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Wickmanite from Whealcock Zawn, Botallack, Cornwall

The rare mineral wickmanite, $Mn^{2+}Sn^{4+}(OH)_6$, was first described from Långban, Sweden (Moore and Smith, 1967), where it occurs as brown to honey yellow octahedra up to 2 mm in size in pockets in magnetite ore and in a brecciated jacobsite–richterite–manganophyllite skarn. It was later found in a nepheline-syenite pegmatite at Tvedalen, Norway (Amli and Griffin, 1972), associated with leadhillite and hydrocerussite; at Pitkaranta, Karelia, USSR (Nefodov *et al.*, 1977), in a hydrothermally mineralised skarn; and at Llallagua, Bolivia (Kampf, 1982), where it occurs in pockets in stannite. It has now been found at Whealcock Zawn, Botallack, Cornwall, the first recorded occurrence in the UK, having been confirmed at the British Museum (Natural History) by means of X-ray powder diffraction (film no. 5452F).

At Whealcock Zawn the wickmanite occurs as orange-yellow octahedra, up to 1 mm on edge, showing parallel growth. The wickmanite is found in small cavities in a large axinite pod in a discordant calc-silicate body (Alderton and Jackson, 1978) exposed on the south side of Whealcock Zawn (SW 363 340) which is within the metamorphic aureole of the Lands End granite.

The associated minerals include abundant massive and more rarely euhedral grossular, coarsely bladed dark green pargasite, white prisms of apatite to 50 mm, small white rosettes of titanite, rare pinkish crystals of orthoclase (variety adularia), minor chalcopyrite which is locally altered to botallackite (Barstow, pers. comm.), and an unidentified cobalt-bearing mineral.

It is interesting to note that the locality has also produced crystals of the rare tin silicate stokesite (Couper and Barstow, 1977; Couper and Clark, 1977) and may indeed be the type locality for that mineral.

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Cinnabar from the northern Pennines, England

The first record of British cinnabar is that of Braithwaite *et al.* (1963) who described the mineral from Rutland Cavern, Matlock Bath, Derbyshire. A. W. G. Kingsbury subsequently identified cinnabar from several places on Grassington Moor and Greenhow Hill where, in a few places, the other mercury minerals metacinnabarite, calomel, and native mercury were also found (Dunham and Wilson, 1985). Traces of cinnabar have been noted in pan concentrates of stream sediments from two tributaries of the River Clyde near Abington, Lanarkshire (Dawson *et al.*, 1979) and from streams near the Glendinning antimony deposit, Langholm, Dumfriesshire (Gallagher *et al.*, 1983). Cinnabar is described here as a rare supergene mineral from six localities in the Northern Pennines.

The minerals were identified by X-ray diffraction in the Department of Geology, University of Sheffield.

Coldstones Quarry, Pateley Bridge, North Yorkshire [SE 123 641]. The southern face of this quarry exposes the Garnet Vein (Dunham and Wilson, 1985, p. 209), which here is up to 2 m wide and composed mainly of fluorite, baryte, and calcite with small amounts of galena. Supergene minerals include hemimorphite, smithsonite and traces of aurichalcite and rosasite (D. Green, pers. comm.). In places, irregular cavities lined with smithsonite, hemimorphite, and calcite appear to represent original pockets of primary minerals, probably mainly sphalerite. Cinnabar occurs within these cavities as bright orange-red earthy coatings on the other supergene minerals. Locally almost continuous crusts of cinnabar are up to 20 mm across, though most commonly the mineral forms separate masses, 1 mm across. In a few instances cinnabar is overgrown by crusts of clear colourless calcite.

Friarfold–Surrender and Old Rake Veins, Swaledale, North Yorkshire. These veins are prominent members of the group which comprise the North Swaledale Mineral Belt. Both veins carry galena with a little sphalerite and locally traces of chalcopyrite in a gangue of baryte, fluorite, witherite, and rare strontianite. Large dumps of veinstone derived from extensive underground workings remain along the outcrop of the veins. Cinnabar has been identified in samples of oxidised veinstone collected from the dumps of three of these workings: Bunton (or Bunting) Level, Gunnerside Gill [NY 9403 0121], old shallow workings on the outcrop of Friarfold Vein at the head of Flincher Gill [NY 9587 0219] and the Brandy Bottle Incline, also in Flincher Gill [NY 9600 0200]. At each of these localities cinnabar is present as thin orange-red to brownish-red earthy coatings up to 2 mm across lining cavities in pockets of cellular smithsonite or baryte. Associated supergene minerals include hemimorphite and aurichacite (Young, 1987).

Natrass Mines, Alston, Cumbria [NY 7346 4484]. The dump from Nattrass Level, which gave access to workings in Nattrass Old, Millican's and Nattrass Redgroves Veins, contains appreciable quantities of brown cellular 'dry bone' smithsonite. Cinnabar has been found in a few blocks of this as bright orange-red earthy patches, 0.5 mm across coating cavities in smithsonite.

Silver Top Quarry, Hallbankgate, Brampton, Cumbria [NY 5860 6068]. The Four Fathom Limestone exposed in this disused quarry shows abundant mineralization, both as fillings of joints and minor faults and as patchy replacements of the adjacent limestone. The mineralised fissures trend both N–S and E–W, though the latter appear to be the most abundantly mineralized. Fissure fillings are up to 0.5 mm wide. The commonest introduced mineral is baryte which occurs mainly as white to pale pink and buff banded, compact, fine-grained, crystalline, nodular masses which resemble the 'cawk' variety of the Derbyshire Pennines. Rare specks of galena up to 1 mm across occur locally in this baryte. Adjacent to these fissures, the limestone is commonly replaced for up to 1.5 m by dark brown earthy goethite and fine-grained crystalline calcite in which occur numerous pockets of baryte exactly similar to that of the fissures. Curved rhombic crystals, now pseudomorphed by goethite, presumably represent original siderite or ankerite though neither mineral has been identified in an unaltered state. In places scattered octahedral galena crystals up to 10 mm across form discontinuous bands in the goethite.

At the western end of the quarry the altered limestone commonly exhibits a cellular texture where it is composed of a mixture of fine-grained calcite, earthy 'limonite' and abundant 'dry bone' smithsonite. No unaltered sphalerite has been seen, though small masses of chalcopyrite (<2 mm) are present locally. Cavities up to 3 mm across within this altered rock are commonly filled with bright turquoise-blue aurichalcite. Cinnabar is locally common in this material as bright orange-red earthy masses and coatings filling, or partially filling, cavities up to 1 mm across. In many instances it encrusts bladed crystals of aurichalcite.

Discussion. At each of the localities described here, cinnabar encrusts minerals of undoubtedly secondary origin. It is thus late in the supergene paragenesis. At none of the localities has any evidence been found for cinnabar as a primary mineral. This is in contrast to the classification of Dunham and Wilson (1985, p. 106), where cinnabar is listed as a primary vein mineral.

The close association between cinnabar and supergene zinc minerals suggests that a small amount of mercury may have been present in the primary sphalerite and that this has become available to form cinnabar during oxidation. Unaltered sphalerite has not been found at the cinnabar localities described here and we have been unable to find any analyses of British sphalerites for mercury. However the presence of very small amounts of mercury within sphalerite has been noted by Palache *et al.* (1944).

At all of the localities described here, except Silver top Quarry, cinnabar is a minor secondary mineral in known veins within the richly mineralized Northern Pennine Orefield. The Silver Top occurrence is relatively remote even from the peripheral zones of the Northern Pennine fields, though its position close to the Stublick Fault line is intriguing. Baryte–galena mineralization has been reported from other sites along, or close to, the Stublick line in the Brampton area (Trotter and Hollingworth, 1932), and near Housesteads (G. A. L. Johnson, pers. comm.). The formerly important galena–witherite deposits of Settlingstones and Fallowfield near Haydon Bridge are also close to this structural line. It is thus possible that the Stublick Fault line may, at least locally, be associated with epigenetic mineralization. The formerly important deposits of the Haydon Bridge–Settlingstones–Fallowfield area may be structurally associated with this line.

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