British Columbia Department of Mines and Petroleum Resources
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NOTES ON BERYLLIUM

Beryllium is a grey, hard, brittle metal. It is the only lightweight (S.G. = 1.85) metal with a high melting point (m.p. = 1285° C.). It is an excellent sound transmitter, is highly permeable to X-rays, and has special applications in atomic energy because it moderates (slows down) neutrons produced by fission, reflects neutrons in radium- or polonium-beryllium neutron sources, and has the lowest thermal neutron absorption cross-section of all metals.

Beryllium is used chiefly in alloys, particularly with copper. It imparts to the beryllium-copper special properties of high resistance to fatigue, corrosion, wear, heat, and volume change as well as increasing strength, hardness, and electrical and thermal conductivity. Because of these properties the alloy is useful for making springs, gauges, valves, electrical spring contacts, and precision control instruments. Other uses for the alloy are in the manufacture of low-sparking safety tools, as a setting for industrial diamonds, in aircraft, and for various military needs.

Its special atomic properties make beryllium a material of increasing importance in the atomic energy and X-ray fields.

Certain beryllium compounds find use in the manufacture of phosphors for coating fluorescent light tubes.

Hot pressed and machined beryllium oxide shapes are used in the nuclear, aircraft, missile, and electronic industries. Beryllium oxide is also used in crucibles and coatings for crucibles.

Beryl is used as a ground-coat frit in ceramics and in the manufacture of electrical insulators and spark plugs.

A few forms of beryl serve as gems, the green emerald being most familiar.

MINERALOGY

Beryllium is present in many minerals but to date the only commercial production has been from the mineral beryl. Other minerals that in the future might provide

alternative sources are helvite and phenacite.

Beryl: is a beryllium-aluminum silicate that contains 14 per cent beryllium oxide when pure. It has a hardness of 7.5 to 8, specific gravity of 2.6 to 2.8, vitreous lustre, and lacks cleavage. The colour is commonly green but may be blue, red, yellow, or colourless and the streak is white. The mineral is characterized by its green colour and hexagonal crystal form. It is occasionally massive and then may easily be mistaken for quartz. Other minerals with which beryl may be confused are apatite, which is much softer, and topaz, which has pronounced cleavage.

Helvite: is a silicate-sulphide of beryllium, iron, and manganese that contains 13.6 per cent beryllium oxide when pure. It has a hardness of 6 to 6.5, specific gravity of 3.1 to 3.4, vitreous to resinous lustre, and lacks cleavage. The colour is yellow to brown, red, or green and the streak is uncoloured. Helvite commonly crystallizes in small tetrahedral crystals resembling garnet with which it is often associated and confused.

Phenacite: is beryllium orthosilicate which contains 45.5 per cent beryllium oxide if pure. It has a hardness of 7.5 to 8, specific gravity of 2.9 to 3, vitreous lustre, and conchoidal fracture. It is colourless, wine yellow, pale red, or brown. This mineral is easily mistaken for quartz.

OCCURRENCE

Beryl: is usually found in pegmatites and to a lesser extent in schists and other metamorphic rocks close to pegmatites or or pegmatite-bearing granites. Associated minerals are quartz and feldspar with varying amounts of mica, pyroxene, and certain rare minerals.

Helvite: is found in pegmatites, gneiss, and contact metamorphic zones. It is most likely to occur at contacts where there is evidence of rare minerals or coarse crystallization of common minerals. Common associated minerals are garnet, magnetite, pyroxene, and beryl.

Phenacite: is most commonly found in pegmatites but also occurs in granite druses and schist. It is associated with microcline, topaz, quartz, emerald, and chrysoberyl.

With the exception of well-crystallized beryl these minerals could all be easily overlooked in the field,

especially if they occur in small grains or disseminated. Detectors called berylometers have been developed which it is hoped will prove useful in prospecting for beryl minerals. These detectors work on the principle that beryllium-containing minerals will reflect induced radiation from a suitable source. The detector contains a source of radiation plus a device to register the reflected radiation.

Berylometers can be obtained from Nuclear Enterprises Limited, 1750 Pembina Highway, Winnipeg 9, Manitoba. The price is approximately $2,000. The radioactive source used in the instrument is useable for 4 to 6 months and costs approximately $90 plus freight charges to and from Ottawa. A license to purchase a radioactive source must be obtained from Atomic Energy of Canada Limited, P.O. Box 93, Ottawa, Canada, Commercial Products Division, and the source is bought from them.

CHEMICAL FIELD TEST

The United States Bureau of Mines reports a simple reliable field test for beryllium in Information Circular 7946. A small sample of powdered rock is fused in a sodium carbonate-sodium hydroxide bead in a wire loop. The bead is dissolved in water, quinizarin solution is added, and the resulting solution is viewed under ultraviolet light. Pink-to-orange fluorescence indicates beryllium in concentrations as low as 0.013 per cent.

Quinizarin solution is prepared by adding one-quarter teaspoon of technical grade quinizarin powder to 25 millilitres of ethyl or methyl alcohol, and allowing the reagent to stand several hours to form a saturated solution. The solution is filtered and the filtrate diluted with four times as much alcohol. The prepared reagent should be carried in a glass stoppered or polyethylene dropping bottle. It must not come in contact with rubber or oil and should be kept out of direct sunlight or intense electric light.

The flux is prepared by grinding two parts sodium hydroxide pellets with three parts anhydrous sodium carbonate as rapidly as possible. Prepared flux must be kept in a tightly stoppered glass or polyethylene container.

The water used should be soft and low in metallic ions, especially calcium ions.

A blank test, using only the reagents and water without any known beryllium containing material, should be run to check that nothing is present in the material used that will give a false indication.

To make the test a molten bead of flux is built up in a one-quarter inch loop on the end of a piece of wire (preferably platinum, but iron, nickel, chomel, or alumel will do). The molten bead is touched to the powdered sample and the adhering powder is fused in the bead until entirely dissolved. The wire with the bead is placed in 5 to 10 millilitres of water in a test tube and heated to dissolve the bead. The wire is removed, the solution is cooled, and ten drops of the quinizarin solution are added. A purple or lilac colour should result. A small amount of this solution is poured in a cavity in a white porcelain spot plate and examined in the dark under an ultraviolet light. Pink-to-orange fluorescence indicates beryllium.

Similar tests using different chemicals are described in United States Bureau of Mines Report of Investigation No. 5620.

BRITISH COLUMBIA DEPOSITS

No commercial deposits of beryllium minerals are known in British Columbia although several occurrences are on record. Beryl has been reported in pegmatite on Midge Creek[1], Hellroaring Creek[2], Skookumchuck Creek[3], White Creek[4], Incomappleux River, Mount Begbie[5], the Silver Creek trail near Illecillewaet[6], on the Yellow Creek mica claims near Boat Encampment at the "big bend" of the Columbia River, on Mica Mountain near Tete Jaune[7], near Lempriere, near the head of Dortatelle Creek[8], near Fort Grahame[9], in the Horseranch Range near McDame[10], and in the vicinity of Jennings River[11].

Helvite has been identified in skarn from Needle Point Mountain near McDame[12].

Beryllium was detected in samples from the Frdahl and Pinchbeck claims in the Duncan River area but the host mineral was not identified[13].

1. Geol. Surv., Canada: Paper 60-21, p. 11; Mem. 228, p. 35.
2. Geol. Surv., Canada, Paper 60-21, p. 12; Minister of Mines, B. C., Ann. Rept., 1960
3. Geol. Surv., Canada: Paper 60-21, p. 11; Mem. 292, pp. 44, 64.
4. Geol. Surv., Canada: Paper 60-21, p. 11; Mem. 228, p. 33.
5. Geol. Surv., Canada: Paper 60-21, p. 10; Mem. 296, p. 162.
6. Geol. Surv., Canada: Paper 60-21, p. 10; Sum. Rept., 1928A, pp. 149, 156.
7. Minister of Mines, B. C., Ann. Rept., 1920, p. N95.
8. Geol. Surv., Canada, Mem. 251, pp. 32, 64.
9. Geol. Surv., Canada, Sum. Rept., 1927A, p. 32.
10. Minister of Mines, B. C., Ann. Rept., 1955, p. 9.
11. Geol. Surv., Canada, Paper 60-21, p. 6.
12. Geol. Surv., Canada, Paper 60-21, p. 6; Minister of Mines, B. C., Ann. Rept., 1955, p. 11.
13. Minister of Mines, B. C., Ann. Rept., 1945, p. 107A.

MARKETING

Beryl is marketed as cobbed crystals or masses free from adhering or intergrown gangue. It must contain 10 to 12 per cent beryllium oxide. November, 1960, prices quoted in the Engineering and Mining Journal for short ton units of 20 pounds were: (1) U. S. domestic = $46 - $48, (2) Imported = $31.75 - $34.50.

Estimated world production for 1958 was 7,000 tons. Most of this was used in the United States. Major producing countries were Brazil, Southern Rhodesia, Argentina, U. S. A., South Africa, and Madagascar.

POSSIBLE BERYL BUYERS

Beryllium Corp., P.O. Box 1462, Reading, Pa., U.S.A.

Beryl Ores Co., P.O. Box 499, Route 1, Arvada, Colo., U.S.A.

Brush Beryllium Co., 4301 Perkins Ave., Cleveland 3, Ohio.

Derby and Co., Inc., 285 Madison Ave., New York 17, N.Y.

Foote Mineral Co., 18 W. Chelten Ave., Philadelphia 44, Pa.

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Nonmetallic Minerals, Ladoo and Myer, Second Edition, 1951, McGraw-Hill Co., New York, pp. 101-107.

Rarer Metals, J. DeMent, H.C. Dake, and E.R. Roberts, 1949, Temple Press, Bowling Green Lane, London, E.C. 1.

Minerals Year Book, Bureau of Mines, U.S. Dept. of the Interior, Washington, D.C.

Beryllium Occurrences in Canada, Geol. Surv., Canada, Paper 60-21, 1960.

Field Test for Beryllium, U.S. Bureau of Mines, I.C. 7946, R.I. 5620, 1960.