Holme St Cuthbert

[NY 105 470]–[NY 145 490]

Potential GCR site

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Introduction

Holme St Cuthbert, north-west of Aspatria in Cumbria, is a major complex of glaciofluvial landforms at a height of 30–48 m OD. It has been interpreted as an esker-fed deltaic complex deposited into a pro-glacial lake ponded between an ice front trending NE–SW and the drumlin country to the east. It has been suggested as marking one of the terminal positions of the Late Devensian Scottish Readvance ice sheet, which advanced on to the Cumbrian lowland (Huddart, 1970, 1991, 1993, 1994; 1997; Huddart and Tooley, 1972; Huddart *et al.,* 1977; Huddart and Clark, 1994). However, it is a controversial location because it also has been interpreted as marking a glaciomarine morainal bank deposited from Lake District ice into a high sea level during deglaciation of the Irish Sea ice sheet (Eyles and McCabe, 1989).

Description

The landforms around Holme St Cuthbert are shown in (Figure 5.62) and several well-defined morphological zones can be recognized. In the south-east is a series of NE–SW-trending drumlins. Immediately adjacent to, and surrounding these drumlins north-east of Westnewton are the low-lying, poorly drained Bellwater, Common, Cockley and Chapel Mosses. Overlooking this area of low relief is a steep, east-facing scarp that runs for 4.8 km between Round Hill in the north to New Cowper in the south. This scarp forms the eastern extremity of a flat-topped surface that extends for 0.8 km and rises from 42.7 to 48.8 m OD in an east–west direction, and which is bounded to the west by a scarp slope running from Raise How to Hangingshaw Moss. Both scarps are crenellated and lobed. Around New Cowper there is evidence for a lower level between 30.5 and 36.6 m OD. West of the flat-topped zone is an area containing many undrained depressions and rising above the gen eral surface are several NW–SE-trending linear ridges.

The evidence for the pro-glacial lake hypothesis for the origin of this complex was obtained from several sand and gravel pits. The sedimentary facies can be divided into topsets and fore-sets, both associated with a fluvial–deltaic system. The topset facies were best represented in Greggains' Pit (Figure 5.63) by 12–15 m of pebble gravel and pebbly, coarse sand, although there is also medium-grained sand infilling channels. The transverse-to-current section reveals large erosional channels, imbricate, gravel bars and occasional disturbed stratification. Palaeocurrent data indicate a constant transport direction from the north-west. The grain size increases from the stratigraphical base to the top of the pit. The lowest topset sediments consist of horizontally stratified, coarse and medium sands, with occasional small, erosional scours which pass up vertically into pebbly, coarse sand, with occasional pebble gravel channels and finally into imbricate, pebble gravel units and pebble gravel channels. The individual channel fills vary from solely pebble gravel to a gradation from a basal pebble gravel, through coarse- and medium-grained sand to rippled, fine-grained sand.

The foreset facies is preserved both below the topsets in Greggains' Pit and laterally to the east in Armstrong's Pit. The facies can be divided into foresets proper, which are large-scale, cross-stratified sets, dipping at between 14 and 30°, through toesets to bottomsets, which dip at 2–5°. There is a continuum from foresets to bottomsets deposits. These beds are characterized by:

1. the individual beds decreasing in angle in the down-dip sedimentary transport direction from 21° nearest the sediment supply to 2–3° in the distal bottomsets;
2. the sediment grain size generally decreasing in the down-dip direction from pebbly, coarse sands in the proximal zone to silty sand and silts in the distal zone;
3. a total foreset height at about 30 m;

4. a predominance of ripple drift, small-scale, cross-lamination.

The best development of foresets proper is located in Armstrong's and Hards Cottage Pits (Figure 5.64). Palaeocurrent data from these pebbly foresets range from 89 to 174°. In the Hards Cottage Pit the bottomsets are dominated by parallel laminated fine sands and silts, with subsidiary sinusoidal and type 'b' ripple cross-lamination and occasional sets of solitary, tabular cross-stratification. There is a lack of type 'a' ripple cross-lamination, which indicates that the depositional environment was dominated mainly by suspension, with occasional phases of solitary sand-wave movement across the bottomset surface. In Armstrong's Pit the dominant stratification type is type 'a' ripple cross-lamination, which indicates that bedload transport was more important in this part of the delta.

(Figure 5.65) shows log profiles in bottomsets from Greggains' Pit and reveals cycles of both increasing and decreasing bedload movement relative to suspension fall-out in the changes in sedimentary structure. These cycles end with parallel lamination and/or clay, which indicates only suspension sedimentation. If these represent a temporal cycle and the clay bands possibly indicate a winter period of no sediment transport, then there are records of at least nine years sedimentation in logs 11 and 12. If an annual cycle is assumed then an average of 1.4 m, with a range between 0.5 and 4.2 m, was deposited per year.

The lithological composition of the pebble gravels is dominated by high percentages of Criffel granite and other southern Scottish erratics, such as greywackes and Lower Calciferous Sandstone conglomerate from the Kircudbrightshire coast (Huddart, 1970; Huddart and Tooley, 1972).

Interpretation

These sediments and landforms are thought to represent glaciofluvial sedimentation prograding into a pro-glacial lake formed in a depression between the drumlin belt to the east and ice to the west and south. Within the foreset and bottomset zones in the delta complex the following processes operated. Firstly, gravitational sliding on the foreset slope to give proximal, pebbly coarse sands and secondly, pulsatory density underflows caused by the high sediment concentration that flowed along the lower delta slopes. These deposited the various types of ripple drift, from small-scale current ripple trains in combination with high suspension rain-out and the isolated, large-scale cross-stratified sets from sand waves. Occasional scouring was associated with higher flow speeds at the current head. Some underflows may have been triggered by slumping on the foreset slope, but most were initiated by the high sediment concentration.

Thirdly, there was continuous sedimentation from suspension, which resulted in parallel laminated sands and silts and which also contributed to the formation of the ripple-drift sequences.

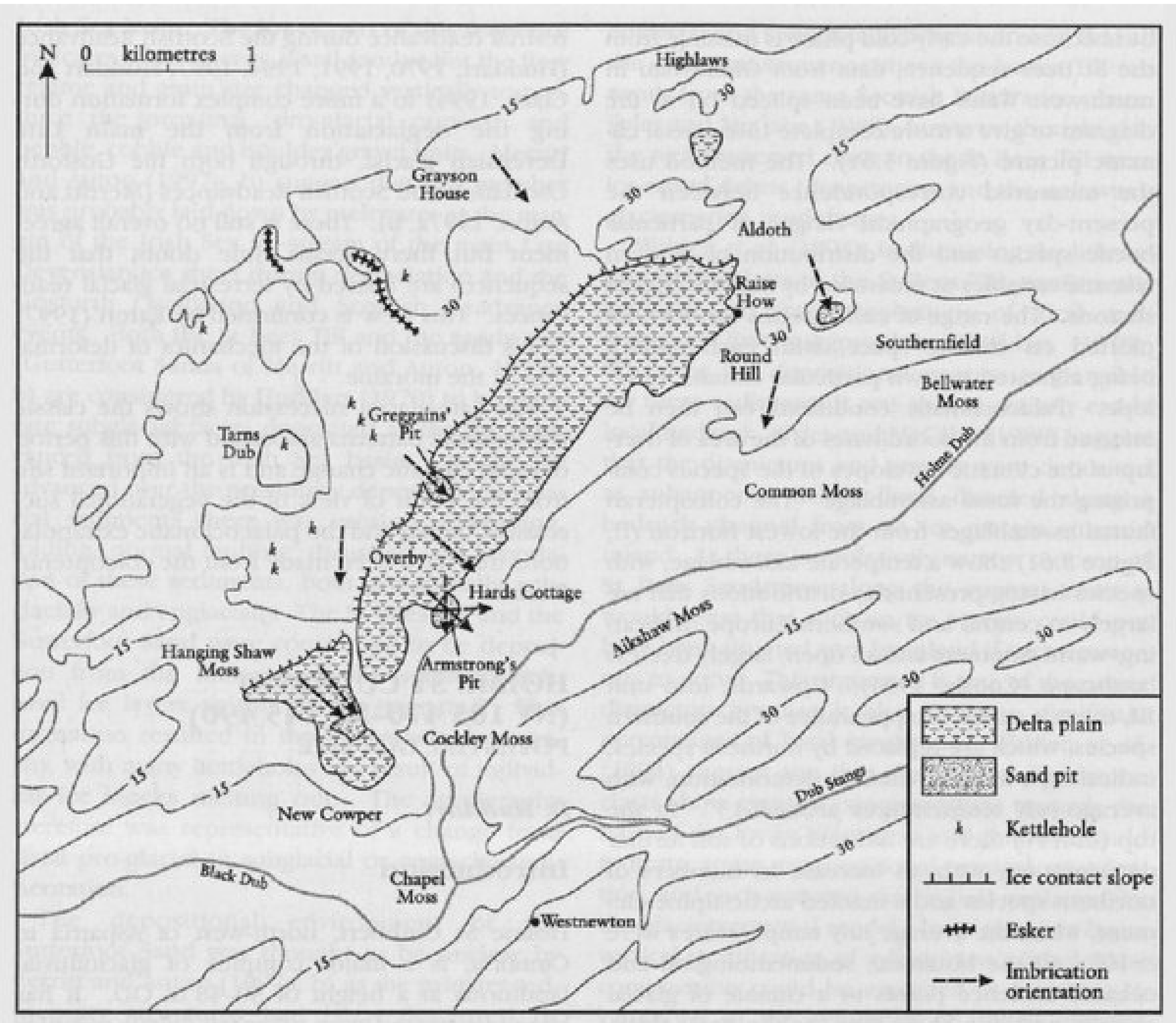
Two lake surfaces have been levelled at 42.7 in and *c.* 30.5 m OD, based on the transition from topset to foresets. The later, lower lake stage is not extensive and has been located only in the southern part of the delta complex at New Cowper. Profiles shown in (Figure 5.66) depict the two main stages, which overflowed in the initial lake stage through a channel east of Westnewton and probably at the later stage through the Black Dub. The ice front that held up this pro-glacial lake clearly post-dated the main Late Devensian glaciation, and the ice-marginal position of the later readvance of Scottish ice, based on the palaeocurrent evidence and the lithologies, has been correlated with ice-marginal positions in the Carlisle Plain, Harrington, St Bees and Annaside–Gutterby Banks (Huddart, 1970 1991, 1994; Huddart and Tooley, 1972; Huddart *et al.,* 1977).

The Holme St Cuthbert deposit is probably one of the three sites marked near the Solway shore by Eyles and McCabe (1989), from the Risehow area to near Carlisle, but the exact locations are not given in their text. Nor does their text discuss alignments, altitudes and limits of the suggested morainal banks. However, it is clear that Holme St Cuthbert is one of seven locations on the Cumbrian coastal lowlands interpreted as sites of morainal banks built out as tidewater sediment accumulations at the retreating margins of glaciers (e.g. Powell, 1981; Huddart and Peacock, 1989). Each complex may represent a temporary halt of the margin because they are typically associated with bedrock highs and relatively shallow water (Eyles and McCabe, 1989). The Holme St Cuthbert deposit supposedly marks the middle morainal bank in the Solway lowlands marking a temporarily stable marine terminus of the inland ice. Eyles and McCabe (1989) thought that such banks were related closely to the presence of drumlins in adjacent areas behind (i.e. upstream of) the banks. They presented no data for the sedimentology of this deposit, nor were relationships in Cumbria between morainal banks, ice streams and drumlin formation discussed. It should be noted that on the coasts south from Mawbray and on the Furness peninsula, drumlins have been been eroded partially or wholly, which indicates a former greater extent of drumlin tracts so that the contemporary margins of land-based ice would have been seaward and not landward of present coastlines. There also are no marine macro- or microfossils, as are often found in unequivocal morainal banks (Huddart and Peacock, 1989). Ice marginal positions demonstrated here also have been ignored by McCabe *et al.* (1998) in their discussion of the Heinrich I event in the northern Irish Sea basin.

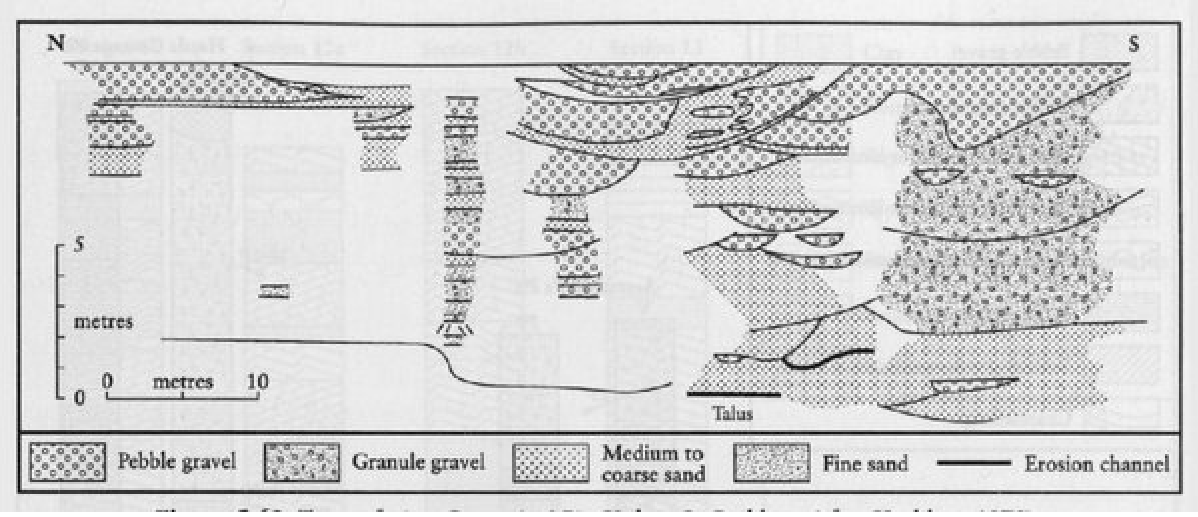
Conclusions

The sedimentary sequences and landforms at Holme St Cuthbert have been interpreted as esker-fed, ice-contact 'Gilbert-type' deltas into a pro-glacial lake from Scottish ice to the west and north-west. This ice ponded up water to the east in the Holme Dub valley to a depth of approximately 30 m. The conclusion from this evidence is that the sedimentary environment was not a morainal bank but a pro-glacial lake, that ice was not present to the east (inland) but to the north■west and west, and that the sediment sequence was deposited as a later phase and was not intimately related to the drumlin stage.

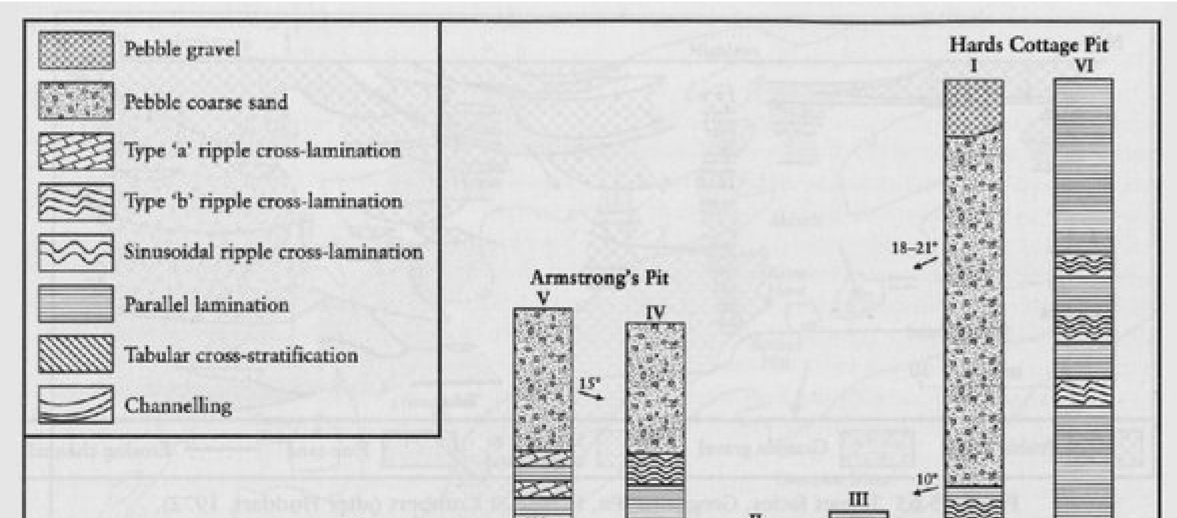
References



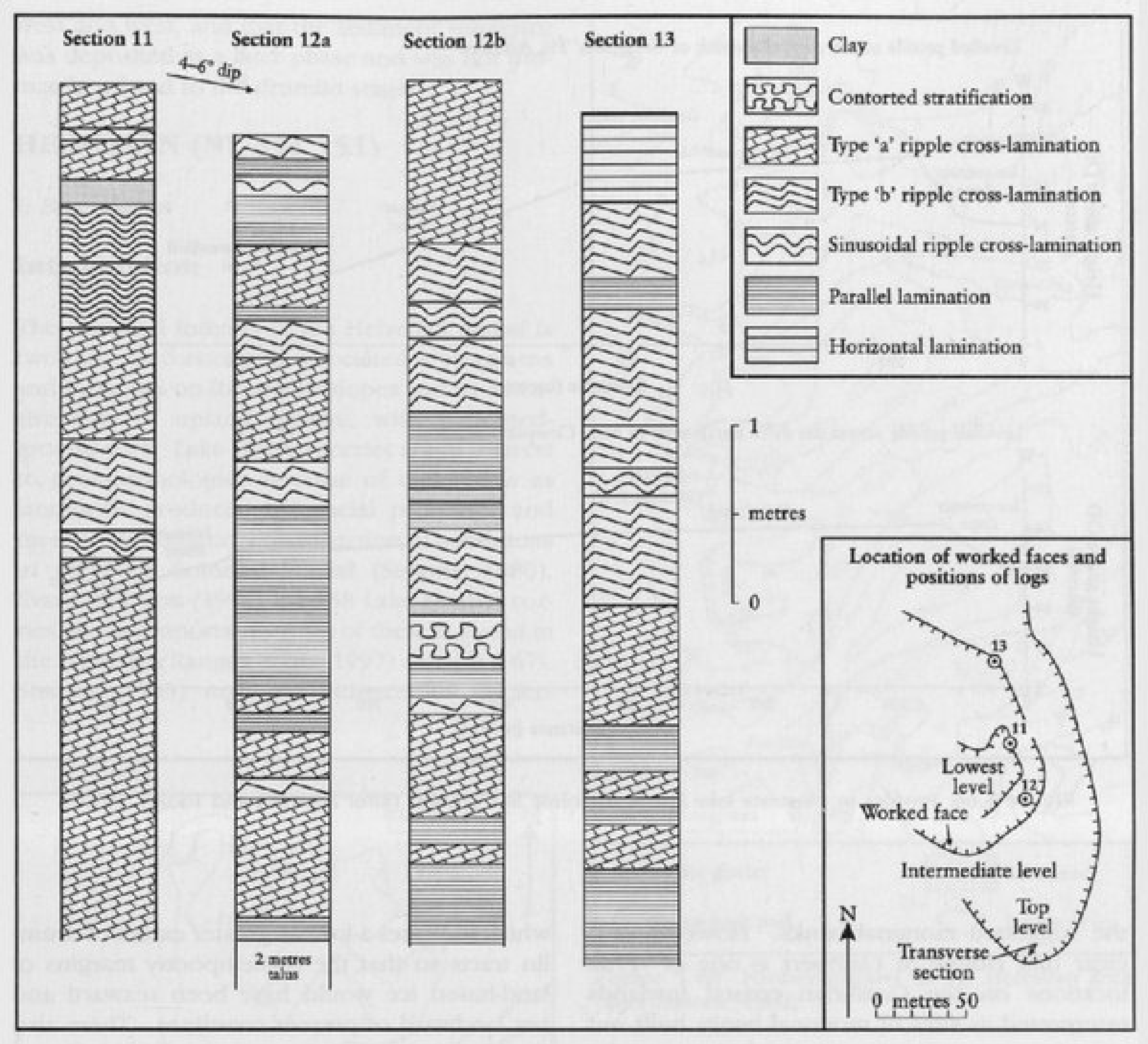
(Figure 5.62) Pro-glacial lacustrine sediments and landforms in the Holme St Cuthbert area (after Huddart, 1991).



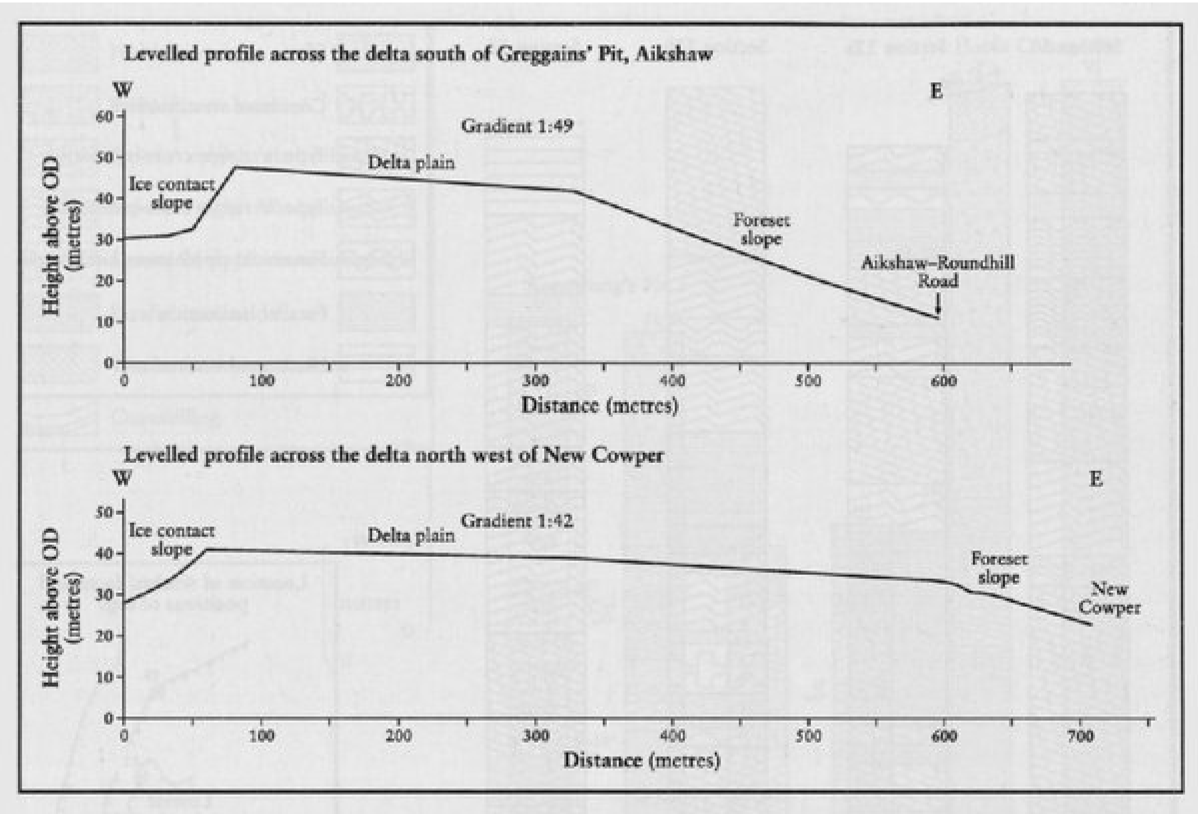
(Figure 5.63) Topset facies, Greggains' Pit, Holme St Cuthbert (after Huddart, 1972).



(Figure 5.64) Foreset and bottomset facies, Armstrong's Pit and Hards Cottage Pit (after Huddart, 1972).



(Figure 5.65) Bottomset facies, Greggains' Pit (after Huddart 1972).



(Figure 5.66) Profiles to illustrate lake levels at Holme St Cuthbert (after Huddart and Tooley, 1972).