

The occurrence of scarbroite at Muskiki Lake, Saskatchewan, Canada

SCARBROITE ($\text{Al}_{14}(\text{CO}_3)_3(\text{OH})_{36}$) was described by Vernon (1829) and Duffin and Goodyear (1957, 1960) as a soft, white, fine-grained material associated with quartz, gibbsite, kaolinite, and calcite, in vertical fissures in a sandstone at Scarborough, Yorkshire, England. Recently, scarbroite was identified in the clay-sized fraction ($< 2.0 \mu\text{m}$) of near-shore Muskiki Lake sediments, a paragenesis significantly different from previously reported occurrences.

Muskiki Lake is a relatively large (11.3 km^2) sodium-magnesium-sulphate-rich hypersaline lake, about 85 km ENE of Saskatoon, Saskatchewan, Canada. During the summer of 1981, the lake was at a low level, with brine concentrated in three sub-basins. Grab samples of the top 10 cm of non- evaporite lake bottom sediments from the southern sub-basin were collected at 300 m intervals. In addition, samples were collected at 20 cm intervals in a trench dug on the dry lake shore.

Experimental. The samples were washed with distilled water to remove the soluble salts; all wash water was retained for analysis. The coarse fraction ($> 62 \mu\text{m}$) was removed by wet sieving the dispersed (with sodium hexametaphosphate) insoluble sediments. Various silt- ($62\text{--}2 \mu\text{m}$) and clay-sized ($< 2 \mu\text{m}$) fractions were isolated using standard settling techniques. Oriented samples were prepared for the clay fractions by allowing several drops of aqueous clay suspension to settle and dry on glass slides. Rapid drying minimized differential grain-size settling. Samples were identified on a Philips Automated Powder Diffraction System PW1710 using monochromatic $\text{Cu-K}\alpha_1$ radiation. Prepared standards were used to estimate mineral percentages. Full laboratory procedures and complete study results appear in Egan (1984).

Results. Scarbroite occurs in the dry near-shore surface (0–10 cm) sediments of Muskiki Lake, in association with illite, kaolinite, smectite, chlorite, huntite, feldspars, and quartz. Traces of dolomite, calcite, carbonate-apatite, and goethite are also present in the sediments. Scarbroite is not present in the deeper sediments (10–100 cm). Brine-soaked near-shore sediments contain only minor amounts of scarbroite. These sediments are predominantly illite and mixed-layer illite-smectite with kaolinite, smectite, chlorite, and traces of dolomite, huntite, quartz, and carbonate-apatite. Scarbroite does not occur in the brine-saturated lake sediments which consist of illite, mixed-layer illite-smectite, kaolinite, and huntite, with minor smectite, chlorite, halloysite, and traces of dolomite, calcite, feldspars, quartz, and carbonate-apatite. Diaspore, jarosite, nordstrandite, and dawsonite occur in the $< 0.25 \mu\text{m}$ fraction of the brine-saturated sediments. Scarbroite seems to be an authigenic product resulting from dessication of Muskiki Lake bottom sediments.

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Wulfenite from Tÿ Coch, Glamorgan (Powys), South Wales

AN interesting suite of rare lead vanadate minerals in manganese ore from an old manganese mine at Tÿ Coch farm, near Porthcawl, Glamorgan (now part of Powys) has been described by Criddle and Symes (1977). The list of lead minerals and elements from this mine has now been extended by a find of the molybdate wulfenite, which is an uncommon mineral in the British Isles.

The wulfenite was found on fracture surfaces within one small boulder of a hard massive fine-grained compact manganese ore with baryte and calcite lenticles similar to that described by Criddle and Symes (1977) as the matrix of pyrobelonite and vanadinite, neither of which have been detected on the wulfenite specimen.

The Tÿ Coch wulfenite forms crystals of bevelled rectangular platy habit, often in complex shapes from parallel growth, mostly projecting from the matrix surface at steep angles. The crystals vary in colour from orange through yellow to greyish-white over short distances, and reach a maximum size of about $3 \times 3 \times 0.5 \text{ mm}$, although most crystals are about 1–2 mm across. Directly associated with the wulfenite are colourless rhombs of calcite (identity confirmed by infra-red spectroscopy).

A sample of the Tÿ Coch wulfenite gave an infra-red spectrum (in 'Nujol' mull, measured from 400–4000 cm^{-1}) similar to those of authentic specimens from Bleiberg, Carinthia, Austria, with ν_3 (MoO_4 asymmetrical stretch) maximum absorption at 778 cm^{-1} , and on heating a powdered sample to dryness with concentrated hydrochloric acid a deep blue residue ('molybdenum blue') characteristic of molybdates was obtained. The analogous tungstate, stolzite, which gives a similar infra-red spectrum, leaves a yellow residue containing tungstic oxide under these conditions.

Molybdenum was not detected in the analyses of the Ty Coch lead vanadates reported by Criddle and Symes (1977). Small amounts of molybdenum and vanadium are not uncommonly found with manganese oxide ores, wulfenite, for example, being well known from the manganese oxide pods in the Mendip limestone (Greg and Lettsom, 1858; Spencer and Mountain, 1923; Alabaster, 1976, 1978; Symes and Embrey, 1977; Eastwood, 1983).

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