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COMMUNICATIONS FROM THE HARVARD MINERALOGICAL MUSEUM.

VII.—ON HARDYSTONITE, A NEW CALCIUM-ZINC SILICATE FROM FRANKLIN FURNACE, NEW JERSEY.

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Presented March 8, 1899. Received March 13, 1899.

IN the fall of 1898, while studying the ore deposit in the new workings at North Mine Hill, Franklin Furnace, in connection with the Franklin Folio of the United States Geological Survey, the writer took down from the wall of a cross-cut at the extreme north workings, and about 900 feet below the surface and near the limestone foot-wall, a specimen of ore composed of small irregularly interlocking grains of green and reddish willemite, lilac-brown rhodonite, franklinite in abundance, and a white mineral which is the subject of this paper. The ore is banded, and the grains average about a millimeter in diameter.

Chemical Composition.—Part of the specimen was pulverized and passed through a 90-mesh sieve, the franklinite and rhodonite taken out by the electro-magnet and portions of the white mineral obtained by careful hand-picking, which were then purified from a trace of calcite by the Thoulet solution, but still contained a few specks of franklinite and an occasional grain of willemite. The following analyses (I. to IV.) were made on separately picked portions:—

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
SiO ₂	38.00	38.10	38.10	..	38.34	.639	.639	88.84	38.66
ZnO	24.00	...	24.30	..	24.45	.802	.323	25.88	24.47
MnO	3.48	...	1.50	1.59	1.50	.021		...	1.43
CaO	33.70	...	33.85	..	34.07	.608	.648	85.78	33.83
MgO	1.43	...	1.62	..	1.62	.040		...	1.61
Fe ₂ O ₃	0.58	...	0.57	0.86					
Ignition	0.58	...	0.52	..					
Total	101.77		100.46		100.00			100.00	100.00

For the iron and manganese determination of IV. over a gram of material was used which had been separated from the willemite, etc., by

the barium-mercury-iodide solution, for the others about $\frac{3}{4}$ of a gram. In I. the mineral was decomposed by HCl alone, in the others after previous fusion with Na_2CO_3 . Iron was first precipitated as basic acetate, then the zinc as sulphide, dissolved and re-precipitated as carbonate, the manganese as sulphide and carbonate, calcium and magnesium, as usual. The manganese carbonate in I. was accidentally contaminated and is inaccurate. Taking III. for computation, in V. it is recalculated to 100, omitting iron and ignition as non-essential. VI. and VII. give the molecular ratios from which we deduce $(\text{ZnMn})\text{O} : (\text{CaMg})\text{O} : \text{SiO}_2$, as 1 : 2 : 2 with Mn to Zn and Mg to Ca as 1 to 15 respectively. The formula is hence $(\text{ZnMn})\text{O}$, 2 $(\text{CaMg})\text{O}$, 2 SiO_2 or ZnO , 2 CaO , 2 SiO_2 . VIII. gives the theoretical composition of the latter, and IX. of the former. The mineral gives off a little chlorine with HCl indicating a higher oxidation for some of the manganese unless due to traces of franklinite, and the ferric iron may also be due in part to that impurity.

Crystal System and Physical Characters.—The grains have no distinct crystalline boundaries, but show several cleavages. Thin sections, prepared by scattering the grains in balsam and grinding thin with emery, give in polarized light numerous basal sections which show a distinct uniaxial cross (without any perceptible opening into hyperbolas) and negative optical sign. These basal sections show two distinct sets of rectangular cleavages apparently normal to the base, and at 45° to each other, one a little better than the other. Prismatic sections show a good basal cleavage (i. e. normal to the negative optical direction) and parallel extinction, with a strong bi-refringence. The mineral is therefore tetragonal with a good basal cleavage and secondary cleavages parallel to the prisms of the first and second orders. The specific gravity determined with the pycnometer on over a gram of the material used in Analyses I. and IV. was respectively 3.397 and 3.395. Hardness between 3 and 4, color white to transparent, with a glassy lustre. *Pyrognostics:* unaltered in the open and closed tubes. It fuses in the forceps with difficulty to a cloudy glass, giving an intense red calcium flame, especially when moistened with HCl. On charcoal the powdered mineral glows intensely, and gives a heavy zinc coating, which is intensified by using Na_2CO_3 , the centre of the assay is then colored bluish green (Mn). A manganese reaction with borax; gelatinizes easily with HCl. Aside from the crystal system it may be separated from willemite by the hardness, negative optical character, and intense calcium flame.

The mineral is named *Hardystonite* from Hardyston township, in which the Franklin mines are situated.

Its systematic position is perhaps not clear without crystallographic material. Having an oxygen ratio of 4:3 it would belong among the intermediate silicates (Dana's System, 6th ed.), and its tetragonal system and cleavages would place it near ganomalite ($\text{Pb}_3\text{Si}_2\text{O}_7$). Some genetic connection with clinohedrite* ($\text{H}_2\text{CaZnSiO}_5$) may be surmised, as both minerals come from the same workings, and the writer is informed that a white mineral, probably hardystonite, has been found there in considerable quantity. It is hoped in a future visit to the mines to obtain further light on these questions.

* Penfield and Foote, Am. Journ. Sci., 1898, Vol. V. p. 289.