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# Llyn Cwellyn Mine

[SH 5486 5569]

## Introduction

A small trial working on the shore of Llyn Cwellyn (Figure 5.31), only recently described in any detail (Colman, 1990; Colman and Appleby, 1991), is unique in the Welsh Caledonides. A narrow vein, which was prospected by a trial level, lies within the metamorphic aureole of the Mynydd Mawr microgranite intrusion and contains abundant fluorite with subsidiary magnetite. A late-stage injection of quartz-carbonate-sulphide mineralization is also present, and the trial was most likely made in order to assess the copper content of this mineral assemblage. A further unusual feature of this mineralization is that the sulphide assemblage contains a number of Pb- and Bi-bearing telluride phases.

## Description

The mineral vein at Llyn Cwellyn Mine (Figure 5.32) is not accessible due to the working being flooded. However, blocks among the tip debris show that it was up to 50 cm in width and the shape of the working suggests a NNW–SSE-striking steep or vertical structure. The host rocks are coarse elastic marine sedimentary rocks belonging to the Upper Cambrian (Merioneth) Marchlyn Formation (British Geological Survey, 1997), situated in a position proximal to the northern margin of the Mynydd Mawr intrusion.

The mineralization comprises early magnetite-pyrite-chlorite aggregates as impregnations of rock clasts, which have a swirling, almost spinifex-like texture in polished section. Massive fluorite, predominantly white but also purple and green, with a purple UV fluorescence, cements the magnetite-bearing clasts. The fluorite is cut and locally brecciated, with a quartz-ferroan carbonate cement which contains areas of chalcopyrite and pyrite. In polished section, pyrrhotite (enclosing pyrite), rare sphalerite and galena accompany the chalcopyrite in minor quantities.

Accompanying the quartz + ferroan carbonate + sulphide assemblage, and visible in polished section, are small quantities of lead- and bismuth-bearing telluride minerals. These tend to form composite grains, which are generally 20–50  $\mu\text{m}$  in size, with the appearance of a myrmekitic intergrowth. Tellurides also form intergrowths with pyrrhotite. To date, the telluride phases from this locality have not been identified, largely because of their complex intergrowth textures.

## Interpretation

The mineral assemblage occurring at Llyn Cwellyn Mine is unique within the overall picture of the Snowdonia mineralization. The quantity of fluorite and the site's position marginal to the Mynydd Mawr intrusion are suggestive of a partially or wholly magmatic origin. Colman (1990), and Colman and Appleby (1991) discussed the rare-earth-element profile of fluorite from Llyn Cwellyn, concluding that the rare-earth-element distribution patterns in the microgranite and in the vein fluorite are similar, suggesting a genetic relationship between the intrusion and the fluorite mineralization.

The Mynydd Mawr intrusion is a peralkaline intrusion (Howells *et al.*, 1991), which contains fluorite as an accessory phase (Bevins, 1994); additionally a number of rare Nb-Ta and rare-earth-element-bearing minerals are present, which are currently under investigation (A. Tindle, pers. comm.).

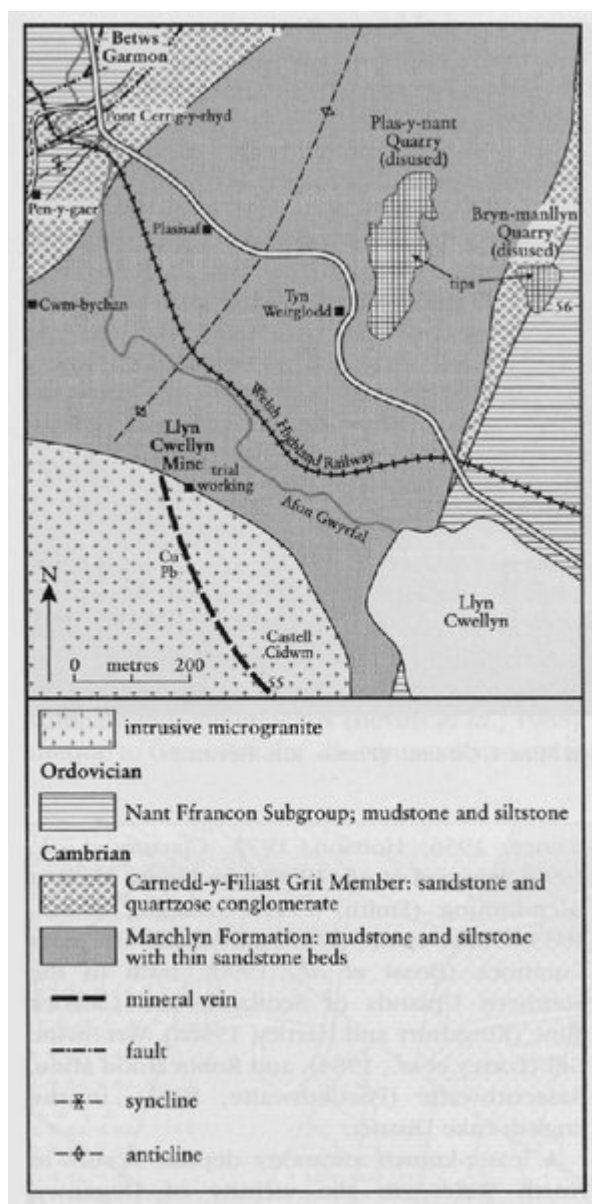
The metalliferous mineralization associated with the fluorite is in some respects similar to that of the Snowdonia district as a whole, with common pyrite and chalcopyrite. However, the occurrence of pyrrhotite intergrown with a number of lead- and bismuth-bearing telluride phases is an unusual feature not seen elsewhere within this province, although pyrrhotite is locally common. The pyrrhotite-telluride mineralization, which post-dates pyrite formation, is indicative of late-stage fluids containing tellurium but with a relatively low sulphur content; under such conditions, all remaining sulphur would be taken up in pyrrhotite, while lead and bismuth would combine with tellurium.

The source for the tellurium is unclear, except that it should be noted that elsewhere in the Welsh Caledonides bismuth and lead tellurides have been recorded from the Dolgellau Gold-belt, in southern Snowdonia (Bevins, 1994; Mason *et al.*, 2002), where they are again a late-stage mineral within the primary paragenesis. It may prove to be the case that the basement which underlies the whole Snowdonia area represents a tellurium-enriched source province, so that elevated levels of tellurium, either substituting for sulphur in sulphides or occasionally occurring as discrete telluride minerals, may be detected geochemically over a wide part of North Wales.

## Conclusions

The Llyn Cwellyn trial working constitutes a unique occurrence of fluorite mineralization in the Welsh Caledonides, and the geochemistry of the fluorite is consistent with a magmatic input to the mineralization, probably from the nearby Mynydd Mawr microgranite intrusion. The metalliferous minerals, which were deposited later than the fluorite, include unusual lead and bismuth tellurides, the identification and genesis of which is the subject of ongoing studies.

## References



(Figure 5.31) Map of the Llyn Cwellyn Mine GCR site. After British Geological Survey 1:50 000 Sheet 119, Snowdon (1997).



*(Figure 5.32) Photograph of the Llyn Cwellyn Mine GCR site. (Photo: R.E. Bevins.)*