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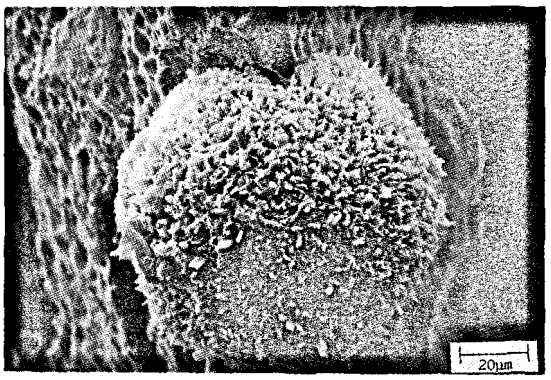
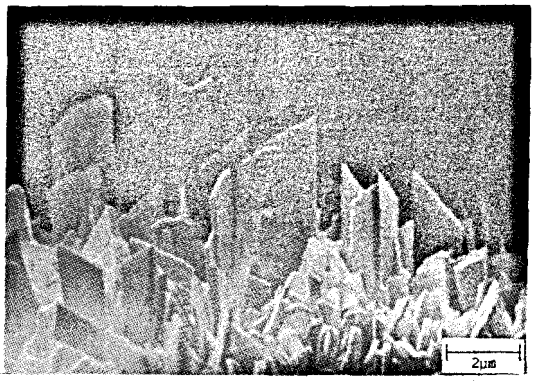
A second occurrence of mahlmoodite, from Cornwall, England

MAHLMOODITE, $FeZr(PO_4)_2{\cdot}4H_2O$, is a rare mineral, hitherto known only from its type locality, the Union Carbide Vanadium mine, Wilson Springs, Garland County, Arkansas, USA. Although illustrated, and correctly formulated by Hey *et al.* (1982) as a new Fe–Zr–Sc phosphate, it has only recently been formally described and named (Milton *et al.*, 1993). Mahlmoodite is very scarce at Wilson Springs and occurs as tiny cream spherules in vugs in vanadium ore. Hey *et al.* (1982) illustrate mahlmoodite spherules on crystals of kolbeckite; more commonly they occur on crystals of sodic pyroxene.

Mahlmoodite has now been identified on a number of specimens from a coastal exposure of Zn-Fe mineralization at Kerriack Cove, between Porthtowan and Portreath, near Redruth, Cornwall, England (NGR SW678470).

Kerriack Cove is situated in Devonian sandstones and slates of the Falmouth and Portscatho series. At the northern end of the cove, an E–W lode bearing quartz, sphalerite, chalcopyrite and galena was worked, principally for zinc, as part of the Wheal Lushington sett (Dines, 1956; Dewey, 1921). Towards the middle of the cove, an E–W trending mineralized fissure vein crops out in a shelf of rock at the base of the cliff. This vein, up to 4 cm wide, carries mainly sphalerite, pyrite, green chlorite and quartz, with minor galena and chalcopyrite, and





FIGS. 1 and 2. FIG. 1 (*left*) A spherule of mahlmoodite on sphalerite from Kerriack Cove, Cornwall. FIG. 2. (*right*). The surface of a mahlmoodite spherule from Kerriack Cove, Cornwall, showing the lath-like habit of individual crystals.

contains numerous small vugs. Samples of vein material were collected on two visits in 1992 and found to contain occasional cream-brown spherules. Energy dispersive X-ray analysis showed these spherules to be an iron zirconium phosphate which at the time matched no known mineral. Following the description of mahlmoodite by Milton *et al.* (1993), the specimens from Kerriack Cove were re-examined and X-ray diffraction data obtained using a Debye-Scherrer camera (NHM X-ray film no. 9512F). The *d*-spacings of the Kerriack Cove mineral are in excellent agreement with the published spacings for mahlmoodite. However, the line intensities agree less well. Milton *et al.* (1993) collected their data using a Gandolfi camera and the discrepancy in line intensities may be attributed to the difference in XRD technique (J.G. Francis, pers. comm.).

Mahlmoodite from Kerriack Cove occurs as tiny compact spherules up to 0.15 mm in diameter (Fig. 1). The natural colour appears to be creamy-white, but many are brownish due to iron staining. Rarely, the spherules have a looser structure, enabling the morphology of individual crystals to be seen more clearly. The crystals are lath-like, sometimes in short stacks, with various terminations as shown in Fig. 2. Spherules from Wilson Springs usually contained a core of loose material, but this is not the case with the Kerriack Cove samples.

When broken, spherules commonly show a concentric banded structure. Semi-quantitative energy dispersive X-ray analysis shows minor compositional variations from band to band. The core contains significant Al, Si, Sc and Ti, all of which decrease in concentration towards the rim; the core also contains traces of Mn and K. Calcium and magnesium occur throughout the spherule, but at higher levels towards the rim. Zinc is largely absent from the core, but present in the outer zones.

At Wilson Springs, mahlmoodite appears to be the last mineral deposited in the vugs in which it occurs (Milton *et al.*, 1993) and this is also true of the Kerriack Cove specimens. The principal constituents of the mineralized veins at Kerriack Cove appear to be largely contemporaneous in origin. In a few examples, pyrite, which always occurs as pyritohedra, is found on sphalerite, and may be last formed of the sulphides.

Mahlmoodite may be found on any surface, but seems to be more commonly associated with sphalerite. It is always scarce and may easily be overlooked. On a few specimens, mahlmoodite is associated with minute tabular crystals of anatase.

Specimens of mahlmoodite from Kerriack Cove have been deposited at the Natural History Museum, London, and the Smithsonian Institution, Washington, DC.

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