# A Mineralogical Note on the Euxenite-Polycrase Series Mineral from Syowa Base, Antarctica,

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# 昭和基地産放射性鉱物—Euxenite-Polycrase 系鉱物—について

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本鉱物は黒色塊状，貝殻状断口，ガラス光沢を示し，比重は約5.5である．条痕は赤褐色で，千度加熱後は淡褐色に変ずる．薄片の色は赤褐色，等方性を示す．粉末のガイガー計数器による放射能は約 15%U 当量である．

常温ではX線粉末像が得られず，完全にメタミクト状態にある．空気中で1,000°C 7時間加熱した試料のX線粉末像は，euxeniteの標準資料とよく一致する．DTA 曲線は約 760°C に著しい発熱があり，euxenite, eschyniteの特徴を示す．主要化学成分（%）は $UO_2$ 11.84, $UO_3$ 0.67, $ThO_2$ 3.20, $TiO_2$ 24.74, $Nb_2O_5+Ta_2O_5$ 30.76, $\sum Ce_2O_3$ 0.38, $\sum Y_2O_3$ 25.26 などで $AB_2O_6$ の理想式で表わされる．$Nb_2O_5$ と $Ta_2O_5$ の量は略等量であり ($Nb_2O_5+Ta_2O_5$): $TiO_2$ の分子比は 1:3.6 になり，化学成分上からは BRÖGGER の定義による polycrase に属するものである．

Through the kindness of Prof. T. TATSUMI of University of Tokyo, and Mr. T. KIKUCHI of the Geological Survey of Japan, an opportunity has been offered to examine a specimen from Skallen District, which shows distinct radioactivity. Since such radioactive mineral as euxenite, besides allanite[7], monazite[2], has not been previously reported from Antarctica, the material has been investigated in some detail. The specimens were found in a pegmatite vein cutting hornblende-pyroxene dioritic gneiss[6].

The mineral is black and massive with conchoidal fracture and a vitreous luster, and is nearly opaque. Streak is dark reddish brown, and it changes to pale brown after heating at 1,000°C for 7 hours. Specific gravity is about 5.5 measured on a Berman microbalance. In thin section it is yellow-brown, and completely isotropic from alteration.

The mineral is judged to be metamict since unheated material fails to yield x-ray diffraction patterns, whereas it gives a distinct and reproducible patterns after being heated at 1,000°C for 7 hours in air in an electric furnace. Table 1. shows the x-ray diffraction data for the mineral and other typical euxenite specimens. X-ray spectrochemical analyses were also carried out for the specimen and the following constituent elements have been recognized; Nb, Y, U, Th, Yb, Er, Ta, Fe, Dy, Zr, Pb, Ho, Ti,

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Table 1. X-ray powder diffraction data for euxenite.

| (1) Antarctica d (Å) | I | (2) Madagascar d (Å) | I | (3) Ontario d (Å) | I | (4) Chôsen d (Å) | I | (5) hkl |
|---|---|---|---|---|---|---|---|---|
| 7.30 | 1 | 7.28 | 1⁻ | 7.30 | 1 | 7.25 | 1⁻ | 020 |
| — | | 5.18 | 1⁻ | 5.16 | 2 | 5.16 | — | 110 |
| 3.67 | 3 | 3.66 | 2 | 3.66 | 3 | 3.65 | 3 | 130, 111, 040 |
| 3.36 | 1 | 3.36 | 1 | 3.36 | 2 | 3.34 | 2 | 121 |
| 2.98 | 10 | 2.98 | 10 | 2.98 | 10 | 2.98 | 10 | 131 |
| 2.77 | 2 | 2.78 | 2 | 2.77 | 2 | 2.78 | 2 | 200 |
| 2.62 | 1⁻ | 2.62 | 1⁻ | 2.61 | — | 2.62 | 1 | 141 |
| 2.59 | 2 | 2.60 | 2 | 2.58 | 2 | 2.59 | 2 | 002, 220, 150 |
| 2.55 | — | 2.56 | 1⁻ | 2.54 | — | 2.56 | 1⁻ | 012 |
| 2.44 | 1 | 2.45 | 1 | 2.43 | 3 | 2.44 | 1 | 022, 201, 060 |
| 2.30 | 1 | 2.31 | 1⁻ | 2.30 | 1 | 2.30 | 1 | 112, 221, 151 |
| 2.20 | — | 2.21 | 1⁻ | 2.252 | — | — | | 032, 132 |
| 2.18 | — | 2.19 | 1⁻ | 2.199 | 1 | 2.20 | 1 | 240 |
| — | | — | | 2.182 | 1 | 2.18 | 1⁻ | 231 |
| 2.11 | 1 | 2.11 | 1 | 2.106 | 2 | 2.10 | 2 | 132 |
| 2.06 | — | — | | 2.071 | — | 2.07 | — | 161 |
| — | | — | | 2.025 | — | 2.03 | 1⁻ | 241 |
| 1.969 | — | 1.979 | 1⁻ | 1.970 | — | 1.975 | — | 142 |
| 1.931 | — | 1.939 | 1⁻ | 1.935 | 1 | 1.930 | 1⁻ | 170, 052 |
| 1.891 | 2 | 1.898 | 1 | 1.889 | 2 | 1.892 | 2 | 202, 222, 310 |
| 1.821 | 2 | 1.829 | 2⁻ | 1.823 | 4 | 1.821 | 2 | 152, 260 |
| 1.767 | 2 | 1.772 | 1 | 1.769 | 3 | 1.768 | 2 | 062 |
| 1.677 | — | — | | 1.679 | — | 1.679 | — | 242 |

(1) (2) (4) Powdered samples being heated to 1,000°C for 7 hours in air in an electric furnace. Powder patterns were recorded by a Geigerflex diffractometer, using Cu $K\alpha_1$ radiation, Ni, filter; 30 KV, 15 MA; scale factor 16, time constant 2, at 2° $2\theta$ per minute.

(3) ASTM card 5-0603.

(5) After Arnott, R. J. (Am. Mineral., 35, 1950, Nos. 5 and 6, 396).

Gd, Sm, Tm, Ce, Sn, Nd, Mn.

The mineral is readily attacked by mineral acids such as hot concentrated HF and $H_2SO_4$, and by fusion in $KHSO_4$.

A good specimen, free from alteration product forming the outer shell, was pulverized and subjected to analysis. The results are shown in Table 2. The result shows that the mineral contains a considerable amount of Ti, Nb, Ta, Y group rare earths and U, and that the composition of the mineral agrees with that of ordinary euxenite-polycrase series mineral.

The high content of Y group rare earths and the low content of Ce group, characteristic to the euxenite group mineral is also seen in the mineral and that does not conflict with the results given by x-ray spectrochemical analysis.

The mean atomic weight of the Y group rare earths was calculated to be 127, from the weight of oxide and the determination of oxalate equivalent to the rare

Table 2. Chemical analysis.

| | % | %/F.W. | Metals | | Oxygen | |
|---|---|---|---|---|---|---|
| MnO | 0.05 | 0.0007 | 7 | | 7 | |
| $Fe_2O_3$ | 1.07 | 0.0067 | 134 | | 201 | |
| CaO | 0.64 | 0.0114 | 114 | | 114 | |
| MgO | 0.22 | 0.0054 | 54 | | 54 | |
| $\sum Ce_2O_3$ | 0.38 | 0.0012 | 24 | 2504 (A) | 36 | |
| $\sum Y_2O_3$ | 25.26 | 0.0811 | 1622 | | 2433 | |
| $ThO_2$ | 3.20 | 0.0121 | 121 | | 242 | 14613 (0) |
| $UO_2$ | 11.48 | 0.0426 | 426 | | 852 | |
| $UO_3$ | 0.67 | 0.0002 | 2 | | 6 | |
| $(Nb, Ta)_2O_5$* | 30.76 | 0.0870 | 1740 | | 4350 | |
| $TiO_2$* | 24.74 | 0.3096 | 3096 | 4899 (B) | 6192 | |
| $SiO_2$ | 0.33 | 0.0055 | 55 | | 110 | |
| $SnO_2$ | 0.11 | 0.0008 | 8 | | 16 | |
| $H_2O(+)$ | 0.23 | | | | | |
| Total | 99.14 | | | | | |

* $(Nb, Ta)_2O_5/TiO_2=1.0/3.6$ (in mol.).

Euxenite, $(Nb, Ta)_2O_5/TiO_2>1/3$: polycrase, $(Nb, Ta)_2O_5/TiO_2<1/3$ (by Brögger[1]).

earths. Using the figure and taking the atomic weight 89 of Y, as well as the mean value 162 of six elements Sm, Gd, Dy, Ho, Er, Yb into account, content of $Y_2O_3$ in the rare earths is calculated to be 48% in weight. The approximate separation of Nb from Ta was attempted by the tannin procedure, and the ratio of $Ta_2O_5$ to $Nb_2O_5$ was found to be about 1:1 in weight.

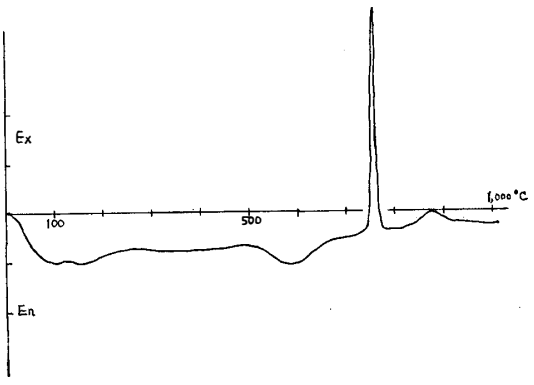


Fig. 1. DTA curve for euxenite, Skallen district, Antarctica. (Recorded by T. SUDÔ and H. SHIMANE)

Neglecting $H_2O$, which is considered as the impurities due to alteration, and adopting the molecular weight of observed mean atomic weight 127 for Y group, the mean atomic weight 140 for Ce group, and the ratio of 1:1 for $Nb_2O_5$: $Ta_2O_5$, the empirical formula of the mineral is expressed as $A_{2504}B_{4899}O_{14613}$, approximately $A_{1.00}B_{1.96}O_{5.83}$, which corresponds to the general formula of $AB_2O_6$ of the euxenite-polycrase mineral.

A differential thermal analysis for the mineral is represented in Fig. 1., kindly recorded by Prof. T. SUDO and Mr. H. SHIMANE of the Tokyo University of Education. The curve shows one significant exothermic peak at about 760°C, this is characteristic to typical euxenite besides eschynite[3]. But eschynite can be differentiated by its high Ce and Th contents[4]. Polycrase does not show distinct thermal changes according to the literature[3].

Euxenite-polycrase series mineral chemically resembles eschynite-priorite series mineral, however, they are usually distinguished by means of x-rays[5], and DTA method[3].

From the above-mentioned data, it is concluded that the mineral is related with euxenite, and chemically classified into polycrase after the definition of BRÖGGER[1].

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