PRELIMINARY REPORT ON METAMICT CERIANITE FROM NESÖYA, LÜTZOW-HOLMBUKTA, EAST ANTARCTICA

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Abstract: Mineralogical studies of a blackish mineral with strong radioactivity from microcline pegmatites of Nesöya, Lützow-Holmbukta, East Antarctica, were performed. This mineral has been completely or almost completely transformed into a metamict state. However, in a heat treatment (1000°C, 7 hours), the powder pattern is identical with cerianite, and the unit cell dimension calculated from the powder X-ray diffraction data is $a_0=5.451$ Å. According to the qualitative analysis by an electron probe X-ray microanalyzer, the mineral consists of lanthanoids and other elements, such as La, Ce, Pr, Nd, Sm, Eu, Gd, Th, Xe, Cs, Pb, Rh, etc. Both the X-ray diffraction data and chemical analysis identify this mineral as a metamict cerianite [Ce(Th)O_2].

1. Introduction

Nesöya lies at 700 m north of Syowa Station, East Ongul Island. A geological reconnaissance was performed by a Japanese geologist in 1957 and since then some members of the Japanese Antarctic Research Expeditions visited the island with various scientific objectives.

The geology and geomorphology of Nesöya and its surroundings was outlined by TATSUMI and KIKUCHI (1959) and the brief petrography was presented by TATSUMI *et al.* (1964). KIZAKI (1964) and YANAI *et al.* (1974) compiled geological map (1:10000 and 1:5000) of East Ongul Island, including Nesöya.

In July 1975, metamict cerianite was discovered from microcline pegmatite of Nesöya by the author (MATSUMOTO). Accordingly, the field survey of the area was performed during the winter season of 1975 by the author and Mr. M. FUNAKI of the 16th Japanese Antarctic Research Expedition 1974–1976 (JARE-16). The same mineral was found from microcline pegmatite to the south of Lake Midori, East Ongul Island by the author. Furthermore, at Syowa Station, the same mineral was discovered as a large boulder (about 35 kg weight) by Mr. M. MANABE of JARE-16.

Cerianite occurs very rarely in the world. Cerianite as a new mineral was reported by GRAHAM (1955) to occur very sparingly in partly absorbed inclusions of wall-rock in a dike-like zone of carbonate rock cutting a nepheline syenite, with magnetite, ilmenite and apatite from Lackner Township, Sudbury, Ontario, Canada.

After that, it was found as a secondary mineral in Morro do Ferro on the Poços de Caldas, Brazil (FRONDEL and MARVIN, 1959), and as pseudomorphs after monazite in pegmatite (JENSEN, 1967), and as an accessory mineral of the granitic rock (PANTO, 1975).

In this paper, mode of occurrence and preliminary mineralogical description of metamict cerianite from Nesöya are given.

2. Geological Sketch and Mode of Occurrence of Metamict Cerianite

Geology and geologic structure of Nesöya are exactly the same as East Ongul Island. In these islands, the crystalline basement rocks consist of paragneisses (garnet gneiss and hornblende gneiss), charnockites (pyroxene gneiss), metabasites and allied rocks, hornblende-biotite gneissose granite, and minor intrusives. Most of these rocks belong to the Ongul Group of YOSHIDA (1977, 1978). These basement rocks are gently or moderately inclined to the east or the west with the north-south trend. Complicated and superposed folds are developed throughout these islands.

Metamict cerianite occurs in microcline pegmatite from the northern part of central Nesöya. Figure 1 shows the geological map of this area. It is composed of crystalline basement rocks and pegmatite dikes. The former are garnet gneiss and many kinds of metabasites, such as eclogitic metabasite, hornblende metabasite, pyrrhotite-molybdenite-bearing metabasite, magnetite-bearing metabasite and molybdenite-bearing hornblende metabasite, the latter are two kinds of pegmatites, namely, hornblende pegmatite and microcline pegmatite.

In this area, the basement rocks strike N20°W to N35°W and dip 45°E. The pegmatite dikes strike mostly northwest, partly northeast, with a vertical dip. Microcline pegmatite dikes are well exposed for about 20 to 80 m along the strike, ranging in width from 50 to 150 cm, and cut the basement crystalline rocks and hornblende pegmatite dikes. Both the pegmatite dikes stand out in relief 30 to 100 cm from the country rocks all around (Fig. 2).

Metamict cerianite-bearing microcline pegmatite is very coarse-grained, and sub-inequigranular, being composed of microcline, plagioclase, smoky quartz and biotite, with accessory metamict cerianite and graphic intergrowth of garnet and quartz. The metamict cerianite occurs mostly in the central part of microcline pegmatite dikes (Figs. 3 and 4), and very rarely in the wall-rock of the pegmatite contact zone (Fig. 5).

3. Mineralogical Properties of Metamict Cerianite

Metamict cerianite from Nesöya is black to dark brownish black and translucent, has conchoidal fractures and vitreous luster with the unaided eye. Individual specimens measure 0.5 to 10 cm in diameter. Metamict cerianite is a massive mineral and crystal planes are not developed. Under the microscope

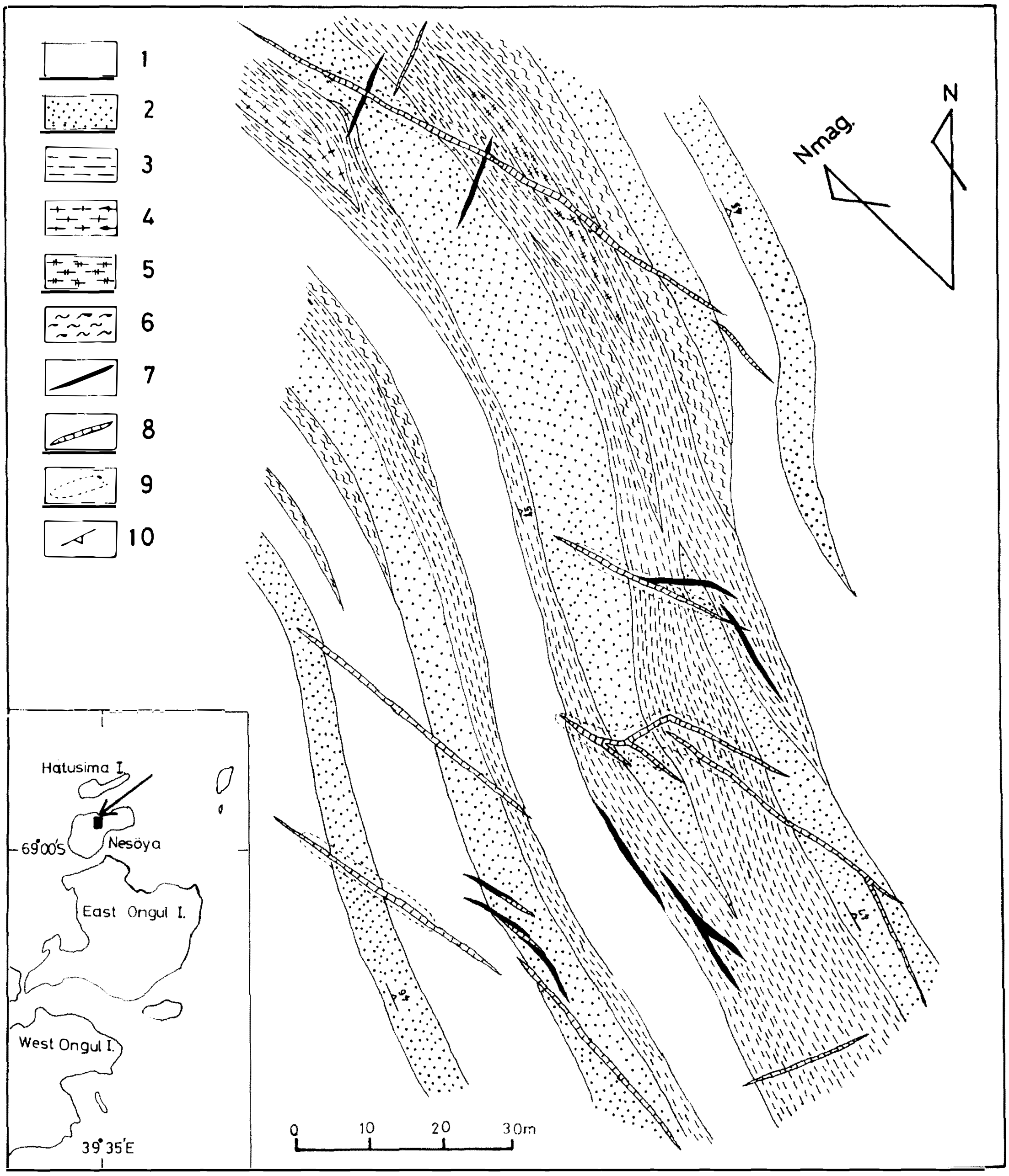

Fig. 1. Geological map of the locality of metamict cerianite, Nesöya, East Antarctica. 1: Garnet gneiss. 2: Eclogitic metabasite. 3: Hornblende metabasite. 4: Pyrrhotite-molybdenite-bearing metabasite. 5: Magnetite-bearing metabasite. 6: Molybdenite-bearing hornblende metabasite. 7: Hornblende pegmatite. 8: Microcline pegmatite. 9: Concentrated area of metamict cerianite. 10: Strike and dip of schistosity.

Fig. 2. Metamict cerianite-bearing microcline pegmatite dikes stand out in relief 30 to 100 cm from the country rock.

Fig. 3. Metamict cerianite (black part) in microcline pegmatite.

Fig. 4. A part of Fig. 3.

Fig. 5. Metamict cerianite in the country rock of microcline pegmatite contact zone.

Fig. 6. Photomicrograph of metamict cerianite from Nesöya. One nicol. Long dimension of photograph = 1.3 mm.

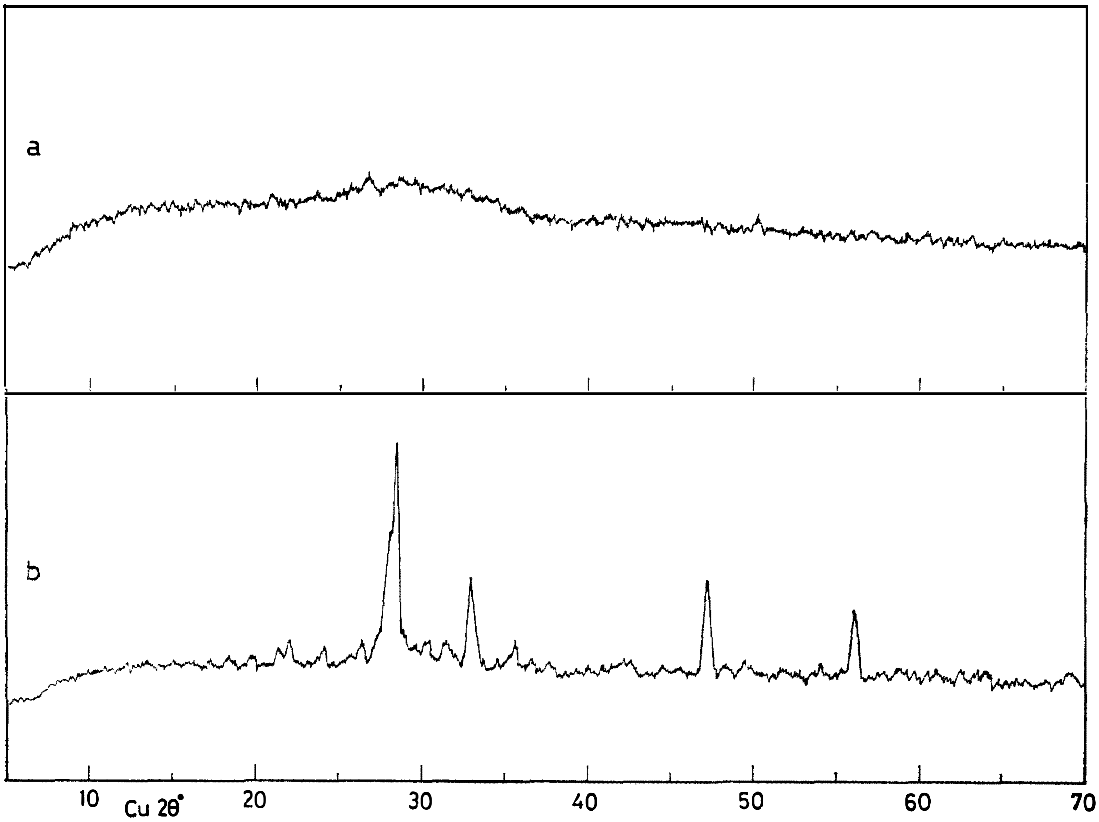

Fig. 7. X-ray diffraction diagram of metamict cerianite (a) and cerianite (b) from Nesöya. a: Sample collected firsthand. b: Sample after heat treatment at 1000 °C for 7 hours under the dry condition in air.

(Fig. 6) it is faintly mud yellow, and is isotropic. In this mineral is included crystals of rutile, hematite, garnet, scapolite, zircon and yttrotitanite (keilhauite). This mineral is characterized by the strong radioactivity.

Powder pattern was taken up by a Norelco Geiger counter X-ray diffractometer using Cu Kα radiation, under the conditions of 35 kV, 20 mA and scanning speed 1/2 degree per minute. Figure 7 shows the results of the X-ray diffraction powder pattern of this mineral, in which the upper part (a) is the sample collected firsthand, and the lower part (b) is the sample after heat treatment at 1000°C for 7 hours under the dry condition in air. The upper figure (a) shows that the mineral has been almost completely transformed into a metamict state, but the lower figure (b) shows several peaks distinctly.

Table 1 shows the results of measurements of X-ray diffraction of the mineral in the heat treatment, together with synthetic pure cerianite (CeO_2) and synthetic pure thorianite (ThO_2) based on the ASTM cards. The mineral from Nesöya and the synthetic cerianite agree exactly. The mineral's unit cell dimention calculated from the powder X-ray diffraction data is $a_0=5.451$ Å, which is slightly larger than the synthetic pure cerianite ($a_0=5.411$ Å), and conspicuously smaller than the synthetic pure thorianite ($a_0=5.600$ Å). From these results, this mineral is considered as a cerianite.

Table 1. X-ray powder patterns and unit cells of cerianite and thorianite.

Nesöya			ASTM cards			
Cerianite 1000°C, 7 hours			Cerianite		Thorianite	
hkl	d(Å)	I/I_1	d(Å)	I/I_1	d(Å)	I/I_1
	3.193	49	—		—	
	3.182	45	—		—	
111	3.151	100	3.124	100	3.234	100
200	2.723	40	2.706	29	2.800	35
220	1.929	48	1.913	51	1.980	58
	1.926	46	—		—	
311	1.643	45	1.632	44	1.689	64
Unit cell (Å)	$a_0=5.451$		$a_0=5.411$		$a_0=5.600$	

Table 2. Qualitative chemical analysis of metamict cerianite from Nesöya.

Lanthanoid	La, Ce, Pr, Nd, Sm, Eu, Gd
Others	Th, Xe, Cs, Pb, Rh, Ti, Cr, Mn, Fe, Mg, Al, Si, Ca, P, Cl

The qualitative chemical analysis of the mineral was made with a JEOL JXA-50A electron probe X-ray microanalyzer. Table 2 shows its composition, consisting of lanthanoids and other elements, such as La, Ce, Pr, Nd, Sm, Eu, Gd, Th, Xe, Cs, Pb, Rh, etc.

Both the chemical analysis and X-ray diffraction data identify the mineral from Nesöya as an amorphous cerium-thorium mineral after cerianite [$Ce(Th)O_2$], namely a metamict cerianite.

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