PERLITE MARKET STUDY FOR BRITISH COLUMBIA

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1.0 INTRODUCTION

This study has been prepared in order to supplement the industrial mineral resource data base of the Geological Survey Branch of the Ministry of Energy, Mines & Petroleum Resources of the Province of British Columbia, which has identified a number of potentially economic deposits of perlite within the Province. (White, G.V.)

Funding for this project was provided by the Canada-British Columbia Agreement on Mineral Development (M.D.A.) through National Resources Canada.

The Terms of Reference provided called for a broad literature review, a listing of relevant processing patents, a thorough domestic (B.C.) market survey, and an analysis of the potential viability of a new local perlite operation utilizing B.C. ore. The existing demand is currently being met by imported products, or domestically expanded goods that rely on imported raw perlite.

2.0 AUTHORITIES

The Contracting Authority for this project was Dale White of Supply & Services Canada in Winnipeg, Manitoba. The Project Authority was Peter Coolen of Natural Resources Canada in Saskatoon, Saskatchewan; the Scientific Authority was Dan Hora of the B.C. Geological Survey Branch in Victoria, B.C., all of whom have been most helpful in the conduct of this study. Mr. Hora has been consulted numerous times during the project and has provided valued resource data and guidance in the preparation of a complete and thorough review of the subject.
3.0 THE STUDY TEAM

The study was conducted by Donald Gunning, P. Eng., of Delta, B.C., an industrial minerals consultant with twenty years of experience in the field in B.C., and by Wayne McNeal of Richmond, B.C., an Economist specialising in resource development, marketing, and transportation analysis. Vital overview and input was provided by John Chapman, P. Eng., of Chapman Mining Services, previously President of Aunm Mines Ltd., a company that mined and processed perlite in B.C. during the mid-1980's.

4.0 BACKGROUND

4.1 The Mineral Perlite

The industrial mineral perlite is a hydrated, rhyolitic, volcanic glass, commonly having a pearly, vitreous lustre, and characteristic concentric or arcuate “onion-skin” fractures. It has a relatively high combined water content of two to five percent that distinguishes it from other hydrous volcanic glasses such as obsidian, hydrated volcanic ash, and pumicite.

It is this “chemical” water held within the perlite glass ‘structure that expands, or “pops”, on heating to create a cellular material of extremely low bulk-density that caters to numerous application demands. Raw perlite in fact may expand up to twenty times its volume when aushed and heated to its softening temperature, usually in the range of 900°C to 1100°C.
Chemically, perlite is an amorphous aluminum silicate; a typical analysis would be as follows:

<table>
<thead>
<tr>
<th>Element</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>72 - 74 %</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>12 - 13 %</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>Approx. 1%</td>
</tr>
<tr>
<td>Na₂O</td>
<td>3 - 4 %</td>
</tr>
<tr>
<td>K₂O</td>
<td>4 - 5 %</td>
</tr>
<tr>
<td>H₂O</td>
<td>3 - 4 %</td>
</tr>
</tbody>
</table>

Perlite is metastable, and eventually with age it will, like any glass, devitrify into microcrystalline quartz and feldspar. Due to this instability, most occurrences are generally of Tertiary or Quaternary Age (less than 50 million years old).

Perlite is chemically inert and exhibits a pH of about 7 in water. Its density ranges between 140 and 150 lbs/ft³ (2,242 - 2,403 kg/m³), and it has a Moh’s hardness of between 5.5 and 7.0. Its colour can vary from light grey to black, transforming to greyish-white to snowy white on expansion. Breese and Barker present a thorough discussion of the composition and geological origin of perlite in their contribution to the new edition of “Industrial Minerals and Rocks,” including an extensive bibliography which forms the framework of the one set out in Appendix A of this report.

4.2 Mining and Processing

Thanks to the massive surficial lava flow nature of most deposits, perlite is usually mineable by open-pit methods, at or near the surface, over broad areas. The brittleness of the ore and its fractured texture generally permits the use of mobile ripping equipment to harvest the rock, thus minimizing drilling and blasting expenses and keeping the overall cost of mining quite low. Production rates are nonetheless modest by most standards, given the relatively low level of
demand for the commodity (well under one million tonnes annually in all of North America).

The as-mined ore, in most cases, undergoes crushing and screening at or near the mine, prior to shipment to expansion plants. Sizing is critical, as it determines which end uses, in expanded form, can be met. The normal range of raw product sizing is 8 mesh to 30 mesh. Figure 1 shows a typical comminution flow sheet.

Since perlite is quite friable, large quantities of dust and excessively fine material are generated during mining and processing that cannot ordinarily be sold; they are typically disposed of as waste, and hence contribute significantly to the cost of the finished product.

The basic mill-size grades of raw perlite are usually siloed prior to shipment; some blending may be done to meet specific product gradation requirements. From this point on, the perlite must be kept dry, in preparation for expansion, a factor that has substantial impact on transportation considerations and costs.

Expansion is normally carried out at a facility remote from the mine, but central to target markets, the goal being to keep shipping costs of the bulky, low density expanded product as low as possible. There are several different expansion furnace designs in use, all involving considerable levels of technical expertise.
Figure 1

TYPICAL COMMUNUTION FLOW.

As-mined Ore

Primary Jaw Crusher

Secondary Cone or Roll Crusher

Dryer

Tertiary Grinding
(hammer or rod mill)

Screening

Coarse products

Air Classifying

Fine products

Fines to Waste
The sized perlite (a different feed size for each expanded product specification) is typically preheated to about 400°C and then subjected to very rapid heating to its softening temperature, usually in a rotary horizontal or stationary vertical furnace. As the combined water in the perlite boils, the resultant steam forms bubbles within the softened rock to produce a very low-density cellular structure. The water content of the ore, together with the heating cycle, will determine the final bulk density of the expanded product. Close process control is required to minimize the incidence of particle explosion, which causes excessive waste fines to be generated.

The very light expanded grains are withdrawn from the furnace by means of suction fans, cooled with entrained air, sometimes heat treated to improve strength and absorption resistance, and finally collected in cyclones and air-classified into the desired size ranges, all the way from 4 mesh to 200 mesh. Baghouses and electrostatic precipitators collect ultra-fine particles to ensure clean-air discharge from the processing facility.

Expanded perlite is in some instances subjected to further size reduction in various types of mills to produce sub 100 mesh gradations for use as filter aids and fillers. Very fine unmilled particles (microspheres) can be silicone coated to provide water repellency for use in lightweight joint cement compounds. Silane coatings have also been used on microspheres for polarity modification for filler applications in plastics.

A complete listing of relevant patents may be found in Appendix B. These include both process and product inventions; the large number of patents registered gives an indication of the very technical nature of the production and application of expanded perlite.
4.3 Marketing

4.3.1 Testing

The evaluation of perlite sources involves a series of tests to establish the suitability of the ore for the various categories of expanded products, usually subdivided into four main groupings:

- Horticulture
- Construction
- Filter aids
- Fillers • Extenders

To maintain quality and performance standards, the Perlite Institute (P.I.) and the American Society for Testing and Materials (A.S.T.M.) have published a number of tests and specifications that apply to expanded perlite products. During exploration, the key parameters of evaluation include chemical analysis (particularly water content), expandability, and crystalline silica content (must be less than 0.1% to avoid carcinogenic classification).

The P.I. tests and A.S.T.M. standards are too numerous to set out completely; a brief sampling of them are listed in Table I.
Table I

PERLITE INSTITUTE TESTS

| PI 109-77   | Sampling Sized Perlite Ore from Hopper Cars |
| PI 113-77   | Sieve-Analysis of Fine Materials            |
| PI 116-77   | Fractional Density of Expanded Perlite      |
| PI 118-77   | Determination of Free and Combined Moisture |
| PI 202-77   | Test for pH Value of Expanded Perlite       |
| PI 305-77   | Yield Test for Perlite Aggregate            |
| PI 307-77   | Perlite Ore Expansibility Test              |
| PI 501433   | Determination of Unit Density and Relative Water Permeability of Powder Type Filter Aids |

A.S.T.M. TESTS

| C 29-78     | Unit Weights & Voids in Aggregate           |
| C 332-82    | Lightweight Aggregates for Insulating Concrete |
| C 549-81    | Perlite Loose Fill Insulation               |
| C 11-81     | Wire-Cloth Sieves for Testing Purposes      |

Physical tests that would normally be performed in establishing expanded perlite product quality would include:

- Expanded bulk density
- Furnace yield
- Compacted density
- Compaction resistance
- Percent non-expandable ("sinkers")
- Dry brightness
- Sieve analysis
43.2 Specifications

Perlite product specifications generally include some maximum and minimum chemical and physical property values, depending upon the demands of the user and his or her application(s). Uses can be grouped according to the expanded product grain size and bulk density, as shown in Table II and Table III.

Table II

TYPICAL BULK DENSITIES OF SOME EXPANDED PERLITE PRODUCTS

<table>
<thead>
<tr>
<th>Application</th>
<th>Density in lb/cu. ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete aggregate</td>
<td>28 - 55</td>
</tr>
<tr>
<td>Portland cement aggregate</td>
<td>20 - 40</td>
</tr>
<tr>
<td>Loose fill insulation</td>
<td>7.5 - 15</td>
</tr>
<tr>
<td>Fillers and filter media</td>
<td>7 - 12</td>
</tr>
<tr>
<td>Plaster aggregate</td>
<td>7.5 - 8.5</td>
</tr>
<tr>
<td>Horticultural aggregate</td>
<td>6 - 8</td>
</tr>
<tr>
<td>Roof insulation board and formed products</td>
<td>3.5 - 4</td>
</tr>
<tr>
<td>Cryogenic insulation</td>
<td>2 - 4</td>
</tr>
<tr>
<td>Cleansers and scouring agents</td>
<td>2 - 4</td>
</tr>
</tbody>
</table>

Note: (lb/cu ft) x 16.018 = (kg/cu m)
The gradation classifications in Table III are very broad, and most products overlap two or more categories. Moreover, the applications vary considerably from one jurisdiction to another, particularly between Europe and North America.

An important additional classification is a superfine (minus 100 mesh) class of expanded perlite that is coated to prevent water absorption, generally referred to
as micro-balloons or microspheres; the coating can be a silicone, hence the use of
the term "siliconized" in some instances. This perlite product is widely used in
the manufacture of lightweight joint cement compounds. The manufacture of
these coated microspheres is technically complex; only three or four expanders in
the U.S. produce them and they command a premium price.

4.3.3 Applications

The uses for perlite are myriad and varied, generally exploiting the expanded
mineral's properties of extremely low bulk density, high brightness, chemical
inertness, high absorption (water retention), low conductivity (both thermal and
acoustical), and non-flammability. The absence of any apparent health hazard is
also a positive marketing characteristic. The demand for perlite has fluctuated
significantly over time, however, as technological change within user industry
sectors and the promotion of substitutes impact on the consumers' needs and
preferences. There is also a high degree of price sensitivity which can drive
substitutions and make locational factors very significant because of the high
delivery costs of these low-density materials.

Hence there are wide variations in usage across national and continental
boundaries, and from one decade to the next within single jurisdictions. The
discussion of uses that follows must be read in this context; a particular
application, dominant in one locale at a given time, may well not be available in
some other circumstances. For ease of presentation, perlite 'markets will be
subdivided here into three groupings that seem to have been adopted in North
America - Construction, Horticultural, and Industrial.
4.3.3.1 Construction Markets

Expanded perlite is generally used in construction applications to impart properties of thermal or acoustic insulation, light weight, or fire resistance. A partial list of such uses would include:

- Acoustic tiles and wallboard
- Lightweight concrete aggregate
- Caulking compounds
- Cryogenic vessel coatings
- Loose fill insulation
- Pipe insulation coatings
- Plaster aggregate & texturing
- Refractory products
- Insulating roofing compounds
- Fireproofing coatings
- Lightweight joint cement filler

In the USA, the term "insulation board is used to describe all fibre, perlite, and perlite-gypsum "formed" board used in roofing, walls, door cores and ceilings. These products constitute the largest single market for perlite in the country. At least two of the major U.S. perlite producers manufacture fireproof boards, mixing expanded perlite with fibres and bonding' and waterproofing agents prior to forming. Several varieties of gypsum plaster insulation board using perlite as an aggregate are also marketed, offering reduced thermal conductivity and greater ease of installation. Continuously cast gypsum fibreboard, a product developed in Europe, contains perlite and could well displace standard gypsum wallboard in North America in the future.
Perlite for plaster aggregate faces falling demand because of the steady decline in the use of interior plaster, replaced by prefabricated boards. Lightweight concrete aggregate and loose fill insulation are competitive markets subject to substitution and price pressure, chiefly from chemical air-entraining agents in the case of concrete that do not involve as much strength loss as does perlite.

Exfoliated vermiculite, expanded clay or shale, pumice, mineral wool and fibreglass all compete for many of these construction markets; each has specific advantages and/or shortcomings in different product areas. Expanded perlite generally prevails where it has a price advantage and some particularly desirable properties to offer.

Two cementitious products that utilize large quantities of perlite, particularly in the Pacific Northwest, are lightweight joint cement and to a lesser degree spray-on ceiling and wall textures. These carefully formulated mixes are used to finish-coat gypsum wallboard. Lightweight joint cement (as opposed to regular grades) is heavily filled with very fine coated perlite microspheres. The silicone coating repels water permitting the minus 100 mesh particles to retain their cellular voids and dramatically reduce the weight of the applied coating.

In spray-on textures, expanded perlite aggregate is a bulking additive that provides a coarse textured surface, very popular for residential ceilings. Styrofoam may be substituted for perlite in these coatings.

Finally, in the manufacture of cast concrete blocks, light weight products containing pumice, or expanded perlite or clay, are offered at a premium price, but with only modest response. Apparently, the reduction of
placement costs (labour) and related expenses does not offset the price premium.

4.3.3.2 Horticultural Markets

Expanded perlite is an important component of soil mixes used for growing a broad range of plants, shrubs and flowers. Greenhouse and outdoor growers consume large quantities of ‘peat moss-based blends utilizing expanded perlite, pumice, or chopped Styrofoam as a lofting agent, reducing compaction and facilitating greater aeration, water drainage and moisture retention. Some growers blend their own mixes on site, others buy premixed product from commercial blenders in bags or in bulk. Light weight in an important quality.

There is also a considerable garden shop retail demand for such blends packaged in small plastic bags. Many wholesale blenders are catering to this demand by setting up automated small bag packaging lines. There is a similar retail demand for small bags of expanded perlite for the home gardener which has stimulated the installation of repackaging facilities by several perlite distributors.

A fairly coarse perlite aggregate is used in these applications, typically in the 4 to 20 mesh sizer range. It’s high brightness (whiteness) is a desirable property; furthermore, it doesn’t discolour over time in the peat mix to the extent that pumice does. Its chemical inertness is ‘of course an essential characteristic.

Other related applications of less significance include soil conditioning, fertilizer and pesticide and herbicide extension (inert carrier), seedling propagation, bulb storage, and drainage beds. The abrasiveness of
expanded perlite is said to be a deleterious property for evergreen seedling growth, and may decrease its use for that purpose over time. Perlite's very light weight and propensity to “float to the top” in soil mixes subjected to very wet environments can be disadvantageous in some (few) circumstances.

Nonetheless, these varied horticultural applications will doubtless continue to be extremely important markets for perlite for many years.

4.3.3.3 Industrial Markets

The remaining markets for expanded perlite can be lumped together in the industrial category. Some of the more significant of these are as follows:

0 Abrasives (polishing compounds)
0 Hand and fabric cleaners
0 Charcoal barbecue base
0 Filter Aids (foods, beverages and industrial products)
0 Foundry ladle insulation
0 Foundry sand additive
0 Oil absorbent
0 Filler in paint, coatings, plastics, and paper
0 Oil and gas drilling fluids additive
0 Packaging material
0 Hazardous liquid viscosity modifier

Some of these historical uses are diminishing in importance, particularly in paint and drilling fluids. Filter aids have long represented a substantial end-use for milled expanded perlite, in a market that is generally dominated by diatomaceous earth.
Traditional filtering applications include:

- water purification
- sugar and syrup processing
- beer and wine production
- vegetable and animal oils and fats processing
- industrial oil refinement
- industrial effluent treatment
- fruit juice filtration

The foundry applications are aggressively sought by vermiculite producers; the total foundry market for perlite is quite small.

Some specially treated grades of perlite mixed with cellulose and other minerals have been formulated to absorb ocean and industrial oil-spills with some success. Other types of spills can also be mitigated with perlite - calcium chloride blends.

A more recent proposed application of perlite is in the synthesis of zeolites. Research conducted in Italy by Giordano et al. indicates that natural mineral aluminosilicates, such as pumice, perlite, and volcanic tuff can be economically zeolitized.

4.4 Supply and Demand History

Most international trade in perlite is in its raw unexpanded form; for the obvious transportation cost reasons. Greece is the largest exporter of perlite ore in the world, mainly from the island of Milos in the Aegean Sea where reserves are estimated to be 250 million tonnes. The U.S. probably processes more perlite than any other country, but exports less than 10% of its production (chiefly to Canada). It imports some ore from Greece, but could easily be self-sufficient if necessary.
Its own resources are estimated to exceed 50 million tonnes. Total world production of perlite is something less than two million tonnes per year. Published figures vary considerably, and uncertainty exists as to China's Statistics - an annual Chinese production tonnage of over 0.5 million tonnes was postulated in 1986. World figures reported by M.J. Allen are higher than those given by Breese & Barker for the years 1981 to 1989, largely because of a much higher output attributed to Greece. Table IV below has been extracted from these two sources (USSR figures are suspect).

Table IV

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Czechoslovakia</td>
<td>10</td>
<td>10</td>
<td>40</td>
<td>45</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Greece</td>
<td>124</td>
<td>167</td>
<td>198</td>
<td>178</td>
<td>209</td>
<td>160</td>
</tr>
<tr>
<td>Hungary</td>
<td>64</td>
<td>96</td>
<td>99</td>
<td>94</td>
<td>121</td>
<td>110</td>
</tr>
<tr>
<td>Italy</td>
<td>100</td>
<td>95</td>
<td>91</td>
<td>80</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Japan</td>
<td>60</td>
<td>65</td>
<td>77</td>
<td>75</td>
<td>75</td>
<td>7</td>
</tr>
<tr>
<td>Mexico</td>
<td>13</td>
<td>22</td>
<td>46</td>
<td>3</td>
<td>2</td>
<td>39</td>
</tr>
<tr>
<td>USSR</td>
<td>300</td>
<td>330</td>
<td>363</td>
<td>599</td>
<td>599</td>
<td>545</td>
</tr>
<tr>
<td>Turkey</td>
<td>30</td>
<td>24</td>
<td>25</td>
<td>61</td>
<td>154</td>
<td>145</td>
</tr>
<tr>
<td>USA</td>
<td>589</td>
<td>660</td>
<td>579</td>
<td>452</td>
<td>523</td>
<td>580</td>
</tr>
<tr>
<td>TOTAL (including others)</td>
<td>1,294</td>
<td>1,475</td>
<td>1,527</td>
<td>1,634</td>
<td>1,845</td>
<td>1,778</td>
</tr>
<tr>
<td>TOTAL (excluding China)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The indicated rate of increase in world production over this 18 year period is less than two percent per year.
W.P. Bolen of the **U.S. Bureau of Mines** reported statistics for the last *two* years as follows. (Mineral commodity summaries - 1994).

<table>
<thead>
<tr>
<th>Table V</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PROCESSED PERLITE PRODUCTION (’000 TONNES)</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Greece</td>
</tr>
<tr>
<td>U.S.A.</td>
</tr>
<tr>
<td>other countries</td>
</tr>
<tr>
<td>TOTAL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>U.S.A. PERLITE VOLUMES (’000 TONNES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sold production</td>
</tr>
<tr>
<td>Purchased imports (Greek)</td>
</tr>
<tr>
<td>Exports (mainly to Canada)</td>
</tr>
<tr>
<td>Apparent consumption</td>
</tr>
<tr>
<td>Ave Price, f.o.b. mine ($US/tonne)</td>
</tr>
</tbody>
</table>

Clearly, domestic perlite demand in the U.S. has been relatively stable over time. There did appear to be a significant up-turn in the late 1970's, but current consumption is back down to 1970 levels.

Greek imports to, the eastern U.S. arise out of the western location (mainly New Mexico) of US mines, causing unfavourably high delivered costs of domestic ore.
on the east coast. U.S. exports of raw perlite to Canada substantially offset the Greek imports.

Bolen also gives a breakdown of U.S. domestic consumption by market segment, as show in Figure 2.

In the 1991 Bureau of Mines Minerals Yearbook, Bolen reported U.S. sales in short tons by end-use, as shown in Table VI (short ton x 0.907 = metric tonne).

<table>
<thead>
<tr>
<th>Use or Application</th>
<th>1990</th>
<th>1991</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Aggregate</td>
<td>11,600</td>
<td>14,500</td>
</tr>
<tr>
<td>Fillers</td>
<td>26,600</td>
<td>32,100</td>
</tr>
<tr>
<td>Filter Aids</td>
<td>233,400</td>
<td>76,400</td>
</tr>
<tr>
<td>Formed Construction Product</td>
<td>292,400</td>
<td>291,200</td>
</tr>
<tr>
<td>Horticultural aggregate</td>
<td>49,600</td>
<td>53,300</td>
</tr>
<tr>
<td>Low-temp insulation</td>
<td>4,900</td>
<td>5,700</td>
</tr>
<tr>
<td>Masonry + loose fill insulation</td>
<td>13,300</td>
<td>10,400</td>
</tr>
<tr>
<td>Plaster aggregate</td>
<td>10,100</td>
<td>7,300</td>
</tr>
<tr>
<td>Other</td>
<td>34,700</td>
<td>7,100</td>
</tr>
<tr>
<td><strong>TOTAL (rounded)</strong></td>
<td>527,000</td>
<td>498,000</td>
</tr>
</tbody>
</table>
1993 U.S. EXPANDED PERLITE CONSUMPTION

By Market Segment

- Building Construction Products: 65%
- Filter Aids: 14%
- Other: 12%
- Horticultural: 9%
The importance of formed products such as acoustical ceiling tile, pipe insulation, and roof insulation boards to the U.S. perlite industry can clearly be seen in these figures. This does not necessarily apply regionally, however.

Greece's emergence as an export force is significant - production commenced there in 1958. The western U.S. States are richly endowed with perlite resources; enough to last for at least a century. Clearly, world supply is capable of meeting demands for the foreseeable future, as manifested in the rather flat price trend shown earlier - increasing from U.S. $29.90 per tonne to only $30.49 per tonne over four years (f.o.b. mine); only about 0.5 percent per year.

In the U.S. Mineral Commodities Summaries for 1994, Bolen reports that seven companies operated nine perlite mines in the Western States, New Mexico having the greatest production. Expansion plants were said to number 68, covering 34 states, underlining the market-driven nature of locational decisions. Breese and Barker plotted mine' and plant locations as shown in Figure 3.

It should be noted that the expanded perlite industry is very young, having been born commercially at the end of the Second World War, after a decade of research and development in the United States. The Perlite Institute Inc. of Staten Island, New York, was founded in 1949 to coordinate the development of specifications and the publication of technical and application information re expanded perlite products. It continues to effectively meet these needs.
Figure 3
PERLITE LOCATIONS

KEY
○ deposit (s)
A plant(s) or mine(s) 22
With regard to Canadian Statistics, the 1992 Canadian Minerals Yearbook reports the following data:

<table>
<thead>
<tr>
<th>Perlite Imports</th>
<th>1990</th>
<th>CDN Value</th>
<th>1991</th>
<th>CDN Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw ore from the U.S.A.</td>
<td>22,000</td>
<td>$2.8 million</td>
<td>28,000</td>
<td>$3.3 million</td>
</tr>
<tr>
<td>Raw Ore from Greece</td>
<td>8,400</td>
<td>$0.6 million</td>
<td>6,300~</td>
<td>$0.5 million</td>
</tr>
<tr>
<td>Expanded from the U.S.A.</td>
<td>3,400</td>
<td>$1.8 million</td>
<td>3,400</td>
<td>$1.6 million</td>
</tr>
</tbody>
</table>

Greek imports to eastern Canada are considerably cheaper than ore purchased in Western Canada from the Southwestern U.S. States, mainly New Mexico and Colorado, as a result of long overland transportation routes in the latter case. There is currently no raw perlite production in Canada.

The volume of expanded perlite products manufactured in Canada for domestic consumption appears to be in the neighbourhood of 30,000 tonnes annually, with apparent consumption somewhat higher by virtue of the import of U.S. finished goods. If the orthodox per capita relationships are valid, one might therefore expect an apparent annual consumption of expanded perlite in B.C. of about 3,000 tonnes, which is in fact somewhat greater than the maximum annual sales volume achieved by Aurun Mines Ltd. in the mid-1980's.
4.5 **Substitution Factors**

In concluding this background section, some general comments regarding product substitution are perhaps appropriate. In virtually all of the market segments discussed in Section 4.3.3, expanded perlite competes with some other material(s) for market share on the basis of both properties and price. This competition is particularly severe in the construction product area. One exception might be the use of coated microspheres in lightweight joint cement where no other natural product appears to be capable of displacing perlite.

A summary of substitute materials by product group can be listed as follows:

**Construction**
- exfoliated vermiculite
- pumice
- expanded clay, shale, or slag
- volcanic cinders
- foamed concrete
- air-entraining agents

**Insulation**
- fibreglass
- mineral wool
- diatomite
- asbestos
- cellulose
- polystyrene beads
- plastic foam
- exfoliated vermiculite
While perlite has significant application advantages over most of its competitors in many of these markets, demand remains extremely price sensitive, frequently resulting in substitutions being made based strictly on cost, despite some sacrifice in product quality. One example would be the use of chopped Styrofoam instead of perlite in some potting soil mixes for retail sales, where quality discrimination by the end users is not significant.

In 1985, Meisinger concluded that “No significant technological or supply problems exist in the industry” but “the market for expanded perlite is certainly threatened by alternate lightweight mineral materials.”
Bolen, this year, comments that “Alternate materials can be substituted for all uses of perlite, if necessary”. In the 1991 Minerals Yearbook, he stated that "increased (perlite) demand is expected as the economy recovers, but large, sustained growth in perlite consumption is unlikely.”

While all of these conclusions are probably valid in the global or continental sense, distinct regional considerations override them in determining local supply, demand and competitive factors that would lead to the development of a perlite mine in any single jurisdiction. Transportation factors are paramount in making production decisions of this sort.

5.0 BRITISH COLUMBIA RESOURCES

There are no active perlite producers anywhere in Canada. British Columbia claimed the only operating mine in recent history, located about 60 km northwest of Clinton. This deposit, “the Frenier”, was quarried by Aurun Mines Ltd. of Vancouver from 1983 through 1985. The ore was shipped by truck to Aurun’s crushing, screening and expansion plant in Surrey, B.C.

The B.C. Geological Survey Branch lists 18 perlite occurrences in the province in its MINFILE database compilation, as shown in Appendix E, some located near tidewater, but without road access.
During 1989, G.V. White of the B.C. Geological Survey Branch carried out an investigation and evaluation of six volcanic glass deposits in B.C. Their locations are shown on the map in Figure 4, taken from his paper. The four perlite occurrences are the Frenier, the Francois Lake and Uncha Lake deposits near Burns Lake, west of Prince George in the geographic center of the Province, and the Port Clements showings at the north end of the Queen Charlotte Islands. The sites visited by White were limited to those accessible by road. The Frenier, Francois and Uncha Lake, and Blackwater Creek (Port Clements) deposits were all reported by White to contain expandable perlite.

The Francois Lake deposit was mined briefly in 1953 by Western Gypsum Products of Winnipeg. Except for Frenier, there is little published analytical data from these deposits.

In 1990-91, CANMET undertook to test the expansion properties of the ores described by White. Morin and Lamothe published their results in B.C. Geological Fieldwork in 1990. They reported weight losses for each sample tested as follows:

- Frenier: 316%
- Uncha Lake: 3.2%
- Francois Lake: 3.0%
- Port Clements - Blackwater Creek: 4.3%
- Port Clements - Gold Creek: 7.9%

The softening temperatures of these materials varied between 1240 and 1290°C. The authors concluded that all of these ores were expansible, Gold Creek having the best potential as a filler. The Frenier sample showed the lowest bulk density after expansion.
Figure 4

Locations of perlite/vermiculite occurrences in British Columbia

There is a great deal of information available on the Frenier perlite; it is of proven quality, having been successfully expanded and marketed on a commercial scale. All customers contacted commented very favourably on the suitability of the Aurun products for their applications. John Chapman described the property in his unpublished 1984 C.I.M. Annual General Meeting paper. A typical chemical analysis of Frenier expanded perlite published by Aurun is as follows (dry basis).

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SiO₂</td>
<td>77.37%</td>
</tr>
<tr>
<td></td>
<td>Al₂O₃</td>
<td>12.44%</td>
</tr>
<tr>
<td></td>
<td>K₂O</td>
<td>4.84%</td>
</tr>
<tr>
<td></td>
<td>Na₂O</td>
<td>1.86%</td>
</tr>
<tr>
<td></td>
<td>Fe₂O₃</td>
<td>1.11%</td>
</tr>
<tr>
<td></td>
<td>CaO</td>
<td>0.71%</td>
</tr>
</tbody>
</table>

The only variances between this analysis and those from “typical” U.S. and Greek ores are slightly higher silica and lower sodium contents. The Aurun reported pH of 8.3 is a little higher than that claimed as “normal” (approx 7.0).

Adding to the credibility of the Frenier material is research done by Giles and Poling at the University of B.C., wherein they determined optimum parameters for the manufacture of commercial filter aid grades of expanded perlite at Aurun, concluding that competitive products could readily be produced.

To summarize then, there are several potentially economic sources of perlite in B.C., including the proven Frenier deposit near Clinton, the previously mined occurrence and others near Bums Lake, and showings near Port Clements on the Queen Charlotte Islands. These latter occurrences have only been very tentatively investigated. Further exploration might well identify additional reserves in the same area. Preliminary expansion tests suggest that all of these deposits contain commercially expansible perlite.
The target markets for these ores would presumably be existing expanders on the prairies, in Vancouver, and in Northwest Oregon. The interior deposits should be within reach of the western Prairie markets (certainly closer than Colorado or New Mexico), and the Queen Charlotte sites would present an opportunity to take advantage of very cost-effective barge transport to west coast consumers. None of the expansion plants in question are irrevocably committed to their current perlite ore suppliers, according to recent interviews. Further, with a lower-priced ore available, some of these processors might conceivably replace some of the finished (expanded) grades of perlite currently being imported into the region from the U.S.A.

6.0 B.C. SUPPLY - PAST AND PRESENT

For many years, B.C. expanded perlite consumers had very few purchasing options. The closest source of expanded products was W.R. Grace in Edmonton who had to import their ore from as far away as New Mexico. The only option was to buy from U.S. expanders in Southeastern Idaho, Oregon, Colorado, California, Arizona, New Mexico and elsewhere - all a long way away, entailing extremely high freight costs.

The establishment of Aurun Mines Ltd. in the B.C. lower mainland in about 1983 provided a welcome local source of product. Aurun very quickly gained a dominant market share in the region, particularly in construction and horticultural sectors, attaining an ultimate production level of about 2700 annual tonnes. Since the untimely and regrettable closure of Aurun’s operation in 1990, there has been one notable change (improvement) in the supply-side; W.R. Grace has commissioned a perlite expansion facility adjacent to their vermiculite exfoliation plant in Vancouver, providing local supply to supplement traditional shipments into this market from Edmonton. Grace clearly dominates the B.C. market given its locational advantage. Neither Grace nor Aurun have produced coated microspheres, which continue to be imported from mid-west and southwest United States.
W.R. Grace & Co. operate perlite expanders in Ajax, Ontario (2 furnaces), in Winnipeg, Edmonton, and now Vancouver. They also have a plant in Florida that processes imported perlite from Greece. Their Canadian plants all rely on U.S. ore; the source for their western expanders had been National Perlite Products Co. in Malad City, Idaho, which has been shut down for over a year, forcing Grace to go further south for supply.

The only other substantive participant in the B.C. market is the Supreme Perlite Company of Portland, Oregon; Supreme has been in business for forty years using ore from the Southwestern States. Their products are generally well received in B.C., and they have captured a significant market share. Supreme have a perlite deposit in Baker County, in Eastern Oregon, that they hope to develop into a complete ore source; in the meantime they continue to purchase some of their ore from New Mexico.

It should be noted that there have been several other perlite deposits identified in Washington and Oregon that could conceivably attract development in the future.

7.0 PACIFIC NORTHWEST MARKETS

The estimates of perlite consumption put forward in this Section and in the CONCLUSIONS to follow are based on interview responses from users and distributors and the experience of the Consultants. Sales figures from producers within the region were not made available. The writers are very grateful to all those perlite consumers who responded so cooperatively to this survey.

7.1 Alberta

Numerous industry sectors were surveyed in Alberta regarding their current purchases of expanded perlite products Companies were selected on the basis of known past usage or their involvement in an industry with some history of
perlite consumption. Alberta would be a significant market for any emerging B.C. perlite producer.

Of the Alberta filter aid users contacted, none are purchasing perlite; all of them use diatomaceous earth for this purpose. The largest consumer is a vegetable oil plant that requires about 350 tonnes per year. One reason given for perlite’s unpopularity was its plugging or clogging characteristic in the filter, probably due to excessive fines.

With regard to the oil and gas drilling business, there again appears to be no perlite used. One well-established distributor contacted numerous drilling companies and fluid formulators and was advised that perlite was not in use anywhere within the industry. One respondent said that at one time it had been used as a lightener in some plugging cements, but had been replaced by an Australian “ceramic sphere” product. A major drilling fluid manufacturer interviewed confirmed the absence of any perlite applications, as did the Province’s major barite producer.

A pipe production company that had once bought expanded perlite for use in an insulating pipe coating application for heavy oil extraction (coating the steam pipes) reported that there has been no call for this product since 1989 with the demise of the heavy oil exploration business. There may be some minor pipe insulation demand in other sectors.

The horticultural industry is the major consumer of expanded perlite in Alberta, particularly in the production of peat moss based soil mixes. The largest single consumer is located near Edmonton. They installed their own perlite expanders several years ago, previously having purchased expanded product from W.R. Grace in Edmonton. They use up to 40 percent by volume of perlite in their soil mixes, consuming approximately 2300 tonnes per year of raw perlite from
Colorado. They had utilized ore from National Perlite in Malad City, Idaho; until that facility shutdown. They obviously represent an extremely important market for any would-be B.C. perlite mine. The same company reports consuming almost twice as much perlite in their Winnipeg plant - about 4500 tonnes annually. These would together account for perhaps twenty percent of the total Canadian perlite consumption.

The expansion plant of W.R. Grace in Edmonton consumes substantial tonnages of imported perlite ore; precise figures are not available. Products from this plant are widely distributed throughout Western Canada. Grace also supplies a second large peat moss soil blender in Winnipeg, who sells product throughout the west, and who indicates an annual perlite consumption of about 1100 tonnes per year. They use a like amount of vermiculite in their mixes which they also acquire from Grace. They have a second plant in Quebec where they operate their own perlite expanders, using imported ore from abroad (South Africa was the indicated source). They have achieved higher yields of expanded perlite at Winnipeg by transporting the product (from Edmonton) in pneumatic trucks, blowing the product into storage silos thus creating less fines (waste), than with the traditional plastic bag packaging that allows substantial abrasion dusting during handling.

Two other soil blenders were interviewed in southern Alberta. One of them buys about 140 tonnes per year of expanded product from Grace for both the production of peat moss soil blends and for redistribution to a wide network of nurseries and garden shops. The other company consumes a similar tonnage (140-180 per year) for its own blending facility and for repackaging into small bags for retail outlets. Their source of supply is a U.S. producer in Colorado. Freight makes up almost 20 percent of the delivered perlite cost. One of these companies is considering pumice (from Oregon) as a substitute. Brightness is an important characteristic for both of them.
While a thorough review of concrete aggregate markets in Alberta was not possible, it was noted that one major concrete producer is using a locally expanded shale for lightweight applications. As will be discussed under B.C. markets, this industry does not appear to be a potentially large consumer of perlite.

The other substantial user of perlite in Alberta is the joint cement industry. Plants in Edmonton and Calgary use perhaps 1300 tonnes per year between them of coated microspheres, imported from two or three different U.S. sources, for the manufacture of lightweight joint cement. Perlite aggregate has been used for stippled ceiling textures, but this has now been in part replaced by Styrofoam beads.

Clearly, Alberta does represent an important market for raw perlite and expanded perlite, products. W.R. Grace and the peat moss blenders obviously account for a very large proportion of the total demand; they should all be attracted to a closer source of raw material. Similarly, the joint cement producers would doubtless welcome a cheaper (closer) alternative supplier of microspheres.

7.2 Washington State

The consumption of expanded perlite in Washington State is similar in character to that in B.C.; the demands flow from many different applications, but typically in relatively small quantities. This description of the market will include some reference to a few important situations in Oregon.

In the, horticultural sector, there is stiff competition among blenders of soil products (peat moss-based) that use expanded perlite. At least one large B.C. producer and several others from the Portland, Oregon area compete aggressively with the Washington entities for both grower and retail (packaged) business.
The three largest Washington blenders were all interviewed. Their total consumption of perlite is between 350 and 4.50 tonnes annually. They all produce various blends for both grower and retail markets. One of them is a national company that formulates their mixes quite scientifically; they use a mixture of peat moss, vermiculite, pumice, and expanded perlite in each product, varying the proportions to suit customer needs, horticultural specifications, and changes in raw material characteristics. They buy their perlite and vermiculite from an Arizona producer who supplies all of the Company’s blending facilities throughout the Western States. The perlite is shipped in 4 cu. ft. (110 litres) bags, by truck, in combination with vermiculite. The Seattle plant in question uses up to fifty cu. yds. (38 cu. m.) of pumice per week, bought in bulk from Oregon, but in this case the pumice is complimentary to the perlite, not a substitute.

The other two Washington soil blenders buy their material from Supreme Perlite of Portland; one of them uses 60 cu. ft. (1,700 litres) reusable mini-bulk” bags. One did purchase perlite from Aurun Mines Ltd. when they were in business. They both sell their soil products in bulk and various sizes of plastic bags, including numerous “house-brand” labels. One of them uses perlite in preference to pumice because of its higher brightness. The larger of these two processors is closing its plant in June, which will present considerable growth opportunities to the remaining two and their out-of-state competitors.

With regard to filter aids, little or no perlite seems to be sold for this purpose in Washington. One major chemical distributor reports substantial sales of diatomaceous earth for filtration purposes, but no demand for perlite, which they also carry. Interviews with breweries and wineries in the State confirmed this report; they all use diatomaceous earth and no perlite in their filter aid applications. Similarly, there is virtually no demand for perlite from paint and coatings manufacturers in the area.
Regarding stucco and plaster additives, one substantive industrial building supply distributor and concrete ready-mix company was interviewed. Their only sales of expanded perlite are to plasterers for textured plaster admix. Their total annual consumption is less than ten tons, which they purchase from Supreme Periite in Portland the quality and packaging is said to be very good. It would appear that the overall usage of perlite in the concrete, plaster, and masonry fields in Washington is very limited, as is the case in B.C. and Alberta.

A very significant outlet for perlite in Washington is in the manufacture of lightweight joint cement. There are three companies in the Sea-Tat area making joint compound, one of which is very small. The other two enjoy over 95 percent of the market, and consume approximately 900 tonnes per year of coated perlite microspheres between them, from three different ‘Midwest and Southwest U.S. producers, all delivered in large bags via railroad boxcars. Little or no textured plaster is made, hence there is not much consumption of coarser aggregates of uncoated expanded perlite.

The manufacture of fireproof door cores, a major application for expanded perlite in the U.S. generally, appears to be now centred in the midwest states. Georgia Pacific Ltd. (G.P.) at one time produced these in Portland, but relocated the business eastward some time ago. G.P. reports this to be their only other perlite consuming product, besides joint cement, which they manufacture in other regions of the U.S.

Another substantial use of perlite, the production of formed acoustic ceiling tiles, is evident in the Pacific Northwest, in Oregon. One company in the northeastern part of the State produces a wood fibre tile (amongst 300 other products), but uses no perlite whatsoever in the formulation.' The other Oregon tile producer, located on the Columbia River, north of Portland, makes a mineral-based product, consisting essentially of slag-wool, perlite and binders. They have their own
perlite expanding furnaces and bring in raw ore from Colorado in bulk rail cars. Then annual perlite consumption totals about 26,000 tonnes, almost as much as is used per year in all of Canada. The company’s ore purchases are arm’s length in nature and they are therefore very open to alternate (cheaper) potential sources of this vital raw material. They have other similar plant facilities in the Eastern and Southeastern States. They expand their perlite to a relatively fine sire gradation, thus requiring a fine ore feed size, which doubtless endears them to their suppliers, since the ore fines are typically difficult to dispose of.

7.3 British Columbia

British Columbia represents a broad and sizable market for a wide range of expanded perlite products, particularly in the lower Fraser Valley and Greater Vancouver areas. The only expander of perlite in the region, however, is W.R. Grace and Co. of Canada Ltd., in Vancouver, who have dominated the market since the departure of Aurun Mines. Consumption or production figures for Grace’s operation are not available, but they do produce a full range of expanded products (excluding microspheres, coated or otherwise), as can be seen in Table VIII, extracted from their published' data sheet.

7.3.1 Horticultural

The blending of peat moss-based soils is an important industry in Southwestern B.C., despite the absence of any local peat moss source and the competitive presence of blended product from the large prairie producers.
## Table VIII

**W.R. Grace & Co. Expanded Perlite Products**

<table>
<thead>
<tr>
<th>Grace. Product</th>
<th>Typical Bulk Dens.</th>
<th>% Retained - U.S. Sieve Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8 mesh</td>
<td>16 mesh</td>
</tr>
<tr>
<td>Cryogenic</td>
<td>3.0 lb/ft³</td>
<td>1.0</td>
</tr>
<tr>
<td>Industrial ALW</td>
<td>4.0 &quot;</td>
<td>1.7</td>
</tr>
<tr>
<td>Industrial AMW</td>
<td>4.8 &quot;</td>
<td>0.7</td>
</tr>
<tr>
<td>Industrial AHW</td>
<td>7.0 &quot;</td>
<td>0.2</td>
</tr>
<tr>
<td>Industrial K</td>
<td>8.3 &quot;</td>
<td>0.8</td>
</tr>
<tr>
<td>Industrial H</td>
<td>6.0 &quot;</td>
<td>50.9</td>
</tr>
</tbody>
</table>

**Note:** See Appendix D for micron equivalents.

In Greater Vancouver, there is one major bulk blender serving wholesale plant growers in Southwestern B.C. and in Washington State. Once a customer of Aurun, this company currently buys expanded perlite from Oregon, in 50 cu. ft. (1,400 litres) reusable mini-bulk bags, most of it coarse aggregate with a small proportion of medium size for seedling mixes. Substantial quantities of pumice are also used by this blender for certain plant mixes. There are several other commercial blenders in the area, three of whom were interviewed. They all specialize in packaged blended products for retail customers and purchase their perlite in 4 cu. ft. (110 litres) plastic bags from W.R. Grace. Two of them use Oregon pumice as a partial substitute, and as a preferred agent in some cases. It is cheaper than expanded perlite and doesn’t “float to the top” in wet environments as perlite does, but it is not as white. One of these three uses some Styrofoam as a substitute in low-price products. All three do
extensive ‘house brand’ bagging for chain stores and nurseries, and also re-package perlite in small plastic bags for retailers. Some also redistribute smaller bags of Grace perlite directly to their customers.

The total annual consumption of expanded perlite by all four of these blenders is in the neighbourhood of 450 tonnes. Anticipated growth rates are optimistic as the horticultural and landscaping industries seem to keep well ahead of the rest of the economy.

At least two major garden supply distributors handle, re-package and re-sell W.R. Grace perlite in the B.C. lower mainland (and on Vancouver Island). This activity adds a further 90 tonnes or so per year of volume to the above-noted 450 tonnes.

Several commercial greenhouse owners were interviewed, some of whom do their own soil blending, buying perlite directly from Grace or from one of Grace’s distributors. ‘Consumptions vary all the way from 5 to 200 tonnes per year. One substantial operator purchases his soil requirements in blended form from one of the large prairie peat moss companies. These businesses account for a total perlite consumption of about 400 tonnes per year.

The total of all of these Greater Vancouver horticultural demands is about 1000 tonnes per year, nearly all in the coarse aggregate size range.

7.3.2 Industrial

As in the other jurisdictions surveyed, the use of expanded perlite for filter aids in B.C. seems to be extremely limited. Of the breweries, sugar and fat refineries, and fruit juice processors interviewed, none used any perlite, expressing strong preference for diatomaceous earth. Consumptions vary from 20 to 500 tonnes per
ineffective in bacteria filtration. The Vancouver Aquarium and numerous municipality. swimming pools did at one time use Aurun products for water filtration.

A major chemical distributor confirmed this trend. They distribute both perlite and diatomaceous earth filter aids and report no demand for the former, despite compelling evidence of satisfactory performance in other locales.

This same distributor, who is very active in the supply of wet and dry chemicals and industrial minerals to local paint companies, reported that there was also zero demand for perlite as a filler in paint and coatings; nor were they aware of any usage in the plastics sector.

There is some demand for expanded perlite in the manufacture of castable refractory products, although a depressed oil and gas exploration business in the west generally has diminished this market. Currently, only about 30 tonnes per year are required in B.C. for this application (once as high as 100 tonnes per year).

7.3.3 Construction

Two major concrete block manufacturers in Southwestern B.C. were interviewed; neither use any perlite. Lightweight block of 34 or 29 lb. versus the standard 40 lb (18 kg) comprises less than ten percent of total block sales, reportedly, because of the 15 percent price premium. Expanded clay or shale is the preferred lightweight aggregate when required. High fire-rating wall-block calls for perlite aggregate, but orders for this product are said to be rare.

With regard to poured concrete, 60 to 70 percent of which is pumped in this market, virtually no perlite is used, largely because it can't be pumped as a result of its high water absorption under pressure. Difficulty in obtaining high cured
strength levels is also an impediment to use. One operator suggested that low density back fill projects (minimal cement contents) might be a potential market for expanded perlite. A very dry mix is used, and volumes tend to be very sizable. Insulated roof topping (not pumped) is another possible application, but such jobs apparently arise very infrequently.

A popular construction product once thought to have contained perlite is spray-on insulation (eg: Grace’s "Monocoat"). The filler of choice is now, reportedly, chopped styrofoam. Perlite was too abrasive and caused troublesome levels of erosion of spray nozzles. Vermiculate has also apparently been rejected for this application, because of concerns over asbestos contents. A competitive product once made in eastern Canada (now just in the U.S.) is a fire-proof plaster-perlite-cellulose formulation, which, if it were to be manufactured here, could represent a significant market for expanded perlite.

One major roofing compound manufacturer was interviewed - no perlite is used in their mineral filled, tar-based formulations.

In the plaster and stucco field, interviews with building supply dealers revealed a small demand for perlite for a few special applications, including lightweight stucco, hollow door admix, and mortar sand replacement for difficult access cement jobs. No loose-fill insulation usages were mentioned. The total demand in this sector appears to be in the range of 50 tonnes per year.

The largest market for perlite in this category is in the manufacture of lightweight dry wall joint cement and ceiling textures. The latter products utilize expanded perlite aggregate, as noted earlier. Significant quantities are involved in B.C., well in excess of 500 tonnes per year. Lightweight joint cement production in the Province accounts for imports of U.S. coated miacospheres in even greater
volumes. An estimate of total microsphere usage in Alberta, B.C., and Washington is given in the Conclusion section of this report.

8.0 TRANSPORTATION, DISTRIBUTION, AND PRICES

As noted many times in this review, the extremely low bulk density of expanded perlite makes it very expensive to transport, hence the strong economic bias towards locating "poppers" (expanders) close to finished product markets, even to the extent of "captive" facilities tied to a single user, such as have been constructed at the ceiling tile plant in Oregon, and the peat moss-based soil blender in Edmonton. With a twenty-to-one expansion ratio, economics strongly favour the transport of ore as opposed to expanded product wherever possible. Another important factor is the considerable friability of expanded perlite that gives rise to significant abrasion (dust) losses of product during handling and transport. Fiily; bulk handling of expanded perlite must be carried out carefully, so as to avoid any exposure to water.

Concerning means of trade, perlite products in the region seem typically to be sold directly from the manufacturer to the customer, except where purchase quantities are small or where the source and consumer are far apart, in which cases distributors are often utilized. Wholesale customers of course often become distributors, as has been noted, through a process of repackaging into smaller retail units for resale through various garden shops or chain store outlets.

There are few if any political barriers to perlite trade in North America - no duties apply to cross border (Canada-U.S.) shipments.

Finally, the pricing of these products seems to be stable within the region, reflecting a reasonably competitive situation. The standard 110 litre (4 cubic feet) bag of medium and coarse gradations sells for about $6.00 to $6.50, f.o.b. supplier’s plant in Canada, or approximately $4.00 U.S. from American producer plants, making the latter price
competitive here after allowing for freight and exchange. Prices may be marginally lower in Alberta. A $6.00 bag price converts to about $215.00 per tonne, but virtually no one in this industry think in terms of weight - all measures are volumetrically based.

By contrast, the price of coated microspheres is very high - in the order of U.S. 25 to 30 cents per pound, f.o.b. plant (Midwest or Southwest State). Freight and exchange brings this up to almost Cdn 50 cents per pound, or $900 per tonne, delivered to B.C. With only three or four sources of this product in the entire U.S., severe price competition would not normally be anticipated.

9.0 CONCLUSIONS

- Existing markets for expanded perlite in Western Canada and the Pacific Northwest States seem to be relatively stable and to a large extent within industry sectors exhibiting better-than-average mid-term growth prospects.

- There is a potentially strong regional demand for high quality raw perlite ore sourced within B.C. Combining probable consumptions in Northwest Oregon, Vancouver, and Edmonton, the total market would approach 35,000 tonnes per year. Almost 75 percent of this is vested in one U.S. consumer.

- At least one known B.C. perlite deposit is of proven commercial quality, and several others appear to have commercial potential.

- High value-added coated perlite microspheres represent a substantial dollar volume of business. The total regional consumption is likely in excess of 2,700 tonnes annually (Alberta, B.C., and Washington), which has a delivered value of Cdn$ 2.5 million or more.
**Table IX**

**SUMMARY OF MARKETS**

(B.C., Alberta, Washington, N. W. Oregon)

<table>
<thead>
<tr>
<th>Perlite Form</th>
<th>Annual Tonnes</th>
<th>Approx. Cdn $ Value</th>
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</thead>
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<tr>
<td>sized ore</td>
<td>35,000</td>
<td>$1.4 million</td>
</tr>
<tr>
<td>Expanded Perlite</td>
<td>7,000</td>
<td>$1.5 million</td>
</tr>
<tr>
<td>(excluding microspheres and captive markets)</td>
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</tr>
<tr>
<td>Coated Microspheres</td>
<td>2,700</td>
<td>$2.5 million</td>
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Appendix A

Bibliography
Bibliography


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Appendix B

Perlite Patents
CODES FOR COUNTRIES AND FOR KINDS OF PATENTS

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<th>COUNTRY CODE</th>
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OPI — “Open for publication inspection”
EXPANSION PROCESSES FOR PERLITE.
TITLES AND NUMBERS FOR PATENTS REGISTERED IN THE U.S. OR CANADA.
(NANY OF THESE ARE ALSO REGISTERED IN OTHER COUNTRIES)

Expanding perlite granules using heavy liquid fuel - by mixing liquid fuel with preheated air before feeding to burner nozzle

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Controlling density of expanded perlite - by passing prod. through conduit, applying radiation from one side, and detecting amt. of non-absorbed radiation on the other side

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In situ bonded expanded perlite - by reacting perlite with sodium and/or potassium silicate

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Expanded perlite - contains alkali metal cpd additive

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Perlite expansion method

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Expanded mineral particles esp. perlite having non-porous surfaces - obtd. by slow expansion at controlled temp. to avoid cracking

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Perlite expansion process including improved heat recovery with improved yield

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B-2
Fluid treatment apparatus. - with two concentric annular treatment regions in each of which circumferential fluid flow is established

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Expanded and coated perlite production by expanding perlite ore in hot gas stream and coating the hot expanded particles e.g. with a polydimethyl siloxane! emulsion

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Expansion furnace for granular materials employs upflow fluid bed furnace with solids injection at base of 'flame

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Vertical tube furnace for expanding perlite for vermiculite with coaxial preheater chamber contg. baffles around tube

US 4318691 | A    | 820309 | 8212 |

Expanded perlite coated with emulsion of organo-silicon cpd. - dried and heated to particles resistant to attrition

US 4183980 | A    | 800115 | 8004 |
US 4255489 | A    | 810310 | 8113 |
Furnace for expanding perlite employing **burner** firing downwards with perlite injection into flame at top of combustion chamber

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Preparing fine **perlite** dust for expansion by mixing with boric acid and-heating

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Free-flowing, compaction resistant expanded perlite particles - coated with self-crosslinking acrylic! polymer, used as heat insulator

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Bonding fine dust fractions of expanded perlite - by spraying with **paraffin** hydrocarbon after cooling

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Expanded perlite coated with emulsion of organo-silicon cpd. - dried and heated to particles resistant to attrition

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Bonding fine dust fractions of expanded perlite - by spraying with paraffin hydrocarbon after cooling

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Expanded perlite made for use in filtration processes. - where oxygen added to burner flame improves yield and quality

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Hydrophobic expanded perlite compositions. - contain buffered aq. silane emulsion additives

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Expanded perlite fillers coated with polysiloxane and heated to improve resistance to attrition

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EXPANDED PBRLITE - PRODUCT APPLICATIONS

Battery separator material - comprising expanded perlite glass fibres and opt. plastics fibres

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Non-digestible expanded perlite granules as pig feed additive - allows addition of vitamin(s) and oligo-elements, gives an improved carcass and allows excrement to form excellent manure (OE 15.5.79)

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Asbestos-free bituminous compsn. for roofing - contg. expanded perlite filler and high-structure carbon black

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Ignition coating for charcoal briquettes - contains alcohol, gum cellulose binder and wicking material, esp. particulate expanded perlite

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Fire door core of high compressive strength and low density — made from expanded perlite, gypsum, cement and organic binder and pref. unexpanded vermiculite

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Free-flowing, compaction resistant expanded perlite p — used as heat insulator

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Plaster moulding compsns. for low m.pt. metal casting — are fibre-free and include fine expanded perlite and non-fibrous fillers

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Oil-adsorbing compsn. for removal of oil from water — comprising expanded perlite, cellulosic fibre and asphalt sizing

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Fire resistant, insulating or acoustical board compsn. — comprising expanded perlite, wollastonite, mineral and vegetable fibres, colloidal clay and paraffin wax

Patent Family:

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Fibre-reinforced expanded perlite insulation board — having starch included in binder for improved mechanical properties

Patent Family:

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Rigid inorganically bonded thermal insulator - comprising expanded nerlite: alkali metal silicate: zinc oxide: sodium hexafluorosilicate and fibrous material, e.g. mineral wool

**Patent Family:**

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Cellular high temp. insulation composite - comprising moulded cured mixt. of expanded perlite, aluninate cement, clay, wollastonite and resin

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Compsn. for treatment of spilt liq. caustic base - by neutralisation and absorption contains citric acid, expanded perlite, flour, colloidal silica pH indicator and water

**Patent Family:**

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Plaster moulding compsns. for low m.pt. metal casting - in which conventional fibrous talc is replaced by non-toxic expanded perlite and fibrous wollastonite

**Patent Family:**

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Compression moulded hardened composite articles - contg. expanded perlite and urea! melamine formaldehyde! resin modified with Gp.-1VB metal

Household abrasive cleanser compsn. - contg. expanded perlite abrasive, colloid-forming clay e.g. smectite as suspending agent and surfactant

Extra lightweight expanded perlite cement concrete block - contains additive of triethanolamine salt of p-dodecyl benzene sulphonic acid

Oil Spillage hydrocarbons sepn. from water - absorbed in floating mixt. of expanded perlite, asphalt, fibrous filler and pref. clay

Thermal and acoustic insulation - made from expanded perlite or vermiculite with an aq. acid and a waterglass soln.

Heat insulating calcium silicate bound structural material - is produced from lime expanded perlite and reinforcing fibres
Expanded perlite board contg. gypsum and organic fibre - by forming mat from aq. slurry

Patent Family:
CC Number Kind Date Week
US 3988199 A 761026 '7645 (Basic)
CA 1065350 A 791030 7946

Insulating/protective structure for frozen substrates - comprising expanded perlite coated with chemically-combined bituminous material

Patent Family:
CC Number Kind Date Week
US 3903706 A 750909 7538 (Basic)
CA 1061031 A 790821 7936

Perlite board continuous prodn., for insulation - by mixing expanded perlite and aq. slurry contg. binder, using less water

Patent Family:
CC Number Kind Date Week
US 3888962 A 750610 7525 (Basic)

Hydrocarbon septd. from mixts. with water - using absorbent made from expanded perlite,, asphalt cellulose fibres

Patent Family:
CC Number Kind Date Week
US 3855152 A 741217 7501 (Basic)
BE 824-559 A 750515 7524
NL 7416148 A 760615 7627
DE 2459378 A 760624 7627
GB 1468420 A 770323 7712
CA 1043759 A 781205 7851
IT 1037096 B 791110 8808

Structural plate with light core.- contg expanded perlite, fibrous material and binder

Patent Family:
CC Number Kind Date Week
DE 2336400 A 740214 7408 (Basic)
JP 49092106 A 740903 7445
GB 1446014 A 760811 7633
CA 1007006 A 770322 7714

Decorating wet core wallboard - using porous pigmented composition containing expanded perlite

Patent Family:
CC Number Kind Date Week
CA 930500 A 000000 7331 (Basic)
GB 1359935 A 740717 7429
US 3984596 A 761005 7642
Expanded perlite insulation jacket - for cryogenic fluid supply lines, permenantly evacuated when transporting liq gas

Patent Family:
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Oxidn catalyst - for methacrolein prepnn consisting of metal eg iron-molvbdenum oxides on expanded perlite support

Patent Family:
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Insulating compsn for undergound conduits - of mixt of asphalt and asphalt-coated expanded perlite

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Expanded perlite with silicate binder insulation - protecting austenitic stainless steels from stress corrosion

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Insulation panels of expanded perlite

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A moulded insulating material tha contains (1) 60-75% wt. cellular expanded perlite, (2) 8-12% bentonite clay as a mineral binder, (3) 5-8% water dispersible

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Strong low density mineral wool structural panels - obtd. by dewatering frothed mixt. contg. mineral wool, polyvinylacetate latex, expanded perlite and cationic amine-based surfactant, using

Patent Family:
CC Number Kind Date Week
us 5047120 A 910910 9139 (Basic)

Explosive water-in-oil emulsion compsn. - contains hydrocarbon, emulsifier, ac. soln. of oxidising salt, and expanded perlite with density below 0.6 G per cubic cm as void-former-

Patent Family:
CC Number Kind Date Week
DE 4001917 A 910725 9131 (Basic)
CA 2007348 A 910709 9138
FR 2659322 A 910913 9147
JP 4042884 A 920213 9213

Precast, prestressed concrete - has smooth, expanded perlite in wet mix with pozzolan comprising diatomaceous clay and micro-silica, water and aggregate

Patent Family:
CC Number Kind Date Week
WO 9014319 A 901129 9050 (Basic)
AU 9058111 A 901218 9113
EP 431112 A 910612 9124
JP 4500065 W 920109 9208
US 5114617 A 920519 9223

Cement for relining and re-sizing chimneys - contg. Portland cement, volcanic glass which is pref. expanded perlite, micro-silica, air entraining agent and plasticiser

Patent Family:
CC Number Kind Date Week
US 4963191 A 901016 9044 (Basic)

Emulsion explosive having continuous phase of fuel and emulsifier - and dispersed aqueous oxidiser salt contains expanded perlite as void providing agent

Patent Family:
CC Number Kind Date Week
us 4940497 A 900710 9030 (Basic)
AU 9048932 A 900712 9036
GB 2232975 A 910102 9101
ZA 9001580 A 901228 9105
ES 219522 A 910616 9129
NO 9000886 A 910826 9143
PT 93640 A 911031 9148
NL 9000101 A 911118 9149
GB 2232975 B 921216 9251
AU 643196 B 931111 9401

B-12
Adsorbent mfr. from calcium sulphate hemi-hydrate and expanded perlite
- involves adding water and calcining, esp. for adsorbing animal excretion

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Roofing system using expanded perlite board - has perforations into which partially molten bitumen coating flows

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Lightweight fire resistant core for fire door - comprises expanded perlite and gelatinised starch adhesive

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Lightweight insulating polymer concrete esp. for LNG storage areas - comprising epoxy! resin binder, hydrated flame retardant, and one or both of aluminium silicate hollow spheres and expanded perlite

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Lightweight joint cpd. for gypsum wallboards - having improved uniformity with the adjacent board when painted, contains water-imuervious expanded perlite of specified particle size

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B-13
Fireproof insulation using aluminium dihydrogen phosphate as binder obtd. from expanded perlite or blowing agent e.g. dolomite, alumina or magnesia powder and e.g. bentonite, used on structural members

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Expanded perlite treated with amino functional silicon cpd. and use in joint compound for wallboard joints

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Insulating surface of mass of molten steel using an expanded perlite-and fibre-contg. board

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Roofing panel having e.g. polyurethane foam contg. reinforcing structure and sandwiched between thin expanded perlite-based plate

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Lightweight compsn. for finishing joints between wallboards comprises filler, binder, treated expanded perlite, non-levelling agent and thickener.

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Expanded perlite-silicate insulation material contg. kaolin and fibres has good heat stability and impact resistance; low density and thermal conductivity.

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Flowable thermosettable resin surfacing compsn. contg. diatomite, expanded perlite and glass fibres used to form impact resistant, watertight layers on wooden boat hulls.

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Building material for mouldings or mortar with very low density made by mixing expanded perlite with silicate binder and foaming agent.

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Fire door comprising core and edge banding each made from expanded perlite, gypsum and aq. binder, or similar compsn.

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Composite insulation with enhanced capacity has polyurethane foam between silicate coated expanded perlite ceramic layers

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High strength coherent insulating material contg. expanded perlite, sodium or potassium silicate, water, and phosphate to provide high transverse strength

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Combustible blocks prep'd. by dispersing expanded perlite in gelled liq.-fuel

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Expanded perlite board comprising tacky binder which is permanently tacky when dry

**Patent Family:**

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Fire retarding sprayable insulating compsn. contains expanded perlite and portland cement and cures rapidly at ambient temp.

**Patent Family:**

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Mineral board mfr. from expanded perlite and resin binder by pressing to crush perlite after shaping for high strength prod.

Weather resistant roofing or siding panel having good thermal insulation is made from fibre; binder and expanded perlite

Water-resistant bonded perlite structural material obtd. by curing moulded mixt. of expanded perlite and aq. alkali silicate under controlled conditions of temp. and humidity

Fireproof heat-insulating compsn. contg. cellulose fibres and expanded perlite particles, opt. resin-coated

Firelighters comprising fuel and water in resin matrix contg. expanded perlite for longer burning

Insulating panel for roof renovation or reconstruction is made from expanded perlite with grid of grooves and rebated side edges
Appendix C

Perlite Institute,
Use & Applications Chart
Appendix D

Size Conversions Chart
### Appendix D

**SIEVE SIZE CONVERSIONS**

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Appendix E

"MINFILE" Listing of B.C. Perlite Occurrences
MINFILE NUMBER: 092ISW082

NATIONAL MINERAL INVENTORY:

NAME(S): PROSPECT CREEK, PEARL

STATUS: Showing

NTS MAP: 092103E

LATITUDE: 50 00.48

LONGITUDE: 121 04.00

ELEVATION: 760 Metres

LOCATION ACCURACY: Within 500 Metres

COMMENT: Perlite Layer on the west bank of Prospect Creek, approximately 0.8 kilometres from its confluence with Spius Creek (Assessment Report 13336).

COMMODITIES: Perlite

MINERALS

SIGNIFICANT: Perlite

MINERALIZATION AGE: Cretaceous

DEPOSIT

CHARACTER: Massive

CLASSIFICATION: Volcanogenic

SHAPE: Tabular

DIMENSION: 6 x 3 Metres

STRIKE/DIP: 030/40E

HOST ROCK

DOMINANT HOST ROCK: Volcanic

FORMATION

SPENCES BRIDGE

FORMATION

SPIES CREEK

LABORATORY:

PERLITE

RHYOLITE

ANDESITE

BASALT

GEOGRAPHIC SETTING

TECTONIC BELT: Intermontane

TERRANE: Overlap Assemblage

PHYSIOGRAPHIC AREA: Thompson Plateau

CAPSULE GEOLOGY

The Prospect Creek showing is located on the west bank of Prospect Creek, approximately 0.8 kilometres from its confluence with Spius Creek.

The area is underlain by Riddle and Upper Cretaceous Kingsvale Group effusive volcanics (redefined to the Spies Creek Formation of the Spies Bridge Group; Geological Survey of Canada Map 42-1969).

Rocks close to the showing comprise volcanic breccia and phaneritic, amygdaloidal, vesicular, porphyritic and spherulitic andesites and basalts.

Two parallel amber to brown perlite layers are exposed over 6 by 3 metres and separated by spherulitic, glassy rhyolite (possibly dykes or chilled contact zones) striking 030 degrees and dipping 40 to 60 degrees southeast (Assessment Report 13336). Another two metre wide perlite layer is exposed 200 metres to the south (upslope).

Perlite layers are terminated by flat-lying andesite.

Perlite displays pitchy lustre and contains scattered feldspar and quartz crystals and spherules.

BIBLIOGRAPHY

EMPR AR 1954: A185
EMPR EXPD 1983: 270; 1984: 203
EMPR ASS RPT 11852 '13336
GSC OF 980
GSC VE 262
GSC P 46-8; 47-10; 81-1A, pp. 185-189; 85-1A, pp. 349-358
BIBLIOGRAPHY

GSC MAP 1010A; 1386A; 42-1989

DATE CODED: 870331
DATE REVISRD: 910207

CODED BY: AFU
REVISED BY: SNB

FIELD CHECK: N

MINFILE NUMBER: 0921SW082
MINFILE NUMBER: 0920 OR

NAME(S): FRENIER, EMPIRE VALLEY

STATUS: Past Producer

LOCATION: Clinton

LATITUDE: 51° 20' 43" N

LONGITUDE: 122° 21' 01" W

ELEVATION: 1295 Metres

DIRECTIONS: Within 5000M

COMMENTS: Open pit, 9 kilometres east of Black Dome Mountain and 7 kilometres west of the Fraser River, just north of Higginbottom Creek, 20 kilometres north-northwest from Lillooet (Fieldwork 1988).

COMMODITIES: Perlite

MINERALS

SIGNIFICANT: Perlite

ASSOCIATED: Silica

AGE: Eocene

DEPOSIT

CHARACTER: Massive

SHAPE: Tabular

DIMENSION: 3 x 0 Metres

COMMENTS: The deposit consists of a flat-lying flow of volcanic glass up to 30 metres thick.

HOST ROCK

DOMINANT HOST ROCK: Volcanic

STRATIGRAPHIC AGE GROUP: Eocene

FORMATION: Kamloops

LITHOLOGY: Perlite

Rhyolite Tuff

Rhyolite Flow

Rhyolite Crystal tuff

Volcanic Breccia

Pitchstone

GEOLGICAL SETTING

TECTONIC BELT: Intermontane

TERRANE: Overlap Assemblage

PHYSIOGRAPHIC AREA: Chillcotin Plateau

RESERVES

ORE ZONE: FRENIER

CATEGORY: Inferred Ore

YEAR: 1991

QUANTITY: 380,000 Tonnes

COMMODITY: Perlite

GRADE: 100.0000 Per cent

COMMENTS: Reserves based on an average thickness of 30 metres and a specific gravity of 2.3.


CAPSICLE GEOLOGY

Locally, volcanic and sedimentary rocks of the Eocene Kamloops Group unconformably overlie Middle and Upper Lower Cretaceous Spences Bridge Group volcanics west of the Fraser River and Fraser fault system.

Volcanic rocks at the Frenier open pit site are correlated with the Kamloops Group and consist of devitrified rhyolite tuff, vesicular rhyolite flows, rhyolite crystal tuff, perlite and volcanic breccia with clasts of varied composition. The lower 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; h-. immediately south of the pit, in Higginbottom Creek, it crosscuts the underlying lithologies. In outcrop the perlite is a hang-, light grey, glassy rock, crosscut by veins of opaline silica and pitchstone. Fine fractures are visible in hard 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 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. When heated using a hand-held propane torch, crushed perlite expands rapidly to many times the original size. The deposit has been divided into "coarse" and "fine" perlite with inferred reserves calculated by Aurum Mines Limited of 3.8 million tonnes, using an average thickness of 30 metres and a specific gravity of 2.3 (Fieldwork 1989, page 483; Open File 1992-1). The same perlite horizon is reported to occur on the area of high relief about 1.5 kilometres to the east-northeast. These outcropping are separated from the pit area by a south-flowing creek. Six thousand tonnes of crude perlite was shipped by truck from 1983 through 1985. The mine has been inactive since 1986 because of transportation difficulties resulting from an old, low-capacity bridge across the Fraser River.

BIBLIOGRAPHY

EMPR ASS RP 7009, "11077, '12636
EMPR AR 1949-A261, A262
EMPR EXPL 1977-E289
EMPR FIELDWORK '1988, pp. 519-523; '1989. PP. 481-483
EMPR MAP 65, 1989
GSC MAP 29-1963; r-1972; 1292A
GSC EF 534; 2207
GSC P 67-54
CJES Vol. 21, pp. 1132-1444
W MINER Apr/1984
N MINER Feb. 2, Mar. 22, Sept. 6, 1984; Aug. 25, 1986
NW PROSP Sept./Oct. 1986
IPDM March/April 1984
EMPR ENG INSPI Annual Report 1990

DATE CMED: 850724
DATE REVISED: 901012

CODED BY: GSB
REVISED BY: GO

FIELD CHECK: N
FIELD CHECK: Y

MINFILE NUMBER: 0920 072
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**SUMMARY TOTALS:**

- **Mined:** 6,500 tonnes
- **Milled:** 6,500,000 kilograms

**Recovery:**

- Perlite: 7,162 tonnes
- Perlite: 14,330,043 Dounds

**Comments:**

MINFILE NUMBER: 0920_083

NAME(S): Empire Valley

STATUS: Showing
NTS NAP: 092006B

LATITUDE: 51 23 17
LONGITUDE: 122 16 43
ELEVATION: 1000 Metres

LOCATION ACURACY: Within 5 KM

COMMENTS: Located in the vicinity of the Empire Valley Ranch Western Homes and Living, October 1961. Industrial Minerals File.

COMMODITIES: Agate Perlite Gemstones

MINERALS SIGNIFICANT: Agate Opal Jasper Perlite

DEPOT CHARACTER: Unknown

CLASSIFICATION: Industrial Min.

HOST ROCK: Volcanic c

STRATIGRAPHIC AGE: Eocene Oligocene

LITHOLOGY: Volcanic Mafic Porphyry Basalt Andesite Tuff Breccia

GEOLOGICAL SETTING

TECTONIC BELT: Intermontane
TERRANE: Overlap Assemblage

PHYSIOGRAPHIC AREA: Chilcotin Plateau

CAPSULE GEOLOGY

The area of the Empire showing is underlain mainly by Eocene and younger volcanics comprising rhyolitic and dacitic tuff, breccia and flows, and minor andesite and basalt. Also occurring in the area are Oligocene and Lower Miocene porphyritic and amygdaloidal andesite and basalt tuff, breccia and flows.

Agate, "thundereggs" and perlite occur on the property of Empire Valley ranch and beyond. Stringers and nodules of chalcedony are contained in a mafic volcanic porphyry underlying the perlite. The quality is apparently good. Opal and jasper are also reported to occur.

BIBLIOGRAPHY

ENPR IND MIN File (Western Homes & Living, Oct. 1961)
GSC P 772-55, pp. 27, 28
OPEN FILE 534, 2207

DATE CODED: 850724
DATE NEW SEQ: 911029

CODED BY: GSS
NEW SEQ BY: GJP
MINFILE NUMBER: 0920 103

NAME(S): MOORE LAKE

STATUS: Showing
NTS MAP: 092001E
LATITUDE: 51 09 43
LONGITUDE: 122 12 02
ELEVATION: 1554 Metres

LOCATION: Within 500m

COMMENTS: The location given is centrally located relative to three outcrops of
volcanic glass at EMO556000mE, EMO567550mN; EMO555800mE, EMO566840mN;
and EMO555850mE, EMO566830mN (Open File 1988-29).

COMMODITIES: Perlite, Volcanic Glass

MINERALS

SIGNIFICANT: Perlite
ASSOCIATED: Plagioclase, Biotite

MINERALIZATION AGE: Eocene

DEPOSIT

CHARACTER: Stratiform
CLASSIFICATION: Volcanogenic
SHAPE: Tabular
DIMENSIONS: 2000 x 1000 x 10 Metres

COMMENTS: Probably in the core of a northwesterly trending syncline.

HOST ROCK

DOMINANT HOST ROCK: Volcanic

STRATIGRAPHIC AGE GROUP: Eocene
FORMATION: Unnamed/Unknown Group
IGNEOUS/METAMORPHIC/OTHER: Unnamed/Unknown Formation

LITHOLOGY: Flow Banded Rhyolite

GEOLOGICAL SETTING

TECTONIC BELT: Intermontane
TERRANE: Methow

PHYSIOGRAPHIC AREA: Chilcotin Plateau

CAPSULE GEOLOGY

Within Eocene volcanic rocks on the eastern margin of the
Chilcotin Plateau, equivalent to the Kamloops Group volcanics to the
east, are deposits of volcanic glass which, in both hand specimen
and thin section, have the characteristics of perlite.

The Moore Lake showing consists of flow banded, slightly
porphyritic (plagioclase, hornblende, biotite) flows containing about
9 per cent water but not expandable upon heating. Farther to the
northwest along the same zone one sample collected is
expandable upon heating to about 50 per cent of that of the perlite deposit near Empire Valley (Open File 1988-29).

BIBLIOGRAPHY

EMPR FIELDWORK 1987, pp. 411-415
EMPR OF 1988-29
GSC OF 534; 2207

DATE CODED: 880324
DATE REM SET: 910301
CODED BY: PBR
REM SET BY: DGS

FIELD CHECK: Y

MINFILE NUMBER: 0920 103
NAME(S): FRENCH BAR CREEK

STATUS: Showing
NTS MAP: 0920016
LATITUDE: 51 10 33
LONGITUDE: 122 13 11
ELEVATION: 1593 Metres
LOCATION ACCURACY: Within 500M
COMMENTS: On the ridge crest overlooking South French Bar Creek and Moore Lake.

COMMODITIES: Perlite

MINERALS
SIGNIFICANT: Perlite
ASSOCIATED: Melilite

MINERALIZATION AGE: Eocene

DEPOSIT
CLASSIFICATION: Stratiform Volcanogenic Industrial Min.
SHAPE: Tabular
DIMENSION: 50 x 30 x 10 Metres
TREND/PLUNGE: 315/32E

HOST ROCK
DOMINANT HOST ROCK: Volcanic

STRATIGRAPHIC AGE GROUP: Eocene
FORMATION: Unnamed/Unknown
LITHOLOGY: Porphyritic Flow Banded Dacite Volcanic Glass

HOST ROCK COMMENTS: These rocks are probably correlative with the Kamloops Group east of the Fraser River.

GEOLOGICAL SETTING
TECTONIC BELT: Intermontane
TERRANE: Methow

CAPSULE GEOLOGY

Within Eocene volcanic rocks on the eastern margin of the Chilcotin Plateau are glassy volcanic flows in which the glass, in hand specimen and thin section, has characteristics of perlite. These rocks are probably equivalent to the Eocene Kamloops Group to the east of the Fraser River. Whereas most of the occurrences of volcanic glass do not expand upon heating and, hence, are not strictly perlite, the French Bar Creek showing contains about 90 per cent water and upon heating expands to about 50 per cent of the perlite mined by Aurun Mines near Empire Valley. The French Bar Creek showing is a single large outcrop of porphyritic flow banded dacite.

BIBLIOGRAPHY

EWPR FIELDWORK 1987, pp. 411-415
EMPR OF 1988-29
GSC OF 534; 2207

DATE CODED: 880324
DATE REVISED: 910302
CODED BY: PBB
REVISED BY: DGR

FIELD CHECK: Y

MINFILE NUMBER: 0920 106
MINFILE NUMBER: 093C 010

NAME(S): ANAHIM PEAK, TSITWTL PEAK

STATUS: Showing

NOTES: NTS MAP: 093C 13E
LATITUDE: 52 45 30
LONGITUDE: 125 38 00
LOCATION ACCURACY: Within 1 km

COMMODITIES: Perlite

MINERALS
SIGNIFICANT: Perlite
MINERALIZATION AGE: Unknown

DEPOSIT
CHARACTER: Stratiform
CLASSIFICATION: Volcanogenic Industrial Win.

HOST ROCK
DOMINANT HOST ROCK: Volcanic

STRATIGRAPHIC AGE GROUP:
Tertiary: Ootsa Lake

FORMATION: Undefined Formation

LITHOLOGY:
Obsidian
Rhyolite
Dacite
Basalt
Sediment/Sedimentary

GEOLOGICAL SETTING
TECTONIC BELT: Intermontane
TERRANE: Overlap Assemblage

COMMENTS: Suspect Terrane overlap.

CAPSULE GEOLOGY
The Anahim Peak perlite showing occurs in an area underlain by Tertiary volcanic rocks of the Ootsa Lake Group and Miocene basalt. The Ootsa Lake Group consists mainly of rhyolite and dacite with minor amounts of basalt and andesite. Eclastic sedimentary rocks also occur within the Group.

Although little information is available on this perlite occurrence, it is assumed that the perlite has formed from obsidian of the Ootsa Lake Group.

BIBLIOGRAPHY
EMPR FIELDWORK 1992, PP. 475-481
GSC AR 1876-1877, P. 78
GSC MAP 1424A; 1202A; 10-1957

DATE CODED: 850724
DATE REVISED: 890127
CODED BY: GSS
REVISED BY: DGB
FIELD CHECK: N

MINFILE NUMBER: 093C 010
**MINFILE NUMBER:** 0930 017

**NAME(S):** LAGOON BAY

**STATUS:** Showing

**NTS MAP:** 093004W

**LATITUDE:** 52° 04' 00" N

**LONGITUDE:** 127° 52' 42" W

**LOCATION ACCURACY:** Within 1 km

**COMMENTS:** Near the southwest corner of King Island.

**COMMODITIES:** Perlite

**MINERALS**

- **SIGNIFICANCE:** Perlite
- **MINERALIZATION AGE:** Unknown

**DEPOSIT CHARACTER**

- **CLASSIFICATION:** Stratiform
- **MINERALIZATION:** Volcanogenic Industrial Min.

**HOST ROCK**

- **DOMINANT HOST ROCK:** Volcanic

**STRATIGRAPHIC AGE GROUP**

- **FORMATION:** Unknown

**LITHOLOGY**

- Glass
- Granodiorite
- Paragneiss
- Andesite
- Volcanic

**HOST ROCK COMMENTS:** Perlite is probably derived from Tertiary Bella Bella Formation volcanics.

**GEOLOGICAL SETTING**

- **TECTONIC BELT:** Coast Crystalline
- **TERRANE:** Plutonic Rocks
- **PHYSIOGRAPHIC AREA:** Fiord Ranges (Northern)

**CAPSULE GEOLOGY**

The region is underlain by the Coast Plutonic Complex, consisting of one to few kinematic quartz diorite to granodiorite batholiths intruded into Paleozoic to Mesozoic metasedimentary and metavolcanic rocks. Younger supracrustal assemblages overlying deformed rocks include the (?) Cretaceous Gambier Group and Tertiary Bella Bella Formation volcanic rocks.

The Lagoon Say perlitic showing occurs in an area mapped as dominantly foliated granodiorite and paragneiss. On the west side of Fisher Channel, west of the showing, is an area underlain by andesitic volcanic rocks of the Bella Bella Formation. While no volcanic rocks have been mapped in the area of the showing, it is likely that Bella Bella volcanics have been deposited here and that the perlite is derived from these rocks.

**BIBLIOGRAPHY**

- EMPR AR 1961-657
- GSC M67 372, p. 26
- GSC MAP 1327A; 1424A
MINFILE NUMBER: 093F 026
NAME(S): UNCHA LAKE
STATUS: Showing
NTS Map: 093F13E
LATITUDE: 53 51.15
LONGITUDE: 125 38.10
LOCATION: Within 1 KM
COMMENTS: North side of Dayezcha Mountain.
COMMODITIES: Perlite
MINERALS
SIGNIFICANT: Perlite
MINERALIZATION AGE: Unknown
DEPOSIT
CLASSIFICATION: Stratiform
CLASSIFICATION: Industrial Min.
DIMENSION: 0023
COMMENTS: Perlite beds are 7.6 to 23 metres thick and dip 10 to 30 degrees south.
HOST ROCK
DOMINANT HOST ROCK: Volcanic
STRATIGRAPHIC AGE
GROUP: Ootsa Lake
FORMATION: Undefined Formation
IGNEOUS/METAMORPHIC/OTHER
LITHOLOGY: Porphyritic Rhyolite
Felsic Volcanic
Epiclastic
GEOLOGICAL SETTING
TECTONIC BELT: Intermontane
TERRANE: Stikine
PHYSIOGRAPHIC AREA: Nechako Plateau
CAPSULE GEOLOGY
The region in which the Uncha Lake showing occurs is within the Intermontane Belt, underlain dominantly by Lower to Middle Jurassic volcanic and sedimentary rocks of the Hazelton Group. These rocks are overlain by the Upper Cretaceous to Lower Tertiary Ootsa Lake Group and Miocene plateau basalt. Intruding Lower Jurassic rocks of the Hazelton Group are composed of granodiorite, diorite, and quartz diorite plutons of the Lower Jurassic Topley intrusive suite. Felsic plutons of probable Cretaceous age intrude both Lower and Middle Jurassic Hazelton strata.

The Ootsa Lake Group of Upper Cretaceous to Lower Tertiary age comprises mainly felsic volcanic rocks and their epiclastic derivatives. The Uncha Lake perlite showing occurs within rhyolite of this group on Dayezcha Mountain. The perlite dips 10 to 30 degrees south and is 7.6 to 23.0 metres thick. The perlite is interbedded with light to dark grey porphyritic rhyolite layers 2.0 to 9.0 metres thick. The perlite is light grey to pale greenish-grey, some perlitic glass occurrences in the area are resinous brown.

BIBLIOGRAPHY
EMPR EXPL 1976-E206; 1977-E253; 1978-E289
EMPR AR #1953-194; 1955-97
EMPR FIELDWORK 1992, pp. 475-481
EMPR PF: (Monthly Report, Smithers Office, Feb. 1979)
GSC MAP 1131A; 1424A
GSC MEM 324, p. 54
GCL #231, 1979
MINFILE NUMBER: 093F 027

NAME(S): CHESLATTA LAKE

STATUS: Showing

ANTS. MAP: 093F11W

LATITUDE: 59° 47' N

LOCATION ACCURACY: Within 1 KM

COMMENTS: Location on Geological Survey of Canada Map 113111.

COMMODITIES: Perlite

MINERALS: Perlite

MINERALIZATION AGE: Unknown

DEPOSIT CHARACTER: Stratabound

CLASSIFICATION: Volcanogenic

INDUSTRIAL MINERAL: Industrial N.

HOST ROCK: Volcanic

DOMINANT HOST ROCK: Volcanic

STRATIGRAPHIC GROUP: Cretaceous-Tertiary

FORMATION: Ootsa Lake

LITHOLOGY: Rhyolite

Felsic Volcanic

Epiclastic

GEOLOGICAL SETTING:

TECTONIC GEL: Intermontane

TERRANE: Stikine

PHYSIOGRAPHIC AREA: Nechako Plateau

CAPSULE GEOLOGY

The region in which the Cheslatta Lake showing occurs is within the Intermontane Belt, underlain dominantly by Lower to Middle Jurassic volcanic and sedimentary rocks of the Hazelton Group. These assemblages are overlain by the Upper Cretaceous to Lower Tertiary Ootsa Lake Group and Miocene plateau basalt. Intruding Lower Jurassic rocks of the Hazelton Group in the northeastern part of the map sheet is a belt of granodiorite, diorite and quartz diorite plutons of the Lower Jurassic Tooley intrusive suite. Felsic plutons of probable Cretaceous age intrude both Lower and Middle Jurassic Hazelton strata.

The Ootsa Lake Group of Upper Cretaceous to Lower Tertiary age comprises mainly felsic volcanic rocks and their epiclastic derivatives. The Cheslatta Lake perlite showing occurs within a rhyolitic sequence of this group.

BIBLIOGRAPHY

EMPR FIELDWORK 1992, p. 475-481
GSC M113; 1424A
GSC MAP 1131A; 1424A

DATE CODED: 850724
DATE REV SED: 890127

CODED BY: GSS
REV SED BY: OGB

FIELD CHECK: N

MINFILE NUMBER: 093F 027
MINFILE NUMBER: 095F 028
NAME(S): Henson Hills, Ootsa Lake

STATUS: Showing
NTS MAP: 095F12E
LATITUDE: 53 36 25
LONGITUDE: 125 39 19
LOCATION ACCURACY: Within 1 km
COMMENTS: Location on Geological Survey of Canada Map 1131A.

COMMODITIES: Perlite

MINERALS
SIGNIFICANT: Perlite
MINERALIZATION AGE: Unknown

DEPOSIT
CHARACTER: Stratigraphic
CLASSIFICATION: Volcanogenic Industrial Min.

HOST ROCK
DOMINANT HOST ROCK: Volcanic

STRATIGRAPHIC AGE
Cretaceous-Tertiary
Ootsa Lake

LITHOLOGY:
Rhyolite
Felsic Volcanic
Epiclastic

GEOLOGICAL SETTING
TECTONIC BELT: Intermontane
TERRANE: Stikine

PHYSIOGRAPHIC AREA: Nechako Plateau

CAPSULE GEOLOGY
The region in which the showing occurs is within the Intermontane Belt, underlain dominantly by Lower to Middle Jurassic volcanic and sedimentary rocks of the Hazelton Group. These assemblages are overlain by the Upper Cretaceous to Lower Tertiary Ootsa Lake Group and Miocene plateau basalt. Intruding Lower Jurassic rocks of the Hazelton Group in the northeastern part of the map sheet is a belt of granodiorite, diorite and quartz diorite plutons of the Lower Jurassic Topiey intrusive suite. Felsic plutons of probable Cretaceous age intrude both Lower and Middle Jurassic Hazelton strata.

The Ootsa Lake Group of Upper Cretaceous to Lower Tertiary age comprises mainly felsic volcanic rocks and their epiclastic derivatives. The Henson Hills perlite showing occurs within a rhyolitic sequence of this group.

BIBLIOGRAPHY
EMPR FIELDWORK 1992, pp. 475-481
GSC MEM 324, p. 54
GSC MAP 1131A; 1424

DATE CODED: 850724
CODED BY: GSB
DATE REVISED: 890127
REVISED BY: DBS

E-14
MINFILE NUMBER: 093K 001

NAME(S): FRANCOIS, MA, LOT 6946

STATUS: Past Producer

NTS MAP: 093K04E

LATITUDE: 54 02 33

LONGITUDE: 125 38 59

ELEVATION: 0792 Metres

LOCATION ACCURACY: Within 500M

COMMENTS: Approximate centre of Lot 6946 (Fieldwork, 1989).

COMMODITIES: Perlite

SIGNIFICANT MINERAL AGE: Tertiary

DEPOSIT

CHARACTER: Massive Industrial

CLASSIFICATION: Volcanogenic

DIMENSION: 15x 2 Metres

COMMENTS: Perlite bed at the quarry.

HOST ROCK

DOMINANT HOST ROCK: Volcanic

STRATIGRAPHIC AGE GROUP: Cretaceous-Tertiary

FORMATION: Ootsa Lake

LITHOLOGY: Rhyolite Tuff

Rhyolite Breccia

Banded Rhyolite

HOST ROCK COMMENTS: The Ootsa Lake Group is Upper Cretaceous to Lower Tertiary in age.

GEOLOGICAL SETTING

TECTONIC BELT: Intermontane

TERRANE: Overlap Assemblage

COMMENTS: Suspect Terrane overlap.

CAPSULE GEOLOGY

Perlite was quarried on the north shore of Francois Lake, 22 kilometres south of the town of Guns Lake. The deposit is underlain mainly by Upper Cretaceous to Lower Tertiary rocks correlated with the Ootsa Lake Group. These comprise shallow to medium dipping, devitrified (in part), banded rhyolites, rhyolite breccias, spherulitic rhyolites and tuffs. This series of rocks has a general strike of 040 degrees and an average dip of 30 degrees to the northwest. The quarry on the Lake shore exposes a 2-metre thick bed of dark grey to black, medium grey weathering perlite over a distance of 15 metres in sharp contact above and below with cherty rhyolite. The bed strikes northeast and dips 15 to 35 degrees northwest. The rock exhibits typical onion-skin texture with radiating fractures perpendicular to strike. In places it is brecciated and siliceous with pronounced flow welding. North of the Lake, 300 metres, a similar perlite bed, 15 metres thick, striking northeast and dipping 30 degrees northwest, 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 bed is underlain by coarse grey tuff. Perlite from both sites expanded a similar amount to that tested at the Frenier deposit (0930 072) when heated by a hand-held propane torch (Fieldwork 1989, p. 483). A sample of perlite tested by CANMET exhibited the following characteristics (Fieldwork 1990, pages 265 to 267):

MINFILE NUMBER: 093K 001
CAPSULE GEOLOGY

Per cent water loss when heated to 800 degrees Celsius: 3.0
Softening temperature (degrees Celsius): 1250-1270

During the period 1949 to 1953 Western Gypsum Products Ltd. of Winnipeg mined approximately 1587 t of perlite.

BIBLIOGRAPHY

EMPR A R 1949-258-261; 1952-261; 1953-194
EMPR EXPL 1978-290; 1979-334
EMPR ASS RPY 7446
GSC MEX 252, pp. 198-199
GSC MAP 631A; 907A; 1424A

DATE CODED: 850724
DATE REVISED: 910329
CODED BY: GSG
REVISED BY: PSF

MINFILE NUMBER: 023K 001

E-16
**MINFILE NUMBER:** 093K 001  
**NAME:** FRANCOIS  
**STATUS:** Past Producer

<table>
<thead>
<tr>
<th>Production Year</th>
<th>Tones Milled</th>
<th>Tones Millied</th>
<th>Commodity</th>
<th>Grams Recovered</th>
<th>Kilograms Recovered</th>
</tr>
</thead>
<tbody>
<tr>
<td>1953</td>
<td>1,587</td>
<td></td>
<td>Perlite</td>
<td></td>
<td>1,587,000</td>
</tr>
</tbody>
</table>

**SUMMARY TOTALS:** 093K 001  
**NAME:** FRANCOIS

<table>
<thead>
<tr>
<th>Metric</th>
<th>Imperial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milled: 1,587</td>
<td>1,749 tons</td>
</tr>
<tr>
<td>tones</td>
<td>tones</td>
</tr>
</tbody>
</table>

**Recovery:**  
**Perlite:** 1,587,000 kilograms 3,498,735 pounds

**Comments:** 1953: For period 1949-1953.
MINFILE NUMBER: 093L 258

NAME(S): TSALIT MOUNTAIN

STATUS: Showing
NTS MAP: 093L03W
LATITUDE: 54°09'30"N
LONGITUDE: 126°56'40"W
ELEVATION: 1035 Metres
ACCURACY: Located 1 km within the northwest slope of Tsalit Mountain, along Fenton Creek.
COMMENTS: Perlite

COMMODITIES: Perlite

MINERALS SIGNIFICANT: Perlite
MINERALIZATION AGE: Unknown

DEPOSIT CHARACTER: Massive
CLASSIFICATION: Volcanogenic Industrial Min.

HOST ROCK DOMINANT HOST ROCK: Volcanic

STRATIGRAPHIC GROUP: Ootsa Lake
AGE: Tertiary
FORMATION: Undefined Formation

LITNOLOGY:
- Rhyolite Flow
- Dacite Flow
- Volcanic Breccia
- Tuff
- Perlite
- Porphyritic Feldspar Trachyte
- Quartz Porphyritic Rhyolite

GEOLOGICAL SETTING:
- TECTONIC BELT: Intermontane
- TERRANE: Stikine
- PHYSIOGRAPHIC AREA: Nechako Plateau

CAPSULE GEOLOGY:

The area is underlain by Tertiary Ootsa Lake Group volcanics comprised mainly of rhyolitic to dacitic flows, tuffs, and breccia. The youngest formation in the area, tentatively named "Fenton Creek volcanic rocks", are found mainly in a 2.4 by 4.0 kilometre laterally elongated zone on the northwest slope of Tsalit Mountain. This unit consists of volcanic breccias, lava, tuff, and dikes which are thought to be post-Miocene in age. In places, especially east of Fenton Creek, this unit is comprised mainly of cream coloured glassy rhyolitic lava (perlite) and breccia. Immediately to the northwest this volcanic complex changes to predominantly feldspar porphyry trachyte and to the south to quartz porphyry rhyolite.

BIBLIOGRAPHY:
- EMRR GEM #1972-373-379,*Fig. 40
- EVRR MAP 69-1
- GSC OF 351
MINFILE NUMBER: 103A 005

NAME(S): PENNY ISLAND

STATUS: Showing
NTS MAP: 103401E
LATITUDE: 52 09 36
LONGITUDE: 128 06 42
LOCATION ACCURACY: Within 1 KM
COMMENTS: Located near Bella Bella.

COMMODITIES: Perlite

MINERALS
SIGNIFICANT: Perlite
MINERALIZATION AGE: Unknown
ISOTOPIC AGE:

DEPOSIT
CHARACTER: Vein
CLASSIFICATION: Magmatic
DIMENSION: Metres
COMMENTS: Dykes strike between 145 and 175 degrees and have near vertical dips.

"O5. ROCK
DOMINANT HOST ROCK: Plutonic

STRATIGRAPHIC AGE
Triassic
Tertiary

FORMATION
Unnamed/Unknown Informal
Unnamed/Unknown Informal

LITHOLOGY: Glass Dike
Intrusive

HOST ROCK
COMMENTS: Amorphous dykes most likely associated with andesitic rocks of the Bella Formation.

GEOLOGICAL SETTING
TECTONIC BELT: Coast Crystalline
TERRANE: Alexander

PHYSIOGRAPHIC AREA: Milbanke Strandflat

CAPSULE GEOLOGY
Black, highly fractured, amorphous glass dykes are part of a group of numerous dykes in the area that cut batholithic rocks. The dykes strike 145 degrees to 175 degrees and have a vertical dip.

BIBLIOGRAPHY
GSC SUM RPT 1921, Part A, p. 27A
GSC M111 372, p. 79
GSC MAP 9-1966; 1328A; 1385A
GSC P 66-25

DATE CVERD: 860414
DATE REVISED: 881125

CODED BY: GRF
REVISED BY: JNR

FIELD CHECK: N
FIELD CHECK: N
MINFILE NUMBER: 103F 019
NAME(S): IRONSIDE MOUNTAIN

COMMODITIES: Perlite, Volcanic Glass

MINERALS: Perlite, Silica
ALTERATION: Pyrite, Argillic
CCWENTS: Gossanous area; alteration minerals are not indicated in text.
ALTERATION TYPE: Argillic, Silicification
MINERALIZATION AGE: Unknown
ISOTOPIC AGE: Unknown

DEPOSIT CHARACTER: Massive, Stratiform
SHAPE: Irregular, Industrial Min.

HOST ROCK DOMINANT HOST ROCK: Volcanic

STRATIGRAPHIC AGE GROUP: Tertiary
FORMATION: Masset
LITHOLOGY: Basaltic Flow, Basaltic Breccia, Rhyolite Flow, Rhyolite

HOST ROCK COMMENTS: Tart Member

TERRANE: Wrangell

PHYSIOGRAPHIC AREA: Queen Charlotte Ranges

CAPSULE GEOLOGY

The area is underlain by a series of Tertiary sub-aerial basaltic flows and breccias and rhyolite ash flows of the Masset Formation, which forms a plateau volcanic sequence up to 5 kilometres thick dipping gently to the east. Perlite occurs as a flowlike mass in rhyolite units of the Tartu Facies. A large gossanous area has zones of argillic alteration, silicification, and pyritization which may reflect the presence of a subvolcanic intrusive. The area was staked in 1986 by City Resources as the Virgo claims and was staked in 1987. No economic mineralization or significant assays were reported (Assessment Report 17053).

BIBLIOGRAPHY

EMPR BULL *54, pp. 115, 175
EMPR EXPL 1979-280, 251; 1980-540
EMPR ASS RPT 17053
GSC P 86-20; 88-1E; 89-1H
GSC MAP 13851

DATE CODED: 860604
DATE REVISED: 890215
CODED BY: LDJ
REVISED BY: G.P
WINFILE NUMBER: 103F 020

NAME(S): COATES CREEK, SEA VIEW

STATUS: Showing

NTS MAP: 103F10W

LATITUDE: 53 42.20

LONGITUDE: 132 47.10

ELEVATION: 0450 Metres

ACCURACY: Within 500M

COMMENTS: Figure 3 (Assessment Report 6926).

COMMODITIES: Perlite, Volcanic Glass

MINERALS

SIGNIFICANT: Perlite

MINERALIZATION AGE: Unknown

ISOTOPIC AGE: Unknown

DEPOSIT

CHARACTER: Stratiform, Massive, Syngeneric

CLASSIFICATION: Volcanogenic, Syngeneric

SHAPE: Regular

DIMENSION: 0400 x 0100 x 0050 Metres

COMMENTS: Southern body.

HOST ROCK

DOMINANT HOST ROCK: Volcanic

STRATIGRAPHIC AGE

GROUP: Tertiary

FORMATION: Masset

LITHOLOGY:

Basaltic Flow

Basaltic Breccia

Rhyolite Flow

Rhyolite

HOST ROCK COMMENTS: Talki Member

GEOLOGICAL SETTING

TECTONIC BELT: Insular

TERRANE: Wrangell

PHYSIOGRAPHIC AREA: Queen Charlotte Ranges

CAPSULE GEOLOGY

The area is underlain by a series of Tertiary sub-aerial basaltic flows and breccias and rhyolite ash flows of the Masset Formation, which form a plateau volcanic sequence up to 5 kilometres thick dipping gently to the east.

Perlite occurs as a flowlike mass in rhyolite units of the Tertiary Facies. The perlite is a "peary" lustered acidic to sub-acidic volcanic glass with a deep blue "serpentinitic" appearance on fresh surface and grey to brown-black on weathered surface.

The perlite forms two possibly unconnected bodies. The southern body strikes north-south for 400 metres and is 100 metres thick and 50 metres wide. The northern body, 250 metres Long, 100 metres wide, and about 100 metres thick, strikes east-west.

BIBLIOGRAPHY

EMPR ASS RPT #6926
EMPR BULL 54, pp. 115, 175
GSC P 86-20; 88-1E; 89-1H
GSC MAP 1285A

DATE CODED: 860604
REVIEWED: 861202

CODED BY: LDJ
REVIEWED BY: JWR

FIELD CHECK: N

MINFILE NUMBER: 103F 020

E-21
MINFILE NUMBER: 103F_021

NAME(S): SKELE SAY

STATUS: Showing
NTS MAP: 103F10W
LATITUDE: 53 32 10
LONGITUDE: 132 51 50
ELEVATION: 0600 Metres

LOCATION ACCURACY: Within 500m

COMMENTS: Figure 34 (Bulletin 54). Located north of Sake Say, Graham Island.

COMMODITIES: Perlite Volcanic Glass

MINERALS SIGNIFICANT: Perlite

MINERALIZATION AGE: Unknown
ISOTOPIC AGE: DATING METHOD: Unknown
MATERIAL DATED:

DEPOSIT CHARACTER: Stratiform Massive Syngenetic Industrial Min.
CLASSIFICATION: Volcanogenic Syngenetic
SHAPE: Irregular

HOST ROCK
DOMINANT HOST ROCK: Volcanic

STRATIGRAPHIC AGE GROUP FORMATION IGNEOUS/METAMORPHIC/OTHER
Tertiary Undefined Group Masset

LITHOLOGY: Basaltic Flow Basaltic Breccia Rhyolite Flow Rhyolite

HOST ROCK COMMENTS: Tartu Member

GEOLOGICAL SETTING TECTONIC BELT: Insular TERRANE: Wrangell

CAPSULE GEOLOGY

The area is underlain by a series of Tertiary sub-aerial basaltic flows and breccias and rhyolite ash flows of the Masset Formation, which form a plateau volcanic sequence up to 5 kilometres thick dipping gently to the north-east. Perlite occurs as a flowlike mass in rhyolite units of the Tartu Facies.

BIBLIOGRAPHY
EMPR BULL 54. pp. 115. 175
GSC P 86-20; 88-1e; 89-1h
GSC MAP 1385A

DATE CODED: 860604 CODED BY: LDJ
DATE REVISED: 881202 REVISED BY: JNR
FIELD CHECK: N

MINFILE NUMBER: 103F_021
MINFILE NUMBER: 103F_022

NAME(S): BLACKWATER PERLITE, BLACKWATER CREEK

STATUS: Showing

NTS MAP: 103F/09W

LATITUDE: 53.3405

LONGITUDE: 132.2150

ELEVATION: 0150 Metres

LOCATION

ACURACY: Within 500m

COMMENTS: Symbol, Figure 34 (Bulletin 54).

COMMODITIES:
Perlite
Volcanic Glass

MINERALS

SIGNIFICANT: Perlite

MINERALIZATION AGE: Unknown

ISOTOPIC AGE: Unknown

MATERIAL DATED:

DEPOSIT

ORIGIN:

Stratiform

CLASSIFICATION:
Volcanogenic

SHAPE:
Irregular

HOST ROCK

DOMINANT HOST ROCK: Volcanic

STRATIGRAPHIC AGE:
Tertiary

GROUP:
Undefined Group

FORMATION:
Masset

LITHOLOGY:
Basaltic Flow
Basaltic Breccia
Rhyolite Flow
Rhyolite

HOST ROCK

COMMENTS: Tartu Member

TECTONIC BELT:
Insular

PHYSIOGRAPHIC AREA:
Queen Charlotte Ranges

CAPSULE GEOLOGY

The area is underlain by a series of Tertiary sub-aerial basaltic flows and breccias and rhyolite ash flows of the Masset Formation, which form a plateau volcanic sequence dipping gently to the north-west. Perlite occurs as a flowlike mass in rhyolite units of the Tartu Facies (Bulletin 54).

The area was staked in 1986 by City Resources as the Linda claims, and was prospected in 1987. No economic mineralization or significant assays were reported (Assessment Report 17083).

BIBLIOGRAPHY

EMPR BULL 854, p. 175
EMPR ASS RPT 17083
GSC P 86-20: 88-1E; 89-1H
GSC MAP 1385A

DATE CODED: 860604
DATE REVISED: 890215
CODED BY: LDJ
REVISED BY: GJP

FIELD CHECK: N
FIELD CHECK: N

MINFILE NUMBER: 103F_022

E-2,3
MINFILE NUMBER: 103F 023

NAME(S): CANOE CREEK

STATUE: Showing

NATIVE: 53°30'30"N

LONGITUDE: 132°15'20"E

ELEVATION: 0150 Metres

LOCATION ACCURACY: Within 500m

COMMENTS: Symbol, Figure 34 and Figure 5, Sheet C (Bulletin 54). Located east of Maria Lake, Graham Island.

COMMODITIES: Perlite Volcanic Glass

MINERALS

SIGNIFICANT: Perlite

MINERALIZATION AGE: Unknown

ISOTOPIC AGE: Unknown

DEPOSIT

CHARACTER: Stratiform

CLASSIFICATION: Volcanogenic

SHAPE: Irregular

HOST ROCK

DOMINANT HOST ROCK: Volcanic

STRATIGRAPHIC AGE

GROUP: Tertiary

FORMATION: Masset

LITHOLOGY: Basaltic Flow Basaltic Breccia Rhyolite Flow Rhyolite

HOST ROCK COMMENTS: Tartu Member

GEOLOGICAL SETTING

TECTONIC BELT: Insular

TERRANE: Wrangell

PHYSIOGRAPHIC AREA: Gwen Charlotte Ranges

CAPSULE GEOLOGY

The area is underlain by a series of Tertiary sub-aerial basaltic flows and breccias and rhyolite ash flows of the Masset Formation, which form a plateau volcanic sequence dipping gently to the north. Perlite occurs as a flow-like mass in rhyolite units of the Tartu Facies.

BIBLIOGRAPHY

EMPR BULL 54, p. 175
EMPR ASS RPT 14540
EMPR EXPL 1985-C364
ssc P 86-20; 88-1E; 89-1H
GSC MAP 1385A

DATE CODED: 860604
DATE REVISED: 8812202

CODED BY: LDJ
REVISED BY: JNR

MINFILE NUMBER: 103F 023

NATIONAL MINERAL INVENTORY: 103F9 Pr12

MINING DIVISION: Skeena

UTM ZONE: 08

NORTHING: 5932109

EASTING: 681996