Skelwith Hill, Cumbria

[SD 331 809]

Introduction

The Skelwith Hill GCR site [SD 331 809] is a shoreline cliff section on the eastern side of the Leven Estuary, 2.5 km south-east of Greenodd, south Cumbria. It shows an exceptional section of terrestrial deposits at the junction between the predominantly marine sequences of the Martin Limestone and the Red Hill Oolite. The development of multiple calcrete profiles and possible mudflows seen here mark this as one of the most important sites for the exposure of the Chadian–Arundian stage boundary in south Cumbria. Significant descriptions of the geology are given by Nicholas (1968), Rose and Dunham (1977), Leviston (1979) and Barraclough (1983), but the account that follows is based largely on the sedimentological study by Adams and Cossey (1981).

Description

This locality provides a critical section of the junction between the Martin Limestone and the Red Hill Oolite (Dunham and Rose, 1941; Rose and Dunham, 1977) (Figure 4.6) and (Figure 4.7). Locally this boundary defines the line of division between *the Seminula gregaria* Subzone (*Athyris glabristria* Zone) and the *Camaraphoria isorhyncha* Subzone (*Michelinia grandis* Zone) of Garwood (1913, 1916), the boundary between 'Major Cycles 2 and 3' of Ramsbottom (1973), and the Chadian–Arundian stage boundary of George *et al.* (1976). Early accounts make reference to fabrics of algal origin close to, but either side of, the Martin Limestone–Red Hill Oolite boundary (Nicholas, 1968; Rose and Dunham, 1977; Leviston, 1979), and to the development of limestone breccias, considered as marine in origin, at the base of the Red Hill Oolite (Leviston, 1979). The existence of breccias at this level was taken by Ramsbottom (1973) and Mitchell (1978) to indicate a stratigraphical break and non-sequence at the Chadian–Arundian boundary prior to the main Arundian transgressive event. In their reevaluation of the Skelwith succession, Adams and Cossey (1981) described this part of the sequence in detail (see (Figure 4.6)).

At the base of the sequence, less than 2 m of Martin Limestone is exposed, comprising unfossiliferous grey micrites with thin, discontinuous, sub-horizontal sheets of laminated micrite and short, elongate and crudely sub-vertical rods of sparry calcite (rhizocretions) which increase in density towards the top of the formation. Although formerly regarded as algal structures, the repeated association of these thin micritic layers with rhizocretions (rootlet structures), both at this level and in the overlying breccia, has resulted in their re-interpretation as laminar calcretes and the product of subaerial weathering in soil profiles during periods of emergence (Adams and Cossey, 1981). Some calcite pseudomorphs after gypsum also occur near the top of the Martin Limestone.

The breccia at the base of the overlying Red Hill Oolite (referred to here as the 'Skelwith Breccia') ranges in thickness from 0.3 m to 1.0 m and comprises 'rounded and subangular blocks of dark-grey limestone up to 5 cm in diameter set in a marly dolomitic matrix' (Rose and Dunham, 1977). Sorting in the breccia is generally poor, but matrix-supported fabrics are common and clast composition is variable. Although the predominant clasts are either homogeneous micrites or fine pellet grainstones, some of the micrite clasts contain rhizocretions and are most probably locally derived from the underlying beds. Nicholas (1968) reported other clasts coated with micrite laminae and unusually blackened 'pebbles', the like of which cannot be seen at any level beneath the Dalton Beds in south Cumbria. Locally the breccia is split into two thinner units ((Figure 4.7); and see Nicholas, 1968) separated by a micritic limestone with laminar calcrete fabrics and rhizocretions similar to those of the underlying Martin Limestone (Adams and Cossey, 1981). Calcrete laminae and rhizocretions also occur throughout the lower breccia, but rhizocretions only are found in the higher interval close to its top surface. Both breccia layers have irregular but sharp bases.

Above the Skelwith Breccia, Rose and Dunham (1941) reported 10 m of Red Hill Oolite with a rich coral-gastropod fauna in the basal 4 m section and rare shells together with *Syringopora* higher up in the sequence. The fauna includes *Michelinia megastoma, Spirophyllum* '*Koninckophyllum*' *praecursor, Clisiophyllum, Palaeosmilia murchisoni, Axophyllum*

simplex, Syringopora cf. *reticulata* and *Spiriferellina,* and is typical of the Arundian Stage. Lithologies are dominated by fossiliferous bioclastic and peloidal grainstones, but ooids are altogether lacking (Adams and Cossey, 1981; Adams *et al.,* 1990).

Interpretation

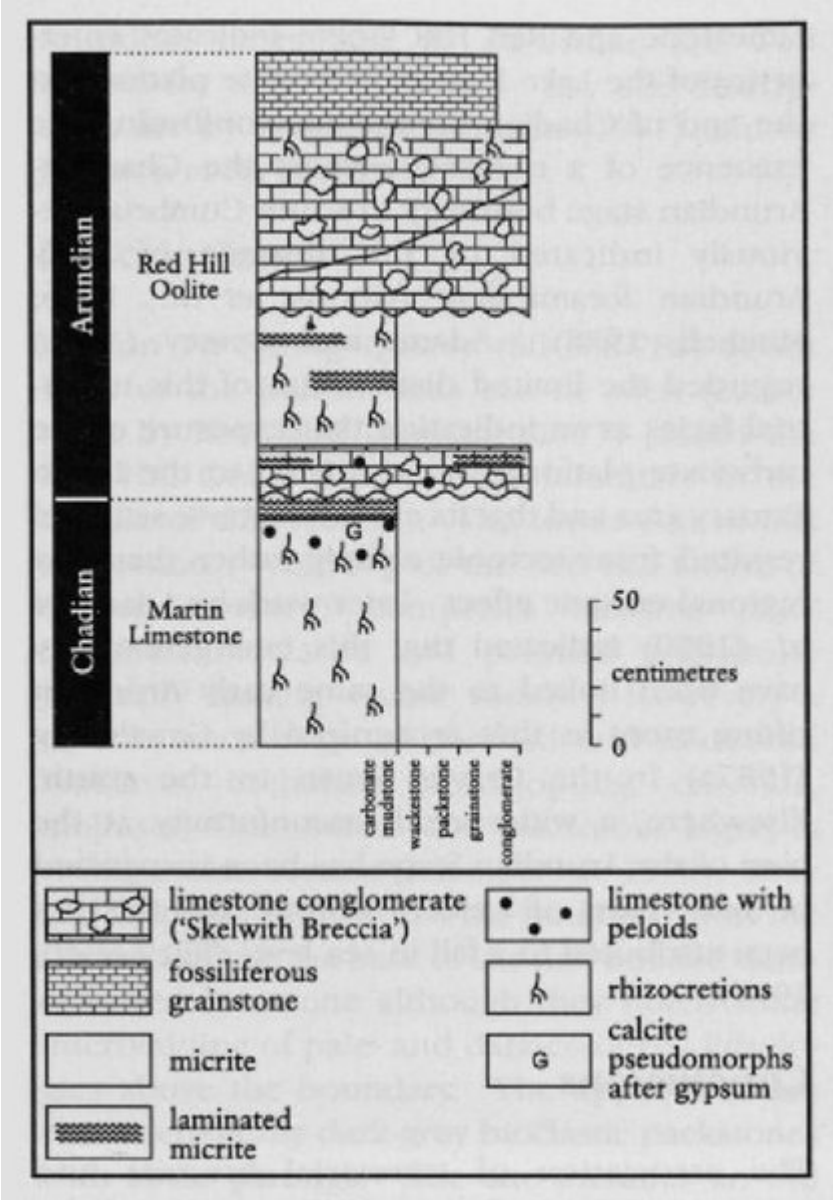
The formation of multiple calcrete profiles at the top of the Martin Limestone and in the Skelwith Breccia at the base of the Red Hill Oolite indicates a period of prolonged subaerial exposure at the end of Chadian times and repeated episodes of soil formation in a terrestrial environment that was receiving a continuous supply of sediment (Adams and Cossey, 1981). The occurrence of laminar calcretes within the breccia indicates a terrestrial origin for the breccia, rather than a tectonic or marine origin as previously supposed by Garwood (1913) and Leviston (1979). Adams and Cossey (1981) considered the breccia to be a product of repeated mudflows, while Barraclough (1983) regarded it as an in-situ alteration product due to calcretization.

The development of terrestrial deposits sandwiched between marine beds of the Martin Limestone and Red Hill Oolite indicates emergence of the Lake District carbonate platform at the end of Chadian times; thus confirming the existence of a non-sequence at the Chadian–Arundian stage boundary in south Cumbria previously indicated by the absence of early Arundian foraminifera (George *et al.,* 1976;Mitchell, 1978). Adams and Cossey (1981) regarded the limited distribution of this terrestrial facies as an indication that exposure of the carbonate platform was restricted to the Leven Estuary area and that its elevation above sea level resulted from tectonic activity rather than any regional eustatic effect. Later work by Adams *et al.* (1990) indicated that this emergence may have been linked to the same early Arundian rifting event as that recognized by Gawthorpe (1987a) in the Craven Basin to the south. Elsewhere, a widespread unconformity at the base of the Arundian Stage has been recognized in many parts of western Europe and this has been attributed to a fall in sea level (Riley *et al.,* 1995).

Conclusions

The association of terrestrial breccias and calcrete palaeosols at this site provides convincing evidence of a break in the continuity of marine limestone deposition (non-sequence) in south Cumbria during early Arundian times. The spectacular calcretes seen here are among the finest and most complex of their kind to be found anywhere in the Lower Carboniferous successions of northern England. They developed within ancient soil profiles as the Lake District carbonate platform became exposed above sea level at the end of Chadian times. Together these features make Skelwith Hill a site of outstanding regional stratigraphical and sedimentological significance.

References



(Figure 4.6) Simplified sedimentary log across the Martin Limestone-Red Hill Oolite boundary at the Skelwith Hill GCR site. After Adams and Cossey (1981).

(Figure 4.7) Terrestrial breccias and caicretes at the junction of the Martin Limestone (Chadian) and the Red Hill Oolite (Arundian) at the Skelwith Hill GCR site. The prominent pale bed containing calcrete fabrics behind the hammer separates the two units of the Skelwith Breccia, one in the foreground below the hammer and the other immediately above the deeply weathered (recessed) layer. The stratigraphical position of these breccia beds is illustrated in (Figure 4.6). (Photo: P.J. Cossey.)