Clydach Halt Lime Works, Gwent

[SO 234 126]

Introduction

The Clydach Halt Lime Works GCR site, at the disused Clydach Halt Lime Works [SO 2342 1261], 4 km east of Brynmawr, is the type section for the Arundian Clydach Halt Member of the Llanelly Formation, and contained within it are excellent exposures of fossil soils (palaeosols). The unit represents an extended period of soil development during a major, regional retreat of the sea, exposing newly formed limestones to weathering and soil formation under different climatic conditions. The member is underlain by the Gilwern Oolite, which formed in very shallow water but became exposed to rainwater following a sea-level fall leading to extensive dissolution. The member provides an example of the sorts of complex histories associated with marginal marine terrestrial land-surfaces. This section is also the type locality for the Cwm Dyar Geosol, a prominent fossil soil. George (1954) provided early descriptions of the section. Detailed accounts of the sedimentology and palaeosols have been given by Wright (1981a, 1982b) and Barclay (1989).

Description

This site was used for lime production, from at least the mid-19th century until about 1959 (van Laun, 1979). It covers both the accessible southern, smaller quarry and the larger, largely inaccessible main face to the north. The oldest exposed beds comprise shelly crinoidal dolomite representing the Blaen Onnen Oolite (3 m) and these are overlain by the Coed Ffyddlwn Formation. Barclay (1989) provides a log of this section marked as the 'Cwm Quarries'. The Coed Ffyddlwn Formation (12 m) consists of medium-bedded, largely dolomitized peloidal limestones with minor thin shale and clay bands. The main part of the south quarry provides a near-continuous section in the Llanelly Formation (18 m), together with the top few metres of the underlying Gllwern Oolite. The top of this oolite is rubbly with numerous small pipes filled with light-green clay (Wright, 1982a). Overlying it is the Clydach Halt Member (averaging 1.4 m in thickness) of the Llanelly Formation (Figure 9.8), with nodular to columnar to prismatic, finely crystalline pedogenic calcretes (Wright, 1982b). Within it, two main horizons can be identified, with the lower one preserved apparently in a depression in the top of the Gilwern Oolite (Figure 9.8). Each calcrete would correspond to developmental stages 3–4 in the classification of Machette (1985). Separating the two calcrete units is a discontinuous conglomerate composed of reworked calcrete and oolite clasts, set in a calcrete matrix (Figure 9.8). Within the upper calcrete unit are irregular lenses and nodules of brown-weathering ferroan dolomite (Figure 9.8). The first bed of the overlying Cheltenham Limestone Member is a 15 cm-thick ostracode-bearing limestone. The rest of this member (total thickness of 7.6 m) consists of peloidal limestones with a restricted biota of vermiform gastropods (?microconchids) and ostracodes with oncoids and microbial laminites. Detailed sedimentological descriptions of this unit are to be found in Wright (1981a). Thin green clay horizons also occur in the member, and one of these, 6.1 m above the base, is associated with a calcrete crust horizon a few centimetres thick, the Darrenfelen Geosol (Wright, 1981a). At 6.8 m above the base of the member is a prominent clay-rich horizon, 0.5 m thick, with highly contorted centimetre-thick plates of finely crystalline calcrete (pseudo-anticlines), the Cwm Dyar Geosol, marking the top of the member (Figure 9.9). It is overlain by the bioclastic grainstone, the Uraloporella Bed, which forms the base of the Penllwyn Oolite Member (total thickness of 4.1 m) of the Llanelly Formation. The unit consists of oolitic and peloidal limestones with grapestone-like aggregates. The uppermost member of this formation, the Gilwern Clay Member (3.5 m), is partially exposed but is difficult to access near the top of the northern quarry, where the unit is broadly similar in nature to that found in nearby Llanelly Quarry and consists of red and green clays with calcrete nodules. A few metres of the overlying Dowlais Limestone are also exposed at the top of the northern quarry.

The Blaen Onnen Oolite, the Coed Ffyddlwn Formation and the Gilwern Oolite comprise the upper part of the Clydach Valley Group of Barclay (1989). The age of the unit is problematic (Barclay, 1989), with macrofossils from the base of the Gilwern Oolite (the Coral Bed) indicating an Arundian age, but forami-nifera and conodonts suggesting a Chadian age (Figure 9.2). The Llanelly Formation has produced foraminifera (Barclay, 1989) and conodonts (Stone, 1991) indicating an Arundian age. The Dowlais Limestone is of Holkerian age (Barclay, 1989).

Interpretation

The key features of this site are the exposures of the Clydach Halt Member and the Cwm Dyar Geosol. The juxtaposition of the highly solution-weathered top of the Gilwern Oolite and the calcrete-bearing palaeosols of the Clydach Halt Member could only be explained by invoking a climate change between the two units. The top of the Gilwern Oolite is a major subaerial exposure surface in the region, and although better exposed in other sections, its relationship with the Clydach Halt Member makes this small site an important one. The nature of the palaeokarst at the top of the Gilwern Oolite has been discussed by Wright (1982a), and probably represents a relatively short-lived humid phase. The Clydach Halt Member, with its calcretes (Figure 9.8), is best explained as the deposits of a semi-arid landscape, with stable terrace surfaces on which calcrete-bearing soils developed, cut through by stream-flood and sheet-flood deposits. The calcretes correspond to highly developed forms indicating that the land surfaces on which they formed existed for long periods of time, perhaps as much as several hundred thousand years in each case for the two calcretes. The conglomerate separating the two calcretes probably represents a minor stream-flood deposit, which was itself calcretized. The process of calcretization has taken place largely within clays, but locally the oolitic grainstones of the Gilwern Oolite have also been replaced by calcrete. The ferroan dolomite lenses and nodules are identical to other forms found widely in the pre-Holkerian successions in the region, and were analysed by Wright *et* al. (1997), and interpreted as having formed as primary precipitates and not as a replacement of calcrete, in a brackish marsh. It seems likely that this brackish event occurred immediately before the deposition of the first ostracode-bearing limestone of the restricted marine Cheltenham Limestone Member. However, because of the ambiguous relationships between the ferroan dolomite and the host calcrete it is not possible to categorically identify which was the earlier, and it is possible that the brackish event occurred before formation of the upper calcrete.

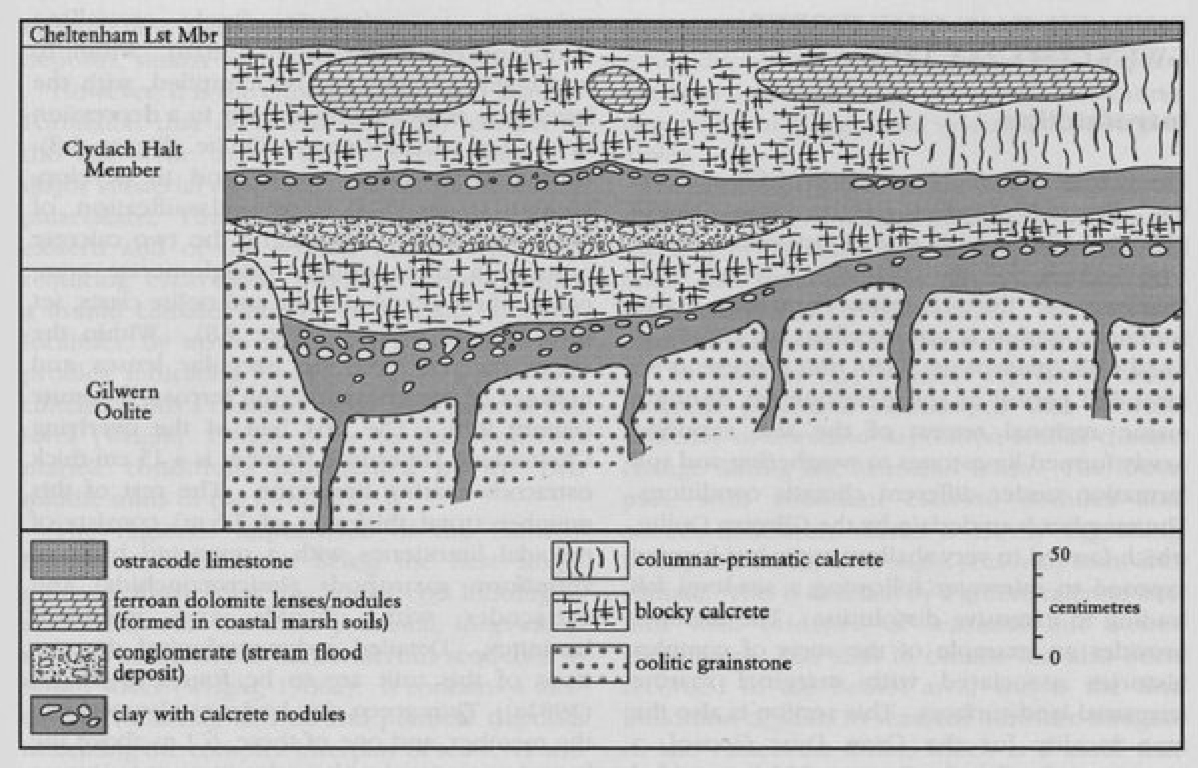
Restricted marine conditions prevailed during the deposition of the Cheltenham Limestone Member, with subaerial exposure surfaces represented by the thin palaeosol, the Darrenfelen Geosol (Wright, 1983), and the prominent Cwm Dyar Geosol capping the member. This latter palaeosol is a stage 3-type calcrete representing a prolonged period of soil formation and suggests that the Cheltenham Limestone Member represents a late highstand to lowstand system tract (Wright, 1996).

The Penllwyn Oolite Member represents very shallow water, protected, back-shoal deposition, with the Uraloporella Bed forming the transgressive base to this unit. The overlying Gilwern Clay Member is a floodplain deposit which at nearby Llanelly Quarry (see GCR site report, this chapter) reveals a complex history of climate change and marine flooding. The Dowlais Limestone is a low-energy, marine deposit, which was probably deposited in a very broad non-restricted lagoon.

Conclusions

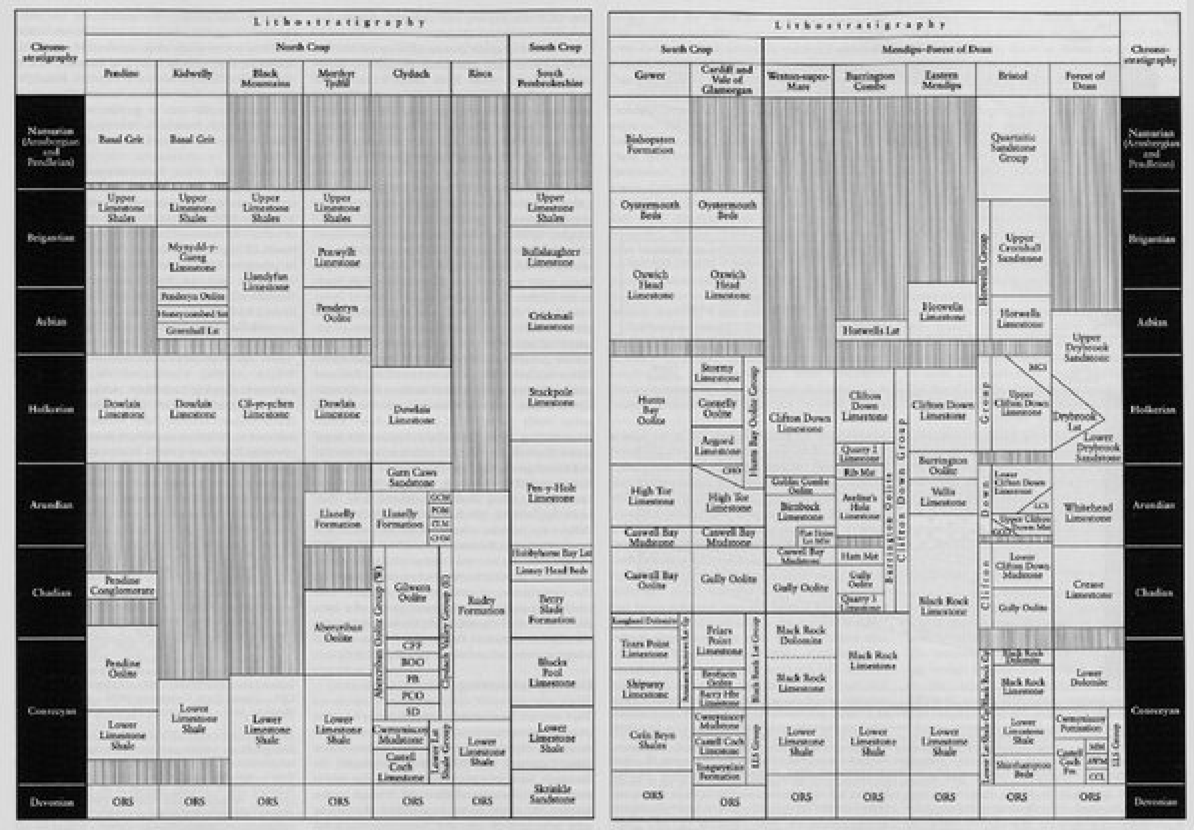
The site contains a well-exposed section through the middle part of the Lower Carboniferous succession; however, its main importance is that it provides a unique glimpse into the nature of the early Carboniferous landscape and its climates. The calcrete palaeosols and associated deposits reveal that there was a major period of exposure prior to the Arundian, with a short humid phase followed by a prolonged semi-arid phase. The humid phase created an extensive rubbly palaeokarstic horizon at the top of the Gilwern Oolite. Calcrete soils developed over long periods on stable land surfaces, with minor erosion phases, during the semi-arid phase. During early transgressive phases, ferroan dolomites developed in brackish marshes.

References



(Figure 9.8) Schematic representation of the complex relationships found in the Clydach Halt Member at Clydach Halt Lime Works. The Gilwern Oolite was deposited in very shallow marine conditions and exposed by a fall in sea level. It underwent dissolution by rainwater to produce a distinctive type of rubbly palaeokarst horizon, in a humid climate. This is overlain by two calcrete palaeosols separated by a thin conglomerate composed of calcrete and oolite clasts. This thin conglomerate was also calcretized. The lower calcrete is preserved in a small depression in the top of the Gilwern Oolite but in other sections at the site only the upper calcrete is visible. See text for further details. After Wright (1982b).

(Figure 9.9) Deformed calcretes (pseudo-anticlines) of the Cwm Dyar Geosol in the Cheltenham Limestone Member of the Llanelly Formation at Clydach Halt Lime Works. (Photo: V.P. Wright.)



(Figure 9.2) Simplified stratigraphical chart illustrating the most widely used lithostratigraphical terms for the Lower Carboniferous sequences in South Wales, the Forest of Dean, Bristol and the Mendips. (SD — Sychnant Dolomite; PCO — Pwil y Cwm Oolite; PB — Pantydarren Beds; BOO — Blaen Onnen Oolite; CFF — Coed Ffyddlwn Formation; CHM — Clydach Halt Member; CLM —Cheltenham Limestone Member; POM — Penllwyn Oolite Member; GCM — Gilwern Clay Member; LIS —Lower Limestone Shale; CHO — Cefnyrhendy Oolite; CCL — Castell Coch Limestone; AWM — Astridge Wood Member; MM — Mitcheldean Member; GCO — Goblin Combe Oolite; LCS — Lower Cromhall Sandstone; MCS — Middle Cromhall Sandstone.) Areas of vertical ruling indicate non-sequences. Not to scale. Based on information from and after Welch and Trotter (1961), Green and Welch (1965), Institute of Geological Sciences (1973, 1977c), George et al. (1976), Wright (1982b), Whittaker and Green (1983), Burchette (1987), Waters and Lawrence (1987), Barclay et al. (1988), Scott (1988), Barclay (1989), Wilson et al. (1990) and Kellaway and Welch (1993).