# New Nepheline Syenites From Bigwood Township, Ontario*

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## INTRODUCTION

The author has collected from Bigwood Township, near French River, Sudbury District, Province of Ontario, specimens of syenite of types hitherto not named. In the Bigwood locality a suite of intrusive rocks ranges from quartz-bearing adamellite into nepheline-rich litchfieldite. The rocks of this suite are characterized by a general scarcity of dark constituents, by their content of soda-rich plagioclases and microperthite, and by an approximate balance in the amounts of potash and plagioclase feldspars. Among this suite are certain fine grained, pink rocks low in ferro-magnesian constituents and low also in their content of nepheline. Some fall, according to Johannsen's classification, between families 14, 15 and 10 and 11. If they had a little quartz they could be called sodaclase syenites and monzonites, but the occasional small content of nepheline allies even those free of nepheline (and free of quartz) with the families 14 and 15 rather than with 10 and 11.

For rocks falling in family 1114, those richer in potash than in soda feldspars and characteristically low in ferro-magnesian constituents, the name *Bigwoodite* is proposed. For rocks falling in family 2115, those with more plagioclase than potash feldspars, the name *Rutterite* is proposed. These names might have been supplanted by *nepheline-sodaclase syenite,* and *nepheline sodaclase monzonite,* but confusion might easily arise with *sodaclase nepheline syenite,* which is *litchfieldite,* 2119, and the term *nepheline sodaclase monzonite* might refer equally well to rocks numbered 2114 and 2115.

## SYENITIC ROCK FACIES

The rocks described in this paper are found in the township of Bigwood, Sudbury District, Ontario, and in small parts of Delamere township and Parry Sound District adjoining. The major part of the bedrocks of this locality are well bedded, highly metamorphosed sediments of Huronian age. They enclose two large masses of apparently intrusive rocks. These masses are concordant with the foliation of the paragneisses and appear to be sill-like in shape. One of these masses is

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sodaclase adamellite; the other is a composite mass of gray nepheline syenite and pink syenites, which are characterized by compositions corresponding to rocks in Johannsen's classification of Families 2115P., 2114P., 1115P., and 1114P.

A considerable quantity of the pink syenite must have enough dark constituents to fall in family 2114, for which Brögger has already provided the name *fenite*[1]. But a distinctive feature of *Bigwoodite* is its low ferromagnesian content which first called the writer's attention to it as a possible source of glass rock. Consequently a distinctive name for that variety seems desirable. By increase in nepheline content it grades into family 2118, *lakarpite*[2], but the nepheline rich phases, although more striking, are probably not so widespread in outcrop as those with little or no nepheline. Similarly, the syenites in which the plagioclase content is greater than that of microperthite and potash feldspars grade from 2115, *rutterite*, with little or no nepheline into 2119, which is *litchfieldite*. There are leuco phases of *rutterite* and *litchfieldite* but they seem to be more rare than the leuco-rock called *bigwoodite*.

## BIGWOODITE

Bigwoodite (1114) in the type locality lies in an elongated mass which appears to have replaced the country rock for a distance of about eight miles along, and about one mile across the strike. The rock is medium grained, composed essentially of microcline, albite, microperthite, and hornblende. The plagioclase varies in composition from approximately $Ab_{90}$ to $Ab_{100}$. The microcline is irregularly intergrown with albite in microperthitic and less conventional textures. Hornblende is highly pleochroic and bright green, presumably high in soda. In many specimens aegirine-augite or biotite takes the place of the dark mineral. The dark minerals are arranged in places in bands or streaks which are discontinuous and even patchy in distribution. Potash feldspar in places is considerably in excess over albite and thereby causes the rock to go over into the family 2114. Calcite is a common accessory mineral, and in some facies of the rock constitutes an important proportion of the rock. Other phases, graphite-, corundum-, and nepheline-bearing might have been described but do not seem to the writer to require separate rock names. The association of this rock with nepheline bearing facies, its gradation into typical litchfieldite, allies it clearly with the nepheline rather than with the quartz bearing rocks. Otherwise, since it contains in typical facies neither quartz nor nepheline, its place would be on a line between 1115 and 1110.

## RUTTERITE

*Rutterite* (2115) can be distinguished only with difficulty from *fenite* (2114) in the field, and is distinguished from *bigwoodite* and other members of the first class by its higher content of dark consti-

[1] and [2] These names provided by Prof. Johannsen's personal communication.

tuents. It is characteristically an equigranular, medium grained, dark pink rock which grades into the blue gray nepheline syenite by loss of dark constitutents and decrease in amount of the pink feldspar, microcline, and increase of gray albite. It grades also into the ruddy adamellite by increase in ferromagnesian minerals and addition of quartz. Different facies grade both into the quartz bearing rocks and into those with nepheline. It occupies a truly transitional position between the two groups.

It is composed essentially of feldspar with minor quantities of nepheline, quartz (epigenetic), biotite, graphite, magnetite, and amphibole. In places calcite is important. The feldspars are usually microperthite, microcline, and albite. In several specimens examined by Dr. R. H. Pegrum[3], Dr. Chas. Milton[4], and by the writer almost pure albite was noted.

The plagioclase varies in composition ordinarily between $Ab_{90}$ and $Ab_{100}$.

## NEPHELINE SYENITES

Within the exposure of bigwoodite there are two areas of nepheline syenite. The northern one extends from the northwest corner of Con. 6. Lot 12, Bigwood township nearly three and one-half miles to the northeast corner of Con. 3, Lot 10. The maximum width of the mass at the surface is one-half mile in Con. 5, Lot 11. The total area is about one square mile. The southern mass extends from the northeast end of Con. 2, Lot 11, Bigwood township to the north shore of Pickerel River, a distance of nearly three miles. Its greatest width is nearly three-quarters of a mile, and the total area of the body at the surface is about one and one-half square miles. This rock is well exposed on both banks of French river for about one-half mile in Lot 10.

In general the nepheline syenite may be described as a gray, medium to coarse grained, gneissoid rock composed essentially of white feldspar, pink nepheline, and black biotite or amphibole with magnetite, zircon, calcite, cancrinite, and sodalite frequently present as accessories[5]. The gneissic structure, which is a marked feature of this rock, is shown by the parallel arrangement of the biotite and amphibole and the tendency of the minerals to segregate into bands. The latter is especially true of the northern mass. Jointing in the rock is not particularly noticeable but it was observed in both bodies, and its direction is parallel to the jointing in the surrounding country gneiss, that is, east and west. On the French River, joint faces in the syenite occasionally form scarp faces on the river shore.

[3] R. H. Pegrum, field associate of the writer during the seasons 1925-27 who wrote a doctor's dissertation (hitherto unpublished) upon this and similar syenites.

[4] Charles Milton, formerly a student at the University of Illinois, where he prepared an unpublished study of certain specimens collected by the writer in Bigwood township.

[5] Minerals from the new nepheline syenite area, French River, Ontario, T. L. Walker and A. L. Parsons. University of Toronto Studies. Geol. Ser. No. 22, 1926. p. 6-14.

The nepheline syenites everywhere show conformable relations with the bigwoodite, and the gradation between these rocks is perfect in regard to both minerals and texture. Within the nepheline syenites there frequently occur coarse grained, pegmatitic masses and veins which are usually parallel to the foliation but occasionally cut across it at a low angle. A few veins in the nepheline syenite on the French River definitely cut across the foliation and in some cases they are parallel to the joints.

Both these nepheline syenite bodies in Johannsen's rock classification are litchfieldites (2119) with local variations to leuco-litchfieldite (1119) and mela-litchfieldite (3119).

## ADAMELLITE

On the western side, the bigwoodite is in intimate intrusive contact with well bedded country gneisses, and on the east side with a slightly gneissose rock, a sodaclase adamellite (216″). The adamellite is altered with curious blotches of discoloration near the contact with the bigwoodite, and the bigwoodite, losing its characteristic composition by the addition of quartz, grades into syenite.

Perhaps the bigwoodite and nepheline syenites are connected genetically with the sodaclase adamellite, which in turn appears to be an offshoot of much larger masses known as the Dead Island sodaclase adamellites which lie chiefly to the south and west of the bigwoodite.

**Pink and white massive rocks.**—Near the bigwoodite there are also minor outcrops of feldspathic rock somewhat different from the bigwoodite. These rocks are nearly white where exposed. Near the northern line of lot 7, concession II, Bigwood township, about three-quarters of a mile west of the Canadian Pacific railway, white streaks lie within a dark, hornblendic gneiss which is the adamellite. The adamellite is coloured chiefly by the hornblende and its weathered products. Both the dark and white rocks are garnetiferous to about an equal degree, and seem to be distinguished from one another by the presence of hornblende in the dark rock, and by the gneissic texture characteristic of the dark rock and absent in the white streaks. These rocks are associated intimately with a fine, pink, alaskite-like gneiss in narrow layers and bands, which appears to be part of the bigwoodite. There appears in this place to be a gradation between the dark adamellite and the bigwoodite, both being garnetiferous, whereas the white streaks appear to be quite massive, containing unsheared feldspar crystals, apparent to the unaided eye. Another white rock outcrops near the railroad about one mile south of Rutter station. It is somewhat coarse grained and massive in texture, apparently composed solely of white feldspar and garnet. Under the microscope (Thin section 108—1925), however, quartz is apparent as interstitial filling between the feldspars. The groundmass is flecked with scarce, very small, dark green flakes of biotite. The garnets are distinctly skeletal, and of two kinds, the more

abundant being brown and the rarer being pale pink. Cloudy areas of plagioclase are replaced partly by bright, fresh, clear areas of younger microcline.

Examination of the pink rock under the microscope, shows (Thin section 109—1925) great similarity to the white rock. It is composed of albite partly replaced by both microcline and quartz. Grains of zircon and apatite are scattered throughout the specimen examined, and magnetite appears in both small and large grains. Mineralogic analyses of these rocks follow:

ROSIWAL ANALYSES (by volumes)

| | (1) | (2) |
|---|---|---|
| Quartz | 26.5 | 27.4 |
| Microcline | 39.6 | 41.2 |
| Albite | 30.7 | 21.7 |
| Garnet | 2.1 | 4.2 |
| Biotite | 0.6 | 0.4 |
| Magnetite | —— | 0.1 |
| Zircon | trace | trace |
| Apatite | 0.3 | trace |

(1) White layers of massive rock, near Rutter. Leucosodaclase-adamellite, Rock number 116″.

(2) Pink layers of massive rock, near Rutter. Contact phase of bigwoodite (?). It might be called a sodaclase-alaskite, with Rock number 116′.

The foregoing analyses illustrate the close relation existing between the pink and the white rocks. The rather high content of quartz allies these rocks with the outer, or contact, phases of bigwoodite. The nearly massive texture of these alaskite-like rocks, their very high content of alkaline feldspars, and their sill- or dike-like shapes lead one to regard them as late arrivals in the episode of intrusion which produced the suite of rocks to which they belong.

## MINERAL AND CHEMICAL CLASSIFICATION

This suite of rocks is marked first of all by its sodaclase characteristics. Some of the plagioclase feldspars examined under the microscope appeared to be almost pure albite. The rocks are usually low in ferromagnesian minerals. Such dark rocks as occur are in streaks or bands, local in development. Streakiness is quite characteristic. This streaky nature of the rocks makes accurate analysis or description of the rock types difficult, and makes areal mapping almost impossible. It is now uncertain whether 14 or 15 is the more prevalent of the two rock families. The sample listed as No. 4 in the chemical analyses was thought to be representative of family 2114, but upon analysis it was discovered to be 2115. It is certain that rocks of the family 14, in which potash feldspar is distinctly predominant over soda feldspar, are very prevalent in the rocks of Bigwood township. They vary from distinctly pale to dark colored types. The leucorock, bigwoodite (1114), is illustrated by the Rosiwal analyses as Nos. 1 and 2. These analyses are fairly representative of the very pale pink phase of the rock. Darker

phases, fenite (2114), are common, but very dark phases, shonkinite (3114), are rare and small in area.

These rocks show general excess of salic molecules over the femic; nevertheless, most of the adamellites and some of the nepheline bearing rocks fall in class II of the C. I. P. W. classification and in Class 2 of Johannsen's classification. Feldspars are extreme or dominant over both quartz and feldspathoids, consequently the rocks fall in orders 4, 5, and 6 of the C. I. P. W. classification and exclusively in order 1 of Johannsen's. In Johannsen's classification further separation depends first upon the presence of quartz or of feldspathoids, then upon the nature of the plagioclase, which is albitic ($Ab_{90}$—$Ab_{100}$) in all of these rocks, and upon the relative quantity of the potash and plagioclase feldspars. Many of these rocks fall in the sodaclase adamellite family 6″ — 7″, but grade through sodaclase monzonite into the definitely feldspathoid rocks, lakarpite and litchfieldite, with an unusual development of the transition rocks low in nepheline—bigwoodite, fenite, and rutterite. The chemical analyses show a definite gradation from sodaclase adamellite to leuco-litchfieldite. The gradation goes from class 4 to class 6, rutterite and bigwoodite syenites both being in class 5. The peralkalic nature of the series is shown by the fact that all the analyses fall within or nearly within rank 1. The relative importance of soda and potash is reflected in the range of subrangs from the dopotassic in bigwoodite and fenite to the dosodic in the litchfieldites.

ROSIWAL MINERALOGIC ANALYSES

| | Johannsen's Rock Classification | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Orthoclase | 36.7 | 81.56 | 47.6 | 52.7 | ..... | ..... | ..... | ..... | 75.86 | 12. | 3.24 |
| Microcline | 22.3 | ..... | ..... | ..... | 47.1 | 44.6 | 42. | 41.20 | ..... | 45. | 29.17 |
| Microperthite | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1.58 |
| Albite | 37.6 | 11.09 | 35.7 | 44.3 | 25.7 | 47.9 | 45.94 | 44.40 | 7.15 | 21. | 40.34 |
| Hornblende | 3.1 | ..... | 1.62 | 8.9 | 19.6 | 7.1 | 12. | 14.22 | ..... | 1. | ..... |
| Biotite | ..... | ..... | 6.23 | 1.9 | ..... | ..... | ..... | ..... | ..... | 9. | 2.28 |
| Magnetite | .3 | ..... | 1.88 | trace | ..... | trace | ..... | ..... | ..... | 1. | ..... |
| Calcite | ..... | ..... | 2.01 | ..... | ..... | ..... | ..... | ..... | ..... | 4. | ..... |
| Apatite | ..... | ..... | ..... | ..... | ..... | 0.3 | .02 | .08 | ..... | ..... | .73 |
| Titanite | ..... | ..... | ..... | ..... | ..... | ..... | .04 | .10 | ..... | ..... | ..... |
| Zircon | ..... | ..... | ..... | ..... | ..... | 0.1 | ..... | ..... | ..... | ..... | ..... |
| Nepheline | ..... | 7.35 | 4.32 | .9 | 0.6 | ..... | ..... | ..... | 12.95 | 7. | 21.08 |
| Cancrinite | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 2.47 | ..... | 1.58 |
| Epidote | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1.57 | ..... | ..... |
| Rock family | 1114 | 1114 | 2114 | 2114 | 2114 | 2114 | 2115 | 2115 | 1118 | 2118 | 1119 |

1114, Bigwoodite.
2114, Fenite.
2115, Rutterite.
1118, Leuco-lakarpite.
2118, Lakarpite.
1119, Leuco-litchfieldite.

CHEMICAL ANALYSES

| | 1 | 2 | 3 | 4 | 5 | 6a | 6b | 6c |
|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 64.79 | 59.51 | 59.58 | 62.01 | 55.90 | 69.35 | 71.36 | 66.75 |
| $Al_2O_3$ | 19. | 18.09 | 18.11 | 13.59 | 22.12 | 14.38 | 13.93 | 17.96 |
| $Fe_2O_3$ | .39 | 2.50 | .84 | 6.68 | .96 | 1.80 | .97 | .25 |
| FeO | .46 | 1.79 | 2.50 | 1.96 | 4.33 | 3.13 | 2.30 | 1.04 |
| CaO | .76 | 1.48 | 2.98 | 2.98 | .44 | 1.32 | .50 | 2.50 |
| MgO | .54 | 1.67 | 3.51 | 1.18 | .37 | .13 | .25 | 1.88 |
| $Na_2O$ | 4.76 | 4.97 | 3.76 | 5.17 | 8.35 | 4.05 | 3.84 | 4.16 |
| $K_2O$ | 9.30 | 8.28 | 8.76 | 5.17 | 6.42 | 5.60 | 5.43 | 5.60 |
| $H_2O+$ | ..... | .50 | ..... | .04 | .57 | .28 | .48 | .12 |
| $H_2O-$ | ..... | ..... | ..... | .08 | ..... | trace | none | |
| $TiO_2$ | ..... | ..... | ..... | .71 | .05 | .29 | .37 | .08 |
| $P_2O_5$ | ..... | ..... | ..... | .41 | ..... | .04 | .08 | ..... |
| MnO | ..... | ..... | ..... | ..... | .14 | .02 | ..... | ..... |
| $CO_2$ | ..... | .89 | ..... | ..... | .67 | .05 | trace | ..... |
| S | ..... | ..... | ..... | .08 | ..... | .25 | .01 | ..... |
| BaO | ..... | ..... | ..... | ..... | ..... | .05 | .02 | ..... |
| ..... | ..... | ..... | ..... | less O/S .06 | ..... | less O/S .19 | .07 | ..... |
| Total..... | 100.00 | 99.68 | 100.04 | 100.00 | 100.32 | 100.55 | 99.64 | 100.34 |
| C. I. P. W. classifications | I, 5, 1, 2 | II, 5, 1, 2 | II, 5, 1-2, 2 | II, 5, 1, 3 | I, 6, 1, 4 | I, 4, 1, 3 | I, 4, 1, 3 | I, 4, 1, 3 |

1. Bigwoodite (1114) computed from Rosiwal analysis No. 1. Bigwood township.
2. Fenite (2114) computed from Rosiwal analysis No. 3. Bigwood township.
3. Fenite (2114) computed from Rosiwal analysis No. 5. Bigwood township.
4. Rutterite (2115) analyzed by R. J. C. Fabry. Bigwood township.
5. Leuco-litchfieldite (1119) analyzed by H. C. Rickaby[1]. Bigwood township.
6. Sodaclase-adamellite (216″). Dead Island Mass,
   - 6a. Lump sample collected by T. T. Quirke, analyzed by R. J. C. Fabry.
   - 6b. Chip samples collected by F. F. Grout, analyzed by Grout.
   - 6c. Rosiwal analysis from part of lump sample 6a, analyzed and computed by Quirke. All these samples numbered 6a, b, and c come from the same location on the east side of Dead Island.

[1] H. C. Rickaby. University of Toronto Studies. Geol. Ser. No. 22, 1926.