MINERALOGICAL NOTES

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Birnessite from Gourock, Renfrewshire, Scotland

ORIGINALLY discovered at Birness in Aberdeenshire (Jones and Milne, 1956), birnessite has subsequently been identified at two other localities in Scotland: in exhalative sediments in Peebleshire (Nicholson, 1983) and in the cement of a raised beach deposit in Wigtownshire (Nicholson, 1988). This note records the discovery of a fourth Scottish locality for birnessite.

The mineral occurs in Craigmuschat Quarry, Gourock, as obvious coatings along joint planes and fractures within a trachyte sill. Coatings composed only of the manganese oxide are usually less than one millimetre thick; however, birnessite also occurs as a minor component in iron oxide coatings which attain a maximum thickness of 10 mm. These are composed principally of hematite, but also include goethite, minor baryte and rare calcite. The blue–black to black colour of birnessite makes this mineral quite distinct against the red–bluish hues of the iron oxides. The mineral was analysed by X-ray powder diffraction (XRD) using Co-$K\alpha$ radiation with a scan speed of 1° 2θ/min, and identified by the JCPDS Mineral Powder Diffraction File. The diffraction pattern of the Gourock birnessite is in very good agreement with that of JCPDS PDF card 23-1046, usually within ± 0.01 Å, permitting confident identification. The only divergence between the two patterns is the principal 7 Å line (7.13 Å for Gourock birnessite, compared with 7.09 Å for JCPDS PDF card 23-1046). This is not unusual: Burns and Burns (1977) have discussed the problem of birnessite identification, and show that the characteristic dominant *d*-lines of the mineral vary from 7.0–7.2 Å and 3.5–3.6 Å. Representative specimens have been placed in the mineralogical collection of the Hunterian Museum, Glasgow.

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Birnessite from Treburland Mine, Altarnun, Cornwall

BIRNESSITE was first recognized as a new mineral species in a manganese-oxide-rich pan in fluvio-glacial sand and gravel at Birness, Aberdeenshire, by Jones and Milne (1956). Since then the mineral has been reported as a member of the manganese oxide assemblage in a number of geological environments in localities around the world. Birnessite has been most commonly recorded as a constituent of oceanic manganese oxide nodules (e.g. Crerar and Barnes, 1974; Scott *et al.*, 1974; Cann *et al.*, 1977; Schrader *et al.*, 1980; Sorem and Fewkes, 1980; Glover, 1977) though other parageneses included fluvio-glacial sediments in Finland (Koljonen *et al.*, 1976), soils in Indiana (Ross *et al.*, 1976) and as an oxidation product of manganese carbonates and silicates in Korea and France (Kim, 1974; Perseil *et al.*, 1974). Birnessite has recently been reported from three further Scottish localities; in exhalative sediments in Peebleshire (Nicholson, 1983) in a raised beach deposit in Wigtownshire (Nicholson, in press) and in fractures in a sill in Renfrewshire (Nicholson, this volume). The mineral has not previously been recorded from England.

Birnessite has recently been identified (X8523)* in specimens collected from the small amount of dump material remaining at the Treburland Manganese Mine, Altarnun, Cornwall [SX 237 795]. Here the mineral forms hard, black, glossy, rather brittle massive crusts up to 10 mm thick which surround masses of medium to coarsely crystalline rhodonite and tephroite. Earthy black pyrolusite commonly coats the surface of the birnessite. Pyrolusite was the main ore worked at this small mine,

* BGS X-ray.

where it occurred as large masses apparently formed by oxidation of rhodonite and tephroite, both of which commonly occur as unaltered cores in the pyrolusite (Russell, 1946). In describing the large variety of manganese and other minerals at this locality Russell (*op. cit.*, p. 225) commented that some of the pyrolusite occurred in a black shining form. It is likely that at least some of this material may be the mineral now identified as birnessite.

There is no doubt that the birnessite at Treburland occurs as an oxidation product of the primary manganese silicates. Birnessite has previously been described as an early oxidation product of manganese carbonates at Janggun Mine, Korea (Kim, 1974) and as an alteration product of rhodochrosite and rhodonite in quartz veins at Gouax de Larboust Hautes Pyrenées, Hautes Garonne, and Ariege, France (Perseil *et al.*, 1974).

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A note on occurrence and optical orientation of brewsterite

GREG and Lettsom (1858) note that brewsterite occurs in cavities of amygdaloidal rocks at the Giant's Causeway but it has not been found by any subsequent workers. A search of the Ulster Museum mineral collection revealed the following five specimens which, on the basis of their morphology, could be the brewsterites of N.E. Ireland.

1 'Brewsterite', Mourne Mtns, I1574
2 'Thomsonite', Moneymore, I8662
3 'Crystallized zeolithe', Giant's Causeway, I3179
4 'Epistilbite with aluminite', Co. Antrim, I1524
5 'Primitive stilbite', Giant's Causeway, I1520

The first specimen is a gneissose granitic rock, 7 × 5 × 4 cm in size. It is covered with stumpy prisms of a pale citrine-coloured mineral which matches the description of the Strontian brewsterite and without doubt is wrongly labelled. The rest of the specimens have a basaltic matrix and there is no reason to doubt that they are Irish. Optical examination revealed that these specimens contain thomsonite (no. 2) and stellerite (nos. 3, 4, 5). Stellerite has flat terminations, compared with the pyramidal appearance of stilbite. The two minerals can be differentiated by single crystal X-ray diffraction and chemical analysis, but optical distinction is not so easy, as both minerals are biaxial (−) and length-fast with X: a = 0–5°. Epistilbite is also supposed to be biaxial (−) but is length-slow. Thomsonite and brewsterite are biaxial (+) but brewsterite differs from it in having inclined extinction. It is concluded therefore that the occurrence of brewsterite

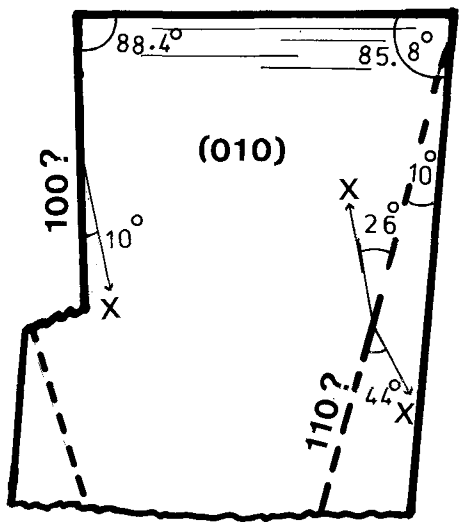

FIG. 1. Optical relations in growth sectors of brewsterite as seen in its (010) cleavage flakes. The trace of the optic plane and the fast vibration direction are shown by arrows. Growth zonation marks are indicated by horizontal lines and sector boundaries (twin planes?) by dashed lines.