# Annaside and Gutterby Banks

[SD 085 966]–[SD 104 837]

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## Introduction

This site provides important sedimentological, stratigraphical and geomorphological evidence for interpreting the glacial stratigraphy of Cumb ria and has been discussed by Mackintosh (1870, 1877), Smith (1912), Huddart (1970, 1991, 1994, 1997), Huddart and Tooley (1972) and Huddart *et al.* (1977). The morainic landforms along the narrow coastal plain between Black Combe and the sea consist of a series of hummocky hills, with many enclosed depressions, and there is a definite marginal-edge limit between Coteley Bank in the south to Annaside, with an outlier around Barfield Tarn. The best sectional evidence is found between Annaside and Gutterby Banks [SD 085 966]–[SD 104 837].

## Description

In describing the coastal plain drifts between the Duddon and St Bees, Mackintosh (1870, 1877) recognized three divisions:

1. an upper, red, loamy clay, containing few boulders, partly derived from Permian strata;
2. sand and gravel, containing pebbles and a few boulders of most of the rocks found in the clay above and below it;
3. a lower, reddish, yellowish or yellowish-brown boulder clay, which was largely derived from volcanics and Coal Measure shales.

Mackintosh thought the drifts were deposited by floating ice, and although his simplified stratigraphy was regarded as broadly correct, Smith (1912) argued that the 'lateral and vertical variations in character and the changes in level of the drifts are probably much greater than he (Mackintosh) imagined.' Smith (1912) considered that the 'Middle Sands and Gravels' were formed during the waning of the ice sheet that deposited the 'Lower Boulder Clay', preceding a slight advance that introduced the 'Upper Boulder Clay'. Huddart (1997) considered that this landform and sediment assemblage marked the limit of a readvance of Irish Sea ice on to the coastal lowland after the main Late Devensian glaciation. Eyles and McCabe (1989), however, considered the assemblage to be a glaciomarine morainal bank.

The stratigraphy, mapped by Huddart (1970) is shown in (Figure 5.53), and the following units were identified.

8. Raised coastal sediments found only in Selker Bay (Huddart and Tooley, 1972)

7. Kettlehole sediments, including laminated silts, sands and gravels and peats

6. Till: the Coteley Member

5. Sand and gravel: the Coteley Bank Member

4. Till: the Gutterby Spa Member

3. Gravel: the Annaside Member

2. Sand: the Annaside Member

1. Till: the Selker Member (Huddart, 1970; Thomas, 1999).

The basal unit, the Selker Till (unit 1, above), shows 2 m of dark reddish brown, sandy, pebbly till with a sand/silt matrix ratio of 0.55 (Huddart, 1971a), much higher than the values obtained from the till units higher in the stratigraphical sequence. This high ratio, plus the high pebble content, are the reasons for correlating this unit with the Lowca Till at St Bees. The Annaside Member (units 2 and 3, above) displays an upward succession from fine-grained sands, through coarse sands to gravels and this sequence is fairly constant in thickness and height throughout the length of the coastal sections. Log 9 (Figure 5.54) shows a typical coarsening upwards succession. At beach level parallel laminated silt is succeeded by thin units of small-scale, cross-stratified and parallel laminated fine-grained sand and silt and thicker units of horizontally stratified coarse sand. Above are units of large-scale cross-stratification and horizontal stratification succeeded by 2 m of horizontally stratified coarse sand and 3 m of pebble gravel. This is capped by 2 m of red till. Similar glaciofluvial sequences are illustrated in logs 1 and 10, with low-flow-regime indicators predominating. Soft-sediment deformation is characteristic of the low-flow-regime sequences and contorted stratification, load casts, flame structures and sandy clasts within silts indicate the importance of grain size and density contrasts during suspension sedimentation. The thickest sequence of gravels is found at Annaside Bank (Log 8, (Figure 5.54)), where 12 m occur. The gravels are generally imbricate and the palaeocurrent pattern shows a dominant transport direction from the north-west.

Huddart (1970) grouped units 4, 5 and 6 into the Gutterby Spa Complex. The lowest unit, the Gutterby Spa Member, is composed of a tripartite sequence consisting of till–sandy clay–till, with no obvious break in sedimentation. The individual units vary in thickness in different locations and at the northern end of Annaside Bank the sandy clay is missing and till composes the whole section. The type site for the sequence is at Gutterby Spa and the succession is shown in log 12 (Figure 5.54). Above granule gravel at the base of the succession is a reddish brown, sandy till unit with a few pebble gravel clasts and many sand inclusions and sandy channels. There is no disturbance at the top of the unit where the till merges upwards into the sandy clay. The sandy clay attains its greatest development at this site, where it is 8.5 m thick and includes a 2.2 m sequence of intermixed sand and silt and parallel laminated sand and clay. Concretions are common and tend to form at the base of clay bands. The upper till in this tripartite succession is reddish brown, very sandy, with few pebble clasts and has comminuted shell fragments (Smith, 1912).

## Interpretation

The sediments along this coastal plain have been correlated with those from St Bees, but here they are relatively undeformed. The lowest unit, Selker Till, is interpreted as the basal till of the Late Devensian main glaciation advance and is equivalent to the Lowca Till at St Bees and the

Ravenglass Till (Huddart, 1970). During advance, subglacial meltwater activity eroded drainage channels across the bedrock floor and deposited the subglacially engorged eskers on the lower slopes of Corney, Bootle and Little Fells (Smith, 1967) (Figure 5.55). The Irish Sea ice sheet then retreated and readvanced, with pro-glacial, braided rivers producing a thick, widespread sandur sequence. The lower part of the Annaside Sands and Gravels indicates deposition in the lower flow regime and probably represents distal sandur and/or marginal glacio-lacustrine deposition, with deltas prograding into the dammed lakes. Evidence from dropstones and the general sediment sequences is indicative of such environments, although large-scale foresets, as noted at Holme St Cuthbert, are not evident. That the ice sheet was advancing is indicated by the vertical increase in grain size and the change to upper-flow-regime indicators. Proximal, pro-glacial, longitudinal bar deposition is indicated by the imbricate, pebble gravel units, and the thin till units and clay balls are thought to represent flow till deposition from the nearby ice front into the proximal sandur system and reworking of such flow tills by outwash streams. Deposition was from the north-west and west.

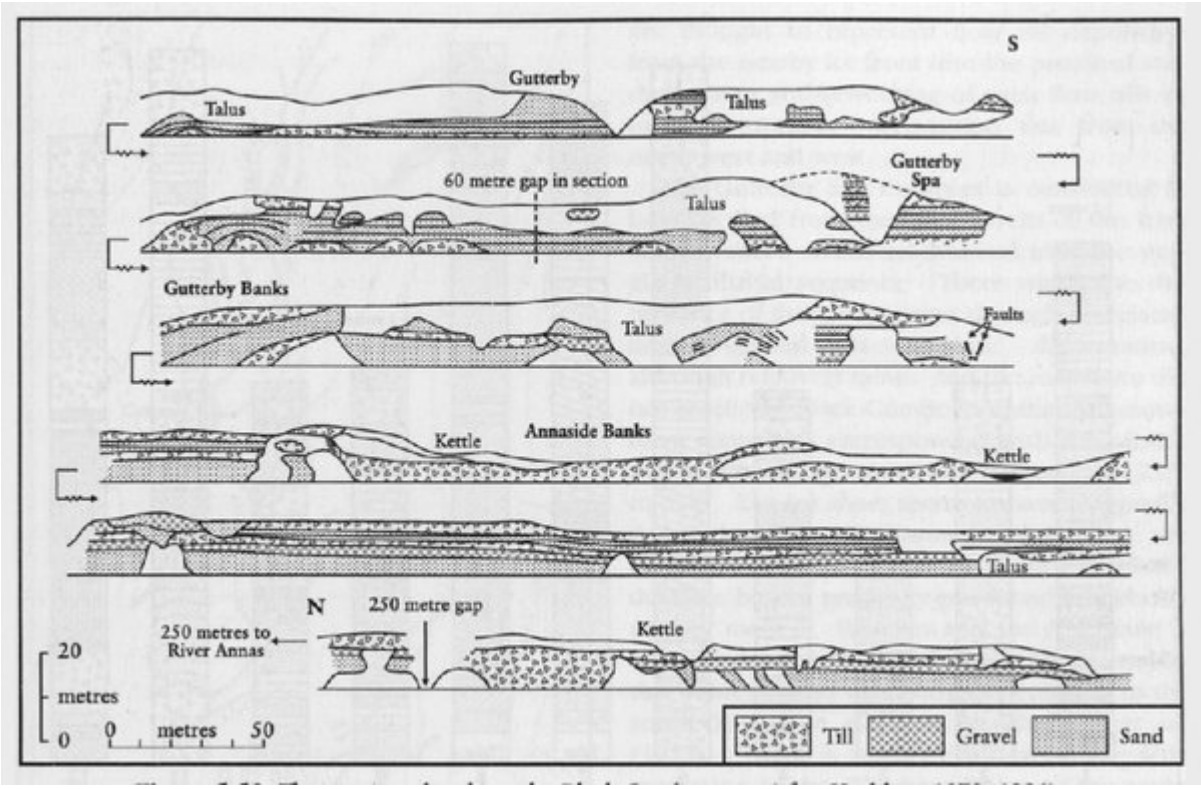
The Gutterby Spa Complex is considered to have formed from the basal layers of the Irish Sea ice sheet, which readvanced over the pro-glacial fluvial sequence. There was some disturbance of these sequences through pro-glacial and englacial glaciotectonic deformation, although relatively minor, and the readvance did not reach the Black Combe foothills. Ice movement directions corresponded with the sandur palaeocurrent directions and ranged from 255° to 328°. The ice sheet seems to have marginally decayed at its maximum extent and the till–sandy clay–till melted out *in situ.* Isolated dead-ice blocks gradually produced kettleholes as they melted. Whether this ice readvance is correlated with the Low Furness Readvance on the Walney Island and Furness peninsula to the south has been debated by Huddart *et al.* (1977). There is evidence for lacustrine sedimentation in the Whicham Valley to the south (Bryant *et al.,* 1985; Clark and

Smith, 1998) and it seems likely that this same ice sheet blocked off that valley to create a pro-glacial lake.

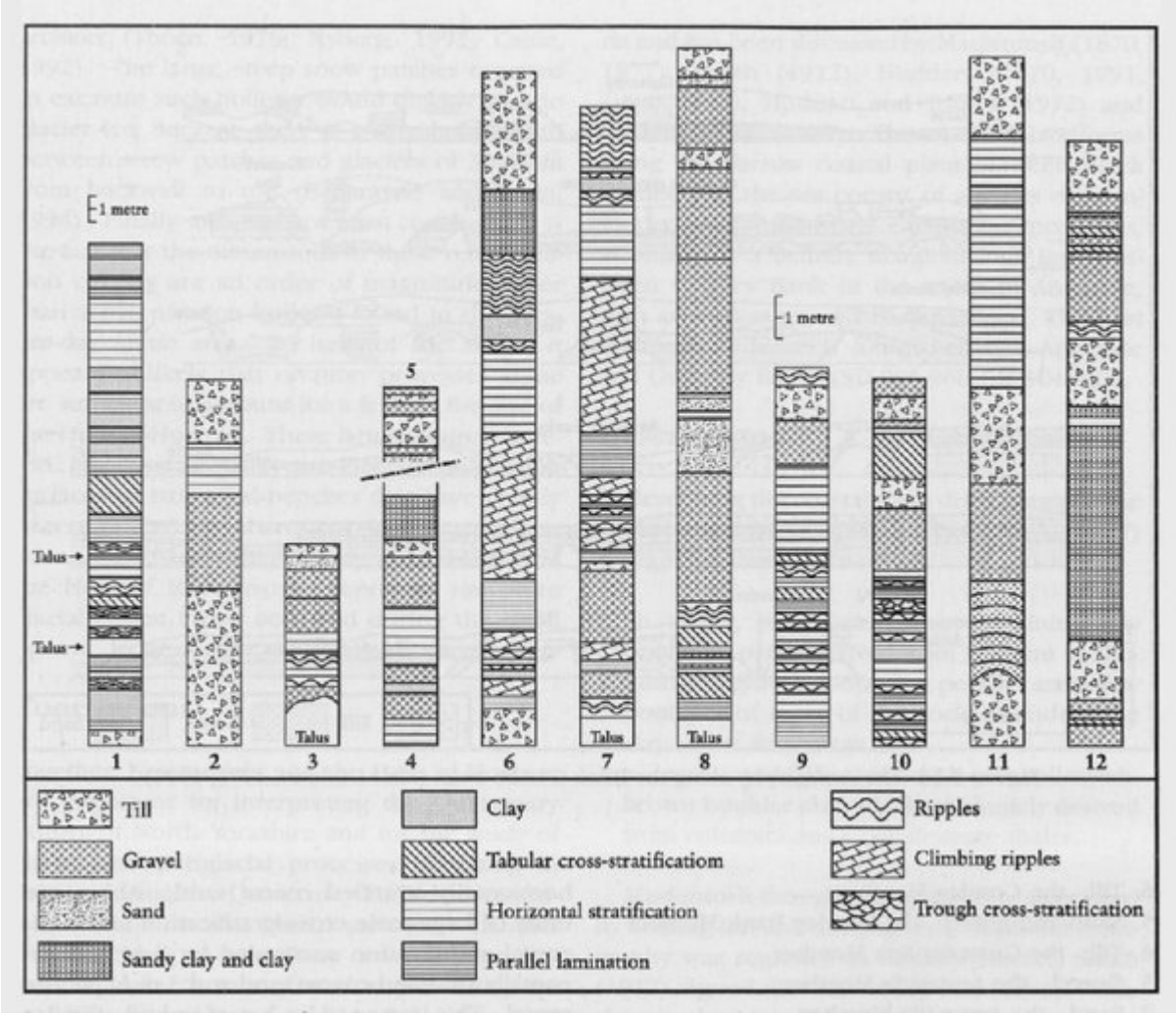
## Conclusions

The stratigraphical succession and landform assemblage along the Black Combe coastal plain indicate a moraine that marks an ice-marginal position of the Scottish Readvance phase of the Irish Sea ice sheet. There is no evidence for glaciomarine morainal banks or glaciomarine mud drape sedimentation as discussed by Eyles and McCabe (1989), but it is possible that this moraine could be linked to either a surge of the Irish Sea ice sheet, or as part of the Heinrich I phase of McCabe *et al.* (1998), but with all the evidence pointing to deposition from the northwest and west and not from the Lake District as he implies.

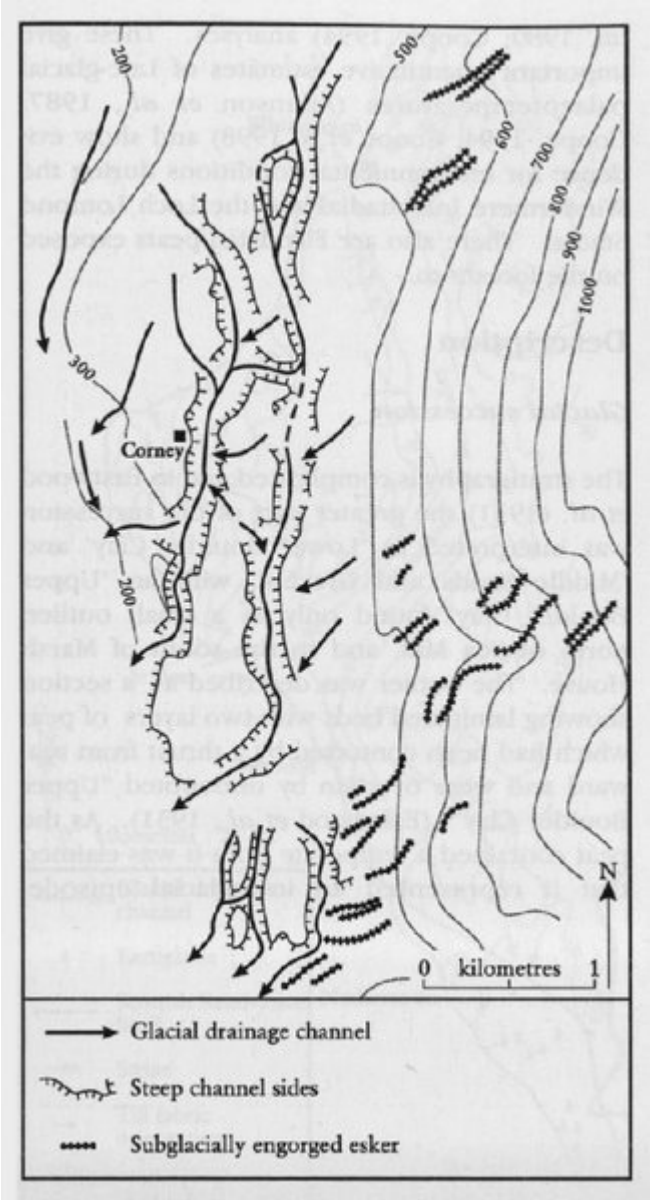
**References**




*(Figure 5.53) The stratigraphy along the Black Combe coast (after Huddart, 1970, 1991).*




*(Figure 5.54) Sedimentary logs, Black Combe coast (after Huddart, 1970, 1991).*




*(Figure 5.55) Glacial meltwater channels and sub-glacially engorged eskers on Comey Fell (after Smith, 1967; Huddart and Tooley, 1972).*