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A Beryllium-bearing Variety of Allanite

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Several communications[1] have recently been published concerning the occurrence of various rarer minerals including thorogummite, yttrialite, tengerite, abukumalite, fergusonite, xenotime, zircon, etc. at Iisaka Village, Daté County, Fukushima Prefecture. Associated with these minerals, a characteristic black mineral with pitch-like lustre was also found to occur in the same locality. The mineral usually exists in massive form showing no crystalline faces, and measuring about 15~25 mm in diameter embedded in feldspar. Streak is greenish grey; specific gravity, 3·67; hardness, 5~6. It shows a weak radioactivity of about 15 per cent. of that shown by the Ceylon monazite. Distinct differences between this mineral and the ordinary allanite from the same locality, the latter usually existing as prismatic crystals, are recognisable in lustre, specific gravity, and radioactivity,

TABLE I.

Constituents	Per cent.	Molecular ratio	
SiO_2	30·58	50·9	6·0
Al_2O_3	12·71	12·5	
Rare earths	23·94	15·0*	
ThO_2	0·26	0·1	3·7
ZrO_2	0·57	0·4	
Fe_2O_3	5·74	3·6	
FeO	10·81	15·0	
MnO	2·05	2·9	5·0
BeO	2·49	10·0	
CaO	8·20	14·6	
UO_3	trace	—	
H_2O (+)	3·33	18·5	2·2
(Total)	100·68		

(1) S. IIMORI and S. HATA: *Sc. Pap. I.P.C.R.*, **34** (1938), 447 (Thorogummite); *ibid.*, 504 (Fergusonite). S. HATA: *ibid.*, 455 (Yttrialite); *ibid.*, 619 (Xenotime and Zircon); *ibid.*, 1018 (Abukumalite). T. IIMORI: *ibid.*, 832 (Tengerite).

* The mean atomic weight of the elements was roughly assumed as to be 160.

though both are almost indistinguishable in colour, streak, and hardness.

About five grams of not-stained and well-lustrous fragments were carefully selected and employed for analysis. The result of analysis is given in Table I.

As indicated in Table I, the molecular ratio of $R^{II}O : R^{III}_2O_3 : SiO_2$ is 5·0 : 3·7 : 6·0, the oxygen ratio of all the basic oxides to silica being 4 : 3, which corresponds to a subsilicate, and when treated like this, it does not exactly coincide with the Tschernik's formula[2] of allanite. Since the ionic radius of beryllium rather resembles that of aluminium, however, it may be so considered that a part of aluminium atoms can be substitutionally displaced by the atoms of beryllium in such a mineral. Then, the general formula, $X_2Y_3Z_3(O, OH)_{13}$, of allanite proposed by F. Machatschki[3] is nearly satisfied, actually being computed as $X_{2\cdot5}Y_{3\cdot0}Z_{2\cdot7}(O, OH)_{13\cdot4}$, where X: rare-earth elements, Ca, Mn, Th, Zr; Y: Al, Be, $Fe^{"}$, $Fe^{"'}$; and Z: Si, and a slight discrepancy from the normal formula will be ascribed to its partial weathering as subsequently stated. Hence, this mineral is also nothing but a variety of allanite characterized by containing a fairly marked quantity of beryllia. The beryllium-bearing allanites have hitherto been found only in a few localities, for instance, in Bedford County (BeO : 0·52%),[4] and Amherst County (BeO : 0·24%),[5] both belonging to Virginia, U. S. A., and also in Radantal, Harz, Germany (BeO : 0·42%).[6] In these foreign allanites, the content of beryllia is rather very low as compared with the present one. So there leaves another trifling doubt that this beryllia might be attributed to the intimate inclusion of any other beryllium-rich minerals, for instance, such as, gadolinite, etc. in the allanite crystal. In order to ascertain whether beryllium is one of the proper constituents of this mineral or not, it was attempted to purify the sample by adopting the method of magnetic separation. For this purpose, a good specimen was crushed and the powder passed through a hundred mesh screen. The pulverized sample, thus obtained, was effected to be separated by means of a strong electromagnet

(2) G. TSCHERNIK: *Z. Krist.*, **47** (1910), 292.
(3) F. MACHATSCHKI: *Centralbl. Min.*, Abt. A (1930), 89, 153.
(4) W. T. POGE: *Chem. News.*, **46** (1882), 195.
(5) J. R. SANTOS: *Chem. News.*, **38** (1878), 95.
(6) I. FROMME: *Tsch. Min. Mit.*, **28** (1909), 323.

into two parts, one being homogeneously paramagnetic and amounting to about eighty per cent. of the total, and the other, the remaining twenty per cent., consisting of rather more weakly and heterogeneously paramagnetic ingredients. The former is slightly greenish black, while the latter brownish black in colour, the brownish tinge becoming gradually more distinct with decrease of magnetic property. This fact suggests that the brown portion will probably be the altered product due to the weathering of the essential part of the mineral. The analysis made on this brown portion showed that it was also chiefly composed of silica, alumina, lime, rare earths, and beryllia, the last being estimated as to be 5·1 per cent. Since alumina and lime are not usually contained so much in gadolinite as this, it proves, therefore, that this portion must surely be the weathered substance resulted from the intrinsic part of the present mineral. The increase of beryllia content may also be accepted as the result of weathering, as is known that the beryllium content of the Amherst allanite is 0·24 per cent. as BeO in its core, 0·94 per cent. in the inner layer, as well as 1·95 per cent. in the outer layer of its crust. J. R. Santos[7] formerly stated about this phenomenon that alumina and beryllia consistently survives in the weathering of allanite, and this seems to be quite in accord with the present case. From the foregoing results, it is to be concluded that the present mineral is no doubt a beryllium-bearing variety of allanite. The occurrence of such variety of allanite containing beryllium in Iisaka might have some connections with the fact that any beryllium-rich minerals, such as beryl, gadolinite, trimerite, etc., have never been found in this locality notwithstanding the presence of several species of rare minerals in the same district.

In conclusion, I wish to express my sincere thanks to Dr. S. Iimori for the valuable advices and to Messrs. S. Hata and O. Nagashima for their united aids in collecting the specimens.

(7) *loc. cit.*