

Hydromagnesite in British Columbia, Canada

George J. Simandl¹, Jana Simandl², Melissa Rotella¹, Mike Fournier¹, and Alicia Debrecini¹

¹British Columbia Ministry of Energy and Mines, Victoria BC

²McGill University, Montreal Quebec

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 are too small to compete with the large sparry magnesite deposits in British Columbia (Grant, 1987 and 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 BC, exploration and/or re-evaluation of known hydromagnesite occurrences may result in the discovery of deposits with potential as a source of natural flame retardants. Rapid growth of the inorganic, natural flame retardant market or participation of the developer with the existing captive market are essential for the successful development of these resources.

FLAME RETARDANTS - BACKGROUND

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

In the mid 1990s inorganic flame retardants comprised about 70% of the consumption in the USA. Aluminium hydroxide (ATH), accounted for more than 50% of the total demand. More recent data indicates that flame retardant markets in the USA and Europe account for 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 endothermic decomposition into an oxide and water content. The released water vapor isolates flames and dilutes flammable gases. Magnesium-based compounds are relatively new in the flame retardant market. ATH, which has a low stability field of 200°C, is only applicable to polymer systems compounded and processed at low temperatures such as polyvinyl chloride, ethylene vinyl acetate copolymer, polyethylene. Due to the higher stability of $Mg(OH)_2$ of up to 340°C it can be applied in 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 via specific synthetic routes 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 the Europe and USA combined. The price for synthetic $Mg(OH)_2$ is estimated at 1800 to 2700 US\$/tonne.

There is no published market data for 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.

The ore from the Serbia basin of Kozani is probably the best documented example. It consists of a mixture of huntite-hydromagnesite with very low iron contents ($Fe_2O_3 < 0.03\%$), high whiteness (~95% in comparison with chemically produced MgO) and total impurities (aragonite, calcite, magnesite, etc.) less than 8% (Georgiades *et al.*, 1996).

An average mineralogical composition, established by a combination of XRD and chemical analyses, of current ores is as follows: huntite (46%), hydromagnesite (46%), magnesite (4%), aragonite (3%), calcite (1%). Typical chemical analysis of the ores consist of MgO (38.0%), CaO (9.5%), H_2O (9.1%), CO_2 (43.4%) and LOI (52.5%).

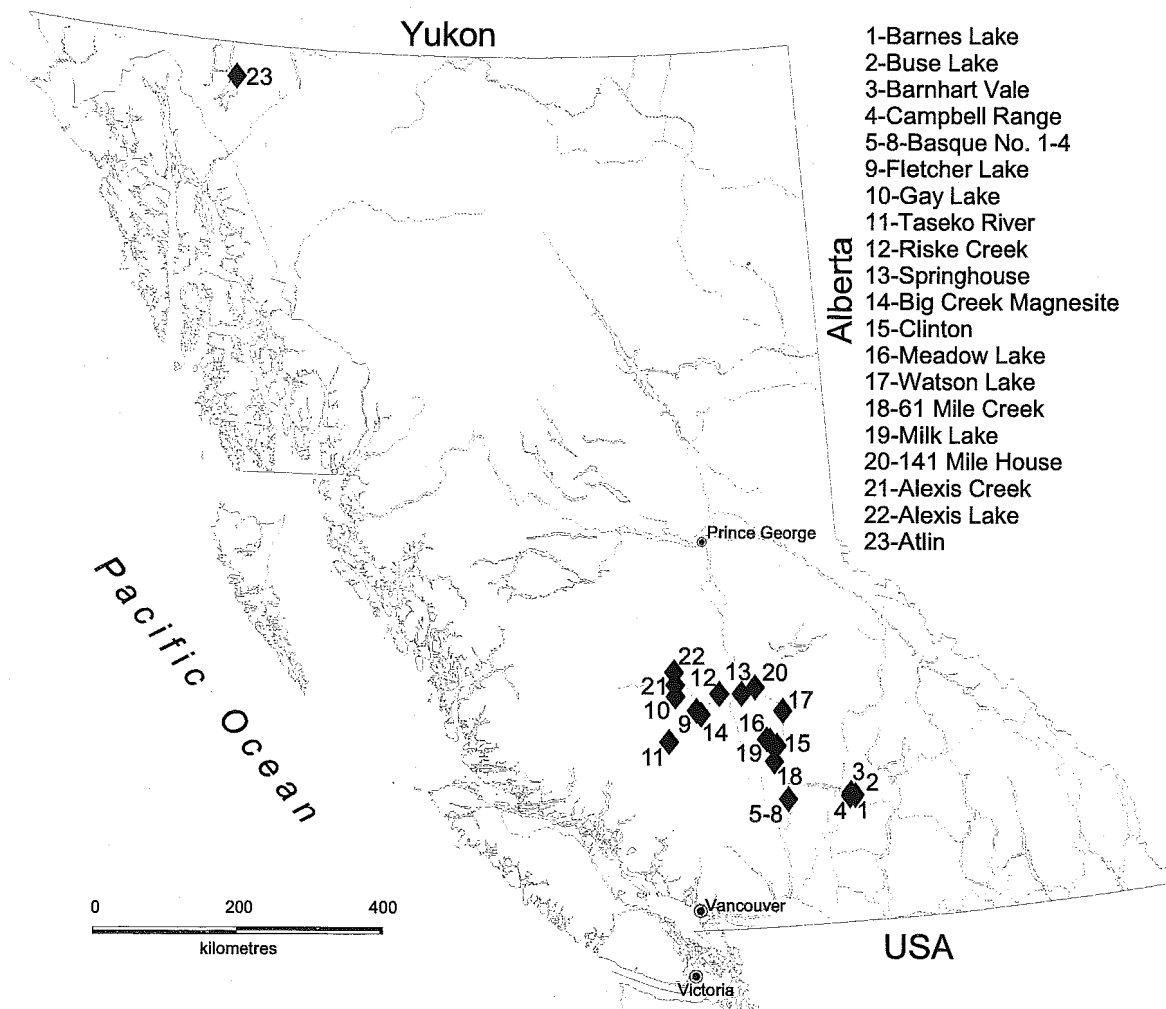


Figure 1. Hydromagnesite Occurrences in BC.

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 10mm 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 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, d_{50} 0.5-0.7 microns. Where d_{50} indicates that 50% of the particles are between 0.5 and 0.7 microns in diameter. The high huntite material has d_{50} 0.3-0.4 microns. The d_{97} of both products is below 5 microns (Sedigraph 5000D) and 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

The hydromagnesite occurrences in BC were documented by Reinecke (1920); Cummings (1940) and reviewed by Grant (1987). They were considered chiefly as a potential source of magnesia as the flame retardant market did not exist at that time. The geological setting and sedimentation within Cariboo area playas and saline lakes is described by Renault and Stead (1991). The latter study suggests that hydromagnesite-magnesite in these environments are 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; 3) in marshy valley-bot-

TABLE 1
HYDROMAGNESITE OCCURRENCES IN BC WITH CORRESPONDING MINFILE NUMBER
 Please consult (<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

toms and in saline mudflats of ephemeral lake complexes. In the latter environment they occur in peripheral mudflats or near spring water discharges. The detailed genesis of hydromagnesite-magnesite accumulations in British Columbia is beyond the scope of the present study and the reader is invited to consult Renault and Stead (1991) and Calvo *et al.* (1995). Huntite was not reported in British Columbia deposits prior to the early 1990's (Renault, 1993), since most of the attempts to characterize hydromagnesite deposits in British Columbia predate the first description of huntite by Faust (1953).

All known British Columbia hydromagnesite occurrences reported in Minfile (<http://www.em.gov.bc.ca/Mining/Geolsurv/Minfile/default.htm>) are listed in Table 1 and located in Figure 1. Sufficient information about thickness, mineralogy, continuity or the extent of the British Columbia hydromagnesite occurrences is lacking. In many cases H₂O+ analyses, which are an essential factor in estimating hydromagnesite and huntite content, were not available. In most cases, the description of the analytical method was not given and no scanning electron or modern X-Ray diffraction data was available.

SUMMARY

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

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