Meathop Quarry, Cumbria

[SD 432 791]

Introduction

The Meathop Quarry GCR site [SD 432 791], on the west side of the Kent Estuary 3 km ENE of Grange-over-Sands, provides arguably the finest section of the Martin Limestone (late Chadian) in south Cumbria. The site includes the old quarry faces running north-south adjacent to the road, the face adjacent to the railway, running east-west, and the low cliff on the south side of the railway, bordering the estuary. It displays the most complete section of the Martin Limestone available, from close to the unconformity with the Silurian Slates (the Basement Beds being thin or absent in this area; see (Figure 4.2)) to the contact with the overlying Red Hill Oolite. The succession was originally described by Garwood (1913) and has since been studied by Leviston (1979) and Barraclough (1983). The locality is also mentioned by Rose and Dunham (1977).

Description

The Martin Limestone at this site consists of 46 m of well-bedded, mostly sparsely fossiliferous, yellowish-weathering, variably dolomitized limestones. Barraclough (1983) subdivided the sequence into two unequal parts. The lower part (Figure 4.5), approximately 33 m thick, comprises a heterolithic assemblage of pellet-dominated mudstones, wackestones, packstones and grainstones, stromatolite and oncoid units, calcretized beds and calcareous shales. Dolomite is present in many beds, especially in coarser units and in the stromatolites. At its base, Garwood (1913) recorded the Camarotoechia proava Band and, some 2–4 m above the base of the section, an algal limestone development (Garwood's 'Algal Layer') associated with beds containing desiccation polygons. One prominent desiccation horizon 4 m up from the base and formerly displayed as a magnificent polygonal mud-cracked bedding-plane surface (e.g. Leviston, 1979, plate 1) has now been partly lost as a result of specimen collection.

The remaining 12 m of Martin Limestone is much less variable than the lower part. Barraclough (1983) described it as 'mixed faunal packstone', comprising poorly sorted bioturbated beds with brachiopods, corals, foraminifera, algae, bryozoans, calcispheres and pellets being the dominant grains. Interbedded shales are absent and overall there is less dolomite, although some is present in most beds.

At the top of the quarry, the Spirifer furcatus Band described by Garwood (1913) is a rubbly weathering bed containing oncoids and fragmented fossils that Mitchell (1978) assigned to the Red Hill Oolite (Arundian). Garwood (1916) later described this as the richest development of the Spirifer furcatus Band in the 'North-West Province'.

Beds below the 'Algal Layer' were originally ascribed to the *Solenopora* Subzone by Garwood (1913) and those above this horizon to the *Seminula gregaria* Subzone. Much of Garwood's *Athyris glabristria* Zone is therefore represented in the section. Details of the fauna and flora were also provided by Garwood (1913), who recorded *Archaeosigillaria vanuxemi* and fragments of *Bothrodendron* (Jackson, 1910) from calcareous shales in the lower part of the succession, and a rich coral fauna from the higher *Seminula gregaria* Subzone beds that included a number of 'new' taxa, namely *Siphonophyllia* '*Campophyllum*' *ciliata, Axophyllum* '*Carcinophyllum*' *simplex, Carruthersella compacta, Koninckophyllum* '*Lophophyllum*' *meathopense* and *K.* '*L*'. *vesiculosum,* an assemblage most typical of the Chadian Stage (Mitchell, 1989; Riley, 1993). In addition, N. Riley (pers. comm., 2002) has noted the presence of *Eoparastaffella* and bilaminar *Koninckopora* in the *Seminula gregaria* Subzone beds indicating a late Chclian, basal Viséan age for this part of the succession. Fossils are not, however, abundant and much of the fauna is fragmented.

Interpretation

Garwood (1913) correlated the oncoid-bearing unit (his 'Algal Layer') in the lowest part of the succession at Meathop with a similar 'Algal Layer' at the top of the Coldbeck Beds (= Coldbeck Limestone; see (Figure 5.3), Chapter 5) at Ravenstonedale that Mitchell (1972) and Ramsbottom (1973) took as a marker for the Tournaisian–Viséan boundary in northern England (see Stone Gill–Scandal Beck GCR site report, Chapter 5). Thus the lowest 4 m of limestones at Meathop Quarry were originally assigned to the Tournaisian Series (Courceyan Stage) and the overlying beds to the Viséan Series (Chadian Stage) (Rose and Dunham, 1977). However, the Coldbeck Limestone is now attributed entirely to the Chadian Stage, with the 'Algal Layer' indicating a mid-Chadian regression (Ramsbottom, 1977a). The Martin Limestone is now regarded as being entirely of Chadian age, with the oncoid band and associated desiccated surface attributed to the mid-Chadian regression (Mitchell, 1978).

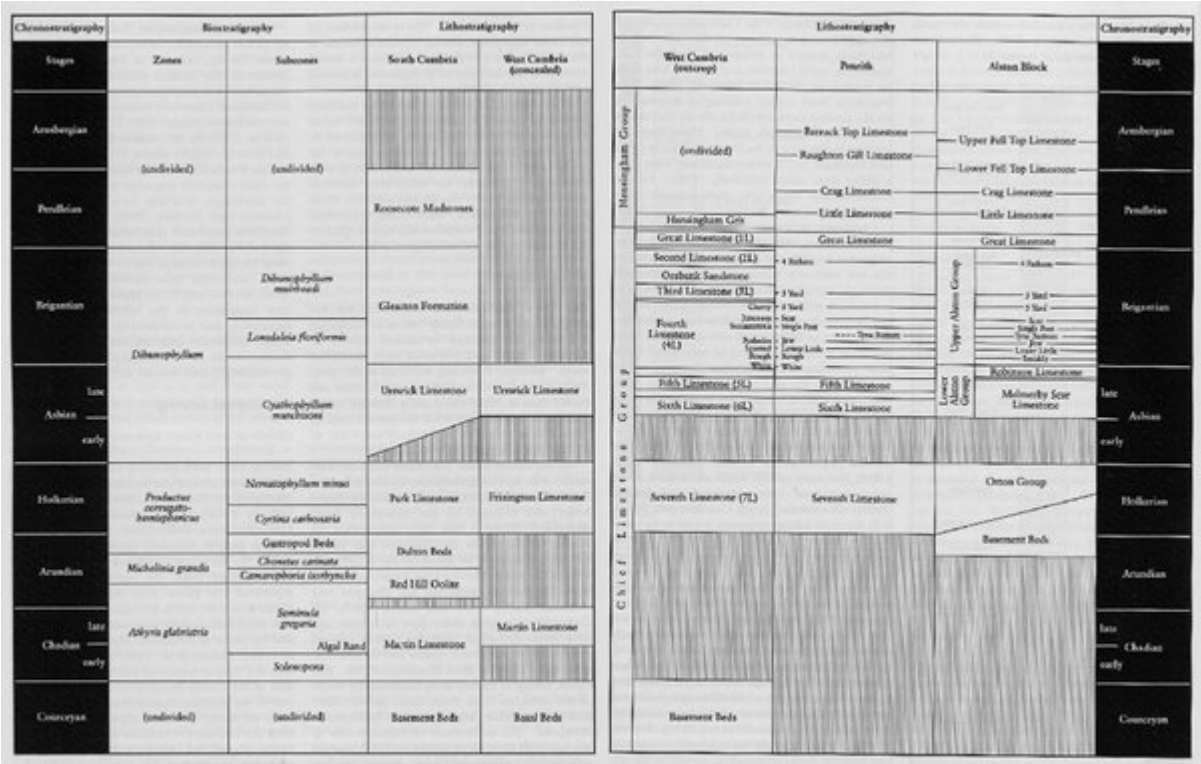
Nicholas (1968) and Leviston (1979) recognized that the Martin Limestone in south Cumbria records shallow marine and tidal-flat deposition. Barraclough (1983) made more detailed interpretations and suggested that in the lower part of the succession, the finer-grained units represented channel, pond and algal marsh sub-environments of a tidal-flat complex and the coarser grainstone units represented channel delta deposits from the seaward side of the tidal flat. The mixed faunal packstones that form the upper part of the succession at Meathop Quarry were interpreted as shallow offshore shelf deposits by Barraclough (1983) and thus represent a transgressive episode that flooded the tidal-flat complex.

The brecciated appearance of the Spinier furcatus Band has been taken as evidence of a non-sequence at the base of the Arundian Stage (Mitchell, 1978), although Adams and Cossey (1981) and Barraclough (1983) noted the absence of any features diagnostic of emergence, in contrast to sections across the Chadian–Arundian boundary around the Leven Estuary to the west, where emergent features are well developed.

Conclusions

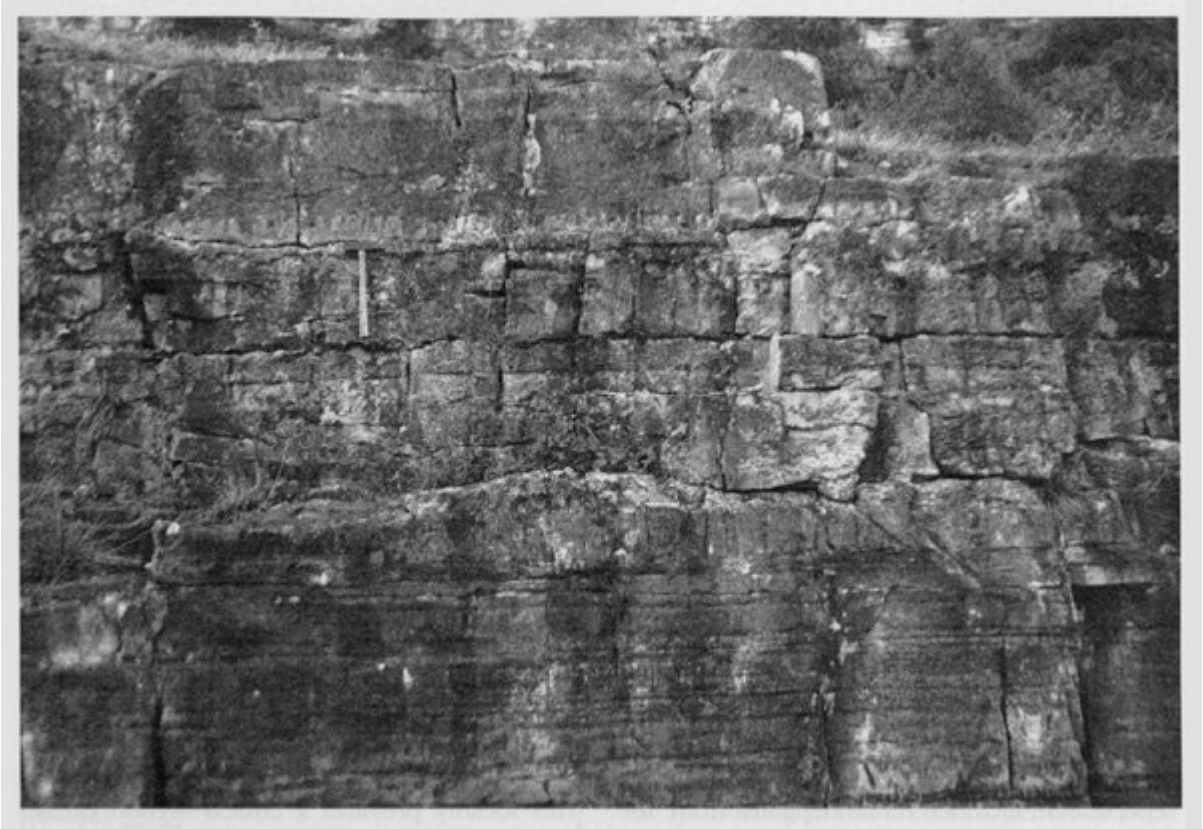
Meathop Quarry is the best exposure of the lowest part of the Carboniferous Limestone succession in south Cumbria. The site is valuable for its excellently displayed carbonate rocks and structures representing the deposits of a tidal-flat complex and for the evidence for drowning of the complex as a result of relative sea-level rise during Chadian times.

References

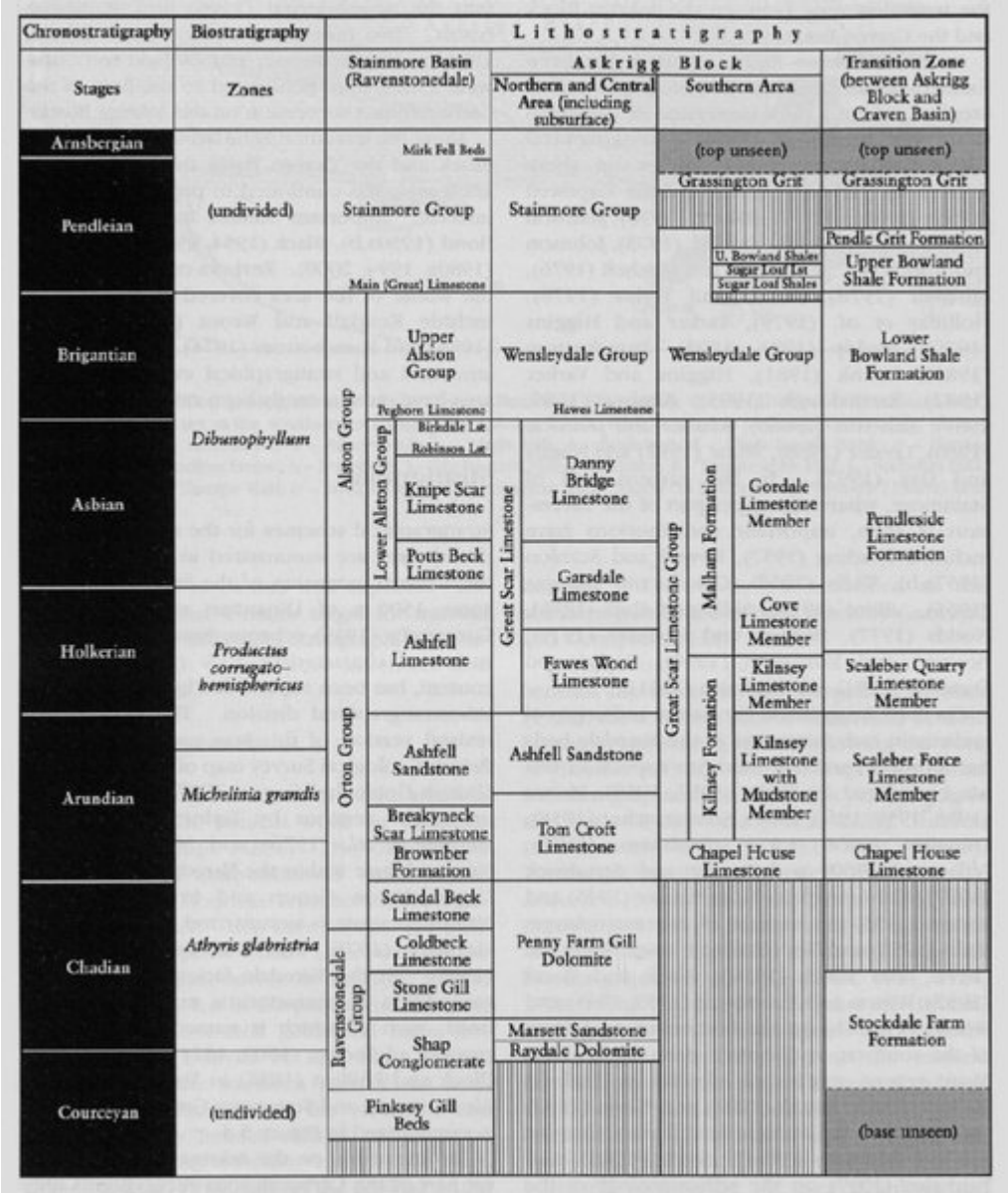


(Figure 4.2) Simplified stratigraphical chart for the Lower Carboniferous succession of the Lake District Block and Alston Block; the age of the Basement Beds is uncertain in many areas. Compilation based on information from Eastwood et al.

(1931), George et al. (1976), Rose and Dunham (1977), Mitchell (1978), Ramsbottom (1978a), Arthurton and Wadge (1981), Athersuch and Strank (1989), Horbury (1989), Dunham (1990), Barclay et al. (1994), Chadwick et al. (1995) and Akhurst et al. (1997). Zonal biostratigraphy (Chadian–Brigantian only) after Garwood (1913). Areas of vertical ruling indicate non-sequences. Not to scale. Note that following text submission, the majority of those lithostratigraphical units in the 'South Cumbria' and West Cumbria (concealed)' columns have been designated as formations (Johnson et al., 2001).



(Figure 4.5) Typical thin-bedded peritidal limestones in the lower part of the Martin Limestone (Chadian) at the Meathop Quarry GCR site. (Photo: A.E. Adams.)



(Figure 5.3) Simplified stratigraphical chart for the Lower Carboniferous sequence of the Askrigg Block and Stainmore Basin. Compilation based upon and modified after George et al. (1976), Dunham and Wilson (1985), Arthurton et al. (1988), British Geological Survey (1997b,c), and Mundy (2000). Zonal biostratigraphy (Chadian–Brigantian only) after Garwood (1913). For further details of the Wensleydale Group, Upper Alston Group and Stainmore Group successions, see (Figure 5.4). Areas of vertical ruling indicate non-sequences. Not to scale.