NEPHELINE SYENITE FROM BEEMERVILLE, SUSSEX COUNTY, NEW JERSEY

A. S. Wilkerson,
Rutgers University, New Brunswick, New Jersey*

Abstract

A petrographical study of an intrusion of nepheline syenite in northwestern New Jersey reveals the presence of fluorescent hackmanite. Ten new mineral analyses of the syenite are presented.

Introduction

During July, 1945, A. K. Snelgrove, Director of Rutgers University Bureau of Mineral Research, M. E. Johnson, New Jersey State Geologist, and the writer visited the nepheline syenite area near Beemerville, Sussex County, New Jersey. A study of the syenite was undertaken to determine the commercial possibilities of the rock for the ceramic industries, especially for glass manufacture. Results obtained from this study will be published by the writer and J. E. Comeforo† as a bulletin of the Bureau.

Geology of Area

The southernmost end of the intrusion of nepheline syenite is slightly more than one mile northwest of Beemerville or about 10 miles northwest of Franklin, in the northwestern part of the State. The intrusion forms a terrace on the lower part of the eastern slope of Kittatinny Mountain. The intrusion, probably a lenticular sill but possibly a dike, is roughly elliptical in plan, is about 2 miles long, and not more than 800 or possibly 900 feet wide at its broadest part. Its northeastward trend is parallel to the strike of the associated bedded rocks—the Shawangunk conglomerate of Silurian age to the west and possibly lying on the syenite, and the Ordovician Martinsburg shale to the east and possibly beneath the syenite.

The area is wooded, outcrops are few and poor, and contacts are obscured. The relief of the area is low but the topography is rough due to numerous mounds which are separated by depressions.

Although the bulk of the intrusion is nepheline syenite, it varies considerably both in texture and mineral composition along its strike, and grades into other phases locally. It is cut by narrow dikes of leucite-

* Published by permission of the Director, Rutgers University Bureau of Mineral Research.

† Research Associate, Bureau of Mineral Research.

tinguaite.[1] Porphyritic facies likewise occur. These are not exposed in a manner which permits their relationship to the syenite proper to be discerned. The porphyry areas are small.

Kemp[2] places the age of the intrusion as post-Silurian and pre-Triassic.

Petrography

The nepheline syenite is medium to dark gray in color. It has almost invariably a granular texture, but locally it is trachytoidal. Many samples are of medium-size grain, but others are coarse grained. A megascopic examination reveals nepheline, feldspar, biotite, pyroxene, and magnetite. Normally the nepheline possesses a greasy luster and is dark in color due to inclusions. Some specimens contain a quantity of magnetite sufficient to appreciably affect the needle of a Brunton compass when brought close to the compass.

Under a mercury-vapor light many samples fluoresce, sometimes as high as fifty per cent of the surface fluorescing in an orange color. A study of colorless, isotropic, fluorescent fragments in immersion liquids shows the material to have an index of refraction of 1.487, that of hackmanite. Hackmanite (variety of sodalite) has not previously been reported from this area.

Under the microscope most specimens are hypautomorphic-equigranular. Cataclastic texture is local. Some orthoclase and nepheline show fractures extending through adjacent minerals. Also peripheral crushing of grains was noted and in some instances almost complete crushing of some of the crystals into smaller grains. The syenite is composed of orthoclase feldspar, nepheline with or without accompanying sodalite (variety hackmanite), either aegirine or aegirine-augite, biotite rich in iron, and a small quantity of melanite garnet unevenly distributed throughout the rock. Plagioclase feldspar occurs only in minute amounts in some specimens and is absent from others. Magnetite, apatite, sphene, and small amounts of fluorite, zircon, and pyrite occur as accessories.

The outline of orthoclase crystals is generally allotriomorphic. Some are twinned according to the Carlsbad law. The size seldom exceeds 17 mm.×6 mm., but locally may be about 2 inches long. Crystals of feldspar contain much nepheline poikilitically included, and also contain inclusions of all other primary minerals. Portions of crystals are altered to a clay-like material and to cancrinite.

Nepheline is euhedral to subhedral and seldom exceeds 10 mm.×7 mm.

[1] Wolff, J. E., Leucite tinguaite from Beemerville, N. J., Harvard Coll. Mus. C. Z. *Bull.* **38** (Geol. Ser. 5), 273–277 (1902).

[2] Kemp, J. F., The elaeolite syenite near Beemerville, Sussex County, New Jersey: *N. Y. Ac. Sci.*, Tr. **11**, 71 (1892).

in size. Its index of refraction being greater than orthoclase, nepheline stands out in relief when enclosed in the feldspar. Inclusions are magnetite, apatite, sphene, biotite, pyroxene, and infrequently some orthoclase. The usual decomposition product is cancrinite, but some colorless mica is present as well as a colorless, birefringent, radiating zeolite (?).

Some sodalite, variety hackmanite, is found in practically all specimens. Some specimens have the sodalite concentrated in planes, and it is these specimens which are beautifully fluorescent. Sodalite normally is anhedral to subhedral, but where euhedral dodecahedral outlines are observed. It frequently fills veinlets in fractured nepheline and orthoclase. Crystals seldom measure more than 2.50 mm.×1.50 mm.

The most common ferromagnesian minerals are aegirine-augite and aegirine. These soda-bearing monoclinic pyroxenes are not found together in the same specimen, however. Aegirine-augite is about twice as abundant as aegirine. These pyroxenes occur in crystals with irregular outline, sometimes better defined in the prismatic zone, less often well-defined on the basal pinacoid. Crystals are never terminated. Aegirine-augite has marked pleochroism with X=olive green, Y=olivine green and Z=yellowish green; aegirine has strong pleochroism with X=clear green, Y=yellowish green, and Z=yellowish brown. The maximum size of crystals is 3.50 mm.×1.25 mm.

Characteristic of the syenite is a golden-brown to dark reddish-brown biotite with strong absorption. The mica occurs as subhedral and anhedral crystals as well as in shreds. Crushed fragments of the rock under a binocular, however, reveal well-formed pseudohexagonal "books." The mica is closely associated with the pyroxenes, magnetite, and sphene. The maximum size of crystals is 3.25 mm.×1.00 mm.

Garnet, variety melanite, is not uniformly distributed throughout the intrusion, but at a few localities it comprises almost 4 per cent of the mineral assemblage. It attains a maximum size of 2 mm. in diameter. Some melanite contains inclusions of magnetite, pyroxenes, biotite, and a small amount of nepheline.

Colorless apatite, usually as stout prisms or rounded basal sections, attains a maximum size of about 0.7 mm.×0.1 mm. It is included in all the primary minerals.

Magnetite is found in well-developed crystals, subhedral crystals, and as anhedra. The maximum size is 1.50 mm. in diameter. It is usually unaltered, but a small amount has changed to hematite. It is intimately associated with biotite, pyroxenes, and sphene and is also included in these minerals as well as in the feldspar and feldspathoids.

Well-formed wedges with rhombic sections, and subhedral and anhedral crystals of sphene are numerous. Some of the crystals are twinned.

Seldom do the crystals exceed 2.25 mm. in length by 2 mm. in width. Sphene appears in two generations, one very early and the other late in the sequence of crystallization.

Zircon is present in a few very minute crystals. Purple fluorite, soda-rich plagioclase, and pyrite occur in traces in some specimens. Eudialyte, eucolite, or other similar minerals were not recognized as being present in the specimens examined.

Although Emerson,[3] Kemp,[4] Iddings,[5] Wolff,[6] and Aurousseau and Washington[7] have studied the Beemerville syenite only two mineral analyses are given in terms of percentage mineral composition.[8] Ten other mineral analyses are here presented. The first three are from the southern third of the intrusion, numbers 4 through 7 from the middle third, while 8 through 10 are from the northern third. Analyses 11 and 12 are those presented by Wolff. Number 13 is the average.

	1	2	3	4	5	6	7	8	9	10	11	12	13
nepheline	73.0	41.5	45.8	52.6	43.5	37.3	50.1	47.3	25.8	31.4	74.2	9.8	44.4
orthoclase	6.0	37.5	39.4	34.6	20.0	40.4	22.4	39.4	62.6	47.7	9.5	72.3	36.0
sodalite	tr	—	tr	2.8	0.8	tr	1.5	1.0	0.3	5.0	—	—	0.9
aegirine	—	—	—	—	—	0.5	—	9.1	8.8	13.3	—	—	8.8
aegirine-augite	11.9	5.0	7.0	1.7	16.9	—	7.6	—	—	—	8.7	15.4	
biotite	3.2	6.9	1.6	4.0	5.7	12.8	11.2	0.2	0.6	tr	1.8	0.2	4.0
sphene	4.2	5.6	3.3	0.8	6.8	4.8	5.4	2.4	1.4	2.5	5.3	2.0	3.7
magnetite	1.0	3.2	2.7	2.2	2.6	3.7	1.6	0.6	0.3	tr	—	—	1.6
apatite	0.7	0.3	0.2	tr	0.1	0.5	0.2	tr	tr	—	0.5	0.2	0.2
melanite	—	—	—	1.0	3.6	—	—	—	—	—	—	—	0.4
acid plagioclase	—	—	—	tr	—	—	—	tr	—	—	—	—	tr
fluorite	—	—	—	—	—	—	—	—	tr	tr	—	—	tr
pyrite	—	—	—	tr	—	—	—	—	tr	—	—	—	tr

[3] Emerson, B. K., On a great dyke of foyaite or elaeolite syenite, cutting the Hudson River shales in n.w. New Jersey: *Am. Jour. Sci.* (3) **23,** 302–8 (1882).

[4] Kemp, J. F., *op. cit.*, pp. 60–71.

[5] Iddings, J. P., Nepheline-syenite from Beemerville, Sussex Co., N. J.: *U. S. Geol. Survey, Bull.* **150,** 209–211 (1898).

[6] Wolff, J. E., Post-Ordovician igneous rocks: *U. S. Geol. Survey, Folio* **161,** 12–13 (1908).

[7] Aurousseau, M., and Washington, H. S., The nepheline syenite and nepheline porphyry of Beemerville, N. J.: *Jour. Geol.*, **30,** no. 7, 571–586 (1922).

[8] Wolff, J. E., *op. cit.*, p. 12.