURRENCE (MINFILE 93F 027)

It required extensive searching in heavily forested and till-covered terrain to locate a 5 to 7-metre outcrop of weathered, medium grey to pearly black volcanic glass. The showing was located 1.5 kilometres south of Cheslatta Lake at latitude 53°43'15"N and longitude 125°27'W. The volcanic glass occurs as lenses in dirty white to light grey rhyolite. Samples heated using a propane torch glowed red but did not expand.

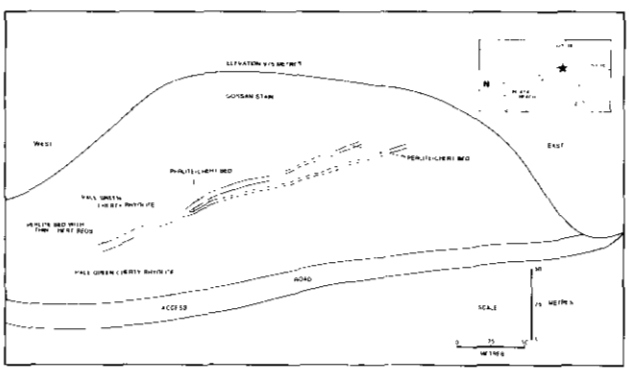


Figure 5-1-5. Sketch section of the Ootsa Lake perlite showing located 66 kilometres south of Burns Lake (93F/12).

### TSALIT MOUNTAIN VOLCANIC GLASS (MINFILE 93L 258)

Volcanic breccia, glassy rhyolite lava, tuff and dikes were reported by Church (1972) near Fenton Creek, west of Tsalit Mountain. This sequence, which is the uppermost part of the Francois Lake Group, has been dated as Eocene. The reported chemical analysis of the glass indicates a significant percentage of water but the glass does not expand when heated.

## PORT CLEMENTS AREA

### BLACKWATER CREEK (MINFILE 103F 022)

Occurrences of volcanic glass and perlite are documented by Sutherland Brown (1968, page 175) in dikes and flow-like masses in rhyolitic units of the Masset Formation, Queen Charlotte Islands. Proximity to tidewater, with the possibility of using inexpensive water transportation to reach major market areas along the coast, makes the Graham Island occurrences particularly interesting. Two of these sites (perlite) and three sites recently mapped by Cathy Hixon of the

Geological Survey of Canada (personal communication, 1989) were tested using a propane torch. Material at Sites 2, 4 and 5 expanded when heated while rhyolitic units at the two other sites did not (Figure 5-1-6).

**Site 2:** Medium grey to black (fresh surfaces) perlite crops out for 85 metres along a roadcut immediately northeast of bridge Q9 on Blackwater creek. The bed strikes north and dips 65° east. Till and forest cover away from the road prevent examination of the unit but tested samples expanded to several times their volume. They did not however, expand as quickly or as much as the Frenier perlite.

**Site 4:** Black, medium-grained glassy dacite containing 2 to 4-millimetre phenocrysts of potassium feldspar violently popped when heated, not swelling gradually as other tested perlite. This expandable rock crops out for 300 metres along a roadcut above Florence Creek.

**Site 5:** Several large boulders of medium grey perlite (3 to 5 metres across) were found along the road just north of Gold Creek. Samples expanded when heated but did not compare in volume to Frenier perlite. Traverses above the site failed to locate perlite in place.

Sampling and testing of volcanic glass and perlite occurrences in this study was restricted to the Port Clements area for logistical reasons. Other felsic and perlitic units in the Masset Formation may contain expandable rock and should be the focus of exploration programs in the Queen Charlotte Islands as the accessibility of other sites improves.

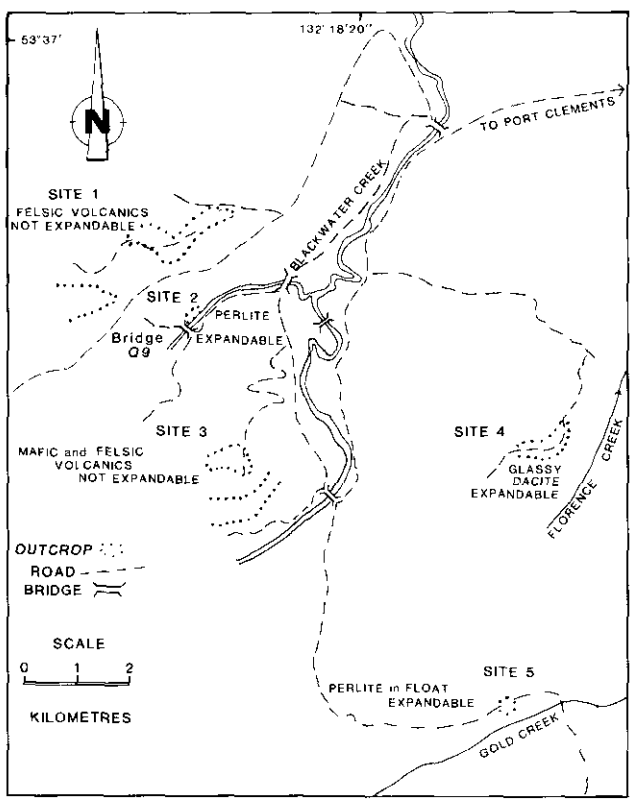



Figure 5-1-6. Perlite prospects, Port Clements area, Queen Charlotte Islands.

# VERMICULITE

## JOSEPH LAKE OCCURRENCE (MINFILE 93K 077)

The Joseph Lake vermiculite prospect, 14 kilometres southeast of Fraser Lake, was staked in 1987 by J. Steiner of Fraser Lake. The area is underlain by Jurassic granite, granodiorite and quartz diorite (Tipper *et al.*, 1979). Granite at the site is medium grained (2 to 3 millimetres), light grey in colour (with a pink tone), and contains rectangular plagioclase phenocrysts up to 7 centimetres long. An access road crossing the prospect exposes a weathered zone approximately 75 metres long (Figure 5-1-7). Weathered rock has a distinct reddish orange colour and contains mica flakes which swell when heated with a propane torch. Immediately northeast of this zone fresh granite crops out along a prominent ridge. In many places mica flakes from fresh-looking rock also expand on heating.

The nature and percentage of expandable mica concentrated in the weathered zone is not yet known and analytical, petrographic and processing tests are required to evaluate the potential of this prospect.

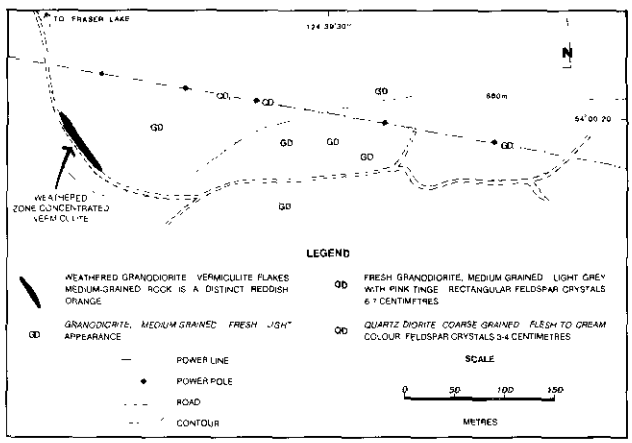



Figure 5-1-7. Joseph Lake vermiculite prospect 14 kilometres southeast of Fraser Lake (93K/02E).

## SOWCHEA CREEK SHOWING (MINFILE 93K 083)

The Sowchea Creek vermiculite prospect, staked by A. Almond in 1987, is located 17 kilometres southwest of Fort St. James. Most of the area is covered by glacial till but Jurassic medium-grained hornblende diorite crops out north of Sowchea Creek. Here, vermiculite derived from weathered diorite is concentrated along a 150-metre zone (Figure 5-1-8). Laboratory and petrographic analyses of samples collected from the zone are required to establish the percentage of vermiculite and its extent.

Both the Joseph Lake and Sowchea Creek expandable mica prospects occur in both fresh and weathered zones of Jurassic intrusions. Other similar intrusions are mapped in the region (Tipper *et al.*, 1979), and should be the focus of prospecting or exploration programs.

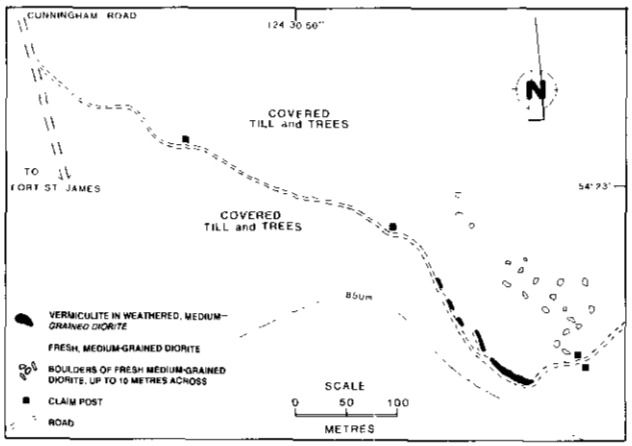



Figure 5-1-8. Sawchea Creek vermiculite prospect located 17 kilometres southwest of Fort St. James (93K/07E).

## SUMMARY

Of the six perlite and two vermiculite sites described, one, the Frenier deposit, located west of Clinton, has reserves outlined. Two other sites, Francois Lake and Uncha Lake contain significant amounts of expandable perlite and are potential commercial sources. The extent of expandable perlite at Blackwater Creek is not known. Material tested at Ootsa Lake and Sites 4 and 5, south of Port Clements, did not swell when heated but rather "exploded", unlike volcanic glass from Cheslatta Lake and Tsalit Mountain, which glowed red without expanding.

Additional exploration is necessary to fully assess the potential of each site and processing tests on bulk samples are required to document each deposit's potential to produce perlite/vermiculite which will meet industry specifications.

## ACKNOWLEDGMENTS

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# NOTES