COPY

Rare-earth minerals

STATE DEPARTMENT OF GEOLOGY AND
MINERAL INDUSTRIES
1069 STATE OFFICE BUILDING
PORTLAND 1, OREGON

Oct. 23, 1952

Mr. Leo D. Baker
P. O. Box 312
Glendale, Oregon

Dear Sir:

Mr. Appling who was in this office yesterday when you mentioned being interested in a book on rare-earth minerals informed me to-day that he was mistaken about a new publication pertaining to these minerals having been brought to his attention. The book that he had in mind was a new one on gem minerals and not the rare-earth minerals.

The rare-earth minerals are the oxides or carbonates of the rare-earth metallic elements of which 14 are known. Their names are cerium, neodymium, lanthanum, samarium, gadolinium, dysporsium, ytterbium (yttrium ?) erbium, praseodymium, lutecium, terbium, holmium, thulium, europium.

Rare-earth minerals, because of their rarity and as they most often occur in small quantities,are difficult to determine and the best procedure is verification by spectrographic analysis when their presence is suspected. Only a few of these minerals have distinctive physical properties or optical properties that can be detected under a microscope. Some of them are radioactive due to contained radioactive elements, thorium and uranium.

The favored occurrence of these minerals is in pegmatite veins or dikes. There is some commercial production from placers and lode properties.

Some of the rare-earth minerals and information pertaining to them follow:

(1) Monazite, common source of rare-earths and thorium. It occurs in placers as a honey yellow to greenish yellow

resinous grains, some of which are iron-stained to reddish brown and are opaque. H - 5 to 5½; G - 4.9 to 5.3. Has excellent cleavage. Owing to its brittleness, monazite may be cracked between the teeth. It is slightly radioactive. Occurs in granite, granite gneiss, and related pegmatites. Commercial deposits restricted almost entirely to placers. Gold placers in Idaho batholith and certain beach sands as in Florida are a source of monazite.

(2) Bastnasite, a fluorcarbonate of the cerium metals, hexagonal prismatic crystals, wax yellow to reddish brown. H - 4; G - 5. May resemble a pile of thin plates. Also anhedral masses; granular. Cleavage indistinct, basal parting, luster vitreous to greasy. Found in pegmatites, granites, contact zones, etc. Associated with tin, fluorite, etc.

(3) Euxenite, a niobate and titanite thorate of cerium metals, prismatic crystals, brownish black, infusible. H - 6½; G - 4.7 to 5. Fracture conchoidal, irregular. Streak yellowish, grayish, or reddish brown. Radioactive. Found in granite pegmatites with the other rare-earth minerals.

(4) Samarskite, rare-earths (Ce, Y, Nb, Ta) with iron calcium and uranium oxides. Rectangular prisms, massive; luster vitreous to resinous, splendent; color velvet black; and streak dark reddish brown. H - 5 to 6; G - 5.6 to 6.8. Associated with columbite in granite pegmatites.

(5) Allanite,(orthite) (epidote group) contains rare-earths. Brown to black, opaque monoclinic crystals. H - 6; G - 3.5 to 4.2. Becomes amorphous and denser on heating. Accessory mineral in granites and pegmatites.

(6) Cerite, a hydrous silicate of cerium metals, lime, and ferrous oxide, is brittle, opaque, brown to red, orthorhombic mineral usually massive. No cleavage, dull resinous luster. H - 5½; G - 4.9. Occurs associated with bastnasite in pegmatite, Bastnaes, Sweden.

Dana's Testbook of Mineralogy published by John Wiley and Sons, Inc., New York City, New York, is one book that has some information about rare-earth minerals, but it is widely scattered throughout the volume. This book sells for about $6.00. A book entitled, "The Rare Earths: Their Occurrence, Chemistry, and Technology" by S. I. Levy and published by Edward Arnold and Co., 1924, London, England is listed

in one bibliography, but I know nothing of the availability or price of this book. Another book is "The Analysis of Minerals and Ores of the Rarer Elements" by Schoeller and Powell which was published by J. B. Lippincott Company in 1940.

I hope this information is helpful to you.

Sincerely yours,

David White
Geologist

DJW:ams

Rare-earth minerals

March 27, 1952

Mr. Norman S. Wagner
State Assay Laboratory
2033 First Street
Baker, Oregon

Dear Wag,

After wading through numerous varieties of rare-earth minerals listed in Dana, "The analysis of Minerals and Ores of the Rarer Elements," by Schoeller and Powell (J. B. Lippincott Company, 1940), Bateman's "Economic Mineral Deposits," and a few others, I have made a list of some of the rare-earth minerals and minerals of the rare metals columbium, tantalum and germanium.

The rare-earth minerals are, because of their rarity, quite difficult to determine and the best procedure is verification by spectrographic analysis when their presence is suspected. Only a few of the minerals have distinctive physical properties. This also seems to be true of their optical properties detected under the microscope. Some of them are radioactive due to contained radioactive elements, and a few are fluorescent.

The favored occurrence of these minerals is in pegmatites; however, due to their rarity they are usually obtained as by-products in treatment of other ores. There is some commercial production from placer and lode properties.

As you are undoubtedly aware identification of these minerals as any other unfamiliar species is greatly aided by direct comparison with <u>known</u> minerals especially when seen under the microscope. Word-descriptions seem to have a flexible interpretation. We have only very few of these minerals in our files.

Some of the Rare-Earth Minerals

(1). <u>Monazite</u>, common source of rare-earths and thorium. It occurs in <u>placers</u> as honey yellow to greenish yellow resinous grains, some of which are iron-stained to reddish brown and are opaque. H - 5 to 5½; G - 4.9 to 5.3. Has excellent cleavage. Owing to its brittleness, monazite may be cracked between the teeth. It is slightly radioactive. Occurs in granite, granite gneiss, and related pegmatites. Commercial deposits restricted almost entirely to placers. Gold placers in Idaho batholith and certain beach sands as in Florida are a source of monazite.

(2). Parisite $CaCe_2F_2(CO_3)_3$, brownish yellow to red, acute double hexagonal pyramids with perfect basal cleavage, streak yellowish white. Fracture subconchoidal to splintery. Brittle, H - 4½; G - 4.26 to 4.38. Luster vitreous to resinous and pearly. Found in pegmatite veins, e.g., Quincy, Mass. and Ravall, Mont.

(3). Bastnäsite, a fluorcarbonate of the cerium metals, hexagonal prismatic crystals, wax yellow to reddish brown. H - 4; G - 5. May resemble a pile of thin plates. Also anhedral masses; granular. Cleavage indistinct, basal parting, luster vitreous to greasy. Found in pegmatites, granites, contact zones, etc. Associated with tin, fluorite, etc.

(4). Xenotime, yttrium phosphate, brown to red-brown or yellow, transparent to opaque. Tetragonal; perfect cleavage. Vitreous luster. Streak pale brown, yellowish or reddish. H - 4½; G - 4.5. Occurs in pegmatite veins, granitic and gneissoid rocks.

(5). Euxenite, a niobate and titanite thorate of cerium metals, prismatic crystals, brownish black, infusible. H - 6½; G - 4.7 to 5. Fracture conchoidal, irregular. Streak yellowish, grayish, or reddish brown. Radioactive. Found in granite pegmatites with the other rare-earth minerals.

(6). Samarskite, rare-earths (Ce, Y, Nb, Ta) with iron calcium and uranium oxides. Rectangular prisms, massive; luster vitreous to resinous, splendent; color velvet black; and streak dark reddish brown. H - 5 to 6; G 5.6 to 6.8. Associated with columbite in granite pegmatites.

(7). Fergusonite, a metaniobate (and tantalate) of yttrium with erbium, cerium, uranium, etc., in varying amounts; also iron calcium, etc. Fracture subconchoidal, brittle. H - 5½ to 6; G - 5.8 to 4.3. Dull luster on outer surface, on fracture brilliantly vitreous and submetallic. Color brownish black, streak pale brown. Occurs in granite pegmatites rich in other rare-earth minerals.

(8). Allanite (orthite) (epidote group) contains rare-earths. Brown to black, opaque monoclinic crystals. H - 6; G - 3.5 to 4.2. Becomes amorphous and denser on heating. Accessory mineral in granites and pegmatites.

(9). Gadolinite, ferrous beryllium, yttrium silicate; brown to greenish-black brittle, massive; no cleavage, splintery to conchoidal fracture. H - 7; G 4 to 4.5. Glows when heated to 430°C., and is then soluble in acids, the amorphous variety becoming crystalline and denser. Occurs principally in pegmatite veins associated with allanite and other rare-earth minerals.

(10). Yttrialite, yttrium thorium silicate, massive, amorphous, translucent, olive-green. H. - 5½; G - 4.6, associated with gadolinite. Radioactive.

(11). Yttrocrasite, a complex titanite of yttrium, with calcium, thorium, uranium, lead, iron. Radioactive, black with bright pitchy luster. H - 5½; G - 4.8. Found in granite pegmatite in Texas.

(12). Delorensite, ferrous uranium yttrium titanate, resinous, black, orthorhombic crystals; radioactive. H - 5.5; G - 4.7. Found in pegmatite Graveggia, Piedmont, Italy.

(13). Yttrofluorite, yttrium calcium fluoride, yellow to brown transparent cubes with poor octahedral cleavage. Vitreous to greasy luster, brittle. H - 4½; G - 4.5. Found in pegmatite in northern Norway.

(14). Yttrocerite, yttrium cerium calcium fluoride, violet-blue to white, massive; vitreous to pearly luster. H - 4½; G - 3.4. Similar in form to fluorite (Fluorite at times takes on varying amounts of YF_3, yttrofluorite and $YCeF_3$, yttrocerite).

(15). Cerite, a hydrous silicate of cerium metals, lime, and ferrous oxide, is brittle, opaque, brown to red, orthorhombic mineral usually massive. No cleavage, dull resinous luster. H - 5½; G - 4.9. Occurs associated with bastnaesite in pegmatite, Bastnaes mine, Sweden.

(16). Beckelite, a zirconosilicate of cerium metals and calcium found in brown transparent octahedra and dodecahedra with cubic cleavage. H - 5; G - 4.1. Occurs in nephaline-syenite on north shore Sea of Azov, Russia.

Columbium, tantalum, and germanium minerals

Columbite-tantalite, a niobate and tantalite of iron and manganese which is an isomorphous series grading from almost pure columbite to almost pure tantalite. The percentage of tantalite is approximated by the specific gravity of the mineral; 5.4 Sp. gr. = 5% Ta_2O_5, 6.5 sp. gr. = 50% Ta_2O_5, 7.4 sp. gr. = 75% Ta_2O_5. The mineral is iron black, grayish and brownish black, etc. Streak dark red to black. Luster submetallic often brilliant, sub-resinous. Crystals short prismatic, often rectangular and tabular, frequently twinned in various ways. Subconchoidal uneven fracture, brittle; H - 6. Often confused with wolframite which has more distinct cleavage, and with tourmaline which has different crystal form. Occurs in pegmatite veins and placers.

Microlite. Microlite is a commercial ore-mineral but much rarer than tantalite. Essentially a calcium pyrotantalate containing niobium (columbium), fluorine, etc. Very small modified octahedral crystals, pale yellow to brown, rarely red. Isometric. H - 5½; G - 5.5. Infusible. Rare occurrence as dark specks in large crystals of pegmatite dikes. Concentrated by gravity.

Germanium is obtained from zinc refinery slimes and is contained in the minerals germanite and argyrodite.

Argyrodite is a silver sulpho-germanate. Crystals are indistinct, occasionally octahedral and dodecahedral, frequently twinned, also massive. Color steel-gray on fresh fracture, with tinge of red turning to violet and black. Uneven conchoidal fracture. Britte. H - 2.5; G - 6.1 to 6.3. Streak grayish black. Occurs with siderite ($FeCO_3$) in silver, lead, and zinc sulfide mineralization.

Germanite, a sulfide of copper and germanium with iron, zinc, gallium, and arsenic in smaller amounts. No crystals have been found, but determined isometric. No cleavage, brittle. H - 4; G - 4.46 to 4.59. Color dark reddish gray. Metallic luster. Dark gray to black streak. Occurs intimately associated with pyrite, tennantite, enargite, galena, and sphalerite at Tsumeb, south-west Africa.

Of the minerals listed under the rare-earth group above, only a few are or have been of economic importance the rest are simply of mineralogical interest. Some of the known rare-earth minerals are omitted because of lack of data and restricted occurrence.

Sincerely,

Len

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