MINERALOGICAL NOTE

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Bottinoite, a mineral new to Britain

BOTTINOITE, $Ni(H_2O)_6[Sb(OH)_6]_2$, is a new mineral described by Bonazzi *et al.* (1992) as an alteration product of ullmannite at the Bottino mine, Alpi Apuane, Tuscany, Italy. The tabular or short prismatic crystals were reported as light-blue rose-like aggregates associated with ullmannite, siderite, calcite, quartz, phlogopite, pyrite, and chalcopyrite. Bonazzi *et al.* observed that bottinoite closely resembles the synthetic compound prepared by Beintema (1936).

The mineral can now be reported from three localities in the British Isles: (*a*) Brownley Hill mine, Nenthead, Cumbria, England; (*b*) Hendre Felen mine, Ysbyty Ystwyth, Dyfed, Wales; and (*c*) Mynydd Gorddu mine, Bont gôch, Ceulanymaesmawr, Dyfed, Wales. In all these occurrences bottinoite has been confirmed by X-ray powder diffraction photographs. The association with ullmannite is common to all known occurrences of the mineral.

Brownley Hill mine (Grid ref. NY 778447). The mineral was found underground in a minor vein called Tatters String that was worked in the Great Limestone (Carboniferous), between the Brownley Hill and Brownley Hill North veins. Around ten specimens were collected in late 1982 by S. A. Rust and M. Weller. Bottinoite occurred in a single cylindrical cavity over 1 m long and 15 cm in diameter, parallel to the course of the vein, in a north-east stope face 1.25 m above a rubble backfilled floor. The cavity was lined with colourless to white pyramidal quartz; intergrown cubo-octahedral galena was concentrated at the base of the cavity with minor creamy to dark brown dolomite crystals and occasional calcite. Some areas of the galena were lightly coated with pyrite and some tiny modified cubic metallic grey crystals; the latter are almost certainly ullmannite. Bottinoite was observed as light blue spherulitic aggregates up to 3 mm in diameter on the galena, with white acicular cerussite and scattered rounded yellow-green crystals of native sulphur up to 0.5 mm in diameter. Minor amounts of hydrozincite were also noted on or near masses of sphalerite; bournonite has also been confirmed from the same vein.

Two specimens of bottinoite on galena are incorporated in the Natural History Museum mineral collection under the numbers B.M. 1992, 451–452. The larger of these is apparently richer in bottinoite than material reported from the type locality by Bonazzi *et al.*, 1992. Several fragments from these specimens were analysed using a Microscan IX electron probe microanalyser; pure metal standards were used for the determination of Ni, Sb and As, and analysed wollastonite for Si. The accelerating potential was 20 kV. The oxide weight percentages obtained after on-line correction of the measured intensities are shown in Table 1 (column 1), together with the Ni and Sb values determined by Bonazzi *et al.* (1992) for the type material and the calculated composition of $Ni(H_2O)_6[Sb(OH)_6]_2$.

The composition of the Brownley Hill bottinoite is close to that of the type material but shows the same high cation total relative to

TABLE 1. Analyses of bottinoite (wt.%)

	1	2	3
NiO	15.92	15.19	12.16
Sb_2O_5	69.12	62.60	52.65
As_2O_5	0.53	-	-
SiO_2	0.31	-	-
H_2O	-	-	35.19
Total			100.00

1. Brownley Hill, Nenthead, Cumbria.
   Mean of 4 analyses:
   range NiO 14.92-16.66 wt.%;
   Sb_2O_5 62.29-75.69 wt.%.

2. Bottino mine, Alpi Apuane, Tuscany, Italy.

3. Theory for $Ni(H_2O)_6[Sb(OH)_6]_2$.

synthetic material. Bonazzi *et al.* (1992) ascribed this to dehydration under the electron beam.

Hendre Felen mine (Grid ref. SN 720695). Bottinoite was found on the surface, in two areas from the most south-westerly dump of the long disused lead trial. The material was collected in 1989 by S. A. Rust, and around 60 specimens are known to exist. It occurred in a veinstuff of brecciated mudstone-sandstone cemented by vughy quartz, with cavities up to 1 cm in diameter. Disseminated primary minerals of chalcopyrite, ullmannite, galena and calcite occasionally formed euhedral crystals within the quartz cavities. Crystal aggregates of bottinoite were seen to be nucleated around cubic crystals of ullmannite up to 3 mm in size. On one specimen the bottinoite had grown on bindheimite-replaced ullmannite crystals. Mimetite, caledonite and susannite have also been confirmed from this mine dump.

Four micromount specimens of bottinoite from this locality are registered in the NHM collection as B.M. 1992, 453–454. Electron probe microanalysis of several fragments of this material showed similar Ni : Sb ratios to the other bottinoite occurrences, and there was a good match between the respective X-ray powder difraction patterns.

Mynydd Gorddu mine, Bont gôch, Ceulaymaesmawr, Dyfed, Wales (Grid ref. SN 668861). Three specimens were collected by S. A. Rust in late 1992; one specimen in the NHM collection is registered as B.M. 1992, 455. In this specimen, bottinoite is seen to encrust cleavage planes on small masses of ullmannite enclosed in quartz, with chalcopyrite and galena. Other supergene species noted were cerussite, chrysocolla, malachite, pyromorphite, hemimorphite, bindheimite and wulfenite.

References

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