THE RELATION OF FRENCH AND AMERICAN GRÜNERITES TO SIMILAR FERRO-MANGANESE AMPHIBOLES OF SWEDEN

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In recent years several attempts have been made to arrange in a series the characteristics of non-aluminous amphiboles. Sundius[1] and Winchell[2] succeeded fairly well in representing refraction, birefringence and specific gravity as a continuous function of the molecular percentages of iron and manganese. Unfortunately, the properties of Lake Superior grünerite, an important link in this series was hitherto practically unknown. A reëxamination of this amphibole[3] revealed new aspects which seem worth while to be taken into consideration.

Neglecting other constituents, Sundius calculated the molecular percentages of $FeSiO_3$, $MnSiO_3$, and of $MgSiO_3$, the $FeSiO_3$ containing also a small amount of ferric iron. Those values which refer to ferro-manganese amphiboles are reproduced from his table on page 163, retaining his numeration; to these amphiboles are added the respective data of French and American grünerites.

	$FeSiO_3$	$MnSiO_3$	$MgSiO_3$	α	β	γ	$\gamma-\alpha$	sp. gr.
6	40.83	14.76	44.41	1.650	(1.665)	1.679	0.029	3.311
5	47.26	16.00	36.73	1.650	(1.670)	1.695	0.035	3.34
4	60.88	11.66	27.64	1.663	(1.684)	1.699	0.036	3.396
3	66.55	14.35	19.10	1.6696	1.6904	1.7057	0.036	3.446
2	69.71	20.63	9.66	1.673	(1.697)	1.713	0.040	3.516
I	83.57	1.39	15.04	1.666	1.684	1.700	0.034	3.44
II	90.38	0.16	9.46	1.672	1.697	1.717	0.045	3.518
III	96.37	—	3.63	(1.696)	(1.7415)	(1.752)	0.056	3.713

(6) Ö. Silvergruvan, (5) Brunsjögruvan, (4) Stromshult, (3) V. Silvberg, (2) Dannemora, (I) Mt. Humboldt, Michigan, (II) La Malières, near Collobrières (Kreutz), (III) Collobrières (Grüner and Lacroix).

The indices within parentheses are calculated. Of the original French grünerite, analyzed by Grüner, only $N=1.73$ (indice

[1] Nils Sundius; Zur Kenntnis der monoklinen Ca-armen Amphibole (Grünerit-Cummingtonit-Reihe), *Geol. För. Förh., Stockholm,* **46,** p. 154 (1924).

[2] A. N. Winchell; The $FeSiO_3$-$CaSiO_3$-$MgSiO_3$-$NaFeSi_2O_6$ system of monoclinic amphiboles, *Am. Mineral.*, **10,** p. 335 (1925).

[3] Stephen Richarz; The amphibole grünerite of the Lake Superior region, *Am. J. Sci.*, **14,** (fifth series), 150 (1927).

médian) is given by Michel Lévy and Lacroix (Minéraux des roches, 2, 147) which equals $\alpha+\beta+\gamma/3$. From this N and from the negative optical angle $2V=50°$, the indices given above were calculated. Of course, they have only an approximate value, until exact measurements become available.

Combining $FeSiO_3$ and $MnSiO_3$ and plotting this sum against $MgSiO_3$, the optical data and the specific gravity of the above table result in the following figure.

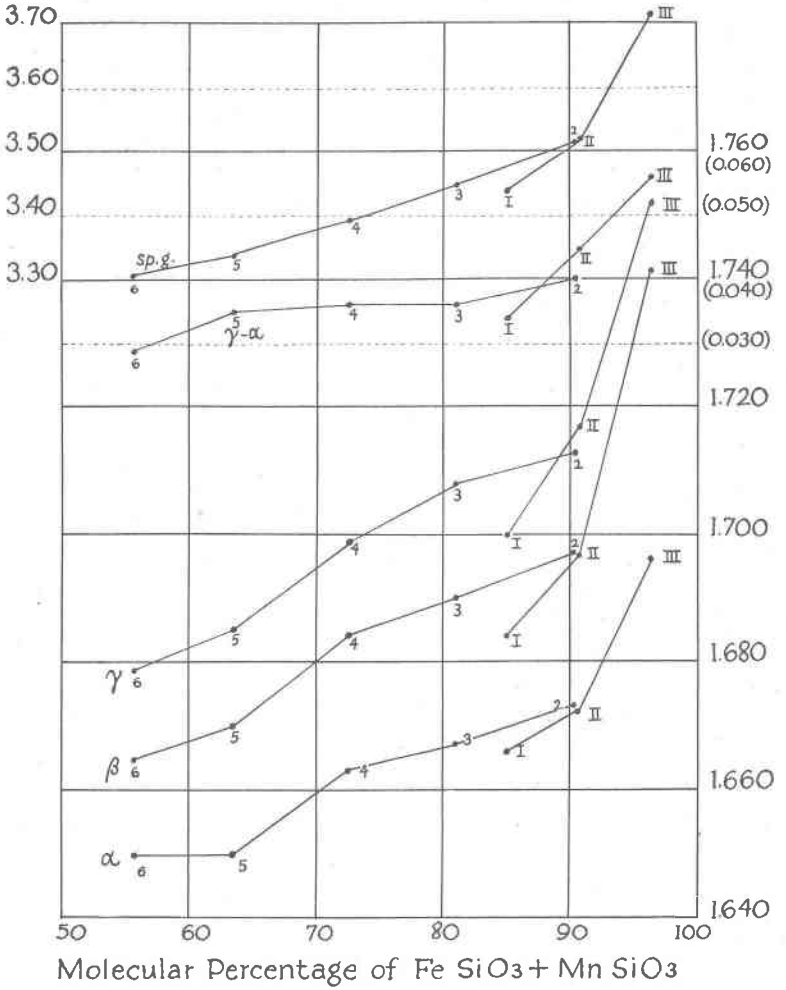

FIG. 1.

It is evident from this diagram that the original grünerite and its American variety do not form a continuous series with the ferro-manganese amphiboles of Sweden. Apparently, the high amount of MnO affects the optical constants in quite a different manner than the high percentage of ferrous iron influences the refractive indices of grünerite. The indices of Lake Superior grünerites which contain 85% $FeSiO_3+MnSiO_3$, are about as low as those of the ferro-manganese amphibole number 4 with only $72\frac{1}{2}$%, the birefringence is even lower. However, with the increase of iron in the French grünerites, refraction and double refraction mount rapidly. On account of these differences it would be more appropriate, to reserve the name grünerite for those ferrous amphiboles, in which the amount of manganese is negligible, and to apply the name "Dannemorite" to the ferro-manganese varieties, as was proposed by Palmgren.[4]

There seems to be a growing tendency to disregard Grüner's and Lacroix' original data on grünerite from Collobrières. After the thorough reëxamination of grünerite from the same or a neighboring locality by Kreutz, there is no good reason to reject the work done by the former investigators, although the analysis is incomplete and the optical properties need to be checked by modern methods. We are certainly justified in assuming that Grüner and Lacroix studied a different variety of grünerite than Kreutz, one which was richer in iron and poorer in magnesia; the optical characteristics are in fair agreement with this change in chemical composition. It is to be hoped that the French mineralogists in the near future restudy the material collected at various localities in the vicinity of Collobrières, both chemically and optically. As far as macroscopical appearance is concerned, the variability of the grünerite from Collobrières may be inferred from the following. Lacroix describes in a later publication the fibers of grünérite as olive-green ("des fibres souvent rayonnées de grünérite d'un vert olivâtre, à éclat vif.)[5] My friend, Professor Kreutz, was kind enough to send me a sample of the grünerite which he investigated. These fibers are colorless to pure white with a silky luster. This difference in color suggests a difference in chemical composition and consequently in the optical characteristics.

[4] "Es scheint mir das beste, den Namen Dannemorit als den ältesten beizubehalten, und unter diesem Namen zukünftig die manganhaltigen Varietäten des Grünerit zusammenzufassen." John Palmgren; Die Eulysite von Södermanland, *Bull. Geol. Inst. Univ. Upsala*, **14**, 161 (1916–1917).

[5] A. Lacroix; Sur une roche de fayalite; *Comptes rendus de l'Acad. des Sci.*, **130**, 1778 (1900).