

"PERLITE" FROM TERRACE MOUNTAIN, VERNON AREA: POSSIBLE INDUSTRIAL APPLICATIONS

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INTRODUCTION

Very little is known about natural hydrated glasses in British Columbia, except perlite. Perlite is defined as natural volcanic glass with a pearly lustre, macroscopic or microscopic onion-skin texture, and rhyolitic composition with 2 to 5% incorporated water (H_2O^+). From the industry point of view, however, all hydrated felsic rocks, including rocks with pumiceous and granular textures, are classified as 'perlite' if they expand significantly during heating. Similarly, 'expanded perlite' is defined as a light-weight aggregate produced by rapid thermal expansion of crushed source rocks; the expansion may be as much as 20 times by volume (Breese and Barker, 1994). The key properties of expanded perlite are low density, fire resistance, good thermal and sonic insulation properties and the ability to retain water. Expanded perlite is used extensively in acoustical ceiling tile, concrete, plasters and various horticultural applications. A worldwide survey of minerals in lightweight applications was prepared by Loughbrough (1991), minerals in fibreglass was covered by Russell (1991) and a market study of classical perlite applications was completed by Gunning and McNeal (1994). More than 17 perlite occurrences are currently known in British Columbia (White, 1990; Hora and Hancock, 1994). Unfortunately, volcanic glass that does not expand is usually disregarded by industry. It has potential applications in the production of mineral wool for thermal insulating materials, castings, as a component of sound insulating tiles and as a composite in bituminous roofing sheets. The choice of raw material for these types of applications is based mainly on chemical composition, homogeneity, availability and cost. For example, high sodium content may reduce the need for soda ash and high alumina may reduce the requirements for kaolin addition.

TERRACE MOUNTAIN PERLITE

A large deposit of perlite occurs on Terrace Mountain (lat. $50^{\circ}06'$, long. $119^{\circ}38'$) 30 kilometres southwest of Vernon and 25 kilometres northwest of Kelowna (Figure 1). Access to the area is by a network of

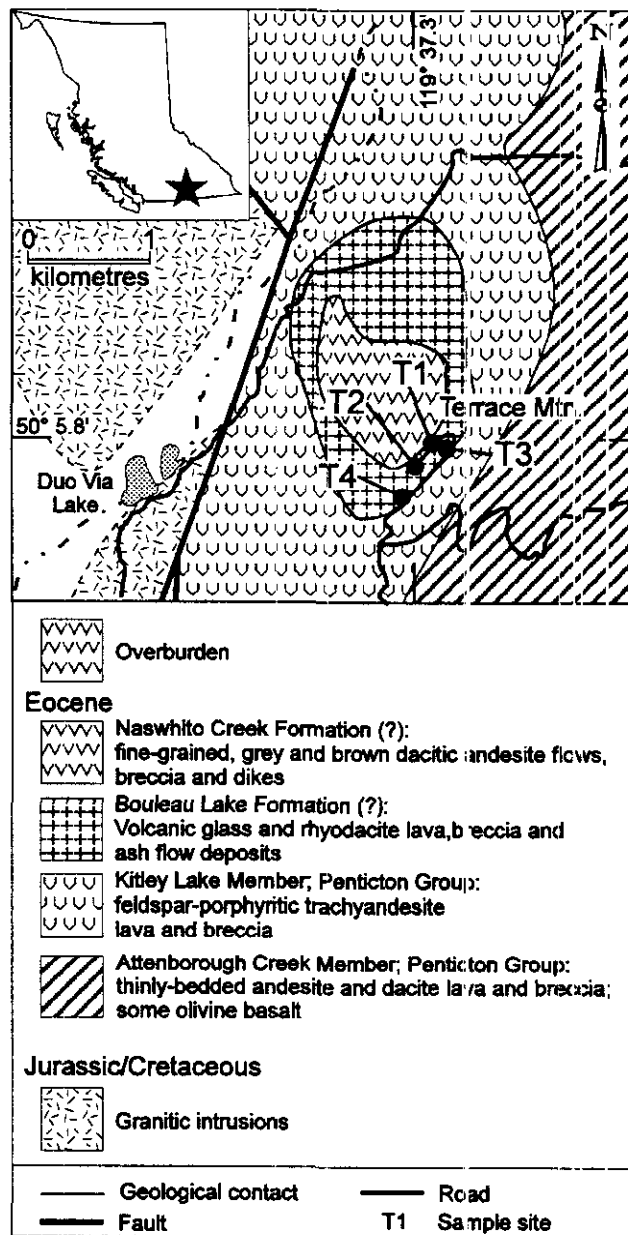


Figure 1. Location and geology of the Terrace Mountain hydrated obsidian deposit (modified from Church, 1980).

logging roads connected to the paved highway along the west shore of Okanagan Lake.

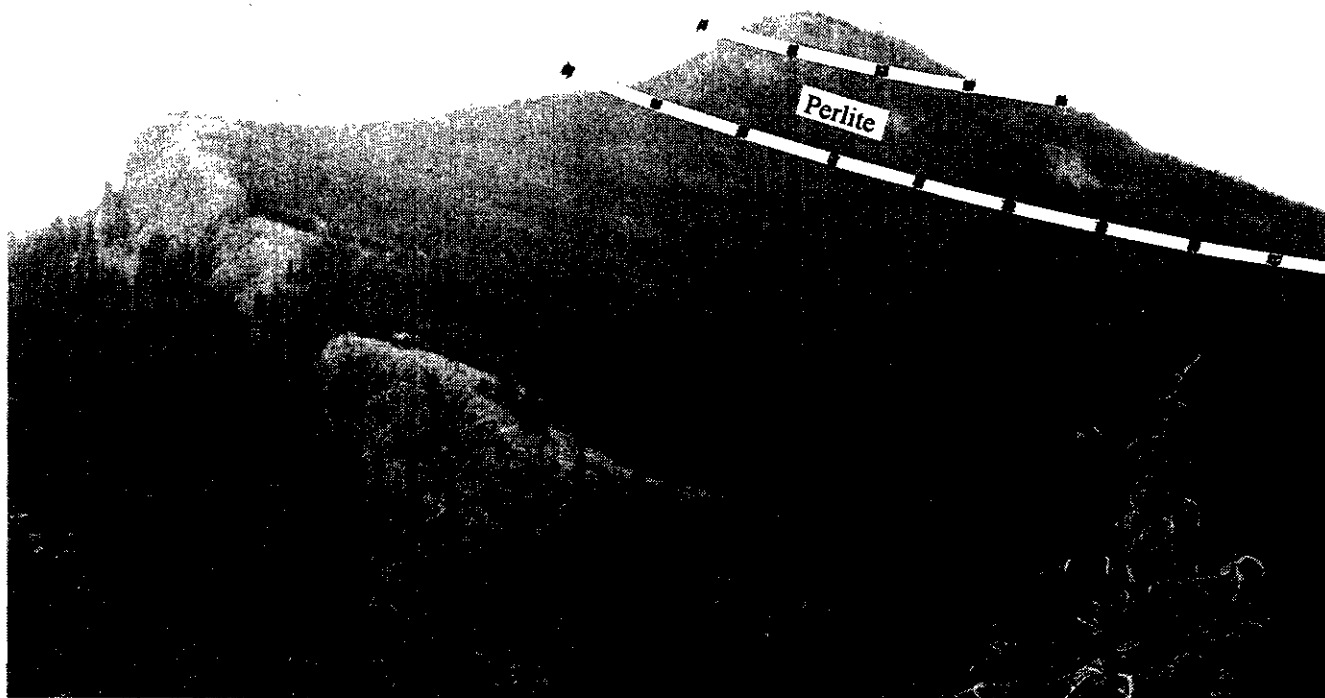


Photo 1. View of Terrace Mountain (looking south) showing the major volcanic units dipping west.

GEOLOGICAL SETTING

Tertiary rocks were first mapped in the Vernon area by Jones (1959) although he made no attempt to describe the structure of the Tertiary outliers or to distinguish the major Miocene and Eocene volcanic units. Detailed mapping of the Tertiary assemblage was completed by Church (1980) at which time a glassy lava unit (perlite) was delineated on the upper slopes of Terrace Mountain.

Terrace Mountain is underlain mainly by relatively fresh volcanic rocks, equivalent to the Penticton and Kamloops Groups (Eocene), in a northerly elongated, westerly dipping half-graben. This structure has been developed on a basement complex consisting of strongly folded and faulted Paleozoic and Mesozoic oceanic cherts, turbidites and greenstones, cut by younger Mesozoic granitic rocks (Church, 1980; 1982). The Tertiary volcanic succession is about 900 metres thick and consists, from top to bottom of: fine-grained dacite, forming a tilted hat, 30 metres thick, on the summit; underlain by 120 metres of perlite containing feldspar and biotite phenocrysts; underlain in turn by a series of feldspar porphyritic trachyandesite lava flows 180 metres thick, and a series of andesitic lava flows and breccias approximately 550 metres thick at the base (Photo 1). The summit dacite is tentatively correlated with similar rocks near Naswhito Creek, 20 kilometres to the north; the volcanic glass unit that contains feldspar and biotite phenocrysts may be equivalent to the Bouleau Lake ash-flow deposit that occurs below the Naswhito Creek unit. The trachyandesites and andesitic units exposed on the lower slopes of Terrace Mountain are tentatively correlated with the Kitley Lake and Attenborough Creek

members, respectively, of the Penticton Group (Church, 1982).

The age of the volcanic glass unit, determined from K-Ar analysis of the biotite phenocrysts, is 52.3 ± 1.8 Ma (Church, 1980). This is similar to the age of the Marron Formation of the Penticton Group (Church, 1973; 1982).

PERLITE DEPOSIT

Perlitic rock covers several square kilometres on the upper slopes of Terrace Mountain. It is grey on fresh surfaces, alters to light brown and is characterized by fractured, unaltered plagioclase phenocrysts (2 to 7 mm in diameter), comprising about 15% of the rock. Accessory biotite, usually less than 3 millimetres in size is also set in a greenish grey glassy matrix. Anhedral olivine crystals less than 0.5 millimetre across, iron oxide (0.5 mm) and pyrite (0.5 mm) are trace components disseminated through the glass matrix. Perlitic onion skin and arcuate fractures are visible throughout the glass (Photo 2), which is, in places, partially converted to palagonite. The degree of palagonitization varies through the deposit, but is generally minor.

The chemical composition of the rock resembles alkali-rich dacite (Table 1), differing somewhat from the rhyolite compositions that are typical of world-class perlite deposits and well known British Columbia occurrences, such as the Frenier perlite. The Terrace Mountain perlite has lower SiO_2 , and higher Al_2O_3 , CaO and TiO_2 contents than other major perlite occurrences. Nevertheless, the H_2O^+ content is in the range

characteristic of most perlites. The rock has very low SO₂ content, minimizing the potential of sulphur release to the atmosphere during processing.



Photo 2. Microphotograph of the perlite showing feldspar phenocrysts in glassy matrix. PE = perlite; PL = plagioclase; BI = biotite; MT = magnetite.

TABLE 1. CHEMICAL COMPOSITION OF TERRACE MOUNTAIN PERLITE COMPARED WITH ANALYSES OF SAMPLES FROM SOME WELL KNOWN PERLITE DEPOSITS.

	Terrace Mt BC	No Agua NM	Superior AZ	Big Pine CA	Akita Japan	Argentina
SiO ₂	66.65	72.10	73.60	73.60	74.20	72.30
TiO ₂	0.47	0.06	0.10	0.07	0.06	0.08
Al ₂ O ₃	15.59	13.50	12.70	13.20	12.90	13.40
Fe ₂ O ₃	1.25	0.80	0.70	0.80	0.68	1.00
FeO	0.68					
MgO	0.42	0.50	0.20	0.10	0.05	0.30
CaO	1.46	0.89	0.60	0.60	0.45	0.59
Na ₂ O	4.42	4.60	3.20	4.10	4.10	3.40
K ₂ O	4.85	4.40	5.00	4.10	4.00	4.70
H ₂ O ⁺	3.37	3.00	3.80	3.30	3.30	3.70
H ₂ O ⁻	0.67					
CO ₂	0.11					
SO ₂	<0.05					

IMPORTANCE OF THIS OCCURRENCE

The possibility of producing insulating fibre or tiles and castings from the melted rock should be further investigated. A plant located at Stara Voľa near Lazne Kynzvar in the Czech Republic provides an example of an operation where volcanic rock is melted and cast into a variety of shapes (Hruska, 1991). Traditional melting material for such a plant is basalt. An industrial insulation plant in Grand Forks, British Columbia, owned by Bradford Enercon Inc., manufactured mineral wool insulation for industrial products until 1991. The melting technology employed at this operation was electric melting and coke-fired cupola. The plant was melting locally available copper slags blended with imported basalt rock. A similar plant, owned by United States Gypsum Company, is located near Tacoma, Washington. These two cupola, coke-fired operations use a combination of local basalt and slag to produce a variety of industrial and commercial insulation products.

The advantages of the Terrace Mountain occurrence are its size and favorable location in southern British Columbia, close to both the Okanagan area and American markets. Assuming no problems related to the porphyritic texture, the high water content of the rock could contribute towards lowering the temperature of fusion, relative to unhydrated but otherwise chemically equivalent rocks, resulting in substantial energy savings. The low iron and relatively high alumina provide an interesting alternative source of fibre-forming chemistry that could displace the much more energy-intensive basalt additive currently in use. Further detailed studies are needed to determine if such a rock would meet specifications for batch formulations required by the industry for non-expanding applications.

The degree of expansion is not expected to match that of perlites currently on the market, or potentially available from the Frenier deposit or other British Columbia occurrences. On the other hand, preservation of water in the Terrace Mountain occurrence is an important indicator of exploration potential to find "true perlite" deposits in the area. Rhyolitic rocks were reported by Church (1980) in the Bouleau Lake area, however these rocks have low water contents.

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REFERENCES

- Breese, R.O.Y. and Barker, J.M. (1994): Perlite; in *Industrial Minerals and Rocks*; 6th Edition, Carr, D.D., Editor, *Society for Mining, Metallurgy and Exploration, Inc.*, pages 735-749.
- Church, B.N. (1973): Geology of the White Lake Basin; *B.C. Ministry of Energy, Mines and Petroleum Resources*; Bulletin 61, 120 pages.
- Church, B.N. (1980): Geological Map of the Terrace Mountain Outlier (parts of 82L4, 5); *B.C. Ministry of Energy, Mines and Petroleum Resources*, Preliminary Map No. 37.
- Church, B.N. (1982): Notes on the Penticton Group, A Progress Report on a New Stratigraphic Subdivision of the Tertiary, South-central British Columbia; in *Geological Fieldwork 1981*, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1982-1, pages 12-16.
- Gunning, D. and McNeal & Associates Consultants Ltd. (1994): Perlite Market Study for British Columbia; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Open File 1994-21.
- Hora, Z.D. and Hancock, K.D. (1994): Nazko Cinder Cone and New Perlite Occurrence; in *Geological Fieldwork 1994*, Grant B. and Newell, J.M., Editors, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1995-1, pages 405-407.
- Hruska, J. (1991): Czechoslovakia's Minerals, Production Reserves and Exploration; *Industrial Minerals*, No. 289, pages 49-53.
- Jones, A.G. (1959): Vernon Map-area, British Columbia; *Geological Survey of Canada*, Memoir 296, 186 pages.
- Loughborough, R. (1991): Minerals in Lightweight Insulation; *Industrial Minerals*, No. 289, pages 31-35.
- Russell, A. (1991): Minerals in Fibreglass; *Industrial Minerals*, No. 290, pages 27-41.
- White, G.V. (1990): Perlite and Vermiculite Occurrences in British Columbia; in *Geological Fieldwork 1989*, *B.C. Ministry of Energy, Mines and Petroleum Resources*; Paper 1990-1, pages 481-487.