
Ponterwyd Quarry

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Highlights

The quarry near Ponterwyd has been selected to show examples of the rare, small-scale folds and cleavage which are superimposed on the regional Caledonian structures of west Central Wales. The site also provides an example, possibly unique, of the relationship between lead veining and the later deformation which is assumed to be Caledonian.

Introduction

This site exposes Lower Silurian interbedded fine sandstones, siltstones, and mudstones, described by Cave and Haim (1986), which are located in the south-western part of the Plynlimon Dome. Of particular interest are the folds and cleavage which are imposed on the main cleavage. These late structures, together with a vein of galena which cuts some of them, are described, discussed, and illustrated by Fitches (1972). Fitches (in discussion of Phillips, 1972) drew attention to their relevance to the timing of mineralization with respect to deformation of the rocks of the Welsh Basin.

Description

(Figure 4.16)A, a sketch plan of the quarry, gives the location of the localities discussed below. The bedding generally strikes NNE–SSW and dips steeply westward, and is the right way-up according to the abundant cross-lamination, ripple marks and trace fossils. Cleavage strikes NNE–SSW and dips very steeply westward.

(Figure 4.16)A, B & C

In the west face of the quarry, immediately north of the spoil tips (Locality 1, (Figure 4.16)A), there are several recumbent folds of the cleavage and bedding. The axial plane of one fold is oriented $360/12^{\circ}W$, the hinge plunging $20/191^{\circ}$. The folds have open to gentle profiles, wavelengths of *c.* 0.20 m and amplitudes of *c.* 0.05 m; hinge zones are narrow and limbs are planar, giving a chevron style. A feeble crenulation cleavage is axial planar to the folds. This fabric is replaced locally by zones of very thin quartz veinlets which are also axial planar.

Several more late folds, forming a conjugate set, are exposed in the east face of the quarry, in the north-east corner (Locality 2, (Figure 4.16)A and (Figure 4.14)B). Wavelengths are in the range 0.30 m to 2 m. Some of the folds have axial planes striking NNE–SSW ($010\text{--}015^{\circ}$) and dipping moderately to the east ($45\text{--}50^{\circ}$), and hinge lines that plunge gently to moderately northward $15\text{--}30^{\circ}$ to $010\text{--}020^{\circ}$. Other folds in the conjugate set have axial planes oriented approximately $035/20^{\circ}SE$, and hinge lines plunging *c.* $05/205^{\circ}$. A feeble crenulation cleavage is axial planar to the steeper folds. Bedding surfaces in this fold complex are commonly slickensided (striations and quartz slickencrysts) as a result of flexural slip during folding.

Cutting folds of both orientations is a 0.15 m wide zone of quartz veins ($064/84^{\circ}SE$) which is exposed from the quarry floor to the top of the east wall. One 0.03 m-wide vein in the middle of the zone is composed of galena.

The north face of the quarry (Locality 3, (Figure 4.16)A and C) exposes the profiles of the recumbent and inclined folds which make up the conjugate set of late folds described above. The folds at the eastern end of this face are those at Locality 2. One of these folds is of particular interest for the mineralized veinlets associated with it (see figure 2 of Fitches, 1972). Part of its hinge zone is occupied by a carbonate-filled saddle-reef, and its upper limb contains a tension gash array, formed during folding, in which quartz and pyrite (and possibly chalcopyrite although it is too small to identify in the field with confidence) have segregated.

Interpretation

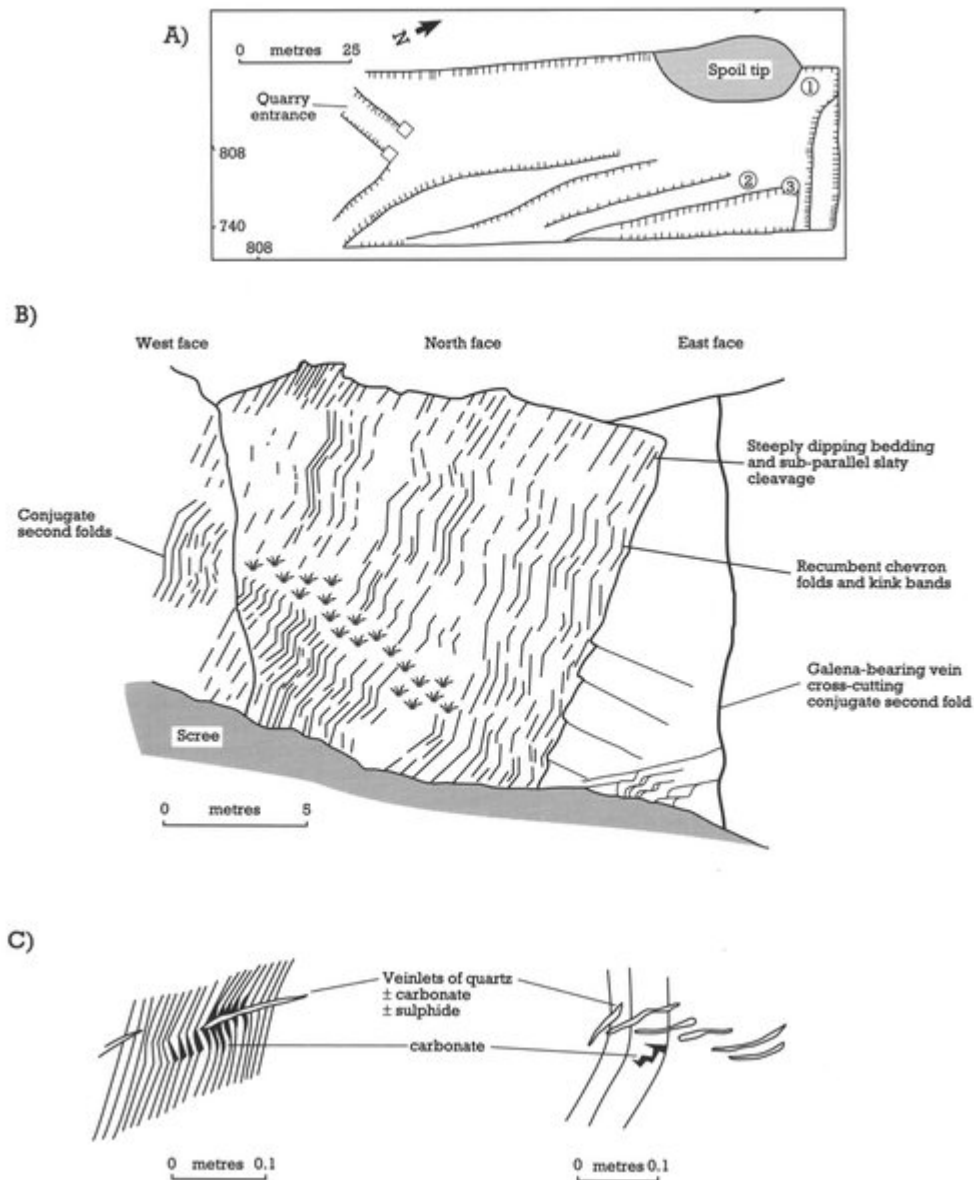
Folds and crenulation cleavages which are imposed on the main end-Caledonian folds and cleavage have been reported from various parts of the Welsh Basin (Roberts, 1979; Martin *et al.*, 1981; Fitches, 1972; Smith, 1988). Fitches and Roberts considered that the late (post-main deformation) folds with flat-lying axial planes, like many of those exposed in the Ponterwyd Quarry, belong to a regional set, while steep folds imposed on the recumbent ones represent a younger regional set. It was pointed out by Tremlett (1982) and Craig (1985), however, that these locally developed, late structures commonly appear to be associated with faults, and that they are therefore unlikely to be products of regional events. This fault-related explanation is supported by observations in other parts of the Welsh Basin. Near the Bala Fault, kink bands and crenulations, for example, imposed on the main cleavage are spatially related with the fault zone (Bracegirdle, 1974; Fitches and Campbell, 1987).

The sulphide-bearing veins in the Ponterwyd Quarry provide information on the timing of mineralization with respect to deformation in this part of the Welsh Basin. The fact that pyrite, and possibly chalcopyrite, are found in tension gashes produced during the late folding indicates local segregation of sulphides from the host rocks into low-pressure regions during deformation. The galena vein, however, cuts across, and is therefore at least slightly younger than all the late structures. This relationship of galena mineralization to the late structures shows that in this case mineralization is unlikely to be related to dewatering of the sedimentary pile during the main end-Caledonian (late Silurian–early Devonian) deformation (Fitches, in discussion of Phillips, 1972).

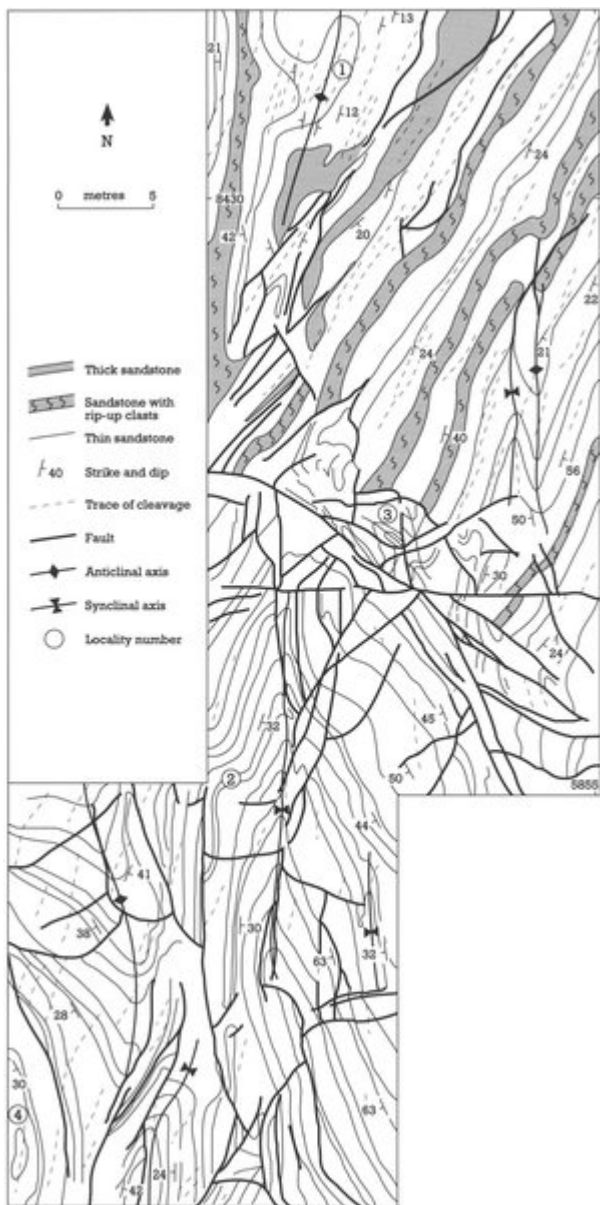
Conclusions

Ponterwyd Quarry contains numerous, particularly well-exposed examples of folds imposed on, and therefore younger than, the main Caledonian structures. At this site these consist of cleavage (very fine, closely spaced, parallel fractures), and steeply dipping bedding in these Silurian strata. Superimposed on these two sets of features are a variety of folds (Z-shaped and S-shaped, and sometimes chevron-shaped) and a second generation of cleavage with parallel quartz veins. The superimposed folds and the cleavage are regarded as late-Caledonian structures found uncommonly in several parts of the Welsh Basin. Mineralized veins in the quarry are associated with the second generation of structures: they provide information, possibly unique in the Welsh Basin, on the timing of relationships between the formation of lead veins and the tectonic structures.

[References](#)



(Figure 4.16) Ponterwyd Quarry. (A) Plan of quarry showing the three localities described in the text. (B) Locality 2; steeply dipping bedding and subparallel slaty cleavage deformed by recumbent second-phase chevron folds and kink bands (after Fitches, 1978, figure 1). (C) Locality 3; saddle-reefs and tension gashes (after Fitches, 1972, figure 2).



(Figure 4.14) North Clarach. Fold–cleavage–fault relationships on wave-cut platform (modified from map produced by R Johnson, University College of Wales, Aberystwyth, 1977). Localities 1–4 referred to in the text.