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Industrial Mineral Report No. 10

# BARITE IN ONTARIO

By

G. R. GUILLET

1963

ONTARIO
DEPARTMENT OF MINES

Hon. G. C. Wardrope, *Minister* D. P. Douglass, *Deputy Minister*

M. E. Hurst, *Director, Geological Branch*

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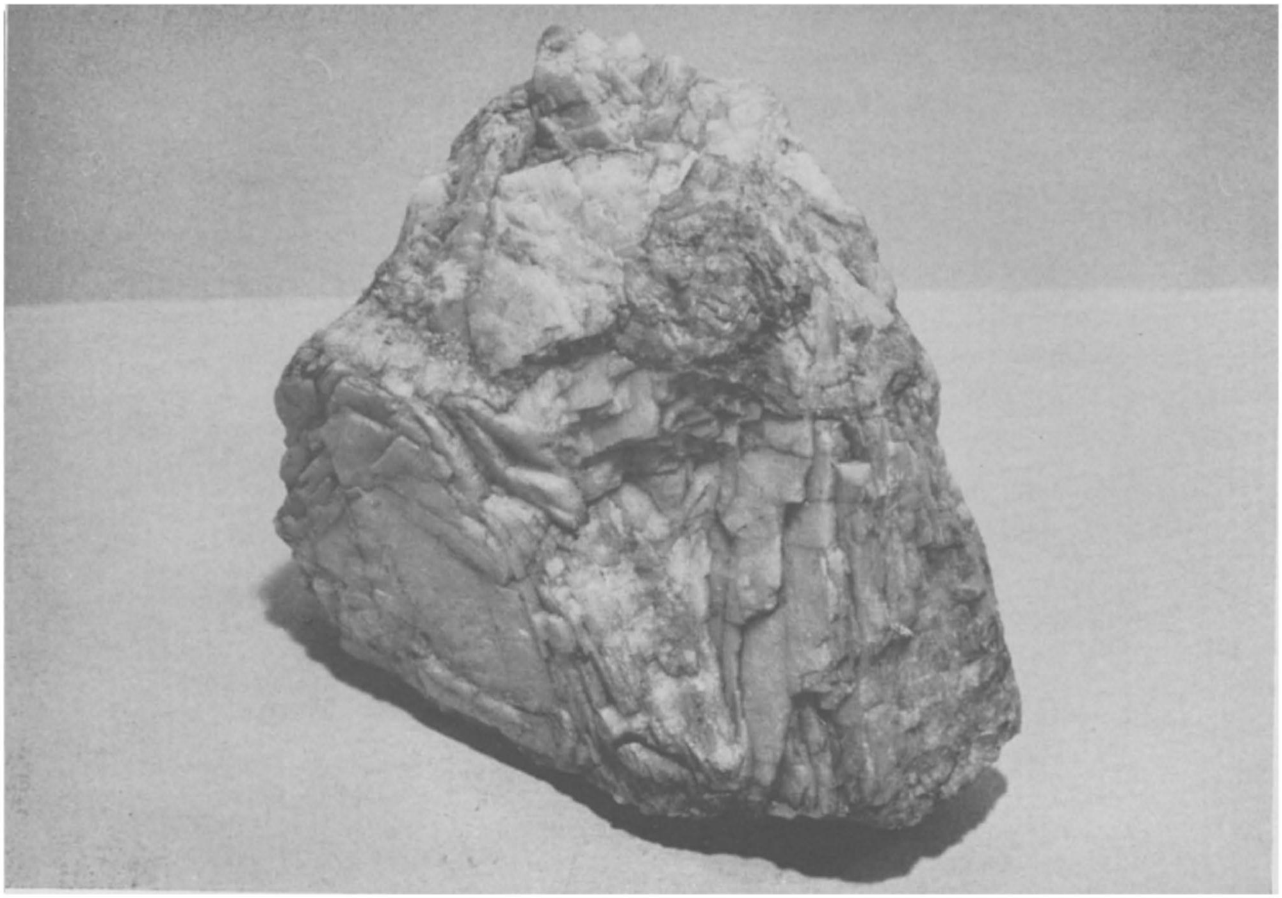


Coarse platy barite from McKellar Island, Lake Superior.
Specimen is approximately ⅔ natural size.

# BARITE IN ONTARIO

*BY*

**G. R. GUILLET[1]**

## INTRODUCTION

Barite has not been mined in Ontario since 1948. The total production in the province is recorded at less than 10,000 tons. Although Canada ranks in the top five among world barite producers, its position is due to a single operation in Nova Scotia. Canadian production is dependent on the requirements of the oil-well drilling industry in the United States, but because of their size and location, Ontario's deposits cannot compete in this market. The development of domestic markets in the glass, chemical, and filler industries, where whiteness and high purity is of consequence, is the key to a barite industry in this province.

Barite deposits in Ontario are found in three widely separated areas: the Lake Superior region near Port Arthur–Fort William; the Timmins–Matachewan area in northeastern Ontario; and, southeastern Ontario north of Kingston. All are vein deposits of rather limited extent, but some are of high purity.

## ACKNOWLEDGMENTS

In the preparation of this report the author has made extensive use of reports by J. S. Ross (1960) and H. S. Spence (1922); he wishes to acknowledge his indebtedness to these authors. Thanks are also due E. G. Pye, Resident Geologist, Ontario Department of Mines, Port Arthur, and R. M. Ginn, formerly Resident Geologist, Ontario Department of Mines, Timmins, for their assistance in the Lake Superior and Timmins areas respectively.

[1]Geologist, Ontario Department of Mines.

## COMPOSITION AND PROPERTIES

Barite, $BaSO_4$, has also been called "barytes" and "heavy spar." It is found in platy crystals or fine-grained compact masses, and is white or light shades of grey, brown, and pink. Aggregates of thin platy crystals in parallel orientation often form botryoidal masses or cockscomb structures sometimes referred to as "crested barytes." Fine-grained compact varieties may have the appearance of massive gypsum. The pure mineral is 65.7 percent barium oxide and 34.3 percent sulphur trioxide. It is relatively insoluble in water and acid. Barite crystallizes in the orthorhombic system and has three good cleavages. Having a specific gravity of 4.5, it is unusually heavy for a non-metallic mineral; its weight is its most distinctive feature and most important industrial property. Hardness varies from 2.5 to 3.5, and commercial ores are known as "hard" or "soft" depending on the ease with which they are ground. Barite is clean, non-toxic, and relatively inexpensive.

## USES AND SPECIFICATIONS

### Drilling-Mud Additive

Finely-ground barite that is held in suspension by a colloidal clay gives a drilling-mud of a sufficient specific gravity to contain most oil and gas pressures encountered in oil-well drilling. All deep rotary drilling requires a circulating fluid to cool the bit and remove the cuttings from the hole. When a bentonite clay is added to water, a suspension is formed that tends to seal-off weak porous horizons and give a smooth strong wall to the hole. Barite assists in floating away the lighter rock fragments at the bit-face, and the increased weight of the mud column tends to control the high gas pressures that sometimes cause dangerous and costly blow-outs. Increasing viscosity of the mud imposes a practical limit of about 50 percent (by volume) on the amount of barite that can be added. Thus apparent specific gravities for the mud solution are possible up to about 2.5.

Specifications for drilling-mud additive are not rigid and are usually determined by mutual agreement between producer and consumer. The important considerations are specific gravity, particle-size, and content of soluble salts. The minimum specific gravity of the barite product is usually set at 4.2, but shipments as low as 4.0 have been accepted. Drilling-mud grades are all finer than 200-mesh and commonly are at least 90 percent minus-325-mesh. Because the presence of soluble salts (particularly sodium chloride and various calcium salts) will cause undersirable flocculation of the mud, these salts cannot be tolerated in more than trace amounts. The common impurities such as silica, clay, calcium carbonate, strontium sulphate, iron, lead, and zinc, are not harmful in small amounts except to the extent that they may tend to reduce the overall specific gravity of the product. A minimum content of 94 percent barium sulphate is generally necessary to meet the specific gravity requirements.

### Filler

Ground barite is used as an extender in both oil-base and water-base paints. Advantages claimed are low oil-absorption, a dense non-porous texture, and neutral colouring. Its only shortcoming is a low index of refraction, resulting in less hiding power than is desirable. It is used as a filler in inks, oilcloth, linoleum, rubber, and paper. Ground barite that is discoloured by iron stains may require bleaching with sulphuric acid for higher-quality uses. Barite is also used as a white pigment in paints, and for "dry colour" on which various coloured pigments are precipitated. Superior grades of paint, and most papers, require *blanc fixe*, a uniformly fine-grained and artificially precipitated barium sulphate (*see* Chemical and Related Products).

The most important specifications for barite fillers are colour and particle-size. Barite, for higher-grade uses, must possess a good natural whiteness or must be easily bleached to a high degree of whiteness; however, a substantial market exists also for light-coloured (off-white) products where weight and particle-size are the main considerations. All filler grades are finer than 200-mesh, and most are minus-325-mesh. The required content of barite varies with the different grades. Most uses require a product that analyzes at least 90 percent $BaSO_4$, but lower-grade products have been used. The better grades for paint are required to contain a minimum of 94 percent $BaSO_4$. The ASTM (American Society for Testing Materials) specification D602-42 for barium sulphate pigments is as follows:

| | Barytes | *Blanc Fixe* |
|---|---|---|
| Barium sulphate, minimum percent | 94 | 97 |
| Ferric oxide, maximum percent | 0.05 | 0.02 |
| Free silica (quartz, clays, other foreign materials) maximum percent | 2.0 | 2.0 |
| Moisture and volatile matter, maximum percent | 0.5 | 0.5 |
| Water-soluble matter, maximum percent | 0.2 | 0.2 |
| pH, minimum | 3.5 | 3.5 |
| Plus-325-mesh, maximum percent | 0.5 | 0.5 |

## Chemical and Related Products

A variety of barium chemicals is used in industry. Because barite is insoluble, the first step in the production of barium chemicals is its conversion to a soluble form. This may be accomplished in several ways, the most important of which is the reduction of the natural sulphate (barite) to the soluble sulphide form known as "black ash". Lump barite is roasted with carbon in a rotary kiln at 2,400°F., and the black ash that is produced is leached in water. The resulting barium sulphide solution is filtered to remove excess carbon and impurities, and is then ready for conversion to the desired barium compound.

The requirements for barite in the chemical industry specify a minimum of 94 percent $BaSO_4$. Barium, present as barium carbonate, cannot be included in the 94 percent because it will not convert to black ash. Both calcium sulphate and iron inhibit the reduction of barite to black ash and, therefore, are undesirable. In the case of iron, a limit of 1 percent as $Fe_2O_3$ is sometimes specified. Because of its high fluxing action in the black ash kiln, fluorine cannot be tolerated in more than trace amounts. Commercial practice requires the barite kiln feed to be sized in the range of 4- to 20-mesh.

#### BLANC FIXE

*Blanc fixe*, a chemically pure barium sulphate, is precipitated from the black ash solution by the addition of sodium sulphate. It can also be produced directly by dissolving barite in concentrated sulphuric acid and diluting the solution with water. Barite is soluble in the concentrated acid but is relatively insoluble in dilute sulphuric; dilution of the concentrated solution causes the precipitation of pure barium sulphate. *Blanc fixe* is used as a filler where higher purity is required. It can act as a base or extender in oil paints and as a pigment in water paints. For use as a paper-filler it is often sold wet, dispersed in a pulp containing 20–30 percent water.

#### LITHOPONE

Lithopone is an intimate mixture of barium sulphate and zinc sulphide. It is formed by adding a solution of zinc sulphate to the black ash solution, resulting in the co-precipitation of the two salts in the approximate proportion of 70 percent barium sulphate, 30 percent zinc sulphide. Lithopone, which at one time was the principal white pigment used in paints, has been largely supplanted by titanium dioxide pigments. The titanium pigments, although they are more expensive, have three times the hiding power of lithopone.

#### BARIUM CARBONATE

Barium carbonate is precipitated from the black ash solution by adding either soda ash (sodium carbonate) or carbon dioxide gas. It is used mainly in the brick industry; it reacts with the soluble salts in clays to form less soluble ones, thereby preventing the formation of scum and efflorescence on the brick. In the manufacture of both crown and flint glasses, it can be added to the batch to increase the lustre and improve the ringing tone of the glass. Minor uses are found in enamels, as a constituent of the salt bath for carburizing iron and steel, and in the purification of water and brines through the removal of calcium, magnesium, and sulphate ions.

#### BARIUM CHLORIDE

Barium chloride is commonly prepared by treating barium carbonate with hydrochloric acid. In common with other soluble barium compounds, it can be used for control of efflorescence and scum on brick and other ceramic products, for carburizing steel, and removing sulphate ions from water. It is used also in the manufacture of barium metal, as a mordant in textiles, and in the preparation of white kid leathers.

#### BARIUM OXIDE

Barium oxide is prepared by heating barium carbonate with carbon to about 2,500°C. It can be used in glass to increase the refractive index (and thus the lustre), density, and elasticity, but it has little advantage over a glass-grade of natural barite. Its principal use is in the manufacture of barium metal and barium hydroxide.

#### BARIUM METAL

Barium metal is produced either by electrolyzing molten barium chloride, or by reducing barium oxide with aluminium powder under partial vacuum in a heated retort. The latter method is used by Dominion Magnesium Limited to produce several hundred pounds of the metal each year. Its high rate of electron emission under the stimulation of an electric potential makes it useful for special functions in the electronics industry.

#### OTHER BARIUM CHEMICALS

Barium hydroxide can be used for control of efflorescence and scum in brick manufacture, and in the process for the recovery of sugar from sugar-beets. Barium nitrate can be used as a source of BaO for enamel frits, and in the manufacture of detonators and green signal flares. Barium titanate, in crystal form or in special ceramic bodies, has unusual properties that are finding application in electronic and ultrasonic equipment.

### Glass and Ceramic Whitewares

Barite is a useful constituent of the glass batch for a number of reasons. The addition of a small amount of barite increases the workability of the batch, assists decoloration, and increases the brilliance of the glass. It can also be used to flux the froth that tends to form on the surface of the melt in the glass tank. Barite has also been shown (Russell, Valencia, and Emrich, 1956, p.73) to have promise in the manufacture of semivitreous and nonvitreous whiteware; barite bodies exhibit maturing ranges 3 to 11 times greater than those of conventional bodies.

Specifications for glass-grade barite call for a minimum of 98 percent $BaSO_4$. Maximum allowances for the principal impurities are: silica 1.5 percent, alumina 0.15 percent, and iron (as $Fe_2O_3$) 0.15 percent. Most consumers specify a particle-size within the range of 40- to 140-mesh, the coarser sizes being preferred only in the fluxing of surface froth. Whiteware bodies require a 325-mesh product.

### Heavy Aggregate

Because of its density, lump barite that is used as an aggregate in concrete is an effective shielding against atomic radiation. Ross (1960, p. 22) also reports that an "asphalt mixture containing ground barite and rubber has recently been developed for roads, aircraft runways, roofing paints, papers, sidings, and undercoatings." It is claimed to provide a more flexible seal-coat (i.e. subject to less cracking), thus promoting longer life. Barite is an excellent heavy aggregate for many purposes where its cost can be justified. Barite for aggregate need not be of high purity, but any impurities in it should not be those that effect the soundness of the finished product, nor should they be present in sufficient amount to greatly reduce the bulk density of the aggregate. Most uses as aggregate will require lump- or gravel-sizes.

## MODE OF OCCURRENCE

Barite occurs in vein, replacement, and residual deposits; it is deposited from solutions of hydrothermal or meteoric origin. The most important deposits are those formed by replacement of sedimentary rocks, and the leading sources in both United States and Canada are deposits of this type. Deposits derived from the weathering of barite-bearing rocks are second in importance in United States. Vein deposits are widespread, and all Ontario occurrences are of this type.

### Vein Deposits

Barite may be the principal vein mineral in both simple and composite veins. Most composite veins are composed of alternating or successive layers of several minerals. Calcite, quartz, and fluorite are the most commonly associated minerals. Barite is also a common gangue mineral in lead-zinc-silver veins. Barite veins often include fragments or "horses" of country rock and in highly-sheared areas may be represented by a stockwork of barite stringers. Veins are typically narrow, irregular, tabular bodies with variable compositions, but some may be very high-grade. Texturally, they are coarse to massively crystallized, some banded, some vuggy, and comb structure is common along the walls. In rare cases, coarse barite tabulae are imbedded in a dense, fine-grained, barite groundmass.

Barite veins show no chemical preference for host-rock type, but will have maximum development in the brittle or more competent rocks of a given area. They are true fissure-filling bodies with sharp clean walls, and only rarely do they show minor features of replacement. They are usually steeply dipping, and often cut the host-rock parallel to a principal direction of jointing. Barite veins in Ontario commonly do not exceed a width of 10 feet and a length of several hundred feet, but in one case (McKellar Island, Lake Superior) a barite-calcite vein attains a width of 60 feet. Vein deposits are widespread in western United States and many of the higher-grade and more accessible ones have been mined. Ontario's barite deposits are all veins of limited extent but some are of high purity.

### Replacement Deposits

Replacement deposits of barite are large irregular bodies formed by the replacement of a permeable rock zone by barium sulphate solutions. If the replacement is complete, a comparatively massive high-grade body, such as the body at Walton, Nova Scotia, may result. A "bedded-replacement" body results from the selective replacement of certain favourable beds, the intervening layers being only partly replaced. Replacement deposits are rarely as pure or white as vein deposits, but they are commonly larger and more uniform. Sedimentary rocks of Paleozoic age are the most common host-rocks.

The large high-grade orebody at Walton, Nova Scotia, is an irregular lens in Mississippian limestone. A lead-zinc-copper sulphide body is associated with it, at depth, on the footwall side. Both orebodies were deposited from low-temperature hydrothermal solutions in post-Triassic time. A large low-grade bedded-replacement body in Arkansas occupies the nose of a plunging syncline of Mississippian shale. The barium sulphate solutions are attributed to the neighbouring Magnet Cove alkaline complex of Cretaceous age. The deposit extends about ¾ mile along each limb. The productive zone is 30–50 feet thick, but individual beds vary in thickness up to 3 feet, with low-grade material intervening. Replacement deposits have also been exploited in Nevada and California. None is known in Ontario, but there is little reason why they should not exist, especially in the Paleozoic rocks of southern Ontario where barite veins are widespread.

### Residual Deposits

Residual deposits consist of barite fragments in a layer of soil or clay resulting from the weathering of barite-bearing rocks. The barite is derived from veins or replacement bodies in soft sedimentary host-rocks. The resistance of barite to chemical decomposition is an important factor in its preservation. Barite fragments from sand-size to boulder-size are usually rudely concentrated in a zone overlying the barite source.

Residual deposits in Missouri are among the more important barite sources in United States. Fragments of white crystalline barite constitute 10 percent of a residual clay blanket up to 30 feet thick, overlying narrow barite veins in dolomite. Barite is also produced from residual deposits in Georgia, Tennessee, and South Carolina. Residual deposits of economic size are unlikely to be found in Ontario, because of either the scouring action of recent glaciation or a general lack of residual weathering in pre-glacial time.

# BARITE OCCURRENCES IN THE LAKE SUPERIOR REGION

Barite is a common gangue material, with calcite and quartz, in the silver-bearing veins of the District of Thunder Bay. Many such veins are known in a belt, 25 miles wide and 150 miles long, that follows the general line of the Lake Superior shore from Nipigon Bay to the international boundary. Some have been successfully worked for silver; at least one has been a barite producer, and several (Tanton 1931, pp. 89, 145) have produced crushed calcite for plaster, stucco, and chicken-grit.

The McKellar Island vein is a potential source of good-quality barite; it is described on pages 8–11. The following section also contains descriptions of veins on the neighbouring islands of Jarvis and Spar, and an occurrence on the mainland in O'Connor township. The many other veins in which barite is present to a greater or lesser degree are described by Tanton (1931, pp. 88–194).

## Summary List

Those properties in which barite is the principal vein-material are included in the accompanying summary. Figure 1 shows the location of the more important barite occurrences. The property numbers in the figure correspond to those in the Summary List and in the descriptions following it.

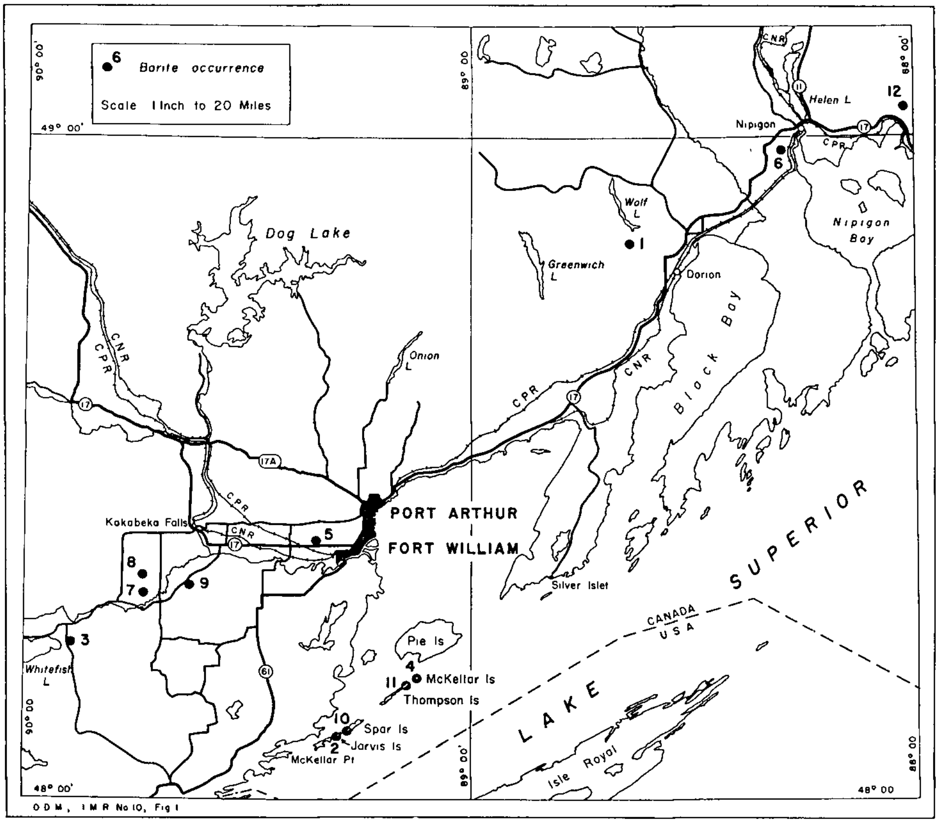



Figure 1—Lake Superior region, barite occurrences.
The numbers correspond to those in the text.

# SUMMARY LIST OF BARITE OCCURRENCES IN THE LAKE SUPERIOR REGION

| No. on Figure 1 | Location | Owners or Operators, and Production | Remarks | References (in order of importance) |
|---|---|---|---|---|
| 1 | Glen twp., south-central part. | Dorion Lead and Zinc Mines Ltd. (pre-1907)—prospect.<br>Thunder Bay Lead and Zinc Mining Co. (1927). | Veins of barite to 1½ ft. thick and 250 ft. long in a fracture zone cutting Sibley sedimentary rocks and granite. | Tanton 1931, p. 180. |
| 2 | Jarvis Island; in Lake Superior, 24 miles south of Port Arthur. | T. Macfarlane (1868–70).<br>Ontario Mineral Lands Co. (1870–71).<br>Unnamed English interests (1871–88)—some silver.<br>J. G. Cross.<br>Sudbury Basin Mines Ltd. (1927).<br>Westfield Minerals Ltd. | White calcite-barite vein, 3–15 ft. thick, in diabase. | *See* page 7.<br>Ingall 1888, p. 43.<br>Tanton 1931, p. 190. |
| 3 | Lybster twp.; Mining Location R. 61, 1½ miles southeast of Silver Mountain station. (Scripture's vein). | Prospect. | White barite-calcite vein, 2–3 ft. thick, cutting diabase and taconite. | Tanton 1931, p. 114. |
| 4 | McKellar Island; in Lake Superior, 18 miles south of Port Arthur. | P. McKellar (1869).<br>United States Baryta Co. (1885–94)—8,402 tons.<br>Duluth Barytes Co. (1894)—500 tons.<br>International Minerals and Chemical Company (Canada) Ltd. (1961). | Massive, white, barite-calcite vein, 30–60 ft. wide, 450 ft. long, cutting diabase. | *See* page 8.<br>Ingall 1888, p. 40.<br>Tanton 1931, p. 188.<br>Spence 1922, p. 56. |
| 5 | Neebing twp.; con. V, lot 17. | A. Cooper (1927)—prospect. | Vein of coarse, platy barite, 2 ft. thick, in Animikie iron formation. | Tanton 1931, p. 147. |
| 6 | Nipigon twp.; con. III, lot 9. | M. Lofquist and A. Maata (1920–23)—prospect. | Vein of pink barite, 1–2 ft. thick, in granite. | Tanton 1931, p. 181. |
| 7 | O'Connor twp.; Mining Location T. 142. (Beaver Junior). | Prospect. | Composite vein, 4 ft. thick, in which coarse, white barite is a major mineral constituent. | Tanton 1931, p. 131. |
| 8 | O'Connor twp.; Mining Locations T. 143, T.144 | V. Feeley and J. McDermott (1960)—prospect. | Ribs of white barite to 2 ft. thick, in quartz-calcite veins cutting Animikie taconite. | *See* page 11.<br>Tanton 1931, p. 123. |
| 9 | O'Connor twp.; con. I, lot 9. | R. Hymers (pre-1927)—prospect. | Coarse, white barite-calcite vein, ½–2½ ft. thick, cutting Animikie taconite. | Tanton 1931, p. 123. |
| 10 | Spar Island; in Lake Superior, 23 miles south of Port Arthur. | Col. J. Prince (1846). | Banded calcite-barite-quartz vein, 6–16 ft. thick, cutting diabase. | *See* page 11.<br>Ingall 1888, p. 41.<br>Tanton 1931, p. 189. |
| 11 | Thompson Island; in Lake Superior, 19 miles south of Port Arthur. | T. Macfarlane (1853).<br>Montreal Mining Co. (1873–74). | Composite vein, 4 ft. thick, composed of barite with minor calcite and quartz. | Ingall 1888, p. 41.<br>Tanton 1931, p. 189. |
| 12 | Township 91; 12 miles east of Nipigon. | | Composite vein, 10 ft. thick, containing ribs of barite up to 2 ft. thick, in granite. | Tanton 1931, p. 185. |

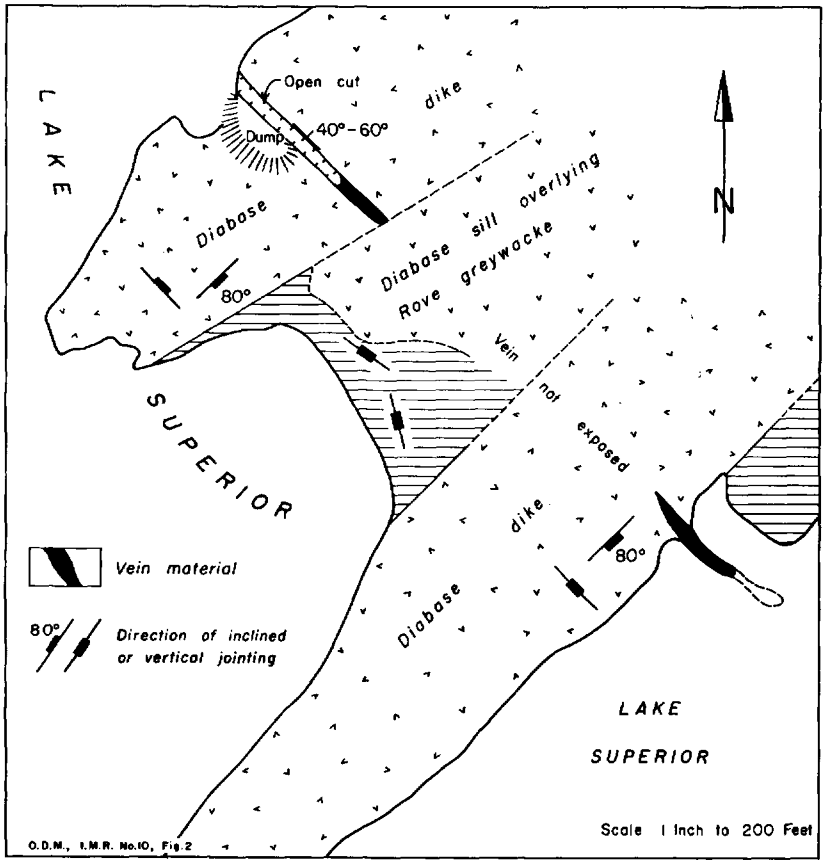



Figure 2—Sketch of the barite vein at the west end of Jarvis Island, Lake Superior.

## Descriptions of the Principal Occurrences

### DISTRICT OF THUNDER BAY
### JARVIS ISLAND (2)

A vein crossing the western end of Jarvis Island was discovered in 1868. During 1869 and 1870, T. Macfarlane sank a shaft on the vein to 32 feet and recovered a small amount of silver. The Ontario Mineral Lands Company worked the deposit for several months during the summer of 1871 before selling it to unnamed English interests. When operations ceased in 1872, two further shafts had been sunk to 78 and 160 feet, and some drifting and stoping had been done. Work was resumed in 1886 and continued until 1888, during which time the main shaft was deepened and further drifting was carried out along the vein. In 1928, Sudbury Basin Mines Limited purchased the property from J. G. Cross. In 1962 it was controlled by Westfield Minerals Limited. According to J. G. Cross (Burgess 1928) the mine has produced $30,000 worth of silver, but has never been worked for barite. However, Tanton (1931, p. 89) believes the property has been a barite producer.

Jarvis Island is in Lake Superior and lies 1½ miles offshore, 24 miles south of Port Arthur. It owes its existence to the same dike of Keweenawan diabase that forms the backbone of the island chain that includes McKellar Island 10 miles to the northeast. The vein crosses the wide western end of the island. It is exposed on both sides of the island where it cuts dikes of diabase (*see* Figure 2) but is obscured for 400 feet in the low-lying central part where a thin sill of diabase overlies greywacke of the Rove Formation (Animikie Series). The two dikes are convergent toward the northeast. They are jointed in two directions; one is parallel to the vein structure, and one is at right angles to the vein structure with a southerly dip of 80°. Jointing in the greywacke is vertical in a direction of N.15°W. and variably inclined in a direction of N.55°W.

The vein strikes N.45°W. and dips 40–60°NE. Assuming it is continuous through the low central part of the island, it is 800 feet long. On the north side of the island it is exposed almost continuously for 200 feet, but it has been removed in a deep open-cut over much of this distance. Widths vary up to 15 feet and average about 6 feet. Examination of a large waste dump near the cut indicates that the vein material is about 50 percent barite. Calcite is common, and quartz and wallrock fragments constitute about 10 percent. On the south side of the island the vein pinches and swells from 3 to 7 feet in a continuous outcropping 70 feet long. It appears to pinch-out completely under water 70 feet from shore. Narrow parallel stringers are associated with the main vein for several feet on both sides. The vein material at the south end is 80 percent calcite and about 10 percent each of barite and quartz.

The vein is coarsely-banded wherever observed. At the south end, aggregates of coarse (up to 6-inch) white calcite crystals are separated by white barite ribs that are up to several inches thick. At the north end, Ingall (1888, p. 43) reports the following sequence:

Footwall (southwest) contact.

| Feet | |
|---|---|
| 0-4 | Coarse calcite with thin quartz seams. |
| 4-6 | Mostly calcite, but with some barite and minor quartz. |
| 6-12 | Coarse barite with minor calcite. |

Hangingwall (northeast) contact.

He goes on to describe the vein as exposed in the shaft as follows: "The same banded structure is visible in the main shaft, where there is, however, a good deal of decomposed rock enclosed, and slickensided walls would indicate fissuring and movement subsequent to filling." As with the McKellar vein, quartz is encrusted in a narrow zone of stubby terminated crystals along the vein contacts. However, it is also present in the body of the vein, either disseminated or in thin encrusted seams, in somewhat greater amount than in the McKellar occurrence. Sphalerite, galena, pyrrhotite, and pyrite have been reported (Ingall 1888, p. 43) in minor amount.

## DISTRICT OF THUNDER BAY

### McKELLAR ISLAND (4)

A large barite-calcite vein was discovered by the McKellar brothers on this island in 1869. In a search for silver, the vein was subsequently developed from a shaft 130 feet deep, an adit 150 feet long, and a crosscut 60 feet long. In 1886, thirty men were employed mining barite from an open pit (Ingall 1888, p. 41). Shipments totalling 8,402 tons of hand-cobbed barite were reported by the United States Baryta Company of Cleveland for the period 1885–1894. The Duluth Barytes Company also shipped 500 tons in 1894. The property was acquired by International Minerals and Chemical Corporation (Canada) Limited in 1961.

McKellar Island is in Lake Superior and lies directly south of Pie Island and 18 miles by air due

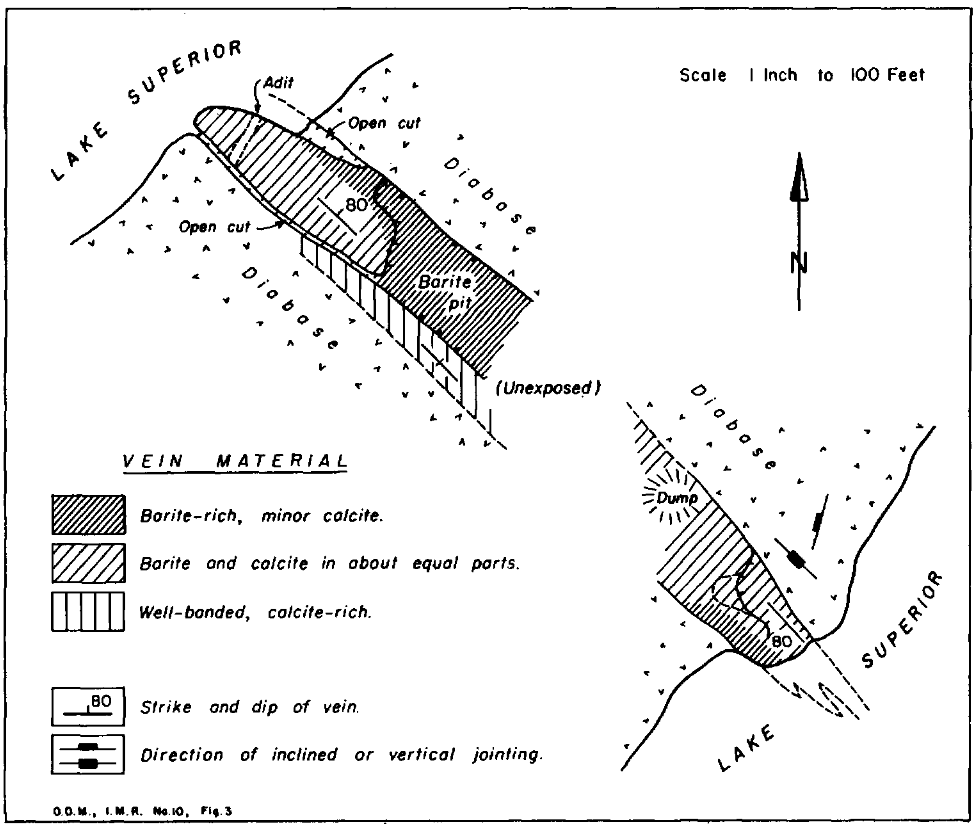
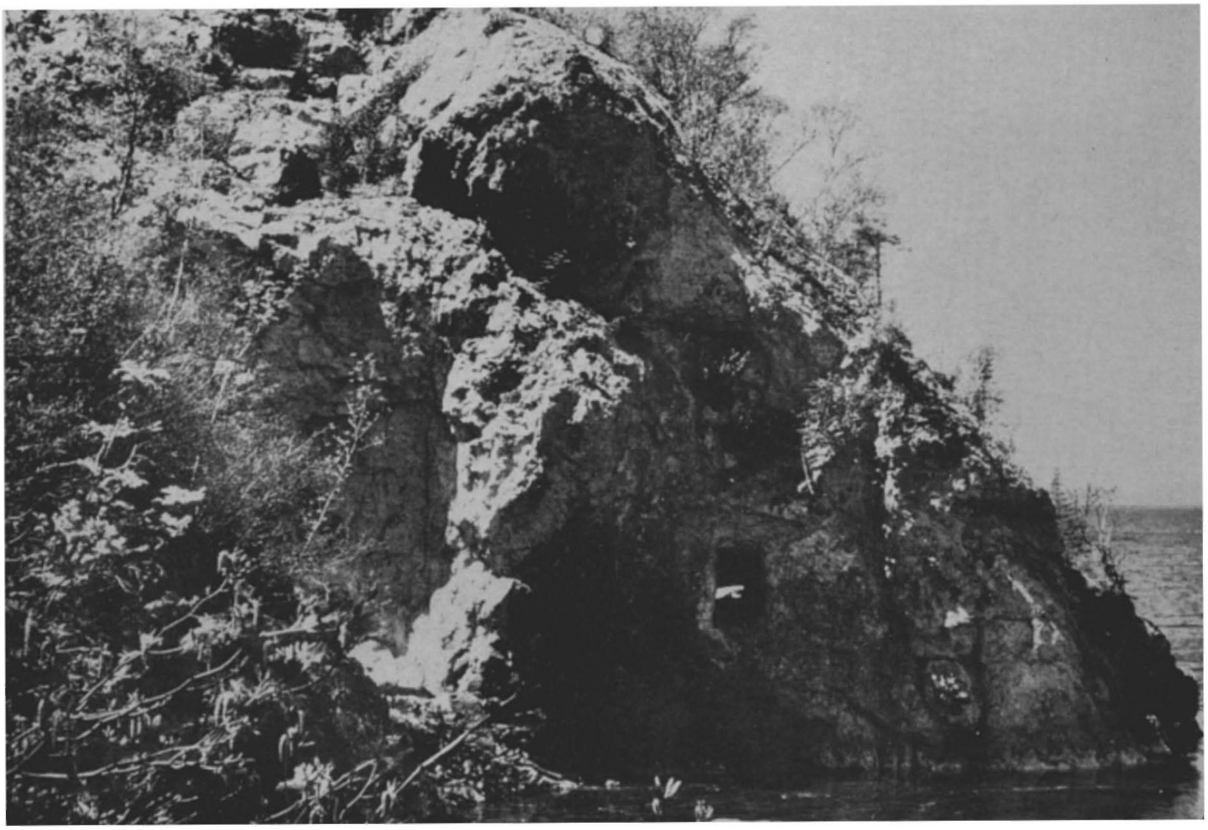



Figure 3 — Sketch of the barite vein, McKellar Island.

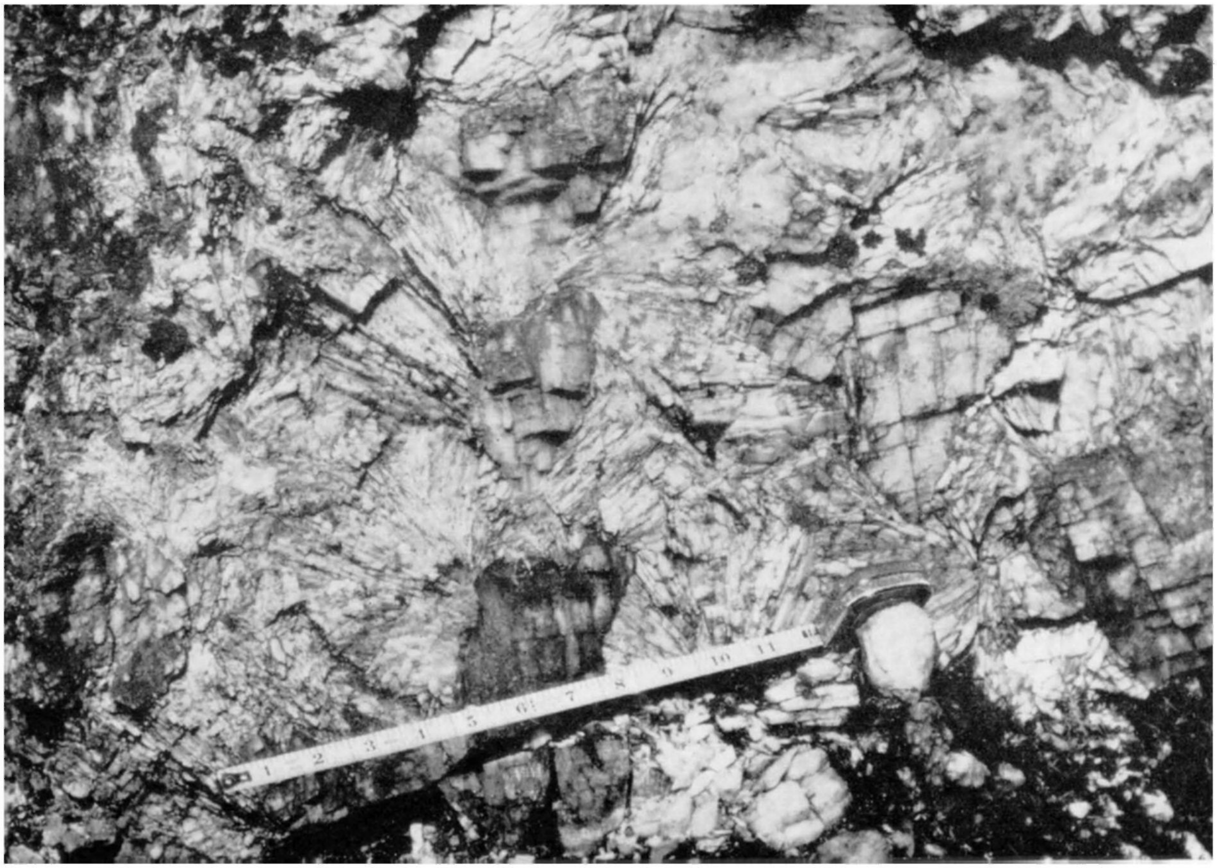


**McKellar Island, north side, showing the adit entrance in the steep northeast flank of the barite vein. The adit crosses the width of the vein and connects with a narrow open-cut paralleling the west contact. The adit opening is 4 feet by 6 feet, and is about 8 feet above water-level.**

south of Port Arthur. It can be reached by boat chartered at Port Arthur, or by float-equipped aircraft if the lake is not too rough to permit a landing. A dike of Keweenawan diabase trends northeast from McKellar Point on the mainland, and forms the islands of Victoria, Jarvis, Spar, Thompson, and McKellar, northeast in that order. McKellar Island is a steep-sided rugged outcrop, 1,000 feet long by 450 feet wide with a maximum elevation of about 75 feet above water.

The vein strikes N.45°W. and dips vertically, crossing McKellar Island near its middle and widest point. Jointing in the diabase is closely spaced, parallel to the vein; a poorer joint system strikes N.15°E. and has a moderate to steep westerly dip. The vein is 450 feet long, and is 40 feet wide on the north side of the island. It is 30 feet wide on the south side, and reaches its maximum width of 60 feet about 150 feet back from the north side. The north end of the vein drops steeply into deep water and the 4- by 6-foot adit portal (*see* photo above), which is about 8 feet above water-level, cannot be reached without a boat. The gradient to the lake on the south side is more gradual, and the vein is seen to pinch rapidly as it passes under the lake.

About half of the vein is exposed in outcrop; a portion of the south-central part is partially obscured by scrub growth and light soil. At its widest point the vein has been quarried down 25 feet over an area 45 by 75 feet (*see* Figure 3), but the floor is concealed by moss and rubble. A deep narrow fissure near the west contact on the north side of the island may be, in part, a natural break, but it has probably also been mined for silver. A smaller cut for the same purpose occupies the east contact, and an irregular cut on the south side of the island may also have been made for silver. Although the writer did not see any metallic minerals, the more accessible showings were probably removed in these operations. Ingall (1888, p. 41) states that "The metallic minerals consist of zinc blende with a little galena and pyrite which are for the most part concentrated in dark-coloured bands in the main vein, of which bands there are two on the north side and



**Barite-calcite vein-material, McKellar Island. Barite is shown in typical divergent platy habit; calcite is in blocky patches with well-marked cleavage.**

one on the south side of the island." Assays of these dark bands (Hoffman 1888, p. 25) show traces of silver but no gold.

Structurally, the vein consists of two parts: a coarsely-banded, almost massive, assemblage of very coarse barite and calcite, which forms the major part of the vein; and, a narrow distinctly-banded portion, which is discontinuous along the west wall. The more massive section consists typically of equal amounts of white barite and calcite in individuals up to 10 inches and averaging 3–6 inches. Locally barite predominates and may constitute as much as 90 percent of the vein-material. A 10-foot zone along the west contact near the water's edge on the south side of the island is such a zone. The area from which barite has been quarried may have averaged 75 percent barite. Adjacent to the barite pit is a 15-foot zone of well-banded vein-material that forms the west contact. This zone is 80 percent calcite in bands up to 12 inches wide separated by ribs of barite ⅛ to 3 inches wide.

Barite in the main body of the vein is present as white radiating tabular aggregates (*see* photo). The calcite also is white but is easily distinguished by its blocky cleavage and grey weathered colour. Quartz is present in minor amount, filling secondary fractures in the vein-material and diabase. It is colourless to milky, and in places amethystine, and forms crusts of stubby crystals terminated inwards; in some cases, a narrow cavity remains between opposing crusts. The east contact is marked by a 1-inch zone of encrusted quartz, some crystals of which are short, terminated, hexagonal prisms up to 1½ inches in diameter oriented at right angles to the vein wall. A few of these crystals are zoned with pale purple centres and colourless borders. Minor purple fluorite was noted with quartz, filling narrow fractures in diabase.

The McKellar vein would appear to represent about 50,000 tons of a barite-calcite mixture above

*Courtesy E. G. Pye*

Vein exposure at the southwest end of Spar Island, Lake Superior. The vein is 14 feet wide at the water's edge.

lake-level. With some form of gravity separation, a high-grade barite concentrate representing about half this tonnage might be realized. Because both minerals appear quite pure and of good colour, concentrates of each might be marketable.

### DISTRICT OF THUNDER BAY
### O'CONNOR TOWNSHIP (8)

Barite is present in several veins on Mining Locations T.143 and T.144 in O'Connor township, 25 miles west of Port Arthur.

The main occurrence is exposed in 14 trenches over a length of 1,200 feet on the north flank of a ridge about ¼-mile south of Pitch Creek. A lenticular vein 1–15 feet wide, and in some places branching to form two parallel veins, strikes N.80°E. and dips 70°N. It cuts flat-lying taconite of the Gunflint Formation. The vein consists principally of calcite, and lesser amounts of both clear and amethystine quartz. Fragments of wall-rock are common. Green fluorite is present in minor amount, and galena is present in traces. Cream-coloured barite is sporadically present in ribs several inches to a maximum of 24 inches thick. It is present in coarse, unoriented, platy crystals, many having a thin layer of encrusted quartz between them. The barite ribs show preference for the wall zones, rather than the centre of the vein, and have their greatest development where the vein is widest. Where the vein is narrow, barite is usually absent. The average barite content of the entire vein is about 10 percent.

Tanton (1931, p. 123) describes a vein on the north bank of Pitch Creek as follows:

> The vein strikes north 55 degrees east and dips between 50 degrees and 75 degrees southeast. It is exposed for a length of 150 feet and is 5 feet wide. The vein consists chiefly of coarsely crystalline, platy barite, white calcite, and quartz, with small amounts of green fluorite and a little disseminated galena. The barite makes up approximately one-third of the total volume and is intimately associated with the calcite.

### DISTRICT OF THUNDER BAY
### SPAR ISLAND (10)

Ingall (1888, p. 41) states that "This island is part of the old Prince location, and was one of the first worked properties on the lake, operations having been carried on there in the years 1846 and 1849." Logan (1863, p. 708) refers to two shafts on the vein to depths of 24 and 47 feet. Although there appear to be no records of further work, some operations undoubtedly were carried on after the turn of the century. Several large waste dumps attest to a considerable development underground, and winch equipment, boilers, and a rail tramway indicate more recent activity. Disseminated sulphides of copper, silver, lead, and zinc were the minerals of interest, but no production figures are available.

The vein crosses the western extremity of Spar Island, in Lake Superior, exactly 1 mile northeast of the Jarvis Island vein. It is 23 miles due south of Port Arthur, and 2 miles from the nearest mainland. The vein cuts a complex of diabase sills and dikes that intruded the Rove Greywacke. Jointing in the diabase is well-developed parallel to the vein at N.25°W. A second joint system strikes N.80°E.; both dip vertically.

The vein can be traced from shore to shore, a

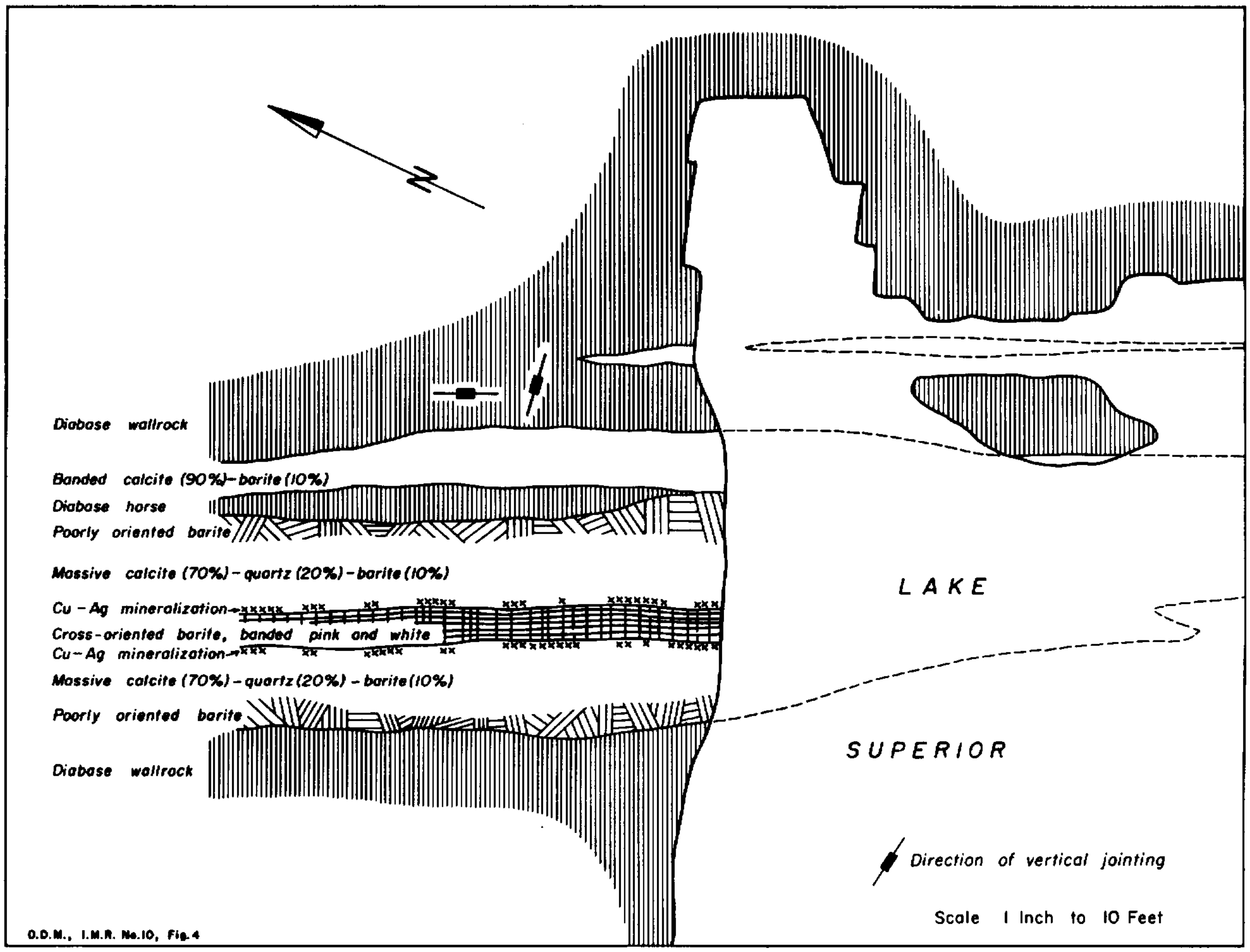



**Figure 4—Sketch of the banded vein at the southwest end of Spar Island, Lake Superior, showing distribution of the principal vein minerals. Sulphide minerals are disseminated on both sides of a central barite rib.**

distance of 280 feet in a direction of N.25°W., and is visible in shallow water on the south side for a further 150 feet. It is best exposed on the south shore (*see* photo p. 11) where it outcrops continuously for 60 feet. The vein dips vertically and, according to Ingall (1888, p. 41), the wallrocks have been displaced 65 feet horizontally. The vein-material is predominantly coarse white calcite; white or pale pink barite constitutes about 25 percent, and quartz 10 percent. Narrow parallel stringers are present in places, and fragments of wallrock are not uncommon in the vein-material.

Figure 4 is a sketch of the vein outcrop on the south shore. The vein is symmetrically banded about a central 2-foot rib of barite. The coarse barite laminae are cross-oriented with respect to the vein walls, but a pink-and-white colour-banding is superimposed on the laminae and is parallel to the walls. Fine disseminated sulphides are present in a 2-inch zone on both sides of the barite rib. A 4½-foot interval separates the central barite rib and the vein wall on one side, and a horse of diabase on the other. It is composed mostly of a massive assemblage of coarse white calcite, colourless quartz, and white barite in the proportion of 70, 20, and 10 percent respectively. A zone of irregular width, varying up to 2 feet, is in contact with the diabase, and consists of poorly-oriented creamy-white barite crystals. On the east side, a 2-foot horse of diabase separates the main body of the vein from a 3-foot zone of banded calcite and barite. Coarse white calcite constitutes 90 percent of the zone, but barite is present in the form of thin ribs running lengthwise.

## BARITE OCCURRENCES IN THE TIMMINS-MATACHEWAN REGION

Barite is the principal mineral constituent in five widely separated veins in the Districts of Sudbury and Timiskaming. Since 1910, these veins have been the most actively explored of the Ontario barite occurrences, and small commercial shipments have been made from three of them. They are typically 3–8 feet wide, but locally they vary from stringers to widths of 16 feet. The vein-material consists of white to slightly grey barite, and contains minor amounts of calcite and quartz and traces of fluorite and sulphide minerals.

Several minor occurrences of barite are mentioned by Burrows (1920, p. 64) near Elk Lake and Matachewan but, generally speaking, the five main deposits are completely isolated from others of their kind. The host rocks include representatives of almost every major rock unit in the area except the Pleistocene and Recent. The veins cut Nipissing diabase, Huronian sedimentary rocks of the Cobalt Group, Algoman granite and syenite, and Keewatin volcanic rocks. Like the silver veins of Cobalt and Gowganda, the barite veins appear to owe their origin to the Nipissing diabase; however, unlike the Cobalt and Gowganda veins, they are composed mostly of barite, a mineral virtually unknown in the silver veins of the Cobalt and Gowganda areas.

### Summary List

The accompanying summary gives the salient features of each deposit. Figure 5 shows the location of these deposits. The numbers in the figure correspond to those in the Summary List and in the descriptions following it.

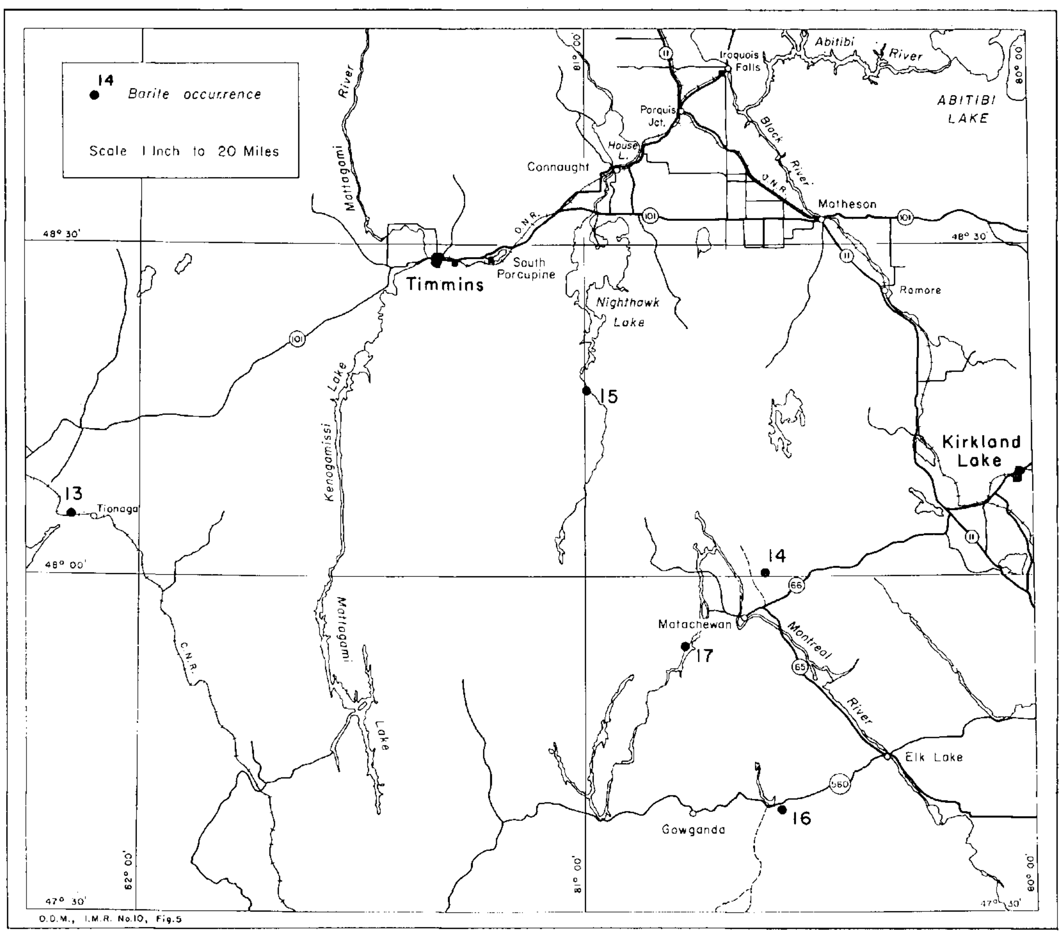



Figure 5—Timmins-Matachewan region, barite occurrences. The numbers correspond to those In the text.

## SUMMARY LIST OF BARITE OCCURRENCES IN THE TIMMINS-MATACHEWAN REGION

| No. on Figure 5 | Location | Owners or Operators, and Production | Remarks | References (in order of importance) |
|---|---|---|---|---|
| **District of Sudbury** | | | | |
| 13 | Penhorwood twp.; 2½ miles west of Tionaga. (Ravena deposit). | R. Cryderman (1917).<br>Barite Syndicate (1923)—200 tons.<br>Weaver Minerals Ltd. (1933)—20 tons.<br>B. Meen (1940)—222 tons.<br>Falconbridge Nickel Mines Ltd. | Massive, compact, white barite, in a composite vein up to 16 ft. thick, cutting granite. | *See* page 15.<br>Spence 1922, p. 35.<br>Todd 1925, p. 16.<br>Rogers 1922, p. 21. |
| **District of Timiskaming** | | | | |
| 14 | Cairo twp.; west shore of Browning Lake. (Biederman claim). | L. Biederman (1914)—prospect. | Grey-white barite with minor quartz, in vein up to 16 ft. thick cutting red syenite. | *See* page 17.<br>Burrows 1918, p. 237.<br>Spence 1922, p. 38. |
| 15 | Langmuir twp.; south boundary. (Premier Langmuir mine). | Premier Langmuir Mines (1911-18)—60 tons.<br>Canada Nighthawk Mines Ltd. (1931-32)—160 tons.<br>Canada Baryte Mines Ltd. (1938-39)—335 tons.<br>Woodhall Mines Ltd. (1943-48)—1,400 tons<br>Norbarite Mines Ltd.<br>Northern Barite Development Co. Ltd. | White barite with minor quartz and calcite, in two veins, 3-6 ft. thick. | *See* page 18.<br>Berry 1942, p. 13.<br>Gibson 1918, p. 45.<br>Spence 1922, p. 44. |
| 16 | Lawson twp.; 1 mile southeast of Longpoint Lake. (Eby or Scott claim). | H. D. Eby and Co. (1939-40)—225 tons. | Lens of white barite, 8 ft. thick and 60 ft. long, in diabase. | *See* page 19.<br>Spence 1922, p. 39. |
| 17 | Yarrow twp.; west shore of Mistinikon Lake. (Glendinning property). | Ontario Barium Company Ltd. (1920)—prospect.<br>H. D. Glendinning.<br>Independent Mining Corp. Ltd. (1959).<br>H. D. Glendinning Estate. | Several veins of grey-white barite up to 14 ft. thick, in Cobalt sedimentary rocks. | *See* page 21.<br>Spence 1922, p. 40.<br>Burrows 1920, p. 64. |

## Descriptions of the Principal Occurrences

### DISTRICT OF SUDBURY
### PENHORWOOD TOWNSHIP (13)
#### Cryderman or Ravena Deposit

A vein of white barite is exposed on a low ridge of granite on the north side of the Canadian National railway 2½ miles west of Tionaga Station and about 50 miles southwest of Timmins. The vein, at one time known as the Ravena deposit, lies on patented property consisting of two claims, S.4419 and S.4421. Access is by railway from Sudbury (135 miles), or by road from Timmins. To reach the property by road, it is necessary to take a private road, south from highway No. 101, controlled jointly by the Kukatush Mining Corporation and a lumber company with operations centred at Horwood Lake Station.

Following the discovery of the vein and staking of the property by Russell Cryderman in 1917, development work was carried out by C. H. Hitchcock for the Barite Syndicate. Exploration by stripping and trenching was followed by diamond-drilling in 1920. Six holes were drilled, totalling 1,012 feet. In 1923, 200 tons of hand-cobbed lump barite were shipped from an open-cut. In 1933, Weaver Minerals shipped 20 tons. Working the same open-cut, Ben Meen shipped 222 tons of lump barite in 1940. At the time of the writer's visit in 1962, five deep trenches had been dug at intervals in the low swampy ground east of the vein over a distance of 800 feet. The property was lately controlled by Ventures Limited until it merged with Falconbridge Nickel Mines Limited; as a result of the merger of these companies in 1962, Falconbridge Nickel Mines Limited now controls the property.

Geology of the region is described by Harding (1938, p. 6). Barite is present as a fracture-filling in a ridge of pink Algoman granite. The granite intrudes Keewatin basic volcanic rocks, and blocks of the Keewatin are common in the granite. Beds of iron formation and other sedimentary rocks are also present in the Keewatin group. Both Keewatin and Algoman rocks are cut by dikes of Keweenawan diabase.

Barite was deposited in an erratic fracture system that pinches and swells from mere stringers to widths of 16 feet. The vein reaches its greatest width at the northeast end of the granite ridge and disappears in the swamp to the east. Here an open-cut (*see* photo) follows the vein into the ridge for 100 feet, attaining a maximum depth of 40 feet and an average width of 6 feet. At this point the vein strikes N.45°E. and dips vertically approximately parallel to a poorly-developed jointing system in the granite. Striations on the walls of the cut dip at a moderate angle to the east.

**Open-cut on the barite vein near Tionaga, Penhorwood township. Mining was carried on in 1923 and 1940.**

Severe fracturing of the granite, which occurred previous to the shearing that localized the deposition of barite, is marked by numerous stringers of milky-white quartz. The vein pinches abruptly at the southwest end of the cut and is only seen as stringers elsewhere on the property. A second vein, 2–4 feet wide, is also exposed in the northeast face of the ridge at a point 40 feet west of the mouth of the open-cut. Commenting on the drilling and trenching in 1920, C. H. Hitchcock (Rogers 1922, p. 21) states that the vein structure is traceable for a length of 1,600 feet and to a depth of 130 feet. His map shows an 8- to 12-foot width of vein-material near the southwest end of the ridge, 400 feet from the open-cut, but the vein is now covered by overburden at this point. More recent trenching in swampy ground northeast of the open-cut has completely caved and has concealed any bedrock that might have been reached.

Except for horses of wallrock, which are relatively common, the vein-material is almost entirely barite. Impurities are virtually restricted to the wallrock zone where alternating ribs or laminae of barite and calcite, ¼- to 1-inch thick, occur in a zone up to 6 inches wide. This zone is sometimes preceded by a 1-inch zone of white quartz and purple fluorite in immediate contact with the wall. The barite is predominantly a massive, snow-white, fine-grained variety, but scattered coarse tabular crystals are present throughout the finer groundmass. Only near the the contacts does the barite occasionally show tints of brown and green. In a few places, tabular laths of barite can be seen in contact with the wallrock; their flat surfaces are oriented at right angles to the surface of the wallrock. Traces of chalcopyrite are associated with fluorite in the wall zone.

The results of surface sampling by Hitchcock (Spence 1922, opposite page 36) are shown in Figure 6. The average of ten channel samples is claimed to be 95.5 percent $BaSO_4$, but the sampling excludes fingers and horses of wallrock. Concerning Hitchcock's sampling, Spence (1922, p. 36) states: "The writer's examination showed, however, that the leads, as indicated, are not to be taken as carrying uniformly clean barytes; the veins, especially in their widest portions, are inclined to finger out into a number of barytes stringers, separated by either granite or white quartz. In mining these zones, therefore, a considerable amount of cobbing would have to be done, in order to secure clean barytes." With regard to the diamond-drilling, Hitchcock (Rogers 1922, p. 22) states: "Boreholes 1, 2, 3 and 5 cut a total of 38.6 feet of vein matter; of this, 29.3 feet was classified as barite and averaged 85.0 percent of barium sulphate." It is further stated that a 1,200-pound bulk sample was analyzed by the St. Joseph Lead Company of New York with the following result: barium sulphate 96.14 percent; silica 1.89 percent. Spence (1922, p. 36) reports that a ground sample tested for colour against a standard sample of prime-white grade is "clear white, and is equal if not superior to the standard."

There is good evidence in this case for relating the barite genetically with the Keweenawan, because dikes of diabase were encountered in the drilling and are known to be exposed a short distance south. However, the competency or relative brittleness of the rock was the main factor in determining whether or not openings suitable for barite deposition were formed. It seems likely to the writer that veins of economic interest will be restricted to the brittle Algoman granite.

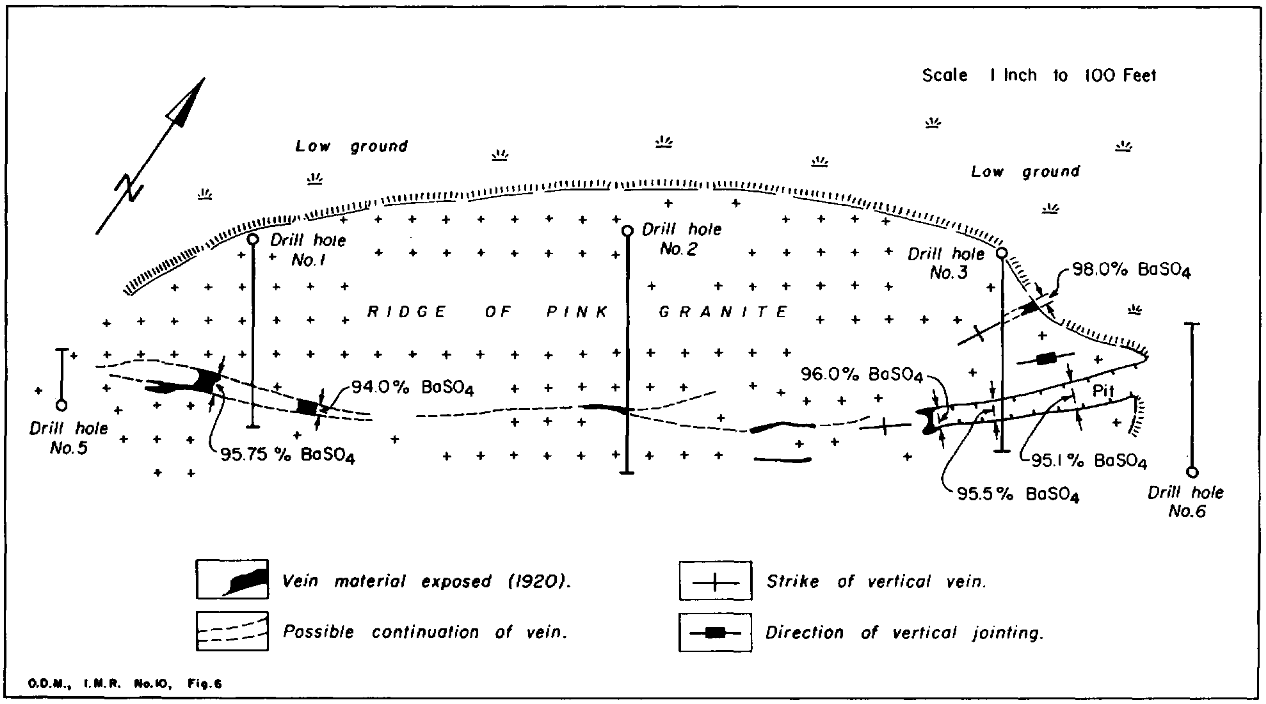
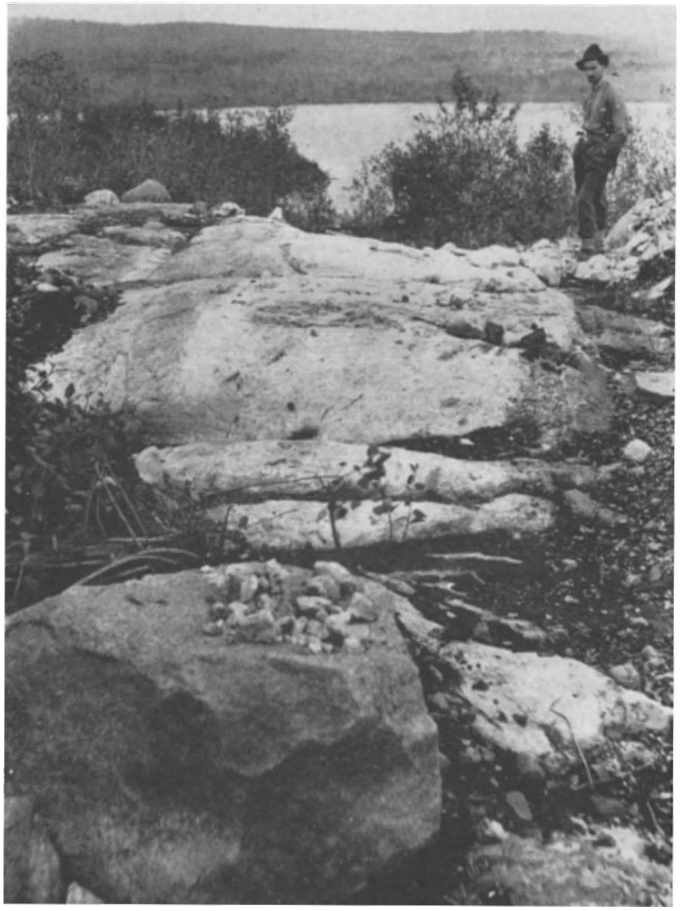



**Figure 6—Sketch of the barite vein, Penhorwood township, showing results of surface sampling by C. H. Hitchcock in 1920. Sketch is modified from H. S. Spence (1922).**



Vein exposure on the west shore of Browning Lake, Cairo township. Photo from Burrows (1918, p. 237).

**DISTRICT OF TIMISKAMING**
**CAIRO TOWNSHIP (14)**
**Biederman Claim**

A barite vein known as the Biederman deposit is exposed on the west shore of Browning Lake in northern Cairo township. It lies about 5 miles northeast of Matachewan and can be reached from that town by a bushroad and a walk of about a mile. The bushroad goes north from highway No. 66 at a point about 3 miles east of Matachewan and just east of its junction with the Elk Lake highway, No. 65; its course parallels Browning Lake but lies ¾ mile west of it. The writer knows of no trail to the property, but the showing can be readily found on the shore near the south end of the constriction in the southern half of the lake.

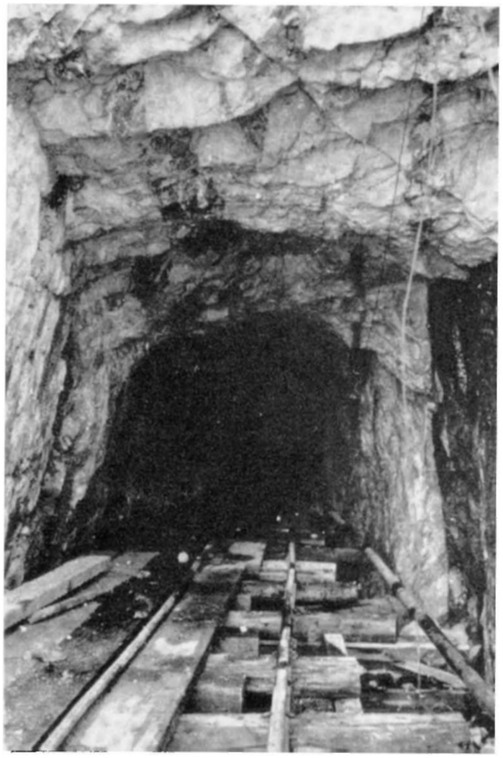
The property comprises a single claim, MR. 16042, patented to Lizzie Biederman in 1914. Prior to 1918, a small amount of stripping was carried out along the vein, and a shallow shaft was put down. In 1962, the property was being held by Abraham Greenbaum and associates of Toronto. They report (personal communication) that little work has been done on the property, and no geological or engineering reports have ever been made. There has been no production.

According to Spence (1922, p. 38) the vein "is enclosed in a reddish-brown, aplitic, hornblende syenite" that forms a ridge rising 75 feet above the lake. The ridge trends northerly, forming the west shore of the lake for some distance. Spence (1922, p. 38) describes the vein as follows:

> The barytes occurs on a well-defined vein, striking N.65°W., and at right angles to the course of the ridge. The sinking of a pit 6 by 6 feet, and 15 feet deep, on the shoulder of the ridge, and the removal of the comparatively thin covering of soil along the vein, constitute the whole of the development work undertaken. The vein is practically vertical, with a very slight dip to the north. Where opened up in the pit, the vein has a width between walls of 16 feet, but the vein matter contains horses and fragments of country rock, which would render cobbing of much of the ore necessary. The vein exhibits its maximum width at this point, and narrows to 9 feet of clean barytes at 40 feet west of the pit. It has been stripped for a total distance of 85 feet; beyond this point the rocks are hidden beneath a light dirt covering. At 100 feet from the shoulder of the ridge and 25 feet to the north of the main lead, a small barytes stringer, 2 feet wide, outcrops for a distance of 20 feet.

A large dike of diabase with a north-south strike is exposed a short distance to the south. The regional geology is described by W. S. Dyer (1936).

Although the barite is described by A. G. Burrows (1918, p. 237) as being "for the most part quite white in colour and of good quality" Spence



**The adit entrance on the barite vein in Langmuir township. The adit was sealed in 1961. Photo from Berry (1940, p. 15).**

(1922, p. 38) notes a considerable amount of off-colour material:

Much of the surface ore has a pinkish or brownish tinge; small amounts of sulphides—galena, zinc blende, and chalcopyrite—and also of purple fluorite, occur along the contacts, but were not noticed in any quantity in the vein proper. The principal impurity in the ore is silica, which appears to be present as an accessory constituent throughout much of the vein. In addition, a siliceous zone, as much as 30 inches wide at one point, appears to persist along the hanging (north) contact; this zone consists of a fine-grained, barytes-quartz matrix, carrying stringers and interspersed crystals of coarser, spathic barytes. Such a zone is absent on the footwall. Both coarsely spathic and fine-grained barytes occur in the body of the vein.

The only analytical work that has been done is reported by Spence (1922, p. 39). One sample representative of the full width of the vein was analyzed by the Mines Branch (Canada Dept. Mines and Tech. Surveys), Ottawa, with the following results:

| | |
|---|---|
| $BaSO_4$ | 74.85 |
| $SiO_2$ | 16.80 |
| $CaCO_3$ | 2.93 |
| | 94.58 |

A. G. Burrows (1918, p. 237) reports a sample across 8 feet analyzed 90.50 percent $BaSO_4$. A ground sample that was tested for colour against prime-white barite exhibited a light grey cast.

## DISTRICT OF TIMISKAMING
## LANGMUIR TOWNSHIP (15)
### Premier Langmuir Mine

In 1910 a barite deposit was staked near the south boundary of Langmuir township, 20 miles southeast of Timmins. The seven claims, now patented and numbered R.S.C.215 to 220 inclusive and P.7079, are all on the west side of the Nighthawk River. Access to the property is by boat from the north shore of Nighthawk Lake, a distance of nearly 20 miles. In past years, a winter road has been opened cross-country to South Porcupine. The deposit lies ½ mile west of the river but is reached by a good trail that marks the former existence of a connecting tramway used for barge-loading.

Between 1911 and 1922, Premier Langmuir Mines Limited actively developed the property. An adit (*see* photo) was driven on the main vein for 160 feet, and a vertical shaft was sunk at its entrance to a depth of 130 feet. A level was established at 60 feet, and 80 feet of drifting was carried out. A second shaft was sunk to 75 feet on a small adjacent vein. In 1918, a 30-ton mill was constructed and 60 tons of barite were shipped. From 1923 to 1937, intermittent operations were carried on by Canada Nighthawk Mines Limited. In 1933, 160 tons were mined from the floor of the adit, and 70 tons were milled. In 1938, Canada Baryte Mines Limited took over the property and, the following year, advanced the adit 20 feet, withdrawing 335 tons of barite of which 181 tons were shipped. Woodhall Mines Limited operated the property from 1943 to 1949, and mined 150 tons in 1945, 1,200 tons in 1946, and 40 tons in 1947. Trial shipments of 40 and 47 tons were made in 1947 and 1948 respectively. Reorganization of the company in 1949 resulted in the formation of Norbarite Mines Limited. Whitby Ore Mills Limited was formed to take over the company's grinding plant at Whitby. In 1962, the property was controlled by Northern Barite Development Company Limited.

Two barite veins are exposed in the north face of a ridge of massive dark Keewatin greenstones and banded tuffs (*see* Figure 7). The volcanic rocks are intruded by dikes and *lit par lit* injections of syenite. The main vein strikes N.30°W. in the face of the ridge but follows an easterly trend (N.70°W.) over most of its length. It pinches to a stringer in the southeastern slope of the ridge 1,000 feet from its first outcropping. Hogg (1946) describes the vein as follows:

The barite vein reaches widths of 6 feet, but over the majority of its length is less than 3 feet, with inclusions of wall rock. On the [north] face of the hill at the tunnel entrance, it widens downward from 3 feet to 6 feet, and the tunnel is collared in this wide section. The tunnel is now 187 feet long. The vein narrows as it enters the tunnel from 6 feet to an average width of about 3 feet, which includes a large number of wall rock fragments. At the face, it is 5 feet 9 inches wide, but 2 feet of this is made up of wall rock fragments . . . The vein can be traced on surface over the length of a claim before it weakens to the east, but widths are at no place better than in the tunnel.

A second vein, separated from the first by about 60 feet of countryrock, trends eastward along the base of the ridge. Hogg (1946) describes it as follows:

This vein, where mined, is 3½ to 5 feet wide over a length of 80 feet. Traced west it pinches to a narrow vein and its strike indicates that it would join up with No. 1 vein near the entrance to the adit. Traced east, it narrows and pinches out in about 200 feet. Work has been done further east on narrow fractures filled with barytes but these are probably parallel fractures rather than continuation of No. 2 vein.

Both veins dip vertically, and their southern walls are comparatively sharp. The northern walls are brecciated, and angular fragments of greenstone and syenite are cemented in a barite matrix. Barite in the main vein is generally white, but that of the smaller vein is less pure (Spence 1922, p. 45, 46). The texture is coarse-grained, dense, and compact. In addition to fragments of wallrock, the vein-material contains impurities of calcite, minor quartz, and traces of galena, sphalerite, chalcopyrite, and native silver (Spence 1922, p. 46). Epidote and purple fluorite are encrusted in some places along the walls of the vein or in contact with wallrock fragments.

Spence (1922, p. 46) reports that a representative sample, ground to minus-200-mesh, exhibits a shade of colour that is a faint blue-grey in comparison with a sample of prime white barite. An average sample of ore from the adit was analyzed by A. Sadler of the Mines Branch, Ottawa, (Spence 1922, p. 46) as follows:

| | |
|---|---|
| $SiO_2$ | 3.08 |
| $CaCO_3$ | 8.10 |
| $BaCO_3$ | 0.62 |
| $BaSO_4$ | 88.45 |
| $R_2O_3$ | 0.10 |
| | 100.35 |

**DISTRICT OF TIMISKAMING**
**LAWSON TOWNSHIP (16)**
**Eby or Scott Claim**

A small lens of white barite exists ½ mile south of the Elk Lake–Gowganda road (highway No. 560) about a mile southeast of Longpoint Lake. Access is difficult because of the lack of a recognizable trail or other distinguishing landmark. The deposit lies in low bush country about

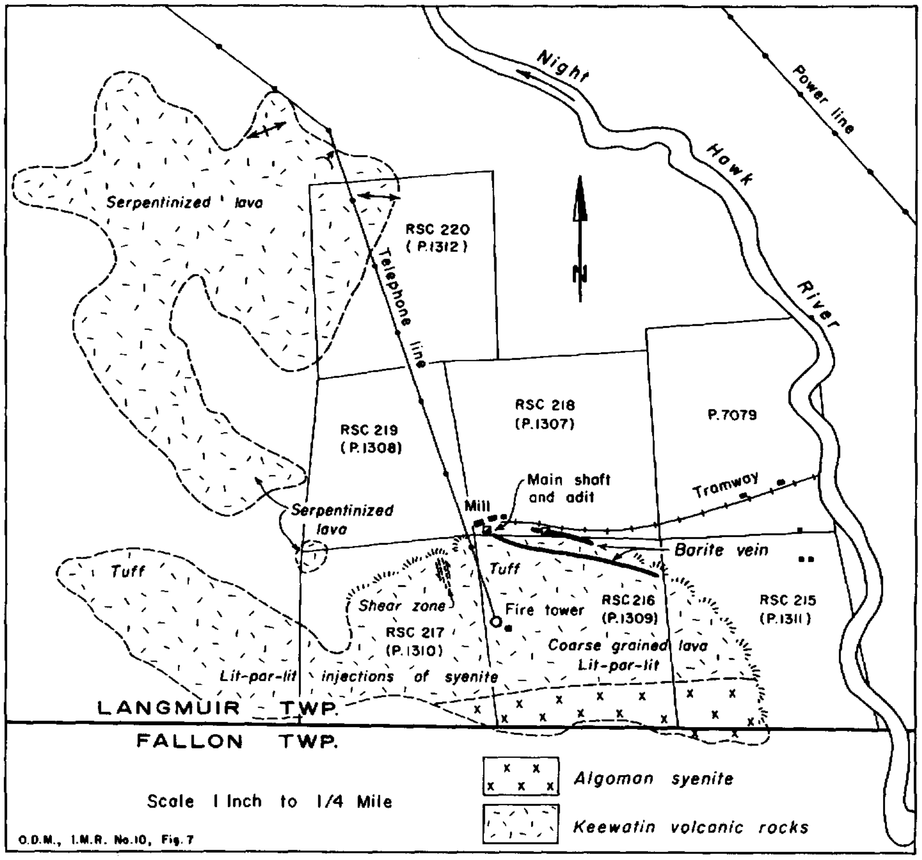



Figure 7 — Geological sketch of the vicinity of the barite occurrence in Langmuir township. Modified from L. G. Berry (1942).

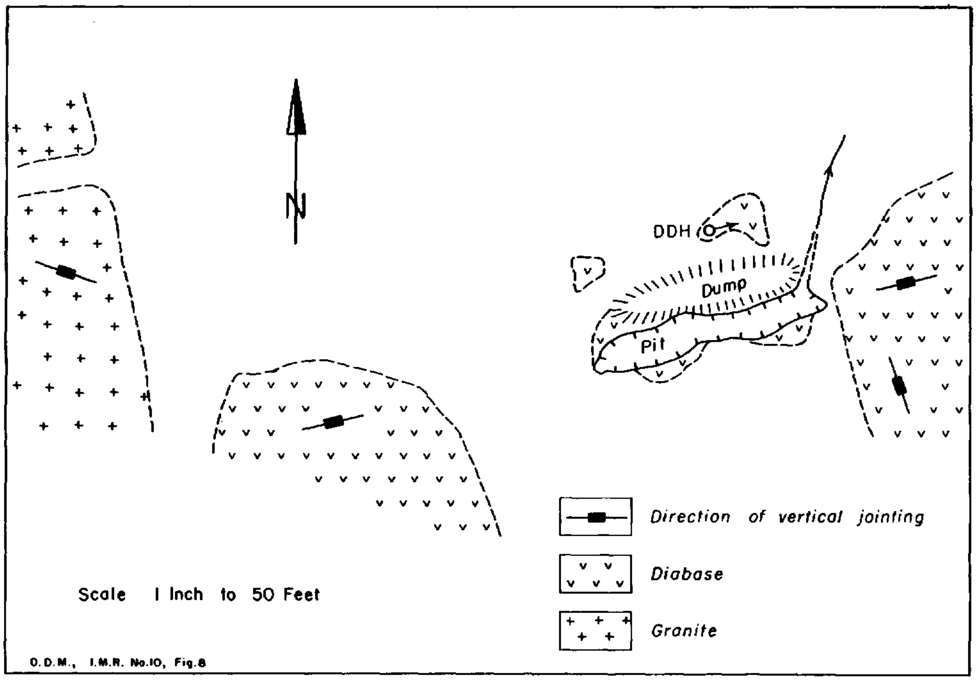



**Figure 8 — Geological sketch of the barite occurrence in Lawson township.**

¼ mile east of a wagon-road that runs south from highway No. 560 and is parallel to, and 1½ miles east of, the Beauty Lake road.

Prior to 1920, a single claim was staked by H. D. Eby of Toronto. In 1939 and 1940, 142 tons and 83 tons respectively were shipped from an open-cut by H. D. Eby and Company. At the time of the writer's visit in 1962, the area around the cut had been recently brushed-out and a single diamond-drillhole had been put down. The ground was open for staking throughout the latter part of 1962.

The barite is an irregular lens, 60 feet long by 8 feet wide, cutting medium- to coarse-grained Nipissing diabase. It lies in low ground, less than 10 feet above swamp-level, between two parallel ridges of diabase 100 feet apart. The lens strikes N.75°E. and dips vertically. W. S. Dyer (1940, p. 4) reports that the results of diamond-drilling proved the occurrence to be shallow. The lens has been opened along its entire length to a depth of 8 feet, but the cut is now water-filled. The east end of the occurrence is terminated abruptly against the steep flank of a diabase ridge. The suggestion of a tailing-out of the vein material to the north along the edge of the ridge apparently prompted the recent drilling of a single hole in this area (*see* Figure 8). The west end of the occurrence is concealed by drift, but mineable widths apparently do not continue as far as the western ridge of diabase. Walls of the deposit are irregular, corroded, and vuggy. Brecciation of the wallrock is not conspicuous. There are two sets of joints in the diabase; one is parallel to the long direction of the barite lens (N.75°E.), and one is approximately at right angles to it (N.20°W.). There is no increase in the frequency of joints on-strike with the barite lens, and continuation of the barite structure in this direction is, therefore, doubtful. However, a shallow but continuous depression, 8 or 10 feet wide, crosses a low ridge of granite in a direction parallel to the barite lens but offset 100 feet north. The granite is a medium-grained pink rock of Algoman age, typically well-jointed at N.70°W.; it forms a series of low rounded ridges west of the barite lens. No barite was seen in association with the depression in the granite.

The regional geology is described by E. S. Moore (1956). The barite deposit is just off the eastern edge of his map-sheet. Moore notes several ages of diabase, represented by both dikes and sills. The barite occupies a fracture in the earliest, a sill of Nipissing diabase. The limited extent and abrupt termination of the lens suggests that the ridges of diabase at both ends may be dikes. If the barite formed before the intrusion of these dikes, other segments of the lens may have been offset by them. The depression noted in the granite ridge may be such a segment. If the dikes intruded before the formation of the barite, the lack of continuation of the barite structure may be due to a difference in competency between the sill and dike rocks, as is the case in many of the Lake Superior occurrences. Barite is not reported (Todd 1926, p. 77) as a constituent of silver veins in the Gowganda area, a fact which would seem to preclude a common origin for the two.

H. S. Spence (1922, p.40) describes the barite as follows:

> The barytes is of very good quality, and is practically free from objectionable impurities in the shape of sulphides, fluorite, etc. The ore consists of a close aggregate of large, platy crystals, ranging from white to colourless; the latter often exhibiting a high degree of iridescence. Some stained material was noticed, but much even of the surface ore is only slightly off-color.

Some of the barite is of the fine-grained compact variety. Calcite is present but rare, and fine needles of green actinolite exist in some places with hematite near the walls.

The tenor of barite is high. H. S. Spence (1922, p. 40) reports that a grab sample analyzed by the Mines Branch, Ottawa, gave the following result:

| | |
|---|---|
| $BaSO_4$ | 98.03 |
| $SrSO_4$ | 0.70 |
| $CaSO_4$ | 1.20 |
| | 99.93 |

A ground sample tested for colour against a sample of prime white barite is "equal if not superior to the standard," according to Spence (1922, p. 13), who also suggests that the barite in this deposit is softer (with respect to ease of milling) than the barite in other northern Ontario occurrences.

### DISTRICT OF TIMISKAMING
### YARROW TOWNSHIP (17)
#### Glendinning Property

After the discovery of barite along the west shore of Mistinikon Lake, 6 miles southwest of Matachewan, four claims were staked in 1917. Mistinikon Lake is a broadening of the west arm of the Montreal River. Access to the property is by boat, 1½ miles from the abandoned Matarrow mine, or 4 miles from Christie's tourist camp at the Young-Davidson landing on the east shore.

Between 1917 and 1920, stripping and trenching was carried out by the Ontario Barium Company Limited, and a shallow shaft was put down on the "creek vein" (*see* Figure 9) under the direction of M. B. R. Gordon. In 1933, H. D. Glendinning is reported to have taken out a ½-ton sample for test purposes. In 1940, W. S. Dyer directed a moderately extensive trenching and sampling program that uncovered three veins. Under the direction of J. M. Baker, Independent Mining Corporation Limited did 3,289 feet of diamond-drilling in 1959 and staked an additional nine claims. The original four patented claims,

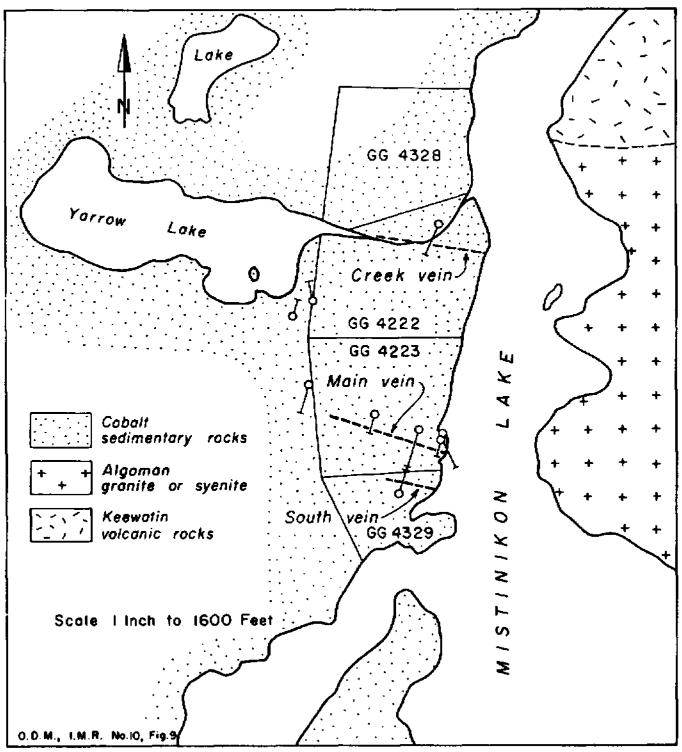



**Figure 9 — Barite veins on the Glendinning property, Yarrow township.**

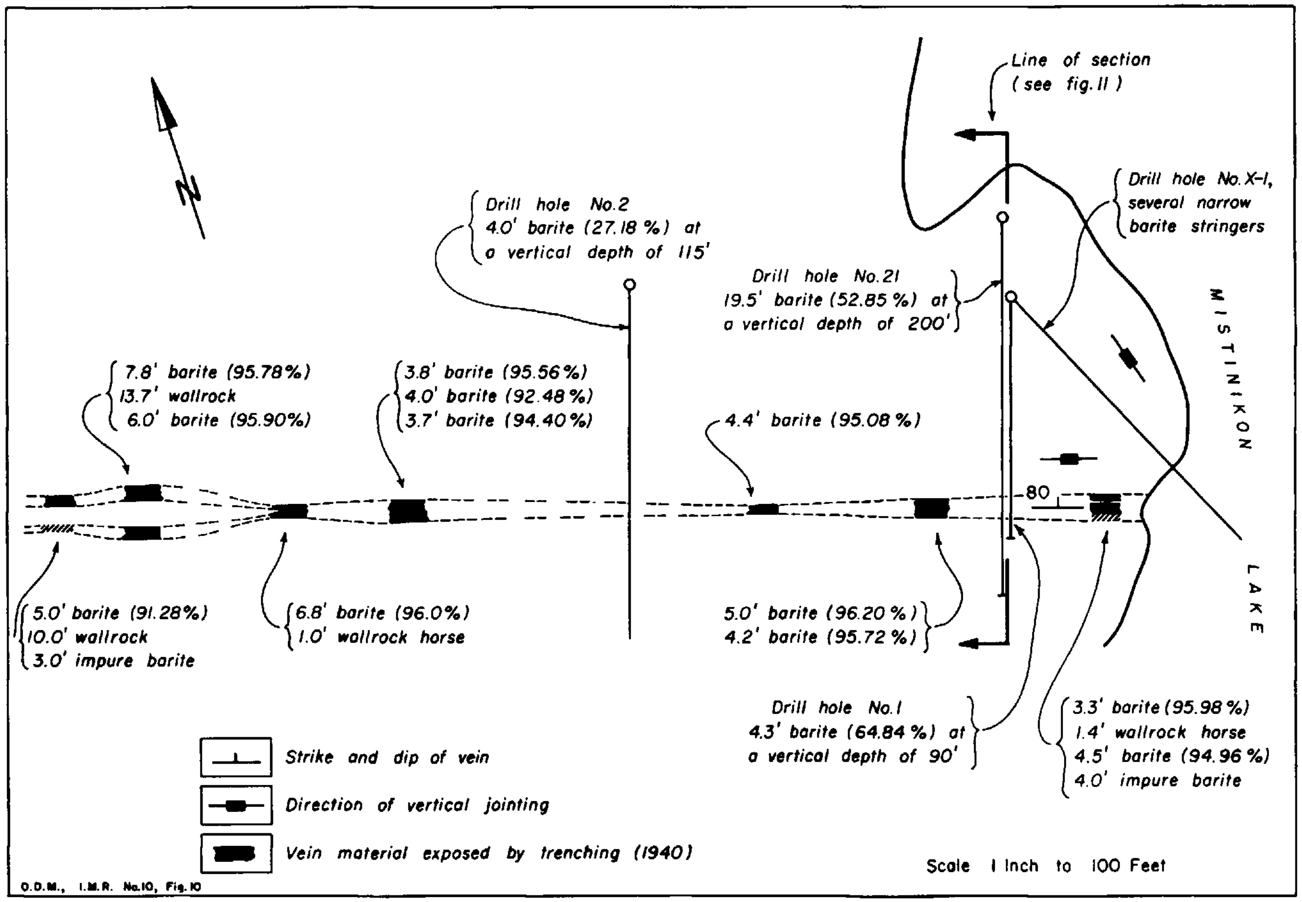
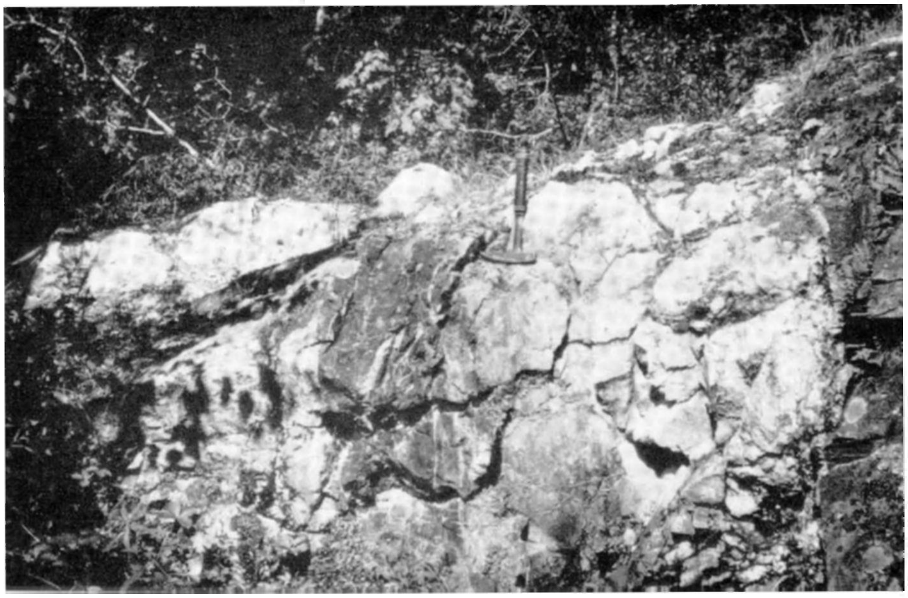



**Figure 10 — Surface plan of the main barite vein on the Glendinning property, showing the results of surface and drillhole sampling. Results of surface sampling from W. S. Dyer (1940); drillhole sampling from J. M. Baker (1959).**



**Exposure of the main barite vein on the west shore of Mistinikon Lake, Yarrow township.**

G.G.4222, 4223, 4328, 4329, form part of the estate of the late Dr. H. D. Glendinning.

The barite is present as a vein-filling in east-west fractures cutting interbedded greywacke-conglomerate and arkose of the Cobalt group. The rocks dip gently eastward. Greywacke-conglomerate is the wallrock for all the surface barite showings. The greywacke matrix is either a dark greenish grey or a dusky red. The rock contains a low to moderate content of angular pebbles, principally of coarse-grained pink granite. Beds of arkose are not exposed on the property but are interesected in drillholes at a shallow depth. They are fine- to medium-grained pink rocks that, according to Baker (1959, p. 1), are sometimes "so completely recrystallized that the rock looks like good coarse-grained red granite." The east shore of the lake across from the barite showings consists of granitic and syentic rocks flanked on the north and south by Keewatin volcanic rocks.

The main vein is best exposed at the shore (*see* photo) near the south boundary of claim G.G. 4223. It strikes N.73°W. and dips 80°N. Trenching has indicated its continuation for 600 feet with an average width of 8 feet (Dyer 1940, p. 1). At the lake it is a single vein 14 feet wide, but 400 feet west it becomes two parallel veins separated by 10 to 15 feet of wallrock. Diamond-drilling (Baker 1959) near the lakeshore indicates a vein-width of 4 feet in arkose at a vertical depth of 90 feet, thickening again to 12 feet in conglomerate at a depth of 200 feet. A hole, 200 feet west, intersected a 3-foot vein in arkose at a depth of 100 feet, but drilling west of this point failed to intersect significant amounts of vein-material. A hole drilled to check the vein's structure at a depth of about 150 feet beneath the lake also failed to intersect vein-material more than a few inches thick.

The vein-material is almost entirely barite containing only traces of calcite, quartz, and finely disseminated hematite. The barite varies in colour from white to tints of grey, purple, and brown, and in some places shows a faint colour-banding parallel to the walls. Horses of wallrock are present in some places. Spence (1922, p. 43) describes the barite as follows:

> In general, it is coarsely spathic, often yielding cleavage pieces several inches across; locally however, the grain becomes finer, and in some cases is hardly distinguishable, the ore being dense and compact, with a few interspersed large crystals. Little in the nature of accessory mineral impurities can be seen at any of the exposures, the chief being specularite and chalcopyrite, in minute quantities. The presence of thin films of specularite between cleavage plates of barytes is probably the cause of the purplish tint possessed by much of the ore, especially that at the walls. Most of the barytes possesses a greyish tint, relatively little of the material being clear white.

The tenor of barite at various points on the vein, as indicated by channel samples and drill cores, is detailed on Figures 10 and 11. Dyer (1940, p. 1) reports that the average grade of thirteen 100-pound samples taken at seven locations over a length of 550 feet was 95.0 percent $BaSO_4$, excluding horses of wallrock and obviously low-grade zones. The analysis of vein intersections in the drill cores did not, in general, substantiate this grade at depth. Although a finely-ground sample was reported by Spence (1922, p. 44) to exhibit a "prime white" colour, a sample tested by the Ontario Research Foundation (Dyer 1940, p. 3) showed a very slight bluish tint. A complete

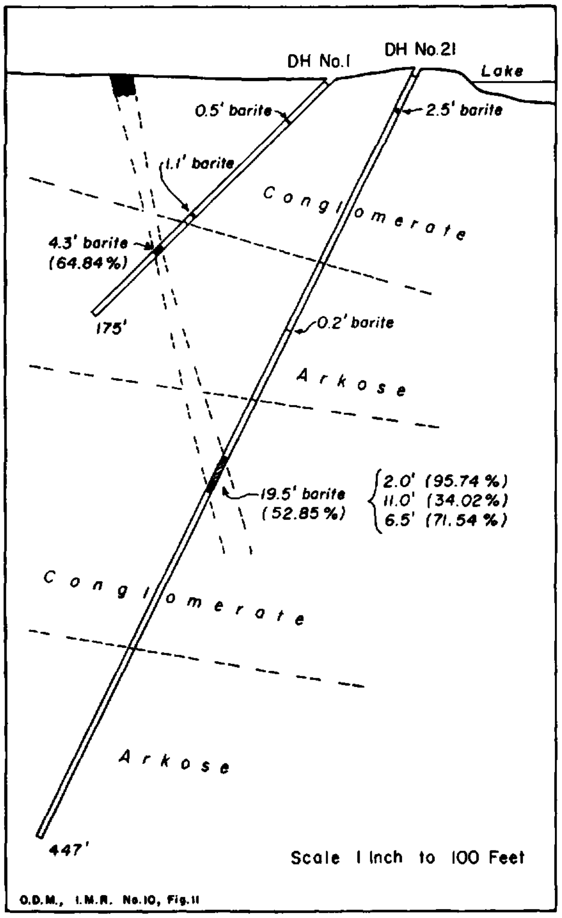



**Figure 11—Vertical section, looking west, through the main barite vein on the Glendinning property. Modified from J. M. Baker (1959).**

analysis of a channel sample, taken by Dyer (1940, p. 3) across a width of 6.8 feet at a point 450 feet west of the lake, was made by Swastika Laboratories Limited with the following results:

| | |
|---|---|
| BaO | 63.49 |
| SrO | 0.60 |
| CaO | 0.82 |
| $SO_3$ | 33.43 |
| $SiO_2$ | 1.20 |
| $R_2O_3$ | 0.25 |
| F | 0.02 |
| Pb | 0.02 |
| Cu | 0.01 |
| Ignition loss | 0.24 |
| | 100.08 |

A second vein, the "south vein", was found by trenching in 1940, 350 feet south of the main vein. Dyer (1940, p. 3) reports a tenor of 90.90 percent $BaSO_4$ over a vein-width of 8 feet. Drilling (Baker 1959) intersected a brecciated zone, 4 to 5 feet wide, consisting of quartz, carbonate, hematite, and fragments of the arkose wallrock at a vertical depth of 70 feet. Analysis of the 7-foot core intersection shows 12.04 percent $BaSO_4$.

A third vein is exposed in the bed of Yarrow Creek 1,800 feet north of the main vein. The showing comprises two veins, each about 6 feet wide, separated by 7 feet of conglomerate. A shallow shaft 6 feet square has been sunk on the vein on the north side of the creek. Strike of the vein is parallel to the major jointing direction, as in the main vein (N.73°W., vertical dip). Stringers of barite, containing hematite and rock inclusions, are exposed north of the creek 400 or 500 feet west, and the same distance east, on the shore of Mistinikon Lake. The barite is the fine-grained compact variety with only very few coarse platy intergrowths. It is less pure than the veins to the south, and shades of grey, mauve, and brown are arranged in a distinct banding parallel to the walls. A mild relief on weathered surfaces suggests the colour-banding is the result of compositional variations, probably in the proportion of included hematite and quartz. A channel sample across one branch of the vein was reported to grade 77.14 percent $BaSO_4$. Drilling (Baker 1959) beneath the showing encountered 2 feet of vein-material grading about 50 percent barite in arkose at a depth of 70 feet.

Although no intrusive rocks are present, the barite veins are generally ascribed to a hydrothermal origin related to the Keweenawan diabase. In this case, structural control appears to be related to the principal direction of jointing. Not only do the veins parallel the major joint system, but they also occur at points of maximum joint frequency. The opening of fractures suitable for barite deposition is shown by drilling results to depend also on the relative competency of the rocks. Baker (1959, p. 1) states that beds of arkose "are the more incompetent beds of the series, and as a result were less favourable to fracturing. . . . [In arkose] the fractures are either greatly reduced in width, or completely absent."

## BARITE OCCURRENCES IN SOUTHEASTERN ONTARIO

### Barite Veins

Many occurrences of barite have been reported in southeastern Ontario, principally in the Counties of Frontenac and Lanark. Spence (1922, pp. 12-13) describes them collectively as follows:

Most of the barytes of the small veins in the Ottawa district is of the compact, opaque type. It . . . is made up of a dense aggregate of thin, platy crystals, arranged in roughly parallel or slightly divergent grouping, at right angles to the vein walls. The barytes has deposited as a crust on both vein walls, and rough banding parallel to the walls is often

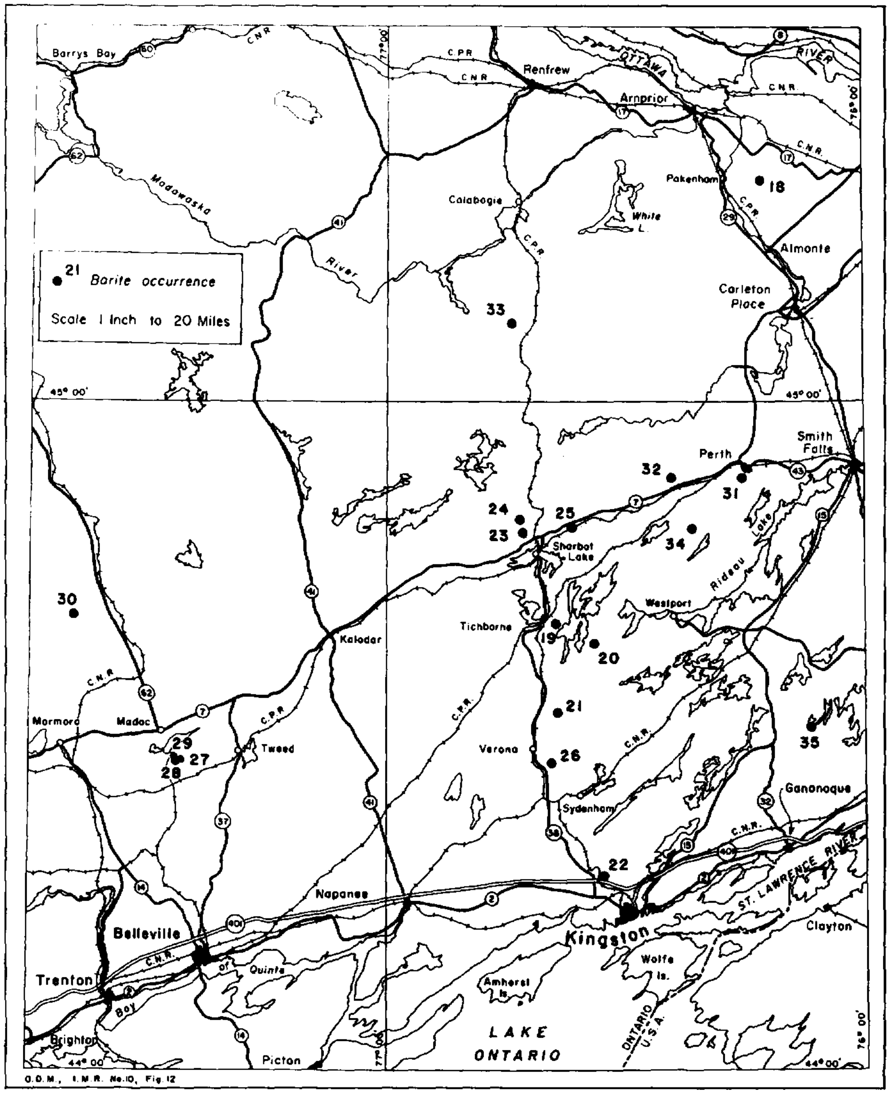



**Figure 12—Part of southeastern Ontario, barite occurrences. The numbers correspond to those in the text.**

visible in the ore. There is frequently a distinct parting down the middle of the vein, and wherever free spaces existed, there has been development of "crested" barytes. There is a wide variation in the colour of the barytes of these veins, the ore ranging from white through cream and pink to brownish-red. Generally, the colour seems to be dependent on the nature of the enclosing rock; where this is white, crystalline, Archaean limestone, or grey Ordovician limestone, the colour is usually light; while the veins enclosed in gneiss carry a pink to reddish barytes. In some instances, the veins in Ordovician limestone have their ore darkened by hydrocarbon (anthraxolite). There is close similarity between the ore of practically all the deposits in the area in question and the barytes is quite distinct in character from that of other Canadian localities. With perhaps a few exceptions, the veins of this district are too narrow to be worked profitably.

Their economic value is discussed further by Spence (1922, p. 49) as follows.

Few of the barytes veins in southeastern Ontario attain economic dimensions. Those found enclosed in gneiss are in every case merely narrow stringers. Certain of those found traversing Pre-Cambrian, crystalline limestone have been worked in a small way; but this class, also, does not exhibit important economic possibilities. The same applies to the veins found in the Palaeozoic limestones. While these last deposits, in some cases, possess greater width than those of the two former types, they often contain a great deal of brecciated country rock, the barytes occurring as a cementing medium for the rock fragments. In some cases, the rock matter in deposits of this type preponderates over the barytes.

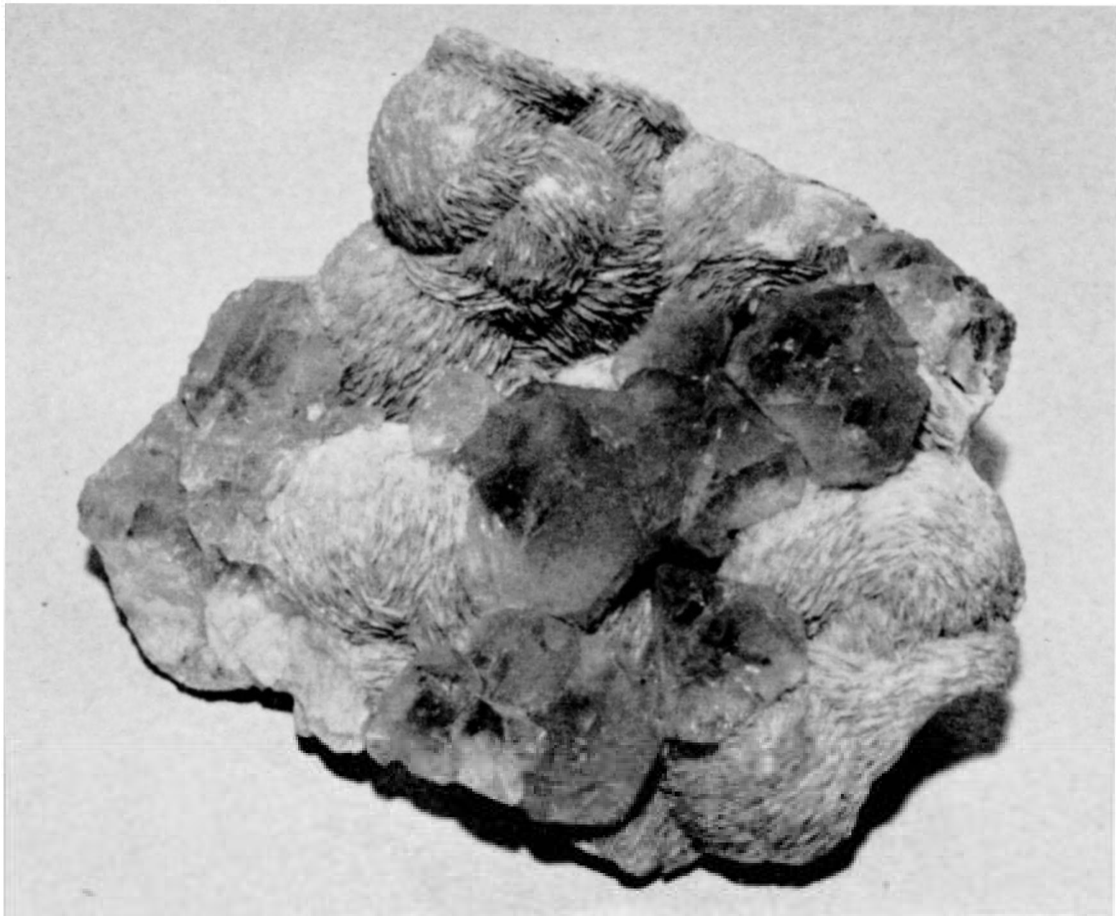
## Barite-Fluorite Veins

Barite is also associated with fluorite and calcite in veins in Huntingdon and Madoc townships, Hastings county. In most of the deposits that have been worked for fluorspar, barite constitutes 10 percent, or less, of the vein-material. However, south of Moira Lake, in Huntingdon township, a few fluorspar deposits carry 40 to 50 percent barite. In some places the barite is concentrated in distinct lenses or zones, but in most places it is finely interbanded with the fluorite, making selective mining and hand-cobbing difficult

## SUMMARY LIST OF BARITE OCCURRENCES IN SOUTHEASTERN ONTARIO

| No. on Figure 12 | Location | Owners or Operators, and Production | Remarks | References (in order of importance) |
|---|---|---|---|---|
| **Carleton County** | | | | |
| 18 | Fitzroy twp.; con II, lot 4. | J. Currie (pre-1922)—prospect. | Soft, grey-white barite cement in a brecciated zone in Ordovician limestone. | Spence 1922, p. 49. |
| **Frontenac County** | | | | |
| 19 | Bedford twp.; con. II, lot 23. | S. McEwen—prospect. | 8-inch vein of red barite in granite. | |
| 20 | Bedford twp.; con. VI, lots 16–18. | J. Brennan (pre-1915)—prospect. | Banded calcite-barite-galena vein, up to 4 ft. thick, cutting Grenville marble and paragneiss. | Uglow 1916, p. 25.<br>Harding 1951, p. 41. |
| 21 | Hinchinbrooke twp.; con I, lot 1. | T. R. Howes (1907)—prospect. | Barite-calcite vein, up to 2 ft. thick, in Grenville marble. | Harding 1951, p. 41. |
| 22 | Kingston twp.; con. IV, lots 16, 17, and con. V, lots 15, 16. | J Woodruffe (pre-1900)—100 tons. | Barite vein, 1–3 ft. thick. | *See* page 29.<br>Spence 1922, p. 50. |
| 23 | Oso twp.; con. I, lot 20. | (1880's)—prospect. | | Spence 1922, p. 51. |
| 24 | Oso twp.; con. I, lot 25. | Rogers (1908)—prospect.<br>J. Crawford. | Three parallel veins of white barite 1–3 ft. wide, in Grenville marble. | Spence 1922, p. 51.<br>Harding 1951, p. 40. |
| 25 | Oso twp.; con. VI, lot 16. | C.P.R. (rock-cut)—prospect. | Several stringers of pink barite, up to 3 ins. thick, in pink and grey gneiss. | Harding 1951, p. 41. |
| 26 | Portland twp.; con. VIII, lot 5, and con. IX, lot 5. | E. Botting (1917).<br>Mica Products Ltd. (1918)—200 tons. | White barite cement in a 6-ft. brecciated zone in Ordovician limestone. | *See* page 29.<br>Spence 1922, p. 51.<br>Gibson 1919, p. 48. |
| **Hastings County** | | | | |
| 27 | Huntingdon twp.; con. XI, lot 14, E. ½. (Howard property, or Hill vein). | Messrs. Wellington and Munro (1918)—some fluorspar.<br>Canadian Industrial Minerals Ltd. (1918–20).<br>Reliance Fluorspar Mining Syndicate (1941)—1,800 tons fluorspar.<br>Wood Land Mineral Co. (1942)—292 tons fluorspar.<br>Fluoroc Mines Ltd. (1944). | Fluorspar vein, 2–5 ft. thick, with banded pink and white barite and minor calcite, in Ordovician limestone. | *See* page 29.<br>Wilson 1929, p. 49. |

| | | | | |
|---|---|---|---|---|
| 28 | Huntingdon twp.; con. XI, lot 14, W. ½. (Johnston property). | R. T. Gilman (1943).<br>Fluoroc Mines Ltd. (1944–47)—1,150 tons fluorspar.<br>Reliance Fluorspar Mining Syndicate Ltd. (1949). | Banded fluorite-barite vein up to 10 ft. thick, in Ordovician limestone. | *See* page 30. |
| 29 | Huntingdon twp.; con. XII, lot 13. (Noyes mine). | D. Henderson (1916).<br>Messrs. Wellington and Munro (1917)—barite and fluorspar.<br>Canadian Industrial Minerals Ltd. (1918–20)—14,000 tons fluorspar.<br>Noyes Mining Syndicate Limited and Moira Fluorspar Mining Syndicate Limited (1920–40).<br>R. T. Gilman (1941–43)—9,000 tons fluorspar. | Lenses of massive and banded fluorite and barite, up to 17 ft. thick and 200 ft. long, in pink granite. | *See* page 30.<br>Wilson 1929, p. 51. |
| 30 | Lake twp.; con. XI, lot 8. | W. Sweeny (1867)—prospect. | 10- to 18-in. galena-barite vein. | Uglow 1916, p. 29. |
| **Lanark County** | | | | |
| 31 | Bathurst twp.; con. I, lot 25. | Prospect. | | Gibson 1919, p. 48. |
| 32 | Bathurst twp.; con. VI, lot 12, E. ½. | J. Palmer (1917)—prospect. | Stringers of barite, up to 18 ins. thick, in a fracture zone 10 ft. wide. | Spence 1922, p. 52. |
| 33 | Lavant twp.; con. VIII, lot 20. | T. B. Caldwell (1918–19)—1 carload. | Barite vein up to 5 ft. thick, with accessory quartz and sulphide minerals, in Grenville marble. | *See* page 31.<br>Spence 1922, pp. 13, and 53. |
| 34 | North Burgess twp.; con. X, lot 20. | T. Farrell (1918).<br>H. C. Bellew (1918–21)—400 tons.<br>Barite Products Ltd. (1934). | Clean, white barite in 2-ft. vein in granite gneiss. | *See* page 31.<br>Spence 1922, p. 55. |
| **Leeds County** | | | | |
| 35 | Lansdowne twp.; con. VIII, lot 2. | Prospect. | 2-ft. calcite-barite-galena vein. | Uglow 1916, p. 28. |



Nodular aggregates of platy barite, with crystals of green fluorite, from a vein in the Madoc area. Specimen is approximately natural size.

or impossible. In the former case, concentrates of both barite and fluorspar have been produced by selective methods (eg. the Noyes mine); in the latter case, mining has generally not been successful.

For both barite and fluorspar markets, it is desirable to produce clean concentrates of the two minerals. Fluorine is intolerable in barite that is intended for chemical uses, but small amounts are not critical in filler and glass applications, provided the amount is constant from shipment to shipment. A natural mixture of 30 percent barite and 70 percent fluorspar from a deposit in Kentucky has been used commercially in the glass batch (Harness and Barsigian 1946, p. 24). Acid-grade fluorspar concentrates require a minimum sulphur content, and therefore can tolerate only trace amounts of the natural sulphate, barite. Gravity concentration by simple jigging and tabling methods permit some beneficiation according to the Bureau of Mines Investigation No. 2235 (Canada 1947), but sink-float separations in suitable heavy media are even better (Ladoo and Myers 1951, p. 226). Flotation separation, used in conjunction with heavy-media separation, is perhaps the best approach to the separation of these fluorite-barite mixtures, but there is scope for further improvement.

### Barite-Galena Veins

Barite is also a common gangue mineral, with calcite, in veins containing galena. Such barite is commonly pink to red, compact and soft, and may be interbanded with calcite. Like other barite veins in southern Ontario, barite-calcite-galena veins are narrow and of limited extent. They tend to be concentrated geographically in Tudor and Lake townships, Hastings county, and in Bedford township, Frontenac county.

### Summary List

All deposits in which barite forms a significant part of the vein-material are listed in summary, but only those for which some production is recorded are further described in the text. Location numbers on Figure 12 correspond to those in the list and in the descriptions following. Veins that have been investigated principally for their barite content are described in detail by Spence (1922, pp. 48–55). Wilson (1929, pp. 40–77) describes the fluorite-barite veins in the vicinity of Madoc, Hastings county. The calcite-barite-galena veins are described by Uglow (1916, pp. 17–30).

## Descriptions of the Principal Occurrences

### FRONTENAC COUNTY, KINGSTON TOWNSHIP

**CONCESSION IV, LOTS 16, 17**
**CONCESSION V, LOTS 15, 16** } (22)

A number of scattered barite showings are aligned in a northwesterly direction over a distance of 14 miles, from a point 6 miles northwest of Kingston to the vicinity of Varty Lake. About 100 tons were mined in the 1890s from the east end of the zone, and ground in a local flour mill for use in paint. Spence (1922, p. 50) gives the following description of the productive section:

> The barytes occurs as a well-defined, vertical vein in horizontally-bedded Black River (Ordovician) limestone. The vein strikes northwest, and has a maximum width of 3 feet at the northwest exposure, narrowing to 2 feet in the southeast pit. The vein can be traced 300 feet northwest of these workings, and shows up again about half a mile away, across a small valley. The workings consist of several narrow pits at intervals along the vein, the deepest being down 25 feet. Practically no dead rock has been removed, the pits extending only to the walls of the vein.
>
> The barytes remaining around the workings is of a drab or greyish-white shade, rather than a good white. It is opaque, compact and massive, exhibiting a banded and often modified mammillary structure.

Spence (1922, p.50) states further that "crested barytes" is usually found to have been developed along "conspicuous partings parallel to the walls," and that many of these partings are filled with a black asphaltic substance. Small isolated crystals of calcite are the only other obvious impurity, but a grab sample taken by Spence analyzed 6.2 percent strontium sulphate. The ground barite has a drab grey colour.

### FRONTENAC COUNTY, PORTLAND TOWNSHIP

**CONCESSIONS VIII AND IX, LOT 5 (26)**

A small barite showing 2 miles northeast of Hartington was opened in 1917. In 1918, "during the working of a feldspar deposit, about 200 tons of inferior barite were extracted by Mica Products, Limited, but no shipments were made" (Gibson 1919, p. 48). The occurrence is described by Spence (1922, p.51) as follows:

> A small pit, 15 feet deep, has been opened on a deposit of barytes occupying a faulted zone in Ordovician limestone. The deposit strikes northeast and has no well-defined walls; its apparent width is about 6 feet, but the exposures are insufficient to indicate exactly its lateral extent. The pit has exposed the lead for about 12 feet; outside of this, any further continuation of the deposit is concealed beneath hillside drift to the north, and swampy ground to the south.
>
> The barytes occurs as the cementing material of brecciated, blue-grey Ordovician limestone, fragments of which are present in large quantities in the deposit. Small stringers of barytes, also, strike off from the main body into the enclosing limestone. Large, fretted crystals of white calcite are common, enclosed in the barytes vein matter, and free crystals of calcite often encrust the tabular crystals of crested barytes on parting planes. The barytes itself is massive, with a faint approach to platy structure parallel to the planes of growth; it is opaque and creamy white in colour.

Spence (1922, p. 52) states further that a selected sample from the stockpile was analyzed in the Mines Branch laboratory with the following result:

| | Percent |
|---|---|
| $BaSO_4$ | 89.27 |
| $SrSO_4$ | 4.90 |
| $CaCO_3$ | 5.36 |

A ground sample was "faintly greyish."

### HASTINGS COUNTY, HUNTINGDON TOWNSHIP

**CONCESSION XI, LOT 14, EAST HALF (27)**

**Howard or Hill Vein**

A vein on this property, known as the "Howard" or "Hill," was worked by Messrs. Wellington and Munro in 1918 and 1920, Canadian Industrial Minerals Limited from 1918 to 1920, Reliance Fluorspar Mining Syndicate in 1940–41, Wood Land Mineral Company in 1942, and Fluoroc Mines Limited in 1944. Shipments of fluorspar totalling about 2,500 tons are recorded, but barite has not been recovered. The deposit has been worked both by open-cut and underground mining. Two shafts have been sunk on the vein to depths of 36 and 60 feet. Most of the production has come from the 36-foot level where 425 feet of drifting was carried out along the vein. Work had started on the 60-foot level when the mine was closed in 1944.

The vein strikes northwest and dips 80°SW. The country rock is grey Ordovician limestone to a depth of 180 feet and pink or grey granite below that depth. The vein is 1–4 feet wide on the 36-foot level and averages about 3-feet. On this level the vein-material consists of about equal amounts of barite and fluorite, with 10 percent of calcite and rock fragments. Diamond-drilling indicates that the vein is represented below a 100-foot depth by narrow calcite stringers containing only minor amounts of barite and fluorite.

The vein-material exists in both massive and banded form. Narrow zones of massive yellow-green fluorite exist in many places along the walls;

the centre and major portion of the vein consists of interbanded barite and fluorite. Craigie (1940) describes the vein-material as follows:

It was seen that, as a general rule, the fluorite and barite occur in bands alternating with one another. The width of the fluorite bands is seldom less than ¼ inch and reaches a maximum of about 2½ inches. Barite occurs frequently in thinner bands and seldom reaches more than 1½ inches in width. Barite has a tendency to occur in spherulites or nodules consisting of thin plates arranged radially or intertwined. A minor amount of barite is scattered throughout the vein in small individual crystals. Calcite occurs in clear crystals grouped in areas or lining vugs.

The photo on page 28 illustrates the spherulites or nodules mentioned above.

The barite bands consist of closely-packed radiating clusters in cross-orientation. Colour-banding is pronounced in many places owing to bleaching of the pink barite against the fluorite.

### HASTINGS COUNTY, HUNTINGDON TOWNSHIP CONCESSION XI, LOT 14, WEST HALF (28)

#### Johnston Property

In 1943, R. T. Gilman found a vein on this property by diamond-drilling and sank a shaft on it to 55 feet. Known as the Johnston mine, it was operated by Fluoroc Mines Limited in the years 1944 to 1947 and by the Reliance Fluorspar Mining Syndicate Limited in 1949. A total production of 1,150 tons of ore is recorded, but only 187 tons of hand-cobbed fluorspar is known to have been shipped. All mining was done on the 55-foot level where drifting followed the vein for 280 feet. The shaft was deepened to 78 feet in 1949, and a concrete collar was poured to replace the original timbered shaft to bedrock.

The vein strikes northwest across the north half of the property; it is in line with the Noyes vein but is offset several hundred feet west of the strike of the Howard vein. Ordovician limestone is the country rock to a depth of 175 feet, and granite lies below. The drilling program carried out by the Canadian government in 1943, outlined a vein up to 7 feet wide and averaging about 3 feet over an 800-foot length (Fawcett and Wilson, 1943). The vein-material consists of about 50 percent grey-green fluorite, 35 percent pink barite, and 15 percent white calcite. The three minerals are typically interbanded, and much of the banding is too fine to permit effective hand-cobbing.

The mineral dressing laboratory of the Bureau of Mines in Ottawa conducted several tests (Canada 1947) on a 1,600-pound sample to determine whether or not gravity methods would effect a satisfactory separation of the barite and fluorite. The head sample analyzed 60.30 percent $CaF_2$, 21.12 percent $BaSO_4$, and 16.29 percent $CaCO_3$. By a combined jigging and tabling process, a fluorspar concentrate, representing 86.4 percent of the available fluorite, was produced; analysis showed 71.1 percent $CaF_2$, 5.4 percent $BaSO_4$, and 20.4 percent $CaCO_3$. There was no attempt to make a barite product; however, both jigging and tabling produced a barite concentrate which, though essentially free of calcite, was about one-third fluorite. Much of the fluorite was due to attached barite-fluorite particles.

### HASTINGS COUNTY, HUNTINGDON TOWNSHIP CONCESSION XII, LOT 13 (29)

#### Noyes Property

Fluorite-barite veins were discovered on this property by Donald Henderson in 1916. The deposit was worked by Messrs. Wellington and Munro in 1917-18, and by Canadian Industrial Minerals Limited, 1918-20; it had produced more than 15,000 tons of fluorspar and a little barite when the mine was closed in 1920. From 1920 to 1940, the property was owned by the Noyes Mining Company Limited, or leased to Moira Fluorspar Mining Syndicate Limited, but no mining was carried out. R. T. Gilman operated the Noyes mine from 1941 to 1943, recovering about 9,000 tons of fluorspar ore. The underground development on the property consists of two shafts and five working levels over a length of more than 1,000 feet and to a depth of 275 feet, and includes 2,500 feet of drifting and a large number of raises, winzes, and cross-cuts.

The deposits occupy lenticular fault cavities that have been formed by differential movement along the fault. Displacement of the limestone-granite contact on both sides of the vein indicates (Wilson 1929, p. 46) the northeast side is relatively displaced southeastward at least 100 feet. The normally pink granite country rock is bleached grey in contact with vein-material.

Wilson (1929, p.52) describes the deposit as follows:

The fluorspar produced from the Noyes mine has been obtained chiefly from lenticular enlargements on a vertical or nearly vertical vein which extends in a northwesterly direction diagonally across the property. These lenses range from a few feet to over 200 feet in length and from a few inches to 17 feet in width. They consist mainly of fluorspar and barite in varying proportions, fluorspar being predominant in some lenses and barite in others.

The principal fluorspar pod averages 8 feet in width over a length of 200 feet on the 125-foot level. The body rakes to the southeast at a moderate angle and shows an increased barite content at depth. R. H. Binch, mine superintendent in 1943, told the writer that no [fluorspar] ore remains above the 225-foot level. A longitudinal section of the mine-workings shown by Wilson (1929, p. 55) indicates barite-rich vein-material, from 1 to 6 feet wide, over a length of 300 feet on the 225-foot level.

A narrow open-cut, just northwest of the No. 2 shaft, is 150 feet long and up to 25 feet deep. It exposes banded vein-material up to 4 feet wide, from which some barite was shipped in 1918. The vein-material consists of "bands of pink to white barite from ½ to 4 inches wide, alternating with bands of honey-yellow fluorspar from ½ to ⅛ inch wide" (Wilson 1929, p. 53).

### LANARK COUNTY, LAVANT TOWNSHIP CONCESSION VIII, LOT 20 (33)

A barite vein cutting Grenville marble is found in rough terrain 2 miles west of Clyde Forks station on the Canadian Pacific railway. It was developed by stripping and test-pitting by T. B. Caldwell in 1918-19. One carload of crude barite was reported shipped to United States. The occurrence is described by Spence (1922, p. 53) as follows:

The deposit of barytes consists of a single vein, which has been exposed by stripping for a distance of 150 feet. The strike of the vein is northwest, and the apparent dip 30° northeast. The maximum width, as disclosed in the open pit, is 5 feet. The lead occurs near the crest of a ridge rising to a considerable height above a wide valley . . . The barytes is of the hard crystalline variety, is medium- to coarse-grained, and semi-translucent. It thus differs radically from the soft, opaque type of the other deposits in this region. The bulk of the ore is white with a slight bluish or grey tinge.

The deposit is remarkable for the amount and variety of the sulphide minerals it carries. These are present in some amount practically throughout the vein, but are especially abundant in certain portions of it. In the bottom of the pit [15 feet deep], barytes gives way almost completely to these metallics, mixed to some extent with quartz. Much of the surface barytes along the outcrop is stained green or blue by the oxidation products of the copper minerals present. The principal sulphides present are tetrahedrite, stibnite, bornite, chalcopyrite, and pyrite.

Samples of the vein-material assayed by the Mines Branch, Ottawa, showed low values in copper and silver, and traces of gold, arsenic, and antimony (Timm 1920, p. 87). Flotation studies on these samples, ground to pass 100-mesh, indicated that 80 percent of the copper and 50 percent of the silver could be recovered, and the process would yield a clean white tailing grading 97.75 percent $BaSO_4$.

### LANARK COUNTY, NORTH BURGESS TOWNSHIP CONCESSION X, LOT 20 (34)

A vein of barite 8 miles southwest of Perth was worked by H. C. Bellew during the years 1918-21. Production of 200 tons is recorded for each of the last two years, 1920 and 1921, but no shipments appear to have been made. The occurrence was traced for more than 1,000 feet. Spence (1922, p. 55) describes it as follows:

The barytes occurs as a single vein, striking northwest, and having a maximum width, as exposed in the surface pits, of about 2 feet. The vein traverses granite gneiss, and has a vertical dip. The ore is of the soft variety, massive, with an approach to platy structure, and of a prevailing light cream colour. Crystallized, crested barytes is common in druses. No mineral impurities of any kind were noticed at any of the exposures.

An analysis of a sample made up of material taken from the ore piles at the various openings on the vein, and analysed in the Mines Branch laboratory, showed:

| | |
|---|---|
| Barium sulphate | 95.26 |
| Strontium sulphate | 4.00 |

A representative sample of the barytes from this deposit, ground to pass 200 mesh, unbleached, and tested for colour against a standard sample of prime white, paint barytes, proved barely distinguishable from the standard.

## GRADE AND EVALUATION OF BARITE DEPOSITS

The relatively low unit-value and high transport cost of barite imposes severe limitations on its cost of production. Factors of first importance in the evaluation of a deposit are its size and availability, its grade and ease of concentration, and the cost of delivery to the principal market. To be economic, a deposit must have a natural advantage in one or more of these categories. Unfortunately, none of Ontario's deposits is attractive with regard to size and low-cost mining, and only a very limited market is within a reasonable distance of them. However, some are of sufficient quality to require a minimum of beneficiation.

The large easily-mined replacement deposits account for the major share of the world's barite production. The deposit at Walton, Hants County, Nova Scotia, has produced about 3 million tons and has reserves estimated at 2 million tons. The barite ore, although off-colour and containing ½ to 1½ percent iron oxide, grades over 90 percent barite and can be shipped for drilling use with a minimum of beneficiation. Orginally produced from an open-pit, the barite is now mined underground. For the drilling-mud market on the Texas and Louisiana coasts, barite from the Nova Scotia deposit competes because of cheap gravity concentration and low-cost ocean transport. Two companies recover barite from surface and underground operations on the Magnet Cove deposit in Arkansas. Reserves are extensive, and although the ore grade is 50–70 percent barite, it is easily concentrated by flotation to 95 percent. The Arkansas deposit has the advantages of size and efficient concentration and, because of the scarcity of deposits that are more advantageously located, can be marketed in the large Gulf of Mexico drilling area. Barite from residual deposits in Missouri is of prime white colour, and by simple gravity processes can be made suitable for high-quality uses as well as for drilling-mud. Advantages of residual deposits are cheapness of mining and ease of beneficiation.

Veins have been mined in the western United States, usually where the natural grade of the ore was sufficient without further beneficiation and the deposit was readily accessible. None has been worked more than 40 miles from a railway (Peters 1958, p. 973). A vein being worked in California (Lenhart 1957, p. 120) is 50 feet thick and grades 75–80 percent barite. It is jig-concentrated to an off-colour product grading 93 percent barite. In British Columbia, Mountain Minerals Limited mines two barite veins from open-cuts and adits. The veins are high-grade and vary from 11 to 35 feet in thickness and up to 600 feet in length. The barite is of the white crystalline variety and can be upgraded by hand-sorting to paint and glass grades.

The size of most of the Ontario deposits is not sufficient to justify an elaborate concentrating plant; for this reason, deposits grading less than 90 percent barite are of doubtful value unless they are easily up-graded by selective mining or hand-sorting. If further concentration can be justified, gravity separation using jigs and tables will be preferable to flotation, because of both the cost and the marketability of the product. The very fine grinding that is usually necessary for effective flotation leaves the product poorly suited for chemical and glass markets. The cheapest method of mining vein deposits will normally be open-cut, with later development by adit or shaft-sinking depending on the terrain.

Barite lends itself to normal methods of testing. Samples should be analyzed chemically for $BaSO_4$ and $Fe_2O_3$, and for various markets the content of $CaO$, $SiO_2$, $SrSO_4$, and Fl may be important. Whiteness is of prime importance, and the degree of whiteness can be determined by comparing the ground sample to a known standard. A related property, light reflectivity, is important in some filler uses. Specific gravity determinations are essential for the drilling-mud market.

Preliminary examination of a deposit should include stripping, trenching, and channel sampling at intervals not exceeding 100 feet. It is important that the sample be truly representative of the full width, from wall to wall, because many vein deposits are banded and the proportion of impurities is, in many deposits, greater in the wall zone. Large fragments or horses of country rock are perhaps best not included in preliminary sampling, but their size and frequency must be recorded for later calculations of ore grade and reserves. Following a satisfactory surface program, diamond-drilling at intervals dictated by the uniformity of the ore will normally follow. Veins are notoriously variable, and a well-developed vein structure in one rock unit may disappear in a less competent adjoining one.

## MINING, MILLING, BENEFICIATION

Barite is mined by conventional surface or underground methods. The removal of coarse impurities from the ore is accomplished by hand-sorting, gravity methods (jigging, tabling, and heavy-media separations), or flotation. Iron stains and organic discolorations can be removed by water-washing or acid-leaching. Grinding to the fine sizes that are required by most markets is done wet or dry, depending on whether the ore is wetted in previous or subsequent treatment. The products are shipped dry in bulk or in bags.

Many replacement deposits are mined first by open-pit or glory-hole methods, and later by shrinkage-stoping or block-caving from underground workings. Until 1958, the high-grade deposit at Walton, Nova Scotia, shipped unbeneficiated barite to grinding plants on the Atlantic and gulf coasts of United States. The Walton ore is now up-graded by heavy-media separation and jigging before shipment but, because of tariff restrictions, the final grinding is still done in United States. Arkansas ore is wet-ground to 325-mesh, and siliceous and iron-bearing impurities are removed by flotation. The ore is up-graded from less than 70 percent barite to more than 95 percent. Barite can either be floated or depressed in the flotation circuit, and the concentrate is filtered, dried, and calcined to remove the flotation reagents.

Residual deposits are mined by open-pit methods and the clay is removed in log-washers. Fine barite in the overflow is, in some operations, recovered by tabling or flotation. Coarser fragments are crushed and may be further beneficiated by jigging.

Vein deposits are mined by open-cut, or by shrinkage-stoping from adits or underground levels. Hand-sorting is customary to remove wallrock fragments and other obvious waste. Jigging or tabling may be used if further beneficiation is required.

Because of a high tariff on ground barite entering United States, most exports to that country are in the crude (unground) state. Hand-sorted barite is exported in lump sizes; heavy-media products are mostly coarser than ⅛ inch; jig and table concentrates are about 20-mesh; and, flotation concentrates are usually minus-200-mesh. Final milling is done at plants in the major consuming areas. The concentrates are dry-ground using ball or Raymond mills, unless the barite is subsequently to be bleached, in which case wet grinding is customary. Barite for the drilling industry is normally ground to 95 percent minus-325-mesh. Paint and filler applications usually specify a similar grind. The chemical and glass industries prefer coarser grades, for which flotation concentrates are rarely suited because of their fineness.

The barite industry recognizes "hard" and "soft" barite depending on the ease with which it can be ground. Hard barite is preferred for the chemical and lithopone industries, but soft barite is preferred for most other uses because of easier grinding. Soft barite is also more easily bleached; dark-coloured impurities are taken into solution in a bath of dilute sulphuric acid, and the insoluble barite is washed and dried.

## MARKETING

Because more than 90 percent of all barite is consumed in oil-well drilling, the major markets are in the active oil fields. In North America, the most important field is on the Texas-Louisiana coast of the Gulf of Mexico; in 1958 it was estimated to be consuming 85 percent of all drilling-mud used in United States (Peters 1958, p. 975). The west Texas and mid-continent fields account for about 5 percent; western markets, such as California, Colorado, New Mexico, Wyoming, and Montana, take up most of the remaining 10 percent. Drilling in western Canada, Alaska, and the Northwest Territories is supplied with barite from deposits in British Columbia and the states of Washington and Montana. Ontario barite cannot compete in any of the major oil fields.

Chemical and filler markets are principally in the highly industrialized eastern states, and are supplied mostly from U.S. sources in Georgia, Tennessee, South Carolina, and by ocean shipments from Nova Scotia and Europe. High-quality Missouri barite, especially bleached and water-ground and floated grades, supply part of the northeast area of U.S.A. Ontario barite of comparable quality might compete in the latter market.

The two principal barite producers in United States are Baroid Sales Division of National Lead Company, and Magnet Cove Barium Corporation, a subsidiary of Dresser Industries. Both operate mines on the large replacement deposit in Arkansas. Magnet Cove also operates the Walton deposit in Nova Scotia; the National Lead Company mines residual deposits in Missouri. Smaller mines usually sell their barite to the larger companies or to custom grinders. In 1960 barium chemicals were being manufactured by 13 companies in United States, almost all of whom purchased barite from the larger firms.

Paint and filler grades in eastern Canada are marketed by the Pigment and Chemical Company Limited, which has offices in Montreal and Toronto. White barite is obtained from British Columbia and is ground by Industrial Fillers Limited in Montreal. Markets requiring a superior whiteness use water-ground and floated or bleached Missouri barite. Some off-colour German barite is also sold in Canada. There is virtually no domestic barium chemical industry, all Canadian requirements being imported from United States and United Kingdom. A brick company in Quebec produces minor amounts of black ash (barium sulphide) for its own use. Dominion Magnesium Limited at Haleys Station, Ontario, may produce up to several hundred pounds of barium metal each year.

Crude barite is sold in bulk. Ground barite is sold in bulk or in 100-pound paper bags. Bleached, and other grades for high-quality uses are usually

BARITE PRICES — U.S. FUNDS, 31 DECEMBER 1962

| | | |
|---|---|---|
| Georgia | Barytes ore, crude, f.o.b. cars: | |
| | Jig and lump, per short ton | $18.00 |
| | Beneficiated, per short ton in bulk | $21.00 |
| | in bags | $23.50—$25.00 |
| Missouri | f.o.b. mine or mill, carload lots, per short ton: | |
| | Water-ground and floated, bleached | $45.00—$49.00 |
| | Crude ore, minimum 94% $BaSO_4$, less than 1% Fe | $16.00—$18.00 |
| | Crude oil-well drilling, minimum 4.3 specific gravity, in bulk | $18.00 |
| | Some restricted sales | $11.50 |
| | Ground, oil-well grade | $26.75 |
| Imported | c.i.f. Gulf ports, in bulk, per short ton: | |
| | Crude oil-well drilling, minimum 4.25 specific gravity | $11.00—$14.00 |
| Canada | f.o.b. Walton, Nova Scotia: | |
| | Crude, in bulk per long ton | $11.00 |
| | Ground, in bags per short ton | $16.50 |

sold in paper bags of 50- or 100-pound capacity. Because of the weight of barite, transportation cost is an important part of the delivered price.

Prices quoted in the E. & M. J. Metal and Mineral Markets for 31 December 1962, are as shown in the table on page 33.

These prices are nominal because sales are usually negotiated between producer and consumer. Sometimes crude barite is sold on a penalty-premium basis, whereby the price per ton is increased or decreased 25 cents for each 1 percent $BaSO_4$ or 0.1 percent $Fe_2O_3$ above or below a certain standard, often 95 percent $BaSO_4$ and 1 percent $Fe_2O_3$.

The tariff on barite entering United States is $2.55 per long ton for crude barite, and $6.50 per long ton for ground, or otherwise manufactured, barite. The term "crude" does not restrict the up-grading of a barite ore by various processes of beneficiation, but does imply that some further processing (usually grinding) will be necessary in United States before the product is useful to the consuming industry.

Price information is scanty in the Toronto area because of the limited market. Sales are made through individual negotiations between dealer and consumer. The Pigment and Chemical Company quote prices of $70–$80 per ton, bagged, and in carload lots, for paint-grade British Columbia barite. Crude (unground) British Columbia barite is worth about $40 per ton at the grinding plant in Montreal.

## PRODUCTION AND CONSUMPTION

Statistics on the barite industry of United States are given by Skow and Schreck (1962). World production of barite in 1961 was 3 million tons. The major producing countries were United States, West Germany, Mexico, and Canada, in order of importance. Production in United States for 1961 was 731,381 short tons, a marked decline from the peak of 1,351,913 tons in 1956. Arkansas, Missouri, Georgia, and Nevada were the top producing states. United States imports in 1961 were 608,160 tons, principally from Canada, Mexico, and Peru.

Details on Canadian production are given by Ross (1962). Production in 1961 was 191,403 short tons, of which 90 percent was exported to United States, Trinidad, and Venezuela. Magnet Cove Barium Corporation at Walton, Nova Scotia, accounted for about 90 percent of the Canadian production; the remainder came from deposits in British Columbia operated by Mountain Minerals Limited, Baroid of Canada Limited, and Sheep Creek Mines Limited. Canadian imports in 1961 totalled 1,889 tons of ground barite from United States, West Germany, and United Kingdom.

The history of barite production in Ontario is detailed by J. S. Ross (personal communication) as follows:

| Year | Shipment | Source |
|---|---|---|
| | short tons | |
| 1885 | 300 | McKellar Island |
| 1886 | 3,864 | McKellar Island |
| 1887 | 400 | McKellar Island |
| 1888 | 1,100 | McKellar Island |
| 1890 | 1,842 | McKellar Island |
| 1892 | 315 | McKellar Island |
| 1894 | 1,081 | McKellar Island |
| 1918 | 60 | Langmuir twp. |
| 1923 | 200 | Penhorwood twp. |
| 1933 | 20 | Penhorwood twp. |
| 1939 | 323 | Langmuir and Lawson twps. |
| 1940 | 305 | Penhorwood and Lawson twps. |
| 1947 | 40 | Langmuir twp. |
| 1948 | 47 | Langmuir twp. |
| Total | 9,897 | |

The production of 8,902 tons between 1885 and 1894 is all credited to the McKellar Island deposit, although there is some question as to whether the Jarvis Island deposit may also have produced barite during this period.

Consumption of barite in United States and Canada during 1960 is given by Skow and Schreck (1962) and by Ross (1962), and is summarized here as follows:

| | United States | Canada |
|---|---|---|
| | short tons | short tons |
| Well-drilling | 920,283 | 23,809 |
| Barium chemicals and lithopone | 185,201 | 23 |
| Paint | 18,273 | 953 |
| Rubber | 17,082 | 218 |
| Glass | 15,012 | 364 |
| Miscellaneous | 1,180 | 116 |
| Total | 1,157,031 | 25,483 |

The consumption of barite in oil-well drilling is a function both of the rate of drilling activity and of the pressures encountered in the oil and gas horizons. Because pressures normally increase with depth, a high rate of exploration activity in the deeper oil fields is most favourable to the barite industry. The deep Texas-Louisiana gulf-coast field is still the major barite-consuming area although drilling activity has decreased in recent years. According to Ross (1960, p. 18) the consumption of barite in 1957 in one area off-shore along the Louisiana coast was 1 ton per 10 feet of hole. The average consumption during 1959 for all oil drilling in United States was 5.6 tons per 1,000 feet of hole, but in Canada it was only 1.8

tons per 1,000 feet. As much as 50 percent of the barite used could be reclaimed (Peters 1958, p. 976), but the practice has not been widely adopted. Other possible weighting materials, such as celestite, galena, and hematite, do not in general have as desirable a combination of properties, and are not expected to be serious competitors of barite.

North American consumption of barite for lithopone has suffered a marked decline through competition with the more expensive, but generally superior, titanium dioxide pigments. Barite consumption in the glass, chemical, paint, and rubber industries shows fluctuations from year to year, but in general is static.

# APPENDIX – RELATED MINERALS

## WITHERITE

Witherite, $BaCO_3$, is the only other barium mineral of commercial value. It is a comparatively rare mineral, occurring in granular or columnar masses and twinned orthorhombic crystals. Witherite has a hardness of 3½, a specific gravity of 4.3, and a vitreous lustre. Cleavage is poorly-developed, and the mineral breaks with an uneven fracture. Witherite is transparent to translucent and is commonly white or light shades of grey or yellow. It is distinguished from barite by its effervescence in acid and from strontium minerals by its green barium flame in the flame test.

Witherite finds its principal application in the production of barium chemicals, for which it is preferred to barite because of its solubility in acid. It could likely be used in other barite fields if the supply were adequate and the price competitive. England is the principal source of witherite, and all United States imports are from that country. Imports of crude unground witherite by United States have declined from about 4,000 short tons in the early 1950s to 1,716 short tons valued at $67,280 in 1961 (Skow and Schreck 1962a, p. 8). Witherite is not mined in United States or Canada.

Witherite occurs in veins or replacement deposits where it is not uncommonly a gangue for galena. In Northumberland, England, it is found as lenses up to 10 feet thick in a vein mined for lead and zinc (Ladoo and Myers, 1951, p. 80). The witherite lenses are removed separately and are hand-sorted to a 94-percent grade. Lower-grade material is beneficiated by jigging. A large lens of witherite was mined-out prior to 1940 at the El Portal mine in Mariposa County, California (Harding 1948, p. 5). The lens occurred as a replacement in limestone and was associated with other large lenses composed predominantly of barite. In 1954, Conwest Exploration Company Limited examined a fluorite-witherite-barite replacement deposit in Devonian limestone near the Lower Liard River Crossing on the Alaska Highway (Woodcock and Smitheringale, 1957, pp. 244-247). Separation studies by the Industrial Minerals Division of the Department of Mines and Technical Surveys, Ottawa, indicate a satisfactory recovery of both fluorite and witherite is possible, but the deposit has not been developed.

The first-reported occurrence of witherite in Canada was at the Porcupine Mine in Gillies township, District of Thunder Bay. A composite vein of calcite-quartz-fluorite, 1–4 feet thick, has been mined for its content of sulphide minerals. According to Tanton (1931, p. 125), "At one place there is a seam 3 inches wide and 2 feet long, consisting of white witherite, the carbonate of barium, in radial, fibrous, crystalline aggregates."

## CELESTITE

Celestite, the sulphate of strontium, is closely related, and similar in appearance, to barite. It occurs in tabular crystals, often in radiating groups, is white or light shades of blue or pink, has the same hardness as barite (3 to 3½), but has a slightly lower specific gravity (3.9). Celestite and barite can be distinguished with certainty in a flame test; barite colours the flame green, celestite red.

Celestite is a possible substitute for barite as a weighting agent in drilling-mud, but it is less desirable because of its lower specific gravity and unfavourable colloidal characteristics (Stern 1941, p. 54). Its principal use is in the manufacture of strontium compounds, used in small amounts in a variety of industries. Strontium compounds are used in the purification of caustic soda, the manufacture of red signal flares, the refining of beet sugar, desulphurizing of steel, and in the glass and ceramics industries.

The principal sources for commercial-quality celestite are England and Mexico. In Gloucestershire, England, small irregular masses of white celestite are worked by open-pit methods. A ratio of 1 part celestite to 9 parts waste is considered the limit for economic mining (Schreck 1961, p. 3). Mexican celestite occurs in veins and replacements in limestone, sometimes associated with fluorite. In southern and western parts of United States, celestite occurs in bedded replacement deposits in sandstone and shale, often associated with barite or gypsum.

Celestite is mined by simple open-pit methods, using a minimum of mechanical equipment. Beneficiation is usually by hand-sorting, although the ore is amenable to gravity concentration by jigs or tables. Celestite is imported to United States in lump form; it is dried and ground to 90 percent minus-325-mesh and is packaged in paper bags of 100-pound capacity.

Limited quantities of celestite are being stockpiled by the United States government. The National Stockpile Purchase Specification P-10-R2, issued September 28, 1960, gives the following chemical requirements for celestite (Schreck 1961, p. 1):

| | |
|---|---|
| $SrSO_4$, minimum percent | 95 |
| $CaSO_4$, maximum percent | 1.5 |
| $BaSO_4$, maximum percent | 2 |
| Moisture, maximum percent | 2 |

No limitation is placed on the physical form other than that it be suitable for processing by industry.

There was no production of celestite in United States or Canada during 1961. United States imported 9,931 short tons valued at $244,477 in 1961, a 60 percent increase over 1960 (Skow and Schreck, 1962b, p. 2).

Prices quoted by the Oil, Paint and Drug Reporter for 1961 ranged from $56.70 to $66.15 bagged, per short ton, air floated, and ground to 90 percent minus-325-mesh. The only record of celestite production in Canada was during the period 1918-20 when 200 tons were mined from a deposit in eastern Ontario and several small shipments were made.

## Celestite Occurences in Ontario

Spence (1922, pp. 77-85) described four celestite occurrences in eastern Ontario; there has been no further development of these deposits, and the descriptions that follow are taken largely from Spence's report. In addition, a 2-foot bed of celestite has been reported in Devonian rocks at a depth of 115–125 feet in the vicinity of St. Mary's. The bed was encountered in several diamond-drill-holes put down by the St. Mary's Cement Company.

### CARLETON COUNTY, FITZROY TOWNSHIP CONCESSION VI, LOT 21

A celestite-calcite vein, 1–2 feet thick, was explored for galena in 1910 by a vertical shaft 45 feet deep. The occurrence is near Galetta, 34 miles west of Ottawa.

The material on the dump consists mostly of calcite and fragments of the Grenville marble country rock, but a sample of clean celestite selected by Spence analyzed 93 percent $SrSO_4$. The celestite occurs in masses "of rather loosely-interlocking crystals of tabular habit, and is generally white, to colourless. Occasionally, light blue and reddish shades prevail in the clear crystals. There appears to be little [intimate] admixture of calcite or other foreign minerals with the celestite" (Spence 1922, p. 78).

### FRONTENAC COUNTY, LOUGHBOROUGH TOWNSHIP CONCESSION XII, LOT 5

In 1907, W. Morden extracted a few tons of celestite ore from an occurrence east of Verona and about 25 miles north of Kingston. The deposit lies in a depression at the contact between Grenville marble and gneiss and consists "of a mass of rather loosely intergrown, tabular, crystals of baryto-celestite, forming the cementing material between brecciated fragments of crystalline limestone . . . The bulk of the baryto-celestite is pure white, opaque, and breaks up readily into tabular, cleavage pieces" (Spence 1922, p. 79). A grab sample is reported by Spence to have analyzed:

| | |
|---|---|
| $SrSO_4$ | 75.90 |
| $BaSO_4$ | 15.02 |
| $CaCO_3$ | 7.32 |

### LEEDS COUNTY, REAR OF LEEDS AND LANSDOWNE TOWNSHIP CONCESSION VIII, LOT 2

A vertical vein of celestite, 1–2 feet thick, is exposed in a pit 40 feet long, 5 feet wide, and 20 feet deep, in silicated Grenville marble. The occurrence is south of Lyndhurst, near the road, and about 12 miles north of Gananoque. "The celestite occurs as a rather loose aggregate of clear, lustrous, tabular crystals, of a prevailing bluish colour; but brown, and colourless crystals are also common" (Spence 1922, p. 79). Spence gives analyses for three samples indicating the average grade of the vein to be about 98 percent $SrSO_4$.

### RENFREW COUNTY, BAGOT TOWNSHIP CONCESSION X, LOT 7

A celestite deposit 5 miles southeast of Calabogie was worked by J. E. Wilder from 1918 to 1920. A small grinding plant was built on the property, but of the 200 tons recorded as mined only 23 tons of ground celestite were shipped in 1921 for use in rubber and 27 tons in 1941 for paint. The deposit is described by Spence (1922, pp. 80-85) and Satterly (1945, pp. 111–13).

Four pits were opened in the deposit. These measured 70 by 60 feet and 21 feet deep, 40 by 10 feet and 8 feet deep, 4 by 10 feet and 2 feet deep, and 9 by 4 feet and 4 feet deep. The celestite occurs in white radiating masses up to 1 foot in diameter as the cementing material in breccia zones 1–10 feet wide in white to pink Grenville marble. Satterly (1945, p. 113) also reports that very little staining or impurity is visible, and that the specific gravity of the ore is 3.99. The analysis of a representative sample from the stockpile is given by Spence (1922, p. 84) as follows:

| | |
|---|---|
| $SrSO_4$ | 78.50 |
| $BaSO_4$ | 18.61 |
| $CaSO_4$ | 0.73 |

## BIBLIOGRAPHY

**(Barite only; see also page 39.)**


Baker, J. M.
1959: Glendinning barite deposit; *unpublished report for* Independent Mining Corporation Ltd., Nov. 30, 1959.

Bates, R. L.
1960: Barite; *in Chapter 8 of* Geology of the industrial rocks and minerals; Harper's Geoscience Series, Harper & Brothers, New York, U.S.A., pp. 287–296.

Berry, L. G.
1942: Geology of the Langmuir-Sheraton area; Ontario Dept. Mines, Vol. XLIX, 1940, pt. 4.

Brobst, D. A.
1960: Barium minerals; *Chapter 3 of* Industrial minerals and rocks (3rd edition); American Inst. Min. Met. Eng., New York, U.S.A., pp. 55–64.

Burgess, J. A.
1928: Jarvis Island barite deposit; *unpublished report for* Sudbury Basin Mines Ltd., June 14, 1928.

Burrows, A. G.
1918: The Matachewan gold area; Ontario Bur. Mines, Vol. XXVII, pt. 1, pp. 215–240.
1920: Matachewan gold area; Ontario Dept. Mines, Vol. XXIX, pt. 3, pp. 53–64.

Canada
1947: Gravity concentration of barite and fluorspar from Fluoroc Mines Ltd., Madoc; Canada Dept. Mines and Resources, Bureau of Mines, Industrial Minerals Milling Laboratory, Investigation No. 2235, May 26, 1947.

Craigie, D. E.
1940: Howard property; *unpublished report for* Reliance Fluorspar Mining Syndicate, Sept. 11, 1940.

Cooke, H. C.
1919: Geology of Matachewan district, northern Ontario; Geol. Surv. Canada, Memoir 115.

Dyer, W. S.
1936: Geology and ore deposits of the Matachewan-Kenogami area; Ontario Dept. Mines, Vol. XLIV, 1935, pt. 2.
1940: Glendinning barite deposit; *unpublished report for* Dr. H. D. Glendinning and associates, Aug. 6, 1940.

Fawcett, T. C., and Wilson, M. E.
1943: Johnston fluorspar property; *unpublished plan and section of diamond drilling for the* Metals Controller and Dept. of Mines, Ottawa.
Gibson T. W.
1918: Statistical review of the mineral industry of Ontario for 1917; Ontario Dept. Mines, Vol. XXVII, pt. 1.
1919: Statistical review of the mineral industry of Ontario for 1918; Ontario Dept. Mines, Vol. XXVIII, pt. 1.
Harding, W. D.
1938: Geology of the Horwood Lake area; Ontario Dept. Mines, Vol. XLVI, 1937, pt. 2.
1951: Geology of the Olden-Bedford area; Ontario Dept. Mines, Vol. LVI, 1947, pt. 6.
Harness, C. L., and Barsigian, F. M.
1946: Mining and marketing of barite; United States Bureau of Mines, Info. Circ. 7345.
Hoffman, G. C.
1888: Chemical contributions to the geology of Canada; Geol. Surv. Canada, Summary Rept. 1887 and 1888, part T.
Hogg, N.
1946: Woodhall barytes mine; *unpublished report of the* Resident Geologist, Timmins, Ontario Dept. Mines, Sept. 28, 1946.
Ingall, E. D.
1888: Report on mines and mining on Lake Superior; Geol. Surv. Canada, Summary Rept. 1887 and 1888, pt. H.
Jewett, G. A.
1957: The Walton, N.S., barite deposit; *in* The geology of Canadian industrial mineral deposits, Congress Volume; Canadian Inst. Min. Met., Montreal, Que., pp. 54–58.
Ladoo, R. B., and Myers, W. M.
1951: Barium minerals; *in* Nonmetallic minerals (2nd edition), McGraw-Hill Book Co., New York, U.S.A., pp. 67–82.
Lenhart, W. B.
1957: The story of barite; Rock products, Maclean-Hunter, Chicago, U.S.A., April, 1957, p. 120.
Logan, W. E.
1863: Geology of Canada; Geol. Surv. Canada.
Moore, E. S.
1956: Geology of the Miller Lake portion of the Gowganda silver area; Ontario Dept. Mines, Vol. LXIV, 1955, pt. 5.
Peters, W. C.
1958: Economic position of western barite deposits; Mining Engineering, American Inst. Min. Met. Eng., New York, U.S.A., September 1958, pp. 972–976.
Rogers, W. R.
1922: Statistical review of Ontario's mineral industry in 1920; Ontario Dept. Mines, Vol. XXX, 1921, pt. 1.
Ross, J. S.
1960: The barium minerals industry in Canada; Canada Dept. Mines and Technical Surveys, Mines Branch Info. Circ. 126.
1962: Barite; *in* The Canadian mineral industry 1961; Canada Dept. Mines and Technical Surveys.
Russell R., Valencia C., and Emrich, H. W.
1956: Barite in ceramic whitewares; Journal of the American Ceramic Society, Columbus, Ohio, U.S.A., Vol. 39, No. 2, pp. 73–82.
Schreck, A. E.
1960: Barium; *in* Mineral facts and problems (1960 edition); United States Bureau of Mines, Bull. 585, pp. 85–93.
Skow, M. L., and Schreck, A. E.
1962: Barite; *preprint for the* Minerals yearbook, 1961, Vol. 1, United States Bureau of Mines.

Spence, H. S.
1922: Barium and strontium in Canada; Canada Dept. Mines, Mines Branch, No. 570.

Tanton, T. L.
1931: Fort William and Port Arthur, and Thunder Cape map-areas, Thunder Bay District, Ontario; Geol. Surv. Canada, Memoir 167.

Timm, W. B.
1920: Test No. 122; Ore Dressing and Metallurgical Division, Summary Rept. of the Mines Branch for 1919, Ottawa, No. 542, pp. 86–87.

Todd, E. W.
1925: Groundhog River area; Ontario Dept. Mines, Vol. XXXIII, 1924, pt. 6.

1926: Gowganda vein minerals; Ontario Dept. Mines, Vol. XXXV, pt. 3, pp. 62–77.

Uglow, W. L.
1916: Lead and zinc deposits in Ontario and in eastern Canada; Ontario Bur. Mines, Vol. XXV, pt. 2.

Wilson, M. E.
1929: Flourspar deposits of Canada; Geol. Surv. Canada, Econ. Geol. Series, No. 6.

## BIBLIOGRAPHY

**(Appendix only)**

Enck, E. G.
1960 : Strontium minerals; *Chapter 48 of* Industrial minerals and rocks (3rd edition); American Inst. Min. Met. Eng., New York, U.S.A., pp. 815–18.

Harding, A. C.
1948 : Barite production in the United States; American Inst. Min. Met. Eng., Technical Publication No. 2414, New York, U.S.A., July 1948.

Ladoo, R. B., and Myers, W. M.
1951 : Witherite; *in* Nonmetallic minerals (2nd edition), McGraw-Hill Book Co., New York, U.S.A., p. 80.

Ross, J. S.
1960 : Witherite; *in* The barium minerals industry in Canada; Canada Dept. Mines and Technical Surveys, Mines Branch, Info. Circ. 126, pp. 58, 59.

Satterly, J.
1945 : Strontium; *in* Mineral occurrences in the Renfrew area; Ontario Dept. Mines, Vol. LIII, 1944, pt. 3, pp. 110–13.

Schreck, A. E.
1961 : Strontium; *preprint for the* Minerals yearbook for 1960, Vol. 1, United States Bureau of Mines.

Skow, M. L., and Schreck, A. E.
1962a: Barite; *preprint for the* Minerals yearbook for 1961, Vol. 1, United States Bureau of Mines.
1962b: Strontium; *preprint for the* Minerals yearbook for 1961, Vol. 1, United States Bureau of Mines.

Spence, H. S.
1922 : Strontium; *Part II of* Barium and strontium in Canada; Canada Dept. Mines, Mines Branch, No. 570, pp. 77–90.

Stern, A. G.
1941 : Strontium sulphate; *in* Role of clay and other minerals in oil-well drilling fluid; United States Bureau of Mines, R.I. 3556, p. 54.

Tanton, T. L.
1931 : Fort William and Port Arthur, and Thunder Cape map-areas, Thunder Bay District, Ontario; Geol. Surv. Canada, Memoir 167.

Woodcock, J. R., and Smitheringale, W. V.
1957 : Fluorite-witherite deposit at Lower Liard Crossing, British Columbia; *in* The geology of Canadian industrial mineral deposits, Congress Volume; Canadian Inst. Min. Met., Montreal, pp. 244–47.

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### (FOR BARITE AND APPENDIX)

A



B



C



D



E



F

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