
Odynau Tyle'r Bont, Powys

[SO 063 113]

Introduction

The Odynau Bont GCR site is a disused quarry [SO 0635 1125], 5 km north of Merthyr Tydfil. It exposes the top of the Courceyan–Chadian Abercriban Oolite Group and the lower part of the Arundian Llanelly Formation. The lowermost unit of this formation, the Clydach Halt Member, contains a unique exposure of a set of well-developed fossil soils (palaeosols) which formed on a land surface during a period of major sea-level fall in early Carboniferous times. Six palaeosols are recognized here and these can be compared to present-day calcrete soils found in semi-arid regions. Not only does the site provide evidence of the prevailing climate at this time, but the developed nature of the palaeosols tells us that the area was a land surface for a very long period of time, with each palaeosol possibly having required several hundred thousand years in which to form. Underlying the palaeosols is the rubbly top of the Abercriban Oolite. The rubbly effect is due to a period of rain-water dissolution following exposure of the shallow-water oolite by a fall in sea level. The juxtaposition of dissolution features and semi-arid palaeosols is evidence of climatic change during the Carboniferous Period. The Cheltenham Limestone Member of the Llanelly Formation overlies the palaeosols and exhibits typical features found in very shallow-water limestones. George (1954) provided descriptions of the section. Further details are to be found in Wright (1981a) and Barclay *et al.* (1988).

Description

The key feature of this site is the development of a set of calcrete profiles in the Clydach Halt Member of the Llanelly Formation. The top of the underlying Abercriban Oolite displays minor nibbling, a characteristic of the top of this unit and its equivalent to the east, the Clydach Valley Group (Barclay *et al.*, 1988; Barclay, 1989). This rubbly horizon in the Clydach Valley Group at sites such as Llanelly Quarry (see GCR site report, this chapter) and Clydach Halt Lime Works (see GCR site report, this chapter) is hosted in the Gilwern Oolite, which is probably of Chadian age (Barclay, 1989). However, due to the progressive erosion and overstep of the Abercriban Oolite Group–Clydach Valley Group by the Llanelly Formation (George, 1954; Barclay *et al.*, 1988), the rubbly horizon is here at a lower level in the stratigraphy and may equate to the top of the Clydach Beds of George *et al.* (1976). The Clydach Halt Member, 6.2 m thick, is distinguished from other exposures at this level by the strong development of the palaeosols, named the Tyle'r Bont Pedocomplex by Wright (1981a, 1982b). A pedocomplex is a sequence of soil profiles in close vertical succession. The palaeosols occur as nodular and massive fine-grained carbonates hosted in green and purple-red clays (Figure 9.13)a and (Figure 9.14). In the middle of the unit is a 2 m-thick carbonate which is probably three amalgamated calcretes, the middle part having a strong prismatic structure. Such continuous horizons of calcrete would be classified as stage 3–4 in the sense of Machette (1985). The base of the overlying Cheltenham Limestone Member is marked by a 20 cm-thick bioclastic grainstone with foraminifera, dasycladacean algae (*Koninckopora*) and oncoids, corresponding to the Hendre Bed of Wright (1981a). A bench obscures the complete succession in the Llanelly Formation, which consists of some 4 m of peloidal limestones with prominent clay seams and other related pressure-solution features.

The carbonate nodules and beds of the palaeosols consist of microsparitic calcite and exhibit a range of typical calcrete microfabrics such as floating grains, circum-granular crystallaria and micro-nodules (Wright, 1982b). Although calcretes can be found at this level in other localities, the unique aspect of this site is that so many calcrete horizons occur, providing information of the likely length of subaerial exposure represented by this regional unconformity.

Although Courceyan brachiopod and conodont faunas have been recorded from the Abercriban Oolite, this unit is believed to span the Courceyan–Chadian boundary (Barclay *et al.*, 1988), the younger Chadian Gilwern Oolite having been removed by intra-Carboniferous erosion. The Llanelly Formation has produced foraminifera (Barclay, 1989) and conodonts (Stone, 1991) indicating an Arundian age.

Interpretation

The rubbly horizon at the top of the Abercriban Oolite has been interpreted as a palaeokarstic effect caused by the subaerial exposure of the shallow-water oolites under a humid climate (Wright, 1982a). The overlying palaeosols of the Clydach Halt Member can be compared in terms of macro-structure, microfabric and geochemistry to modern calcrete soils found today in semi-arid to sub-humid regions (Wright, 1982b; Wright *et al.*, 1997). Thus a climate change took place between these two phases. Such soils develop from an initial stage with dispersed concentrations of carbonate, precipitated from downward-moving soil waters, through to the growth of nodules, which become so numerous and large that they coalesce to form continuous beds of soil-formed carbonate. These horizons would most likely have formed between 0.5 m and 1.5 m below the actual land surface at the time of formation. The fact that several horizons occur suggests that the land surface aggraded in stages. Although the rates at which calcretes form vary, soils with the horizons of stage 3–4 calcrete comparable to those seen in the middle part of the member, are generally only found associated with land surfaces that are many tens to several hundreds of thousands of years old. The presence of so many calcrete horizons in the member is a clear indication that the area remained as a land surface for probably half a million years or more.

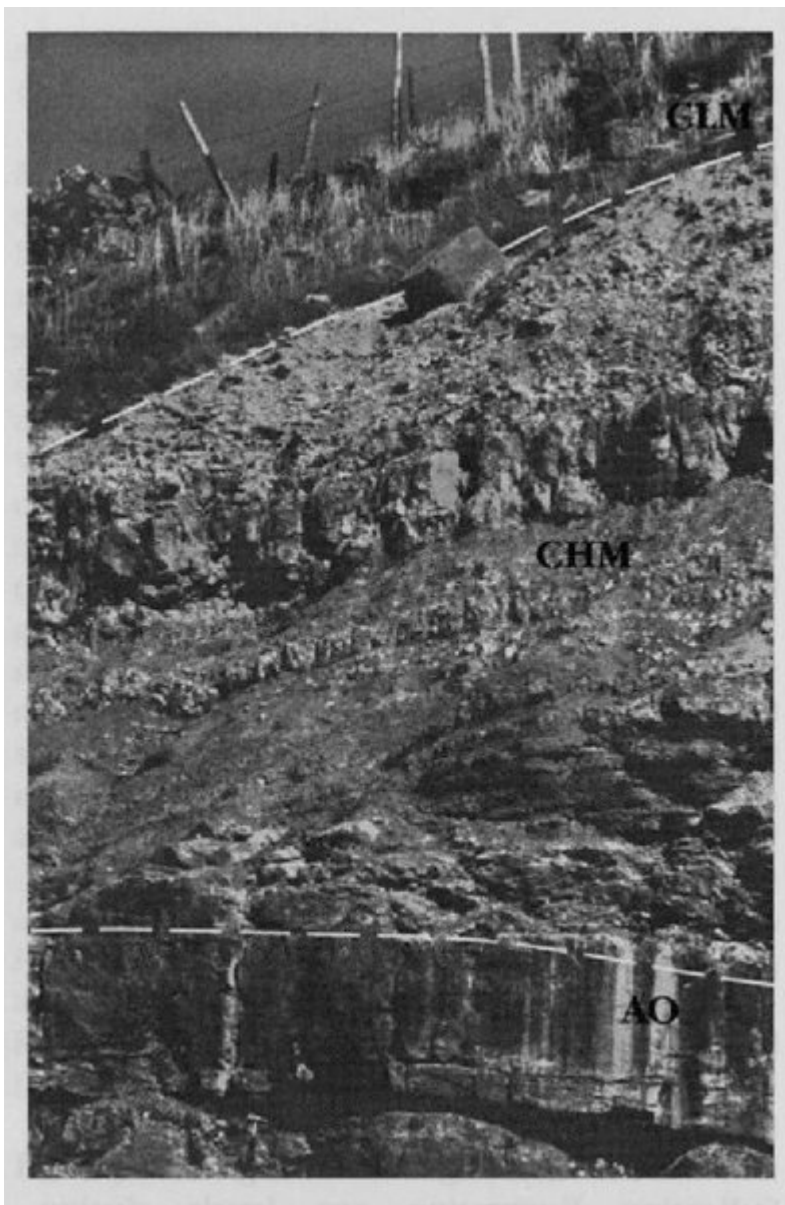
The fact that the horizons are so well developed also indicates that the sedimentation rate was virtually zero for very long periods, followed by periods of aggradation, after which soil formation was renewed at a slightly higher position. Such settings are found in landscapes that are isolated from deposition or erosion on terraced surfaces. The post-Chadian land surface was a complex of stable terraces, with areas between having been eroded by ephemeral rivers that deposited stream and sheet-flood deposits (such as at the nearby site of Baltic Quarry, see GCR site report, this chapter). By integrating this site with other exposures of the Clydach Halt Member it is possible to begin to understand the complexity of a long-lived landscape preserved within the Lower Carboniferous rocks of the region.

Above the Clydach Halt Member, the Cheltenham Limestone Member represents deposition in restricted shallow lagoons and intertidal flats, with occasional influxes of more fully marine waters (Wright, 1986a).

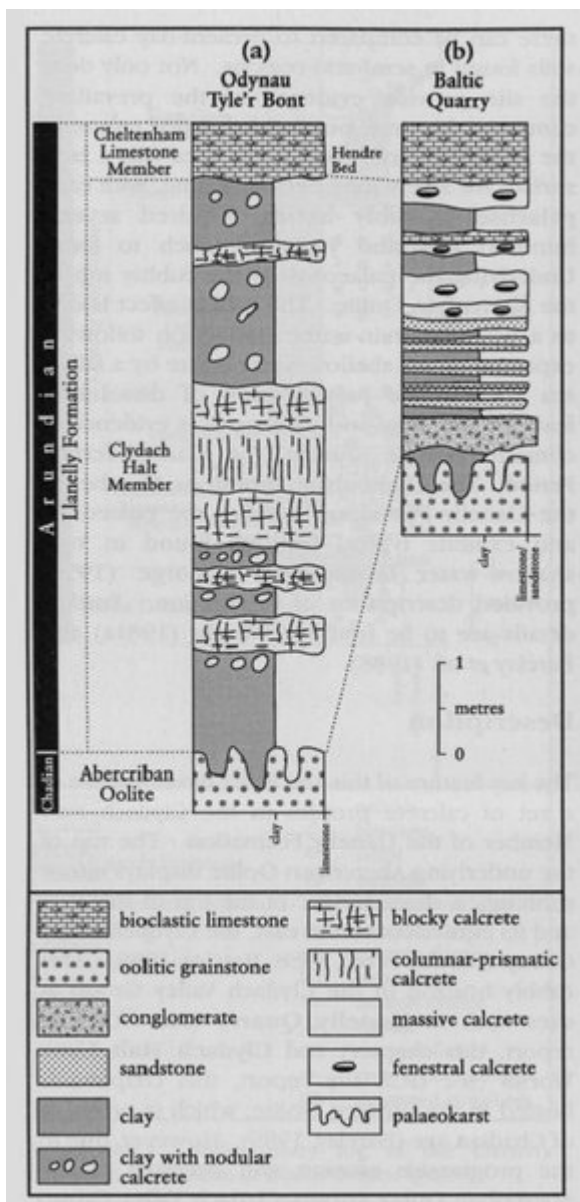
Conclusions

This site, with the best exposure of Lower Carboniferous fossil soils in the region, provides evidence that the sub-Arundian unconformity in the area represents a profoundly long period of time, during which multiple palaeosols developed. Together with other sites containing sections at this level, such as Clydach Halt Lime Works (see GCR site report, this chapter), it is possible to reconstruct a complex and dissected early Carboniferous landscape which developed during what was mainly a period of shallow marine limestone deposition.

[References](#)



(Figure 9.13) Comparative log sections of the Clydach Halt Member (Llanelly Formation) at (a) Odynau Tyle'r Bont and (b) Baltic Quarry, illustrating the development of multiple calcrete palaeosols of the Tyle'r Bont Pedocomplex. Such calcretes are found today forming in semi-arid regions and require extended periods of time in which to develop. The presence of stacked calcrete horizons of this type indicate that the land surfaces aggraded in stages, but it is likely that between each phase the land surface remained stable for possibly hundreds of thousands of years. Note the development of fluvial siliciclastic deposits (conglomerates and sandstones) associated with fenestral calcretes in the Clydach Halt Member at Baltic Quarry. See text for further details. After Wright (1982b).



(Figure 9.14) Calcrete deposits in the Clydach Halt Member (CHM) of the Llanelly Formation at the Odynau Tyle'r Bont GCR site sandwiched between the top of the Abercriban Oolite (AO) (base of section), and the base of the Cheltenham Limestone Member (CLM) (top of section). The calcretes represent a prolonged phase of soil formation under semiarid conditions and probably developed on a highly dissected landscape, the modern equivalents of which can be found in New Mexico and Texas. (Photo: P.J. Cossey.)