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ALLANITE FROM THE MOUNT WHEELER AREA, WHITE PINE COUNTY, NEVADA[1]

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ABSTRACT

Previous workers have shown that allanite can contain up to several per cent beryllia. Accessory allanite from a quartz-monzonite stock exposed near the area of beryllium mineralization in the Snake Range of eastern Nevada contains less than 2 ppm beryllium. This fails to support the hypothesis of a relation between the intrusive rock and the beryllium mineralization.

INTRODUCTION

The occurrence of beryllium minerals at the Mount Wheeler mine in the Snake Range, White Pine County, Nevada, was first described by Stager (1960). Whitebread and Lee (1961) report additional discoveries of beryllium minerals more than a mile north of the Mount Wheeler mine, and present information on the areal geology of the "Wheeler limestone" member that is host to the beryllium mineralization. Whitebread and Lee (1961) also describe the spatial relations between the beryllium deposits and a quartz-monzonite stock that is exposed just north and east of the mineralization in a westward-trending band 1 to 3 miles wide. They also note that there is no apparent evidence to support the working hypothesis of a direct relation between the beryllium mineralization and the igneous rocks in this area, even though the quartz-monzonite stock may be present at depth below the Mount Wheeler mine.

In order to further test such a working hypothesis, a study of the area of intrusive outcrop is in progress. It is already clear that the texture, mineralogy and degree of alteration of this intrusive are rather widely variable from place to place, and it is possible that more than one intrusive phase is represented in the total outcrop area of about 20 square miles (see the maps of Drewes, 1958, and Whitebread, *et al.*, 1962). One part of the intrusive is distinct from the rest in that it contains epidote and allanite as persistent accessory minerals. The presence of allanite is especially interesting here, for this mineral has been reported to contain significant amounts (as much as 5.5 per cent) of BeO (see for example Beus, 1956; Warner, *et al.*, 1959).

The allanite-bearing "phase" of the stock includes the entire portion of the igneous outcrop area (about 5 square miles) drained to the east by Snake Creek (see map of Drewes, 1958). It is a medium-grained rock that is slightly porphyritic in places. The rock is almost always well-jointed

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and the sets within the system, in order of consistency, typically have these approximate trends:

(1) N. 40°E., steep SE to 90°
(2) N. 40°W., moderate NE or SW to 90°
(3) E.–W., moderate N. or S. to 90°

The N. 40°E. set may carry aplites (garnet-bearing) and/or quartz veinlets; these are not abundant. Silicification is rather common along the planes of the N. 40°E. set; because of this the joints often stand out about an inch high and an inch or two wide on weathered surfaces. This silicification locally is accompanied by a concentration of fine-grained epidote (but not allanite). Inclusions of finer-grained more mafic material up to several inches across are common in the allanite-bearing "phase" of the quartz-monzonite stock, but they are rare in other parts of the intrusive. These inclusions are tentatively interpreted to represent fragments of shaly rock in process of assimilation.

Chemical and Physical Properties of Allanite

In order to determine the beryllium and rare-earth contents of the accessory allanite that is present in the intrusive "phase" described above, a pure fraction was recovered from sample 38-MW-60, which was collected at an elevation of 8520 feet on the northeast side of the Snake Creek road, at 38°55′52″ N. and 114°15′26″ W. (see maps of Drewes, 1958, and Whitebread, *et al.*, 1962). The specific gravity of the allanite analyzed was determined in Clerici solution by means of the suspension method to be within the range 3.88–4.02. In thin sections the mineral is present as euhedral crystals 0.5–1.5 mm long, usually associated with epidote, biotite and sphene. The allanite is commonly twinned (Fig. 1) and shows little evidence of zoning within individual crystals. There is no evidence of metamictization, although a few of the euhedral crystals exhibit a very narrow, discontinuous reaction rim (Fig. 1).

Indices of refraction of the analyzed allanite were measured in sodium light by means of the immersion method. The other optical properties listed were determined by means of universal stage plots of three twinned and two untwinned crystals.

$\alpha = 1.762 \pm .005$
$\beta = 1.782$
$\gamma = 1.795$
$\gamma - \alpha = .032$
Biaxial (−); 2V near 55°
X = very pale brown
Y = light brown
Z = reddish brown
Z > Y > X

Dispersion r > v, strong
Optic plane = 010
Composition plane of twinning = 100
$X \wedge c = 32°$

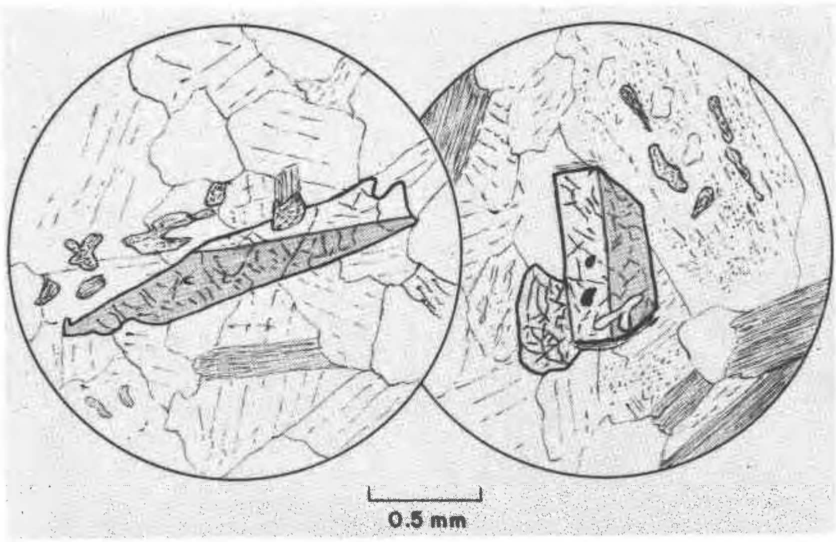

FIG. 1. Twinned allanite from the Mount Wheeler area, White Pine County, Nevada.

A. (left) Composition plane (100) inclined at an angle of 50° from the perpendicular. Note the epidote [2V=80(−)] intergrown with the smaller twin; biotite is growing out from the free end of this epidote. The irregularly-shaped patches with high relief are also epidote. Other minerals are quartz, feldspar and biotite.

B. (right) Composition plane (100) inclined at an angle of 9° from the perpendicular. The material at the ends of the allanite crystal is interpreted to represent incipient development of a reaction rim. The black blebs in the allanite are unidentified; the light inclusion appears to be quartz. The mineral with high relief to the left of the allanite is epidote. The irregularly-shaped patches with high relief in feldspar are also epidote. Other minerals are biotite and quartz.

There is little mention of allanite twinning in the literature. Russell (1937) describes an occurrence, but gives no crystallographic data except to state that extinction is inclined to the composition plane. Hutton (1951) describes an unusual linear feature in allanite, but concludes from the optical behavior of the mineral that this feature does not seem to represent twinning. Volborth (1962), writing on allanite pegmatites in Nevada and California, states: "Many of the allanite crystals are apparently twins with (100) as composition plane (twin-plane?)."

A quantitative spectrographic analysis of the pure accessory allanite from sample 38-MW-60 (Table 1) failed to detect the presence of beryllium; thus if this mineral contains any beryllium, it probably is present in amounts of less than 2 parts per million. In view of the fact that allanite sometimes contains significant amounts of beryllium, the present results certainly do not support the idea of a direct relation between the beryllium mineralization and the igneous rocks in this area. In

TABLE 1. SPECTROGRAPHIC ANALYSIS OF ALLANITE FROM SAMPLE 38-MW-60[1]
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Rare-earth and thorium oxides (weight per cent)		Rare-earth elements, atomic per cent of total rare earths	
Y_2O_3	0.2	Y	1.4
La_2O_3	5.4	La	26.1
CeO_2	10.4	Ce	47.6
Pr_6O_{11}	1.1	Pr	5.1
Nd_2O_3	3.0	Nd	14.0
Sm_2O_3	0.8	Sm	3.6
Eu_2O_3	0.05	Eu	0.2
Gd_2O_3	0.2	Gd	0.9
Tb_4O_7	0.1	Tb	0.4
Dy_2O_3	0.1	Dy	0.4
Ho_2O_3	0.03	Ho	0.2
Er_2O_3	0	Yb	0.02
Tm_2O_3	0		
Yb_2O_3	0.005	Σ La+Ce+Pr	78.9
Lu_2O_3	0	Ce/(Nd+Y)	3.1
ThO_2	0.9	Ce/(La+Nd)	1.2
Total	22.3		
Looked for but not detected: Be			

[1] See Bastron, *et al.* (1960) for a description of the spectrographic method used.

this regard there are, however, two facts to bear in mind. First, as noted above, it is possible that more than one intrusive phase is represented in the outcrop area of this quartz-monzonite stock. Secondly, all beryllium-bearing allanites reported to date are from pegmatitic environments, whereas the allanite described here is present as an accessory mineral in a medium-grained quartz monzonite.

Murata, *et al.* (1957) discuss the systematic variation of rare-earth elements in cerium-earth minerals. These same authors introduce as an index of composition of all cerium-earth minerals with respect to the rare-earth elements a quantity called sigma (Σ), which is the sum of the atomic percentages of La, Ce and Pr. They also point out that a highly selective fractionation of the rare-earth elements is more commonly attained in alkali rocks than in granitic rocks, and therefore cerium-earth minerals from alkalic rocks usually have the higher Σ values. The allanite described here (Table 1) has $\Sigma = 78.90$; this is relatively high for a cerium-earth mineral from a granitic rock. Further work is in progress to determine the range in Σ values of the accessory allanite in this intrusive rock, and to investigate further the possibility of a direct relationship between the intrusive rocks and the beryllium mineralization exposed in this area.

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