
Moel Tryfan

[SH 517 560]

Introduction

The summit of Moel Tryfan and the adjacent quarry offer important exposures of the lower part of the Cambrian succession of the Nantlle area, namely the Tryfan Grit Group, the Cilgwyn Conglomerate and members of the Llanberis Slates Formation (the Purple Slates, Dorothea Grit and Striped Blue Slates), forming the base of the Cambrian as recognized by Sedgwick (1852) in the historical type area.

Morris and Fearnside (1926) summarized early research in the area. Critical for understanding the geology was a tunnel (now closed) driven in 1876 north-westwards from Alexandra Quarry through Moel Tryfan. It became a focus for controversy over the base of the Cambrian when Hicks (1878, p. 152) recognized 'Pebidian' rocks of his 'Pre-Cambrian System' there. The full sequence in the tunnel was described by Blake (1893). Hughes (1917) studied the conglomerates and grits in neighbouring areas, but the most detailed account was given by Morris and Fearnside (1926), and this forms the basis of the present stratigraphy for the region. The area of Moel Tryfan was mapped by the British Geological Survey (1988a), and new information was given by Webb (1983).

Description

Parts of the lower units of the succession are well displayed around the summit of Moel Tryfan, while the higher divisions are superbly exposed in Moel Tryfan (or Alexandra) quarry. North-north-west of the summit, the lowest Cambrian sediments in the area (the Tryfan Grits 'Group') are exposed locally, but as this division is in general rather poorly exposed Morris and Fearnside (1926) took the type section in Moel Tryfan tunnel. The exposures show thinly bedded grey-green siltstones, fine sandstones and quartzose feldspathic tuffaceous sediments, dipping south-east at about 55°. They are extensively recrystallized, but in places structures resembling wavy bedding can be discerned.

The main exposure of the Cilgwyn Conglomerate on the summit of Moel Tryfan shows thickly bedded pebble and cobble conglomerates, dipping south-east at about 60°. Its contact with the Tryfan Grits below is not exposed but is described in the tunnel section as erosive, indicating slight disconformity (Morris and Fearnside, 1926). The thickness of the conglomerate unit here is estimated at 150 m but is variable. The conglomerates are clast-supported and contain rounded pebbles up to 15 cm across but elongated in the direction of cleavage (Morris and Fearnside, 1926). Clasts are mainly of Arvonian ignimbrites, with pink quartzites and jasper.

A large fault that is unexposed but which was observed in the tunnel section is assumed to cut out the Glog Grit 'Group', which elsewhere overlies the Cilgwyn Conglomerate.

Moel Tryfan Quarry (Figure 3.14) exploited an anticlinal fold of the lowest member of the Llanberis Slates Formation — the 'Purple Slates' of Morris and Fearnside (1926). The fold is bounded on the north-west and south-east by faults and is affected by numerous smaller faults and minor folds. The main body of the quarry exposes red, purple and green fine-grained slates, formerly quarried for durable good quality roofing-slates. Green reduction spots are common in the red slates. The cleavage is strong, dipping vertically or north-east at 80°. Bedding can be discerned only where there are thin sandstones: siltstones and sandstones occur regularly in the sequences exposed, with beds 1–2 cm thick being common and thicker (5–10 cm) beds occurring occasionally. They show an abundance of sedimentary structures, such as graded bedding, climbing ripple cross-lamination and, especially, convolute lamination. Some beds show parallel lamination both above and below a ripple cross-laminated division (Crimes, 1970a). Bases are sharp and erosive and may show flute casts and load structures. Some sandstones fine upwards into mudstones indistinguishable from the background slates.

Higher in the inferred succession, sandstones become thicker and more massive, forming the 'Dorothea Grit' of Morris and Fearnside (1926), which they found useful as a marker horizon in deciphering the structure. The Dorothea Grit, seen on the north-west side of the quarry (Figure 3.14), consists of thick- to medium-bedded coarse greywacke sandstones, generally 10–50 cm thick, but occasionally reaching 1 m in thickness. Some beds have pebbly bases, with grains 2–3 mm in size, and most beds show upward fining. Fine parallel-laminated and cross-laminated sandstones occur occasionally at the tops of these beds. Higher, the sandstones become thinner and fewer and appear to pass upwards into the 'Striped Blue Slates' of Morris and Fearnside (1926), seen on the south-east side of the quarry. Thin siltstones and sandstones are common, giving the rock a striped appearance. These beds are the highest exposed and dip south-east at about 50°.

Interpretation

The Tryfan Grit 'Group', which was best seen in the tunnel and was estimated by Morris and Fearnside (1926) to be 300 m thick, consists of a lower division of coarse sandstones and an upper division of sandstones and finely laminated siltstones. Poorly welded quartzose-feldspathic tuffs occur within the sandstones. The Tryfan Grits are underlain by the Arvonian volcanic rocks (locally known as the 'Clogwyn Volcanics') of Precambrian age. In the tunnel the contact was not faulted, so, as at Llyn Padarn, the tuffs in the sedimentary Cambrian sequence indicate a genetic link between the highest Precambrian and lowest Cambrian rocks. No strong unconformity is seen at this horizon, but the Tryfan Grits are of variable thickness and either pinch out laterally or are absent laterally on account of strike-faulting. The nature of the contact between the Arvonian Volcanic Group and the Cambrian sediments remains uncertain. Cattermole and Jones (1970) suggest that there was not a large time-break between these horizons, but that deposition of the Tryfan Grits occurred on an irregular surface formed in Arvonian times.

The Cilgwyn Conglomerate above contains rounded pebbles that can be matched with the local Clogwyn volcanic rocks and with the Mona Complex now exposed on Anglesey (Crimes, 1970a), suggesting derivation from a source in that direction. The overlying Glog Grits (not seen at Moel Tryfan) were deposited in shallow water, according to Morris and Fearnside (1926). The top of this unit and base of the Llanberis Slates Formation are generally faulted, but the character of the Llanberis Slates which are dominantly fine-grained sediments, with packets of graded greywacke sandstones, suggests that the sandstones were deposited by turbidity currents in fairly deep marine conditions. The thicker sandstones of the Dorothea Grits Group show Bouma (1962) sequences of *a* or *ab* type and are proximal turbidites deposited under conditions of high-flow regime. The thinner sandstones within the finer-grained parts of the succession show *bcd* or *cd* Bouma sequences. They were deposited from low- to medium-density flows from a more distal source. Thickness variations within the Dorothea Grit and the complicated structures it shows indicate fault control during deposition (Morris and Fearnside, 1926; Webb, 1983).

Sandstones of the Llanberis Slates have not yielded useful palaeocurrent information, so the source area for those beds remains problematical. The few pebble horizons include fragments of quartzite, jasper and green schist, which could all have been derived from the Mona Complex of Anglesey. However, in some sandstones, blue quartz grains are abundant, as in the Rhinog Formation (see site report for Barmouth Hillside). Blue quartz is not present in local Precambrian rocks, but it has been discovered in southern Leinster (Crimes, 1970a), although this is not necessarily the source area.

The lower sandstones and conglomerates represent shallow-water deposition, and the higher mudstones with intercalated sandstones represent turbidity-current sedimentation in deeper water. Thus, as at Llyn Padarn, subsidence of the area must have occurred throughout this interval to accommodate a thick sequence in a deepening marine basin.

Conclusions

This site exposes rocks of the lower part of the Cambrian in the Arfon area, a classic area in which the Cambrian concept was conceived. The succession of conglomerates and coarse sandstones overlying the Padarn Tuff and succeeded by deeper-water mudstones with occasional sandstones (Llanberis Slates Formation) exemplifies the Lower Cambrian transgression in the Welsh Basin.

References



(Figure 3.14) Alexandra Quarry, Moel Tryfan, looking south-west, showing vertically cleaved Llanberis Slate dipping at about 45° to the left. The Dorothea Grit to the right does not show the cleavage conspicuously. (Photo: British Geological Survey photographic collection, L2333.)