THE GROSSULAROID GROUP (HIBSCHITE, PLAZOLITE)

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Recently the authors published two short articles on hibschite,[1,2] which was first described by Cornu (1905, 1906, 1907) and found in Bohemia (Upper-Turan contact marls of Marienberg and Jungferstein) and in southern France (contact limestone included in Oben basalts).

In the first article the following points are included:

(*a*) A new deposit of hibschite is mentioned: Albian contact marls, found in the neighborhood of the Village of Nikortzminda, Georgia.

(*b*) A characteristic paragenesis of hibschite similar to that mentioned by Cornu is described, in the present case associated with ferrocalcareous garnet; the octahedral shells of hibschite surrounding the dodecahedral nuclei of the garnet.

(*c*) The present generally accepted formula of hibschite ($CaO \cdot Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$) is criticized and revised on account of the unsatisfactory character of the original material used by Cornu.

In the second article:

(*a*) We described methods used to separate hibschite from the granite of Nikortzminda and which resulted in obtaining two concentrates: (1) hibschite concentrates containing 8% of garnet and 2% of calcite, and (2) garnet, with 7.5% hibschite and 4% calcite content.

(*b*) These concentrates were analyzed by I. M. Shumilo whose results are given in Table 1.

(*c*) Our final conclusions are given as to the chemical composition of hibschite (column 1, Table 1) and of the correct formula of this mineral, which is: $3(Ca,Mg)O \cdot (Al,Fe)_2O_3 \cdot 2(Si,Ti)O_2 \cdot 2H_2O$, or in a simplified form: $3CaO \cdot Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$.

The chemical composition of the Nikortzminda hibschite (1) and Crestmore plazolite (2) and (3) are recorded in Table 1

As can be seen, the result is rather unexpected: hibschite appears to be more highly calcareous than it was considered heretofore. The ratio $CaO{:}Al_2O_3$ in its present formula is not as in anorthite, as stated by Cornu, but rather as in grossularite. Thus, it is simply grossularite, in which one molecule of SiO_2 is replaced by two molecules of H_2O.

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[1] Belyankin D. S. and Petrov, V. P., Hibschite in Georgia: *Doklady of the Academy of Sciences, U.S.S.R.*, **24,** No. 4, 1939.

[2] Belyankin, D. S. and Petrov., V. P., Reexamining the chemical formula of hibschite: *Doklady of the Academy of Sciences, U.S.S.R.*, **30,** No. 5, 1941.

These results draw our attention to another similar case of substitution in grossularite found in the literature, namely, that of plazolite from Crestmore, near Riverside, California, which was described by Foshag (1920, 1924). The chemical formula of this mineral: $3CaO \cdot Al_2O_3 \cdot 2(SiO_2 \cdot CO_2) \cdot 2H_2O$ was obtained by this investigator as a result of two chemical analyses given in columns 2 and 3 of Table 1. In Table 2 we compare the occurrence, paragenesis, and properties of the Bohemian and Caucasian hibschites with those of the Californian plazolite described by Foshag.

TABLE 1.

	1		2		3	
	weight %	mol. quant.	weight %	mol. quant.	weight %	mol. quant.
SiO_2	27.57	0.4590	23.85	0.397	25.06	0.417
TiO_2	0.67	0.0084	—	—	—	—
Al_2O_3	18.52	0.1817	22.77	0.223	24.63	0.241
Fe_2O_3	3.70	0.0232	—	—	—	—
FeO	0.15	0.0020	—	—	—	—
MnO	0.08	0.0011	—	—	—	—
CaO	38.39	0.6885	40.13	0.716	40.13	0.716
MgO	2.13	0.0528	—	—	trace	—
H_2O-	0.29	0.0133	9.39	0.521	9.04	0.502
H_2O+	8.55	0.4740				
CO_2	—	—	3.41	0.077	1.13	0.025
Total	100.00		99.55		99.99	

As may be seen from the tables, hibschite and plazolite are very much alike in their properties. Chemically, plazolite differs only by a small and rather variable content of CO_2,[3] and geometrically by the form of its crystals which are dodecahedral instead of octahedral, as in the case of hibschite. Thus, evidently hibschite and plazolite are both members of the same mineral group, for which a preliminary name of *grossularoid group* is being suggested, because of its close relationship to grossularite.

[3] The role of CO_2 in plazolite is not quite clear. Judging from the fact that its content is highly variable in different analyses, falling sometimes as low as 1%, one may suppose that, similar to the case of Nikortzminda hibschite, it may be present in the form of the secondary carbonate of calcium which partly replaces grossularoid. It also seems quite strange to us that in spite of the fact that plazolite is of a somewhat yellowish color, iron oxides are absent in the analysis of this mineral. Additional study of plazolite from the point of view of these two properties would be highly desirable.

Both hibschite and plazolite are at present considered as very rare minerals. However, we are of the opinion that this conception is not correct. We simply do not distinguish these grossularoids from garnet in some of their occurrences, namely, in contact marls with the characteristic paragenesis: zeolites, calcareous hydrosilicates, garnet, gehlenite, etc.

Table 2. Occurrence and Properties of Hibschite and Plazolite

Mineral	Hibschite		Plazolite
Deposit	Marienberg, Bohemia	Nikortzminda, Caucasus	Riverside, California
Occurrence	In contact metamorphosed marls adjoining phonolite	In contact metamorphosed marls adjoining teschenite	In contact metamorphosed marls adjoining granodiorite
Paragenesis	Apophyllite, Natrolite, Garnet	Apophyllite, Thomsonite, Xonotlite, Wollastonite, Garnet, Hedenbergite	Jurupaite, Riversidite, Wollastonite, Diopside, Vesuvianite, Garnet
Habit of crystals	Octahedral	Octahedral	Dodecahedral
Structure	Structure similar to grossularite as shown by the zonal overgrowth on crystals of the latter mineral		Almost the same structure as grossularite according to x-ray data (Pabst, 1937)
Specific gravity	3.05	3.06 ± 0.03	3.129
Hardness	6.0	—	6.5
Light refraction	$N=1.67$	$N_{Na}=1.681$ $N_{500}=1.695 \pm 0.001$ $N_{580}=1.682 \pm 0.001$ $N_{615}=1.671 \pm 0.001$	$N=1.675$
Solubility	Soluble in acids		Easily soluble in acids
Chemical formula	$3CaO \cdot Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$		$3CaO \cdot Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$

In this connection it is interesting to mention that an examination of a suite of minerals from one of such deposits in Transcaucasia, where xonotlite and gehlenite had previously beeen reported (Barsanov, 1937), proved that they contained grossularoid as well. This deposit is situated in the Lopan gorge of southern Osetia and represents a narrow band in the lower Cambrian limestone adjoining a diabasic dyke of Jurassic age.

Here, the same as was the case in Nikortzminda, grossularoid forms shells around the diamond-shaped dodecahedral nuclei of garnet. If these nuclei are very small the shape of their grossularoid shells appears octahedral, like those of typical hibschite; if, on the contrary, the nuclei are larger, and the shell thin, it appears dodecahedral, as that described by Cornu (see his drawing No. 2, 1907, p. 463).

The refractive indices of the Lopan minerals as determined by the immersion method in Na-light are: grossularoid, $N=1.686$, garnet, $N=1.822$.

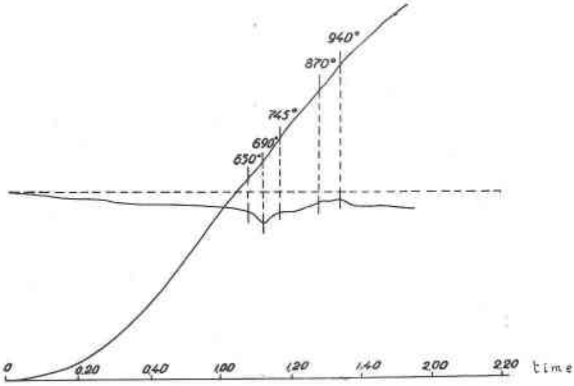

FIG. 1. Heating curve obtained on hibschite concentrate.

Returning to the hibschite of Nikortzminda, we should like to add to the above data the following heating curve, obtained by G. V. Shamkova (Fig. 1). The hibschite concentrate analyzed by I. M. Shumilo served as material for her investigation. Although its quantity was very small (0.5 gr.), the heating curve shows quite distinctly three characteristic thermal effects, one of which is endothermal at a temperature of 650°–690° C, and the remaining two exothermal at 870° C and 940° C. It is possible that the endothermal effect shows, as is the case of kaolin, the transition from the original crystalline substance into an amorphous phase while the exothermal ones show the transition from the amorphous into a crystalline phase and the recrystallization of the resultant crystals into new mineralogical forms.

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