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RECONNAISSANCE OF BERYLLIUM-BEARING PEGMATITE DEPOSITS IN SIX WESTERN STATES

Arizona, Colorado, New Mexico, South Dakota, Utah, and Wyoming

By Henry C. Meeves, Clarence M. Harrer, Melford H. Salsbury, Albert S. Konselman, and Spencer S. Shannon, Jr.

UNITED STATES DEPARTMENT OF THE INTERIOR

BUREAU OF MINES

1966

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Arizona, Colorado, New Mexico, South Dakota, Utah, and Wyoming

by

Henry C. Meeves,[1] Clarence M. Harrer,[2] Melford H. Salsbury,[2]
Albert S. Konselman,[3] and Spencer S. Shannon, Jr.[4]

ABSTRACT

The Bureau of Mines, between 1956 and 1963, examined 18 major pegmatite districts in Arizona, Colorado, New Mexico, South Dakota, Utah, and Wyoming to evaluate their content of beryllium, a material in short domestic supply that has become increasingly important to modern industry.

This examination report includes the salient statistics on the production of pegmatite minerals other than quartz and feldspar; and brief descriptions of 170 specific pegmatite deposits.

INTRODUCTION

Hand-sorted beryl from pegmatites has virtually always been the commercial source of beryllium; practically all beryl consumed in the United States is imported. Many domestic pegmatites contain beryl, but the recovery cost for most of it is high in comparison with prices of imported beryl even at the incentive premium prices paid by the Government during 1952-62. Some domestic pegmatite deposits have been worked for beryl alone, but most beryl has been obtained as a byproduct of mining feldspar, mica, or lithium minerals.

The growing use of beryllium in nuclear energy applications, high speed aircraft, missiles, and spacecraft in the middle 1950s, coupled with the dependency of the beryllium industry in the United States on imported beryl, led the Bureau of Mines to study the beryllium potential of domestic pegmatite deposits.

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This report covers the Bureau's examination of a large number of pegmatite deposits for the presence of beryllium and accompanying incidental minerals in Arizona, Colorado, New Mexico, South Dakota, Utah, and Wyoming during 1956 to 1963.

Similar studies were made on the beryllium potential in nonpegmatite deposits in these and adjoining States; the results have been reported separately.[5]

PRODUCTION

The salient statistics of beryl from 1936 to 1963 are shown in table 1. Much of the data on foreign production, particularly from Communist countries, are estimates. Beryl is mined on every continent and in at least 22 countries, with the largest recorded production coming from Africa and South America.

Domestic consumption has fluctuated widely since 1941 but in general has increased. As table 1 shows, imports have exceeded consumption in most years since 1940; the excess going in the National Stockpile. The domestic beryllium industry had private stocks of beryl on hand at the end of 1963 equal to its needs for 1 year.

The disparity between U.S. production and consumption clearly shows a continuing dependence of the United States on imports.

Beryl is classified as a strategic and critical mineral. Both foreign and domestic beryl have been stockpiled to meet emergency requirements. A Government program for buying domestic beryl at premium prices was instituted in 1952 to stimulate production. Between October 1952 and June 30, 1962, when the program was terminated, a substantial amount of domestic beryl, largely from pegmatite operations, was purchased for the Government stockpile at prices exceeding those of imported beryl (table 1). Government exploration assistance to find new beryllium deposits began under the Defence Minerals Exploration Administration and is being continued under the Office of Minerals Exploration.

DESCRIPTION OF DEPOSITS

Pegmatite investigations were conducted in Arizona, Colorado, New Mexico, South Dakota, Utah, and Wyoming. A representative deposit or group of deposits was examined in each district. A total of 170 individual pegmatite properties were visited between 1956 and 1963 as shown in the Appendix. In the final phase of field activities, the techniques of nuclear detection of beryllium were used. Portable equipment provided rapid, direct, semiqualitative analyses on outcrops or collected samples.

Brief descriptions of the pegmatite districts investigated follow.

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[5]Meeves, Henry C. Nonpegmatitic Beryllium Occurrences in Arizona, Colorado, New Mexico, Utah, and Four Adjacent States. BuMines Rept. of Inv. 9876, 1966, pp.

TABLE 1. - Salient statistics of beryl, 1936-63

(Short tons)

Year	Production		U.S. imports	U.S. consumption	Approximate price per short-ton unit (20 lbs) BeO	
	Domestic (mine shipments)	World (estimate)			Domestic[1]	Foreign[2] (at port of export)
1936.....	28	479	162	200	$3.00	$4.12
1937.....	75	413	182	200	2.19	4.42
1938.....	25	1,153	146	300	3.08	4.10
1939.....	95	996	459	500	2.86	3.18
1940.....	121	2,393	810	600	3.08	2.97
1941.....	158	4,507	2,666	1,200	4.62	5.40
1942.....	269	3,312	2,050	2,352	8.99	6.71
1943.....	356	6,010	4,840	3,058	12.47	7.80
1944.....	388	3,261	3,115	2,176	14.47	9.18
1945.....	39	1,085	1,201	1,738	15.73	10.98
1946.....	100	1,700	1,188	1,013	17.79	8.90
1947.....	145	1,430	767	1,735	17.39	14.95
1948.....	99	2,470	1,720	1,970	26.87	17.41
1949.....	475	4,587	3,811	1,029	32.10	22.52
1950.....	559	7,400	4,860	3,007	30.51	25.43
1951.....	484	6,700	4,316	3,388	33.34	31.67
1952.....	515	8,300	5,978	3,476	41.55	38.75
1953.....	751	8,200	7,998	2,661	43.30	42.66
1954.....	669	7,700	5,816	1,948	41.64	40.23
1955.....	500	8,900	6,037	3,860	49.16	33.52
1956.....	445	12,900	12,371	4,341	47.65	32.77
1957.....	521	11,300	7,920	4,309	48.58	31.50
1958.....	463	[3]7,700	4,599	6,002	47.16	30.59
1959.....	[4]328	[3]11,200	8,038	8,173	47.99	26.52
1960.....	[4]244	[3]12,300	8,943	9,692	45.89	29.11
1961.....	[4]317	[3]12,900	8,516	9,392	W	29.74
1962.....	[4]218	[3]10,900	8,552	7,758	W	30.80
1963.....	1	[3] 7,400	6,243	7,934	W	24.34

W Withheld to avoid disclosing individual company confidential information.

[1] Estimated BeO content of beryl: 1936-51, 10 percent, and 1952-58, 10.9 percent.

[2] Estimated BeO content of beryl: 1936-51, 10 percent, and 1952-63, 11 percent.

[3] Includes the following quantities of low-grade beryllium ore: 42 tons in 1958, 97 tons in 1959, 265 tons in 1960, 805 tons in 1961, 760 tons in 1962, and 750 tons in 1963.

[4] Includes some nonpegmatitic beryl meeting cobbed beryl specifications.

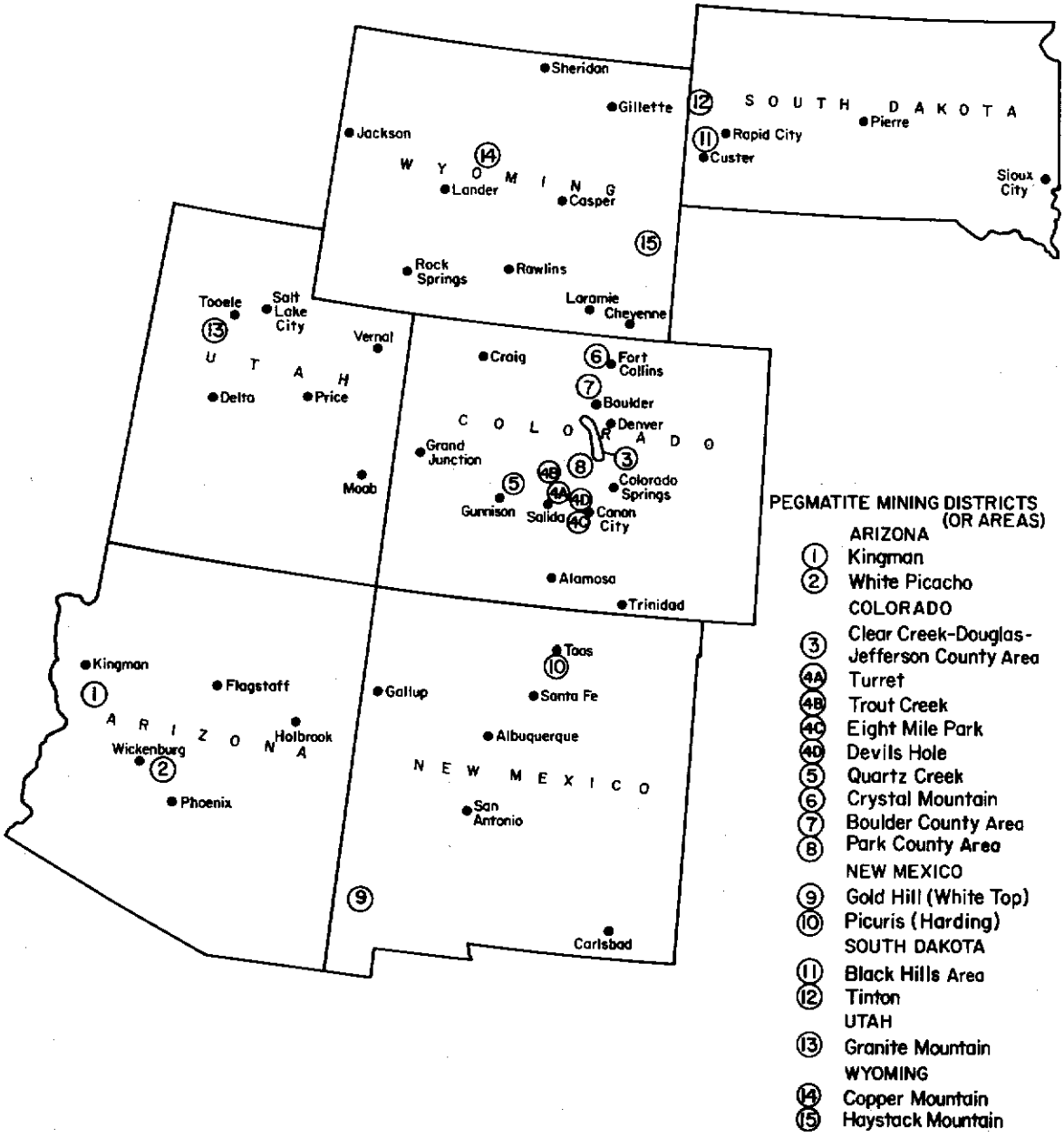

FIGURE 1. - Beryllium-Bearing Pegmatite Districts Examined.

Arizona

Kingman District

The Kingman district (fig. 1, No. 1, and items Arizona 5 to 16 in table A-1) is mainly in the Hualapi Mountains in Mohave County. Some of the pegmatite deposits are north of Kingman. Generally, the deposits are in Precambrian igneous and metamorphic rocks intruded by Tertiary granite and related

rocks (2, 16).[6] The pegmatite deposits are 150 to 2,000 feet long and 1 foot to 100 feet wide, varying from unzoned to zoned; some are pipelike. The pegmatites are slightly more resistant to erosion than the host rocks and usually stand out as slight rises that occasionally have small cliff faces. Another distinguishing feature is that the pegmatites are of a light color, contrasting with the dark-colored host rock. In the areas of granite, the pegmatites grade into the granite, and it is difficult to distinguish between the two. Pegmatites in metamorphic rocks are roughly parallel with the foliation and plication, although occasionally a deposit cutting at an angle across the foliation and plication may be found.

Records of production from the Kingman district are not available, but production of beryl, columbium-tantalum minerals, rare-earth minerals, lithium minerals, and scrap mica is assumed to have been small.

White Picacho District

The White Picacho district (1, 3, 12) embraces about 150 square miles in southern Yavapai and northern Maricopa Counties (fig. 1, No. 2; items Arizona 2 to 4 and 18 to 38 in table A-1), mostly within the Wickenburg Mountains. The pegmatites occur in Precambrian igneous and metamorphic rocks that are covered in places by Tertiary volcanic and sedimentary rocks. The pegmatite exposures appear as light-colored patches and bodies in the dark-colored host rock. The exposures are from 50 feet to over 5,000 feet in strike length, averaging slightly less than 400 feet, and vary in thickness from about 1 foot to 200 feet, the average width being about 40 feet in the more bulbous varieties.

Lithium minerals are the most important economic minerals, with feldspar, scrap mica, and beryl following in order of occurrence. Some columbium-tantalum and other rare minerals have been produced. Minor amounts of bismuth, copper, lead, silver, and zinc minerals are found in a few of the pegmatites, but they are of minor economic importance.

Generally, the lithium-bearing pegmatites are zoned and consist of a border zone, a wall zone, up to five intermediate zones, and a core zone. Lithium minerals, beryl, and other economic minerals may be found in the wall zone and the intermediate zones; seldom are they found in the core zone.

Production from 1941 to 1963 was 154,255 pounds of beryl, 40,117 tons of scrap mica, 5,900 pounds of columbium-tantalum minerals, and 60 tons of spodumene. Commercial feldspar is available at the deposits.

Colorado

Clear Creek-Douglas-Jefferson County Area

Pegmatite dikes and pipes of various sizes have been mined for many years as sources of industrial feldspar, mica, and quartz in the Clear Creek-Douglas-Jefferson County area (fig. 1, No. 3; items Colorado 14 to 31 and 50

[6] Underlined numbers in parentheses pertain to the list of Selected References.

to 75 in table A-1). Beryl, columbite-tantalite, cryolite, gadolinite, yttrofluorite, allanite, and other rare-earth minerals have been recovered as minor byproducts. Mining has been very selective, being limited to small open pits and cuts. The operations are small and usually are carried on by lessees, but occasionally by contractors.

Many pegmatite dikes and pipes, both concordant and discordant, crop out in Precambrian granite and metamorphic rocks varying from a few tens to a few hundreds of feet in both length and width. The vertical extent of the deposits has not been determined by exploration to date.

In general, two types of pegmatites occur.

One pegmatite consists of a distinct-to-indistinct zonal arrangement of various mineral assemblages consisting of biotite, muscovite, and white-to-pink potassic-and-perthitic feldspars in Precambrian metamorphic rocks. The core is usually white or pink-to-rusty-appearing quartz and contains some feldspars, a little white, green, and purple fluorite, and occasionally some topaz. Some of the deposits contain crystals of beryl and plates and crystals of columbite-tantalite, cyrtolite, and allanite. Many of the deposits contain only feldspar, mica, and quartz.

The second type of pegmatite occurs as roughly-cylindrical-to-ellipsoidal pipes or plugs in Precambrian granite. The deposits have a roughly-cylindrical-to-ellipsoidal core of massive, white-to-clear quartz. The core is enclosed by an intermediate zone of pink-to-white potassic-and-perthitic feldspars that contains some purple, green, and white fluorite and minor topaz. An outer wall zone of feldspar and small-to-large books of iron-stained biotite and/or muscovite grades into a reddish-granite host rock. Cyrtolite, allanite, yttrofluorite, and other rare earth minerals occasionally occur as small, erratically distributed pods and clusters in the wall zone. Beryl crystals occur in every zone, including the core, of some of these deposits.

The byproduct minerals of quartz, feldspar, and mica mining are scattered and are too scarce by themselves to sustain mining operations, but they are a source of additional returns in the mining operations. Mining at all of the deposits examined has been intermittent. Most of the properties are idle as there is no market for feldspar and mica in the Colorado area.

Reserves of beryl, columbite-tantalite, and rare-earth minerals are considered to be small. These minerals have been extracted to the present mining depths of open pits and cuts on the deposits. Significant reserves might be developed on a few of the deposits by exploration in depth, primarily for the continuation of quartz, feldspar, and mica mining. Mining at greater depths would be increasingly costly, and the condition of the feldspar-mica market does not encourage such work.

Chaffee-Fremont County Area

The Chaffee-Fremont County area (10) consists of four distinct mining districts; namely, the Turret (fig. 1, No. 4A) and Trout Creek (fig. 1, No. 4B) districts in Chaffee County (items Colorado 6 to 13 in table A-1) and the Eight Mile Park (fig. 1, No. 4C) and Devils Hole (fig. 1, No. 4D), districts in Fremont County (items Colorado 32 to 37 in table A-1).

Only a few poorly zoned pegmatite deposits crop out in Precambrian igneous and metamorphic rocks in Chaffee County.

The pegmatite deposits in the Turret district contain accessory beryl, in crystals from 1 inch in diameter and 4 inches long to 1 foot in diameter and 6 feet long, and columbite-tantalite.

The deposits are mainly potassic feldspar but contain some mica and quartz. One pegmatite consists almost entirely of pure albite.

Intermittent mining was chiefly for feldspar; only a few deposits have been mined by small open cuts for beryl, and these, mainly where beryl appears in the outcrop. The output of beryl and mica in the district has been sporadic and incidental to the production of feldspar. Up to 1963, the production of beryl and mica from the Turret district was 25,489 pounds and about 135 tons, respectively.

Pegmatites in the Trout Creek district are poorly exposed in Precambrian granite. The few well-exposed pegmatites are a maximum of 200 feet long and 50 feet wide, being poorly zoned to well zoned. The cores are generally quartz and may contain accessory microcline, biotite, and muscovite. The intermiediate zones, from one to three in number, are composed of quartz, potassic feldspar, and albite. Radioactivity is usually present in the intermediate zones, and accessory columbite-tantalite, rare-earth minerals, and thorite are sometimes found in these zones. The wall zones grade into the enclosing granite, and contacts are generally obscure.

The pegmatite deposits of Fremont County are scattered over the mountainous portions of the county and are diverse in size, structure, and content. Many of the deposits are isolated and cannot be grouped conveniently, but four districts, Cotopaxi, Eight Mile Park, Devils Hole, and Miconite, are recognizable based on geologic similarity and geographic location. Only two of these districts are described herein.

Pegmatite deposits of the Eight Mile Park district, an area of about 10 square miles, are within or adjoin Royal Gorge Park, a recreational and scenic area 8 miles northwest of Canon City.

The area is underlain by Precambrian igneous and metamorphic rocks that are intruded by pegmatites and a few mafic dikes. The Precambrian complex has been uplifted in relation to Cambrian-Ordovician sedimentary rocks that have been tilted to form an eastward-dipping hogback east of the area and westward-dipping beds west of the area. Beryl-bearing pegmatites are not known to

occur south of the Royal Gorge of the Arkansas River, which bisects the uplift, or north of U.S. Highway 50, although the Precambrian complex containing pegmatites extends beyond these boundaries. Remnants of Ordovician rocks are exposed within the area but not in the immediate vicintiy of the pegmatite outcrops. The resistant pegmatites have formed some of the ridges that constitute prominent topographic features of the district.

The Precambrian rocks include granites, schists, gneisses, aplitic dikes, and pegmatites, the youngest being the aplitic dikes and pegmatites.

The southern portion of the area abounds with small, narrow pegmatite deposits. Some lenses are only a few feet in length. The smaller deposits are not considered to be of economic interest. The larger deposits are roughly tabular bodies that are as much as three-quarters of a mile in length and range from 100 to 650 feet in width.

The pegmatites are composed of quartz, muscovite, and potassic feldspar with accessory biotite, garnet, tourmaline, and beryl. Small amounts of columbite-tantalite, triplite, and other unusual minerals, such as fremontite, are also present.

The pegmatites vary widely in structure and in accessory-mineral content, not only between different deposits but also within a single deposit. Well-defined zones occur only in the Mica Lode deposit (item Colorado 34 in table A-1). Here the feldspar and muscovite occur in large masses that can be easily mined and sorted. Beryl and columbite-tantalite are segregated in the 25- by 90-foot intermediate zone. This zone was exposed near the floor of the 215- by 205- by 131-foot open pit during the last feldspar and muscovite operations, dipping into the south wall of the pit. The portions of this zone remaining above the floor of the main cut are estimated to contain 90 tons of beryl and 2,500 pounds of columbite-tantalite. Assuming that the zone continues downward on the gentle dip observed for 40 feet below the floor of main cut without a reduction in cross section or length, reserves of 400 tons of beryl and 5.6 tons of columbite-tantalite are estimated to occur in this zone.

At other deposits in the Eight Mile Park district, the zoning is poor or absent. Feldspar and quartz are intergrown, and large crystals or masses of either are uncommon. The beryl and columbite-tantalite in these deposits are not segregated so as to be economically recoverable.

The pegmatite deposits of the Devils Hole district, a 4-square-mile area of high relief and of deep, narrow canyons, occur in a Precambrian complex of schist and gneiss. This complex is north of Precambrian granites that are exposed in the Arkansas River canyon to the south. Immediately west of the area, the Precambrian rocks are covered by Tertiary volcanic flows.

The prominent, resistant, light-colored, irregularly-sized-and-shaped pegmatite deposits outcrop at various altitudes and appear to be randomly distributed.

Development on the Zingheim deposit (item Colorado 37 in table A-1), the largest known pegmatite deposit in the district, indicates it to be a tabular body with limited vertical extent. The deposit has been worked mainly for feldspar and mica. Since 1935, beryl has been saved as a byproduct, and, more recently, columbite-tantalite also has been recovered. Rose quartz has been mined in small quantities for mineral specimens and decorative material.

Zoning is well developed only in the southern part of the deposit, and becomes less distinct toward the northern part. The zonal units consist of a wall zone of quartz-microcline-muscovite-albite pegmatite, an intermediate zone of muscovite-albite-quartz pegmatite, and a core zone of massive microcline and quartz pegmatite. No border zone has been distinguished, and contacts with the enclosing schist rock are gradational.

Biotite, garnet, and magnetite are accessory minerals. Some beryl and columbite-tantalite occur in the intermediate zone.

Other pegmatites in the area, dike-like in appearance of outcrop, are only a few feet wide and a few tens of feet long. Some resemble coarse-grain-granite stringers in the schistose host rock. No evidence of rare minerals, other than beryl and columbite-tantalite, was found during the investigation.

No other pegmatite outcrops worthy of more than a brief inspection were found by reconnaissance.

Quartz Creek District

The Quartz Creek (Ohio City) district (fig. 1, No. 5; fig. 2; and items Colorado 38 to 50 in table A-1) is in Gunnison County.

The pegmatite occurrences are on the steep slopes on both sides of Quartz Creek valley and overlook the townsite of Ohio City, a former gold mining community (10, 14). The many individual pegmatite exposures, most of which are long and narrow, crop out in Precambrian metamorphic rocks; a few are in Precambrian granite. The exposures are flat-dipping dikes ranging in length from a few tens of feet to about 1,800 feet and in width from 5 feet to 1,000 feet. Diamond drilling has established downward continuity for 275 feet on the dip for the Brown Derby deposits (14). The pegmatite dikes tend to pinch and swell in the wider sections and often have branching spurs. They are especially irregular in the larger, pod-like sections and more uniform in the long, narrow extensions. Minor fault displacements are in evidence in some of the exposures. The occurrences exhibit extensive to incomplete zonal structure. In some cases, zones have been identified; in others, zoning is less distinct. Zonal structure tends to be discontinuous and asymmetrical, not being developed on both sides of a central core. The zonal sequence is not the same in each deposit, and a specific zone may be present only as a small pod or may be missing altogether.

Two general types of pegmatites, with many variations, are known in the Brown Derby area: (1) A quartz-microcline-muscovite pegmatite with accessory topaz, black tourmaline, and lepidolite; (2) a lithia-bearing type in which

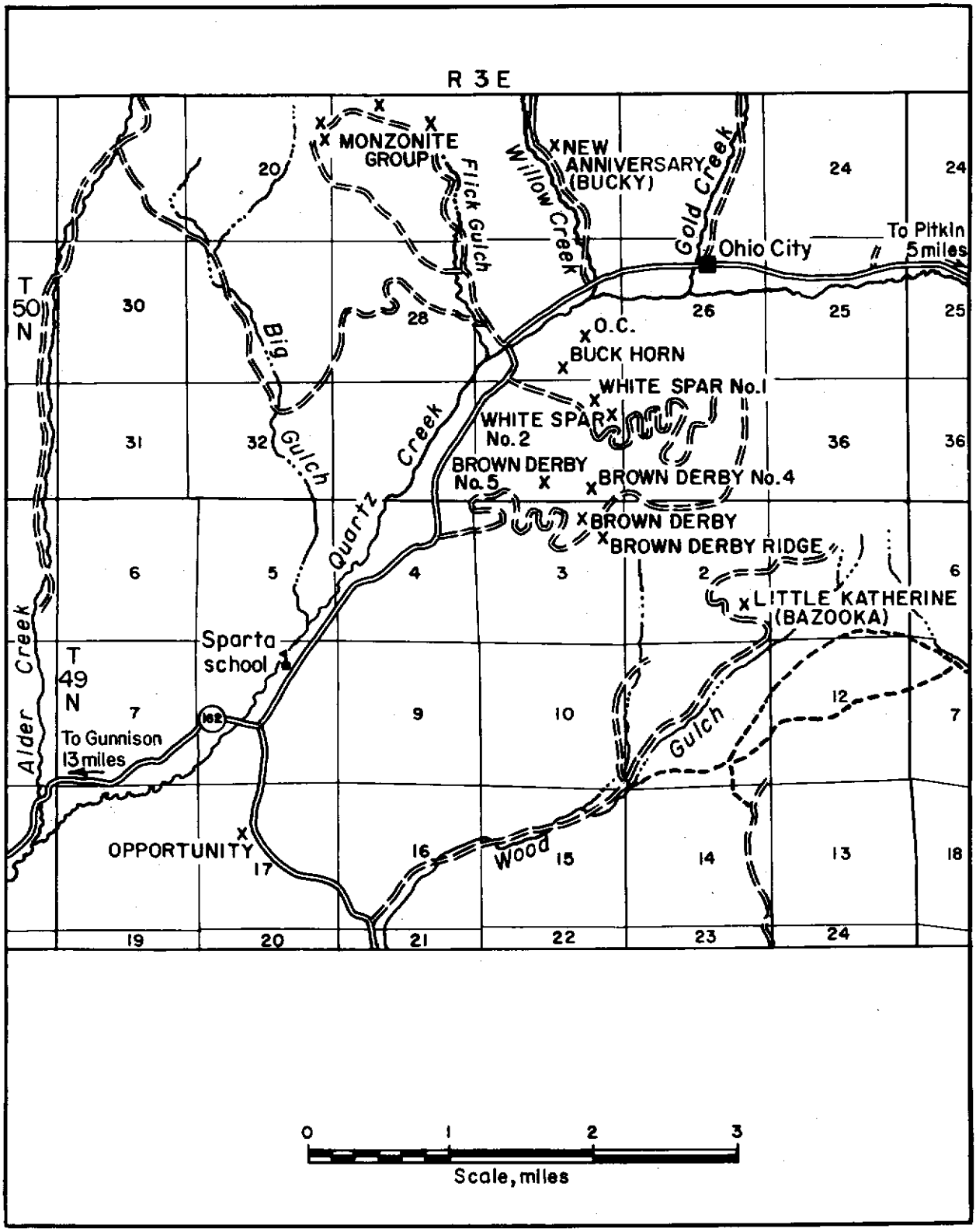

FIGURE 2. - Location of Beryllium Properties, Quartz Creek (Ohio City) District, Gunnison County, Colo.

spodumene, lepidolite, and "watermelon" (red and pink enclosed in green) tourmaline are the principl minerals and tantalite and fluorite are accessory minerals. Locally, albite and cleavelandite are also principal minerals in both types. A deposit may contain only one type or both types of pegmatite. Beryl is present in both types, usually in the intermediate zone or zones, although it is also found in the wall zone and core zone of several of the Brown Derby deposits.

Surface exploration has been done on a number of the properties, but mining has been limited largely to shallow excavations on the Brown Derby and New Anniversary (Bucky) properties.

The district was examined and described by the U.S. Geological Survey in the 1950's (10), and the Bureau of Mines core-drilled the Brown Derby pegmatite in 1950-51 (14).

Bureau of Mines personnel again visited the district in 1962 to examine workings and dumps for white beryl that occurs in an albite-quartz zone along the footwall of the Brown Derby pegmatite No. 1 (fig. 3). This white variety is difficult to identify in hand specimens, and there had been the possibility that some beryl might have been overlooked in the mining operations carried on primarily for lithium. Rock exposures and dumps were checked with a portable nuclear beryllium detector. The dump in front of No. 2 tunnel (fig. 3) proved to have a substantial content of white beryl; some of it in coarse fragments. Many small (maximum of 3 feet in diameter) pods of beryl were also detected in the walls and back of tunnel No. 2, one large pod having been left in the back near the left face of the tunnel. The beryl-rich portion of the dike was in a footwall zone. Sampling results indicated that the dump contains at least 1,500 tons of material averaging about 0.12 percent BeO. There was no basis for estimating the extent of the footwall zone exposed in the tunnel or the tonnage contained therein. However, the material left is estimated to contain as much as 2.97 percent BeO.

The examination indicated that the beryllium content of the deposits, as a whole, was very low and verified the results reported on the earlier Bureau of Mines drilling project and the Geological Survey work. The drill cores for the portions of seven crosscutting drill holes in pegmatite rock, aggregating 458.5 feet, contained, by chemical analyses, from 0.01 to 0.14 percent BeO, and had an average content of slightly more than 0.03 percent BeO.

Table 2 gives the analyses of samples collected during the 1962 examination.

TABLE 2. - Analyses of samples from Brown Derby pegmatite; Gunnison County, Colo., in percent

Sample	BeO[1]	Cb	Ta	Li_2O	P_2O_5	U_3O_8[1]	ThO_2[1]	ThO_2[2]	Rare earth oxide
HCM-187[3]	0.04	0.29	2.44	-	-	-	-	-	--
188	.01	-	-	-	-	3.39	13.35	13.06	40.3
189	.32	-	-	-	-	-	-	-	-
190	.29	-	-	-	-	-	-	-	-
191	.02	-	-	3.16	-	-	-	-	-
192	-	-	-	.59	-	-	-	-	-
193	-	3.00	1.00	-	0.49	-	.14	.06	1.86
194	-	-	-	-	.40	.05	-	-	.42
195	12.18	-	-	-	-	-	-	-	-

[1]Radiometric analyses. [2]Chemical analyses. [3]Numbers refer to figure 3.

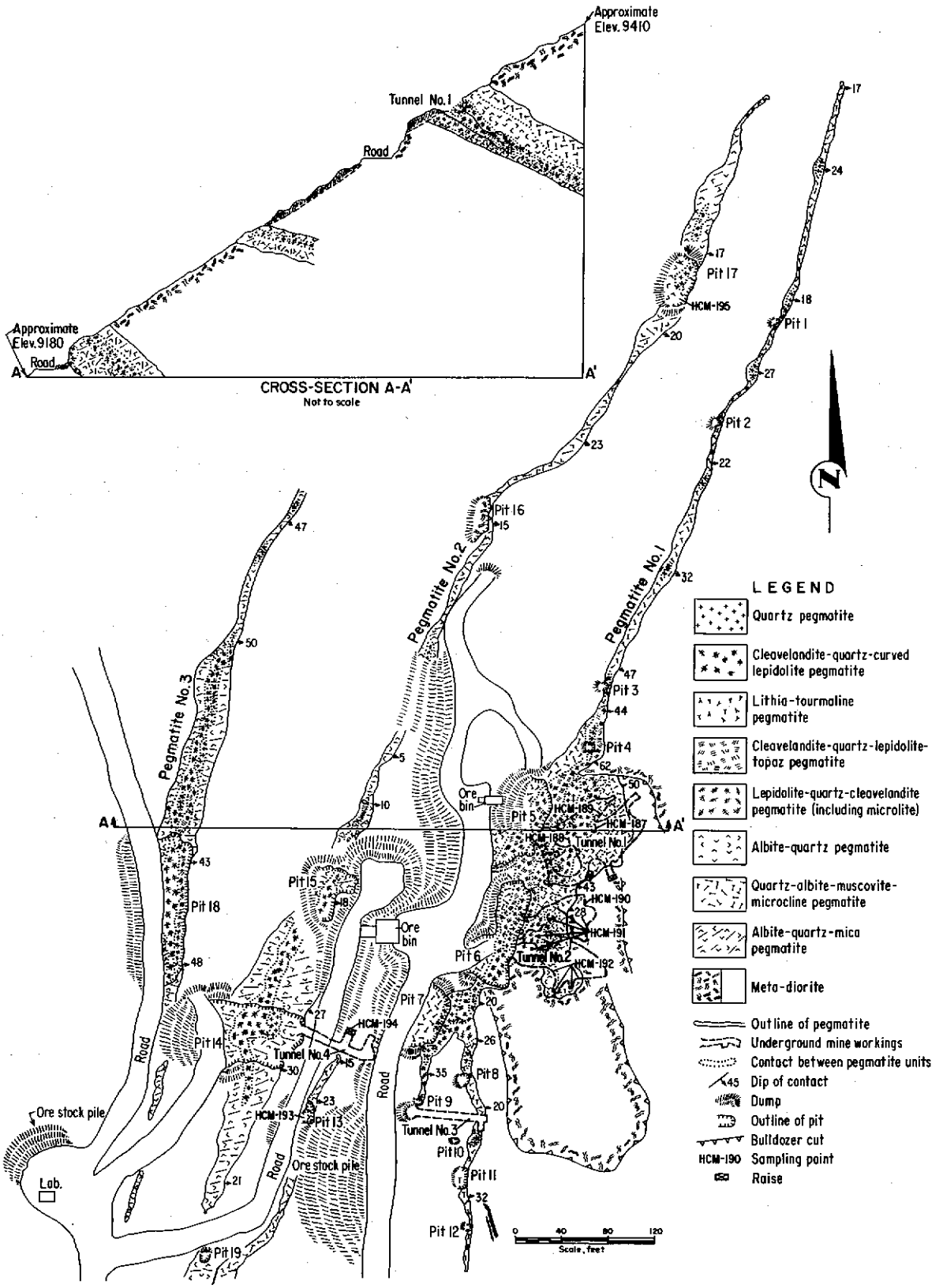

FIGURE 3. - Brown Derby Mine, Gunnison County, Colo.

Crystal Mountain (Storm Mountain) District

Zoned and unzoned pegmatites crop out in Precambrian metamorphic rocks in the Crystal Mountain (Storm Mountain) district (fig. 1, No. 6; items Colorado 74, 78, and 89 in table A-1)in Larimer County. The tabular and elliptical outcrops range from 20 to over 3,000 feet in length and from 1 foot to 100 feet in width. Most are concordant with the enclosing host rock; a few cut across the foliation of the metamorphic rocks.

Zoned deposits contain a white-to-rusty stained quartz or quartz-perthite core. Most deposits have only a wall zone surrounding the core, although some contain as many as three intermediate zones. The wall zone and the intermediate zones contain perthite, plagioclase, microcline, muscovite, biotite, and tourmaline and accessory allanite, apatite, columbite-tantalite, garnet, lithiophilite, rare-earth minerals, thorite, and uranium minerals. The accessory minerals are scarce and are erratically distributed when found in the pegmatites. Beryl occurs as crystals from 1 inch to 2 feet in diameter in almost all zones, with the largest crystals generally in the core zones.

Unzoned pegmatite deposits are heterogeneous mixtures of quartz, orthoclase, perthite, muscovite, and biotite. Accessory minerals are allanite, beryl, columbite-tantalite, lithiophilite, monazite, rare-earth minerals, scheelite, thorite, tourmaline, and uranium minerals. The accessory minerals are erratically distributed as small, individual crystals; occasional pods as large as 15 inches in diameter are found.

The pegmatites have been mined intermittently through small opencuts and some shallow, underground workings. Development, mainly for mica, beryl, and the accessory minerals, proved partially successful. Mining and transportation costs limited most of the activity to those periods when emergency procurement existed.

Other Pegmatite Areas

Other pegmatite districts and deposits in Colorado that contain beryl but are considered of small economic importance as to beryl production are:

Boulder County area (fig. 1, No. 7, and items Colorado 1 to 5 table A-1),

Beryl Gem deposit, Mesa County (item Colorado 98 in table A-1),

Park County area (not including Badger Flats) (fig. 1, No. 8, and items Colorado 99 to 103 in table A-1),

Black Cloud deposit, Teller County (item Colorado 104 in table A-1).

Table 3 lists, by counties, the production of beryl, columbite-tantalite, mica, and other minerals from Colorado pegmatites.

TABLE 3. - Production from Colorado pegmatites, excluding feldspar, by counties, through 1963

County	Beryl, pounds	Columbium-tantalum minerals, pounds	Rare-earth minerals, pounds	Mica		Remarks
				Pounds-sheet	Tons-scrap	
Boulder.....	2,925	Some	Some	-	195	-
Chaffee.....	49,805	1,093	Some	7,970	787	-
Clear Creek..	8,796	188	Some	5,208	210	-
Custer.....	-	-	-	-	8	137 tons thorite.
Douglas.....	Some	-	500	-	-	Yttrofluorite.
El Paso.....	Some	-	-	-	4	39 tons thorite.
Fremont.....	1,086,946	3,574	80,000	30,000	50,438	58 tons lepidolite.
Gilpin.....	-	-	1,128,000	-	-	Xenotime, gadolinite, yttrofluorite.
Gunnison.....	130,049	111,367	30	800	413	2,850 pounds thorite, 2,239 tons lepidolite, 20 tons amblygonite.
Jefferson....	108,152	4,327	15,545	2,000	540	-
Lake.....	311	-	26	-	-	-
Larimer.....	358,790	102	-	88,660	2,022	-
Mesa.....	2,780	-	18,160	-	-	-
Park.....	61,566	2,020	-	-	504	-
Saguache.....	-	-	-	-	13	-
Teller.....	-	-	-	-	14	-
Weld.....	-	8,000		-	-	-

New Mexico

The pegmatite deposits of New Mexico were reported by Redmon (19). Worthy of mention in this report are the White Top deposit in the Gold Hill district in Grant County and the Harding pegmatite in the Picuris district in Taos County.

Gold Hill District

The White Top deposit (fig. 1, No. 9, and item New Mexico 1 in table A-1) comprises three roughly circular, pipe-like zoned pegmatite bodies, ranging from 75 to 125 feet in diameter, in a Precambrian granite. Strikes and dips are indeterminate. The zonal structure in each pegmatite consists of a core of massive white quartz, an intermediate zone of quartz-albite pegmatite, and a wall zone that is gradational. The only beryl observed at the deposit was in the shaft dump near the southernmost outcrop. Columbite-tantalite and other rare-earth minerals have been reported but were not observed.

Picuris District

The Harding pegmatite (fig. 1, No. 10, and item New Mexico 2 in table A-1) is a well-zoned, tabular, flat-lying dike in Precambrian schists and quartzites. The dike is more than 2,500 feet long and ranges in thickness from 25 to 75 feet. Development has exposed the downward dip of the dike for approximately 600 feet.

The main interest in the Harding pegmatite is the occurrence of white beryl. It is difficult to distinguish white beryl from the quartz, feldspar, and spodumene of the deposit. Some pink- and yellow-tinted beryl has been found in the deposit.

The beryl occurs in quartz-albite-perthite-muscovite pegmatite zones that range from 6 inches to 8 feet thick and that occur adjacent to both the hanging wall and the footwall zones.

Other minerals of importance in the Harding pegmatite include lepidolite, microlite, and columbite-tantalite.

Table 4 lists New Mexico production, by counties, of beryl, columbite-tantalite, and mica through 1963.

TABLE 4. - Production from New Mexico pegmatites, excluding feldspar, by counties, through 1963

County	Beryl, pounds	Columbite-tantalite, pounds	Mica	
			Pounds-sheet	Tons-scrap
Bernalillo.....	-	-	30	-
Mora.....	Some reported to be present.	-	11,123	835
Rio Arriba.....	12,748	5,092	604,927	15,191
San Miguel.....	49,015	16,816	12,049	1,115
Santa Fe.....	Some reported to be present.	Some reported to be present.	175	-
Taos.....	1,678,054	-	7,413	14,983

South Dakota

The pegmatite deposits of South Dakota occur in the Black Hills area of Custer and Pennington Counties and in the Tinton district of Lawrence County.

Black Hills Area

The pegmatite deposits of the Black Hills area (fig. 1, No. 11, and items South Dakota 1 to 16 in the table A-1) occur as unzoned to well-zoned bodies in Precambrian schists, gneisses, and quartzites, varying greatly in size with no two being alike. They are mined selectively, usually by two- or three-man operations but occasionally by as many as 10 to 20 men. This practice results in unsystematic development of the deposits. Some pegmatite deposits are mined for feldspar only; some are mined for the rarer minerals; while others are mined for feldspar with the rarer minerals being recovered as byproducts.

The pegmatites of the Black Hills area occur as light-colored, various-textured deposits that contrast with the host rocks. Quartz and feldspar are the major constituents. Beryl, spodumene, amblygonite, lepidolite, and triphylite are minor constituents. Accessory minerals are columbite-tantalite, microlite, cassiterite, and various uranium, thorium, and rare-earth minerals.

The zoned pegmatite deposits have cores of quartz or quartz-feldspar. As many as 13 intermediate zones have been identified and classified according to the mineral assemblages. A wall zone is not always present; a border zone is recognizable in most deposits, but in some cases it grades into the host rock.

The total number of pegmatite deposits (5) in the Black Hills area is not known, but Gynne (9) mapped about 1,500 in a 13-square-mile area.

Tinton District

The Tinton district (fig. 1, No. 12) contains about 200 pegmatite deposits (17, 22) that vary from unzoned to well zoned and range from a few inches to 300 feet in width and up to 1,500 feet in length. Most are nearly parallel to the foliation of the enclosing Precambrian schist. Tertiary igneous rocks have intruded the schists and the pegmatites. The pegmatites are resistant to weathering and stand out as small ridges in the schist host rock. Those that have been weathered are traceable by typical pegmatite float material. A few of the prominent outcrops have branching "limbs" or extensions.

Each zoned pegmatite deposit usually is comprised of a quartz or quartz-feldspar core, as many as eight intermediate zones classified according to mineral assemblages, a wall zone, and a border zone. The wall zone is absent in some of the deposits, and the border zone sometimes grades into the schist host rock.

The major minerals of the deposits are feldspar, quartz, and muscovite. Minor minerals include cassiterite, columbite, spodumene, and amblygonite. Accessory minerals are apatite, tourmaline, lithiophilite, and beryl.

Production of pegmatite minerals, excluding feldspar, in South Dakota is listed in table 5.

TABLE 5. - Production from South Dakota pegmatites, excluding feldspar, by counties, through 1963

County	Beryl, pounds	Columbium-tantalum minerals, pounds	Cassiterite, pounds	Mica		Amblygonite, tons	Spodumene tons	Lepidolite, tons
				Pounds-sheet	Tons-scrap			
Custer....	2,579,852	29,046	13,563	1,494,840	15,421	5,517	1,892	198
Lawrence..	-	109,303	140,483	-	-	14	6,673	10
Pennington	5,403,774	160,816	44,827	716,624	39,456	3,766	61,845	8,342

Utah

Granite Mountain District

The pegmatites of the Granite Mountain district (fig. 1, No. 13, and item Utah 1 in table A-1) are small, narrow deposits in Tertiary quartz monzonite and quartz diorite in the central southern part of Tooele County. The outcrops range from a few feet to 100 feet in length and from a few inches to a few feet in width.

The unzoned to partially zoned pegmatites are composed principally of feldspar and quartz with some biotite and/or muscovite. Accessory tourmaline,

apatite, and magnetite are present. Not all the pegmatite deposits contain beryl. Those that do, contain beryl crystals up to 1 inch in diameter and 3 inches long; however, most beryl crystals are of "pencil lead" size.

Wyoming

The principal occurrences of pegmatites in Wyoming are in the Copper Mountain district in Fremont County and in the Haystack Mountain district, Goshen County.

Copper Mountain District

The pegmatite deposits of the Copper Mountain district (fig. 1, No. 14, items Wyoming 9 and 10 in table A-1) are small, lenticular, light-colored, unzoned bodies that range from 3 to 40 feet wide and from 65 to 500 feet long. These bodies are discordant to the foliation of the dark-colored Precambrian schists, gneisses, and amphibolites that are also intruded by diorite dikes. Some deposits are covered by soil mantles that are as much as 18 inches thick; those covered by soil mantles are traceable by the typical pegmatite float. The deposits are heterogeneous intergrowths of quartz, feldspar, muscovite, and biotite. Accessory minerals include tourmaline, lepidolite in the form of laminated books, beryl crystals that range up to 1,500 pounds in weight, and crystals of columbium-tantalum minerals that are small, scattered, and limonite coated.

Haystack Mountain District

The pegmatite deposits of the Haystack Mountain district (fig. 1, No. 15, and items Wyoming 1 to 8 in table A-1) are zoned bodies that are concordant to the foliation of the Precambrian schists. The deposits range from 5 to 80 feet wide and from 80 to 225 feet long. Most deposits have a core of quartz-plagioclase pegmatite, intermediate zone or zones of quartz-plagioclase-orthoclase-muscovite pegmatite, and a wall zone of quartz-muscovite-tourmaline pegmatite that grades into the host rock. Some white- to blue-colored beryl is found in the intermediate and the wall zones. Very sparse columbium-tantalum minerals are found in the wall zone.

Production of Wyoming pegmatites, by counties, through 1963 is listed in table 6.

TABLE 6. - Production from Wyoming pegmatites, excluding feldspar, by counties, through 1963

County	Beryl, pounds	Columbium-tantalum minerals, pounds	Mica		Rare-earth minerals, pounds
			Pounds-sheet	Tons-scrap	
Albany	277	-	-	-	-
Carbon	-	3,115	-	-	1,000
Fremont	57,746	-	-	40	-
Goshen	5,834	-	2,746	-	-
Natrona	119	-	-	-	-
Niobrara	5,410	-	-	-	-
Platte	-	-	-	148	-

SELECTED REFERENCES

1. Arizona Bur. of Mines. Geologic Map of Maricopa County, 1957.

2. _____. Geologic Map of Mohave County, 1959.

3. _____. Geologic Map of Yavapai County, 1958.

4. Binyon, E. O. Pegmatite Industry of South Dakota and Description of Three Typical Mine Operations. Missouri River Basin Preliminary Report 115, June 1957, 32 pp.

5. Gardner, E. D. Tin Deposits of the Black Hills, S. Dak. BuMines Inf. Circ. 7069, 1939, 78 pp.

6. Gilkey, M. M. Hyatt Ranch Pegmatite, Larimer County, Colo. BuMines Rept. of Inv. 5643, 1960, 18 pp.

7. Gries, J. P. Sampling of Helen Beryl Pegmatite, Custer County, S. Dak. BuMines Rept. of Inv. 4396, 1949, 14 pp.

8. _____. Investigation of the Beecher No. 2 Lithium-Bearing Pegmatite, Custer County, S. Dak. BuMines Rept. of Inv. 4632, 1950, 14 pp.

9. Gwynne, C. S. Pegmatites in Beecher Rock Basins, S. Dak. Geol. Survey Rept. of Inv. 48, 1944.

10. Hanley, J. B., E. W. Heinrich, and L. R. Page. Pegmatite Investigations in Colorado, Wyoming, and Utah, 1942-1944. Geol. Survey Prof. Paper 227, 1950, 125 pp.

11. Hess, F. L., and B. Bryan, Jr. The Pegmatites at Tinton, S. Dak. BuMines Rept. of Inv. 3404, 1938, 19 pp.

12. Jahns, R. H. Pegmatite Deposits of the White Picacho District, Maricopa and Yavapai Counties, Ariz. Arizona Bur. of Mines Bull. No. 162, 1962, 105 pp.

13. Long, A. L., Jr. and J. A. Redden. Geology and Pegmatites of Part of the Fourmile Area, Custer County, South Dakota. Geol. Survey Circ. 245, 1953, 20 pp.

14. McLellan, R. R. Brown Derby Pegmatites, Gunnison County, Colo. BuMines Rept. of Inv. 5204, 1956, 21 pp.

15. Norton, J. J., L. R. Page, and D. A. Brobst. Geology of the Hugo Pegmatites, Keystone, South Dakota. Geol. Survey Prof. Paper 297-B, 1962, 127 pp.

16. Olsen, J. C., and N. E. Hinrichs. Beryl-Bearing Pegmatites in the Ruby Mountains and Other Areas in Nevada and Northwestern Arizona. Geol. Survey Bull. 1082-D, 1960, pp. 135-200.

17. Page, L. R. Pegmatite Investigations, 1942-1945, Black Hills, South Dakota. Geol. Survey Prof. Paper 247, 1954, 228 pp.

18. Redden, J. A. Beryl Deposits of the Beecher No. 3--Black Diamond Pegmatite, Custer County, South Dakota. Geol. Survey Bull. 1072-I, 1960, pp. 537-559.

19. Redmon, D. E. Reconnaissance of Selected Pegmatite Districts in North-Central New Mexico. BuMines Inf. Circ. 8013, 1961, 79 pp.

20. Sheridan, D. M. Geology of the High Climb Pegmatite, Custer County, South Dakota. Geol. Survey Bull. 1015-C, 1955, pp. 59-98.

21. Sheridan, D. M., H. G. Stevens, M. H. Staatz, and J. J. Norton. Geology and Beryl Deposits of the Peerless Pegmatite, Pennington County, South Dakota. Geol. Survey Prof. Paper 297-A, 1957, 47 pp.

22. Smith, W. C., and L. R. Page. Tin-Bearing Pegmatites of the Tinton District, Lawrence County, South Dakota. Geol. Survey Bull. 922-T, 1941, pp. 596 630.

23. Staatz, M. H., and A. F. Trites. Geology of the Quartz Creek Pegmatite District, Gunnison County, Colorado. Geol. Survey Prof. Paper 265, 1955, 111 pp.

24. Thurston, W. R. Pegmatites of the Crystal Mountain District, Larimer County, Colorado. Geol. Survey Prof. Paper 1011, 1955, 185 pp.

25. Tullis, E. L. Beryl Resources of the Black Hills South Dakota. BuMines Rept. of Inv. 4396, 1949, 14 pp.

26. Wilson, S. R., and W. A. Young. Investigation of the New Anniversary-Bucky Pegmatite, Gunnison County, Colo. BuMines Rept. of Inv. 4939, 1953, 7 pp.

TABLE A-1. - Pegmatites investigated

Property	County and location	Occurrence(s)	Principal minerals[1]	General development of property	Sample description	Percent BeO[2]	Remarks
			Arizona				
1. Thompson Beryl (5 claims).	Cochise Secs 14, 23, T 20 S, R 27 E.	Narrow fractures filled with quartz.	Pale blue beryl crystals 1 in by 3/8 in.	Small sidehill cuts	(1) 8-ft sample in granite along quartz vein. (2) 14 in across quartz vein. (3) 8 in across quartz vein. (4) 10 in across quartz vein. (5) 6 in across quartz vein near beryl cluster.	0.003c .10e .37e .58e 1.67e	Few 100 lbs of aquamarine beryl had been collected for gemstones.
2. Ambly.....	Maricopa Sec 7, T 6 N, R 4 W.	Small; unzoned	Grey lepidolite	Open cut	Stripped debris		Chemical analysis gave 2.0% Li_2O.
3. Estermill Group (12 claims).	Maricopa NW1/4, sec 36, T 1 S, R 3 W.	Unzoned; 2 to 10 ft wide; in schist	Muscovite in 1-1/2- to 4-in books	6-ft-deep pit and open cut.	-	-	Muscovite scrap grade.
4. Morning Star.....	Maricopa NW1/4, sec 16, T 7 N, R 3 W.	Bulbous; northern: 600 ft long, 100 ft wide; southern: 300 ft long, 75 ft wide.	Spodumene, amblygonite, sparse lepidolite, scant columbite.	-	-	-	(12)[3]
5. Alma.....	Mohave NE1/4, sec 26, T 17 N, R 14 W.	Dikes; 150 ft long, 1 in. to 2 ft wide, 5 ft deep; in granite.	Euxenite, monazite, samarskite, bismite, fergusonite, beryl, Ag minerals.	4 sidehill cuts	-	-	-
6. Aquarius Cliffs..	Mohave SE part[4] T 17 N, R 12 W.	Numerous narrow, partly zoned bodies.	Green beryl, monazite, euxenite.	Open cuts and trenches.	Grab of beryl-bearing zone.	.005c	-
7. Bayview Beryllium (6 claims).	Mohave Sec 7, T 15 N, R 13 W.	Unzoned; in granite gneiss.	Beryl	3 sidehill cuts	Selected	10.00c[5] 13.00c[5]	-
8. Duncan Mine.....	Mohave NE1/4, sec 12, T 20 N, R 11 W.	Pipe with radiating dikes.	Magnetite, hematite, gadolinite.	Small open cuts	Selected		Spectrographic analysis indicated presence of Cb, Ta, R.E.[6] (16)
9. Hummingbird Group (6 claims).	Mohave Approx.[4] T 39 N, R 15 W.	750 ft long, 1 to 5 ft wide; concordant to mica schist.	Blue beryl 1/16 to 1 in. in diameter, muscovite, kyanite.	Open cut on each of 3 pegmatites.	Grab--open cut No. 1 2 ft chip--open cut No. 2 2-ft chip--open cut No. 3.	.54c .24c .14c	
10. Jeanene (3 claims).	Mohave Secs 30, 31, T 16-1/2 N, R 15 W	Zoned; 300 ft long, 100 ft wide.	Large beryl crystals	Stripped area	Selected granitic samples	1.0-3.92c[7] 0,0,0,0,0, 0,0,0e	-
11. Mica Ace (7 claims).	Mohave Sec 24, T 19 N, R 17 W.	Discontinuous; 500 ft long, 20 to 30 ft wide.	Muscovite	Bulldozed cuts	-	-	Some punch mica occurs in deposit.
12. Mica Giant (4 claims).	Mohave Sec 10, T 19 N, R 15 W.	Dikes; in granite	Muscovite	-	-	-	Some punch and sheet mica occurs in deposit.

13. Rare Metals Mine.	Mohave Sec 26, T 17 N, R 14 W.	Parallel dikes; 2 to 100 ft wide and up to 2,000 ft long.	Euxenite, monazite, samarskite, bismite, fergusonite, beryl, wolframite.	Open cuts, shaft, adit.	-	-	-
14. Silica Hill.....	Mohave Sec 24, T 18 N, R 12 W.	Zoned; quartz-microcline-muscovite pegmatite with quartz cores.	Monazite	-	-	-	-
15. White Hill.....	Mohave Approx.[4] sec 13, T 27 N, R 20 W.	Small, unzoned, fine grained	-	-	General	.005c	Area has produced $2,000,000 Ag.
16. Water Hole Mine..	Mohave Approx.[4] T 13 S, R 12 W.	Pipes; in granite	Magnetite, hematite, columbite, R.E.[8]	-	Selected	-	Nagative results on spectrographic analysis.
17. Windy (6 claims).	Pima secs 20, 29, T 18 S, R 8 E.	Small bodies; 150 ft long and up to 3 ft thick.	Beryl	-	General	.002c	-
18. Berry's Wonder...	Yavapai N1/2, sec 15, T 9 N, R 2 W.	Elongated, zoned	Beryl, apatite	-	General	.005c	-
19. Big Reef Mine (21 claims).	Yavapai SE1/4, sec 8, T 7 N, R 2 W.	Intermittent for over 1,000 ft.	Beryl, garnet, tourmaline, magnetite.	-	Field scanning with nuclear detector of 25 select samples of country rock and pegmatite.	0	-
20. Black Magic.....	Yavapai SW1/4, sec 19, T 10 N, R 1 E.	Exposed 100 ft long, 35 ft wide, 30 ft deep in creek bed.	Mica	-	-	-	Small amount of scrap mica has been mined.
21. Black Pearl (11 patented claims, 5 unpatented claims).	Yavapai NW1/4, sec 18, T 15 N, 4 7 W.	Quartz body; 6,000 ft long, 3 ft wide, 250 ft deep; in granite.	Wolframite, scheelite, beryl, pyrite, fluorite, molybdenite, bismuthinite.	1,565-ft adit, with 5 raises to surface; 155-ft shaft with 700 ft of drifting and 3 stopes.	5 for metallurgical testing.	Ave. .10c	Samples averaged 0.54 WO_3.
22. B. O. Beryl (5 claims).	Yavapai Sec 15, T 9 N, 4 2 W.	Partially zoned bodies up to 1,500 ft long and 10 ft wide in granite.	Beryl	3 bulldozed cuts	-	-	Beryl segregations average less than 5% BeO.
23. Dixie Queen.....	Yavapai SW1/4, sec 34, T 12 N, R 5 W.	Exposed 300 ft long, 100 ft wide, 30 ft deep.	Muscovite; beryl crystals up to 15 in. diameter.	Open cuts; shallow shafts with some drifting.	-	-	Small amounts of scrap mica and beryl have been mined.
24. Independence.....	Yavapai NW1/4, sec 31, T 8 N, R 2 W.	Irregular dikes (two).	Beryl, spodumene, amblygonite.	-	-	-	(12).
25. Juniper Group (10 claims).	Yavapai Sec 12, T 10 N, R 1 W.	Elongate bodies; up to 400 ft long, and 30 ft wide.	Light green beryl crystals up to 2 in. in diameter.	Surface cuts	Metallurgical	Ave. .50c	-
26. Lone Giant.....	Yavapai SE1/4, sec 30, T 8 N, R 2 E.	Zoned body; 500 ft long and up to 25 ft wide.	Beryl, spodumene, lepidolite, columbite.	Shallow open cuts	-	-	(12).
27. Long Dike.....	Yavapai SW1/4, sec 30, T 8 N, R 3 W.	Zoned body; 1,500 ft long, 15 to 50 ft wide.	Beryl, columbite, tantalite, mica.	Open cut	-	-	(12).

See footnotes at end of table.

TABLE A-1. - Pegmatites investigated--Continued

Property	County and location	Occurrence(s)	Principal minerals[1]	General development of property	Sample description	Percent BeO[2]	Remarks
			Arizona--Continued				
28. Lower Jumbo....	Yavapai SE1/4, sec 9, T 7 N, R 3 W.	Poorly zoned; 170 ft long, 50 ft wide.	Blue beryl crystals up to 5 in. in diameter, pink beryl crystals up to 4 in. in diameter, spodumene laths 5 in by 10 in by 16 ft.	-	-	-	(12).
29. Luke's Hoist Area.	Yavapai Secs 23, 26 T 10 N, R 1 W	Poorly zoned bodies; a few 100 ft in length and over 50 ft in width.	Muscovite, beryl	-	-	-	-
30. Midnight Owl...	Yavapai NW1/4, sec 31, T 8 N, R 2 W.	Well zoned; bulbous	Apatite, staurolite, beryl, spodumene, amblygonite, lepidolite, columbite, tantalite, Bi minerals.	3 open cuts	-	-	Largest producing pegmatite in Arizona (12).
31. New Lookout....	Yavapai NE1/4, sec 36, T 8 N, R 3 W.	Dikes with variable attitudes.	Muscovite	-	-	-	(12).
32 Outpost and Outpost Extension.	Yavapai N1/2, sec 3, T 7 N, R3 W, S1/2, sec 34, T 8 N, R 3 W	Well-zoned bodies; over 500 ft long, 160 ft wide, 20 ft deep.	Apatite, beryl, fluorite, garnet, microlite, pyrochlore, pyrite, Bi, Pb, Va, Cu oxides and sulfides, Ag, Mo, cassiterite.	Large bench cut; surface cuts.	-	-	(12).
33. P & G Beryl...	Yavapai Sec 30, T 8 N, R 2 W	Small dikes	Beryl	Shallow pits	Select	3.70c	-
34. Phenacite King.	Yavapai Approx.[4] sec 7, T 10 N, R 1 E.	Unzoned body; 150 ft long, 15 ft wide.	Beryl	3 hillside cuts	(1) Granite (2) Feldspar (3) Quartz (4) Overburden with beryl fragments.	0.006c .004c .004c .092c	-
35. Queen of Mica.	Yavapai Sec 29, T 9 N, R 1 W.	Wall zone; quartz-feldspar pegmatite; in schist.	Muscovite	2 hillside cuts	-	-	Mostly scrap mica; some punch and sheet mica recoverable by careful cobbing.
36. Sunrise.....	Yavapai SW1/4, sec 10, T 7 N, R 3 W.	Zoned; 600 ft long, 60 ft wide; core: Massive quartz pegmatite; intermediate: Quartz-amblygonite-spodumene-perthite pegmatite; wall and border: Perthite-quartz-lepidolite pegmatite.	Lepidolite, spodumene, amblygonite, apatite, columbite, tantalite, garnet, muscovite.	-	-	-	No beryl observed (12).

37. White Jumbo...	Yavapai SW1/4, sec 10, T 7 N, R 3 W	Poorly zones; 100 ft long, 40 ft wide.	Spodumene, amblygonite, lepidolite.	Shallow pits	-	-	No beryl observed (12).
38. White Rock....	Yavapai Approx.[4] sec 26, T 11 N, R 1 E.	Irregular masses 50 ft in diameter.	Beryl	25-ft open cut	Cut from granite. Cut from beryl-bearing quartz.	.003c >.002c	Reported to contain 0.13 BeO.[7]
			Colorado				
1. Beryl Claims (2 claims).	Boulder SW1/4, sec 5, SE1/4, sec 6, T 1 N, R 71 W	Unzoned; No. 1: 400 ft long, 55 ft wide; No. 2: 100 ft long, 70 ft wide.	Beryl	Surface cuts	-	-	Beryl observed in dumps only.
2. Beryl Lode.....	Boulder W1/2, sec 27, T 2 N, R 71W.	Unzoned	Beryl, malachite, garnet.	2 adits; surface cuts.	-	-	(10).
3. Columbine.....	Boulder NW1/4, sec 22, T 2 N, R 71 W.	Unzoned; concordant to mica schist.	Beryl, malachite	75-ft adit with 15-ft raise and 25-ft drift; surface cuts.	-	-	-
4. Little Bonnie Mine.	Boulder SE1/4, sec 33, T 2 N, R 71 W.	Small, irregular subparallel; in granite.	-	40-ft incline with 30-ft drift.	-	-	No beryl observed.
5. Rusty Gold and Cerite (2 claims).	Boulder E1/2, sec 17, T 2 N, R 71 W	Zoned; border and wall: Aplitic pegmatite, intermediate: Thin, dark streak; core: Cerite-epidote pegmatite.	Microcline, monazite, uraninite, cerite, bastnasite, fluorite.	Trenches	-	-	(10).
6. Big Buck and White Cloud (4 claims).	Chaffee Secs 4, 9, T 48 N, R 8 E.	Poorly zoned; in gneiss and schist	Muscovite	-	-	-	Grain size of muscovite ranges from 10- to 200-mesh.
7. Blue Brute and Sevilla Queen (3 claims).	Chaffee Sec 34, T 51 N, R 9 E.[8]	Unzoned dike; in gneiss.	Beryl, scrap mica	2 open cuts	-	-	Beryl is sparse.
8. Bonus Extension (12 claims).	Chaffee Secs 7, 8, T 50 N, R 5 E.[8]	9 en-echelon exposure of unzoned bodies.	Beryl crystals 1/4 in. to 12 in. in diameter and 1/2 to 3 ft long; columbite, tantalite, muscovite.	Large open cut	-	-	-
9. Clara May Lode.	Chaffee NE1/4, sec 11, T 14 S, R 77 W.	Zoned; 200 ft long, 50 ft wide, exposed 25 ft in pits; core: Quartz pegmatite; intermediate: Quartz-plagioclase-albite pegmatite; wall: Granite.	Garnet, euxenite, allanite, bismuthite.	1 large and 1 small pit.	-	-	Beryl not observed.
10. Homestake Mine (3 claims).	Chaffee Sec 34, T 51 N, R 9 E.[8]	Zoned; 500 ft long, 100 ft wide, 200 ft deep in pit; core: Albite pegmatite; wall: Quartz-albite-muscovite-microcline pegmatite.	Apatite, R.E.[8]	Large open pit	Crude ore 1/4 in. reject.	Oe Oe	(10).

See footnotes at end of table.

TABLE A-1. - Pegmatites investigated--Continued

Property	County and location	Occurrence(s)	Principal minerals[1]	General development of property	Sample description	Percent BeO[2]	Remarks
			Colorado--Continued				
11. Rock King.....	Chaffee Sec 34, T 51 N, R 9 E.[8]	3 unzoned; parallel outcrops totaling 500 ft in length and 100 ft in width.	Beryl, garnet, columbite, tantalite.	Large bench cut	-	-	Beryl has been mined from southern outcrop (10).
12. Shirley Group (19 claims).	Chaffee Secs 4-9, T 50 N, R 9 E.[8]	Unzoned; outcrops from 100 to 500 ft long, up to 75 ft wide.	Beryl, garnet, columbite, tantalite, R.E.[6]	1 trench and several small pits.	-	-	-
13. Silver Rocker Group (21 claims).	Chaffee Secs 33, 34, T 51 N, R 9 E.[8]	Poorly zoned; narrow, lenticular outcrops; individual outcrops are from 100 to 1,500 ft in length and up to 250 ft wide.	Garnet, beryl, columbite, tantalite.	6 open cuts	-	-	-
14. Grover.....	Clear Creek S1/2SE1/4, sec 9, SW1/4SW1/4, sec 10, T 4 S, R 72 W.	Zoned; outcrop 1,000 ft long, 40 ft wide; concordant in gneiss.	Beryl, garnet, columbite, tantalite, monazite, samarskite, gahnite.	Large trench; 110-ft adit.	Specimens	-	(10).
15. Saw Mill Gulch.	Clear Creek NE1/4, sec 8, T 4 N, R 72 W.	Irregular, slablike outcrop in gneiss.	Garnet, beryl crystals 1 to 6 in. in diameter and up to 18 in. in length.	Sidehill cut	-	-	-
16. Jacobsen Ranch.	Clear Creek SW1/4, sec 12, T 4 S, R 72 W.	Zoned; core: 2-ft quartz pegmatite; intermediate: 3-ft microcline-quartz-tourmaline pegmatite; border: 3-in. aplitic pegmatite; concordant in biotite gneiss.	Garnet, topaz, beryl crystals up to 3 in. in diameter and 12 in. long.				
17. Saddleback Mountain.	Clear Creek NW1/4, sec 10, T 4 S, R 72 W.	Small dikes; in granite gneiss.	Garnet, xenotime, gahnite, hematite.	Bulldozed strip and small pits.	-	-	-
18. Baldwin.....	Douglas NE1/4NE1/4, sec 13, T 10 S, R 69 W.	Dike; in granite	-	Open cut	-	-	No beryl or R.E.[6] observed.
19. California....	Douglas Center of N1/2N1/2, sec 35, T 8 S, R 69 W.	Unzoned; 400 ft long, 100 ft wide; in granite.	Garnet, fluorite, yttrofluorite, pyrochlore.	2 open cuts	-	-	No beryl observed.
20. Cramer.....	Douglas NE1/4NE1/4, sec 12, T 9 S, R 69 W.	Unzoned; 200 ft long, up to 100 ft wide; in granite.	Fluorite, allanite, euxenite.	Open cut	-	-	Do.
21. Denver.....	Douglas sec 7, T 10 S, R 68 W.	Zoned; 300 ft long; core: Quartz pegmatite; intermediate: Quartz-plagioclase-biotite pegmatite; in granite.	Fluorite, beryl	Large open cut	-	-	-

22. Devils Head....	Douglas NW1/4NE1/4, sec 21, T 9 S, R 69 W.	Quartz-microperthite-cleavelandite pegmatite.	Topaz, amazonstone	Surface cuts	-	-	(10).
23. Little Eddie...	Douglas SE1/4SE1/4, sec 12, T 10 S, R 69 W.	Unzoned; 150 ft long, up to 60 ft wide; in granite.	Fluorite, allanite,	Open cut	-	-	No beryl observed (10).
24. Lone Pine.....	Douglas NW1/4NE1/4, sec 25, T 10 S, R 69 W.	Irregular mass; in granite.	Thorite, xenotime, pyrochlore, parisite.	Large open cut	-	-	No beryl observed.
25. Lost Dutchman..	Douglas SW1/4SE1/4, sec 19, T 10 S, R 68 W.	Zoned; 200 ft long; up to 50 ft wide; in granite.	Allanite	Prospect pits	-	-	Do.
26. Miller Lode (11 claims).	Douglas Sec 8, T 9 S, R 69 W.	Circular mass; in granite.	Fluorite, yttro-fluorite.	Open pit	-	-	Do.
27. Princeton Group.	Douglas SW1/4, sec 10, T 9 S, R 69 W.	Zoned; 1,000 ft long, up to 50 ft wide; in granite.	Thorite, allanite	Surface cuts	-	-	Do.
28. Skeleton No. 2.	Douglas SW1/4SW1/4, sec 36, T 9 S, R 69 W.	Unzoned	Fluorite, yttrofluorite.	Large sidehill cut other surface cuts.	-	-	(10).
29. Spielman.....	Douglas SW1/4SE1/4, sec 19, T 10 S, R 68 W.	Unzoned; 200 ft long, up to 50 ft wide; in granite.	Allanite	Prospect pits	-	-	No beryl observed.
30. Three Musketeers.	Douglas NE1/4, sec 18, SE1/4, sec 7, T 9 S, R 69 W.	Unzoned	Fluorite, monazite	Large open cut	-	-	Do.
31. Watson Park....	Douglas NW1/4NW1/4, sec 36, T 9 S, R 69 W.	Zoned; 500 ft long; 70 ft wide; core: Quartz pegmatite; intermediate: Microcline-cleavelandite-quartz pegmatite.	Fluorite, topaz, allanite.	Sidehill cut	-	-	Do.
32. Bull Gulch Mica (5 claims).	Fremont Sec 26, T 49 N, R 12 E.[8]	Small bodies; in gneiss and schist.	Beryl, columbite, tantalite.	3 small open cuts	Specimens	-	-
33. Climax mine....	Fremont Sec 5, T 16 S, R 72 W.	One of 15 outcrops in section	Beryl	8 open cuts; adits	-	-	(10).
34. Mica Lode.....	Fremont SW1/4, sec 14,	Zoned; 2,000 ft long, 100 to 650 ft wide; core: Microcline-quartz pegmatite; intermediate: Muscovite-quartz-albite pegmatite; wall: Quartz-microcline-muscovite-biotite pegmatite; in quartz-mica schist.	Tourmaline, garnet, apatite, beryl, columbite, tantalite, Bi minerals.	4 open cuts; several trenches.	Specimens	-	(10).

See footnotes at end of table.

TABLE A-1. - Pegmatites investigated--Continued

Property	County and location	Occurrence(s)	Principal minerals[1]	General development of property	Sample description	Percent BeO[2]	Remarks
			Colorado--Continued				
35. Phantom Canyon	Fremont Sec 16, T 17 S, R 69 W	Unzoned; 2,500 ft long, 65 to 200 ft wide; in gneiss and schist.	Beryl, garnet, columbite, tantalite.	2 open cuts	-	-	(10).
36. Suzanna (5 patented cliams).	Fremont Sec 14, T 18 S, R 71 W.	Lenticular; 2,700 ft long, 200 to 500 ft wide; in gneiss and schist.	Beryl, columbite, tantalite, lepidolite.	2 large open cuts; other surface cuts.	-	-	-
37. Zingheim (Devils Hole).	Fremont SE1/4NW1/4, sec 20, T 18 S, R 73 W.	Tabular; 350 ft long, 35 to 200 ft wide.	Beryl, columbite	Large open cut	-	-	(10).
38. Brown Derby (2 claims).	Gunnison NW1/4NE1/4, sec 3, T 49 N, R 3 E[8]	15 zoned pegmatites (3 detailed); in metadiorite.	Lepidolite, beryl, lithia-tourmaline, microlite, columbite, tantalite, monazite, betafite.	16 pits; 2 inclines; 2 tunnels	Channel cuts	0.04e .01e .32e 2.29e .02e 0,0	(10), (14), (23)
39. Brown Derby No. 4.	Gunnison SE1/4SE1/4, sec 34, T 50 N, R 3 E[8]	Two zoned bodies; poorly exposed; in metadiorite.	Lepidolite, topaz, beryl.	Small tunnel; open pit.	-	-	(10), (23)
40. Brown Derby No. 5.	Gunnison SE1/4SW1/4, sec 34, T 50 N, R 3 E[8]	Crudely lenticular; zoned; in metadiorite.	Beryl, lepidolite, microlite, garnet, apatite, topaz.	Large open pit; small tunnel.	Channel cuts	0 5.57e	(10), (23)
41. Brown Derby Ridge.	Gunnison N1/2SE1/4NE1/4, sec 3, T 49 N, R 3 E[8]	4 indistinctly zoned bodies; in diorite, schist, and amphibolite.	Garnet, beryl, helvite.	3 small pits	Channel cuts	12.18e 1.61e 1.58e	(10), (23)
42. Buck Horn.....	Gunnison SW1/4SE1/4, sec 27, T 50 N, R 3 E[8]	Poorly zoned; in hornblende gneiss.	Beryl	2 open pits	-	-	(10), (23)
43. Comet Group (7 claims).	Gunnison SW1/4NW1/4, sec 24, T 12 S, R 84 W.	Small bodies; in biotite-rich porphyritic granite.	Apatite, topaz, lepidolite, beryl.	-	Composite sample of 4 exposures.	0	(10)
44. Complex Group (7 claims).	Gunnison SE1/4SE1/4, sec 14, T 51 N, R 3 E[8]	Iron oxide stained veins; in granite.	Pb, Zn, Cu, Ag, Au, W minerals.	Tunnel; bulldozed cuts.	Composite sample of area.	0	-
45. Little Katherine (Bazooka).	Gunnison SW1/4NE1/4SE1/4, sec 2, T 49 N, R 3 E[8]	Two zoned pods; in metamorphic rocks.	Lepidolite, amblygonite, spodumene, microlite, pyrochlore.	9 open cuts of various sizes.	Channel cuts	0.02e	(13).
46. Monzonite (18 claims).	Gunnison NW1/4NW1/4NW1/4, sec 22, N1/2, NE1/4, and NW1/4, sec 21, SE1/4SE1/4NE1/4, sec 20, T 50 N, R 3 E[8]	Various sized bodies; zoned to unzoned; in granite and metadiorite.	Beryl, monazite, columbite, tantalite, topaz, garnet, crytolite, autunite.	Various sized open cuts.	Channel cuts	12.77e 1.18e 0,0,0	-

47. New Anniversary (Bucky) (5 claims).	Gunnison SW1/4NE1/4, sec 22, T 50 N, R 3 E[a]	Zoned; 1,800 ft long, 450 to 1,000 ft wide; in metadiorite.	Beryl, columbite, tantalite.	Considerable surface workings; 94-ft shaft; 80-ft tunnel.	Specimens	0,0	(10), (23), (26)
48. Opportunity (3 claims).	Gunnison SE1/4NW1/4, sec 17, T 49 N, R 3 E[a]	11 zoned exposures over an area 3,500 ft long, 1,700 ft wide; in granite which is locally biotite rich.	Lepidolite, beryl, microlite, columbite, tantalite, topaz, tourmaline.	8 open cuts	Channel cuts	0.01e	(10), (23)
49. White Spar No. 1.	Gunnison NE1/4NE1/4, sec 34, T 50 N, R 3 E[a]	Roughly lenticular; zoned.	Lepidolite, beryl, microlite, topaz, lithia-tourmaline, columbite, tantalite.	6 open cuts	Specimens	7.71e 0	(10), (23)
50. White Spar No. 2.	Gunnison SE1/4NE1/4, sec 34, T 50 N, R 3 E[a]	Zoned; 220 ft long, 7 to 50 ft wide; in hornblende gneiss.	Lepidolite, beryl	2 open cuts	Channel cut	.16e	(10), (23)
51. Bachman Ranch..	Jefferson SE1/4NE1/4, sec 15, T 3 S, R 71 W.	Unzoned; concordant to mica schist.	Garnet, magnetite, beryl.	2 open cuts	-	-	-
52. Big Bertha.....	Jefferson SW1/4, sec 22, T 8 S, R 70 W.	Unzoned; lobate; in granite.	Fluorite, monazite, thorium, yttrofluorite.	Large open cut	-	-	No beryl observed.
53. Bigger Sweitzer (1 patented claim).	Jefferson N1/2, sec 3, T 3 S, R 71 W.	Zoned; sinuous; core: Quartz-microcline pegmatite; intermediate: Quartz-albite-muscovite pegmatite; wall: Quartz-microcline-albite-biotite pegmatite; in diorite schist.	Beryl, columbite, tantalite, monazite, uraninite.	Large open cut; shaft.	-	-	(10)
54. Buckman Ranch..	Jefferson NW1/4NW1/4, sec 23, T 3 S, R 71 W.	Small; unzoned	-	Open cut	-	-	No beryl or R.E.[e] observed.
55. Catherine No. 1.	Jefferson Sec 3, T 8 S, R 70 W.	Small exposure; in granite.	Fluorite, topaz	2 pits; 1 trench	-	-	Do.
56. Centennial Cone.	Jefferson NE1/4, sec 32, T 3 S, R 71 W.	Zoned; core: Quartz pegmatite; intermediate: Quartz-albite-muscovite pegmatite; outer: Quartz-microcline-muscovite pegmatite; in biotite granite gneiss.	Beryl, monazite	Shallow pits	-	-	(10).
57. Coors Quarry...	Jefferson Sec 18, T 4 S, R 71 W.	Irregular, lenslike bodies; in hornblende gneiss.	Magnetite, garnet, allanite.	6 open cuts; 1 tunnel.	-	-	No beryl observed.
58. Cressman Gulch.	Jefferson SE1/4, sec 17, T 3 S, R 70 W.	4 partially zoned exposures; 1,500 ft long, 10 to 40 ft wide.	Apatite, beryl, columbite, tantalite, manganotantalite.	2 sidehill cuts	-	-	(10).

See footnotes at end of table.

TABLE A-1. - Pegmatites investigated--Continued

Property	County and location	Occurrence(s)	Principal minerals[1]	General development of property	Sample description	Percent BeO[2]	Remarks
			Colorado--Continued				
59. Drew Hill.....	Jefferson NW1/4, sec 34, T 2 S, R 71 W.	Numerous small, zoned exposures; in gneiss.	Chrysoberyl	3 small sidehill cuts.	-	-	(10).
60. East Shaffer Hill.	Jefferson SE1/4SW1/4, sec 7, T 4 S, R 71 W.	Irregular; zoned; concordant in gneiss.	Garnet, magnetite, tourmaline, monazite, microlite.	Surface cuts	-	-	-
61. Elledge (Ramstetter) (2 claims).	Jefferson SW1/4SW1/4SE1/4, sec 15, T 3 S, R 71 W.	Zoned	Beryl (float)	Small sidehill cut	Channel cut Float Float	0 9.69e 0	(10).
62. Gilman Ranch...	Jefferson SW1/4, sec 30, T 2 S, R 71 W.	Many small exposures; in gneiss.	Zircon	4 shallow pits	-	-	Spectrographic analysis indicated presence of Be, Cs, Nb, Ta, R.E.[6]
63. Green Ranch....	Jefferson S1/2, sec 29, T 3 S, R 71 W.	Narrow; zoned; in gneiss.	Beryl, monazite	Sidehill cut	-	-	-
64. Ladwig-Grosso..	Jefferson NE1/4NE1/4, sec 18, T 3 S, R 70 W.	Poorly zoned; sill like; in schist.	Beryl	Shallow cut	-	-	-
65. Ladwig Ranch...	Jefferson SW1/4SW1/4, sec 18, T 3 S, R 70 W.	Swarm of poorly zoned outcrops.	Beryl	Shallow, bulldozed cuts.	-	-	-
66. Little Abner...	Jefferson Sec 29, T 3 S, R 71 W.	Indistinct zonal arrangement; in biotite gneiss.	Beryl samarskite, garnet.	Open cut	-	-	Spectroscopic analysis indicated presence of Cs, Sc.
67. Madonna.....	Jefferson Sec 11, T 8 S, R 70 W.	Swarm; unzoned; in granite.	Thorite, fluorite, yttrofluorite, xenotime.	3 open cuts on two outcrops.	-	-	-
68. Old Luster Lode.	Jefferson SW1/4SE1/4, sec 33, T 7 S, R 70 W.	Zoned; elliptical, pipe-like; core: Massive quartz-pegmatite; intermediate: Perthite-quartz-fluorite pegmatite; wall: Quartz-perthite-biotite pegmatite; in granite.	Fluorite, allanite, cryolite.	Open cut	-	-	-
69. Roscoe Beryl..	Jefferson N1/2, sec 5, T 4 S, R 71 W	Zoned structure; in biotite granite gneiss.	Magnetite, garnet, beryl, gadolinite, monazite, xenotime.	Open cut	-	-	(10).
70. Roscoe Gulch	Jefferson S1/2NE1/4, N1/2SE1/4, sec 31, T 3 S, R 71 W.	10 unzoned outcrops; in lime-silicate gneiss.	Tourmaline, magnetite, garnet, beryl, monazite, allanite.	Several pits	Specimens	-	-

71. Silver Glen Ranch.	Jefferson SW1/4, sec 26, T 4 S, R 71 W.	Zoned; lobate	Garnet, topaz, beryl, bertrandite, thorite, manganocolumbite, monazite.	Large open pit	do.	-	-
72. Soda Creek School.	Jefferson NW1/4, sec 18, T 4 S, R 71 W.	Zoned; egg-shaped; core: Quartz-pegmatite; intermediate: 2 (discontinuous) quartz-microcline-biotite-albite pegmatite with cleavelandite; wall: Albite-quartz pegmatite; in hornblende and garnet gneiss.	Garnet, columbite, tantalite, microlite.	2-level open cut.	-	-	-
73. Sunrise Peak...	Jefferson SW1/4, sec 22, T 4 S, R 71 W.	Several zoned outcrops; core: Quartz-mica pegmatite; intermediate: Microcline-quartz-cleavelandite-mica pegmatite; wall: Quartz-tourmaline-garnet pegmatite.	Beryl, columbite, tantalite, topaz, microlite, samarskite, zircon, xenotime, allanite, monazite, pyrochlore, cryolite.	Large open cut; 6 small pits.	Specimens	-	-
74. Tall Timber Group.	Jefferson NW1/4, sec 6, T 5 S, R 70 W.	3 zoned exposures; in schist.	Beryl, garnet, columbite, tantalite.	2 large open cuts; tunnel; several small pits.	-	-	-
75. Wasson Ranch...	Jefferson Secs 10, 15, T 4 S, R 71 W.	Zoned; core: Quartz-feldspar-biotite pegmatite; intermediate: Feldspar-quartz-mica pegmatite; corcordant in granite gneiss.	Beryl, columbite, tantalite, samarskite, euxenite, thorite.	2 open cuts; short tunnel; shaft; several small pits.	-	-	-
76. White Cloud (2 claims).	Jefferson Sec 36, T 7 S, R 70 W.	Zoned; circular, pipe-like; core: Massive quartz pegmatite; inner: Quartz-perthite-fluorite pegmatite; intermediate: Perthite-quartz pegmatite; wall: Quartz-perthite-biotite pegmatite; in granite.	Topaz, fluorite, cryolite, allanite, microlite, yttrofluorite, gadolinite.	Open cut	Specimens	-	-
77. Beryl Dike.....	Larimer Sec 21, T 8 N, R 71 W.	Unzoned; 200 ft long, 50 ft wide; in granite gneiss.	Beryl	Open cut	-	-	-
78. Beryl Dike (2 claims).	Larimer; SE1/4, sec 2, T 8 N, R 71 W.	Swarm; in quartz-mica schist.	Beryl	2 open cuts on 2 exposures.	-	-	-
79. Big Boulder Beryl.	Larimer SE1/4, sec 36, T 7 N, R 72 W.	Zoned; concordant to mica schist.	Beryl, tourmaline, apatite, garnet, spodumene, autunite.	2 open cuts; shaft; several small pits; 5 drill holes.	-	-	(10), (24).

See footnotes at end of table.

TABLE A-1. - Pegmatites investigated--Continued

Property	County and location	Occurrence(s)	Principal minerals[1]	General development of property	Sample description	Percent BeO[2]	Remarks
			Colorado--Continued				
80. Calypso Beryl..	Larimer Sec 27, T 7 N, R 72 W.	Outcrop; in granite gneiss.	Beryl, tourmaline	Several small pits	-	-	-
81. Cojade.....	Larimer SE1/4, sec 36, T 5 N, R 71 W.	4 small exposures; concordant in granite gneiss.	Beryl, amblygonite, columbite, tantalite.	2 small open cuts; 2 bulldozer-stripped areas.	-	-	-
82. Corral Pole (2 claims).	Larimer SW1/4, sec 24, T 7 N, R 72 W.	Zoned; core: Quartz pegmatite; border: Plagioclase-muscovite-beryl pegmatite; in mica schist.	Beryl	Open cut	-	-	-
83. Crystal Snow...	Larimer Sec 31, T 7 N, R 71 W.	Zoned; in mica schist.	Allanite, beryl	Open cut	-	-	-
84. Debbie Doll....	Larimer Sec 22, T 7 N, R 71 W.	Small, narrow; unzoned; in mica schist.	Beryl, lithiophylite.	Shallow pit	-	-	-
85. Green Crystal (4 claims).	Larimer Secs 27, 28, T 8 N, R 71 W.	2 exposures; in granite gneiss.	Beryl	Several small pits.			
86. Hanks Hole.....	Larimer Sec 28, T 8 N, R 71 W.	Outcrop; in mica schist.	Beryl, tourmaline	Small pit	-	-	-
87. H G & S No. 3..	Larimer Sec 20, T 8 N, R 71 W	Do.	Tourmaline, ruby mica, beryl.	2 small pits	-	-	-
88. Hideabove and Storm Mountain	Larimer Sec 18, T 6 N, R 71 W.	Pegmatite outcrops; in granite; enclosed by mica schist.	Beryl, tourmaline, apatite, garnet, gummite.	2 open trenches	-	-	-
89. Hilltop No. 23.	Larimer Sec 3, T 6 N, R 71 W.	Unzoned; 400 ft long, 30 ft wide;	Beryl	2 open cuts; bulldozed strip.	-	-	-
90. Huckleberry....	Larimer Secs 20, 29, T 7 N, R 72 W.	Dike; in mica schist and granite gneiss.	Beryl, garnet, tourmaline.	Several small pits	-	-	-
91. Hyatt Ranch....	Larimer Sec 28, T 6 N, R 71 W.	Lenticular, asymmetrical; zoned; in biotite granite which cuts quartz-mica schist.	Beryl, bismuthinite, uraninite.	3 open cuts; 3 pits; tunnel; 4 drill holes.	-	-	(6), (10), (24).
92. Kings Kanyon...	Larimer Sec 21, T 7 N, R 72 W.	Outcrop; 500 ft long, 3 to 10 ft wide; in granite gneiss.	Lepidolite, fluorite, amblygonite, beryl.	Several small pits	-	-	-
93. Mount Ethel (4 claims).	Larimer Sec 28, T 8 N, R 71 W.	Outcrop; 1,500 ft long, 100 ft wide; in granite gneiss.	Beryl, tourmaline	Open cut	-	-	-
94. Rattlesnake Park.	Larimer SE1/4, sec 36, T 5 N, R 71 W.	Several parallel bodies; concordant in granite gneiss.	Amblygonite, tourmaline, beryl.	Small open cuts	-	-	Spectroscopic analysis indicated presence of Cs, Sc.

95. Reta Beryl.....	Larimer Sec 27, T 7 N, R 72 W.	Outcrop; 200 ft long, 25 ft wide; in granite gneiss.	Tourmaline, beryl	Do.	-	-	-
96. Thodab (Bull Elk).	Larimer Sec 25, T 7 N, R 72 W.	Outcrop; 200 ft long, 4 ft wide; in mica schist.	Beryl, autunite	Open cut	-	-	-
97. Vona Mae (3 claims).	Larimer Secs 31, 32, T 9 N, R 70 W.	Exposure; 90 ft long, 1 to 7 ft wide; in mica schist.	Monazite	105-ft tunnel	-	-	Chemical analysis returned: 0.01% Y_2O_3, 0.2% ThO_2, 0.5% Ce_2O_3, 0.5% La_2O_3, 0.5% Rb_2O_3.
98. Beryl Gem.....	Mesa Sec 7, T 15 S, R 101 W.	Series of sub-parallel, sill-like dikes; in granite gneiss and schist.	Garnet, beryl	Sidehill cut	-	-	-
99. Big Sheep Horn.	Park W1/2, sec 20, T 11 S, R 73 W.	5 exposures along a N-S line; in granite gneiss.	Beryl, columbite, tantalite.	Sidehill cut; 2 open pits; 10-ft incline.	-	-	-
100. Blue-Green (2 claims).	Park Sec 26, T 11 S, R 73 W.	Zoned; 300 ft long, 25 to 50 ft wide; in granite.	Garnet, beryl	2 small open pits	-	-	Spectroscopic analysis indicated the presence of Sc, Cs, Rb.
101. Christie Ward-Lucky Thirteen.	Park N1/2, sec 24, T 12 S, R 72 W.	Zoned; core: Quartz pegmatite; intermediate: Feldspar-muscovite pegmatite; outer: Quartz-feldspar-mica pegmatite.	Titanocolumbite, aeschynite, priorite, beryl.	3 small open cuts	-	-	-
102. Mary Lee-Little Bear.	Park Sec 22, T 11 S, R 72 W.	Narrow outcrop; in granite gneiss.	Beryl, bertrandite, wolframite, fluorite, topaz, barite.	105-ft tunnel; 120-ft incline.	-	-	-
103. Teller.....	Park NE1/4, sec 31, T 12 S, R 71 W.	Lenticular, irregular; unzoned; in granite schist.	Yttrofluorite, gadolinite.	2 open cuts, bulldozed strip.	-	-	-
104. Black Cloud....	Teller NE1/4NE1/4, sec 9, T 13 S, R 70 W.	Zoned; core: Quartz pegmatite; outer: Quartz-feldspar-fluorite pegmatite; in granite.	Fluorite, apatite, beryl, columbite, tantalite, pyrochlore, microlite, samarskite.	Large open cut with 2 benches.	-	-	-
New Mexico							
1. White Top.....	Grant Sec 29, T 21 S, R 16 W.	3 small, circular, outcrops; zoned; core: Massive quartz pegmatite; wall: Quartz-albite pegmatite, in granite.	Beryl (in dumps)	3 open cuts; shaft	-	0.002c	Spectrographic analysis indicated presence of Li, Rb, Ga, Sc, Yt.
2. Harding.....	Taos S1/2, sec 29, T 23 N, R 11 E.	Tabular dike; zoned; in schist and quartzite.	Beryl, spodumene, lepidolite, microlite, columbite-tantalite, apatite.	Large open cut; underground workings.	-	-	-

See footnotes at end of table.

TABLE A-1. - Pegmatites investigated--Continued

Property	County and location	Occurrence(s)	Principal minerals[1]	General development of property	Sample description	Percent BeO[2]	Remarks
			South Dakota				
1. Beecher.....	Custer NW1/4, sec 18, T 4 S, R 5 E.	Lenticular; zoned; concordant in quartz-mica schist.	Spodumene, amblygonite, beryl, lepidolite, columbite, tantalite, cassiterite.	3 open pits; 2 shafts; 2 inclines; 6 drill holes; several trenches.	-	-	(8), (17), (18), (25).
2. Helen Beryl....	Custer Sec 7, T 4 S, R 4 E.	Irregular; oval; zoned; in quartz-mica schist.	Beryl, spodumene, columbite, tantalite.	Large open cut	-	-	(7), (17), (25).
3. High Climb.....	Custer Secs 22, 27, T 2 S, R 4 E.	Irregular; zoned; concordant in quartz-mica schist.	Beryl, amblygonite, spodumene, apatite, garnet, columbite, tantalite.	5 open cuts	-	-	(17), (20), (25)
4. Highland.....	Custer NE1/4, sec 30, T 3 S, R 4 E.	Oval; zoned; concordant in quartz-mica schist.	Beryl, columbite	Large open pit; incline with raise, tunnel; small pits.	-	-	(13), (17), (25).
5. Lushbaugh-Lillian.	Custer Sec 23, T 3 S, R 4 E.	Outcrop; in schist	Beryl, lithiophylite, triphylite, tourmaline.	Open cut; open cut and shaft with workings.	-	-	-
6. Red Bird.....	Custer Sec 28, T 5 S, R 5 E.	Lenticular; zoned; in quartz-mica schist.	Beryl, tourmaline muscovite.	-	-	-	-
7. Red Deer.....	Custer SE1/4, sec 15, NE1/4, sec 22, T 4 S, R 5 E.	Irregular; zoned; in schist and quartzite.	Muscovite	Open cut; underground workings.	-	-	(4).
8. Tin Mountain...	Custer Secs 35, 36. T 3 S, R 3 E.	Irregular; L-shaped; zoned; in schist.	Spodumene, amblygonite, beryl, columbite, tantalite, pollucite, lepidolite, microlite.	12 open cuts; shaft with 2 levels, stopes; 2 tunnels.	-	-	(17), (25).
9. White Bear.....	Custer NE1/4, sec 11, T 4 S, R 4 E.	Lenticular; zoned; in quartz-mica schist.	Beryl	3 open cuts; 76-ft incline with 2 levels.	-	-	(7), (17), (25).
10. Blue Ox (3 claims).	Pennington Sec 13, T 2 S, R 6 E.	3 small, parallel, dikex; unzoned.	Beryl, tourmaline	3 open cuts; several small pits.	-	-	-
11. Dan Patch.....	Pennington Sec 7, T 2 S, R 6 E.	Oval; pipe-like; concordant in quartz-biotite schist.	Beryl, columbite, tantalite, sphalerite.	Large open cut	-	-	(7), (25).
12. Hardesty.....	Pennington NE1/4, sec 36, T 1 S, R 5 E.	Irregular; zoned; in biotite-garnet-quartz schist.	Amblygonite, beryl, tantalite, spodumene, tapiolite, cassiterite.	4 open cuts; 10-ft shaft.	-	-	(7), (25).
13. Hugo.....	Pennington NE1/4, sec 17, T 2 S, R 6 E.	Irregular; zoned; in quartz-mica-staurolite schist.	Amblygonite, spodumene, apatite, beryl, cassiterite, lithia mica.	Open pits; glory holes; underground development.	-	-	(15), (17), (25).

14. Ingersoll.....	Pennington NE1/4NW1/4, sec 6, T 2 S, R 6 E.	5 dikes; zoned; in quartz-mica schist.	Amblygonite, spodumene, lepidolite, beryl, columbite, microlite, cassiterite.	Open cuts; pits; underground development.	-	-	(17), (25).
15. Peerless.....	Pennington Sec 8, T 2 S, R 6 E.	Several irregular dikes; zoned; in quartz-mica schist.	Lithia-mica, beryl, amblygonite, montebrasite, tantalite, columbite, cassiterite, lithiophylite, triphylite.	Open cuts; pits; underground development; 7 drill holes.	-	-	(17), (21), (25),
16. White Cap.....	Pennington NE1/4, sec 16, T 2 S, R 6 E.	Irregular; zoned; in mica schist.	Amblygonite, lithiophylite, triphylite, beryl, columbite, tantalite, microlite.	2 large, open cuts	-	-	(17), (25).
			Utah				
1. Granite Mountain.	Tooele T 8 S, R 13 W.	Numerous small, narrow dikes; in quartz monzonite and quartz diorite.	Beryl crystals 1 in. in diameter, 3 in. in length (maximum).	Small prospect pits.	Selected channel cuts.	0.007c,0.002c, 0.015c,0.005c, 0.013c,0.048c, 0.005c,0.005c, 0.76c,0.056c, 0.127c,0.005c, 0.41c,3.40c, 0.023c,0.013c, 0.030c,0.005c, 0.005c.	Spectrographic and chemical analysis show presence of Sc, Rb, Cs (10).
			Wyoming				
1. Many Values....	Albany SE1/4, sec 32, T 13 N, R 78 W.	Outcrop; 140 ft long, 15 ft wide; in schist and gneiss.	Garnet, tourmaline, beryl, tantalite, columbite.	20-ft shaft; 15-ft shaft; open cuts.	-	-	(10).
2. Bell (3 claims).	Fremont Sec 29, T 40 N, R 93 W	Small, lenticular, dikes; in schist, amphibolite, gneiss.	Beryl, columbite tantalite.	Small open cut	Specimens	-	-
3. Billy Jack (2 claims).	Fremont NW1/4, sec 27, T 40 N, R 93 W.	Small dike; in schist and gneiss.	Beryl, tantalite	Open pit	-	-	-
4. Kill Lode (27 claims).	Fremont Sec 30, T 40 N, R 93 W.	Swarm of small, lenticular outcrops; in gneiss, schist, amphibolite.	Beryl, columbite, tantalite.	2 shallow pits; bulldozed strip.	Specimens	-	-
5. Kunzite (2 claims).	Fremont Sec 20, T 40 N, R 93 W.	Small, lenticular bodies; in amphibolite, schist.	Tourmaline, lepidolite, beryl, columbite, tantalite.	-	Channel cut	-	Qualitative chemical test strong for Ta.
6. Quien Sabe No. 2.	Fremont Secs 21, 22, 27, 28, T 40 N, R 93W.	2 outcrops; in schist.	Beryl, columbite, tantalite, cassiterite, Li minerals.	5 trenches	-	-	-
7. Sleeper.....	Fremont NW1/4, sec 27, T 40 N, R 93 W.	Bow-shaped outcrop in mica schist.	Beryl, columbite tantalite.	Open pit	Channel cut Dump	0c 0c	-

See footnotes at end of table.

TABLE A-1. - Pegmatites investigated--Continued

Property	County and location	Occurrence(s)	Principal minerals[1]	General development of property	Sample description	Percent BeO[2]	Remarks
			Wyoming--Continued				
8. Whippet (16 claims).	Fremont Secs 22, 27, 28, 29, T 40 N, R 93 W.	Swarm of irregular-outline dikes; in schist, gneiss, amphibolite; intruded by diorite.	Spodumene, lepidolite, beryl, columbite, tantalite, garnet, petalite.	Numerous small pits and trenches.	Specimens	-	(10).
9. Crystal Palace.	Goshen Secs 34, 35, T 28 N, R 65 W.	Concordant; zoned; core: Quartz-plagioclase pegmatite; wall: Muscovite-tourmaline pegmatite; in mica schist.	Tourmaline, beryl.	Large open cut	Specimen	-	(10).
10. Spook No. 4 (Chicago)	Goshen Sec 35, T 28 N, R 65 W.	Zoned dike; in mica schist.	Tourmaline, beryl, apatite.	Open cut	Specimen	-	(10).

[1]Principal minerals other than quartz and feldspar.
[2]c--chemical analysis, e--detector analysis.
[3]Underlined numbers in parentheses refer to works cited in the list of Selected References.
[4]Unsurveyed township.
[5]Results from Albany, Ore.
[6]Refers to either rare earths or rare-earth oxides.
[7]Results of private assayer.
[8]New Mexico principal meridian.

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