Cwm Tregalan–Shadow Gully

[SH 612 531], [SH 6064 5345]

Introduction

Natural exposures at the head of Cwm Llan reveal an unusual facet of the vein mineralization within the Snowdon Caldera of Caradoc age. While this vein mineralization, described under the Lliwedd Mine and Llanberis Mine GCR site reports, is sulphidic in nature, at Cwm Tregalan oxide-dominated iron mineralization, accompanied by minor tin and tungsten, is developed.

Mineralization at the head of Cwm Llan (Figure 5.29) was first noted by Williams (1927), who reported 'dolerites' at the locality which were 'rich in copper where purple-coloured in streaks and patches, and include chalcocite, plush-red cuprite and occasional copper-pyrites and malachite'. To date this occurrence has never been confirmed, and it may prove to be more correctly identified as the red to steel-grey hematite, occurring with chlorite among the pillowed basalts immediately underlying the Lower Rhyolitic Tuff Formation in Cwm Tregalan.

The mineralization in this area, noted by Reedman *et al.* (1985), was first described in detail by Colman and Appleby (1991), who reported enhanced tin and tungsten contents, and identified cassiterite accompanying the abundant magnetite of Shadow Gully. Colman and Appleby (1991) also drew the important distinction between these localized deposits and the more typical Cu-Pb-Zn sulphide-bearing veins of the Snowdon Caldera. They noted that the mineralization was pre-cleavage in age, and suggested that the presence of tin and tungsten indicated a magmatic input to the mineralization. More recently, the tungsten-bearing phase from Shadow Gully has been identified by electron microprobe analysis as scheelite (Bevins and Mason, 1998).

Description

Mineralization at Cwm Tregalan–Shadow Gully is developed along syn-volcanic fractures, and the host rocks overlie sandstones rich in detrital magnetite. The host rocks comprise pillow basalts and welded tuffs which lie at the base of the Lower Rhyolitic Tuff Formation of Caradoc age (British Geological Survey, 1997). The mineralization, therefore, occurs at a relatively low stratigraphical level compared to the sulphide-rich veins, which, within the caldera, tend to occur close to the junction between the Lower Rhyolitic Tuff Formation and the overlying Bedded Pyroclastic Formation.

The Cwm Tregalan deposit comprises NW–SE-and NE–SW-trending veins dominated by quartz, hematite and magnetite, often with a banded texture. Veins reach 70 cm in width; thinner veins are often deformed into tight, convoluted folds. Vesicles in the host basalts, where in proximity to the veins, also contain the same mineral assemblage, suggesting that mineralization of the veins and vesicles was synchronous. Coarse-grained, specular hematite (< 2 cm) forms bladed aggregates in milky quartz, accompanied by minor euhedral magnetite in a quartz matrix. In polished section, the magnetite can be seen to have been deposited after the hematite, locally pseudomorphing it. Chlorite, associated with minor pale-pink to white albite, occurs intergrown with the quartz, while pyrite is a minor, early phase. Secondary alteration has resulted locally in the formation of purplish-red hematite staining.

Shadow Gully is a pronounced NW–SE-trending gully in the crags forming the head of Cwm Tregalan (Figure 5.30), funnelling debris down from the upper slopes. It is floored by brecciated volcanic rocks of the Lower Rhyolitic Tuff Formation, which are cemented by a mineral assemblage similar in some respects to that of the aforementioned vein, but with a number of important additions. The breccia, which is best exposed in the lower part of the gully, is of considerable width, reaching 10 m from wall to wall in places, although it pinches in the upper part of the gully into a network of thinner quartz-magnetite-pyrite veins.

The Shadow Gully mineralization comprises abundant octahedral magnetite up to 2 mm in an interlocking groundmass with occasional areas of quartz and ovoid pyrite growths (the latter replaced by magnetite). Hematite is later in the

paragenesis than magnetite, and forms rims on magnetite crystals and thin cross-cutting veinlets, both visible in polished section. Ore microscopy also reveals the presence of minor chalcopyrite, which forms inclusions in magnetite and fills cracks in the pyrite. Cassiterite has been observed as minute inclusions in magnetite, and scheelite occurs as small (80–150 pm) grains interstitial to the magnetite. Secondary covellite forms rims to chalcopyrite crystals, while limonite is a ubiquitous weathering product.

Interpretation

These two spatially close mineral deposits contain an assemblage which is in marked contrast to the quartz-chlorite-sulphide veins within the remainder of the Snowdon Caldera area. The two occurrences are in many respects similar, except that at Shadow Gully, magnetite is earlier and much more abundant than hematite, chalcopyrite is present, and pyrite is relatively common. However, the similarity of the mineralization at both localities led Colman and Appleby (1991) to interpret the two occurrences as facets of the same mineralizing event, with fracture-hosted veins in the pillowed basalts of the Cwm Tregalan locality passing up into mineralized breccia within the Lower Rhyolitic Tuff Formation in Shadow Gully and finally pinching out in the quartz-pyrite-magnetite veins in the upper part of the gully.

The mechanism invoked by Colman and Appleby (1991) for this upward transition was the lowering of the confining pressure as the hydrothermal fluids moved upwards, allowing them to permeate rocks of the Lower Rhyolitic Tuff Formation, which were then hydraulically brecciated by the mechanism proposed in the model of Phillips (1972). Colman and Appleby (1991) also commented that it was difficult to draw a comparison with the Cu-Pb-Zn mineralization of the Snowdon Caldera veins, as the two styles of mineralization do not occur in contact with one another.

The breccia cement nature of the Shadow Gully mineralization makes it distinct from the Snowdon Caldera veins, which, albeit locally, do contain clasts of wall-rock, but do not constitute breccia cements *sensu stricto.* Furthermore, the oxide-dominated mineralogy (containing only 2.56 wt% S) and very low levels of base-metals, with maximum recorded values of 35 ppm Cu, 126 ppm Pb and 157 ppm Zn (Colman and Appleby, 1991), contrast markedly with the Snowdon Caldera mineralization, despite Shadow Gully lying little more than 1 km away from the major copper-producing Britannia Mine, situated mainly within the Lower Rhyolitic Tuff Formation to the north-east, on the opposite side of Snowdon summit.

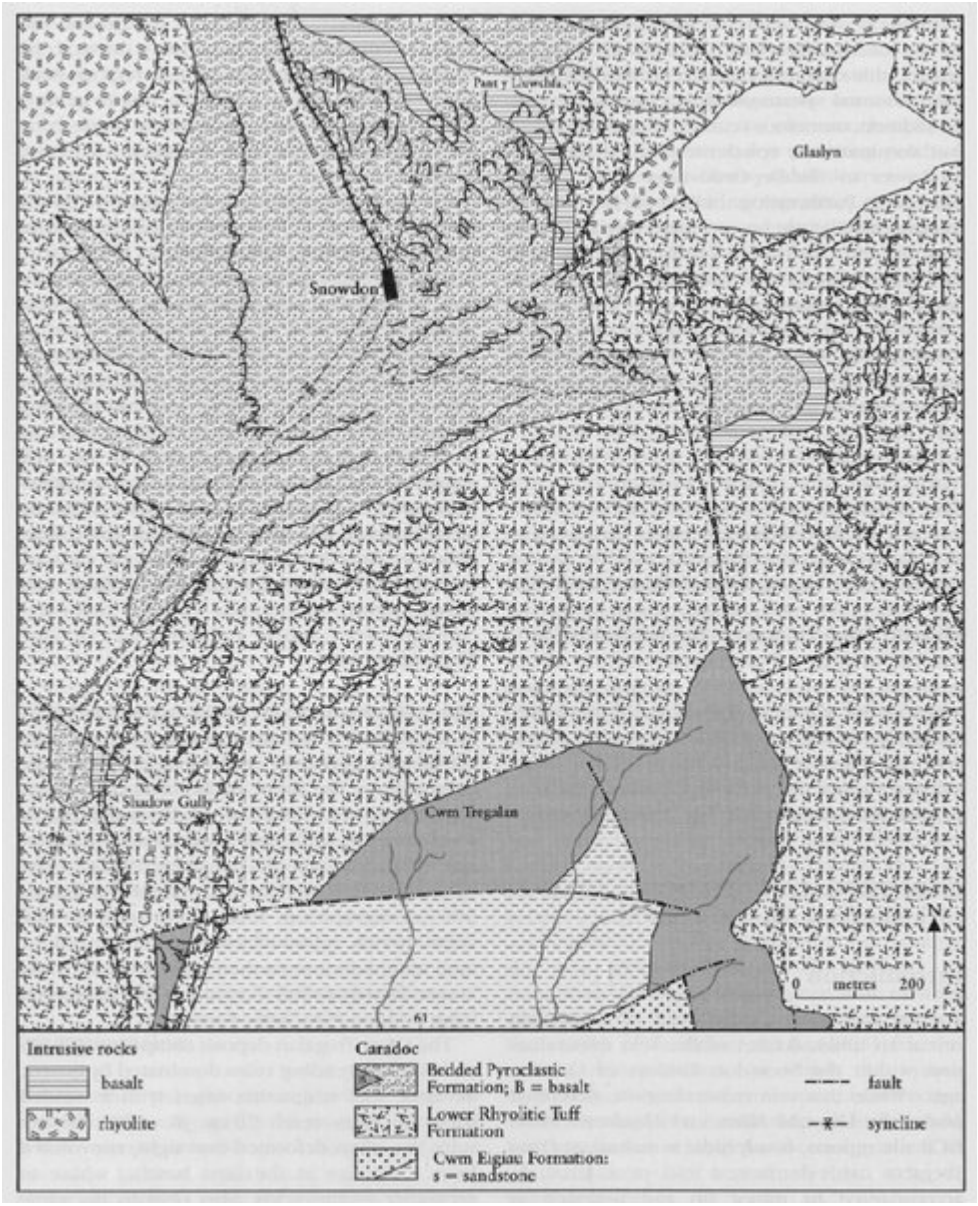
Colman and Appleby (1991) inferred that the elevated levels of tin and tungsten, occurring as cassiterite and scheelite respectively, are suggestive of a direct magmatic input to the mineralization, as are the elevated fluorine contents in the wall-rocks. They suggested that the magnetite-rich sandstones underlying the pillowed basalts of Cwm Tregalan were so different in their magnetite geochemistry to the Cwm Tregalan–Shadow Gully mineralization that the juxtaposition of the two magnetite occurrences was coincidental.

Given that the mineralization at Cwm Tregalan–Shadow Gully is so different from that of the Snowdon Caldera Cu-Pb-Zn veins, and also that it occurs at a lower stratigraphical level, near the base of the Lower Rhyolitic Tuff Formation, it is probable that these oxide-dominated deposits represent a separate and distinct mineralizing event, although whether this event pre- or post-dated the widespread Cu-Pb-Zn mineralization remains to be established.

Conclusions

The oxide-dominated Fe (Sn-W) vein and breccia-zone mineralization of Cwm Tregalan–Shadow Gully is unique within the overall context of the Snowdonia volcanogenic mineralization. The geochemistry of the mineralization suggests that there has been a direct magmatic input, but the age relationship of this mineralization to the more widespread Cu-Pb-Zn vein mineralization within the Snowdon Caldera has yet to be determined, and provides scope for further research.

References



(Figure 5.29) Map of the Cwm Tregalan–Shadow Gully GCR site. After British Geological Survey 1:50 000 Sheet 119, Snowdon (1997).

(Figure 5.30) Photograph of Shadow Gully. (Photo: T. Colman.)