Dolyhir Quarries, Old Radnor

[SO 245 581]

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Highlights

These quarries provide a section through the Church Stretton Fault Zone, one of the active structures between the Welsh Basin and the Midland Platform of England during Palaeozoic time. They expose the clear angular unconformity of Wenlock Series strata on the Precambrian, important in providing dates which constrain interpretation of the regional tectonic history.

Introduction

The complex of quarries around Dolyhir lies within the Old Radnor Inlier, a small fault-bounded and fault-dissected sliver along the south-west continuation of the Church Stretton Fault. The inlier comprises Precambrian sedimentary rocks unconformably overlain by Lower Wenlock limestones. Wenlock age shales surround the inlier, mainly with faulted contacts but, in places, possibly with depositional contacts. The main structural features of the locality are numerous steep faults, mostly cutting both Precambrian and Wenlock rocks.

Early interest in the inlier (Callaway, 1900) focused on the presumed Precambrian sediments and their possible correlation with the Longmyndian of Shropshire. This correlation was supported by later work (Garwood and Goodyear, 1918) which also showed the palaeontological interest of the overlying limestones, and their correlation with the Woolhope Limestone (Lower Wenlock) further east. The recognition of important faulting within the inlier and more detailed work (Kirk, 1951, 1952) produced the model that the inlier was a basement block upthrust along the Church Stretton Fault Belt in Caledonian or later times. The inliers along this fault were important evidence for the theory that the main, NE–SW, 'Caledonoid' lineaments in South Wales and the Borderland overlie steep fault belts that cut the basement to some depth (Owen, 1974; Owen and Weaver, 1983; Woodcock, 1984a). More recent work (Woodcock, 1988) has shown that the post-Wenlock faults in the inlier have dominantly strike-slip rather than dip-slip displacements.

Description

The main geological features of the complex of old and working quarries at Dolyhir in 1985 are summarized in (Figure 4.24) and (Figure 4.25). Strinds Quarry is currently being worked south-westward within the limestone only. Dolyhir Quarry is being extended eastward at all levels. In Strinds Quarry (Figure 4.24), Precambrian sandstones and conglomerates of the Strinds Formation are exposed in the lower faces, dipping steeply to the northwest. Gently dipping Wenlock Dolyhir Limestone unconformably overlies the Strinds Formation, with a patchily developed basal rudite. The three most continuous faults in the quarry strike NNE–SSW and dip steeply to the WNW. They cut both Precambrian and Wenlock and displace the unconformity surface with normal offset (down-throw to the WNW). However, slickensides on these faults all indicate strike-slip displacements. The displacement sense is mostly indeterminate. Common, minor strike-slip faults parallel the continuous faults.

Minor WNW–ESE or NW–SE striking faults are common above the unconformity, and they are dextral where the sense can be determined from stepped slickenfibres. This fault set is interpreted as conjugate to the main northerly set, forming the Riedel shear pattern common in strike-slip systems (see (Figure 4.24) inset). On this basis, the main faults would have a sinistral sense. Minor dip-slip faults strike between NNE–SSW and NE–SW, and show an extensional component both above and below the unconformity.

In Dolyhir Quarry (Figure 4.25), Precambrian rocks again form the lower faces. Strinds Formation sandstones outcropping in the south-east are faulted against the finer-grained, better-bedded sediments of the Yat Wood Formation

in the central and north-eastern parts. This fault zone strikes NE–SW and contains mostly south-east-dipping faults, some showing strike-slip and some dip-slip slickensides. Several subparallel faults cut the eastern part of the Yat Wood Formation, mostly showing dip-slip displacements. None of these NE–SW or E–W striking faults unambiguously cuts the Wenlock unconformity and therefore they could be pre-Wenlock, even Precambrian, in age. They all abut against, or anastomose with, a major, NNE–SSW-striking fault [SO 2442 5828] to [SO 2447 5845] which displaces the unconformity down by about 30 m to the WNW. The central segment of this fault shows dip-slip slickensides. West of the fault, the Yat Wood Formation and Dolyhir Limestone are both cut by two subparallel major faults, one evidencing strike-slip, the other some additional dip-slip component. The unconformity surface, everywhere overlain by basal rudites, is progressively downfaulted towards the north-west part of the quarry. As in Strinds Quarry, the Dolyhir Limestone commonly shows steep NW–SE-striking strike-slip faults with dextral sense. Although the Riedel shear pattern is not so clear here it is still compatible with sinistral shear on the main northerly strike-slip faults (see (Figure 4.25) inset).

Complementing the information from Strinds and Dolyhir Quarries are numerous minor exposures throughout the Old Radnor Inlier and also the extensive Gore Quarry at its north-west end. This is of less stratigraphical interest because it contains only Precambrian rocks, but it contains a suite of faults comparable with those described above (details given by Woodcock, 1988).

Interpretation

The geometrical pattern of structures in the Old Radnor Inlier is exceedingly complex and some aspects of its kinematic interpretation remain tentative. The clearest feature is the predominance of strike-slip faults over dip-slip. About 65% of faults affecting the Precambrian and over 80% affecting the Wenlock show slickensides shallower than 45°. This result, taken with the steep attitude and braided interconnection of most faults, suggests that the inlier has suffered important post-Wenlock deformation in a regime with a strong transcurrent component. The lower proportion of strike-slip faults in the Precambrian is compatible with the post-Wenlock phase having reactivated earlier dominantly dip-slip faults.

Throughout the inlier, a main strike-slip fault set striking N–S, or NNE–SSW is accompanied by a subsidiary set striking NW or NNW. This pattern is most simply explained as a Riedel shear response to sinistral strike-slip deformation, parallel to the NE–SW trend of the inlier (that is, subsidiary faults are produced as a result of strain produced by the principal fault). Strike-slip displacement along the Church Stretton Fault is evidenced elsewhere along its length, principally in the Church Stretton area 40 km away, at its north-eastern end (Figure 4.1). Here (see Woodcock, 1988, for summary) some movements which can only be dated as pre-Llandovery and others which are post-Caradoc strongly suggest sinistral movements from their Riedel pattern, displacement of vertical beds and strike-slip slickensides. However, the Old Radnor Inlier provides the most direct and convincing evidence of sinistral movements which post-date the Wenlock.

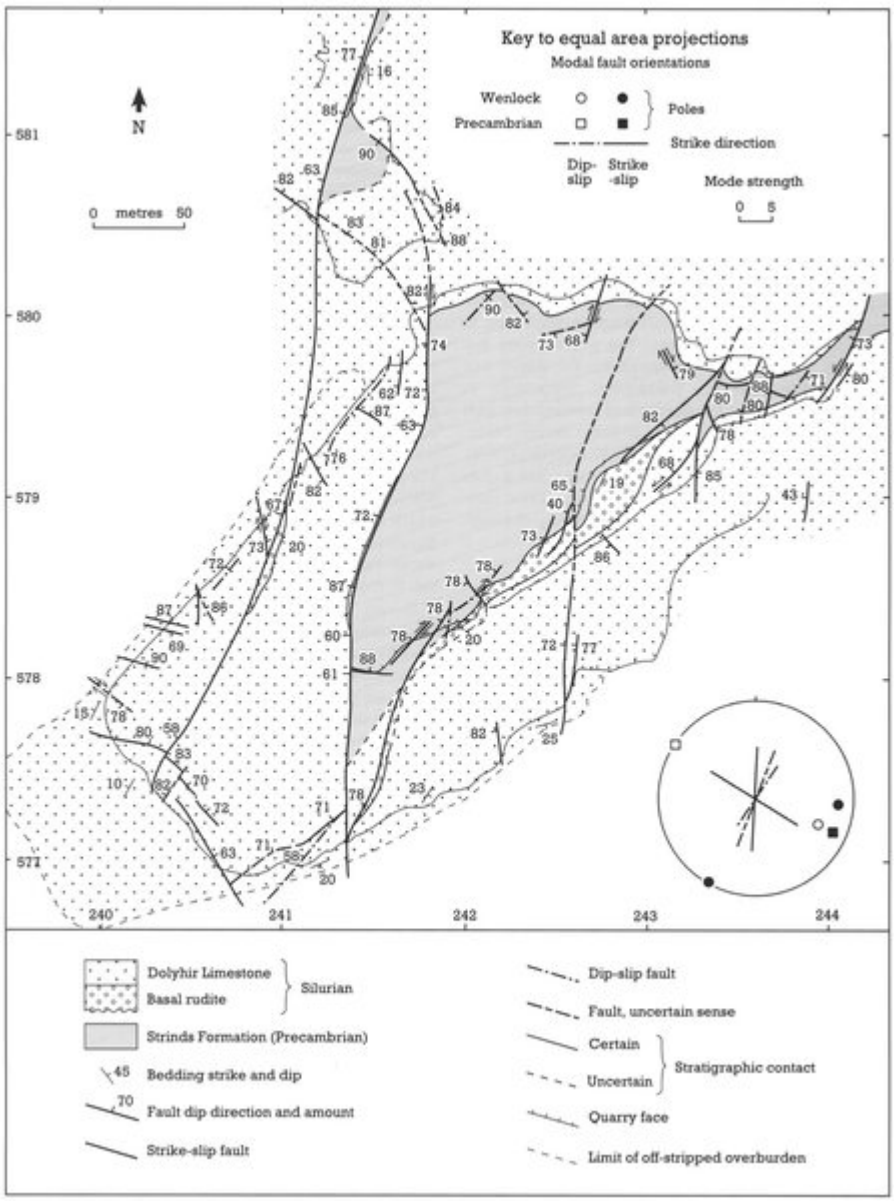
The timing of the sinistral displacements is not well constrained. They could be late Silurian or early Devonian, and driven by the regional sinistral component to the main Acadian (late-Caledonian) deformation in Wales (Woodcock *et al.,* 1988). Alternatively, they could be Variscan or even later, since displacements of this age are evidenced along strike on the Church Stretton Fault. However, there is no direct evidence that the Church Stretton Fault ever accommodated very large lateral displacements (Woodcock and Gibbons, 1988). Where the offset can be measured in the Church Stretton area it ranges from a few hundred metres to 1.5 km (Greig *et al.,* 1968). Allowing for similar movements on faults of indeterminate offset, the total strike-slip across the whole zone probably lies in the range of 2–10 km (Woodcock, 1988). As ideas on the tectonics of southern Britain are further developed, the Dolyhir localities will remain an important source of relevant data.

Conclusions

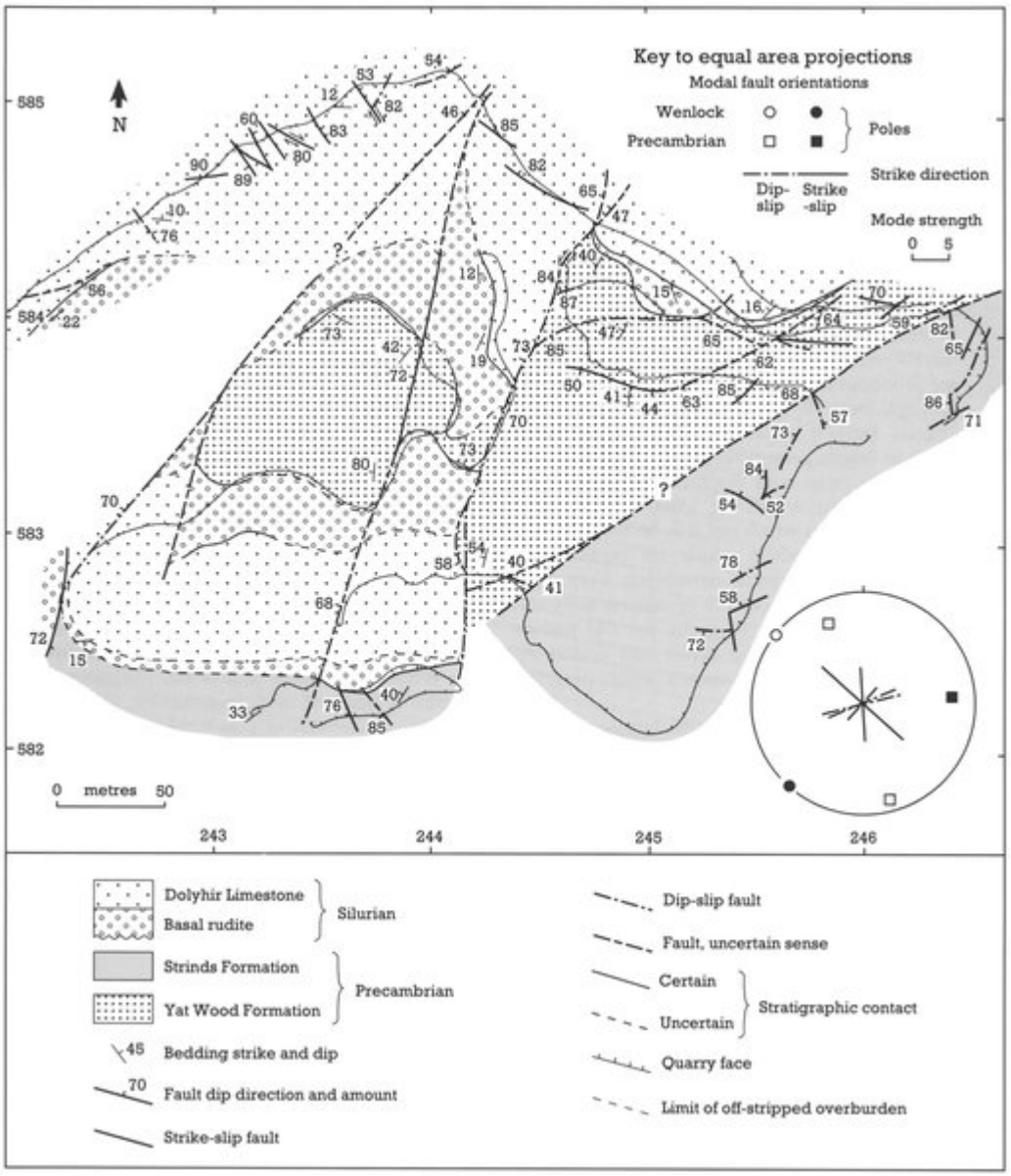
The Dolyhir Quarries provide good sections through the Caledonian Church Stretton Fault Zone, in an area of otherwise poor exposure. The stratigraphical and structural relationships at the locality place constraints on the timing of displacements along this important tectonic boundary. It is a major tectonic lineament which has a long history of activity in the zone between the Welsh Basin and the English Midlands. These relationships demonstrate the involvement of old basement in the fault movements, and, in particular, show an important component of post-Wenlock strike-slip fault

displacement. Although little can be said about the size of such displacements, there is considerable potential for future study of the part that this major lineament played in Caledonian earth movements.

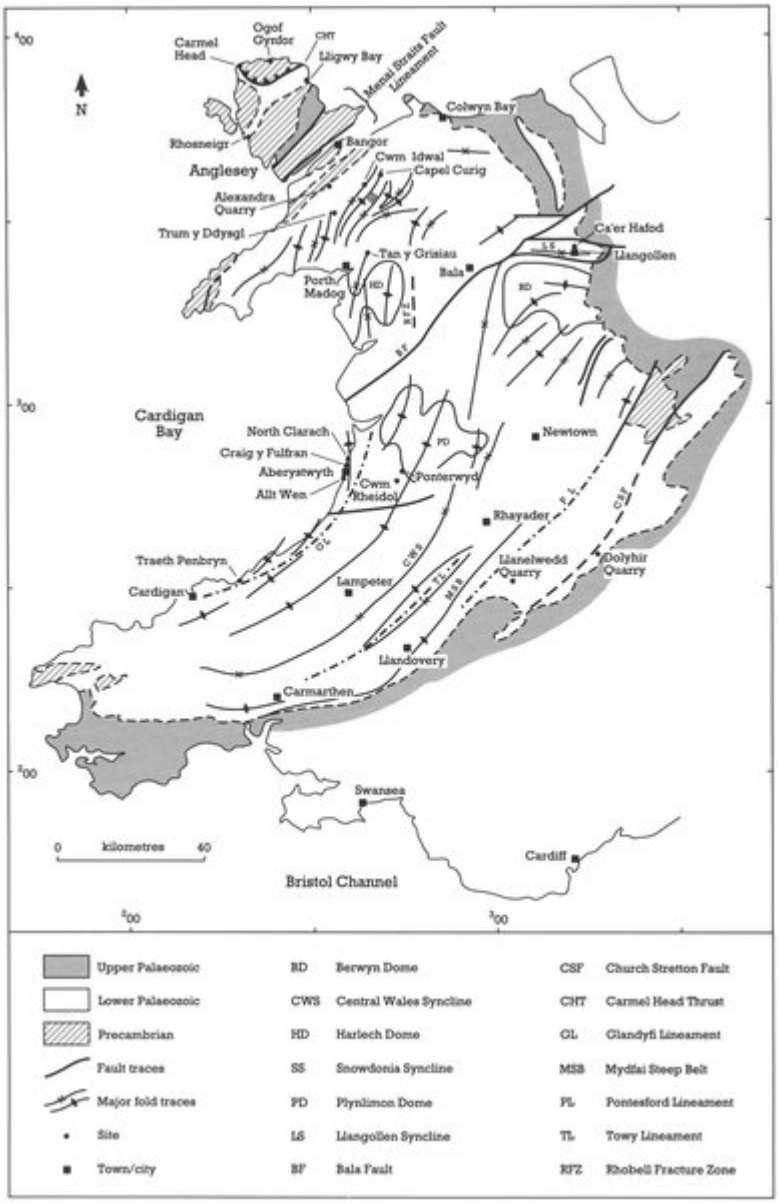
References



(Figure 4.24) Structural map of Strinds Quarry with inset stereogram showing modal orientations of strike-slip and dip-slip faults (after Woodcock, 1988).



(Figure 4.25) Structural map of Dolyhir Quarry with inset stereogram showing modal orientations of strike-slip and dip-slip faults (after Woodcock, 1988).



(Figure 4.1) Map showing the traces of the principal folds and faults of Caledonian age in Wales. The localities described in the text are also shown.