# Artle Beck, Lancashire

[SD 553 624]

Potential GCR site

## Introduction

The Artle Beck site consists of a stream gorge section at Artle Beck [SD 5525 6240], close to the village of Crossgill and 7 km to the east of Lancaster. It lies within the lower part of the Millstone Grit and is of early Namurian (Arnsbergian) age. The section extends from the Eumorphoceras yatesae Marine Band ($E_{2a}3$) in the Roeburndale Formation, across an unconformity into the overlying Wards Stone Sandstone Formation (Figure 6.2) and (Figure 6.18). The site clearly demonstrates the influence of earth movements on sedimentation at the northern margin of the Pennine Basin during early Namurian times. The locality also preserves the thickest and northernmost known development of the E. yatesae Marine Band. Details of the site geology can be found in the British Geological Survey memoir (Brandon *et al.,* 1998) and on the accompanying geological map (British Geological Survey, 1995a). Aspects of the geology are also described by Moseley (1954).

The Lancaster area has one of the thickest early Namurian sections in the world (over 1.6 km thick), rivalled only by that in the Midland Valley Basin, Scotland (Chapter 2) and in Poland. The Artle Beck section forms part of this thick succession and, although it contains a number of depositional breaks, it provides a stark contrast to the thin but complete, sediment-starved Arnsbergian succession preserved farther south, entirely in mudstones (see Saleswheel GCR site report, this chapter).

## Description

The succession is approximately 45 m thick, but is stratigraphically complex. This is due to syn-depositional folding, faulting and unconformity within the Roeburndale Formation, which occupies most of the section in the valley floor, plus unconformity and overstep across these structures by the succeeding Wards Stone Sandstone Formation, seen in the valley sides. (Figure 6.19) demonstrates these relationships and a log of the succession is presented in (Figure 6.18). The basal 5 m lies in thin-bedded siltstones and fine- to medium-grained sandstones in the Roeburndale Formation. These are folded into a broad anticline, truncated by angular unconformity and overlain by black mudstones of the Eumorphoceras yatesae Marine Band ($E_{2a}3$). At the base of this band is a boulder bed made up of reworked siderite and wackestone nodules, some of which show evidence of soft-sediment deformation. The marine band is approximately 19 m thick and grades up into siltstones. Locally these siltstones attain a thickness of approximately 20 m, of which 5 m are exposed. In places this succession is disrupted by faulting. Cutting across these folded and faulted beds with angular unconformity are coarse-grained cross-bedded feldspathic fluvial sandstones belonging to the Wards Stone Sandstone Formation. This overstep is regional and can be mapped over an area of more than 1501=$^2$. The faults and folds within the Roeburndale Formation at Artle Beck do not pass up through the =conformity. The fluvial sandstones of the Wards Stone Sandstone Formation fine upwards and are overlain by a palaeosol and a thin coal, which is succeeded by further fluvial sandstones in erosive contact with the coal.

The fauna of the E. yatesae Marine Band is unusual in that It has both hemipelagic elements, such as the ammonoids *Eumorphoceras yatesae* (the zonal form restricted to this horizon) and *Cravenoceras* cf. *gairense,* the bivalves *Posidonia corrugata, P. lamellosa* (highest known occurrence), *Selenimyalina variabilis,* together with benthic forms, such as smooth spiriferoid brachiopods and inadunate crinoids, some of which are exquisitely preserved with complete arms and pinnules.

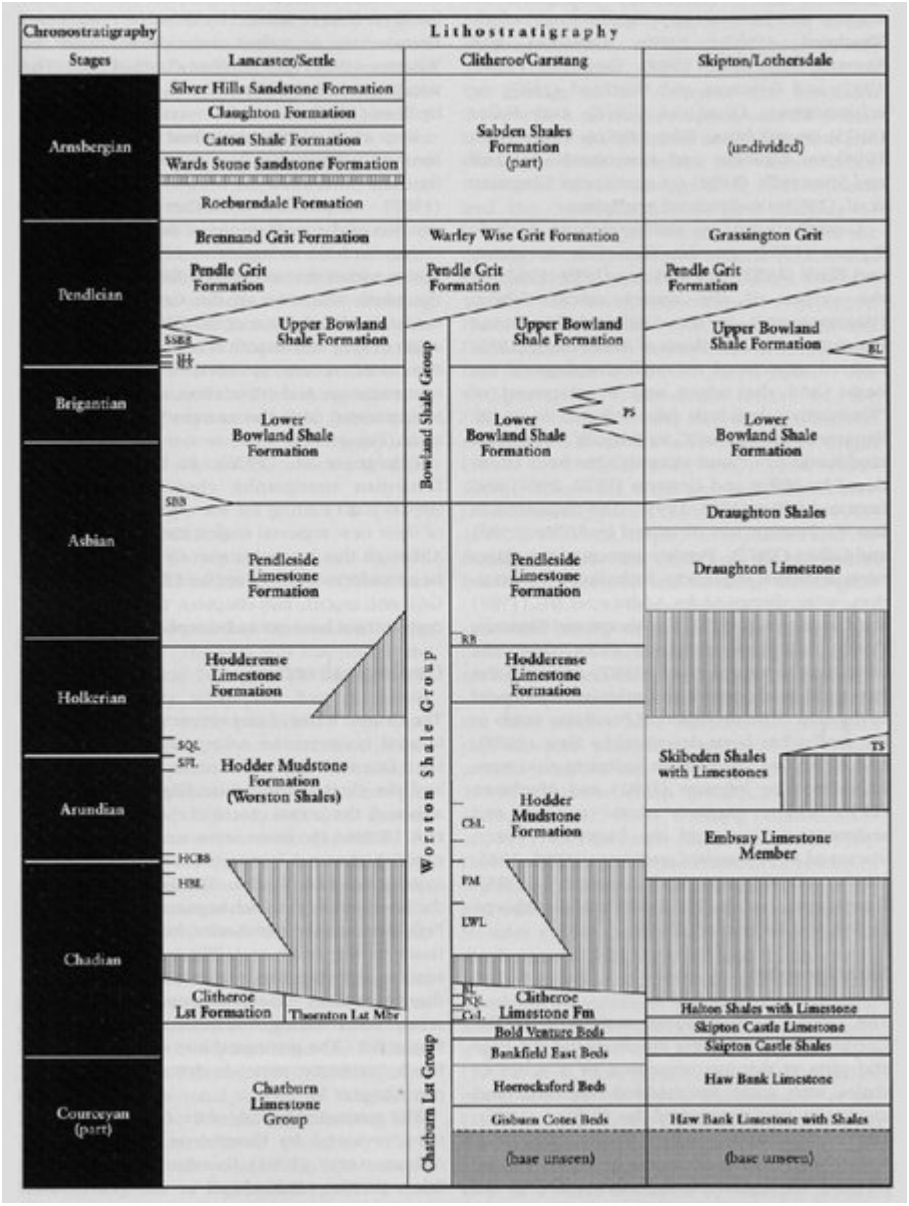
## Interpretation

The siltstones and sandstones beneath the E. yatesae Marine Band are delta-slope turbidite equivalents of the more proximal delta-top Sapling Clough Sandstone, 10 km to the southeast. Prior to deposition of the E. yatesae Marine Band these turbidites were folded. Glacio-eustatic transgression then caused sea-level rise, drowning the Sapling Clough Sandstone delta system, cutting off the sand supply. This transgression eroded the underlying delta-slope area and formed an omission surface. The slope was then draped in marine muds within which carbonate nodules began to form. These partially Milled sediments were then reworked down-slope to form the boulder bed in the basal part of the marine band (probably due to renewed tectonism and associated slope instability). Later, during highstand, thick mud deposition occurred (indicating a rich supply close to the basin margin). The mud surface was oxygenated just enough for a specialized benthos to colonize it. Highstand fill was eventually reached and coarse clastic systems began to prograde across the basin, feeding siltstone turbidites into the Artle Beck section above the E. yatesae Marine Band. Further folding and faulting of the Roeburndale Formation then occured. The glacio-eustatic lowstand that followed caused extensive erosion to the deformed beds of the Roeburndale Formation and resulted in the formation of the unconformity seen at the base of the overlying Wards Stone Sandstone Formation. Base level then rose, either because of glacio-eustasy or because of regional thermal subsidence, to facilitate the deposition of this fluvial deposit.

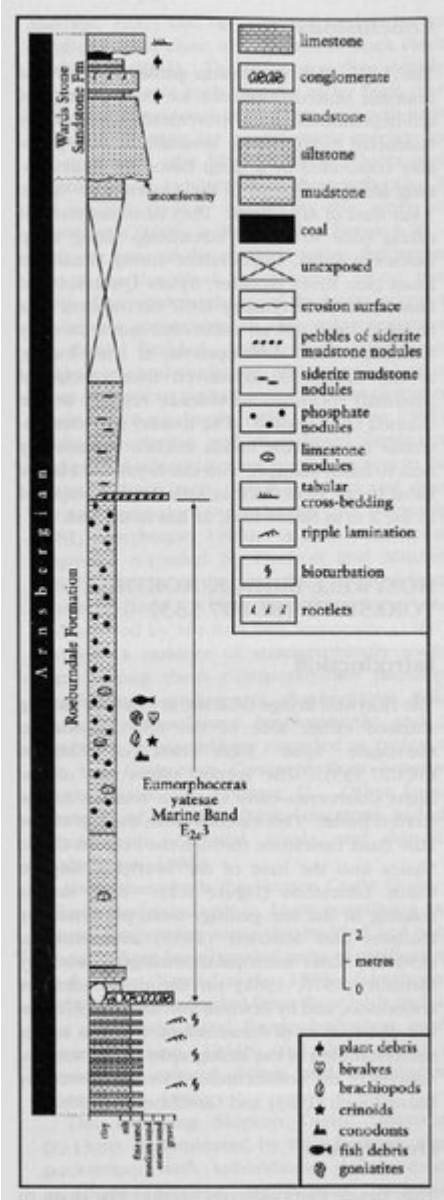
## Conclusions

The Artle Beck succession provides the most dramatic outcrop evidence for the existence of syn-depositional earth movements during early Namurian times. These movements were probably controlled by a deep basement fault running along the trend of the Quernmore Valley, 5 km west of Artle Beck. They demonstrate that rifting (due to crustal stretching) along deep basement faults, so prevalent during Dinantian times (see River Hodder, Sykes Quarries and Dowshaw Delf Quarry GCR site reports, this chapter), was still an influential factor in early Namurian basin development, at least locally, as the Craven Basin moved into a regional (thermal) 'post-rift' subsidence regime, as the thinned crust cooled. The locality also demonstrates how marine bands thicken dramatically next to basin margins, with the E. yatesae Marine Band being 19 m thick at Artle Beck, compared to the 2 m at Saleswheel, 28 km to the SSE.

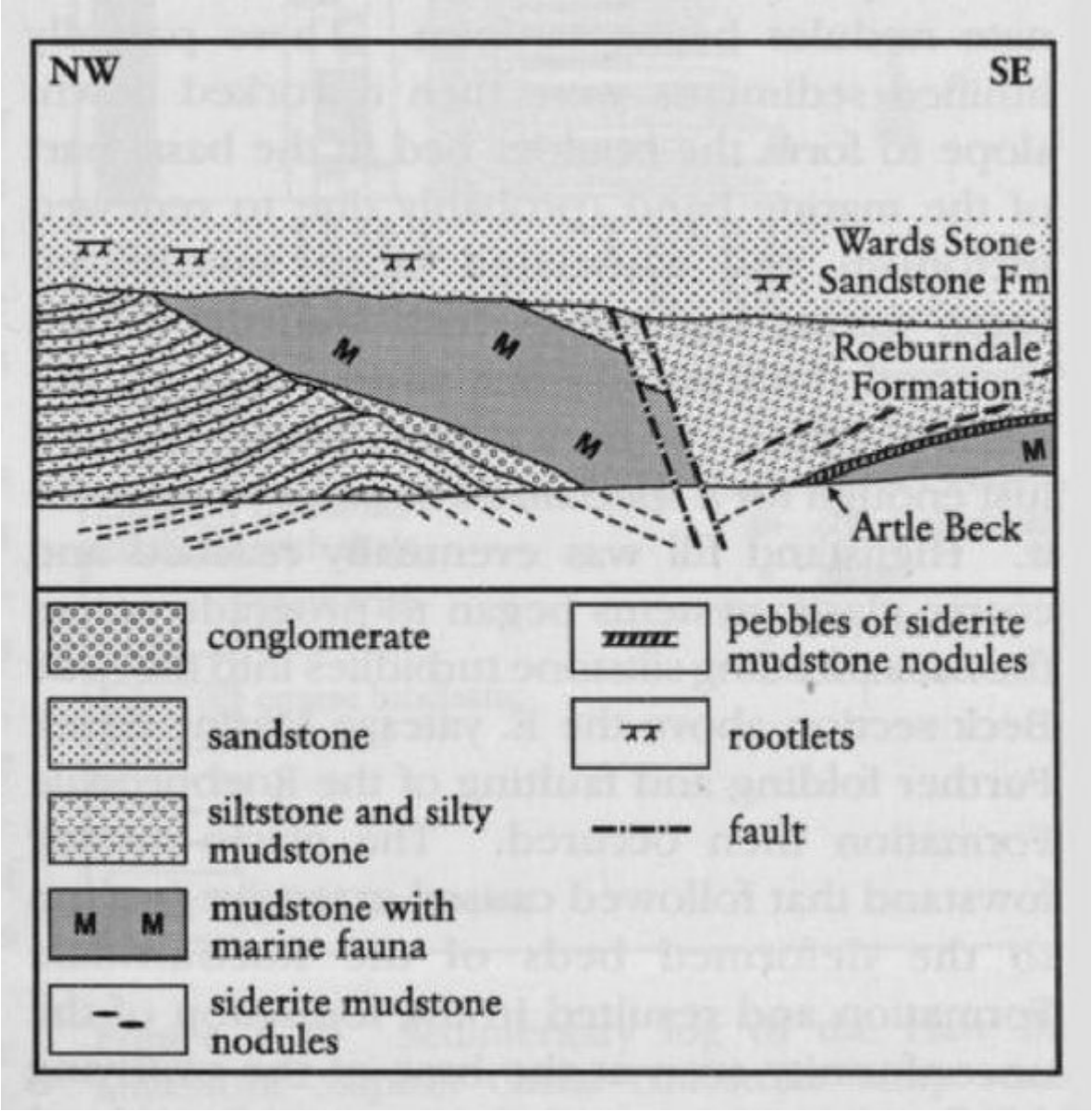
**References**




*(Figure 6.2) Simplified stratigraphical chart for the Lower Carboniferous succession of the Craven Basin. (HBL — Hetton Beck Limestone Member; HCBB Haw Crag Boulder Bed; SFL — Scaleber Force Limestone Member; SQL — Scaleber Quarry Limestone Member; SBB — Scaleber Boulder Bed; SLS — Sugar Loaf Shales; SLL — Sugar Loaf Limestone; SSBB School Share Boulder Bed; CoL — Coplow Limestone Member; PQL — Peach Quarry Limestone Member; BL — Bellman Limestone Member; LWL — Limekiln Wood Limestone Member; PM — Phynis Mudstone Member; ChL — Chaigley Limestone Member; FIB — Rad Brook Mudstone Member; PS — Pendleside Sandstones Member; TS — Twiston Sandstone Member; BL — Berwick Limestone.) Areas of vertical ruling indicate non-sequences. Not to scale. Compilation based on Hudson and Mitchell (1937), Metcalfe (1981), Arthurton et al. (1988), British Geological Survey (1989), Riley (1990a, 1995), Aitkenhead et al. (1992), Brandon et al. (1995, 1998).*




*(Figure 6.18) Generalized log of Arnsbergian strata (Roeburndale Formation and Wards Stone Sandstone Formation) at Artle Beck, near Caton, Lancashire. After Brandon et al. (1998).*




*(Figure 6.19) Schematic section of strata at Artle Beck illustrating possible relationships between units of the upper part of the Roeburndale Formation and lower part of the Wards Stone Sandstone Formation. After Brandon et al. (1998). Note that although this section is not to scale, its length is approximately 400 m.*