Sleightholme Beck, County Durham

[NY 956 107]–[NY 965 115]

Introduction

The Sleightholme Beck GCR site is a stream section [NY 956 107]–[NY 965 115] lying 4 km south-west of Bowes, between Barnard Castle and Brough-under-Stainmore and towards the southern margin of the Cotherstone Syncline in the Stainmore Basin. The section provides particularly fine sections of deltaic and barrier-island deposits associated with the development of the early Namurian (Pendleian, E_1) Great Limestone Cyclothem. Of critical importance is the varied suite of inorganic and biogenic sedimentary structures that provide spectacular evidence of the passage of storms and organic activity within the barrier-island deposits; arguably the finest Lower Carboniferous example of these deposits in northern England. Although aspects of the site geology are recorded by Reading (1957), Wells (1958), Burgess and Holliday (1979), Dunham and Wilson (1985), Hodge and Dunham (1991) and Fairbairn (2001), the account that is presented here is based mainly on the detailed sedimentological work of Elliot (1975).

Description

Exposures extend from the head of 'The Troughs' gorge in a series of river cliffs to the beck crossing 300 m west of the farm at Bar Gap. The 40 m succession comprises a varied mix of siliclastic deposits arranged in two coarsening-upward sequences sandwiched between the Great Limestone and the Little Limestone; and four distinct units within it record the history of the 'Stanhope–Stainmore delta lobe' as it developed within the Stainmore Basin during early Namurian times (Elliot, 1975).

At the base of the sequence (see (Figure 5.15)), and immediately overlying the Great Limestone with its distinctive coral fauna, the oldest unit (A) comprises 4 m of partially silicified mudstone with rhynchonellids and *Zoophycos,* and, in its upper part, *Lingula squamiformis* and plant remains in abundance (Reading, 1957; Elliot, 1975). Elliot (1975) suggested that this unit was formed in a quiet, shallow marine environment.

Above this, the second unit (B) consists of a 17 m-thick coarsening-upward sequence with bioturbated mudstones and flat-laminated and current-ripple-laminated siltstones at the base, which grade into flat-laminated and trough cross-bedded sandstones (palaeoflow to the south-east) at the top (Figure 5.15). These deposits were formed as mouth bars to the distributary streams of an advancing delta lobe that progressively buried the earlier deposited marine unit. A third unit (C) comprises 2 m of mudstone and a shelly limestone coquina with brachiopods, crinoids and gastropods. Elliot (1975) regarded this unit as the product of a transgressive event that flooded the delta top as the delta lobe was first abandoned and then subsequently subsided.

The top unit (D) comprises a coarsening-upward sequence (Figure 5.16) of approximately 16 m thickness, with nodular mudstones and siltstones (6 m) at the base, erosively overlain successively by 7.5 m of laminated and bioturbated sandstone and 2.5 m of trough cross-bedded sandstone (palaeoflow to the north-east). Of particular interest here are the laminated and bioturbated sandstones where bed thicknesses ranges from 10 cm to 60 cm.

Typically each sandstone has a distinctive scour surface at its base and this is superseded by a zone of either flat-lamination or swaley cross-stratification that grades upwards into an intensely bioturbated zone dominated by horizontal teichichnid burrows. In comparing this repeated lithofacies association with Recent barrier-island shoreface associations described by Howard (1971), Elliot (1975) suggested that these sandstones were the product of (i) repeated storms that scoured sediment from the seabed and re-deposited it in a series of swales as the storm abated, and (ii) burrowing organisms that re-colonized and reworked the upper layers of the storm deposits in the intervening fair-weather periods. The prominent discontinuity at the base of the sandstone interval is taken to indicate shoreface erosion of the barrier as it migrated towards land in a WNW direction. The transition into trough cross-bedded sandstones at the top of the sequence may reflect a shoreface-nearshore transition as the barrier migrated a short distance to the north-east later in its history (Elliot, 1975).

Interpretation

Elliot (1975) regarded the Sleightholme succession as the product of four separate depositional events or phases. These included a coastal plain phase, in which the now-silicified mudstones (unit A) were originally deposited in a pro-deltaic, and possibly brackish, marine bay close to the shoreline; a progradational phase, in which the lower coarsening-upward sequence (unit B) formed as the Stanhope–Stainmore delta lobe prograded into the pro-delta area; an abandonment phase, in which marine sediments (unit C) were deposited over the delta lobe as it became starved of sediment and then subsided; and a post-abandonment phase, in which the upper coarsening-upward sequence (unit D) was deposited — a product of offshore, shoreface and nearshore sedimentation on the flanks of a barrier island that migrated across the delta top after the delta was abandoned.

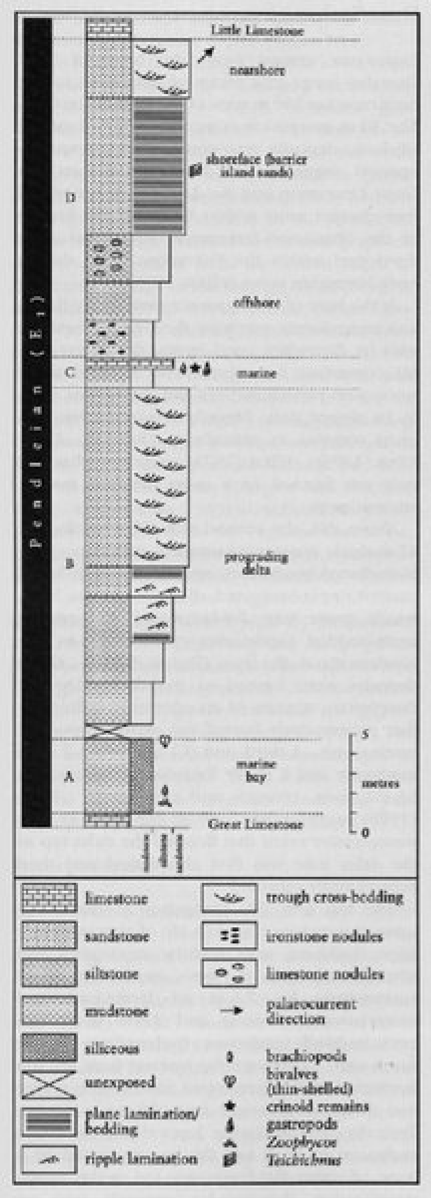
Further work by Hodge and Dunham (1991) indicated that the deltaic deposits at this site area may have been supplied by a branch of the 'Allercleugh Channel' (the main feeder to the Stanhope-Stainmore delta lobe) which extended southwards from Langdon Beck on the Alston Block towards Bowes, and that the post-abandonment (barrier-island) facies might represent an extension of the 'Skears Sandbar' seen to the north between Wolsingham and Middleton-in-Teesdale (see (Figure 4.18) and Rogerley Quarry GCR site report, Chapter 4).

Stratigraphically, the sequence forms an integral part of the lowest Yoredale cyclothem within the Stainmore Group and is of basal Namurian (early Pendleian, E_1) age (Burgess and Holliday, 1979, Dunham and Wilson, 1985). In addition, and despite considerable lateral facies changes, lithostratigraphical correlations of the sequence into neighbouring areas are generally well established. Dunham and Wilson (1985) equate the two prominent sandstone bodies (units B and D) with the High Coal Sill and the White Hazle horizons of the Alston Block, and Reading (1957) and Wells (1958) equate the siliceous mudstoncs (unit A) with the Main Chert of North Yorkshire. The suggestion that the Langdon to Bowes branch channel may have been the 'large river' that sourced the silica in these deposits (as originally envisaged by Wells, 1955) cannot, however, be proven as the contemporaneity of channel development and silica precipitation have not been established (Hodge and Dunham, 1991).

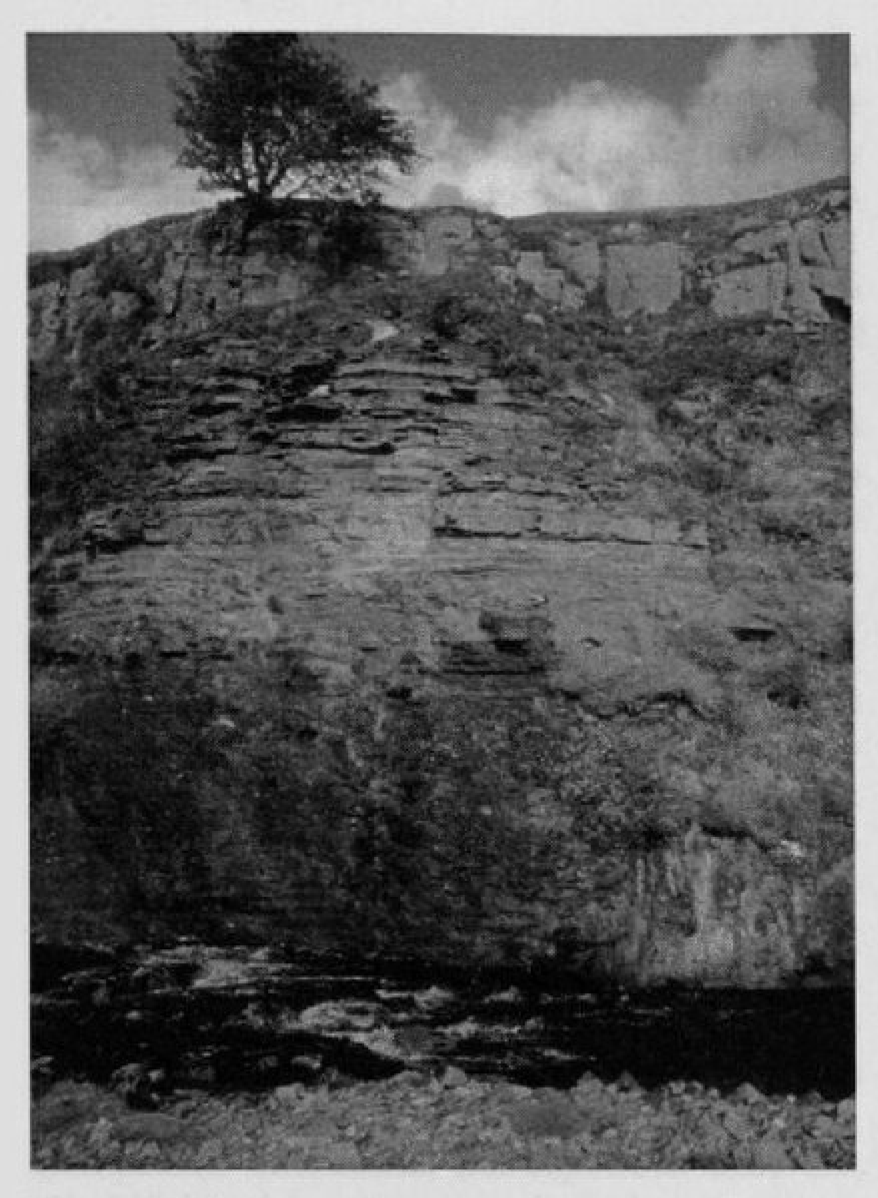
Conclusions

This site provides an outstanding section through the Great Limestone Cyclothem and a detailed record of the history of the Stanhope–Stainmore delta lobe at its distal margin. In contrast to the section at Rogerley Quarry (see GCR site report, Chapter 4) where the same delta lobe can be seen in a more proximal setting, the section at Sleightholme Beck shows spectacular evidence of barrier-island sedimentation, including storm deposits formed during the delta's post-abandonment phase of development. Considered together, the Rogerley Quarry and Sleightholme Beck sites provide some of the clearest evidence of the processes operating within the delta systems of northern England during early Namurian times.

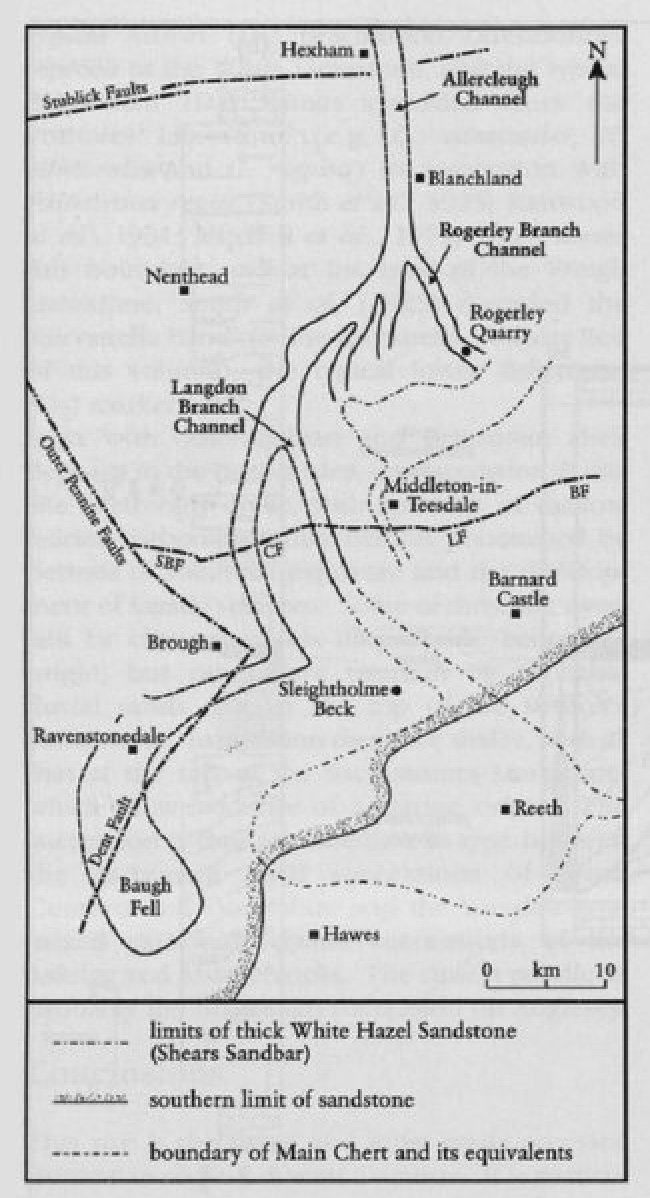
References



(Figure 5.15) Sedimentary log through the deltaic and barrier-island deposits of the Great Limestone Cyclothem at Sleightholme Beck. After Elliot (1975). Units A-D represent stages recognized by Elliot in the development of the Stanhope-Stainmore delta lobe. A — coastal plain interval; B — progradation; C abandonment phase; D — post-abandonment phase.



(Figure 5.16) Coarsening-upward sequence of barrier-island deposits in the Great Limestone Cyclothem, Sleightholme Beck (unit D of (Figure 5.15); see text for further details). Elliot (1975) interpreted the abrupt change from offshore mudstones and siltstones at the base of the sequence to the shoreface sands exposed higher in the sequence as marking the passage of a landward-migrating barrier-island complex. (Photo: P.J. Cossey.)



(Figure 4.18) Palaeogeographical reconstruction to show the course of distributary channels within the early Namurian Stanhope–Stainmore delta lobe and the limits of various Pendleian lithofacies. Also shown are the positions of the Rogerley Quarry and Sleightholme Beck GCR sites. (SBF — Swindale Beck Fault; CF — Closehouse Fault; LF — Lunedale Fault; BF — Butterknowle Fault.) After Hodge and Dunham (1991).