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STRUCTURE, STRATIGRAPHY AND INDUSTRIAL MINERALS IN THE GANG RANCH AREA, SOUTHERN BRITISH COLUMBIA* (92O/8, 9)

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INTRODUCTION

This project is part of a regional investigation into the occurrence of industrial minerals in Tertiary basins of southern British Columbia. The field area is located along the west side of the Fraser River approximately 100 kilometres west of Clinton. Mapping was restricted to the west side of the Fraser fault where Cretaceous to Pleistocene rocks are exposed (Figure 3-8-1). Industrial minerals of interest include zeolite, bentonite, perlite and diatomite.

STRUCTURE

Volcanic, volcaniclastic and sedimentary rocks ranging in age from Early Cretaceous to Pleistocene underlie the field area. To the east, right-lateral strike-slip movement on the Fraser fault has juxtaposed these rocks against Pennsylvanian to Triassic rocks of the Cache Creek complex (Tipper, 1978). The stress regime associated with movement on the Fraser fault has controlled the development of folds and faults within the map area. Northwest-trending upright folds have developed in Eocene sediments immediately west of the Fraser fault. Minor east-dipping reverse faults have accommodated compression in the more brittle Eocene volcaniclastic rocks exposed further west along Churn Creek (Figure 3-8-1). Dips flatten and strata become near horizontal toward the western half of the map area. From Lone Cabin Creek northward along the Empire Valley, Lower Cretaceous volcanic and sedimentary rocks are uplifted and exposed along a major northwest-trending fault (referred to as the Empire Valley fault). Correlation of stratigraphy across this fault indicates approximately 300 metres of west-side-up vertical displacement with no significant horizontal movement. Near-vertical slickensides measured along the Fraser and Empire Valley faults indicate the most recent movement was dip-slip. Vertical motion along these faults may have taken place in response to a decrease in southwest-directed compression as strike-slip movement along the Fraser fault ceased.

STRATIGRAPHY

PENNSYLVANIAN – TRIASSIC

East of the Fraser fault, siliceous volcanic tuffs, black and green ribbon chert and sheared, siliceous black argillite comprise the major part of the Cache Creek Group (Figure 3-8-1). To the south, where the Fraser fault enters the map area, a 150-metre-thick lens of light grey to buff recrystallized limestone is interbedded with black argillite and chert. At the northern end of the map area, near the mouth of Gaspard Creek, green chert and tuff are underlain by mafic flows and gabbro.

CRETACEOUS

West of the Fraser fault the oldest unit exposed is a package of maroon, green-brown and grey, porphyritic to aphanitic volcanic rocks at least 700 metres thick. Potassium-argon dating by Mathews and Rouse (1984) has identified these volcanics as Middle Cretaceous, Albian to Cenomanian in age (90.9 ± 3.2 to 97.4 ± 3.4 Ma). They are assigned to the Spences Bridge Group which has been mapped to the south by Read (1988).

Immediately west of the Empire Valley Ranch headquarters, hornblende-bearing dacite and flow-laminated aphanitic volcanic rocks locally form part of the Cretaceous strata. The presence of pumpellyite, calcite, zeolite and silica in veins, on fracture coatings, and in amygdules throughout the unit indicates that these volcanic rocks have been subjected to subgreenschist grade metamorphism. On the south side of Churn Creek, west of a large landslide (Figure 3-8-1), light green lithic tuff and an underlying sequence of well-bedded conglomerates, gravels, sandstones and mudstones approximately 180 metres thick lie beneath or within the maroon volcanic unit.

EOCENE

Eocene volcanic and sedimentary rocks of the Kamloops Group, approximately 1000 metres in thickness, unconformably overlie Spences Bridge Group volcanics. North of Churn Creek and west of Table Mountain, the contact crops out and is defined by Eocene volcanic breccia overlying amygdaloidal, zeolite-bearing flows of the Spences Bridge Group. The absence of subgreenschist alteration in the Eocene strata is an important distinguishing characteristic between otherwise similar-looking volcanic rocks of the two units. Cross-section X-X′ (Figure 3-8-2) shows a schematic Eocene stratigraphic sequence. Many of the units are discontinuous and pinch out laterally, but four generalized units can be identified over most of the map area.

The lowest (Unit 1) is composed of varicoloured volcanic breccias and minor interlayered laminated and vesicular flows ranging from mafic to dacitic in composition. Unit 1 is thickest in the northern part of the map area around Churn Creek and Gaspard Creek and thins southward, becoming

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British Columbia Ministry of Energy, Mines and Petroleum Resources, Geological Fieldwork, 1988, Paper 1989-1.

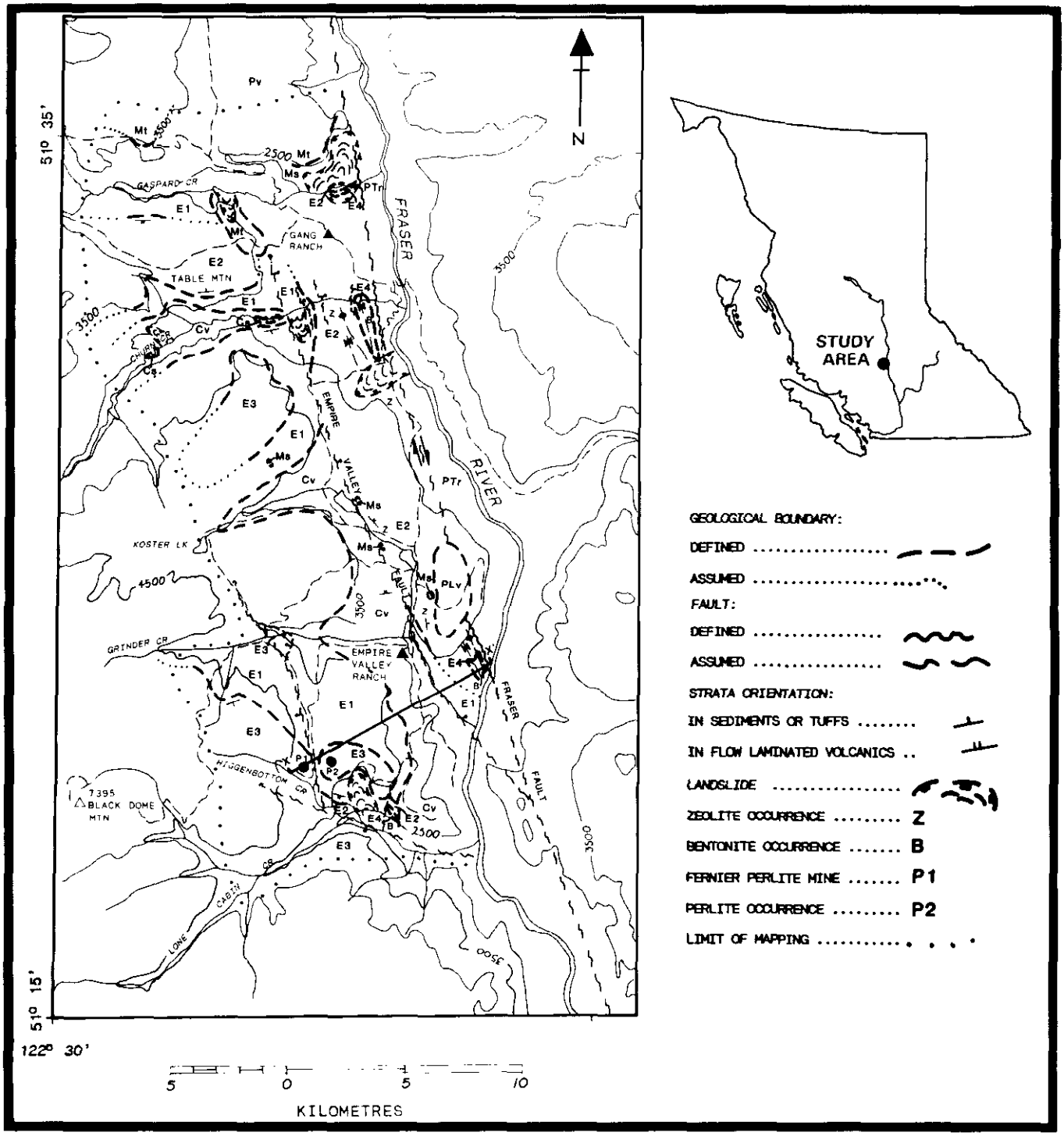

Figure 3-8-1. Generalized geology and location map. *See* Table 3-8-1 for description of rock units and key to symbols.

replaced by predominantly laminated flows with minor volcanic breccia.

The division between Units 1 and 2, east of the Empire Valley fault and north of Churn Creek, is placed arbitrarily at the first occurrence of rhyolitic tuff. Unit 2 is a succession of volcanic breccias and flows interlayered with rhyolitic lithic to ash tuffs. In places the lithic tuffs show graded bedding and sharp basal contacts typical of waterlain deposits.

Unit 3, west of the Empire Valley fault and south of Churn Creek, consists of pink to white feldspar and quartz porphyry rhyolite flows overlain by a thick accumulation of welded and crystal tuffs. From the junction of Black Dome and Koster Lake roads southward to Higgenbottom Creek, a thin layer (1 to 2 metres) of volcanic glass lies between the rhyolite flows and crystal tuffs. At Higgenbottom Creek the volcanic glass is perlitic and appears to be intrusive into the underly-

TABLE 3-8-1
TABLE OF LITHOLOGIC UNITS

Name	Age	Symbol	Industrial Minerals	Description
Chilcotin Group	Pleistocene Pliocene Miocene	Plv Pv n/a		Plateau basalt flows with well-developed columnar jointing.
Fraser Bend Formation	Miocene	Mt Ms	Diatomite	Cream-coloured volcanic ash overlying rhyolitic pyroclastic breccia and well-bedded gravels and conglomerates.
Kamloops Group	Eocene (56.7 ± 2.0 to 49.9 ± 1.7 Ma)	E1		Red, yellow-beige and brown volcanic breccia with interlayered flows.
	(46.8 ± 1.6 to 45.9 ± 1.6 Ma)	E2	Zeolite Bentonite	As above with interlayered rhyolitic tuffs and ashes.
	(48.1 ± 1.7 Ma to ?)	E3	Perlite	Pink to white rhyolite flows overlain by welded and crystal tuffs.
	(45.9 ± 1.6 Ma to ?)	E4	Bentonite	Well-bedded conglomerates, sandstones and siltstones overlain by bentonite layers and minor coal seams.
Spences Bridge Group	Cretaceous (Albian to Cenomanian)	Cv Cs		Massive maroon volcanics with local hornblende porphyry and laminated flows underlain (?) by well-bedded conglomerates, gravels, sandstones and mudstones.
Cache Creek Complex	Pennsylvanian to Triassic	PTr		Siliceous volcanic tuffs, black and green ribbon chert with minor interbedded limestone underlain by basalt and gabbro.

ing rhyolite flows. The rhyolite flows or, where they are absent, the crystal tuffs of Unit 3, directly overlie the volcanic breccias and flows of Unit 1 along a well-defined contact. The presence of perlite clasts in the lithic tuffs and ashes of Unit 2 indicates that they are distal equivalents of the tuffs of Unit 3.

Unit 4 is a sedimentary sequence composed of well-bedded, yellow-brown conglomerates, sandstones and siltstones overlain by bentonitic ash layers and minor coal seams. These sediments overlie Unit 2 and are exposed at three locations immediately west of the Fraser fault and a fourth location on the north side of Lone Cabin Creek near its confluence with the Fraser River (Figure 3-8-1).

Potassium-argon dating of the Eocene volcanics by Mathews and Rouse (1984) determined that the volcanics of Unit 1 range from 56.7 ± 2.0 to 49.9 ± 1.7 Ma and represent the oldest of the Eocene volcanics. The volcanics of Unit 2 range from 46.8 ± 1.6 to 45.9 ± 1.6 Ma and the rhyolite flows of Unit 3 give a date of 48.1 ± 1.7 Ma. The palynomorph assemblage identifies Unit 4 as Early to Middle Eocene (Mathews and Rouse, 1984). The stratigraphic position of Unit 4 with respect to Unit 2 suggests the sediments are actually younger than 45.7 ± 1.6 Ma, the youngest of the Unit 2 volcanics.

MIOCENE

Mathews and Rouse (1984) identified two occurrences of Miocene strata, in the vicinity of the Gang Ranch headquarters, on the basis of palynology. A third occurrence was mapped in the northwestern corner of the map area. The most extensive exposure, located on the north side of Gaspard Creek, consists of a lower 130-metre-thick package of bedded conglomerates and gravels, overlain by a 2 to 5-metre layer of cream to white, semiconsolidated rhyolitic ash. The second occurrence of Miocene strata is located approximately 3 kilometres west of the ranch headquarters. In this area the white to cream ash layer thickens to approximately 75 metres and a recent roadcut at its eastern extent reveals that it locally overlies a rhyolitic pyroclastic breccia approximately 100 metres thick. Clasts within the breccia include blocks of Eocene volcanic rocks near the base of the exposure. White to black pumice fragments and a heterogeneous assortment of clasts, including diatomite and mudstone, are present throughout most of the breccia. Poorly sorted conglomerates are exposed beneath the ash layer, in an irrigation ditch directly north of Table Mountain, but it is not clear if these conglomerates are part of the same unit exposed north of Gaspard Creek. Miocene strata mapped in the northwestern corner of the map area are an isolated occurrence of ash which directly overlies Eocene Unit 1 flow-laminated volcanics. Mathews and Rouse (1984) correlate these sediments on the basis of similar lithology with Fraser Bend Formation sediments in the Quesnel area to the north.

A poorly sorted conglomerate has been mapped at the southeast end of the Empire Valley, approximately 2 kilometres north of the ranch headquarters. It grades into well-sorted and bedded conglomerates and sands which crop out at four different locations along the northwest-trending Empire Valley (Figure 3-8-1). Pebble imbrication in the conglomerate indicates a northwest transport direction which is in agreement with the transport direction determined in the sediments north of Gang Ranch (Mathews and Rouse, 1984). On this basis these rocks are mapped as Miocene in age.

PLIOCENE AND YOUNGER

Plateau basalt remnants of the Chilcotin Group (Mathews and Rouse, 1984; Read, 1988) which yield Pleistocene

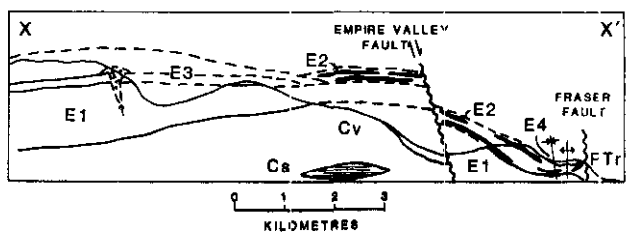

Figure 3-8-2. Schematic cross-section X-X' (Figure 3-8-1) of Eocene and Cretaceous lithologic units (vertical exaggeration X 2).

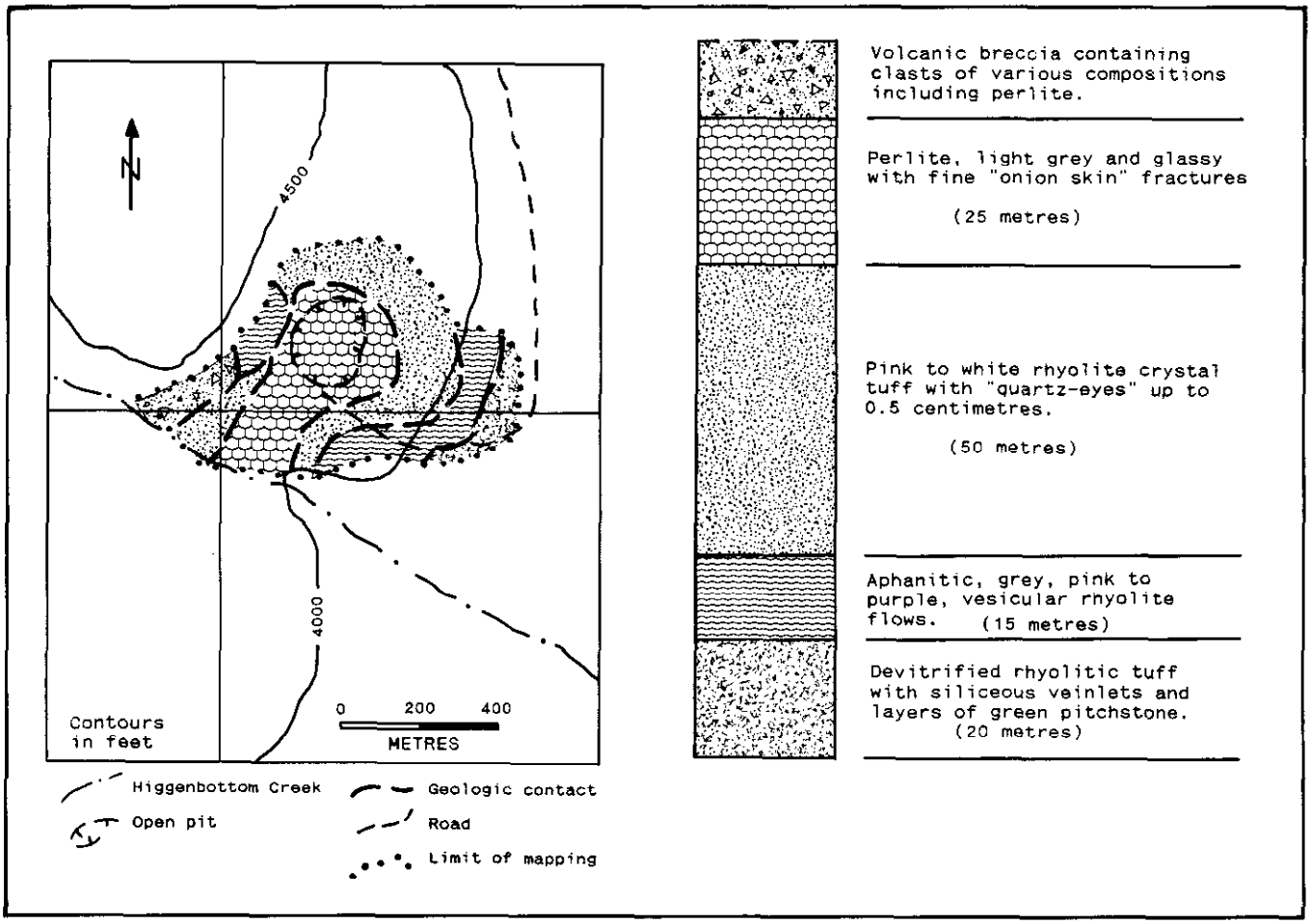

Figure 3-8-3. Geological sketch map of the Frenier perlite deposit and surrounding area.

(1.3 ± 0.1 Ma) potassium-argon ages outcrop north of Gaspard Creek at the northern end of the map area. They are composed of fine-grained, dark grey to black lavas with well-developed columnar jointing. Northeast of the Empire Valley Ranch headquarters the Fraser fault is overlain by plateau basalts dated at 0.78 Ma (Mathews, unpublished data). A number of other occurrences of columnar basalt were mapped in the Empire Valley area but they have not been dated.

INDUSTRIAL MINERALS

ZEOLITES

Preliminary bulk analysis on the rhyolite tuffs of Unit 2 by X-ray diffraction identified heulandite-group zeolites in significant quanitities. These rhyolitic tuffs range from 2 to 10 metres in thickness and can be traced discontinuously from Churn Creek to the Empire Valley Ranch. Further analyses are required to assess the extent of zeolitization and whether the deposits meet industrial standards.

BENTONITE

Layers of white bentonitic ash occur interbedded with the tuffs of Unit 2 and as individual layers in exposures close to the Fraser fault. Layers 1 to 2 metres thick occur along the *fault in the Churn Creek area and to the south where the fault* trace enters the map area. In both areas the bentonite layers can be followed for at least a kilometre along strike. In outcrop the bentonite has a typical "popcorn" appearence on exposed surfaces. Analysis by X-ray diffraction shows it is composed of montmorillonite and illite. Further work is being done on approximately 40 samples, to assess the quantity and composition of the clays present.

PERLITE

Two occurrences of perlite have been mapped in the field area. One of the occurrences, the Frenier deposit (P1, Figure 3-8-1), was developed by Aurun Mines Limited as an open-pit mine in 1983. *The second occurrence (P2, Figure 3-8-1)* is located approximately 1 kilometre east of the Frenier deposit.

THE FRENIER PERLITE DEPOSIT

Aurun Mines Limited currently holds the mineral rights to the deposit. Reserves have been estimated at 450 000 tonnes of perlite with an average expandability factor of 22 times (Aurun Mines Limited, 1986).

Detailed geological mapping in the vicinity of the deposit identified five lithological subdivisions within Unit 3 (Figure

3-8-3). The lowest unit is a white to grey devitrified rhyolite tuff, approximately 20 metres thick, that contains abundant siliceous veinlets and layers of waxy, green volcanic glass (pitchstone). This tuff is overlain by 15 metres of grey, pink to purple vesicular rhyolite flows. Above the flows and directly below the perlite is a unit of pink to grey rhyolite crystal tuff approximately 50 metres thick which contains quartz phenocrysts up to 0.5 centimetre in size. Perlite flows, approximately 25 metres thick, overlie the previously mentioned units in the vicinity of the open pit, however, immediately south of the pit, in Higgenbottom Creek, it crosscuts the underlying lithologies. In outcrop the perlite is a homogeneous, light grey, glassy rock, crosscut by veins of opalline silica and pitchstone. Fine fractures are visible in hand-sample which impart an onion-skin texture to the perlite. A volcanic breccia containing clasts of various composition and size in a light green, siliceous rhyolitic matrix overlies the perlite and grades laterally and vertically into a welded pink rhyolite tuff.

The second perlite occurrence, mapped directly east of the Frenier deposit, appears similar in general character and stratigraphic position to the Frenier deposit. The similarities between the two occurrences suggest there is potential for a second perlite deposit in the area.

DIATOMACEOUS EARTH

As previously mentioned, clasts of diatomite have been identified in Miocene pyroclastic breccias. Due to the fissile nature of diatomite it is unlikely this material has travelled far from its source. Locating the source will be one of the objectives of the 1989 field season.

ACKNOWLEDGMENTS

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