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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

TO ACCOMPANY MAP MR-35

BERYLLIUM IN THE UNITED STATES

(exclusive of Alaska and Hawaii)

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Introduction

This map shows most of the known occurrences of beryllium minerals and of rocks that contain 0.003 percent or more beryllium (0.01 percent BeO) in the United States (exclusive of Alaska and Hawaii). The occurrences are subdivided on the map according to genesis and size. The genetic types of deposits shown are: pegmatite, vein and replacement deposits (exclusive of tactite), tactite, disseminated beryl in granite and rhyolite, hot spring deposits, and residual materials. Deposits of each type that have a total production plus reserve greater than 24,000 lbs. of contained BeO (equivalent to 1200 short ton units of BeO or 100 tons of beryl) are shown by a large symbol. Names are given only for the districts that are of particular economic or scientific importance. Both published information and unpublished data gathered by the U. S. Geological Survey were used in preparing the map and text.

Geology

Beryllium, as a strongly oxyphile element, is not, ordinarily, closely associated with sulfide minerals of the base metals, but instead is with such oxy-compounds as silicates, oxides, or carbonates, and with fluorite. Where found in metal mines, the concentrations of beryllium minerals occur outside of shoots of sulfide ore or represent an earlier stage of mineralization upon which a later sulfide stage was superimposed. Beryllium can replace silicon to a small extent in silicate minerals but tends during magmatic differentiation to remain in the fluid phase, becoming progressively more concentrated in later, more silicic differentiates. The beryllium in some rocks that contain hundredths or even tenths of a percent of the metal is dispersed in such rock-forming minerals as pyroxenes, plagioclase, idocrase, or cordierite, from which it is likely not to be economically recoverable. During weathering the dispersed beryllium generally enters clay minerals or, less commonly, iron or manganese oxides. The most common beryllium minerals are rather resistant to weathering and are therefore broken down into sand- or silt-sized particles with little decomposition. Eventually they too may be altered to clay minerals.

Pegmatites in the conterminous United States show marked regional variations in abundance of beryllium minerals. In several districts in New England, the tin-spodumene belt of North Carolina, the southern Black Hills, and the middle Rocky Mountains, 20 percent or more of the pegmatite dikes contain beryl. In eastern Nevada, Utah, Arizona, in the Amelia County, Va., and Troup County, Ga., areas in the southern Appalachians, and in the areas of the Pikes Peak and Sherman batholiths of Colorado and Wyoming, between 5 and 20 percent of the dikes have beryllium minerals. In most of Nevada, the Pacific Coast, most of the southern Appalachians, and probably the Adirondack Mountains, no more than 5 percent of the dikes contain beryl. The scarcity of beryl in the well known Blue Ridge feldspar and mica deposits is particularly striking. The pegmatites in the East are of Paleozoic age, those in southern California and Latah County, Idaho, are of Mesozoic age. Most of the rest are of Precambrian age.

Zoned pegmatite dikes may contain beryl in any zone, from wall to core, but it is most common in inner zones, where it also is in the largest crystals. Zones that contain lithium minerals generally also contain beryl. Fluorite-bearing pegmatites are likely to contain gadolinite or phenacite either alone, or less commonly, accompanied by beryl. Unzoned pegmatite dikes may have beryl either uniformly or unevenly distributed through them, but not in systematically distributed concentrations. All the unzoned lithium pegmatites that have been examined contain several tenths of a percent beryl.

Vein and replacement deposits are mainly in the Basin and Range province, particularly in west-central Utah, east-central Nevada, southwestern New Mexico, and southeastern Arizona. Outside of the Basin and Range, deposits are found in central Colorado, Virginia, New England, and southern Illinois. The veins range in age from Precambrian to early Tertiary, and cut igneous rocks of Precambrian and Mesozoic age, Precambrian metamorphic rocks, and Paleozoic sedimentary rocks.

The veins include hypothermal quartz-rich veins that contain beryl and are generally accompanied by white mica, fluorite, and in many places, by bertrandite, feldspar, bismuth minerals, wolframite or scheelite, and carbonate minerals. In the conterminous United States such veins have been exploited mainly for tungsten. In some foreign districts similar veins have yielded tin or molybdenum. Since 1955 a few veins have yielded beryllium minerals as the primary products. A few mesothermal veins that contain rhodochrosite and rhodonite also contain minor amounts of helvite. A few epithermal veins contain at least 0.003 percent beryllium but their mineralogy has not been studied.

Replacement bodies of beryllium-bearing rock are in rhyolite tuff of Tertiary age in Utah, and in limestones of Paleozoic age in Nevada and Illinois. The deposits in tuff are of typical epithermal character. They are in a volcanic area and apparently formed at a rather shallow depth. The ores are very fine grained;

the beryllium mineral bertrandite is associated with fluorite, manganese and iron oxides, montmorillonite, chalcedony, quartz, opal, and minerals of zinc and lead. Replacement deposits in limestone consist of beryl, bertrandite, and phenacite associated with quartz, fluorite, and commonly with minerals of tungsten or rare earths. The limestone is not silicated to form tactite, which suggests a rather low temperature of formation.

Beryllium-rich tactites, like the veins and other replacement bodies, are found mainly in the Basin and Range province. Helvite has been found in a few of the tactites, but the beryllium-bearing mineral has generally not been identified and the beryllium is at least in part dispersed in such minerals as idocrase, chlorite, or axinite. Most beryllium-bearing tactites contain fluorite and magnetite, but no other mineral association has been established.

Beryl is widely dispersed as individual crystals or clusters of crystals in granite or quartz monzonite in the Sheeprock Mountains, Utah, Mount Antero, Colorado, near Bagdad, Arizona, and in the Sawtooth Mountains, Idaho. Only small parts of the intrusives contain beryl. The beryl-bearing rocks contain quartz, two feldspars, biotite, and commonly muscovite. Their weathered surfaces may be lighter than those of neighboring rocks. A rhyolite flow of the Thomas Range, Utah, contains red beryl in cavities associated with abundant topaz, and rare bixbyite.

Beryllium has been found to constitute 30 ppm or more (0.01 percent or more BeO) of hot spring deposits in several places in the Western States. The minerals that contain the beryllium are, as yet, unknown, and the metal may be a component of complex iron and manganese oxides. Manganese oxides in deposits of other types in the West generally are not rich in beryllium, but residual manganese ores in the southern Appalachians and at Batesville, Ark., contain 0.003 percent or more of beryllium. At Embreeville, Tenn., both manganese ore and hemimorphite contain similar amounts of beryllium.

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Locality	Lat.	Long.
ARIZONA		
1. Baboquivari Peak. Beryl in veins.	31°51'	111°34'
2. Tungstona. Beryl in veins. Anderson and others, 1955.	34°38'	113°08'
3. White Picacho. Beryl in pegmatites. Jahns, 1952.	33°57'	112°34'
COLORADO		
1. Larimer County. Beryl in pegmatites. Thurston, 1955.	40°35'	105°25'
2. Badger Flats. Beryl and bertrandite in veins. Sharp and Hawley, 1960.	39°04'	105°27'
3. Mount Antero. Beryl, phenacite and bertrandite in veins and disseminated deposits. Adams, 1952.	38°40'	106°15'
4. Quartz Creek. Beryl in pegmatites. Staatz and Trites, 1955.	38°32'	106°32'

Index (cont'd.)

	Lat.	Long.
CONNECTICUT		
1. Middletown. Beryl in pegmatites. Stugard, 1958.	41°33'	72°32'
GEORGIA		
1. Troup County. Beryl in pegmatites. Heinrich and others, 1953.	33°02'	85°02'
IDAHO		
1. Glen Peak. Disseminated deposit.	43°53'	115°00'
ILLINOIS		
1. Hicks Dome. Beryllium in veins. Weller and others, 1952.	37°32'	88°22'
MAINE		
1. Newry-Rumford. Beryl in pegmatites. Shainin and Dellwig, 1955.	44°35'	70°40'
2. Paris. Beryl in pegmatites. Cameron and others, 1954.	44°18'	70°45'
3. Topsham. Beryl in pegmatites. Shainin, 1948.	43°52'	69°52'
NEVADA		
1. Mount Wheeler. Phenacite and bertrandite in replacement deposit. Stager, 1960.	38°54'	114°20'
NEW HAMPSHIRE		
1. Grafton. Beryl in pegmatites. Cameron and others, 1954.	43°40'	71°52'
2. Keene. Beryl in pegmatites. Cameron and others, 1954.	43°05'	72°15'
3. Raymond. Beryl in pegmatites. Page and Larrabee, 1962.	43°02'	71°12'
4. Iron Mountain. Danalite, helvite in tactite. Warner and others, 1959.	44°08'	71°13'
NEW MEXICO		
1. Harding mine. Beryl in pegmatites. Montgomery, 1951.	36°12'	105°49'
2. Iron Mountain. Helvite in tactite. Jahns, 1944.	33°28'	107°39'
NORTH CAROLINA		
1. Spruce Pine. Beryl in pegmatites. Olson, 1944.	35°55'	82°08'
2. Tin-spodumene belt. Beryl in pegmatites. Griffitts, 1954.	35°19'	81°22'
SOUTH DAKOTA		
1. Southern Black Hills. Beryl in pegmatites. Page and others, 1953.	43°47'	103°32'
UTAH		
1. Sheeprock Mountains. Beryl in veins. Cohenour, 1959.	39°54'	112°31'

Index (cont'd.)

UTAH

2. Spor Mountain. Disseminated bertrandite in rhyolite tuff. Staatz and Griffitts, 1961.	39°42'	113°12'

VIRGINIA

1. Irish Creek. Beryl and phenacite in veins. Glass and others, 1958.	37°52'	79°11'
2. Amelia. Beryl in pegmatites. Lemke and others, 1952.	37°22'	78°00'

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