



## SEDIMENTARY-HOSTED, STRATIFORM BARITE E17

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### IDENTIFICATION

SYNONYM: Bedded barite.

COMMODITIES (*BYPRODUCTS*): Barite (possibly Zn, Pb, ± Ag).

EXAMPLES (British Columbia (MINFILE #)- *Canada/International*): Kwadacha (094F020), Gin (094F017), Gnome (094F02E); *Tea, Tyrala, Hess, Walt and Cathy (Yukon, Canada), Walton (Nova Scotia, Canada), Fancy Hill (Arkansas, USA), Mountain Springs, Greystone (Nevada, USA), Jixi and Liulin (China), Fig Tree and Mabiligwe (South Africa).*

### GEOLOGICAL CHARACTERISTICS

CAPSULE DESCRIPTION: Sedimentary-hosted, stratiform or lens-shaped barite bodies, that may reach over ten metres in thickness and several kilometres in strike length. Barite-rich rocks (baritites) are commonly lateral distal equivalents of shale-hosted Pb-Zn (SEDEX) deposits. Some barite deposits are not associated with shale-hosted Zn-Pb deposits.

TECTONIC SETTINGS: Intracratonic or continental margin-type fault-controlled marine basins or half-grabens of second or third order and peripheral foreland (distal to the continental margin) basins.

DEPOSITIONAL ENVIRONMENT / GEOLOGICAL SETTING: Deep, starved marine basins to shallow water shelves. The barite-rich rocks (baritites) were deposited on the seafloor and commonly grade laterally into either shale-hosted Pb-Zn (SEDEX) deposits which formed closer to the submarine hydrothermal vents, or the more distal cherts, hematite-chert iron formations, silica and manganese-enriched sediments.

AGE OF MINERALIZATION: Deposits are hosted by rocks of Archean to Mesozoic ages but are most common in rocks of Phanerozoic, especially in the mid to late Paleozoic age.

HOST/ASSOCIATED ROCK TYPES: Major rock types hosting barite are carbonaceous and siliceous shales, siltstones, cherts, argillites, turbidites, sandstones, dolomites and limestones.

DEPOSIT FORM: Stratiform or lens-shaped deposits are commonly metres thick, but their thickness may exceed 50 metres. Their lateral extent may be over several square kilometres.

TEXTURE/STRUCTURE: The barite ore is commonly laminated, layered or massive. Barite may form rosettes, randomly oriented laths or nodules. Some of the barite deposits display breccias and slump structures. In metamorphosed areas, barite may be remobilized (forming veinlets) and/or recrystallized.

ORE MINERALOGY [Principal and *subordinate*]: Barite.

GANGUE MINERALOGY [Principal and *subordinate*]: Quartz, clay, organic material, celsian, hyalophane, cymrite, barytocalcite, calcite, dolomite, pyrite, *marcasite, sphalerite, galena, and in some cases witherite.*

ALTERATION MINERALOGY: None in most cases. Secondary barite veining. Weak to moderate sericitization reported in, or near, some deposits in Nevada.

WEATHERING: Barite-rich exposures sometimes create vegetation "kill zones".

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**ORE CONTROLS:** Sedimentary depositional environment is mainly half-grabens and basins of second or third order. While Zn-Pb-barite (SEDEX) deposits may require euxinic environment to stabilize sulphides, more oxidized depositional environment may be the key for deposition of high-grade (nearly sulphide-free) barite deposits. Syndepositional faults are extremely important for SEDEX deposits that are commonly proximal to the vents, but may not be essential for all sediment-hosted stratabound barite deposits.

**GENETIC MODEL:** Some stratiform barite deposits form from hydrothermal fluids that exhaled on the seafloor and precipitated barite and other minerals (sulphides, chert, etc.) as chemical sediments. The chemical sediments change composition with distance from the vent reflecting changes in temperature and other parameters of the hydrothermal fluid as it mixed with seawater. Barite-rich sediments can reflect hydrothermal fluids deficient in metals (lack of base metals in the source rock or insufficient temperature or unfavorable physical-chemical fluid conditions to carry base metals) or discharge of hydrothermal fluids in a shallow marine environment that does not favor precipitation of sulphides. Some of the sedimentary-hosted barite deposits are interpreted as chemical sediments related to inversion of stratified basin resulting in oxygenation of reduced waters. Others formed by erosion and reworking of sub-economic chemical sediments (Heinrichs and Reimer, 1977) or of semi-consolidated clays containing barite concretions (Reimer, 1986), resulting in selective concentration of barite.

**ASSOCIATED DEPOSIT TYPES:** Shale-hosted Zn-Pb deposits (E14), Irish-type massive sulphide deposits (E13), sedimentary manganese deposits (F01) and vein barite deposits (I10). In oxygen-starved basins, barite deposits may be stratigraphically associated with black shales enriched in phosphates (F08), vanadium, REE and uranium mineralization and possibly shale-hosted Ni-Mo-PGE (E16) deposits.

**COMMENTS:** There is a complete spectrum from sulphide-rich to barite-rich SEDEX deposits. The Cirque deposit in British Columbia, represents the middle of this spectrum and consists of interlaminated barite, sphalerite, galena and pyrite. Its reserves are in excess of 38.5 million tonnes averaging 8% Zn, 2.2% Pb, 47.2 g/tonne of Ag and 45-50% barite. Witherite, a barium carbonate, occurs as an accessory mineral in some barite deposits and rarely forms a deposit on its own. There has been no commercial witherite production in the western world since the mines in Northumberland, England closed. Recently, the Chengkou and Ziyang witherite deposits have been discovered in China (Wang and Chu, 1994). Witherite deposits may form due to severe depletion of seawater in  $\text{SO}_4^{2-}$  and enrichment in Ba (Maynard and Okita, 1991). Alternatively, these deposits could have formed by high temperature replacement of barite by witherite (Turner and Goodfellow, 1990).

### EXPLORATION GUIDES

**GEOCHEMICAL SIGNATURE:** Barium enrichment on the scale of the basin and other indicators of shale-hosted Zn-Pb deposits, such as high values of Zn, Pb, Mn, Cu and Sr, in rock and stream sediment samples. Strongly anomalous Ba values in stream sediments and heavy sediments are only found in close proximity to barite mineralization because barite abrades rapidly during stream sediment transportation. The difference between  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios of barite and coeval seawater may be used to distinguish between cratonic rift (potentially SEDEX-related) barite occurrences and those of peripheral foreland basins (Maynard *et al.*, 1995).

**GEOPHYSICAL SIGNATURE:** Deposit may correspond to a gravity-high.

**OTHER EXPLORATION GUIDES:** Appropriate tectonic and depositional setting. Proximity to known occurrences of barite, shale-hosted SEDEX or Irish-type massive sulphide occurrences, exhalative chert, hematite-chert iron formations and regional Mn marker beds. Vegetation "kill zones" coincide with some barite occurrences.

### ECONOMIC FACTORS

**TYPICAL GRADE AND TONNAGE:** Deposits range from less than 1 to more than 25 million tonnes grading 30% to over 95% barite with a median size of 1.24 million tonnes containing 87.7 %  $\text{BaSO}_4$  (Orris, 1992). Portions of some deposits may be direct shipping ore. The Magcobar mine in the Silvermines district of Ireland produced 4.6 Mt of 85%  $\text{BaSO}_4$  lump. Barite is produced at some metal mines, including the Ramelsburg and Meggen (8.9 Mt) mines in Germany.

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**ECONOMIC LIMITATIONS:** Several modern applications require high brightness and whiteness values and high-purity products. There are different requirements for specific applications. Abrasivity, grade of concentrate, color, whiteness, density and type of impurities, oil index, water index, refractive index and base metal content are commonly reported for commercially available concentrates. Transportation cost, specific gravity and content of water-soluble alkaline earth metals, iron oxides and sulphides are important factors for barite used in drilling applications. Currently sulphide-free barite deposits are preferred by the barite producers. Some of the barite on the market is sold without complex upgrading. Selective mining and/or hand sorting, jigging, flotation and bleaching are commonly required. It is possible that in the future, due to technological progress, a substantial portion of barite on the market will originate as by-product of metal mining.

**END USES:** Barite is used mainly in drill muds, also as heavy aggregate, marine ballast, a source of chemicals, a component in ceramics, steel hardening, glass, fluxes, papers, specialized plastics and radiation shields, in sound proofing and in friction and pharmaceutical applications. Witherite is a desirable source of barium chemicals because it is soluble in acid, but it is not suitable for applications where inertness in acid environments is important.

**IMPORTANCE:** Competes for market with vein-type barite deposits. Celestite, ilmenite, iron oxides can replace barite in specific drilling applications. However the impact of these substitutes is minimized by relatively low barite prices.

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Draft #3a      December 16, 1997