Mynydd Nodol Mine

[SH 860 393]

Introduction

Ores of manganese have been worked in the Arenig district of North Wales since the 19th century (Dewey and Bromehead, 1915). In contrast to the extensive, bedded silicate-carbonate-dominated manganese ore deposits of the Harlech Dome, to the west (see Llyn Du Bach Complex GCR site report, this chapter), the Arenig ores are vein-hosted black oxides, the genesis of which is of relevance when considering the history of deep weathering and supergene mineralization in Tertiary Britain.

Little has been published regarding these mines. Dewey and Bromehead (1915) described the manganese ores as being hosted by 'a feldspathic ash, generally of a greenish-yellow colour', and that there were 'no true veins, but the ore fills joints and irregular fissures'. The ore was described as mainly consisting of psilomelane, with occasional pyrolusite, derived by leaching of the rocks and re-deposition by surface waters. The ore was said to contain in the range 43–54% manganese, the highest grades being obtained from 'kidney-ore'. The best ore was worth £11/ton in the late 1860s.

More recently, Lynas (1973), in an account of the geology of the Migneint district to the northwest of the Arenigs, described minor manganese mineralization occupying mainly N–S-orientated faults in yellowish tuff of the Aran Fawddy Formation of Ordovician (Caradoc) age. Significantly, X-ray diffraction of the 'psilomelane' present proved it in fact to be hollandite, a Ba-bearing Mn oxide. This represented the first record of hollandite in the British Isles.

The Mynydd Nodol Mine GCR site was selected not only because it is representative but also because small-scale quarrying has revealed a fine exposure of the manganese mineralization (Bevins and Mason, 1998).

Description

A number of slumped adit portals are scattered along the open hillside at Mynydd Nodol, along the outcrop of important manganese mineralization (Figure 5.93). This suggests that the deposits were extensively prospected although only worked to a limited extent. The exposure is visible from the minor unfenced mountain road running across the undulating moorland between Arenig Fawr and Llyn Celyn, as a buff patch on the hillside. Closer examination reveals that the tips from small trial workings have been partially removed, exposing the rocks below.

The exposure (Figure 5.94) reveals numerous strings of black manganese oxide cutting intensely bleached, yellowish to iron-stained reddish acidic tuffs of the Aran Fawddwy Formation, belonging to the Aran Volcanic Group of Ordovician age (British Geological Survey, 1993c), which range in thickness from less than 1 mm to several centimetres. These occupy not only minor N–S-orientated fractures, as described by Lynas (1973), but also joints and irregular cracks of variable orientations in the tuffs. Some of the mineralized fractures also contain the remnants of thin quartz veins. In hand specimen, the ore forms massive, botryoidal coatings to the fracture walls. In polished sections the finely banded nature of the manganese oxide botryoids is evident.

Interpretation

Banded, botryoidal manganese oxide ores occur at several sites within the Welsh Caledonides. For example, in the Central Wales Orefield, a trial on the Camdwr Fault at Drosgol [SN 762 882], over 450 m above sea-level, yielded small amounts of manganese ore (Bevins and Mason, 1997). The ore occurred in a high-level setting in a fracture more usually known for carrying base-metal sulphides in a quartz/ brecciated grey mudstone gangue. At Drosgol, as at Mynydd Nodol, extensive and pervasive bleaching and reddening of the mudstones is a striking feature. Similar mineralization occurs farther north, in iron trials near the Sygun Copper Mine [SH 604 483], where tuffs of the Lower Rhyolitic Tuff Formation, of Caradoc age, are intensely bleached and traversed by botryoidal goethite veinlets, and at Sychnant [SH 758 768],

where attractive botryoidal goethite has been collected (D. Jenkins, pers. comm.).

In both South and north-east Wales, oxide-facies Fe-Mn (+/– Cu, Pb, V, Co and Ni) mineralization is widespread in fractured and hematized Carboniferous strata. Examples in South Wales include T■-Coch (Criddle and Symes, 1977) and the Llanharry orefield (Rankin and Criddle, 1985), both of which, from evidence at the Ogmore Coast GCR site, were formed in pre-Jurassic times in a Triassic continental-arid environment. In North-east Wales, soft, nodular, botryoidal, complex oxides occur at Moel Hiraddug and are represented at the Great Orme Copper Mines GCR site by the 'Copper Dhu' ore.

The Carboniferous-hosted oxide mineralization, in both South and north-east Wales, is complex in mineralogical terms and additionally often has characteristics of epigenetic mineralization, with intergrown quartz, calcite and, in places, barite. The oxide deposits of the Welsh Caledonides, such as Mynydd Nodol, on the other hand, are simple impregnations of voids in severely bleached mudrocks and volcanics. The quartz occurring at Mynydd Nodol is interpreted as representing much older quartz veinlets, which are extremely common throughout the Arenig region (authors' unpublished data). The fact that manganese oxides are now present in the same fractures most probably represents re-activation of pre-existing weaknesses, perhaps with the spaces for oxide deposition having been created by the dissolution of metastable vein minerals such as calcite. In other examples seen at Mynydd Nodol, the oxide mineralization represents the impregnation of fault-gouge, although there is no evidence for contemporary tectonic movement in association with the manganese mineralization.

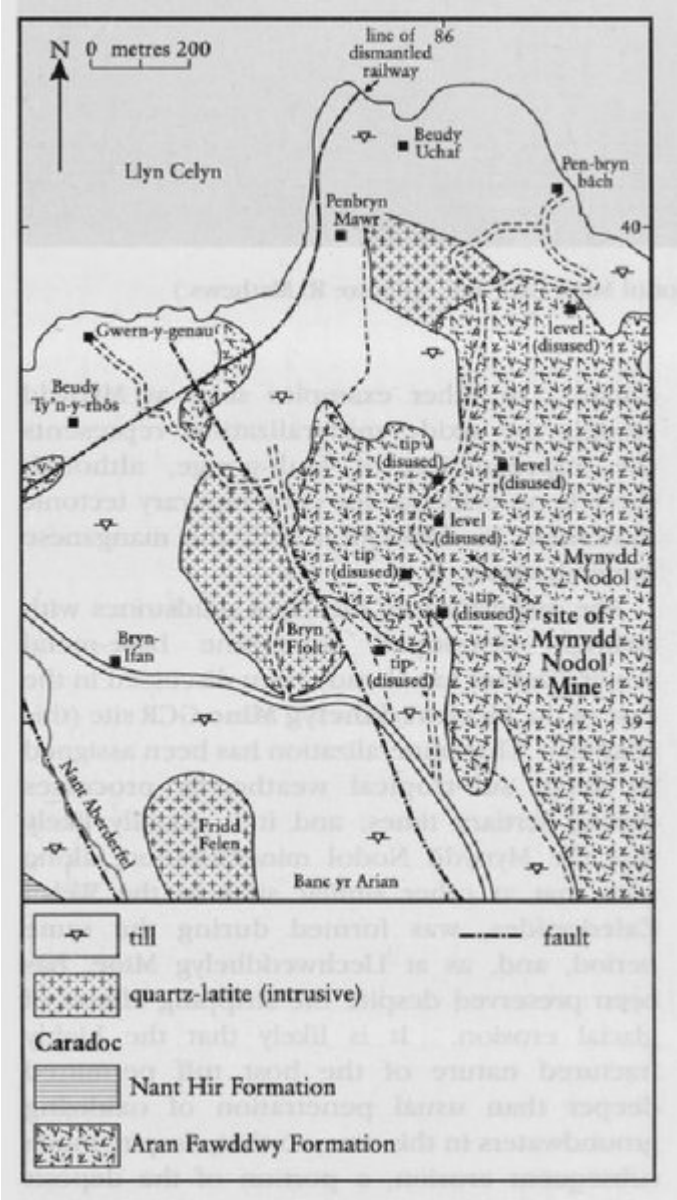
The association of bleached mudstones with strongly developed supergene base-metal mineralization has already been discussed in the case of the Llechweddhelyg Mine GCR site (this chapter). That mineralization has been assigned to deep, sub-tropical weathering processes during Tertiary times, and it is equally likely that the Mynydd Nodol mineralization, along with that at other similar sites in the Welsh Caledonides, was formed during the same period, and, as at Llechweddhelyg Mine, has been preserved despite the stripping effects of glacial erosion. It is likely that the highly fractured nature of the host tuff permitted deeper than usual penetration of oxidizing groundwaters in this area, so that, despite much subsequent erosion, a portion of the deposit remained.

The survival of just a small number of sites where severe bleaching and oxide mineralization is present bears testimony to the extent of erosion that occurred during the Pleistocene glaciations. These sites, typified by Mynydd Nodol Mine, therefore represent a rare example of what much of the surface exposure, especially in fractured areas, would have looked like prior to the glacial epoch.

Conclusions

The Mynydd Nodol Mine GCR site represents a rare, well-exposed example of a sporadically distributed class of mineral deposit within the Welsh Caledonides, namely the association of black Mn-Fe oxides with severely bleached, highly permeable host-rocks. Such deposits formed during protracted and deep, tropical to sub-tropical weathering, most probably during Tertiary times. Most of the weathered material was subsequently stripped away by glacial erosion, leaving only scattered remnants, of which Mynydd Nodol Mine is the best-known example in Wales.

References



(Figure 5.93) Map of the Mynydd Nodol Mine GCR site. After British Geological Survey 1:50 000 Sheet 137, Corwen (1993c).

(Figure 5.94) Photograph of the Mynydd Nodol Mine GCR site. (Photo: R. Mathews.)