MINERALOGICAL NOTE

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Metavoltine from Cockermouth, Cumbria

METAVOLTINE ($K_2Na_6Fe^{+2}Fe_6^{+3}(SO_4)_{12}O_2 \cdot 18H_2O$) is an uncommon mineral which has been reported from a number of associations. Originally described from Madeni Zakh, Persia, now Iran, where it is associated with voltaite and botryogen as an alteration product of pyritic trachyte (Blaas, 1883) it has been recorded as a member of supergene sulphate assemblages associated with sulphide ore deposits at Chuquicamata and elsewhere in Chile (e.g. Gordon, 1940; Scordari *et al.*, 1975 and Giacovazzo *et al.*, 1976) and from the Cetine antimony deposit, Tuscany, Italy (Sabelli and Brizzi, 1984). Van Tassel (1961) described metavoltine from Coal Measures shales in the Hainaut Basin, Belgium and Bud'Ko (1965) noted its presence in part of the Zaunguzsk Sandstone of the Karakum region of Kazakhstan. Foshag (1931) reported metavoltine as a member of a mixed sulphate assemblage in a lenticular body beneath the borate deposits at Borate, San Bernardino County, California. It has also been recorded as a fumarole product at Vesuvius (Zambonini and Carobbi, 1925) and Tristan de Cunha (Baker *et al.*, 1964). The first British occurrence was reported by Ryback and Tandy (1992) from Wheal Edward, Cornwall.

Metavoltine has recently been identified (XE 700)* as a supergene mineral encrusting weathered surfaces of sandstone in Brigham Quarries, Cockermouth, Cumbria [NY 0830 3020]. These quarries were worked in the last century for building stone from the Hensingham Grit, the lowest thick sandstone unit of the local Namurian sequence (Eastwood, 1930). Approximately 6 m of medium to coarse-grained pale grey to white thickly-bedded sub-arkosic sandstone are exposed in the abandoned and partly overgrown faces.

On the westernmost face metavoltine is locally abundant. It occurs as patchy, vivid yellow efflorescent crusts coating areas up to 1.5 m across of the lowest two sandstone beds exposed in the quarry. Individual crusts, which are up to 10 cm across and 0.5 mm thick, consist of rounded aggregates up to 1 mm across composed of minute platy crystals (Figs. 1 and 2). The two sandstone beds are separated by a 25 mm thick dark grey carbonaceous mudstone parting. In places small patches of metavoltine encrust this parting, or are concentrated on the sandstone within 10 cm above or below this level.

Oxidation of pyrite within the mudstone parting together with diffusion of sulphate-rich fluids through the surface layers of the adjacent very porous sandstone have almost certainly provided the source of the metavoltine. Since the closure of

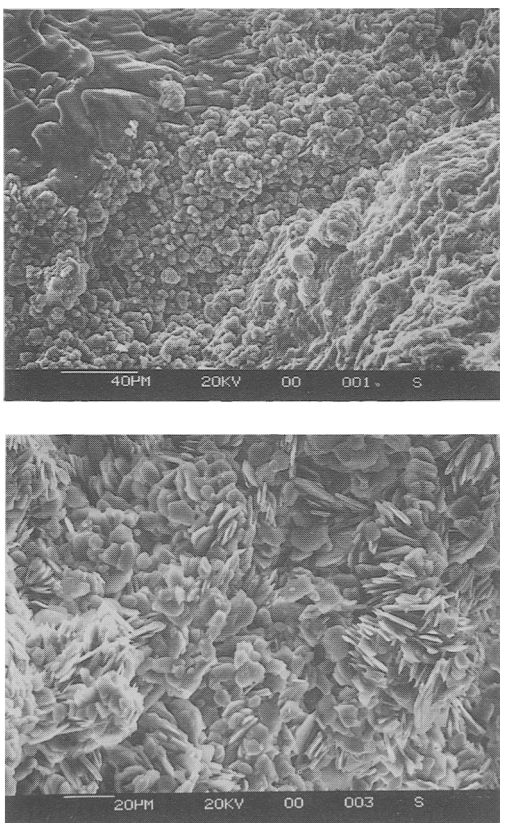

FIG. 1. (*top*). SEM micrograph showing rounded aggregates of platy crystals of metavoltine coating quartz grains in sandstone. Fig. 2 (*bottom*). SEM micrograph showing aggregates of platy crystals of metavoltine.

* BGS X-ray number.

these quarries, the western face was buried for many years beneath dumped quarry waste. The present owner of the site removed this material re-exposing the face within the last few years. The metavoltine crusts appear to have developed within this period.

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