Cwar yr Ystrad and Hendre, Powys

[SO 082 141] and [SO 099 149]

Introduction

These two disused quarries at Cwar yr Ystrad [SO 0815 1410] and Cwar yr Hendre [SO 0995 1492], 6 km north-east of Tredegar, provide the best outcrops of both the lower part of the Courceyan–Chadian Abercriban Oolite Group-Clydach Valley Group and the Arundian Llanelly Formation; the Gilwern Oolite having been removed by erosion in this area before the Llanelly Formation was deposited. The succession was formed in very shallow marine waters no more than a few metres deep, and numerous falls in sea level led to prolonged periods of subaerial exposure which produced dissolution effects best seen at Cwar yr Ystrad at the top of the Abercriban Oolite Group-Clydach Valley Group, and spherulitic, nodular and dolomitic horizons representing fossil soils. The spherulitic calcretes are highly unusual but similar horizons occur in Belgium and southern Germany. Together, these two sites provide an outstanding set of exposures in which it is possible to examine a range of features that formed during sea-level fluctuations.

George (1954) described the overall succession in these outcrops and Barclay (1989) revised the stratigraphy. Wright (1981a) described the sedimentology of the Llanelly Formation and Sear! (1988c) provided detailed information on the sedimentology and diagenesis of the Abercriban Oolite Group–Clydach Valley Group. Faulkner *et al.* (1990) briefly described some of the exposure features at Cwar yr Ystrad.

Description

The two sites are at the boundaries of a large quarrying complex that has been used intermittently for many years. Up to 25 m of the Abercriban Oolite Group is exposed, capped by a few metres of the Llanelly Formation (Figure 9.16). The floor of the disused quarries consists of fine-grained dolomite that may correspond to the Sychnant Dolomite, the lowest unit in the Abercriban Oolite Group–Clydach Valley Group (Barclay, 1989). This is overlain by a few metres of oolitic grainstone with an irregular top (the Pwll y Cwm Oolite) capped by a metre of dolomite, spherulitic and columnar calcite and green shale, probably corresponding to the Pantydarren Beds. Barclay (1989) provided a basic log of the section. Sear! (1988c) carried out detailed studies of the sections below the Llanelly Formation.

Of particular note are the nodular to lensoid to stratiform ferroan dolomites within the sections (Sear!, 1988c), associated with rootlet horizons, organic-rich shales and thin coals. These are also associated with spherulitic and columnar calcites (Sear!, 1989b; Faulkner *et al.,* 1990). These are best developed in the Pantydarren Beds (the 'Daren Ddu Beds' of some authors), and at Cwar yr Ystrad there are two levels with spherulitic and columnar calcites, separated by a bioclastic, peloidal and oolitic limestone up to 3 m thick. Fish remains are common in this limestone.

This is overlain by approximately 14 m of Blaen Onnen Oolite, capped by a rubbly horizon up to 5 m thick. Possible palaeosol horizons occur within this unit, which consists of bioclastic and oolitic grainstones.

The section at Cwar yr Hendre is a cliff face near the entrance to the main quarry. It has a talus apron allowing easy access to a 4 m section of the Llanelly Formation, and this long section also exposes two normal faults forming a small graben-like structure. Several metres of the Blaen Onnen Oolite are exposed, with horizons of sparitic calcite nodules which probably represent palaeosols. The Llanelly Formation is condensed here (Figure 9.17), with the lower two members being only 3.5 m thick. A single calcrete palaeosol, less than 1 m thick, overlies the Blaen Onnen Oolite and constitutes the Clydach Halt Member. This is overlain by a 40 cm-thick coarse bioclastic horizon, the Hendre Bed, with oncoids, dasycladacean algae (*Koninckopora*) and foraminifera (Wright, 1981a), marking the base of the Cheltenham Limestone Member. This is overlain by another palaeosol, and in the remaining metre or so of this member, two other palaeosols can be recognized, corresponding to the Darrenfelen and Cwm Dyar geosols of Wright (1981a). Only 1 m of the overlying Penllwyn Oolite Member is easily accessible, but just above its base is a prominent bed with abundant oncoids, several centimetres in diameter. These are commonly found at the base of the cliff in large slabs. The bed

occurs within a unit containing the problematic *Uraloporella* in abundance, and constitutes the equivalent of the Uraloporella Bed at the base of the Penllwyn Oolite Member. The oncoids contain laminae with spongiostromate and porostromate microfabrics, as well as dark laminae of fascicular optic calcite (Wright, 1981a,c). Similar oncoids occur widely at this horizon in the region but are most abundant at this site and at Cwar yr Ystrad. The Gilwern Clay Member of the Llanelly Formation is exposed, but is not accessible, within the small graben area of the section, and this is composed of medium-bedded sandstones and mudstones.

About 8 m of the Llanelly Formation are recorded from Cwar yr Ystrad although parts of the section, including the Cwm Dyar Geosol (4 m above its base), are now obscured by recent quarrying operations. The original section exposed a thick calcrete palaeosol (the Cwm Dyar Geosol) with abundant fractures, in some of which large calcite spherulites (12–15 cm diameter) had grown (Dixon and Wright, 1983). This site showed that such problematic spherulitic horizons were related to calcrete palaeosol development. This palaeosol unit can be accessed with care along this main section, where spherulitic horizons are associated with ferroan dolomites. Oncoids with fascicular optic calcite are abundant in the Uraloporella Bed overlying the Cwm Dyar Geosol.

The Blaen Onnen Oolite is of Courceyan age (Barclay, 1989), with the base of the *Pseudopolygnathus multistriatus* Zone occurring within the unit. The Llanelly Formation has produced foraminifera (Barclay, 1989) and conodonts (Stone, 1991) indicating an Arundian age.

Interpretation

The key aspect of these sites relates to the range of exposure features that are displayed, including spherulitic calcites and nodular ferroan dolomites, green clays, calcretes and rubbly horizons. These constitute a distinct assemblage of features important for identifying sea-level changes. The rubbly horizon at the top of the Blaen Onnen Oolite has been interpreted as a palaeo-karstic horizon, produced by dissolution by rainwater following a retreat of the sea, under a humid climate (Wright, 1982a). The overlying palaeosols in the Llanelly Formation indicate a semi-arid climate (Wright, 1982b). At Cwar yr Hendre, the close vertical juxtaposition of many exposure features at the top of the Blaen Onnen Oolite and in the Llanelly Formation is a classic example of the sorts of successions that develop on the edges of carbonate ramp deposystems. The spherulitic and columnar calcites in the Llanelly Formation and in the Pantydarren Beds are highly unusual and have no exact modern soil analogue, yet are associated only in the region with exposure features, and have been interpreted as pedogenic in origin by Searl (1989b). They are not replaced evaporites. They pass laterally into nodular horizons resembling calcretes in the Pantydarren Beds, and are associated with less ambiguous calcretes in the Cwm Dyar Geosol in the Llanelly Formation at Cwar yr Ystrad. The lensoid to nodular ferroan dolomites have been interpreted by Searl (1988c) and Wright *et al.,* (1997) as the products of coastal marshes, and may have formed after calcrete development, but immediately ahead of the marine transgression leading to the deposition of the Blaen Onnen Oolite. This distinctive association of spherulites, calcretes and ferroan dolomites represents a subaerial diagenetic facies association which has also been recorded from the late Tournaisian–early Viséan sequences of Belgium and Germany (Faulkner *et al.,* 1990).

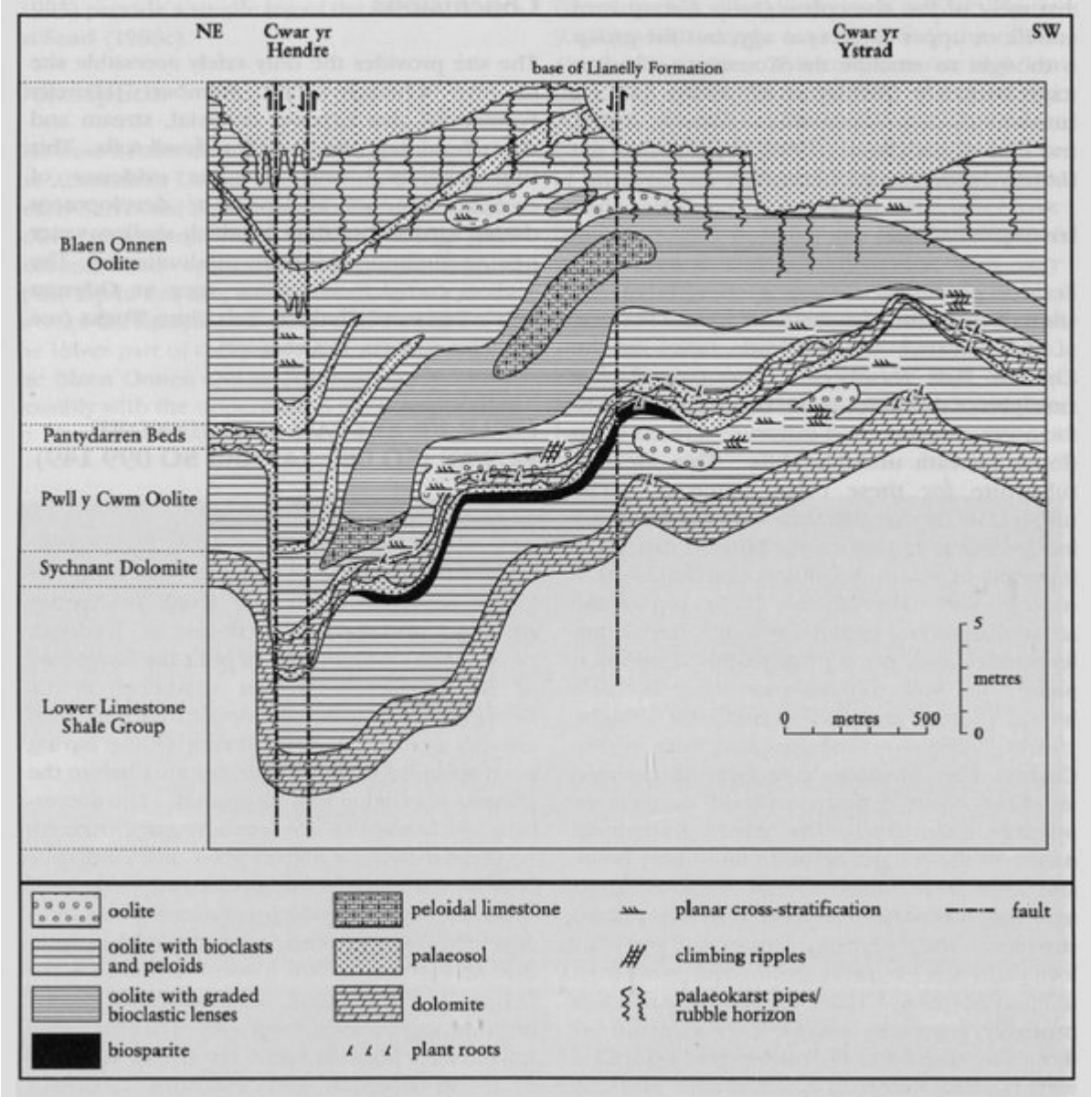
Many of the oncoids in the Uraloporella Bed in the Llanelly Formation show evidence of having had hollow nucleii, which is a characteristic of oncoids that have initially grown on plant stems before becoming detached when the plant died. The fascicular calcite laminae probably represent microbially mediated primary calcitic cements. Such oncoids are very rare in the geological record.

Conclusions

Besides providing exposures through the middle part of the Lower Carboniferous succession, the sites reveal a unique association of exposure features allowing their complex relationships to be determined. The Llanelly Formation, particularly at Cwar yr Hendre, illustrates the complex association of exposure surfaces and shallow-water limestones that characterize the depositional edge of carbonate platforms. The association of calcretes, pedogenic spherulitic and columnar calcites, and ferroan coastal marsh dolomite palaeosols found in the Pantydarren Beds and the Llanelly Formation provides the best example of the types of exposure features associated with lowstand surfaces of early

Carboniferous times. Grainstones associated with the Pantydarren Beds at Cwar yr Ystrad contain common fish remains and warrant more detailed study.

References



(Figure 9.16) Sedimentary facies within the Clydach Valley Group–Abercriban Oolite Group in the Cwar yr Hendre and Cwar yr Ystrad area. The Pantydarren Beds contain a range of exposure-related features, including coastal marsh dolomites. After Searl (1988c).

(Figure 9.17) Section of strata at Cwar yr Hendre illustrating the unconformity between the marine Courceyan Blaen Onnen Oolite (BOO) and the overlying Arundian–Holkerian sequence comprising peritidal and terrestrial deposits of the Llanelly Formation (LF) and marine beds of the Dowlais Limestone (DoL). Evidence of this unconformity is seen in the development of a palaeokarst and pedogenic fabrics in the rubbly top of the Blaen Onnen Oolite. Note the development of the soft-weathering Gilwem Clay Member towards the top of the Llanelly Formation, and the prominent steeply dipping fault towards the right side of the figure. The height of the quarry face is approximately 20 m. (Photo: P.J. Cossey.)