Rhosili Bay

Highlights

A key site where fluvioglacial sands and gravels, thick periglacial heads and possible till deposits provide vital evidence for reconstructing Devensian environments in west Gower, including possible evidence for a Late Devensian ice lobe in Carmarthen Bay.

Introduction

Rhosili Bay [SS 414 900] shows evidence for the glacial and periglacial history of west Gower. Thick head (periglacial) deposits are exposed in coastal cliffs for about 2km at the foot of Rhosili Down, and these form one of the finest examples of a solifluction terrace in Wales. Deposits at Rhosili also help to establish the maximum limit of the Late Devensian ice-sheet in west Gower. Site investigation commenced with Prestwich (1892). It was reinterpreted by Strahan (1907b) and was studied in detail by George (1932, 1933a). Aspects of the Pleistocene history of the site were also dealt with by George (1933b, 1938), Griffiths (1939), Bowen (1966, 1970a, 1973a, 1973d, 1974, 1977a, 1977b, 1980a), Peake *et al.* (1973), Green (1981b), Campbell and Shakesby (1982), Stephens and Shakesby (1982) and Bridges (1985). Campbell (1984) provided a detailed description.

Description

Rhosili Down is formed of Devonian Old Red Sandstone. It trends north-south, and rises steeply above the coastal plateau of Gower to a height of 193m OD. At several localities Old Red Sandstone sandstones and conglomerates crop out as tors. At the west side of Rhosili Down, a large solifluction terrace has been cuffed by the sea. Exposures in the terrace show that, for much of its length, it consists of head (periglacial) of local Old Red Sandstone sandstones and conglomerates. Towards the north end of the bay [SS 414 900], however, a more complex sequence is seen — see (Figure 8); (Campbell 1984) -

5 Blown sand

4 Colluvium (0.5m)

3 Upper head (2.0–3.0m)

2 Gravel containing clasts of mixed lithology (6.0m)

1 Lower head (2.0–3.0m)

The gravel (bed 2) extends laterally for only 150m, and then lenses out to be replaced by head. It overlies the lower head (bed 1) with a sharp undulating boundary, and evidently corresponds with the 'glacial gravel' described by George (1933a) and the 'outwash' of Bowen (1970a). The boundary between beds 2 and 3, however, is gradational, and large pockets of sand and gravel from bed 2 are incorporated within the upper head. Till has also been described from the site, within the gravels of bed 2 (Campbell and Shakesby 1982; Campbell 1984).

Interpretation

Pleistocene deposits were first recorded at Rhosili Bay by Prestwich (1892), who described a bed of shelly sand and gravel (bed 2) between layers of Old Red Sandstone rubble in the coastal terrace. The presence of marine shell fragments in the gravelly drift led him provisionally to refer to the deposit as a 'raised beach'. Strahan (1907b), however, considered the gravel to be glacial in origin, noting the presence of many far-travelled Old Red Sandstone and South Wales Coalfield erratics. He concluded that the gravel had been derived from a northern source, and interpreted the

upper and lower 'rubble' beds as strictly local talus deposits derived from the Old Red Sandstone hills above the bay. Strahan (1907b) could not locate shells similar to those described by Prestwich (1892), but he speculated that the *Mya, Turitella* and *Nassa* shells had been derived from a sea-bed, probably in Carmarthen Bay. This implied a south-east flow of ice, which he suggested might also account for the presence of several igneous (Irish Sea) erratics in the gravel.

George (1932, 1933a) gave a comprehensive account of the deposits at Rhosili in his classic accounts of the raised beaches and glacial deposits of Gower. He suggested that the glacial gravel (bed 2) occurred as a large wedge which thinned to the south. Southwards, the upper and lower head deposits merged imperceptibly, and he considered that deposition of the glacial gravel had been merely "a brief interlude" in the formation of the head deposits. He recorded a number of far travelled rock types from the glacial gravel which included soda felsite (from Ll■n), perlitic-rhyolite (Pembrokeshire?), Llandovery mudstone (Haverfordwest?), horneblende-porphyrite (south Scotland), quartz-hyperite (south Scotland) and Precambrian slate. However, these rock types, thought to have been transported to Gower by Irish Sea ice, formed only a small proportion of the total assemblage so he was confident that the bulk of the gravel had been derived from the north; citing in particular, the presence of Millstone Grit from the North Crop, and Carboniferous Limestone traceable on its fossil content to north-west Gower. The shells described by Prestwich (1892) were considered to have been dredged from the floor of Carmarthen Bay as the Welsh ice moved southwards. The mixture of Welsh and Irish Sea erratics was used as evidence (George 1933a) to suggest that during the 'Older Drift' glaciation, Carmarthen Bay and the Loughor Estuary had been congested contemporaneously with ice masses both from the Welsh uplands and from the Irish Sea Basin. The mixed provenance of the drift deposits in west Gower in general, and Rhosili in particular, was later confirmed by heavy mineral analyses (Griffiths 1939).

George (1933a) considered that the Old Red Sandstone rubble horizons (beds 1 and 3) at Rhosili had been emplaced in a 'rigorous climate', and noted that the surface of the drift terrace was almost flat-topped, sloping gently seawards. Because this terrace and those elsewhere in Gower were cut across deposits of markedly different types (glacial gravel, cemented and uncemented heads, silts and sands), George (1932) remarked that they could not have been formed solely by subaerial processes, and he suggested that the final moulding of the features had taken place by planation during a short period of marine erosion, of unspecified age. He termed such features the 'Post Older Drift Platform'.

Bowen (1966) initially considered that the glacial gravels (bed 2) were of Saalian age, although he revised this in later papers. He accepted that shells in the gravels at Rhosili had been picked up by ice from the floor of Carmarthen Bay and the Loughor Estuary (Bowen 1970a). These shells were then incorporated into outwash from the margin of the Late Devensian ice-sheet which stood somewhere in the region of present day Whitford Point (Bowen 1970a). Gravels from this ice-sheet were deposited at Rhosili and on nearby Worm's Head. He considered that the Irish Sea erratics described by George had been reworked by the Devensian ice from earlier 'Older Drift' glacial deposits. Unlike George he did not believe that the sediments had been deposited by confluent Irish Sea and Welsh ice masses of 'Older Drift' age, citing the relatively undissected and fresh nature of the drifts as evidence for a Devensian age.

Following deglaciation of the Late Devensian ice-sheet, head deposits continued to form at Rhosili, covering the earlier outwash (Bowen 1970a, 1973a, 1973d, 1974, 1977a, 1977b, 1980a). Bowen noted that, as at Morfa-bychan (west Wales), local site conditions had been particularly favourable for the accumulation of solifluction deposits; a high slope of well jointed and well bedded Old Red Sandstone, and a westerly aspect which would have encouraged numerous freeze-thaw cycles, led to deposition of an upper head up to 15m thick. Bowen (1974, 1977a, 1980a) remarked that much of the upper head (bed 3) had probably accumulated during the Devensian late-glacial, and that the impressive solifluction terrace had formed over a period of, at most, 5,000 years. Rhosili Bay could be contrasted (Bowen 1973a, 1977a) with sequences at Glanllynnau in north-west Wales and Horton in south Gower where site conditions had not favoured head accumulation. At Horton, for example, the Devensian Stage was represented by only c. 2m of deposits (Bowen 1977a).

Winter storms in 1979–1980 revealed sediments at the base of the section that Campbell and Shakesby (1982) interpreted as till. Although the stratigraphic relationship of some of these deposits to those in the cliff behind was uncertain, others were interstratified with sands and gravels in bed 2. The clast lithologies and fabric pattern of the till indicated a north-west source, and this led to speculation (Campbell and Shakesby 1982; Stephens and Shakesby 1982) that Late Devensian ice may have reached farther south than others envisaged. They suggested that Carmarthen Bay

may have been occupied by a large piedmont ice lobe, similar to that described in Swansea Bay (Charlesworth 1929; Bowen 1970a).

Following the discovery of the till, the site was reinvestigated by Campbell (1984), who applied methods including Scanning Electron Microscopy, fabric analysis and clast lithological and roundness measurements to the interpretation of the sequence. From the evidence at Rhosili, Campbell (1984) proposed the following sequence of events. During the Late Devensian, around 18,000 years ago, Welsh ice moved southwards across Carmarthen Bay and on to west Gower to deposit shelly till at Broughton Bay. At that time, Rhosili Bay was probably in the periglacial zone, and the lower head may date from this time or even earlier in the Devensian Stage. The Late Devensian ice-sheet appears to have been near its maximum limit, and a mixture of fluvioglacial outwash and, perhaps, flow tills was deposited at the northern end of Rhosili Bay along the proglacial fringe of the ice-sheet. The lower head was truncated, possibly by glacial streams, before deposition of the glacial sands and gravels with their included marine shell fauna from Carmarthen Bay. The mixture of well rounded gravel clasts with large angular blocks of head, suggests that slope deposits may have been incorporated contemporaneously with fluvioglacial debris from the ice-sheet. Following melting of the ice-sheet, favourable site conditions promoted the accumulation of a thick upper head deposit (Bowen 1970a) which now forms the bulk of the solifluction terrace. Towards the end of this periglacial phase, sheet-washing formed a capping layer of colluvial sediments (bed 4). During the Holocene, dune sands (bed 5) were deposited at Llangennith and the northern end of Rhosili Down, and the whole terrace was trimmed by the rising sea.

Additional interest at the site was provided by Green's (1981b) discovery of a flint Palaeolithic handaxe from the foot of the terrace at the southern end of Rhosili Down [SS 414 880]. He suggested that the handaxe, which on its form was of approximately Ipswichian age, had probably been incorporated into the solifluction deposits during the cold Devensian Stage; there was no evidence to suggest that the handaxe had been rolled or transported by fluvial agencies. This was only the second such 'stray' find of a Palaeolithic handaxe in Wales (Green 1981b).

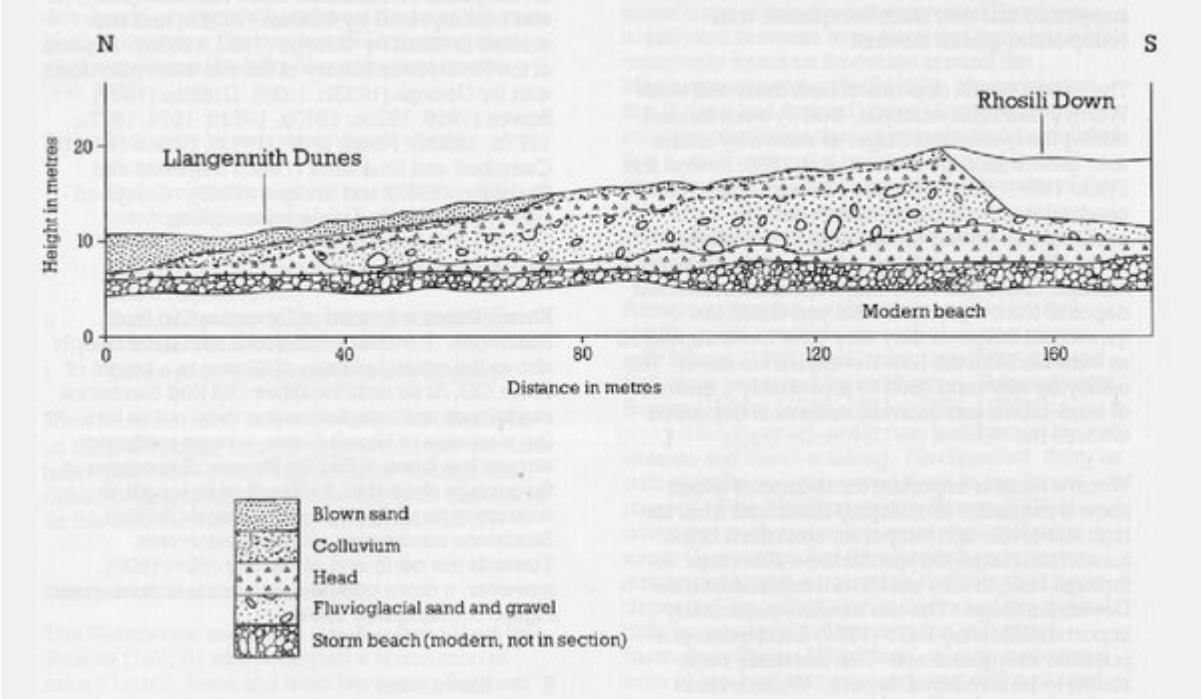
The sequence, therefore, records evidence for two periglacial phases separated by an event when outwash and associated sediments from a nearby Late Devensian ice margin were deposited. The upper head, which forms much of the impressive terrace at Rhosili, is thought to have accumulated in about 5,000 years, following wastage of the Late Devensian ice-sheet and during the Devensian late-glacial. Irish Sea erratics in the glacial outwash gravel provide vital evidence for the enigmatic, possibly 'Older Drift' (pre-Devensian) Irish Sea ice-sheet, which is thought to have affected parts of south and west Gower. The site has also been used as important evidence for the location of the Late Devensian maximum ice margin in west Gower. The exposures provide contrasting evidence to nearby sites at Broughton Bay and Worm's Head.

Rhosili Bay provides a sequence of deposits which demonstrates two phases of periglacial climate in which a large terrace of solifluction deposits accumulated, and between which fluvioglacial sediments were deposited. The latter were deposited by Late Devensian ice and are interbedded with possible flow till, suggesting that the Late Devensian ice-sheet reached almost into Rhosili Bay. The solifluction terrace, associated bedrock slopes and tors are one of the finest landform assemblages of their kind in Britain and clearly show the relationship between bedrock lithology, site aspect and slope factors in the formation of solifluction terraces.

Conclusions

The drift terrace in Rhosili Bay is made up of a succession of deposits which may be used to delimit the maximum extent of the last Welsh ice-sheet. The terrace is also important because of the evidence it provides for the rates of operation of cold climate processes on hill slopes. It is unique in Wales because it can be shown that the majority of its deposits accumulated between the time of ice disappearance and the onset of post-glacial conditions 10,000 years ago.

References



(Figure 8) Quaternary sequence at Rhosili Bay (after Campbell 1984)