Llanelwedd Quarry

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Highlights

Llanelwedd Quarry provides the best-exposed section across the structures of the Pontesford Lineament, one of the major fault belts that was active between the Welsh Basin and the Midland Platform of England in Palaeozoic times.

Introduction

This working quarry exposes rocks of the Builth Igneous Complex (Llanvirn Series) of early Ordovician age, at the southern end of the Builth–Llandrindod Inlier. This inlier exposes a 'window' of Llanvirn and Llandeilo sedimentary and volcanic rocks, unconformably overlain by Upper Llandovery and Wenlock strata. Historically, most interest has focused on the volcano-sedimentary stratigraphy of the locality (Elles, 1940; Jones and Pugh, 1941, 1946, 1949; Fumes, 1978). In a structural context, this area is more important for the numerous fault zones that cut the section. These were first mapped by Jones and Pugh (1949) and interpreted as part of a strike-slip fault system by Jones (1954) and Baker (1971). The site lies in the zone of structures (Woodcock, 1984b), known as the Pontesford Lineament, which extends from the Cheshire Basin to South Wales (Figure 4.1). Although the lineament was intermittently active at least from mid-Ordovician times through to the Triassic, the principal fault displacements, both strike-slip and dip-slip, were late Ordovician to early Silurian (pre-Upper Llandovery unconformity). The best-documented displacements of up to 5 km, dextral movements, occur on faults in the Shelve Inlier, some 40 km north-east of the present site (Lynas, 1988). Woodcock (1984b) estimates that the total (dextral) movement in the zone could be in excess of 20 km. The locality has been used (Woodcock, 1987b) as an example of the structural architecture of a strike-slip fault belt.

Description

The geology of the quarry complex is summarized in (Figure 4.23), based mainly on exposures in four main arcuate working faces, each 20 m high. The map shows the position of the faces in 1984, but they are being continually worked back northwards. To remove the confusing effects of the stepped topography, the map is constructed as a projection on to a hypothetical smooth surface through the top of each face.

The lithological sequence is dominated by basalt lavas, mostly feldspar-phyric and highly vesicular. These contain intercalated agglomerates, a sandstone body and a dolerite sill. This structurally conformable sequence dips moderately westwards. It is cut by numerous faults, mostly striking approximately north, and dipping steeply eastwards. Three major zones of faults can be recognized, summarized as an inset on (Figure 4.23). A central zone mainly comprises NNE–SSW striking dip-slip faults. This zone separates eastern and western zones containing mostly strike-slip faults with the same strike. Minor E–W-striking strike-slip faults also occur. These faults dominate the overall structure, and about 57% of them are strike-slip, 31% oblique-slip, and only 12% are dip-slip faults. Fault slip directions can be determined from cataclastic slickensides and from slickenfibres, elongate crystal growths in the fault planes. The sense of slip can rarely be determined directly from these structures. Offsets of distinctive stratigraphical units can be used to obtain dip-slip senses, but are unreliable for most strike-slip faults, because the strike directions of bedding and faults are so close. The limited data show that most of the dip-slip faults have normal rather than reverse offsets, but that sinistral and dextral offsets on strike-slip faults are equally numerous. Many of the west-dipping 'bedding' surfaces, mainly boundaries of lava-flow units, have also acted as displacement planes. They show northerly strike-slip slickenlines.

Interpretation

The faults in Llanelwedd Quarry record an important strike-slip faulting event along the Pontesford Lineament. This event cannot be dated at this locality, but mapping of the whole Builth–Llandrindod Inlier (compilation by IGS, 1977) shows that many of the faults of the strike-slip system do not cut the unconformable Upper Llandovery (Lower Silurian) and younger cover. Regional evidence suggests an Ashgill (Late Ordovician) age as most likely (Woodcock, 1984b). Llanvirn and Llandeilo rocks in the Builth Inlier are displaced by the faults and Caradoc sequences do not match across the main fault in the Pontesford area. Later reactivation of the Pontesford Lineament is suggested north-east of the Builth area by its coincidence with the fold–fault zone of the Clun Forest Disturbance, affecting rocks as late as those of the Pridoli.

Although the kinematic interpretation of the Llanelwedd faults is made uncertain by the paucity of data on slip sense, Woodcock (1984b) has proposed that the main fault sets (shown in (Figure 4.23)) interact to form a linked system capable of accommodating three-dimensional bulk strain. Woodcock (1987b) suggests that the NNW–SSE strike-slip faults are sinistral and that they have played an antithetic role to more major, dextral, north-east-striking faults mapped beyond the quarry exposures (Jones and Pugh, 1949). These dextral faults seem to splay off the major Cwm Mawr Fault that forms the main element of the Pontesford Lineament within the inlier. Dextral faulting of late Ordovician age has also been suggested further along the lineament in the Shelve Inlier (Woodcock, 1984b; Lynas, 1988).

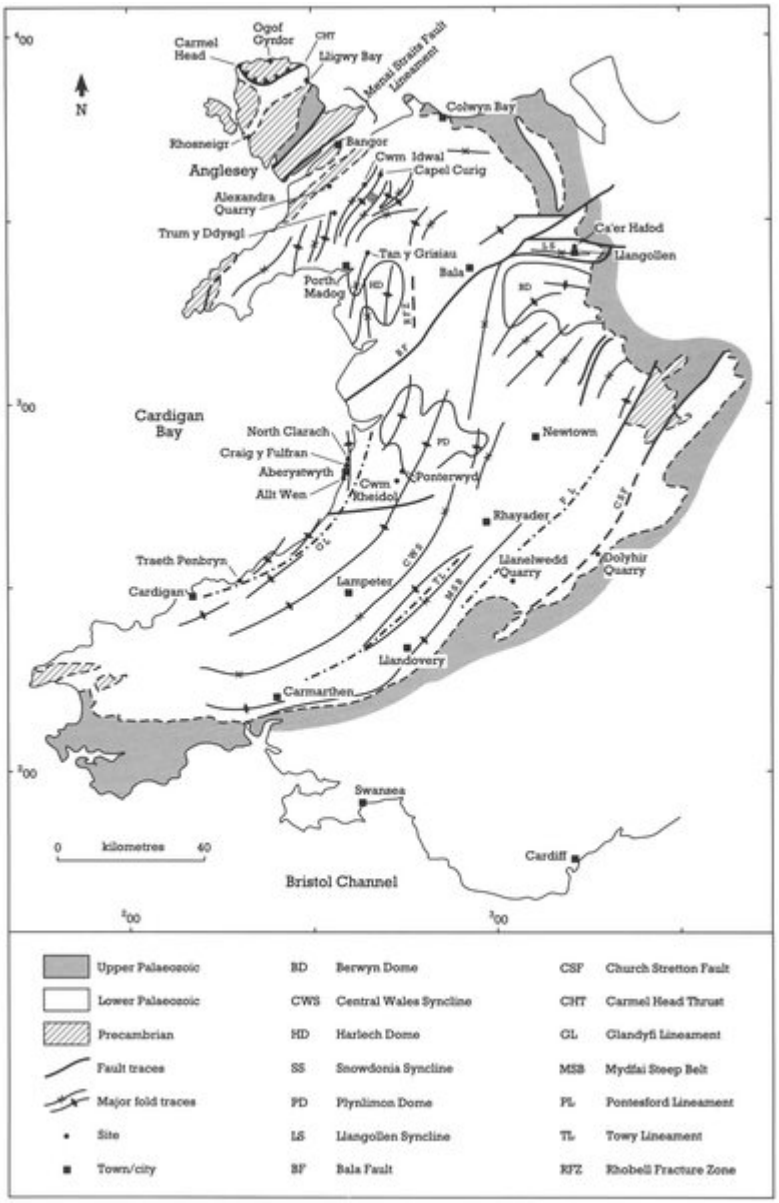
The Ashgill deformation event may have been responsible for juxtaposing the Welsh Basin against the Midland Platform from former, more distant positions (Woodcock and Gibbons, 1988). The suggestion of a dextral sense contrasts with the mainly sinistral displacements which are deduced from evidence across Wales of the main Acadian (late-Caledonian) deformation in late Silurian to early Devonian times. Due to generally poor, natural exposure along the Pontesford Lineament there are very few localities where the evidence for strike-slip is well displayed. Because it is an actively working quarry, Llanelwedd is presently the best-exposed locality. It is likely to remain an important site for testing changing hypotheses on the nature of the lineament.

The good constraints on the three-dimensional geometry of the structure at Llanelwedd give insights into the working of strike-slip fault systems in general. Of particular interest is the way in which four main fault sets (shown in (Figure 4.23)), including the bedding-parallel slip, interact to form a linked system capable of accommodating three-dimensional bulk strain (Woodcock, 1987b). The steep, NNW strike-slip faults dominate, with significant strike-slip on the westerly dipping bedding surfaces and bedding parallel faults. A zone of steep northerly striking dip-slip faults links two of the strike-slip strands and there is a weaker easterly striking set of strike-slip faults. When these four sets of faults are rotated so that the regional bedding is horizontal, three become vertical and one (parallel to bedding) horizontal, presumably their original attitude in late-Ordovician to early-Silurian times. The faults can then be seen as part of a linked, dextral, strike-slip system with accommodation of strain on to smaller dip-slip and bedding parallel faults. The locality is excellent for further detailed investigation of the mechanics of this sort of fault system.

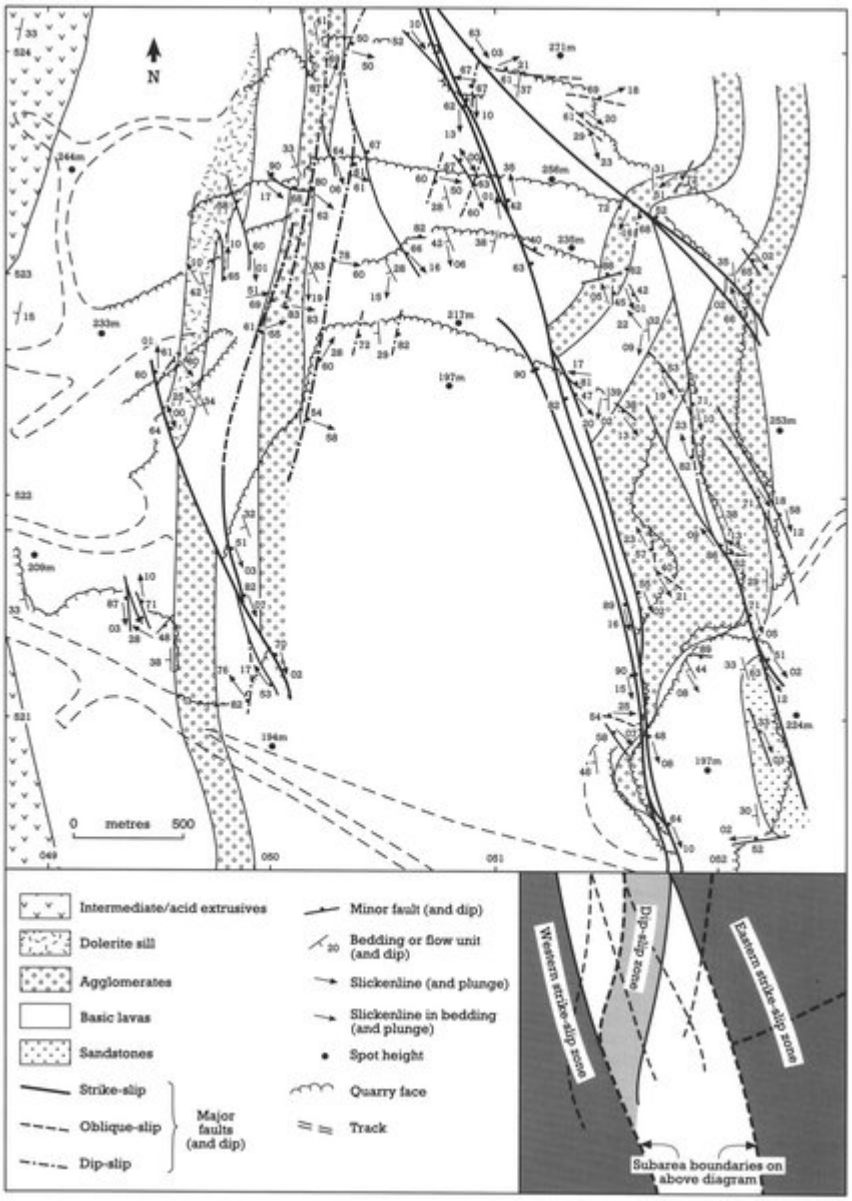
Conclusions

Llanelwedd Quarry is important as a well-exposed locality through the major fault belt known as the Pontesford Lineament. This fault belt was an active zone of dislocation between the Midland Platform and the Welsh Basin during Palaeozoic times. The rocks seen in the quarry are igneous (volcanic and intrusive) rocks of early Ordovician age. The site demonstrates the importance of strike-slip faulting during a deformation event, probably during the Late Ordovician Period (Ashgill), that might have involved large lateral displacements along the line of the lineament. The geometry of the fault system at the locality is also of some general interest in understanding the mechanics of strike-slip fault movements. This is an important site that allows observations on an otherwise poorly exposed feature, which is one of Britain's major Caledonian tectonic structures.

References



(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.



(Figure 4.23) Geological map of the main Llanelwedd Quarry with inset summary of main kinematic zones (after Woodcock, 1987b).