Dol-cyn-afon

[SH 7941 2873]

Introduction

The stream section at Dol-cyn-afon is the basal stratotype locality for the Dol-cyn-afon Formation and one of the best sites exposing the transition from the Dolgellau Formation (Merioneth Series, Upper Cambrian) to the Dol-cyn-afon Formation (Tremadoc Series, Lower Ordovician). The *Acerocare* Zone is overlain by a low Tremadoc assemblage including *Rhabdinopora flabelliformis.*

The lithological change across the Merioneth–Tremadoc boundary from black mudstones to dark-grey, silty mudstones has long been recognized, and the transitional section in the Dol-cyn-afon stream was discovered during the British Geological Survey's resurvey of the area (Allen and Jackson, 1985). Allen *et al.* (1981) gave an account of the geology of the area and described the section. The biostratigraphy and correlative potential of the site was discussed by Rushton (1982). More detailed sedimentological information is contained in Prigmore (1994).

Description

The Dol-cyn-afon stream section exposes *c.* 80 m of strata, commonly dipping at about 20°, or locally more steeply (about 60°), to the southwest. It exposes a transition from the Dolgellau Formation to the Dol-cyn-afon Formation.

The Dolgellau Formation consists of laminated silty mudstones and shales (two or three laminae per millimetre), alternating with laminae of dark-grey and black carbonaceous mudstone. The organic carbon content is high and bioturbation is completely absent. Pyrite is present throughout, both as framboids and as bands of euhedra. Thin (<1 mm) laminae of pale-grey, pyritous, fine-grained sandstone also occur occasionally.

The Dolgellau Formation passes upwards into the Dol-cyn-afon Formation, which is generally tougher and more massive. It consists of striped light- and dark-grey laminated mudstones and contains less organic carbon than the Dolgellau Formation. Dark-grey laminae are usually about 1 mm thick, whereas light-grey laminae are 2–3 mm thick; black laminae are generally absent. Bioturbation is present sparingly and causes some disruption of the lamination. Phosphate nodules and pyrite layers and lenses are common.

In the transition beds, packets of Dolgellau Formation lithology are interbedded with intervals of Dol-cyn-afon type rocks through a thickness of approximately 10–20 m, so the lithostratigraphical boundary is not sharply defined. Allen *et al.* (1981) chose an arbitrary boundary for the base of the Dol-cyn-afon Formation (originally defined as a Member), at the base of a banded dark-grey mudstone 47 cm thick that broadly separates the carbonaceous mudstones below from the less organic-rich silty mudstones of the transitional zone, here some 30 m thick.

The upper part of the Dolgellau Formation yields fossils of the *Acerocare* Zone (including some rarities such as *Acanthopleurella* and *Dichelepyge*) . The zonally significant trilobite *Parabolina heres* Brögger (*sensu lato*) extends to within about 4 m of the top of the formation. The lowest *Rhabdinopora* occurs about 10–12 m above the base of the Dol-cyn-afon Formation, but the species is undeterminable. *Rhabdinopora flabelliformis socialis* occurs, with sponge spicules, *Eurytreta sabrinae* (Callaway), hyolithids, *Beltella* sp. and *Niobella bomfrayi* (Salter), 37 m higher in the section and ranges up for 12 m. Above this the section is disturbed by folding and faulting.

Interpretation

The Dol-cyn-afon section shows changes in patterns of sedimentation across the Merioneth–Tremadoc boundary. The section at Brin-llin-fawr is clearer biostratigraphically, but at Dol-cyn-afon the lithological changes around the basal stratotype of the Dol-cyn-afon Formation are more clearly seen. The subtle colour change from black to dark-grey

mudstones across this boundary may be related to the loss of conditions suitable for the preservation of organic carbon in large quantities. The black mudstones of the Dolgellau Formation were deposited in quiet, restricted environments, with little sedimentary input. The preservation of lamination and absence of bioturbation suggest that anoxic conditions prevailed. Conditions changed slightly as deposition of the Dol-cyn-afon Formation began. Signs of bioturbation indicate that levels of oxygenation were rising, and an increased supply of muddy sediment reflects the development of more open marine conditions. Changes in style of sedimentation in many parts of the world at this horizon have been linked to a eustatic sea-level rise. There is evidence from around the world for a eustatic sea-level fall at the top of the Cambrian, followed by an early Tremadoc sea-level rise (e.g. Erdtmann and Miller, 1981; Fortey, 1984). This event, enhanced by local tectonic controls, was probably responsible for the change in sedimentation seen here.

Conclusions

The Dol-cyn-afon stream section is the type locality for the Dol-cyn-afon Formation and contributes to the recognition and correlation of the Cambrian–Ordovician boundary in Wales and elsewhere. The section shows a subtle colour change in the rocks near this boundary; this can be related to increasing levels of oxygen in the water and may be linked to a global contemporary rise in sea level.

References