Cefn-Coch Mine

[SH 717 231]

Description

Mining at Cefn-Coch (Figure 5.17) commenced in the 18th century, when the vein was reportedly tried for lead (Lewis, 1967), but the main phase of activity began in the 1860s gold rush. Since then, the mine produced a recorded 1234.25 oz of gold intermittently over a 49-year period commencing in 1863 (Hall, 1990). Grades varied up to 30 oz Au/ton of quartz.

The mineralization at Cefn-Coch (Figure 5.19) is hosted by sedimentary rocks of Cambrian age, belonging to the Gamlan Formation (of the Lower Cambrian Harlech Grits Group) and the Clogau Formation (of the Middle Cambrian Mawddach Group), which dip to the ESE and lie on the eastern flank of the Harlech Dome. The Gamlan Formation consists of turbiditic siltstones with a coarse quartzose unit, the Cefn Coch Grit Member, occurring near the top. In contrast, the Clogau Formation consists of black carbonaceous and sulphidic mudstones. Sills of altered dolerite ('greenstone') intrude the succession. Two principal veins occur at Cefn-Coch, which both strike north-east–southwest and dip steeply to the north-west. Normal fault movement along the vein-hosted fractures has occurred to a limited extent.

The southern vein, less than 0.5 m wide and hosted entirely by the Clogau Formation, consists of quartz, dolomite and white mica with minor sulphides (galena, sphalerite, chalcopyrite and arsenopyrite), which occur as small, fine-grained intergrowths. The waste tips from the workings on the southern vein are composed of blocks of black shale with classic developments of quartz-dominated ribbon-veining (Figure 5.20). The texture is indicative of repeated phases of fracture re-activation, fluid injection and mineralization. Cut sections from this vein show important additional features, in particular folding in thin cross-veins at right-angles to the main vein, and the development of intra-vein stylolitic partings parallel to the vein walls where former thin ribbon-edge veneers of wall-rock occurred. Both features are consistent with the interpretation, based on exposures at the Friog Undercliff GCR site, that the gold-belt veins are pre-tectonic with respect to maximum Acadian compression and cleavage development.

The northern vein is a much wider (over 3 m locally), more intensively worked structure. The vein lies partly within the Clogau Formation and associated 'greenstones' and partly along the boundary between the Clogau Formation and the underlying Gamlan Formation. It is recorded (Hall, 1990) that the vein became barren with respect to gold upon entering the flaggy sandstones of the Gamlan Formation. The contrasting textures of the vein mineralization within different host-rocks are clearly demonstrated in this area. Blocks of veinstone on the waste tips show the development, below the Clogau Formation, of massive vein quartz with included brecciated fragments of 'greenstone' and Gamlan Formation turbiditic sandstone.

Sulphides are more abundant in the northern vein and chiefly comprise chalcopyrite, pyrrhotite, pyrite, arsenopyrite, sphalerite and galena. Cobaltite and tellurobismuthite have also been recorded (Gilbey, 1968). As at other gold-belt workings, the sulphides occur in complex intergrowth. Gold is of localized occurrence and was particularly associated with sphalerite (Gilbey, 1968). An old specimen (NMW83.41G.M131) in the collections of the National Museum, labelled 'Cefn-Coch', shows spectacular developments of coarse gold in a quartz matrix with associated sphalerite.

A cross-structure transects the northern vein (but apparently does not displace it) at the site of the old Engine Shaft. Gold was reportedly particularly enriched at this junction (Hall, 1990) and the large amount of stoping undertaken supports this contention. The dumps immediately to the north-east of this major working contain much wall-rock that is heavily impregnated with rhombs of fine-grained arsenopyrite. Oxidation of the arsenopyrite to scorodite is locally intense. Pervasive arsenopyritization is one of the most conspicuous features of wall-rock alteration in conjunction with the development of the gold-belt veins.

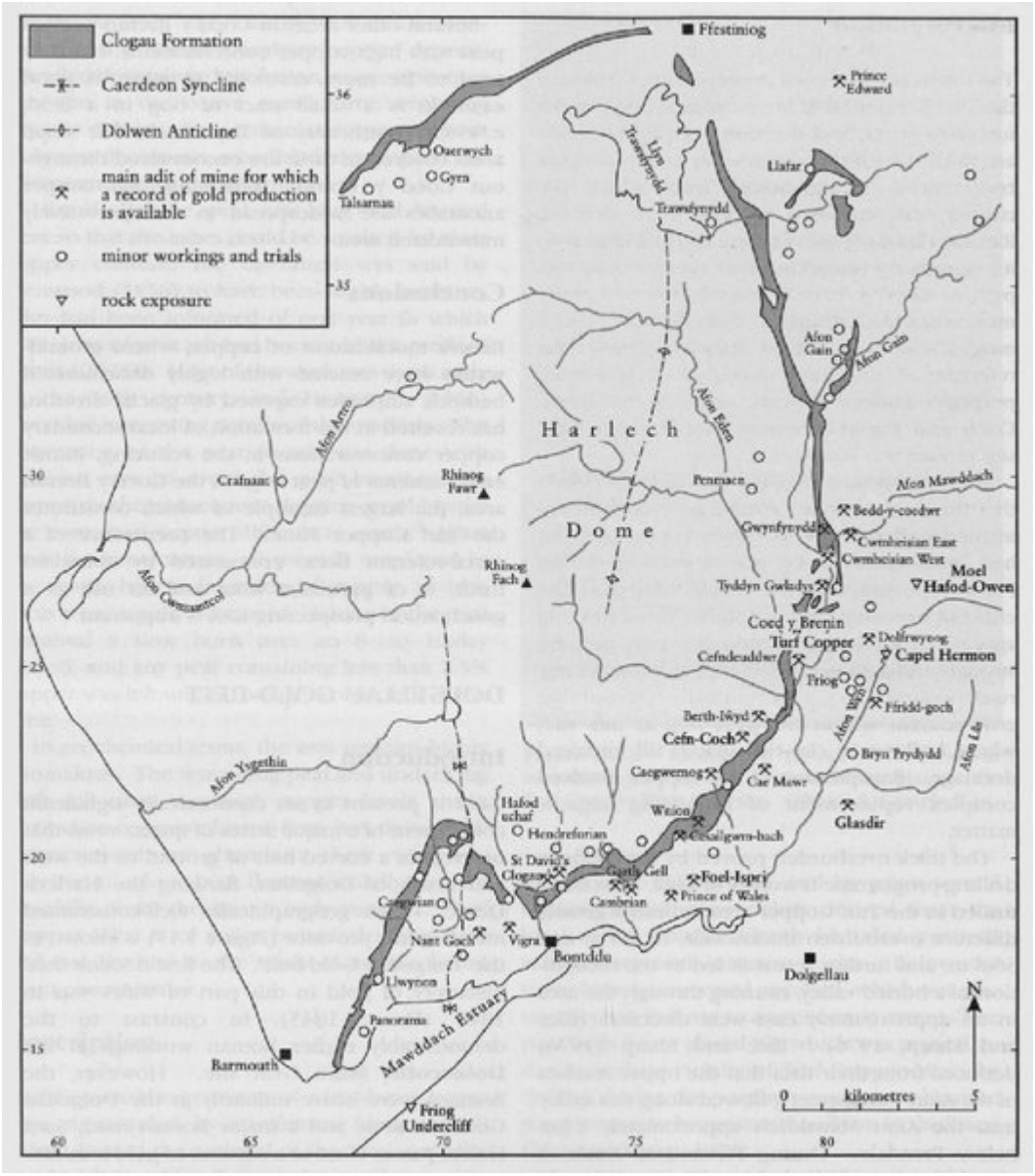
Interpretation

Where gold-belt veins traverse varying host lithologies, marked differences in vein texture occur. Veins entirely hosted by black shales tend to exhibit well-developed, composite book-and-ribbon textures. Veins developed within more competent arenaceous facies and in 'greenstones' commonly consist of breccia cements in which the repeated injections of mineralizing fluids during successive fracturing episodes are less clearly demonstrated, although in paragenetic terms the mineral associations and depositional sequences are either similar or identical.

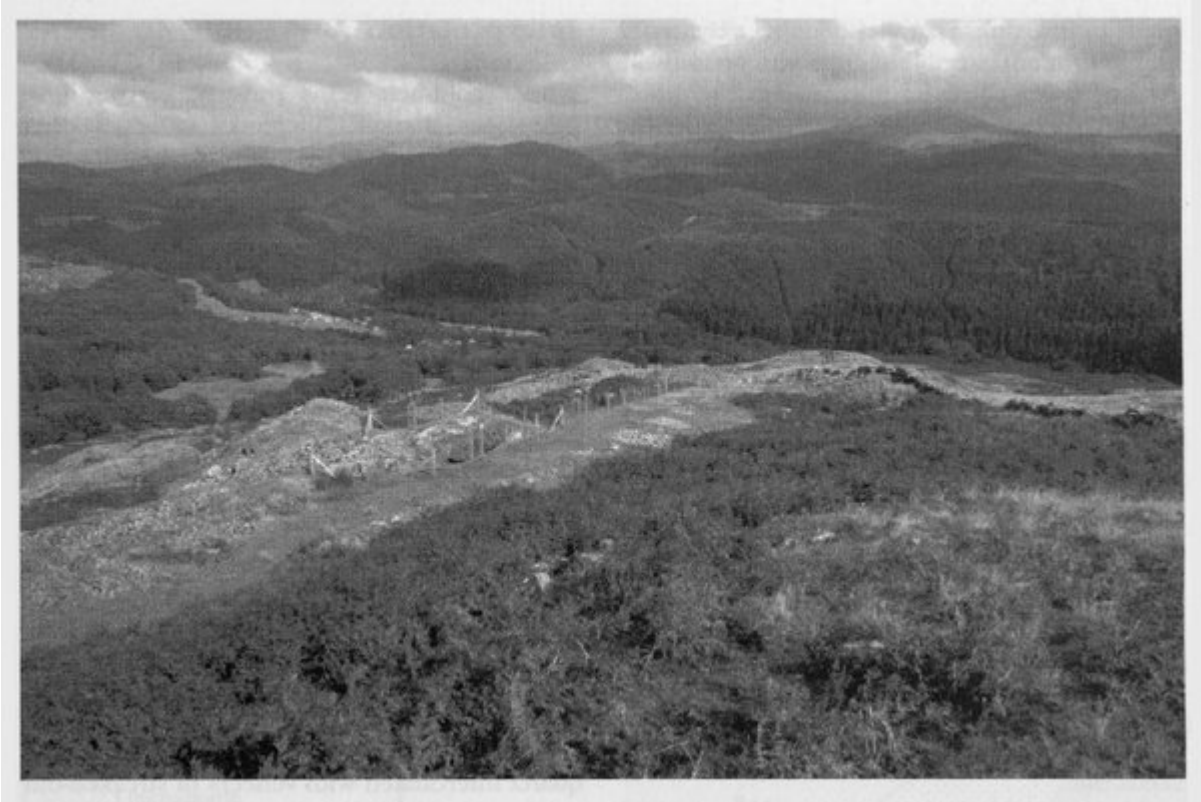
Such features indicate that vein development was strongly influenced by host-rock composition and theology. Under the extensional tectonic regime in which the regional series of normal fault-hosted veins was emplaced, fracturing was initiated by crustal tension and propagated by the hydraulic action of hydrothermal fluids that readily migrated into the developing fracture-zones (Ashton, 1981). Within the black shales, ribbon-veins, comprising multiple leaves of quartz intercalated with veneers of streaked-out argillite wall-rock, were formed by repeated fracturing accompanied by ductile shear along the wall-rock veneers. In contrast, the more competent arenites and 'greenstones' underwent brittle deformation, including hydraulic brecciation (Phillips, 1972), resulting in the emplacement of vein quartz containing randomly orientated angular rock-clasts.

The impoverishment in terms of gold grade with depth is in accordance with the widely held view that gold-shoots were localized where veins passed through black-shale-'greenstone' contacts. Upon entering the more arenaceous facies of the Gamlan Formation, this critical factor was no longer present, and the gold-shoots died out. The association of gold-rich ore-shoots and black-shale host-rocks is a worldwide phenomenon, and is attributed to constituents particular to the black shales (e.g. graphite, pyrite or pyrrhotite) being capable of precipitating gold from hydrothermal fluids by destabilizing gold complexes in solution. The black shales of the Clogau Formation contain both carbonaceous material and sulphides, and it has been proposed that gold was precipitated by destabilization of the $Au(HS)_2$" complex due to reactions between the hydrothermal fluids and constituents of the black-shale wall-rocks (Brand *et al.,* 1989).

References



(Figure 5.17) Map of the Harlech Dome region, showing the locations of the principal gold mines and the Dolgellau Gold-belt GCR sites. After Institute of Geological Sciences 1:50 000 Sheet 135, Harlech (1982).



(Figure 5.19) Photograph of the Cefn-Coch Mine GCR site. (Photo: R. Mathews.)

(Figure 5.20) Quartz-dominated ribbon-veining, Cefn-Coch Mine GCR site. (Photo: J.S. Mason.)