MAGNESITE AND RELATED OPPORTUNITIES IN BRITISH COLUMBIA, CANADA

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BACKGROUND

Magnesite is an industrial mineral used in the production of calcined, dead and fused magnesia as well as magnesium metal. In 1998, the total world magnesite production was estimated at 18 million tonnes (Coope, 1999). In that year, about 8.7 million tonnes of magnesia were produced from natural magnesite and about 1.8 million tonnes were produced from seawater or brines.

North America is a major importer of magnesia products. In 1991 it brought in more than $US 43 million worth of magnesium oxide in which MgO contents exceeding 94%, $US 12.5 million of other magnesium oxides, and $US 5 million worth of magnesite.

Worldwide, the use of magnesium for automotive part die casting and steel desulphurization continues to expand. Mg-metal production for 1998 was estimated at 452 500 short tonnes. If current trends continue, by the year 2003 more magnesium will be used in die casting than in aluminum alloying (Brown, 1999). Although British Columbia has important magnesite resources (Figure 1) and access to the abundant, competitively priced energy required to transform magnesite into value-added products such as magnesium and magnesia, only the Mount Brussilof deposit is in production.

BRITISH COLUMBIA'S MAGNESITE

More than 70 magnesite occurrences have been reported in British Columbia (Figure 1). Most of the significant deposits are hosted by sedimentary rocks that were deposited in shallow marine environments.

Most of the promising sparry magnesite deposits are hosted by sedimentary rocks of Precambrian to Cambrian age in southeastern British Columbia. The deposits are strata-bound and are associated with palaeobathymetric highs of probable tectonic origin. The Mount Brussilof deposit is hosted by the Cambrian Cathedral Formation, which is composed of shallow-marine platformal carbonates that were deposited along the Cathedral escarpment (bathymetric high). Magnesite deposits of the Brisco-Driftwood Creek and Cranbrook areas follow the palaeobathymetric Windermere high. Those in the Brisco-Driftwood Creek area are hosted by the Precambrian (Helikian) Mount Nelson Formation, and those in the Cranbrook area by the Cambrian Cranbrook Formation. These undeveloped deposits have lower MgO and higher SiO_2 and CaO contents than the Mount Brussilof deposit. However, they share a low FeO content, and some have dimensions of potential economic interest.

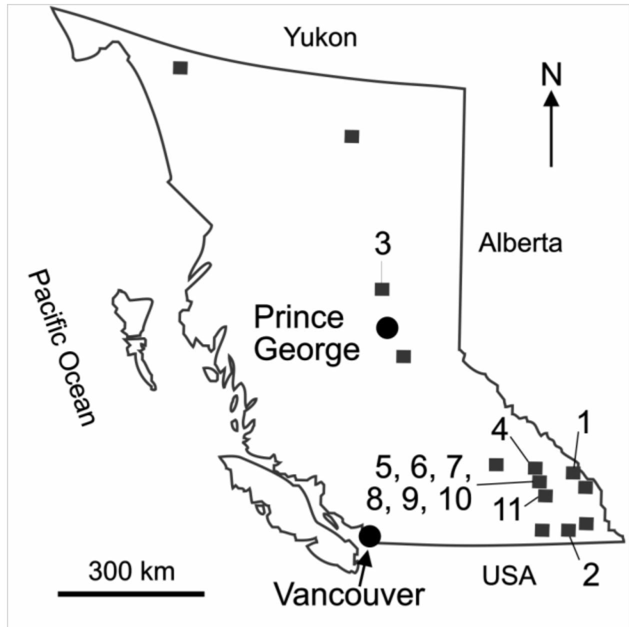

Figure 1. Location of sediment-hosted magnesite deposits in British Columbia. 1-Mount Brussilof (Baymag Mines Co. Ltd.); 2-Marysville; 3- Anzac, 4-Driftwood Creek; 5- Jab; 6-Topaz Lake, 7-Clealand Lake, 8-Bots Lake, 9-Dunbar Creek; 10-Red Mountain, 11-Invermere.

MOUNT BRUSSILOF

Baymag Mines Co. Ltd. owns the world-class Mount Brussilof magnesite deposit. The deposit is located 35 kilometres northeast of Radium Hot Springs. It supplies raw material for high quality caustic and fused magnesia. The ore is so pure that a combination of selective mining and blending precludes the need for upgrading to meet industry specifications (Knuckey, 1998). In 1980, proven and probable geological reserves were 9.5 million tonnes grading over 95% MgO in calcined product, sufficient for a mine life of over 150 years, (Schultes, 1986). Magnesite-bearing strata have been traced for at least 13 kilometres along strike. The Mount Brussilof deposit provides all the present Canadian magnesite production. Baymag Mines Company Ltd. has a capacity of up to 100 000 tonnes per year of high-quality calcined magnesia and 14 000 tonnes per year of fused magnesia. In the past it also supplied magnesite for magnesium metal production.

The deposit is located within the foreland tectonostratigraphic belt and a palaeotopographic high commonly referred to as “Kicking Horse Rim,” east of a Cambrian Cathedral palaeo-escarpment. The rocks east of the escarpment host the magnesite mineralization, and were deposited in a shallower marine environment than their stratigraphic equivalents to the west.

Magnesite ore is coarse, white or light grey in colour and buff when weathered. Textures do vary widely (Simandl and Hancock, 1992). Minor impurities in magnesite ore comprise isolated dolomite crystals, calcite, and dolomite veins and coarse pyrite pyritohedrons or octahedrons. Pyrite stockworks/veins, and subvertical fractures filled by a mixture of beige-coloured ankerite, calcite, chlorite, coarse radiating or single quartz crystals are separated from ore by selective mining.

Replacement features include coarse, white carbonate crystals oriented perpendicular to fracture planes or partings, and lenses of fine-grained dolomite enclosed by sparry carbonates. Bipolar growths of zoned magnesite crystals, magnesite pinolite, rosettes and coarse carbonate crystals with lozenge-shaped cross-sections are also interpreted as diagenetic or metasomatic replacement textures.

OTHER SPARRY MAGNESITE DEPOSITS

The Marysville deposit, which was originally owned by Cominco Ltd., was acquired subsequently by Stralak Resources Inc., and optioned recently to a private exploration company based in The Bahamas. The deposit is located 16 kilometres northwest of Cranbrook and extends for at least 8 kilometres along strike; maximum thickness is estimated at 24 metres. Between 1938 and 1961 the deposit was investigated by trenching, test pitting, underground testing, diamond drilling and geological mapping. The magnesite horizon is within the Cambrian Cranbrook Formation, which consists mainly of quartzites (Hancock and Simandl, 1992).

The Anzac deposit is located 122 kilometres north-northeast of Prince George, in the Misinchinka Ranges of the Rocky Mountains. The magnesite showing is within the Lower Cambrian Gog Group. The property was staked and mapped by MineQuest Exploration Associates Ltd. for Norsk Hydro in 1986. Six magnesite outcrops are located along a strike length of 5 kilometres with apparent thicknesses ranging from 3 to 11 metres (Hancock and Simandl, 1993).

The Brisco-Driftwood Creek deposit is within the Mount Nelson Formation, which was traditionally assigned to the Purcell Supergroup of Middle Proterozoic age. However, it is possible that this formation correlates with the Windermere Supergroup of Late Proterozoic or Early Cambrian age. Magnesite crops out sporadically along a strike length of 5 kilometres. The sparry carbonate zone has a maximum apparent thickness of 175 metres. The deposit was initially explored by Canadian Occidental Petroleum Ltd. (Simandl and Hancock, 1992). The claims lapsed, and the deposit is now owned by three British Columbia prospectors.

The Jab, Red Mountain, Topaz Lake, Cleland Lake, Dunbar Creek, Invermere, Hellroaring Creek and Botts Lake magnesite occurrences are less well known. They are believed to be on the same stratigraphic horizon as the Brisco-Driftwood Creek deposit. Most of them are covered by a thin layer of overburden and their size is not well constrained (Simandl and Hancock, 1992). Magnesium-rich portions of the deposits are almost entirely magnesite with minor concentrations of pyrite, iron oxides, dolomite, calcite, chert, chlorite and mica (Simandl and Hancock, 1996).

GEOCHEMISTRY

Major oxide analyses were carried out on magnesite-bearing rocks from Mount Brussilof, Anzac, Driftwood Creek, Jab, Marysville, Topaz, Cleland Lake and Botts Lake deposits (Figure 2). Although the chemical compositions of samples from these deposits is similar to those from the Mount Brussilof deposit, Mount Brussilof samples generally have higher MgO and lower iron and silica contents. In some cases, this could be due to weathering processes. All deposits appear to have median CaO contents comparable to those from Mount Brussilof; the major impurities are SiO_2 and CaO. The sparry magnesite samples are characterized by low FeO, MnO, Al_2O_3, TiO_2, K_2O and Na_2O contents (Figure 2). The total iron content (reported as FeO) decreases with increasing MgO content of the rocks from limestone to magnesite. Magnesite-bearing rocks from the Mount Brussilof deposit average 18 ppm boron, results from the other deposits are even lower.

SUMMARY

Ore from the Mount Brussilof deposit is selectively mined then blended. It does not require any further upgrading to produce high quality calcined and fused magnesia. Other sparry magnesite deposits in British Columbia have slightly lower MgO grades, and slightly higher SiO_2 contents than Mount Brussilof. However, iron and manganese concentrations in the magnesite crystal lattices

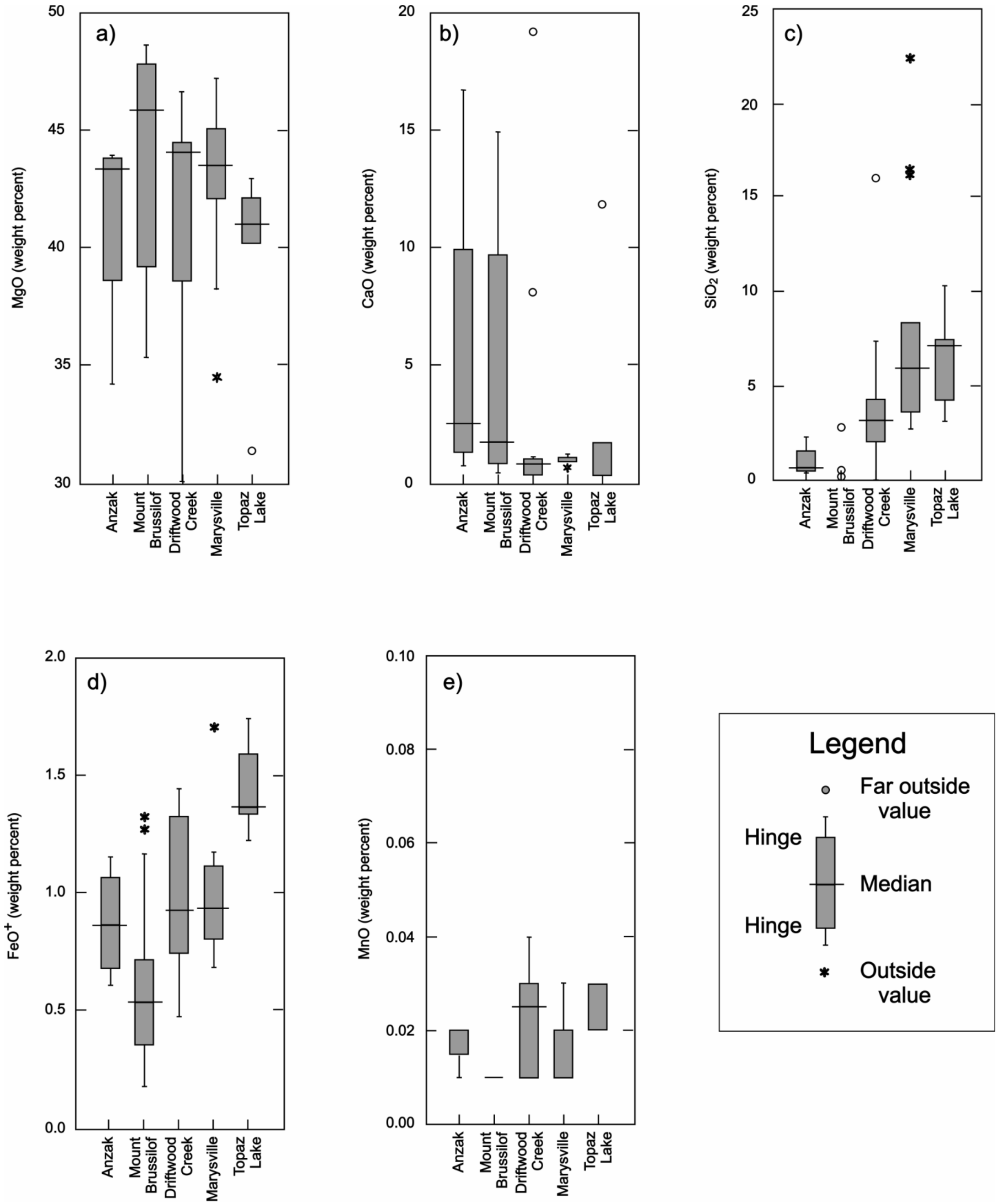

Figure 2. Composition of magnesite-bearing samples form selected magnesite deposits in British Columbia (total iron reported as FeO) Modified from Simandl (2002).

in these deposits are very low, a positive feature. As well, the boron content of these rocks is low. Most of the deposits are coarsely crystalline, so conventional processing methods could probably remove mineral impurities and produce high-purity product. There may be no benefaction required to produce magnesium metal, electrical-grade fused magnesia, or magnesia products for environmental and agricultural applications. The overall characteristics of magnesite-rich rocks from British Columbia compare favorably with those of ores from European sparry magnesite deposits.

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