Morannedd

One of the best available sequences of Late Pleistocene glacial sediments in North Wales, this site provides evidence for two Welsh ice advances probably during the Late Devensian. Controversy has arisen over the time gap between these two events.

Introduction

Morannedd shows an important sequence through Pleistocene deposits in the eastern Ll'n Peninsula. Evidence from the site has been used to show that the area was glaciated by ice from the Welsh highlands on two separate occasions. Although the chronology of events at the site remains uncertain, the sections are amongst the finest in Ll■n that expose tills of local Welsh provenance. The site has a long history of research commencing with Jehu (1909). It has featured in studies by Fearnsides (1910), Synge (1963, 1964, 1970), Saunders (1963, 1967, 1968a, 1968b, 1968c, 1968d, 1973), Simpkins (1968), Whittow and Ball (1970) and Campbell (1985a). The site has been discussed in the context of the Irish Sea Basin and Wales by Bowen (1973a, 1973b, 1974, 1977b).

Description

The exposures at Morannedd [SH 507 381] extend along the coast for about 250m and attain a maximum height of about 9m. Whittow and Ball recorded the following generalised succession, shown in (Figure 34):

6 Hillwash and loess

5 Shaly head (cryoturbated)

4 Yellow-brown gravelly till (Llanystumdwy Till)

3 Soliflucted and weathered surface of Criccieth Till

2 Blue silty clay (discontinuous)

1 Blue-grey argillaceous till (Criccieth Till) with fossil ice-wedge casts

Their sequence, however, has been debated and the interpretation of the sediments is controversial.

Interpretation

Jehu (1909) recognised only a single till at the site (probably bed 4), and established that it contained neither shell fragments nor far-travelled (Irish Sea) erratics. The common occurrence of greenstones in the till led him to suggest that it had been deposited by ice from Snowdonia. He regarded the till as representing the Upper Boulder Clay of his tripartite succession in Ll■n. However, according to Fearnsides (1910), the till also contained boulders from west Caernarvonshire and Anglesey.

The sections at Morannedd were also noted by Synge (1963, 1964) who correlated the drifts of North and north-west Wales with successions in Ireland. At that time, he recognised only a single Welsh till, derived from the east. He regarded the yellow-brown till (bed 4 -the Llanystumdwy Till of Simpkins (1968)) as the weathered surface of the blue-grey till (bed 1) near the base of the section. He also noted that the upper surface of the weathered till was severely disturbed by frost-action, with many vertical stones. On the basis of the weathering and frost disturbance, Synge argued that the till had been deposited probably during the Saalian Stage. He suggested that its deep weathering occurred during the subsequent Ipswichian Stage, while cryoturbation of the upper layers had taken place during periglacial conditions in the Weichselian (Devensian) Stage.

Subsequent workers including Saunders (1963, 1967, 1968a, 1968b, 1968c, 1968d), Simpkins (1968), Whittow and Ball (1970) and Bowen (1974, 1977b) have recognised two tills at Morannedd. Simpkins (1968) termed the blue-grey argillaceous till and the yellow-brown gravelly till, the Criccieth and Llanystumdwy Tills, respectively. She considered that the surface of the Criccieth Till had been weathered during the Ipswichian Stage. The Criccieth Till was therefore taken to belong to the Saalian Stage, and the overlying Llanystumdwy Till, to the Late Devensian.

Saunders also noted the Criccieth Till and its badly weathered and frost-heaved surface, overlain by a gravelly upper till. He presented detailed pebble lithology and till fabric measurements to demonstrate that both tills were of Welsh origin, having been deposited by ice moving ENE to WSW, from the Vale of Ffestiniog. The close correspondence between till fabrics in both horizons was taken to indicate that the direction of ice movement had been substantially similar during both ice advances. It is, however, possible that the most recent of the ice movements caused a marked reorientation of pebbles in the lower till, and that this overprinting masks any original clast fabric patterns.

On the basis of a model developed from lithostratigraphical evidence elsewhere in Ll■n and supported by radiocarbon determinations, Saunders argued that the Criccieth Till had been deposited during the main invasion of the Late Devensian Welsh ice-sheet, and he correlated it with the lower, Irish Sea till of the north Ll■n coast and at Porth Neigwl (the Trevor Till). He suggested that the upper gravelly till at Morannedd had been deposited by a subsequent advance of Late Devensian Welsh ice, and that it could be correlated with the upper till of the north Ll■n coast (the Clynnog Till). Saunders believed that the frost-cracked and weathered surface of the lower till at Morannedd was critical to the interpretation of the sequence. He argued that it indicated a clear hiatus between deposition of the tills, reinforcing his argument that they were the product of two separate ice advances which crossed southern Ll■n during the Late Devensian.

Whittow and Ball (1970) accepted Saunders interpretation of the sequence at Morannedd and considered that the blue-grey till was the product of the first of the inferred glacial advances in Ll■n, and followed Simpkins' (1968) terminology and called it the Criccieth Till. They also noted tectonic structures in its upper layers which could have formed as slump structures during a phase of weathering or as drag features from an overriding ice mass. Whittow and Ball suggested that the upper Llanystumdwy Till (Simpkins 1968), represented a subsequent advance of Welsh ice. A final phase of periglacial conditions was interpreted from the cryoturbated shale head which capped the sequence.

In 1970, Synge likewise distinguished two tills at Morannedd, although he argued that there was no hiatus between deposition of the two. He suggested that the lower till had been deposited by Welsh ice moving in a slightly different direction to that which deposited the upper. The weathering horizon judged by Saunders and Whittow and Ball to have formed during interstadial conditions, and by Synge (1964) and Simpkins during fully interglacial conditions, was reinterpreted by Synge (1970) as an iron-pan effect, and the fossil ice-wedge casts as load structures.

The debate on the exposures at Morannedd is typical of many of the problems in interpreting Late Pleistocene successions in the region (Campbell 1985a). Two features make the site significant. First, Morannedd can be regarded as a reference site for the Criccieth and Llanystumdwy Tills of southern Ll■n. These glacigenic sediments provide evidence that southern Ll■n was glaciated by Welsh ice, probably on two occasions. The strongly preferred ENE to WSW trend of clasts in the Llanystumdwy Till shows that western Ll■n was free from Irish Sea ice during the second of these proposed glacial advances, which otherwise would have impeded and deflected the Welsh ice to a different course.

Second, the fine development of weathering and frost-crack features on the surface of the Criccieth Till provides evidence for a time separation between deposition of the Criccieth and Llanystumdwy Tills. This evidence, however, has proved controversial. Synge and Mitchell argued that the deep weathering at Morannedd and elsewhere in southern Lyn indicated that only the northern coastal fringe of L.Wri was glaciated during the Late Devensian. They considered that drifts south of their reconstructed Late Devensian maximum limit, therefore, dated from the Saalian Stage and that they had been deeply weathered during the Ipswichian.

Whereas Boulton (1977a, 1977b) interpreted a similar sequence from Glanllynnau in southern Lly'n as the result of a single Late Devensian glacial episode, and suggested that the weathering horizon there did not represent a significant break in sedimentation, the evidence from Morannedd has been continually used as support for there having been two

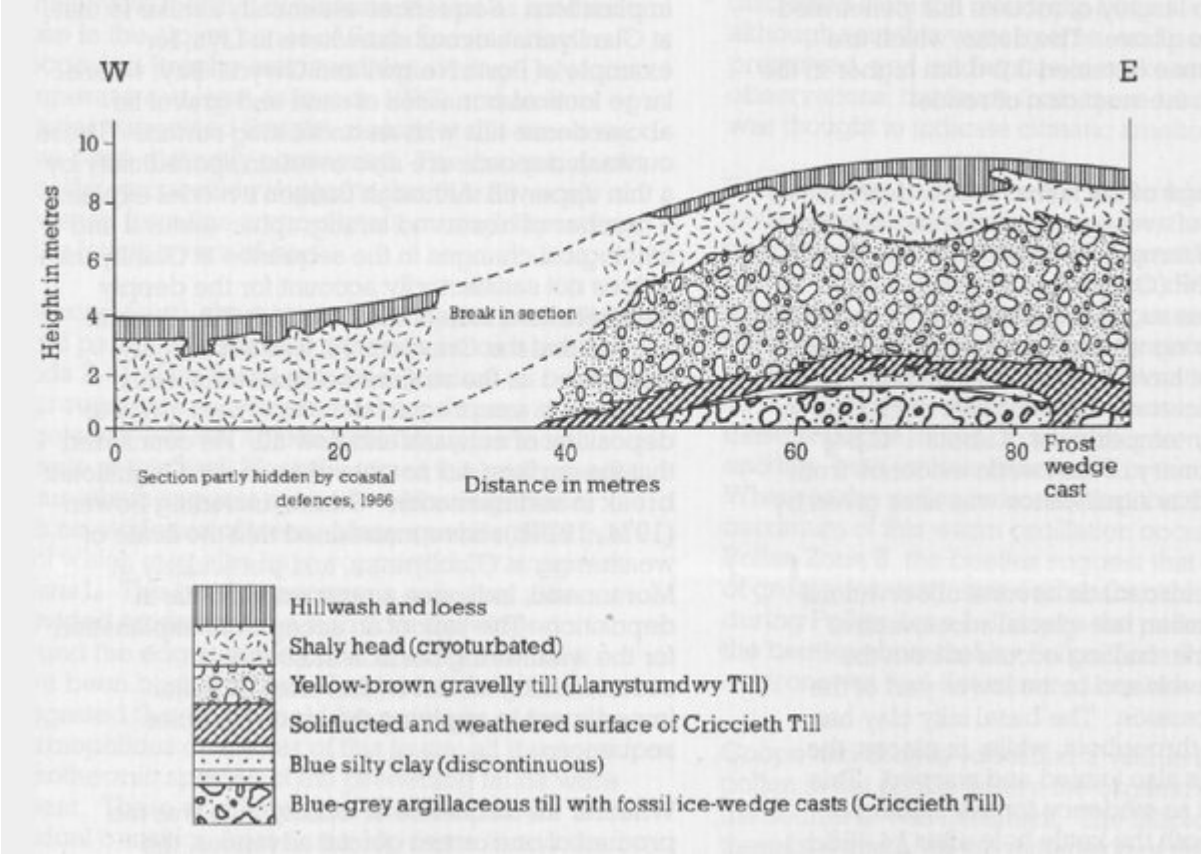
ice advances during the Late Devensian. Bowen (1973a, 1973b, 1974, 1977b) considered that the fine development of the weathering horizon and the fossil ice-wedge casts at Morannedd was evidence for an interval between deposition of the Criccieth and the Llanystumdwy Tills.

Morannedd provides evidence for the glacial history of southern Ll■n. The sections are among the finest in the region through tills of local Welsh provenance. The site can be regarded as a reference site for the Criccieth and Llanystumdwy Tills. The status of the weathering horizon between these tills is critical to the interpretation of the sequence, but has proved controversial. The development of the weathered and frost-cracked surface of the Criccieth Till here could provide evidence for a time interval between the deposition of the Criccieth and Llanystumdwy Tills.

Conclusions

Morannedd is the type site for the main glacial deposits of the southern Ll■n peninsula. It is a reference site for the Criccieth and Llanystumdwy Tills (boulder clays). Between the two tills is a horizon of weathering. Its exact significance is still unknown but it continues to figure prominently in debates about the glacial history of North Wales.

References



(Figure 34) Quatemary sequence at Morannedd (from Whittow and Ball 1970)