# *Tinguaites from Elfdalen and Rupbachthal: Basalts from Madagascar and the Soudan.*

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(I). *Cancrinite-Ægirine-Tinguaite* ("*Sussexite*"), *from Elfdalen, Sweden.*

(II). *Riebeckite-Ægirine-Tinguaite, from the Rupbachthal, Nassau. Compared with similar rocks from Abyssinia and the Canary Islands.*

(III). *Melilite-Basalt from Amparafaravola, Madagascar.*

(IV). *Hornblende-Basalt and Limburgite, from Ahmed Aga, White Nile.*

## I. *Cancrinite-Ægirine-Tinguaite* ("*Sussexite*"), *from Elfdalen, Sweden.*

IN connection with the investigation of ægirine-anorthoclase rocks from Abyssinia, belonging to the grorudite-tinguaite series,[1] an examination was made of specimens of the so-called green phonolite from Elfdalen, which in the British Museum collection accompanied the more ordinary brown and red porphyry from that locality. In the descriptions of the well-known porphyry quarries of Elfdalen, mention is made of this green variety as occurring only in boulders.[2] Törnebohm was the first to record the occurrence of these rocks *in situ*, and to describe their characters.[3] They were found in the form of dykes in the neighbourhood of Heden, near Särna, Dalarne, Sweden, and were interesting as containing cancrinite in clear, well-defined porphyritic crystals as undoubtedly a primary constituent.

The name *Cancrinite-Ægirine-Syenite* proposed by Törnebohm is a rather misleading one, since neither in structure nor in mode of occurrence can these rocks be rightly regarded as belonging to the syenite group.

[1] Min. Mag. 1900, XII, 255-73.

[2] Hjelm. K. Vetensk. Akad. Nya Handl. 1805, pp. 106-8.

[3] Geol. För. Förh. 1883, VI, 383, and Abst. in Neues Jahrb. f. Min. &c. 1883, (ii),—370–.

The object of the present note is therefore to point out what appears to be the true position of these rocks in rock-classification as members of the *Grorudite-Tinguaite* series of Brögger.

Most of the rocks are tinguaites, but some are examples from the basic end of the series to which Brögger would apply the name of "*Sussexite*."[1]

Specimens of these more basic varieties in the Museum collection are olive-green felsitic-looking rocks, showing to the naked eye small transparent prismatic phenocrysts of cancrinite, and numerous long black needles of ægirine.

Under the microscope, porphyritic crystals of cancrinite, rounded nepheline and prismatic ægirine are seen in a fine-grained groundmass, consisting of minute felspar needles and a dense mesh of ægirine needles, such as is characteristic of most grorudites. No felspar phenocrysts are present.

The long, deep grass-green phenocrysts in one specimen consist of true ægirine giving nearly straight extinction and compensating with the quartz-wedge along the length. In another specimen, however, somewhat paler green phenocrysts appear to be intermediate between ægirine and ægirine-augite, for the extinction in most sections varies from 10° to 18°, and compensation takes place along the length (a axis of indicatrix 18° from crystallographic axis *c*): some of the sections had darker green ragged terminations of true ægirine, giving nearly straight extinction.

A quantitative analysis of this rock gave the following result (I), as compared with that of nepheline-porphyry ("Sussexite") (II), from Beemerville, New Jersey, described by Kemp[2]:—

| | I. | | II. |
|---|---|---|---|
| $SiO_2$ ... | 48·83 | ... | 45·18 |
| $Al_2O_3$ ... | 18·71 | ... | 23·31 |
| $Fe_2O_3$ ... | 4·16 | ... | 6·11 |
| FeO ... | 1·91 | ... | |
| CaO ... | 5·19 | ... | 4·62 |
| MgO ... | 1·02 | ... | 1·45 |
| $Na_2O$ ... | 10·63[3] | ... | 11·17 |
| $K_2O$ ... | 3·04 | ... | 5·95 |
| Ign.($CO_2$+$H_2O$) | 5·52 | ... | 1·14 |
| | 99·01 | | 98·93 |

[1] Brögger. Eruptivgesteine des Kristianiagebietes, 1894, I, 173.

[2] Trans. New York Acad. Sci. 1892, XI, 60.

[3] Probably slightly under estimated.

In mineral composition and structure the rock is obviously closely related to members of the grorudite-tinguaite series, while the analysis shows that in chemical composition it approaches the basic end of the series, the type-rock of which is the so-called nepheline-porphyry of Kemp ("Sussexite" of Brögger) from Beemerville, New Jersey.

The chemical relationship of the Elfdalen rock to other members of the series is seen in the following table[1]:—

| | Grorudite Varingskollen. | Grorudite Kallerud. | Sölvsbergite Longenthal. | Tinguaite Hedrum. | Sussexite Elfdalen. | Sussexite Beemerville. |
|---|---|---|---|---|---|---|
| $SiO_2$ | 74·35 | 71·35 | 62·70 | 56·58 | 48·83 | 45·18 |
| $Al_2O_3$ | 8·73 | 12·21 | 16·40 | 19·89 | 18·71 | 23·31 |
| $Fe_2O_3(FeO)$ | 7·21 | 6·76 | 5·99 | 4·34 | 6·07 | 6·11 |
| CaO | 0·45 | 0·22 | 0·95 | 1·10 | 5·19 | 4·62 |
| MgO | 0·07 | — | 0·79 | 0·13 | 1·02 | 1·45 |
| $Na_2O$ | 4·51 | 6·51 | 7·13 | 10·72 | 10·63 | 11·17 |
| $K_2O$ | 3·96 | 3·22 | 5·25 | 5·43 | 3·04 | 5·95 |
| $H_2O(CO_2)$ | 0·25 | 0·33 | 0·70 | 1·77 | 5·52 | 1·14 |

II. *Riebeckite-Ægirine-Tinguaite, from the Rupbachthal, Nassau. Compared with similar rocks from Abyssinia and the Canary Islands.*

This rock has been described as a proterobase[2], and as a diorite-porphyrite.[3] In the present note it is referred to the tinguaite (phonolite) group, owing to the striking resemblance in characters which it presents with tinguaites from Abyssinia, described in the paper already referred to.[4]

Specimens of the rock in the British Museum collection are dark greenish black, and show only a few small phenocrysts of felspar. Under the microscope one or two long phenocrysts of orthoclase (or possibly anorthoclase), with straight extinction and showing no twin striations, are seen in a trachytic groundmass of felspar laths, scattered through which are ragged tufts and feathery patches of grass-green ægirine and riebeckite (with pleochroism from yellow to deep indigo-blue). The latter minerals are especially accumulated round patches of an altered mineral,

[1] See Brögger. Eruptivgesteine des Kristianiagebietes, 1894, I, 176.

[2] W. Schauf, Unters. nassauische Diabase. Inaug.-Diss. Bonn, 1880, p. 17.

[3] Zeits. Deutsch. geol. Ges. 1883, XXXV, 216.

[4] Min. Mag. 1900, XII, 268.

showing in one or two cases sharp hexagonal outlines. This structure is so very similar to that of the tinguaite from Amba Gollo, near Axum, Abyssinia (see Min. Mag. XII, Pl. III, fig. 5), that the altered mineral is here referred to nepheline. Besides ægirine and riebeckite there are moss-like patches of a nearly opaque mineral which in some parts show pleochroism from pale reddish brown to deep red nearly opaque. The same mineral occurs in small amount in the tinguaite from Abyssinia referred to above, and also in the paisanite described in the same paper. It is most probably the soda-amphibole *Cossyrite*.

Very similar to the Rupbach rock both macroscopically and microscopically are specimens in the Museum collection from Gran Canaria and Teneriffe.

Thus a dark greenish rock from the Guimar Road, Gran Canaria, shows in thin section under the microscope one or two long Carlsbad twins of orthoclase (or possibly anorthoclase, which is the prevailing felspar in many specimens of phonolite from the Canary Islands) in a trachytic groundmass of felspar laths with feathery tufts of ægirine and a hornblendic mineral, showing extinctions as high as 30° and pleochroism from pale yellow to purplish brown, and thus closely related to the *Catophorite* of Brögger: ragged patches of altered *Cossyrite* are also present. A specimen from Tiraxana, Gran Canaria, is similar, and shows also large irregular phenocrysts of altered nepheline surrounded by ægirine, as in the Rupbach rock.

Many of the phonolitic rocks of Cripple Creek, Colorado, described by Cross,[1] appear to be of a very similar character.

III. *Melilite-Basalt from Amparafaravola, Madagascar.*

The specimen of this rock in the Museum collection is from a collection of Madagascar rocks, presented in 1889 by the Rev. J. Wills.

It is a dark, fine-grained basalt, showing in section characters very similar to those of the well-known melilite-basalt of Hochbohl, Württemberg. Very numerous small phenocrysts of olivine occur in a base of pale purple augites, with small prismatic melilites and magnetite grains.

The melilite has a slightly brownish tint, but is clear and free from inclusions like the Hochbohl mineral: it occurs in lath-shaped crystals, often club-shaped at the ends, which give straight extinction and compensate with the quartz-wedge across their length like the Hochbohl melilite: the double refraction is very low to almost isotropic: no peg-structure was observed.

[1] XVI Ann. Rep. U. S. Geol. Survey, 1894-5, Part II, p. 35.

Purplish-brown, strongly refractive grains are doubtless to be referred to perofskite, the constant companion of melilite.

## IV. *Limburgite and Hornblende-Basalt-Scoria from Ahmed Aga, White Nile.*

Ahmed Aga is an isolated hill in the desert country, about 100 miles north of Fashoda, on the White Nile. The specimens here described, which were collected and presented in 1900 to the Museum by Capt. Stanley Flower, show that the hill is of volcanic origin. They consist of basalt-scoria, compact limburgite and large fragments (up to 1 in. square) of basaltic hornblende.

The limburgite or magma-basalt is a dense black rock, showing a few small phenocrysts of olivine. Under the microscope small irregular and rounded phenocrysts of olivine, and a few phenocrysts of a pale purple augite, with colourless centres, are seen in a dense groundmass, made up mainly of pale purple augite microlites, with some olivine and magnetite grains, in a nearly colourless isotropic base. One or two foreign fragments of quartz are present, surrounded by the usual alteration-zone of pale-green augite needles. Many of the olivine phenocrysts have suffered partial absorption, and are surrounded by a broad margin of granular augite.

The basalt-scoria shows in thin section irregular phenocrysts of a pale-green augite, altered olivine, and deep red basaltic hornblende, with one or two small fragments of felspar (showing no twin-striations) in a dense, nearly opaque, glassy base.