Comptes Rendus (Doklady) de l'Académie des Sciences de l'URSS
1941. Volume XXXII, № 7

MINERALOGY

NORDITE, A NEW MINERAL OF THE LOVOZERO TUNDRAS

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(Communicated by A. E. Fersman, Member of the Academy, 16.VI. 1941)

The mineral was found by the author in 1935 in the Lovozero alkaline massif (Kola peninsula). The data being rather scanty, its study has been delayed, although some brief information was published under the titles: «Mineral No. 10» (1) and «A silicate of alkalies, alkaline earths, Mn and TR» (2). A more detailed study of the mineral has shown that it cannot be identified with any of the minerals already known, and therefore it was given a new name — nordite (because of its northern origin).

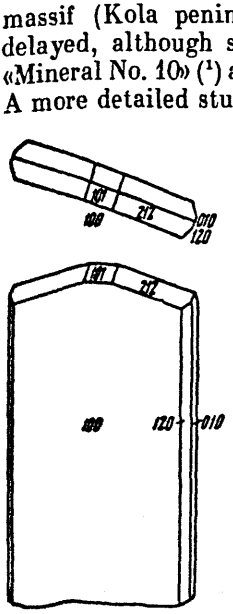

Fig. 1.

Crystallographic Characteristics. Nordite occurs as lamellae up to 1 cm long, up to 0.5 cm wide and up to 0.1 cm thick, rarely in larger segregations. The lamellar segregations of nordite sometimes show a fan-like arrangement. It rarely occurs in crystals, and when it does so, the faces are poorly developed. For goniometrical measurements there were taken only two imperfectly developed small crystals of nordite. The results have shown that it should be considered a mineral of the rhombic syngony. The measuremens revealed the following forms: (100), (010), (110), (120), (212) and (101). Of these the principal form accounting for the outward appearance of the crystal is presented by the faces of one of the pinacoids taken as (100). The faces of the form (110) are very slightly developed as very narrow bands. The general aspect of the crystal is shown in Fig. 1. The faces of forms (212) and (010) in Fig. 1 are shown wider than they actually are (to be more demonstrative).

The form (211) with co-ordinates $\varphi = 69°56'$ and $\rho = 37°22'$ served for computing the axial ratio $a : b : c = 0.730 : 1 : 0.527$. The axial ratio has not been calculated with accuracy, because the faces of the measured crystals are poorly developed and do not give distinct signals. In Table 1 are given the angles φ and ρ obtained when measuring the faces observed.

Physical Properties. The colour of the mineral is light-brown; streak white. Semitransparent (slightly). Cleavage good in one direction (along 100). Fracture from uneven to conchoidal. Brittle. Hardness 5–6. Sp. gravity, determined by the pycnometer, 3.430. Under the blow-pipe it is

easily fused to a blue-coloured glass. The borax bead in the oxidizing flame is light yellowish-green; upon cooling, pale pink, nearly colourless. In the reducing flame shows the same colour, though a paler one; upon cooling, colourless. The phosphate bead in both the oxidizing and the reducing flame is yellowish-green, colourless upon cooling.

Optical Characteristics. The colour of nordite in the thin-section is light-grey. Optically biaxial, negative. The refractive indices determined by the immersion method are as follows: $N_g = 1.642$; $N_m = 1.630 - 1.640$; $N_p = 1.619$; $N_g - N_p = 0.023$; $2V$ obtained by measuring on the Fedorov stage is about 30°. A dispersion of the optic axes is observed: $2V_{Li} = 32°$, $2V_{Na} = 31°30'$ and $2V_{Tl} = 31°30'$. In the sections parallel to the cleavage (along 100) the emergence of the acute bisectrix is observed. The pole of cleavage coincides with the N_p optic axis. A measurement on the Fedorov stage gives the following results: P (pole of cleavage) $N_g = 90°$, $N_m = 89°$, $N_p = 1°$. The optic orientation of the ellipsoid is as follows: $X = N_p$, $Y = N_m$, and $Z = N_g$.

Table 1

Polar Co-ordinates of Nordite

Form	Number of faces measured	φ	ρ
100	4	89°53′	90°06′
110	2	53 58	90 06
120	8	34 38	90 06
010	3	0 12	90 06
212	8	69 56	37 32
101	4	90 28	35 49

X-ray Study. In order to determine the syngony of nordite (since no good material was available for crystallographic study), in the Crystallographic Laboratory of the Academy of Sciences an X-ray study of nordite was made by the Laue method, in sections parallel to (100) and (010). Nordite was found to be a rhombic (and not a monoclinic) mineral.

Chemical Characteristics. In the acids HCl, HNO_3, and H_2SO_4 it is decomposed. A chemical analysis of the mineral made by G. A. Burova is given in Table 2.

Table 2

Oxides	%	Molec. quantities
SiO_2	45.53	0.758
TiO_2	none	—
Nb_2O_5	»	—
Ta_2O_5	»	—
Fe_2O_3	1.84	0.011
Ce_2O_3	8.77	0.027
Σ(La, Di)$_2O_3$	10.48	0.032
ΣY_2O_3	0.95	0.004
MnO	6.04	0.084
SrO	7.40	0.071
CaO	4.46	0.080
MgO	2.00	0.050
Na_2O	11.70	0.189
K_2O	0.08	0.001
F	none	—
Cl	traces	—
Loss on ignition	none	—
Total	99.27	—

The empiric formula of nordite, according to the data of chemical analysis, is as follows: $2\,Na_2O \cdot 3(Sr, Ca, Mn, Mg)O \cdot 0.7TR_2O_3 \cdot 8SiO_2$. From its chemical composition it should be considered a metasilicate. By its chemical composition it approaches most closely the minerals of the pectolite and schizolite group.

A spectroscopic study of nordite made by S. A. Borovick (Institute of Geological Sciences of the Academy of Sciences) revealed, in addition to the elements discovered chemically, the presence of Ti (medium line) and Ga 10^{-4}. Rare earths, according to the data of S. A. Borovick, are represented by Ce, La (strong lines), Yb (weak lines), Nd (0.96% Nd_2O) and Pr (0.62% of Pr_2O_3).

To gain a better idea of the cerium group of rare earths, entering into

the composition of nordite, an X-ray and chemical study of the mineral was carried out by I. B. Borovsky (Institute of Geological Sciences of the Academy of Sciences). It gave the following results: La_2O_3, 8.55%; Ce_2O_3, 8.1%; Pr_2O_3, 1.6%, and Nd_2O_3, 1.85%; total, 20.1% of the grand total of the composition of the mineral.

Occurrence and Paragenesis. Nordite in the Lovozero alkaline massif has been found in the upper course of the valley of the Chinglusuai river, on its left bank. Here the segregations of nordite are confined to pegmatites, found in the talus together with sodalite syenite. The talus of sodalite syenite is located on the slope of the left bank at the foot of an upright wall over 100 m high. It is about 200 m long and about 150 m wide (down the slope). The size of the pegmatitic patches preserved on some blocks of sodalite syenite (up to 2—3 m in diameter) is rather varying, from several centimeters up to 1 m^2 in area and rarely over (up to 2×1.3 m), the visible thickness being from 1 to 10—20 m. The pegmatite patches, in which nordite is encountered, are composed of hackmanite (a variety of sodalite, containing sulphur), partly ussingitized, with a very considerable content of chinglusuite and lomonosovite (a sodium phosphate-titanium silicate). Lamprophyllite, eudyalite, microcline, nepheline, aegirine, sphalerite, neptunite, etc., are subordinate minerals.

The period of formation of nordite is uncertain; it may be only said that its segregations are usually confined to interstices between grains and poorly developed crystals of sodalite. The occurrence in the pegmatites of the Lovozero massif of a new mineral—nordite, into the composition of which enter rare earths (20.2% TR_2O_3), strontium (7.40% SrO), manganese (6.04% MnO), etc., does once more emphasize the important rôle of these elements in the processes of mineral formation in the given massif. Thus, e. g., the presence of rare earths in the Lovozero massif at the present moment is known in the following minerals: loparite (30.80—39.50% TR_2O_3), erikite (55.96%), steenstrupine (24.78%), apatite (3.20%), eudyalite (1.68—2.29%) and others; the presence of strontium—in lamprophyllite (7.46—16.76% SrO), apatite (5.52%), loparite (3.06—3.42%), eudyalite (1.42%), etc.; of manganese—in schizolite (9.35% MnO_2 and 15.92% MnO), neptunite (12.94% MnO), mangano-ilmenite (14.73—16.14%); of titanium—in lovenite (10.34%), steenstrupine (9.06%), chinglusuite (14.53%), lovozerite (3.46%), lamprophyllite (2.92—3.23%), eudyalite (1.64—2.56%), murmanite (2.38—2.42%), etc. It should be noted that most of them (loparite, lamprophyllite, eudyalite, murmanite, lovozerite, mangano-ilmenite, etc.) are rock-forming minerals widespread in the Lovozero alkaline massif.

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Received
16.VI.1941.

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Translated by A. Brashnina.