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SONOLITE, ALLEGHANYITE AND LEUCOPHOENICITE FROM NEW JERSEY[1]

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ABSTRACT

Sonolite and alleghanyite, the manganese analogues of clinohumite and chondrodite respectively, are reported from Franklin and Sterling Hill, N. J. Sonolite locally may have been an ore mineral at Franklin. The original leucophoenicite of Penfield and Warren (1899) is shown to be a valid species, identical with the material of Palache (1910), but the later studies of this mineral by Palache (1928, 1935) and Moore (1967) are composite descriptions of leucophoenicite, sonolite and alleghanyite. Some still undescribed chemical variants of minerals in the chondrodite and olivine groups also have been recognized together with the Mn analogue of humite. Some of these minerals have been confused with leucophoenicite

INTRODUCTION

A survey by X-ray, optical and spectrochemical methods of 60 museum specimens labelled leucophoenicite from Franklin and Sterling Hill has revealed that sonolite and alleghanyite, not hirtherto reported from these localities, have been confused with leucophoenicite in many instances. Additional specimens of sonolite and alleghanyite were found in collections as minerals erroneously labelled glaucochroite, hodgkinsonite and tephroite. In order to obtain a description of authentic leucophoenicite, the type material of Penfield and Warren (1899) preserved at Yale University, and the original specimens later described as leucophoenicite by Palache (1920, 1928, 1935) were reexamined. The type material proves to be distinct from sonolite, alleghanyite and other known manganese silicates and is a valid species. The crystallized leucophoenicite described morphologically by Palache (1910) is identical with the type material. The X-ray crystallography of the crystals measured by Palache has been described by Moore (1967). He refers to this material as m-leucophoenicite, in distinction to other kinds of unidentified leucophoenicite-like material mentioned in this paper. His X-ray study shows that leucophoenicite is monoclinic, pseudo-ortho-rhombic, which in his setting is related to the humite structure-cell when the *c*-axis is halved.

The so-called leucophoenicite, later described morphologically by Palache (1928), comprised two kinds of material. One kind, dull brown to deep tan in color when massive, and showing crystals of a platy habit, has been here identified as alleghanyite. The other specimen, described as showing deep red monoclinic crystals of prismatic habit, could not be found in the Harvard collection. In the summary account of leucopho-

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enicite given by Palache (1935), the crystals of true leucophoenicite described in 1910 are represented by Figures 151 and 154, the later described crystals of unverified leucophoenicite by Figure 152 and 153, and the crystals of alleghanyite by Figure 155–157. The analysis of the morphology of leucophoenicite by Moore (1967) is based on the composite data.

Palache (1935) also cites two chemical analyses of supposed leucophoenicite made in 1926 or before by chemists of the New Jersey Zinc Co. The specimens are not crystallized and were not further described. Reexamination of the original specimen of the material of analyses 3 as cited in page Palache (1937), p. 104, proves it to be sonolite. The material of analysis 2, preserved in the U.S. National Museum, proves to be true leucophoenicite. This analysis and that of the type material reported by Penfield and Warren (1899) are cited in Table 1. Optical and X-ray powder data for the type material are given in Tables 2 and 3.

Additional specimens of leucophoenicite were identified on the basis of the above information among a large collection of minerals from Franklin and Sterling Hill examined during the present study. The optical properties and X-ray interplanar spacings of this material in part vary somewhat from those of the type material. This variation has been found

TABLE 1. PUBLISHED ANALYSES OF LEUCOPHOENICITE AND SONOLITE FROM FRANKLIN

	1	2	3	4	5
SiO_2	25.28	26.74	26.31	26.41	26.36
MnO	60.34	65.19	60.59	60.67	60.63
ZnO	5.35	1.39	4.03	3.72	3.87
FeO	Tr.	.93	—	—	Tr.
MgO	.30	2.06	.21	—	.21
CaO	4.26	1.22	5.64	5.70	5.67
Na_2O	.90	.53	.39	—	.39
K_2O	.18	.14	.24	—	.24
Al_2O_3	1.45	.78	—	—	—
H_2O	2.10	.85	2.70	2.58	2.64
	100.16	99.83	100.11	99.08	100.01

1. Leucophoenicite—Jenkins and Bauer analysis cited by Palache (1935, p. 104, analysis 2)

2. Sonolite—Jenkins and Bauer analysis cited by Palache (1935, p. 104, analysis 3)

3. Leucophoenicite—Warren analysis cited by Penfield and Warren (1899, p. 351, analysis I)

4. Leucophoenicite—Warren analysis cited in Penfield and Warren (1899, p. 351, analysis II)

5. Average of analyses 4 and 5

TABLE 2. OPTICAL DATA FOR LEUCOPHOENICITE, ALLEGHANYITE AND SONOLITE

	Leucophoenicite[a]	Sonolite[b]	Zincian sonolite[c]	Alleghanyite[d]	Zincian alleghanyite[e]
ρ	3.62–3.93	3.87–4.00	3.77	3.80	3.70
α	1.751	1.765	1.695	1.770	1.67
β	1.771	1.778	1.716	1.782	1.680
γ	1.782	1.787	1.725	1.795	1.703
Sign	—	—	—	—	—
H	5.5–6	5.5	5.5	5.5	5
Color	Light pink to deep pink	Pinkish brown to dark reddish-brown to dark brown	Dark brown to brown-black	Brown to pinkish-brown to deep pink (crystals)	Brownish-pink to reddish-pink

[a] Franklin. Specific gravity measurement indicates range of all leucophoenicites studied. Other data from type specimen at Yale described by Penfield and Warren (1899)

[b] Franklin. Data from Harvard Specimen 89916; analysis 3 given by Palache (1935) for leucophoenicite was determined from this specimen

[c] Sterling Hill. Data from specimen showing typical rim of zincian sonolite around pink zincian tephroite.

[d] Franklin. Data from Harvard specimen 91179; part of the pinkish brown material described by Palache (p. 105) as a vein of leucophoenicite.

[e] Sterling Hill. Data from Harvard specimen 105492; light-colored material.

by optical spectrographic and X-ray fluorescence analysis to be caused by compositional variation, chiefly in the content of Zn, from about 4 to 8 percent ZnO, and of Ca, from about 4 to 14 percent CaO. In addition, another mineral closely resembling leucophoenicite in properties and chemical composition but with an X-ray pattern similar to that of humite was observed. This mineral may be a polytype of leucophoenicite.

Most leucophoenicite specimens show this mineral as a constituent of the small hydrothermal veinlets that cut the main orebody. A few specimens were found, however, in which the leucophoenicite occurs in granular willemite-franklinite ore, sometimes making up as much as half of the sample. In this mode of occurrence the leucophoenicite closely resembles tephroite, and doubtless has been mistaken for that mineral in the past. Leucophoenicite probably was a primary ore mineral at Franklin, at least locally.

SONOLITE

This mineral, the manganese analogue of clinohumite, was first described as a new species from Japan by Yoshinaga (1963). Sonolite is much more abundant than either alleghanyite or leucophoenicite at Franklin and Sterling Hill. It appears to have been a minor ore consti-

TABLE 3. X-RAY POWDER DATA FOR LEUCOPHOENICITE, ALLEGHANYITE, SONOLITE AND ZINCIAN SONOLITE

Leucophoenicite[a]		Alleghanyite[b]		Sonolite[c]		Zincian sonolite[d]	
I	*d*	*I*	*d*	*I*	*d*	*I*	*d*
1	5.251	1	7.815	2.5	5.232	2	13.715
2	4.409	0.5	5.196	2	4.632	0.5	6.896
2	4.355	2.5	5.034	0.5	4.416	2	5.158
1	3.951	1	4.382	1	3.984	0.5	4.911
3	3.619	1	4.324	2.5	3.865	2	4.556
1	3.563	0.5	4.128	4	3.616	0.5	4.347
2.5	3.280	1	3.923	1	3.565	1	3.928
0.5	3.239	0.5	3.726	3.5	3.344	2	3.792
0.5	3.186	0.5	3.609	0.5	3.028	3	3.547
2	2.966	1	3.505	10	2.869	0.5	3.509
10	2.882	1	3.258	1	2.841	1	3.421
0.5	2.831	5	3.127	0.5	2.807	2.5	3.280
3.5	2.745	0.5	3.030	5.5	2.699	1	2.972
2	2.717	1	2.950	7	2.651	7	2.822
7.5	2.688	8	2.860	7	2.608	5	2.799
4	2.624	0.5	2.819	4.5	2.504	1	2.740
2.5	2.488	3	2.773	5	2.458	3	2.658
3.5	2.448	5	2.725	0.5	2.360	2	2.631
2.5	2.423	2	2.700	3.5	2.338	3.5	2.594
3.5	2.374	4	2.670	3.5	2.284	4	2.564
2	2.358	6	2.598	1	2.218	4	2.451
0.5	2.287	0.5	2.564	1	2.119	4	2.405
0.5	2.211	1	2.537	0.5	2.065	1	2.334
1	2.201	0.5	2.513	0.5	2.006	5.5	2.305
0.5	2.172	1	2.472	0.5	1.948	1	2.238
0.5	2.054	5	2.425	0.5	1.898	0.5	2.186
0.5	1.991	3	2.377	0.5	1.884	0.5	2.116
0.5	1.970	5	2.357	0.5	1.808	0.5	2.079
0.5	1.894	5	2.341	10	1.743	0.5	1.956
0.5	1.879	0.5	2.310	2	1.694	0.5	1.923

Fe radiation, Mn filter, in Ångström units. Camera diameter 114.6 mm, film corrected for shrinkage.

[a] Franklin, Jenkins and Bauer analysis cited by Palache (1935, p. 104, analysis 3), Specimen C6237—U. S. National Museum

[b] Franklin, Material described by Palache (1935, p. 105) as being leucophoenicite, Harvard specimen 91179

[c] Franklin, Jenkins and Bauer analysis cited by Palache (1935, p. 104, analysis 2), Harvard specimen 89916

[d] Sterling Hill, dark brown rim around zincian tephoroite

Table 3 (continued)

Leucophoenicite[a]		Alleghanyite[b]		Sonolite[c]		Zincian sonolite[d]	
I	*d*	*I*	*d*	*I*	*d*	*I*	*d*
10	1.810	0.5	2.271	2	1.685	0.5	1.867
0.5	1.758	2	2.210	2	1.630	0.5	1.837
1	1.748	2	2.185	1	1.561	0.5	1.809
1	1.716	0.5	2.152	2	1.554	10	1.772
1.5	1.705	1	2.103	4	1.546	0.5	1.753
0.5	1.666	1	2.032	4	1.500	1	1.706
1.5	1.638	0.5	1.998	0.5	1.478	1.5	1.667
1.5	1.618	0.5	1.949	0.5	1.455	1.5	1.651
1.5	1.598	1	1.919	2	1.412	1.5	1.601
4	1.575	2	1.873	0.5	1.404	2	1.572
4	1.562	0.5	1.850	0.5	1.392	2	1.524
0.5	1.551	0.5	1.832	2	1.361	3.5	1.518
0.5	1.535	10	1.799	0.5	1.341	0.5	1.505
0.5	1.519	2	1.773	0.5	1.316	0.5	1.452
0.5	1.505	2.5	1.751	0.5	1.228	2	1.432
0.5	1.475	2	1.730	1	1.207	0.5	1.420
1.5	1.470	2	1.707	1.5	1.180	0.5	1.414
0.5	1.456	4	1.690	0.5	1.171	0.5	1.396
0.5	1.447	0.5	1.667	0.5	1.154	0.5	1.383
0.5	1.436	1	1.647	0.5	1.144	2.5	1.366

tuent in some parts of the ore body at Franklin, where it apparently was mistaken for tephroite in part. Sonolite occurs as pink-brown to brown grains up to an inch in size in coarse franklinite-willemite-zincite ore, and is often associated with manganosite and coarse platy masses of zincite. It also was observed as dull to glassy dark brown masses in veinlets associated with crystallized green willemite and chlorite. Light pinkish-brown crystals of sonolite were observed with zincite crystals and calcite in a hydrothermal veinlet cutting franklinite-willemite ore. A variety of sonolite found by X-ray fluorescence analysis to contain 17.6 percent ZnO occurs at Sterling Hill. It forms dark brown reaction rims up to 10 mm thick around large tephroite crystals associated with franklinite and zincite in calcite, and it also occurs as dark brown masses in ordinary franklinite-willemite ore.

The analysis of sonolite from Franklin reported by Palache (1935) is given in Table 1. Optical and X-ray powder data for this material and for the zincian sonolite from Sterling Hill are given in Tables 2 and 3.

Alleghanyite

Alleghanyite was first described as a new species from Bald Knob, North Carolina, by Ross and Kerr (1932). It was shown to be the manganese analogue of chondrodite by Rogers (1935) and by Campbell Smith, Bannister and Hey (1944). Alleghanyite occurs at both Franklin and Sterling Hill in several different associations. The main occurrence at Franklin was described by Palache (1935):

"Leucophoenicite [alleghanyite] was also found by Mr. Hodgkinson in the north end of the mine near the hanging wall of the west leg of the ore body, within 2 feet of a pegmatite dike, in a continuous seam with swells and pinches, the swells making vugs in which the crystals had formed. The cavities have walls of layered ore containing much franklinite, which, near the margins of the cavities, is in cubic crystals. The walls of the cavities are lined with gray calcite merging inward to pale rhodochrosite, poorly crystallized in parallel groups of rhombohedrons. On the carbonates is a coating of silky, felted sussexite, commonly in a thin, closely adhering film Massive dull-brown leucophoenicite forms a central mass 4 inches across, crystallized toward the center, either in slender, plate-like crystals, shown in figure 156, their broad surfaces deeply striated by twinning, with bright surfaces of the base or basal cleavage; or in isolated stouter and more brilliant crystals, like figure 157. The latter are clear, vivid pink and the plates are clear to opaque dull brown. Some of the platy crystals are aggregated in fan-shaped groups rising from the massive matrix . . ."

Alleghanyite also occurs at Franklin as dull pink masses associated with franklinite, willemite and zincite ore, as glassy pink crystal associated with leucophoenicite in veinlets. It occurs at Sterling Hill as dull to glassy reddish brown masses associated with manganoan calcite and serpentine in veinlets. A chemical variety of alleghanyite with relatively small interplanar spacings and containing up to 11 percent ZnO was found at Sterling Hill in several different types of occurrence: as tiny glassy brown crystals associated with magnesium-chlorophoenicite and hetaerolite on fracture surfaces in ore, as brown reaction rims around tephroite crystals, and as brownish pink masses associated with platy zincite.

The description by Palache (1928; 1935, Figs. 155–157) provides the only morphological data reported for alleghanyite. Optical and X-ray powder data for this specimen are given in Tables 2 and 3. Optical spectrographic analysis established that the material was essentially pure manganese silicate.

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