



SPARRY MAGNESITE

E09

by G.J. Simandl and K. Hancock

IDENTIFICATION



SYNONYMS: Veitsch-type, carbonate-hosted magnesite, crystalline magnesite.

COMMODITY: Magnesite.

EXAMPLES (British Columbia (MINFILE) - *Canada/International*): Mount Brussilof (082JNW001), Marysville (082GNW005), Brisco area and Driftwood Creek (082KNE068); *Veitsch, Entachen Alm, Hochfilzen, Radenthein and Breitenau (Austria), Eugui (Navarra Province, Spain), deposits of Ashan area, Liaoning Province (China), Satka deposit (Russia).*

GEOLOGICAL CHARACTERISTICS

CAPSULE DESCRIPTION: Stratabound and typically stratiform, lens-shaped zones of coarse-grained magnesite mainly occurring in carbonates but also observed in sandstones or other clastic sediments. Magnesite exhibits characteristic sparry texture.

TECTONIC SETTING: Typically continental margin or marine platform, possibly continental settings, occur in belts.

DEPOSITIONAL ENVIRONMENT / GEOLOGICAL SETTING: The host sediments are deposited in a shallow marine environment adjacent to paleobathymetric highs or a lacustrine evaporitic environment.

AGE OF MINERALIZATION: Proterozoic or Paleozoic.

HOST/ASSOCIATED ROCK TYPES: Magnesite rock, dolostone, limestones, shales, chert. Associated with sandstone, conglomerate and volcanics and their metamorphic equivalents.

DEPOSIT FORM: Commonly strata, lenses or rarely irregular masses, typically few hundred metres to several kilometres in strike length. Shortest dimension of the orebody (metres to tens of metres) is commonly normal to the bedding planes.

TEXTURE/STRUCTURE: The magnesite-bearing rocks exhibit sparry, pinolitic, zebra-like, or xenotopic (anhedral) textures on the fresh surface. Magnesite or dolomite pseudomorphs after sulphates. "Box-textures", rosettes, monopolar and antipolar growths are locally present.

ORE MINERALOGY: Magnesite.

GANGUE MINERALOGY (Principal and *subordinate*): Dolomite \pm quartz \pm chert \pm talc \pm chlorite \pm sulphides \pm sulphosalts, \pm calcite, \pm mica, \pm palygorskite, \pm aragonite, \pm clay (as veinlets), organic material. In highly metamorphosed terrains, metamorphic minerals derived from above precursors will be present.

ALTERATION MINERALOGY: Talc may form on quartz-magnesite boundaries due to low temperature metamorphism.

WEATHERING: Surface exposures are typically beige or pale brown and characterized by "granola-like" appearance. Most sulphides are altered into oxides in near surface environment.

ORE CONTROLS: Deposits are stratabound, commonly associated with unconformities. They are typically located in basins characterized by shallow marine depositional environments. Lenses may be located at various stratigraphic levels within magnesite-hosting formation.

SPARRY MAGNESITE

E09

GENETIC MODELS: There are two preferred theories regarding the origin of sparry magnesite deposits:

- 1) Replacement of dolomitized, permeable carbonates by magnesite due to interaction with a metasomatic fluid.
- 2) Diagenetic recrystallization of a magnesia-rich protolith deposited as chemical sediments in marine or lacustrine settings. The sediments would have consisted of fine-grained magnesite, hydromagnesite, huntite or other low temperature magnesia-bearing minerals. The main difference between these hypotheses is the source of magnesia; external for metasomatic replacement and in situ in the case of diagenetic recrystallization. Temperatures of homogenization of fluid inclusions constrain the temperature of magnesite formation or recrystallization to 110 to 240°C. In British Columbia the diagenetic recrystallization theory may best explain the stratigraphic association with gypsum and halite casts, correlation with paleotopographic highs and unconformities, and shallow marine depositional features of the deposits. A number of recent cryptocrystalline sedimentary magnesite deposits, such as Salda Lake in Turkey and the Kunwarara deposit in Queensland, Australia, huntite-magnesite-hydromagnesite deposits of Kozani Basin, Northern Greece, and the magnesite- or hydromagnesite-bearing evaporitic occurrences from Sebkh el Melah in Tunisia may be recent analogs to the pre-diagenetic protoliths for British Columbia sparry magnesite deposits.

ASSOCIATED DEPOSIT TYPES: Sediment-hosted talc deposits (E08) and Mississippi Valley-type deposits (E12) are geographically, but not genetically, associated with sparry magnesite in British Columbia. The magnesite appears older than cross-cutting sparry dolomite that is commonly associated with MVT deposits.

COMMENTS: Magnesite deposits can survive even in high grade metamorphic environments because of their nearly monomineralic nature.

EXPLORATION GUIDES

GEOCHEMICAL SIGNATURE: Tracing of magnesite boulders and blocks with pinolitic texture. Magnesite grains in stream sediments.

GEOPHYSICAL SIGNATURE: N/A.

OTHER EXPLORATION GUIDES: Surface exposures are beige, pale brown or pale gray. White fine-grained marker horizons are useful in southwest British Columbia. "Granola-like" weathering texture is a useful prospecting indicator. Magnesite may be identified in the field using heavy-liquids. In British Columbia the deposits are often associated with unconformities, paleotopographic highs within particular stratigraphic horizons.

ECONOMIC FACTORS

TYPICAL GRADE AND TONNAGE: Grades range from 90 to 95% MgCO₃ with the resources ranging from several to hundreds of million tonnes. British Columbia deposits are characterized by lower iron content than most of the European deposits.

ECONOMIC LIMITATIONS: There is large but very competitive market for magnesia-based products. China is the largest exporter of magnesite. Quality of primary raw materials, cost of energy, cost of transportation to markets, availability of existing infrastructure, and the quality of finished product are major factors achieving a successful operation.

END USES: Magnesite is used to produce magnesium metal and caustic, dead-burned and fused magnesia. Caustic magnesia, and derived tertiary products are used in chemical and industrial applications, construction, animal foodstuffs and environmental rehabilitation. Fused and dead-burned magnesia are used in high-performance refractories. Magnesium metal has wide range of end uses, mostly in the aerospace and automotive industries. The automotive market for magnesium metal is expected to expand rapidly with current efforts to reduce the weight of vehicles to improve fuel economy and reduce harmful emissions.

SPARRY MAGNESITE

E09

IMPORTANCE: Sparry magnesite deposits account for 80% of the world production. Significant quantities of magnesite are also produced from ultramafic-hosted deposits and fine grained or nodular deposits.

SELECTED BIBLIOGRAPHY

ACKNOWLEDGEMENTS: The manuscript benefited from discussion with I. Knuckey and C. Pilarski of Baymag Mines Co. Ltd. Review by D.V. Lefebure is appreciated.

- Chevalier, P. (1995): Magnesium; in 1994 Canadian Mineral Yearbook, *Natural Resources Canada*, pages 29.1-29.13.
- Grant, B. (1987): Magnesite, Brucite and Hydromagnesite Occurrences in British Columbia; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Open File 1987-13, 80 pages.
- Hancock, K.D. and Simandl, G.J. (1992). Geology of the Marysville Magnesite Deposit, Southeastern British Columbia; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Exploration in British Columbia, Part B, pages 71-80.
- Harben, P.W. and Bates, R.L. 1990. Industrial Minerals, Geology and World Deposits. Industrial Minerals Division, *Metal Bulletin PLC*, London, 312 pages.
- Kendall, T. (1996): Dead-burned Magnesite, *Industrial Minerals*, Number 341, pages 25-51.
- Möller, P. (1989): Magnesite; Monograph Series on Mineral Deposits, Number 28, *Gebrüder Borntraeger*, pages 105-113.
- Morteani, G. (1989): Mg-metasomatic Type Sparry Magnesites of Entachen Alm, Hochfilzen/Bürglkopf and Spiessnagel (Austria); in Magnesite; Monograph Series on Mineral Deposits, Number 28, *Gebrüder Borntraeger*, 300 pages.
- Niashihara, H. (1956): Origin of bedded Magnesite Deposits of Manchuria; *Economic Geology*, Volume 51, pages 25-53.
- O'Driscoll, M. (1994): Caustic Magnesia Markets; *Industrial Minerals*, Volume 20, pages 23-45.
- O'Driscoll, M. (1996): Fused Magnesia; *Industrial Minerals*, Number 340, pages 19-27.
- Simandl, G.J. and Hancock K.D. (1996): Magnesite in British Columbia, Canada: A Neglected Resource; *Mineral Industry International*, Number 1030, pages 33-44.
- Simandl, G.J., Simandl, J., Hancock, K.D. and Duncan, L. (1996): Magnesite deposits in B.C. - Economic Potential; *Industrial Minerals*, Number 343, pages 125-132.
- Simandl, G.J., Hancock, K.D., Paradis, S. and Simandl, J. (1993). Field identification of Magnesite-bearing rocks Using Sodium Polytungstate; *CIM Bulletin*, Volume 966, pages 68-72.
- Simandl, G.J. and Hancock, K.D., 1992. Geology of the Dolomite-hosted Magnesite Deposits of Brisco and Driftwood Creek areas, British Columbia; in: Fieldwork 1991, *B.C. Ministry of Mines and Petroleum Resources*, Paper 1992-1, pages 461-478.

Draft #4a December 15, 1997

