Nantymwyn Mine

[SN 791 443], [SN 789 448], [SN 782 447]

Introduction

Nantymwyn Mine (Figure 5.67) is the largest of the old base-metal mines in the southern part of the Welsh Caledonides, a key feature being the spectacular lode exposure along the crest of Pen Cerrig-mwyn [SN 791 443]. Although it is apparently set apart from the main Central Wales Orefield, typified, for example, by the Cwmystwyth Mine GCR site located some 30 km to the north, Nantymwyn is one of a number of scattered, mainly small, mines and trials which occur throughout the southern Cambrian Mountains. Mineralization at Nantymwyn is remarkably similar to that of the Central Wales Orefield, and the site offers an excellent opportunity to compare the mineralization in this, the southern outlier of the Central Wales Orefield, with that of the main part of the orefield.

Production figures for Nantymwyn are, as with all pre-19th century mines, incomplete. However, in the periods 1775 to 1797 and 1824 to 1900, recorded sales of galena . concentrates amounted to 80 000 tons (Hall, 1993). These figures alone place the mine in the same category of lead producers as the celebrated mines of Van, in Powys, and the Snailbeach Mine GCR site (see GCR site report, Chapter 4), in south-west Shropshire. The absolute age of the workings is unclear; peoples passing through the area, including the Romans, who actively extracted gold at the nearby Dolaucothi Mine GCR site, must have noticed the spectacular lode outcrop. According to local tradition, the mine was being worked during the reign of King Charles I, and it is well documented that the mine was being worked intensively by the last quarter of the 18th century (Hall, 1993). Unusually, the mine was serviced by two large 'boat levels', along which the lead ore was brought out on barges for milling. The Deep Boat Level, the blocked portal of which is situated in Rhandirmwyn village, was commenced in 1785; the Upper Boat Level had been in service long before this time. The Deep Boat Level holed through to the main part of the mine in 1798, a drivage of nearly 800 m being completed.

Parts of the mine were extraordinarily rich. For example, in 1779 an orebody was being worked '6ft wide in solid galena, with another 12ft of rich ground alongside' (Hall, 1993). Well before the mid-19th century, the mine had reached its deepest level, some 30 fathoms (nearly 55 m) below the Deep Boat Level. Working continued throughout the remainder of the 19th century, but tailed off as mineral reserves diminished; in the early years of the 20th century the mine was also producing 'sandstone', a sign of difficult times. In 1925, a new phase of activity began when the Sulphide Corporation, proprietors of the famed Broken Hill mines in Australia, took on Nantymwyn in a search for zinc ore reserves. Much development followed, but results were disappointing. Test-milling was discontinued after 1930 and, despite the delineation of mineral reserves totalling 209 000 tons, the low prices of lead and zinc, coupled with the depressed state of the economy, dictated against the operation being profitable. The mine finally closed in 1932.

Description

The extensive tips at Nantymwyn (Figure 5.68) are rich in quartz-sulphide mineralization which has a multi-phase paragenesis, with elements resembling both the Central Wales Orefield early and late (A1 and A2) phases of metallogenesis (Mason, 1994, 1997). As in Central Wales, the transition from early fine-grained polymineralic breccia cements to late simple mineralogies in coarse-grained crustiform deposits is notable. The site is also of interest for the large growth-zoned quartz crystals developed during the later mineralization, which reach up to 15 cm in length.

The mineralization is emplaced in a N–S- to NNE–SSW-trending fracture-system, in contrast with the dominant ENE–WSW trend in the main part of the Central Wales Orefield. The fractures, which dip steeply to the west or WNW form a broad mineralized zone 50–60 m in width, within which individual lodes were recognized. The deposit is hosted by turbiditic rocks of Ashgill age; the richest orebodies, as described above, occurred where the fractures intersected thick packages of massive, gritty sandstones, locally known as the 'Lead Mine Grits'. In the underlying mudstones and shales the degree of mineralization rapidly deteriorated. The mineralization is well exposed on Pen Cerrig-mwyn and reveals a great width of quartz veining enclosing rock clasts in places. The quartz contains numerous crystal-lined cavities.

The paragenetic sequence of the mineralization at Nantymwyn is remarkably similar to that within the main part of the Central Wales Orefield. Early sulphide mineralization is hosted by quartz-cemented breccias; the ore minerals, locally in rich masses, are finely intergrown. Galena is dominant, with accessory chalcopyrite and pyrite. A second distinctive assemblage comprises sphalerite scattered through quartz. In both cases the quartz is compact, with occasional prismatic crystals and is locally accompanied by minor, late ferroan dolomite.

Later mineralization is particularly distinctive, particularly due to the almost chalcedonic banding of the quartz in breccia cements, which is also represented by growth zoning in quartz crystals. The quartz sometimes contains inclusions of chalcopyrite, while outer zones of the crystals are often darkened by the occurrence of numerous small dendritic masses of iron sulphide. This coarsely crystalline quartz is strikingly similar in appearance and accessory mineralogy to that of the A2-d assemblage of the Central Wales Orefield, developed for example at the Frongoch Mine GCR site. However, the size of the crystals at Nantymwyn is exceptional. These all occur as single crystals with fractured bases, often heavily coated in goethite and it is possible that they were dislodged from their growth positions by earthquakes. Unfortunately, undamaged crystals are very rare, although zoned fragments are common.

Secondary mineralization is well developed around the lode outcrop on Pen Cerrig-mwyn and is present in small tips immediately to the west of the outcrop [SN 791 443]. Pyromorphite is conspicuous as green coatings and rare small solid masses. It is arsenic-bearing, with a PO_4:AsO_4 ratio of 90:10 (G. Ryback, pers. comm.). Cerussite is also present as tabular and acicular crystal masses. Linarite and brochantite, post-mining in origin, occur all over the site, although well-formed micro-crystals are rare. Traces of a yellowish-white acicular phase, possibly mimetite, and thin localized erythrite coatings have also been observed. The primary source of the arsenic has yet to be determined.

Interpretation

The mineralized fractures at Nantymwyn, although seemingly anomalous in their NNE–SSW trend, otherwise bear such a strong paragenetic resemblance to those in the main part of the Central Wales Orefield that they are interpreted as representatives of the same, regional phase of mineralization. The structural trend at Nantymwyn is rare in the main part of the Central Wales Orefield, although examples are known, such as at the Snowbrook (Nantyreira) mine (Jones, 1922). This interpretation would date the mineralization at Nantymwyn as having been emplaced episodically between the Devonian and Permian periods. As in the Central Wales Orefield, the inferred mineralizing processes (Mason, 1994, 1997) would comprise initial, post-Caledonian relaxation, allowing the migration of fluids liberated by sediment dewatering during deformation. Later phases of mineralization would have occurred as a result of connate waters being expelled from adjacent Carboniferous to Permian sedimentary basins during extensional phases of the Variscan Orogenic Cycle.

The reason for the rarer NNE–SSW trend of mineralized fractures in the Nantymwyn area may lie in the basement geology. This area was marginal to the Welsh Basin in Lower Palaeozoic times, and extensional fracturing on a northeast–south-west trend in part controlled basin development. Re-activation of such basement fractures during subsequent episodic extensional regimes, during which times the mineralization was emplaced, may have influenced fracture trends in the overlying Lower Palaeozoic strata. Undoubtedly the rheology of the host rocks had a direct influence on the development of rich ore-shoots at Nantymwyn, the more brittle sandstones fracturing with greater ease and creating larger openings than the thinner fractures developed in the relatively plastic argillitic rocks.

Extensional fracture-hosted multi-phase vein-breccia mineralization occurs abundantly within the area traditionally defined as the Central Wales Orefield (Jones, 1922). Nantymwyn, 30 km to the south of the main orefield, is one of a number of scattered workings within the southern Cambrian Mountains where Central Wales-style mineralization was mined. The reason for the relatively low frequency of such mineral deposits in this southern area is unclear. However, within the southern Cambrian Mountains, there are substantial tracts of ground that are, in comparison to the main part of the Central Wales Orefield, heavily masked by a thick glacial-drift cover. This would have precluded successful prospecting activity during the 18th and 19th centuries. The same criteria apply to the area between Llanfyrnach and the southern Cambrian Mountains, where prospecting would have been hampered by a thick soil cover leading to prime agricultural land in an area of relatively subdued topography. Indeed, the apparent low frequency of productive mines

does not necessarily imply a relative scarcity of mineral deposits, as there are recognized geochemical anomalies in southern Cardiganshire in areas with no record of metal extraction (Ball and Nutt, 1975; SJ.S. Hughes, pers. comm.).

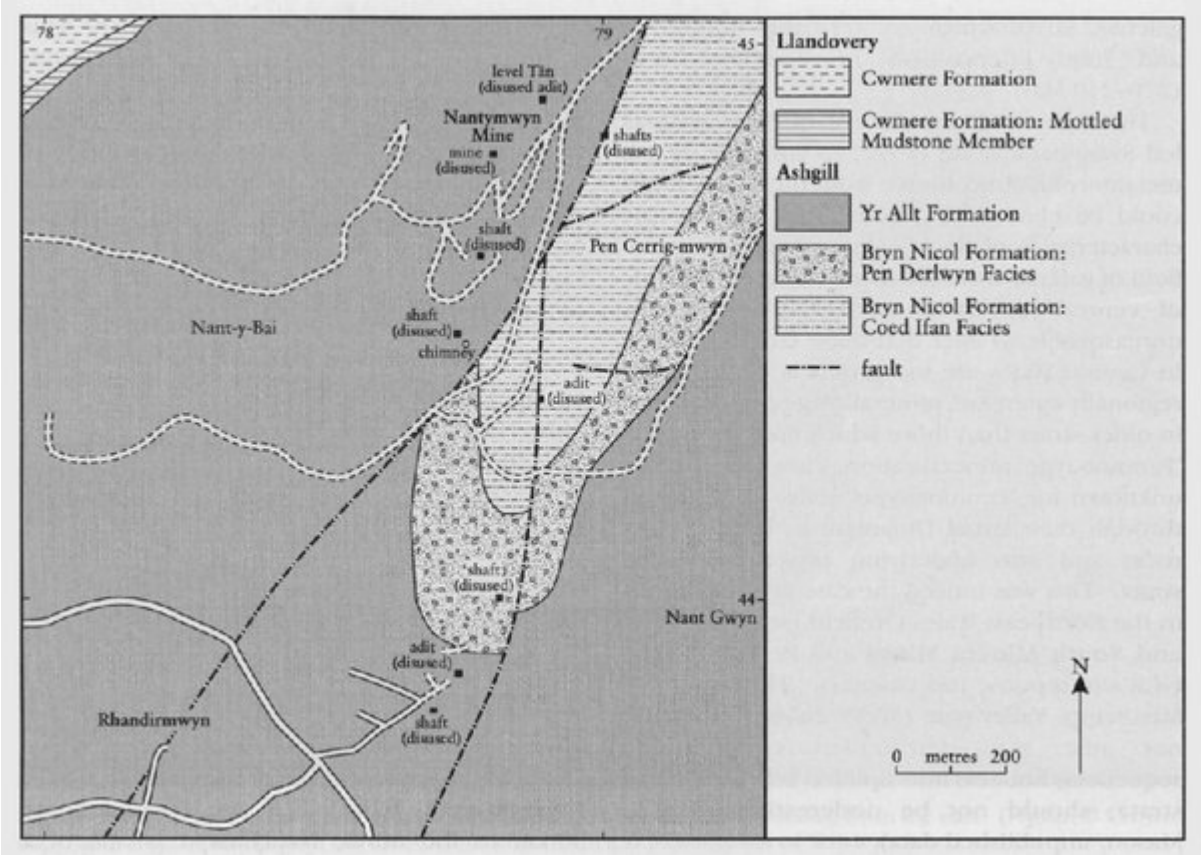
Furthermore, within the main Central Wales Orefield, scrutiny of the distribution of productive mines reveals that these tend also to occur in clusters in certain areas with sizeable, apparently unmineralized tracts of ground in between. It can thus be argued that it is the nature of Central Wales-type ore deposits to occur in specific areas characterized by clusters of mineralized fractures within a much larger area than was defined in the memoir by Jones (1922). The definition of the precise boundaries of the Central Wales Orefield is, therefore, difficult. If based on style and paragenesis of mineralization alone, it would readily comprise the vast tract of Upper Ordovician and Silurian strata in the area bounded by Tywyn, Machynlleth and Newtown in the north and by Fishguard, Carmarthen, Llandeilo and Llandrinidod Wells in the south.

The difficulty in defining the precise boundaries of the Central Wales Orefield serves to emphasize the regional nature of the Central Wales-type mineralization. This is particularly the case with the later (A2) assemblages, which are characterized by their simple mineralogy, coarse grain-size, and frequently crustiform-banded nature. In fact, quartz + calcite + Pb/Zn/Cu/Fe/Ba vein mineralization of a broadly similar nature to the Central Wales A2 assemblages occurs throughout the Lower Palaeozoic strata of Wales and reflects mineralizing processes which affected large areas at certain times.

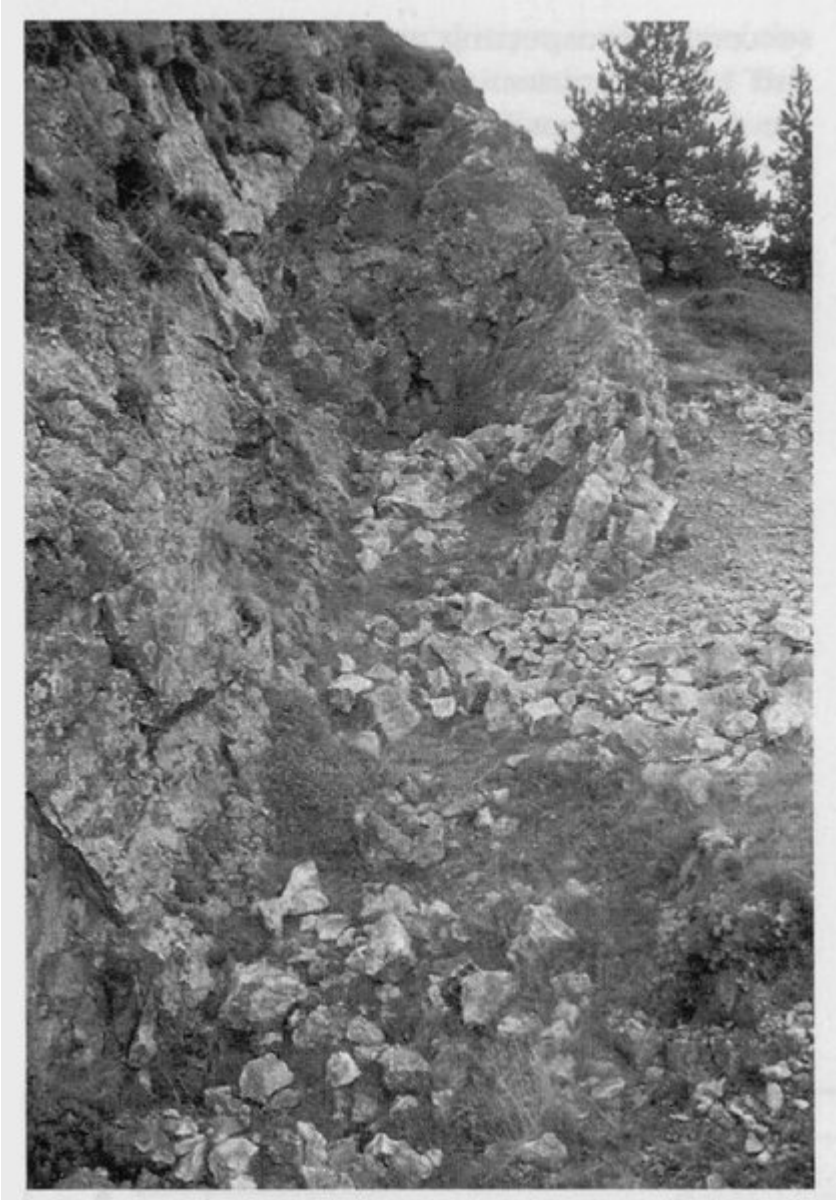
Conclusions

The major Pb-Zn mineralization at Nantymwyn bears critical resemblance to that of the main part of the Central Wales Orefield, such that, together with other scattered deposits throughout the southern Cambrian Mountains, it is interpreted as a peripheral representative of the Central Wales Orefield' mineralization. This conclusion strongly emphasizes the regional nature of post-Caledonian Pb-Zn-dominated vein mineralization occurring along extensional fracture systems cutting the Lower Palaeozoic strata of Wales.

References



(Figure 5.67) Map of the Nantymwyn Mine GCR site. After British Geological Survey 1:50 000 Sheet 195, Lampeter (2006).



(Figure 5.68) Photograph of the Nantymwyn Mine GCR site, showing the wall-like lode exposure on Pen Cerrig-mwyn. (Photo: J.S. Mason, © National Museum of Wales.)