

HYDROMAGNESITE IN BRITISH COLUMBIA, CANADA

By George J. Simandl, British Columbia Ministry of Energy and Mines, Victoria BC, Canada
and McGill University, Montréal, Québec, Canada,
Jana Simandl, McGill University, Montréal, Québec, Canada,
Melissa Rotella, Mike Fournier, and Alicia Debrecini, British Columbia Ministry of Energy
and Mines, Victoria BC, Canada

INTRODUCTION

Hydromagnesite occurrences in British Columbia have been recognized since the beginning of the 19th century (Reinecke, 1920; Young, 1915). However, the known occurrences of hydromagnesite lack the size to compete with the large sparry magnesite deposits in British Columbia (Grant, 1987; Simandl *et al.*, 1996) as potential sources of raw materials for the production of industrial grade caustic, dead-burned and fused magnesia, or magnesium metal.

In British Columbia, exploration and/or re-evaluation of known hydromagnesite occurrences may result in discovery of deposits with potential as sources for natural flame retardants. Rapid growth of the inorganic natural flame retardant market and close collaboration with existing users with captive markets are needed to successfully explore and exploit these resources (Simandl, *et al.*, 2000).

FLAME RETARDANTS

Flame retardants are materials incorporated or applied to products, including plastics and textiles, to increase their resistance to fire. According to the Danish Environmental Protection Agency, at least 350 substances are used as flame retardants.

In the mid 1990s, 70% of the flame retardants consumed in the United States were inorganic. Aluminum hydroxide (ATH), accounted for more than 50% of the total. More recent data indicates that each year flame retardant markets in the United States and Europe consume 344 800 and 339 900 tonnes, respectively (Weber, 2000).

The flame retardant efficiency of ATH, magnesium hydroxide ($Mg(OH)_2$), and similar materials, like hydromagnesite and huntite, is based largely on their endothermic decomposition into an oxide and water. The released water vapor isolates flames and dilutes flammable gases. Magnesium-based compounds are relatively new in the flame retardant market. ATH, which becomes unstable above 200°C, is only applicable to polymer systems compounded and processed at low

temperatures, such as production of polyvinyl chloride, ethylene vinyl acetate copolymer, and polyethylene. In contrast, $Mg(OH)_2$ is stable up to 340°C, so it can be applied during production of polypropylene, nylons and thermoplastic polyesters such as polyethylene terephthalate, polyamide and polybutylene terephthalate. In addition to mined and processed brucite, $Mg(OH)_2$ can be extracted from brines or sea water, or can be manufactured synthetically from magnesite and other Mg-rich minerals, such as serpentinite. The market for $Mg(OH)_2$ is estimated at 10 000 to 15 000 tonnes for Europe and the United States combined. The price for synthetic $Mg(OH)_2$ is generally US\$1800 to 2700 /tonne.

There is no published market data for milled natural huntite-hydromagnesite ore used as a flame retardant, but it is expected to be much lower than that for $Mg(OH)_2$.

HYDROMAGNESITE / HUNTITE

There are a number of hydromagnesite ($Mg_4(OH)_2(CO_3)_3 \cdot 3H_2O$) and huntite ($Mg_3Ca(CO_3)_4$) occurrences worldwide. The major impurities in these deposits are magnesite, aragonite, calcite and dolomite. Only a few of these occurrences are exploited for their flame retarding properties.

Ore from the Serbia basin of Kozani provides a well documented example. Georgiades *et al.* (1996) report that it consists of a mixture of huntite and hydromagnesite with very low iron content ($Fe_2O_3 < 0.03\%$), high whiteness (~95%) relative to chemically produced MgO), the ore contains less than 8% total impurities (aragonite, calcite, magnesite, and other materials).

An average mineralogical composition, based on XRD and chemical analysis data of current ores is as follows: huntite (46%), hydromagnesite (46%), magnesite (4%), aragonite (3%), calcite (1%). A typical chemical analysis of the ore is MgO (38.0%), CaO (9.5%), H_2O (9.1%), CO_2 (43.4%) and LOI (52.5%).

In the Serbia basin of Kozani, beds with known ratios of huntite/hydromagnesite are selectively mined and blended to obtain a marketable product of constant composition and quality. Primary processing consists of

crushing to less than 10 millimetres and drying to less than 1% moisture. Final processing consists of de-agglomeration and air classification to obtain desirable particle shape and particle size distribution. Depending on the specifications of the final product, additional drying and surface treatment may be required (Georgiades *et al.*, 1996).

The typical end product from this locality has a huntite/hydromagnesite ratio of 1:1 and 50% of the particles are between 0.5 and 0.7 microns in diameter. Material with high huntite content is ground finer, with 50% between 0.3 and 0.4 microns. Generally, 97% of particles in both products are below 5 microns and the TAPPI brightness is over 95% (Georgiades *et al.*, 1996). The stability of the product is intermediate between that of $Mg(OH)_2$ and ATH.

HYDROMAGNESITE IN BRITISH COLUMBIA

Grant (1987) reviewed earlier reports by Reinecke

(1920) and Cummings (1940) that documented hydromagnesite occurrences in British Columbia. The early reports considered the deposits chiefly as a potential source of magnesia because the flame retardant market did not exist at that time. Renault and Stead (1991) described the geological setting and sedimentation within Cariboo area playas and saline lakes where deposits of this type are found. This study indicates that hydromagnesite-magnesite in these environments can be found: 1) as major constituents in carbonate playa basins where they precipitated subaqueously or in zones of shallow groundwater discharge; 2) in mudflats surrounding closed perennial lakes; and 3) in marshy valley-bottoms and in saline mudflats of ephemeral lake complexes. In the latter environment they occur in peripheral mudflats or near spring water discharges.

Although the detailed genesis of hydromagnesite-magnesite accumulations in British Columbia is beyond the scope of the present study, the reader is invited to consult Renault and Stead (1991) and Calvo *et al.* (1995) for more information. Huntite was first reported in British Columbia deposits in the early 1990s (Renault, 1993).

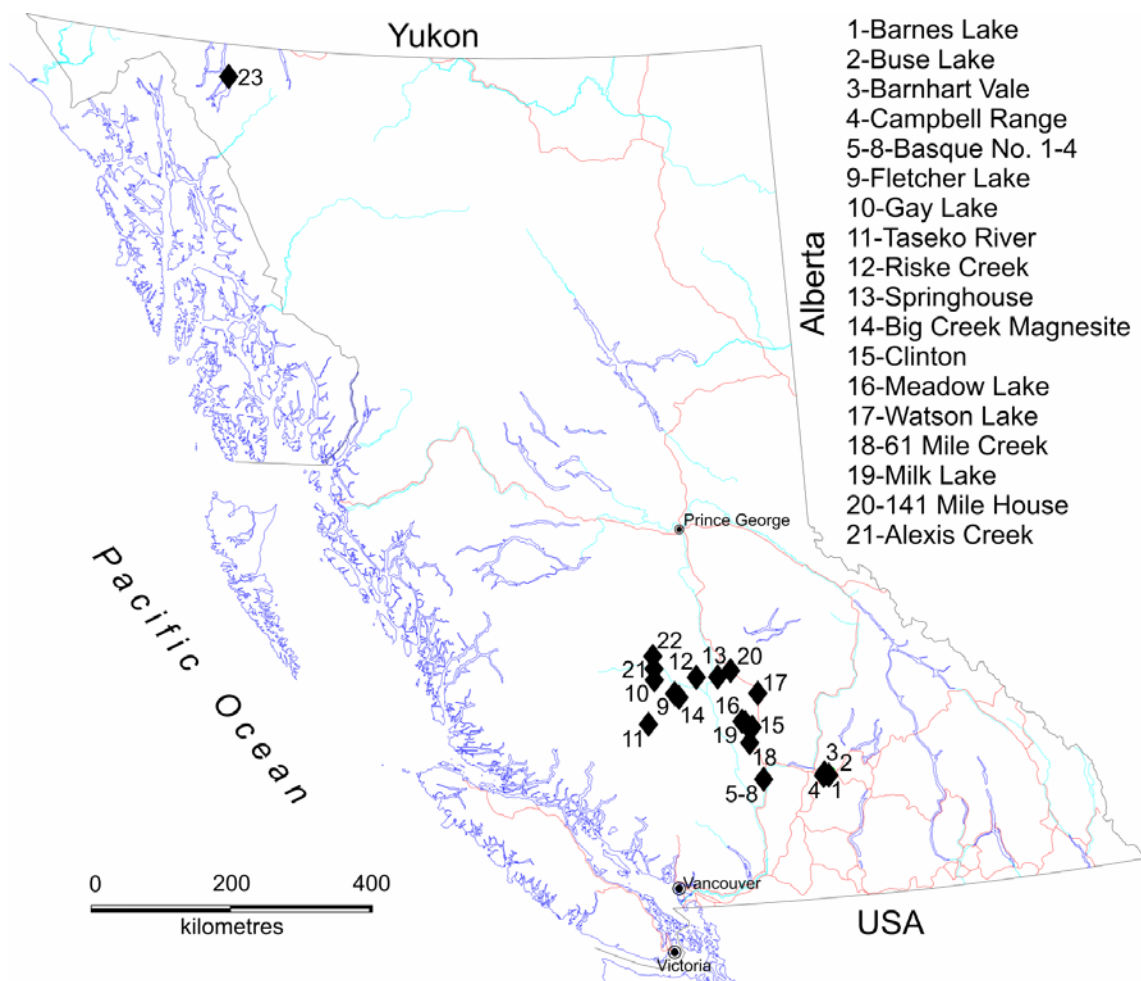


Figure 1. Hydromagnesite Occurrences in British Columbia.

The early reports that attempted to characterize hydromagnesite deposits in British Columbia predated discovery of huntite by Faust (1953).

All known British Columbia hydromagnesite occurrences reported in the Minfile website (www.em.gov.bc.ca/Mining/Geolsurv/Minfile/default.htm) are listed in Table 1 and located on Figure 1. Information about thickness, mineralogy, continuity and the extent of the British Columbia hydromagnesite occurrences is incomplete. In many cases loss on ignition data [H₂O+ analyses], which are an essential factor in estimating hydromagnesite and huntite content, are not available. In most reports, a description of the analytical method is not given and no scanning electron or modern X-Ray diffraction data was available.

TABLE 1. HYDROMAGNESITE OCCURRENCES IN BRITISH COLUMBIA . FOR DETAILS, PLEASE CONSULT THE MINFILE WEBSITE

<http://www.em.gov.bc.ca/Mining/Geolsurv/Minfile/default.htm>

OCCURRENCE	MINFILE NUMBER
61 MILE CREEK	092P 078
BARNHART VALE	092INE049
BUSE LAKE	092INE048
CAMPBELL RANGE	092INE050
SPRINGHOUSE	092O 088
141 MILE HOUSE	093A 156
ATLIN	104N 079
BIG CREEK MAGNESITE	092O 089
CLINTON	092P 072
MEADOW LAKE	092P 074
RISKE CREEK	092O 087
WATSON LAKE	092P 077
ALEXIS CREEK (L.561)	093B 041
ALEXIS LAKE (L.2833)	093B 056
BARNES LAKE	082LNW082
BASQUE NO. 1, 2, 3 and 4	092INW043, 44, 45 and 46
FLETCHER LAKE	092O 084
GAY LAKE	092O 085
MILK LAKE	092P 173
TASEKO RIVER	092O 086

SUMMARY

If current upward trends in the application of flame retardants continue, the improved market potential for hydromagnesite products may justify reassessment of selected known occurrences and exploration for new deposits. British Columbia hydromagnesite deposits do represent primary exploration targets for producers with a captive flame retardant market.

REFERENCES

- Calvo, J.P., Stamatakis, M.G., Magganas, A.C. (1995): Clastic Huntite in Upper Neogene Formations of the Kozani Basin, Macedonia, northern Greece; *Journal of Sedimentary Research*, Volume A65 Number 4, October, pages 627-632.
- Cummings, J.M. (1940): Saline and hydromagnesite deposits of British Columbia; *British Columbia Ministry of Energy, Mines and Petroleum Resources*, Bulletin 4, pages 29, 30, 40-55, 60-62, 101-129.
- Faust, G. T. (1953): Huntite, Mg₃Ca(CO₃)₄, a new mineral; *American Mineralogist.*, Volume 38, page 4.
- Georgiades, G.N., Larsson, B.J. and Pust, C. (1996): Huntite-hydromagnesite production & applications; *12th Industrial Minerals International Congress*, pages 57-60.
- Grant, B. (1987): Magnesite, brucite and hydromagnesite occurrences in British Columbia; *British Columbia Ministry of Energy, Mines and Petroleum Resources*, Open File 1987-13, pages 54-67.
- Reinecke, L. (1920): Mineral deposits between Lillooet and Prince George, British Columbia; *Geological Survey of Canada*, Memoir 118, pages 3, 20-49.
- Renault, R.W. (1993): Morphology, distribution, and preservation potential of microbial mats in the hydromagnesite-magnesite playas of the Cariboo Plateau, British Columbia, Canada; *Hydrobiologia*, Volume 267, pages 75-98.
- Renault, R.W. and Stead, D. (1991): Recent magnesite-hydromagnesite sedimentation in playa basins of the Cariboo Plateau, British Columbia (92P); *British Columbia Ministry of Energy, Mines and Petroleum Resources*, Geological Fieldwork 1990, Paper 1991-1, pages 279-288.
- Simandl, G.J. and Hancock K.D. (1996): Magnesite in British Columbia, Canada: a neglected resource; *Minerals Industry International*, Number 1030, pages 33-44.
- Simandl, G., Simandl, J. and Debreceni, A. (2001): Hydromagnesite-magnesite resources: potential flame retardant material; *British Columbia Ministry of Energy and Mines*, Geological Fieldwork 2000, pages 327-336.
- Weber, M. (2000): Mineral flame retardants - Overview & future trends; *Industrial Minerals*, No. 389, pages 19-27.
- Young, G.A. (1915): Hydromagnesite deposits of Atlin, British Columbia; *Geological Survey of Canada*, Summary Report 1915, pages 50-61.

