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Dehrnite and lewistonite: discredited

DEHRNITE was originally described from Dehrn, Germany, by Larsen and Shannon (1930*a*), and also noted by them (1930*a*, 1930*b*) as occurring in the variscite deposit near Fairfield, Utah. It was initially described as a potassium sodium calcium phosphate and was later shown by McConnell (1938) to belong to the apatite group, as Larsen had originally surmised.

The mineral occurs at the type locality, Dehrn, Germany, as a white crust comprised of radiating crystals attached to a brownish, brecciated phosphorite rock. A portion of the holotype dehrnite was obtained from Harvard University (specimen no. H-92844) and it matches the description of Larsen and Shannon very well. In addition, a portion of the analysed powder was obtained for examination. This 'powder' (actually comprised of small crystal fragments) was labelled in the handwriting of E. S. Larsen, Jr. (C. Frondel, pers. comm.) as *Dehrnite, Dehrn, analysed.* The specimen number H-92844 was attached to the vial and also the vial holding the matrix specimen. This specimen consists of a small sample of phosphorite rock (1 × 1 × 1 cm) coated with a white crust (1 mm thick) comprised of acicular crystals, which are tightly packed in a semi-parallel, partially radiating arrangement. The crystals are elongated on *c*, and have refractive indices of $\omega = 1{\cdot}621$, $\varepsilon = 1{\cdot}613$, determined in sodium light. These refractive indices are in good agreement with those published by Larsen and Shannon: $\omega = 1{\cdot}622$, $\varepsilon = 1{\cdot}614$. The specific gravity of the crystals, determined by flotation, is 3·06, compared with Larsen and Shannon's value of 3·05. The *perfect* basal cleavage noted by Larsen and Shannon was not observed. However, the crystals do have a weak colour-zoning across their length, parallel to $\{001\}$, and some crystals break readily parallel to this zoning. This could have been interpreted as a perfect basal cleavage. In other respects, the sample examined conforms in every detail to the original description. The presence of crandallite on the dehrnite and the brecciated nature of the phosphorite rock confirm that this is the holotype specimen. A second specimen from Dehrn, Germany (NMNH no. R5590), in the Smithsonian collections, is very similar to the type specimen.

The occurrence of dehrnite at Fairfield, Utah, was described by the same authors (1930*a*, 1930*b*). The original Utah dehrnite specimen was not available but a portion of the analysed powder was obtained from Harvard University. It too was marked in the handwriting of E. S. Larsen, Jr. and was catalogued as no. H-95485.

Lewistonite was described from Fairfield, Utah, by Larsen and Shannon (1930*b*). The original specimen was not preserved but a vial marked as *Lewistonite, analysed* in Larsen's handwriting (no. H-95494) in the Harvard collection was examined.

Integrity of the type specimens. The type specimen of Dehrnite from Dehrn, Germany, as noted previously, is identical to the original description and is the valid holotype specimen. However, the vial of analysed powder for lewistonite (no. H-95494) cannot be the original material. An X-ray powder pattern of this material indicated that it is entirely englishite, with no trace of the diffraction lines of apatite. Assuming an error in the original labelling of the vials, the vial marked *englishite-analysed* (Larsen's handwriting) (no. H-95495) was examined and found to contain not englishite but a mixture of apatite and crandallite. An accidental switching of the vials seems likely in view of the consecutive catalogue numbers, but cannot be proven.

This unfortunate condition does not reflect on the competence of the Harvard curators in 1930; the Utah specimens were all subsequently re-examined by E. S. Larsen III in the course of his detailed study of the Fairfield, Utah, paragenesis (Larsen, 1942).

Chemistry. The samples described herein were analysed with an ARL–SEMQ electron microprobe using an operating voltage of 15 kV and a beam current of 0·15 μA. Analysed fluorapatite was used for calcium, phosphorus, and fluorine. Hornblende was used for silicon, aluminum, iron, magnesium, potassium, and sodium, and celestine was used for sulphur and strontium, manganite for manganese, arsenolite for arsenic, synthetic lead oxide for lead, scapolite for chlorine, and baryte for barium. The data were corrected for background, absorption, backscatter, and fluorescence using a computer program. Chlorine, sulphur, lead, manganese, barium, and arsenic are all absent in all samples or present only as traces. A microprobe scan of the holotype dehrnite failed to indicate the presence of any cations other than those reported.

TABLE I

	Dehrnite					Lewistonite			Carbonate-fluorapatite
	Larsen (1930)		H-92844	H-95485	NMNH R5590	Larsen (1930)		Present study	Sandell *et al.* (1939)
	Dehrn	Utah	Dehrn	Utah	Dehrn	Utah	Utah	Utah†	England
CaO	50·88	47·7	54·74	53·12	53·06	41·41	46·78	52·11–55·13	53·94
MgO	n.d.	0·8	0·10	0·16	0·12	7·10	n.d.	0·05–0·41	0·10
FeO*	n.d.	n.d.	0·00	0·00	0·00	n.d.	n.d.	0·04–0·11	—
K_2O	1·20	5·9	0·00	0·00	0·00	3·71	1·36	0·00–0·00	—
Na_2O	7·11	4·4	0·08	0·37	0·10	0·47	4·34	0·02–0·51	—
P_2O_5	37·12	35·7	37·15	36·92	35·02	32·31	37·92	38·79–41·83	38·13
F	none	—	4·02	3·50	3·20	n.d.	n.d.	2·95–3·87	3·71
CO_2	1·49	3·3	—	—	—	n.d.	n.d.	—	3·40
H_2O	1·68	1·9	—	—	—	8·60	7·69	—	0·47
Insol.	0·12	—	—	—	—	0·60	0·00	—	2·27
Al_2O_3	tr.	1·0	0·00	0·00	0·00	3·67	2·53	—	—
SiO_2	—	—	—	—	—	1·12	—	—	—

* Total iron calculated as FeO.

† Range of composition for seven samples and no. H-95495.

Accuracy of data in present study = ±2% of the amount present.

The partial analyses, together with those given in the literature, are presented as Table I. There is very little similarity in the new and old data. Most significant is the almost complete absence of sodium and potassium in the new analyses! Since these are the very elements that were used to justify species status for lewistonite and dehrnite, this gross discrepancy prompted re-examination of the *analysed powders* of Larsen and Shannon's dehrnite specimens. Analysis of thirty-five crystals in the analysed powder (no. H-92844) did not reveal the presence of either sodium or potassium. The analysis of the type specimen conformed to the analysis given in Table I for the analysed powder (no. H-92844). Similarly, no sodium or potassium was found in the analysed powder for the Utah dehrnite (no. H-95485).

Given Larsen and Shannon's admission that the analysed material 'contained a few per cent impurities mostly the phosphorite rock' [*sic*] (1930*a*), the phosphorite matrix of the holotype specimen was also analysed, as was also the phosphorite matrix for the Smithsonian dehrnite (NMNH no. R5590). Within the phosphorite rock, and in close proximity to the dehrnite, is an altered mica containing about 9% K_2O. Hence, it is likely that this mica may be the source of the reported potassium. Sodium was not found in any of the dehrnite or in the phosphorite rock, nor in any of the seven topotype Utah lewistonite specimens studied herein, in amounts greater than 0·51% Na_2O.

The presence of carbonate, CO_3, was indicated by Larsen and Shannon (1930*a*). The samples of dehrnite studied herein did effervesce in hydrochloric acid and were first tested, by microprobe, for the presence of calcite, with negative results. The sodium reported in the initial description of dehrnite remains unexplained, in spite of diligent attempts to ascertain the source of possible error.

X-ray diffraction patterns of both dehrnite (no. H-92844 and NMNH no. R5590) and a number of topotype lewistonites in the Smithsonian collections are all extremely similar and match the diffraction pattern for synthetic fluorapatite. Fluorapatite and fluorapatite with small amounts of carbonate are indistinguishable on the basis of X-ray powder photographs. Lewistonite is known only from the Fairfield, Utah, locality, but dehrnite was reported, on the basis of X-ray diffraction, from globigerina ooze from Sylvania Guyot, near the Bikini Atoll, Marshall Islands, in the Pacific Ocean, by Hamilton and Rex (1959). However, this occurrence of dehrnite was based on X-ray diffraction data published by McConnell (1938), which is irrelevant since the patterns of holotype dehrnite and fluorapatite are indistinguishable from each other. The Sylvania Guyot material was not analysed.

Hence, dehrnite is a carbonate-fluorapatite containing no appreciable sodium or potassium.

An examination of the apatite mineral labelled *englishite-analysed* and seven topotype 'lewistonites' indicates that they, too, are carbonate-apatite containing no appreciable sodium or potassium. The compositional range for these specimens (Table I), coupled with the herein demonstrated inaccuracy of the dehrnite analyses done at the same time and presumably using the same methodology, and the unlikeliness of an apatite with 3·71 % K_2O or 4·34% Na_2O, indicates the extremely strong assumption that lewistonite, like dehrnite, is an invalid species. It is with sincere regret that the work of Larsen and Shannon, who did so much to increase our awareness of the mineralogy of the Utah variscite deposits, is partially discredited.

IMA Commission on New Minerals and Mineral Names—decisions. The foregoing data were presented to the IMA Commission in 1977. It was the decision of the members to accept the specimen (no. H-95495) labelled *englishite-analysed* as the type lewistonite. The Commission members further voted (18-0) to accept the herein given proposal and to formally discredit both lewistonite and dehrnite.

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Hydrothermal nickelian mackinawite in nickel mineralization at Wadi Qatan, Saudi Arabia

NICKELIAN mackinawite is a common alteration product in nickel sulphide ores (Uytenbogaardt and Burke, 1971), but its association with alabandine is unusual. This communication reports the occurrence of nickelian mackinawite associated with pentlandite and alabandine and discusses a possible mechanism for its formation.

At Wadi Qatan, a lens of fine-grained, pyrrhotine-pentlandite and pyrite-pentlandite mineralization lies conformably within a sequence of metamorphosed basaltic and andesitic rocks, intruded by granite and diorite. Field and textural evidence indicate that the pyrrhotine is probably derived from pre-existing pyrite by contact metamorphism, and that much of the pyrrhotine so formed has been locally re-pyritized (Blain, 1978). The resultant assemblages consist of pyrite or pyrrhotine with pentlandite and minor amounts of chalcopyrite, cubanite, alabandine, and molybdenite. Nickelian mackinawite, as an alteration product, has two modes of occurrence: pentlandite → nickelian mackinawite + carbonate, and alabandine → nickelian mackinawite + carbonate. All stages of alteration from incipient (fig. 1*a*) to partial (fig. 1*c*) and total (fig. 1*b*) replacement are present. The nickelian mackinawite, derived from both pentlandite and alabandine, consists of a delicately interwoven, fibrous mat of crystals. It is generally porous in appearance, indicating a volume reduction in the reaction. The associated carbonate minerals form in discrete clusters and are generally less abundant than the mackinawite. In