NEPTUNITE FROM SEAL LAKE, LABRADOR[1]

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INTRODUCTION

In their report on the occurrence of barylite at Seal Lake, Labrador, Heinrich & Deane (1962) noted a bright red, unidentified mineral in the beryllium-bearing fenites. This species has now been identified as the rare titanium silicate, neptunite ($Na_2FeTiSi_4O_{12}$). The mineralogy and petrography of the rocks have been described in detail (Heinrich & Deane, 1962; Nickel, 1962), so that it suffices to report that the host rocks are metasomatic syenitic gneisses (fenites), representing amphibolites altered by alkalic hydrothermal solutions in the exomorphic aureole of an intrusive body of alkalic syenite. Table 1 lists the minerals of the syenite and the fenites.

TABLE 1. MINERALOGY OF THE ALKALIC ROCKS AT SEAL LAKE, LABRADOR

Syenite	Fenites		Veinlets in fenites
Anorthoclase	Orthoclase	Triplite	Quartz
Albite	Albite	Apatite	Albite
Aegirine	Aegirine	Epidote	Barylite
Riebeckite	Arfvedsonite	Sphene	
Sphene	Biotite	Calcite	
Apatite	Muscovite	Sphalerite	
Eudialyte	Barylite	Hematite	
	Eudidymite	Neptunite	
	Pyrochlore		

NEPTUNITE

Neptunite occurs as anhedral grains that range in size from 0.10 to 2 mm. Many of smaller grains are skeletal (Fig. 1) with numerous inclusions of other minerals, particularly albite. Much neptunite, particularly the larger grains, is closely associated with pyrochlore (Fig. 2) and barylite. In some rocks, minute anhedral specks are included in clusters of sodic amphibole. Most of the radioactivity of the fenites stems from pyrochlore, and where pyrochlore grains are embedded in neptunite, a pleochroic halo has been developed in the titanium silicate.

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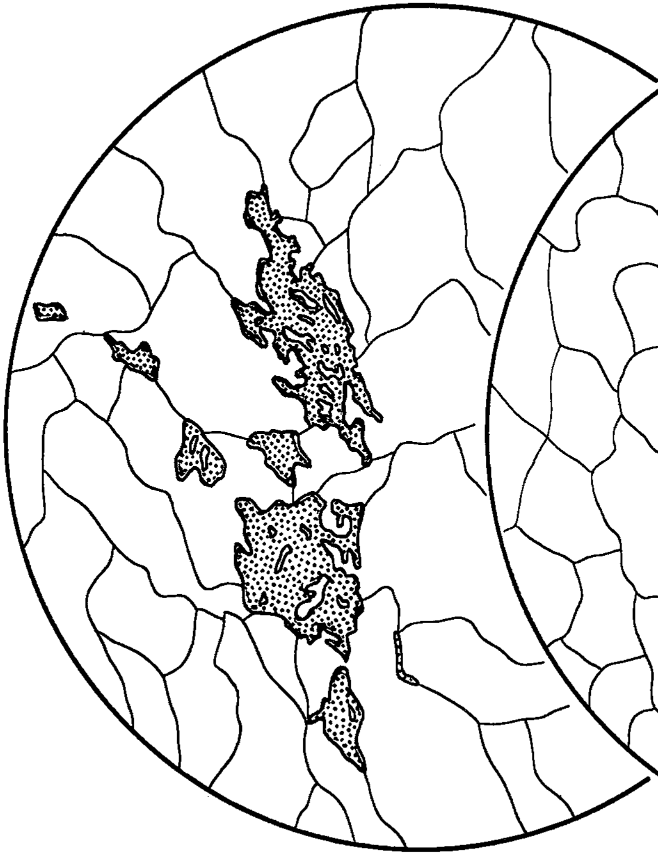

FIG. 1. Skeletal neptunite (0.56 mm long) with intergrown albite.

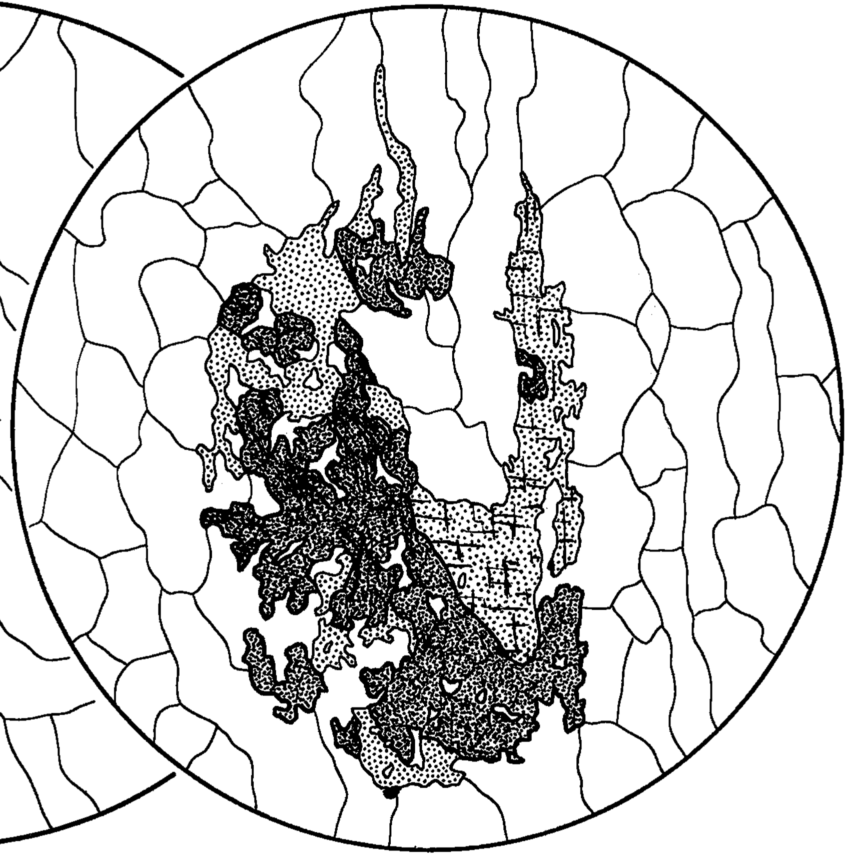

FIG. 2. Large grain of neptunite (2 mm long) intergrown with pyrochlore (dark stipple) and albite (light).

The optical properties of neptunite are listed in Table 2, and Table 3 presents the *x*-ray powder diffraction data, which agrees substantially with that given by Sabina & Traill (1960).

TABLE 2. OPTICAL PROPERTIES OF NEPTUNITE

	USSR (Fersman & Bohnstedt, 1937)	California (?) (Larsen & Berman, 1934)	Ireland (Nockolds, 1950)	Labrador
α	1.689–1.692	1.690	1.691	1.711
β	1.691–1.695	1.699	1.700	1.721
γ	1.717–1.722	1.736	1.735	1.744
$\gamma-\alpha$	0.025–0.033	0.044	0.044	0.033
α	light yellow lemon yellow	pale yellow	pale yellow	golden orange
β	orange, orange yellow	yellowish red	yellow-brown	orange-red
γ	bright orange, yellow red	deep ocherous yellow to brownish red	orange-red	deep red
Absorption	$\gamma > \beta > \alpha$	$\gamma > \beta > \alpha$	$\gamma > \beta > \alpha$	$\gamma > \beta > \alpha$
Sign, $2V$	(+) 35° (Na)	(+) 49°	(+) ca. 40°	(+) 62°
Dispersion	$r < v$, strong	$r < v$, extreme	strong	$r < v$, extreme
Orientation	Optic plane = 010 $b = \beta$ $\gamma \wedge c = 20°$	$b = \beta$ $\gamma \wedge c = 16°$ (110) cleavages		two cleavages at 80°

TABLE 3. *X*-RAY POWDER DIFFRACTION DATA FOR NEPTUNITE
Seal Lake, Labrador camera radius = 57.3 mm cu radiation, Ni filter

d Å	*I*	*d* Å	*I*	*d* Å	*I*
4.68Å	10	2.85	40	1.88	10
3.84	35	2.48	70	1.75	20
3.52	80	2.16	70	1.51	50
3.18	100	2.05	40	1.38	30
2.93	80	1.91	30	1.36	30

PARAGENESIS

Table 4 lists information on the occurrences of neptunite. For all but the California occurrence, neptunite is known to be genetically related to alkalic or alkalic-subsilicic rocks, forming as a deuteric accessory species, (1) in endo- or exo-morphic contact zones, (2) in recrystallized xenoliths or (3) in consangineous pegmatites. Stewart (1959) states that narsarsukite, $Na_2TiSi_4O_{11}$, forms where there is a silica excess (from siliceous wall rocks), high partial pressure of oxygen and abundant Na and Ti, whereas neptunite, $Na_2(FeMn)TiSi_4O_{12}$, forms directly or replaces pre-existing narsarsukite under conditions of lower partial pressure of oxygen.

In addition to replacing narsarsukite (Flink, 1901), neptunite also replaces sphene (Nockolds, 1950) and eudialyte (Bondam & Sörensen, 1959). Neptunite from the Kola peninsula also is regarded as a low-temperature mineral, having crystallized probably at the same time as associated analcite (Fersman & Bohnstedt, 1937). The San Benito assemblage also indicates deposition at low temperatures.

TABLE 4. GEOLOGY OF OTHER NEPTUNITE OCCURRENCES

Locality	Type of deposit	Associated Minerals	Reference
Tutop-Agdlerkofia, Greenland	Foidal syenite pegmatite in sodalite syenite	Analcite zinnwaldite	Bøggild, 1905
Narsarsuk, Greenland	Sodic quartz syenite (?) pegmatite in augite syenite	Aegirine microcline, quartz, elpidite, epididymite, synchysite, polylithionite, calcite	Bøggild, 1905
Kvanefjeld, Julianehaab district, Greenland	Augite syenite and analcite-rich lujavrite	Microcline, soda amphibole, analcite, nepheline, schizolite, natrolite, monazite, acmite, epistolite, sphalerite	Bondan & Sörensen, 1959
Kvanefjeld, Julianehaab district, Greenland	Recrystallized inclusions of pegmatoidal naujaite in lujavrite	Eudialyte, sodalite, analcite, and natrolite and pseudomorphs of analcite + katapleite + acmite + niobian perovskite + neptunite after eudialyte	Do.
Khibina Tundra, USSR	Endocontact zone—altered nepheline syenite (decrease in nepheline and transformation to hornblende syenite)	Aegirine, natrolite, analcite	Fersman, 1926; Fersman & Bohnstedt, 1937
Lovozero Tundra, USSR	Syenite pegmatite (aegirine-microcline type) in lujavrite	aegirine, natrolite, eucolite, ramsayite	Do.
Barnavave, Carlingford, Ireland	Quartz-bearing syenite	Orthoclase, quartz aegirine-augite, sphene	Nockolds, 1950
Near New Idria San Benito Co., California	Zeolite vein in greenstones (altered diabase and Na-amphibole schist) that form a xenolith enclosed in serpentinite	Natrolite, benitoite, joaquinite, actinolite, crossite, glaucophane, albite, aegirine, calcite, aragonite, chalcocite	Louderback & Blasdale, 1909.

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