

THE AMERICAN MINERALOGIST, VOL. 49, JULY-AUGUST, 1964

SARCOPSIDE FROM DEERING AND EAST ALSTEAD, NEW HAMPSHIRE¹DONALD R. PEACOR AND DAVID GARSKE, *The University of Michigan, Ann Arbor, Michigan.*

On the basis of an analysis of Deering, New Hampshire material, sarcopside was assigned the formula $(\text{Fe, Mn, Ca})_7(\text{PO}_4)_2\text{F}_2$ (Holden, 1920), but Mrose and Appleman (1961) showed, on the basis of a structure analysis of Michelsdorf, Silesia material, that it has the formula $(\text{Fe, Mn, Ca})_3(\text{PO}_4)_2$. Thus it appears that either grafftonite $((\text{Fe, Mn, Ca})_3(\text{PO}_4)_2)$ is a dimorph of sarcopside, or each is stable over some characteristic range of Fe, Mn, and Ca solid solution.

A routine single-crystal x-ray analysis of Deering material showed that the cleavage fragment used, at least, was grafftonite. The specimen was obtained from The University of Michigan collection, and is evidently part of the original collection from Deering, as described by Holden (1920, 1924). This material is superficially altered, but Mr. Gunnar Bjareby kindly provided some recently collected unaltered Deering material. Close examination showed this to consist of alternating discontinuous parallel laths (~ 1 mm thick) of two phases, resembling intergrowths of grafftonite and triphylite. Such intergrowths of alternating laths of grafftonite and triphylite are frequently observed, and may originate in exsolution from a single phase.

Cleavage fragments from adjacent laths were examined by means of Weissenberg and precession techniques. The results are tabulated in Table 1, and show the minerals to be grafftonite and sarcopside. A cleavage fragment consisting of both sarcopside and grafftonite was similarly analyzed, and this showed that [010] of both is approximately parallel. The axes diverge by about 3° from parallelism. In addition, $t^*_{(100)}$ of sarcopside is approximately parallel to $t^*_{(101)}$ of grafftonite.

These results suggest that other examples of intergrowths of grafftonite and triphylite should be carefully examined for the possibility that sarcopside, rather than triphylite, is present. The unaltered Deering sarcopside is similar in appearance to triphylite, and the only difference in the appearance of the intergrowth from grafftonite-triphylite intergrowths is in the narrow width of individual laths. This results in a macroscopically homogeneous appearance, especially where partially altered. Holden (1920) recognized the presence of material with differing cleavages and optical properties. However, he apparently did not recognize that grafftonite was present and that the analysis was probably made on two-phase

¹ Contribution No. 261, from the Mineralogical Laboratory, Department of Geology and Mineralogy, The University of Michigan, Ann Arbor, Michigan.

material. The unreliability of the analysis has been discussed by Mrose and Appleman (1961).

One of the authors (D. R. P.) recently found a large mass of what initially appeared to be a typical intergrowth of triphylite and grafftonite on the dumps of the French King #2 quarry, East Alstead, N.H. This material very closely resembles the Deering specimens where superficially altered, and in view of the results on Deering sarcopside, adjacent laths were separated and analyzed by means of precession and Weissenberg methods. This showed that the two intergrown minerals are sarcopside

TABLE I. UNIT-CELL DATA FOR GRAFFTONITE AND SARCOPSIDE

	Grafftonite Deering	Sarcopside Deering	Sarcopside East Alstead
<i>a</i>	8.85 Å	10.49 Å	10.46 Å
<i>b</i>	11.71	4.82	4.80
<i>c</i>	6.16	6.07	6.05
β	98°58'	~90°	90°30'
Space group	$P2_1/c$	$P2_1/a$	$P2_1/a$

and grafftonite. The results for sarcopside are tabulated in Table 1. Individual laths of each are up to 1 mm thick and extend remarkably continuously for several inches across the surface of a specimen. A thin section cut normal to the laths revealed that the material is composed of approximately 40% sarcopside. All laths of sarcopside or grafftonite go to extinction simultaneously.

Samples from adjacent laths of East Alstead material were analyzed by means of *x*-ray fluorescence to determine the approximate ratios of elements in the coexisting phases. The results for the relative amounts show that there is 9.0 times as much Ca, 1.9 as much Mn, and 0.8 as much Fe in the grafftonite as in the sarcopside. This agrees with the results of Mrose and Appleman (1961) who found that sarcopside is Fe-rich, "with a small amount of Fe replaced by Mn and Ca."

These results indicate that sarcopside and grafftonite are not dimorphs over at least a portion of the solid solution range of Fe, Mn and Ca, and that sarcopside is stable with the structure dominated by the smaller Fe ions, and grafftonite stable with the larger Ca and Mn ions. In addition, it is probable that the textural relationships are produced through exsolution.

REFERENCES

- HOLDEN, EDW. F. (1920) An American occurrence of sarcopside. *Am. Mineral.* 5, 99-102.
 — (1924) Further notes on sarcopside. *Am. Mineral.* 9, 205-207.
 MROSE, MARY E. AND DANIEL E. APPLEMAN (1961) Crystal structure and crystal chemistry of sarcopside (Fe, Mn, Ca) $_3$ (PO $_4$) $_2$ (Abs.). *Program Am. Cryst. Assoc. Ann. Meet.*, 18-19.