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# Rotherslade (Langland Bay)

## Highlights

This locality is a rare site proving the position of the maximum extent of the ice front during the last, Devensian, glaciation. Although the rest of south Gower was unaffected by Welsh ice, lying in the periglacial zone, this area was overrun.

## Introduction

The exposures at Rotherslade demonstrate Devensian glaciation in Gower post-dating the raised beach ascribed to Oxygen Isotope Substage 5e. The site provides contrasting evidence to nearby sites at Hunts Bay, Slade and Horton, which demonstrate ice-free conditions throughout the Devensian. The site has a long-standing history of research commencing with the work of Strahan (1907a). It was later studied by George (1932, 1933a, 1933b), Griffiths (1939), Bowen (1966, 1969a, 1970a, 1971a, 1973a, 1973b, 1974, 1977a, 1977b, 1984), Campbell (1984) and Bowen *et al.* (1985). The site has also been mentioned in studies by Stephens and Shakesby (1982), Davies (1983), Shakesby and Campbell (1985) and Bridges (1985).

## Description

The following generalised sequence occurs at Rotherslade [SS 613 872]:

5 Modern soil} (1.0m)

4 Colluvium }

3 Glacial deposits (14.0m)

2 Limestone head with red silty sand matrix (3.5m)

1 Raised beach deposits (0.6m)

Maximum bed thicknesses after Bowen (1971a)

The raised beach deposits lie on a Carboniferous Limestone shore platform at 10m OD, which is dissected by relict potholes and gullies (Bowen 1971a, 1984). In places, the beach sediments adhere to the walls of these gullies and form a tough cemented conglomerate of limestone pebbles, although erratics from the South Wales Coalfield and Irish Sea Basin are also present (George 1932). The raised beach contains numerous marine shells and shell fragments. The thickest sediments are glacial deposits which are often crudely stratified, well imbricated, and contain an erratic suite typical of Breconshire drift (Bowen 1970a).

## Interpretation

The sections at Rotherslade were first described and interpreted by Strahan (1907a). The relationship between the raised beach deposits and the overlying glacial beds was used as critical evidence by Strahan to suggest a 'pre-glacial' or possibly 'interglacial' age for the raised beach sediments at the site and elsewhere around the Gower coast.

George (1932, 1933a, 1933b), who also suggested a 'pre-glacial' age for the *Patella* raised beach, considered that a sand, interpreted by Strahan (1907a) as aeolian, was a fluvio-glacial deposit, overlain by a sequence of interdigitating limestone head and glacial sediments representing glacial deposition at an oscillating ice margin. It was unclear if the glacial sediments belonged to the 'Older' or 'Newer Drift' glaciations (George 1933a, 1933b), but he subsequently

favoured that this part of east Gower had been overrun by the 'Newer Drift' ice-sheet (George 1970).

Griffiths (1939) identified the heavy minerals from the deposits on the west side of Langland Bay as part of his analysis of South Wales drifts. He considered that the drift at Langland consisted of basal layers rich in Irish Sea minerals as well as containing a few Irish Sea erratics. Higher, only a few 'foreign minerals' occurred while the uppermost layers and overlying gravels contained only 'local' (South Wales Coalfield) erratics and minerals. He concluded that the lower part was ground moraine deposited by combined Irish Sea and local Welsh ice of 'Older Drift' age. The overlying drift showed that some of the underlying material had been incorporated by the succeeding advance of 'Newer Drift' Welsh ice (the Tawe glacier). The coarse upper gravel represented the 'outwash fan' of the retreating 'Newer Drift' Tawe glacier (Griffiths 1939). He therefore believed that "at this exposure a complete sequence of deposits representative of both glaciations can be traced in the correct chronological and spatial order"; namely that both post-dated the raised beach.

The exposures at Rotherslade were also studied in a series of papers by Bowen (1966, 1969a, 1970a, 1971a, 1973a, 1973b, 1974, 1977a, 1977b, 1984). He originally suggested that the raised beach at Rotherslade could be Hoxnian, with the overlying deposits consisting of periglacial and redeposited glacial sediments (Bowen 1966). Subsequently, he revised this interpretation, and ascribed the raised beach sediments to the Ipswichian Stage and the overlying deposits, which consisted of head and glacial deposits *in situ*, to the Devensian Stage.

From the evidence at Rotherslade, Bowen (1969a, 1970a, 1984) reconstructed the following sequence of events. During temperate, high sea-level conditions, raised beach sediments accumulated on a limestone shore platform. Erratics from the South Wales Coalfield and the Irish Sea Basin present in the raised beach deposits were considered to have been reworked from glacial sediments of pre-Ipswichian age. As environmental conditions worsened with the onset of the Devensian Stage, locally derived limestone head began to accumulate on the raised beach, and was mixed with colluvial sediments washed from a sparsely vegetated landscape. At the same time, sea-level began to fall and sand from the exposed shore was incorporated into the head deposits (Bowen 1969a, 1971a, 1977a, 1977b, 1984). These head deposits were thought by Bowen (1971a) to have accumulated during the Early and Middle Devensian, under cold but not necessarily continuous periglacial conditions. During the Late Devensian glacial maximum (c. 20,000–18,000 BP), Welsh ice crossed the eastern tip of Gower, depositing a sequence of glacial sediments up to 14m thick; lodgement till at the base overlain by crudely stratified and imbricated ablation till (Bowen 1970a) and fluvioglacial sands and gravels (Bowen 1971a). Lenses of till occur in the gravels, the entire deposit having probably formed in the rapidly changing depositional conditions at an ice margin. Imbrication in the gravel layers indicated that part of the sequence had been subjected to redeposition, partly by solifluction and partly by water. A minimum age of c. 14,000 BP (Bowen 1969a, 1970a, 1971a) for the glacial deposits was indicated by Devensian late-glacial sediments occupying a kettle hole (now destroyed) in the same lithostratigraphic formation at nearby Derwen Fawr, Swansea (Trotman 1963). Bowen (1969a) suggested that the imbrication and fabric of the glacial sediments at Rotherslade also showed that they had been derived from the northeast. Finally, towards the close of the Late Devensian and into the Devensian late-glacial, loess (Case 1984) and colluvial (slope wash) sediments were deposited as a capping to the sequence. Bowen (1977b) considered the site allowed the extent of the *post-Patella* Beach glaciation (Late Devensian) to be established in east Gower. Bowen's interpretation of the sequence at Rotherslade was supported by Peake *et al.* (1973), Stephens and Shakesby (1982), Shakesby and Campbell (1985) and Bridges (1985).

Amino acid dating and correlation by both older and current preparation methods led to the raised beach being ascribed to Oxygen Isotope Sub-stage 5e (Davies 1983; Bowen *et al.* 1985), and the Ipswichian (Bowen and Sykes 1988).

Campbell (1984) applied a range of techniques including Scanning Electron Microscopy of quartz sand grains, clast lithology, fabric and roundness analyses to the interpretation of the Rotherslade sequence. An absence of Carboniferous Limestone clasts in the glacial sediments (also noted by Strahan (1907a)) suggested deposition by ice moving south-west from the Nedd (Neath) and Tawe Valleys rather than south across the extensive limestone terrain of south Gower. The glacial deposits at Rotherslade were thus considered to represent the south-westward extension of a piedmont ice-lobe in Swansea Bay. This interpretation was also supported by clast fabric analysis which showed a strongly preferred northeast to south-west orientation. Campbell (1984), however, noted that this fabric 'trend' could also have resulted from subsequent redeposition of the glacial sediments by solifluction.

Rotherslade has an important stratigraphic record showing changing environmental conditions in central South Wales during the Late Pleistocene, with evidence for a transition from the high sea-level conditions of the Ipswichian Stage, to cold and eventually full glacial conditions during the Devensian Stage, when east Gower was overrun by south-west moving Welsh ice.

The ascription of the raised beach deposits at Rotherslade (Langland Bay) to Oxygen Isotope Sub-stage 5e (Bowen *et al.* 1985; Bowen and Sykes 1988) (c. 125,000 BP) and the pollen analysis of deposits lying in a kettle hole in glacial sediments nearby (Trotman 1963), provide evidence for the ages of these respective deposits. The evidence from Rotherslade is similar to that at Broughton Bay in north-west Gower (Campbell *et al.* 1982; Campbell 1984), and both provide constraints for the extent of Late Devensian ice. Both are dissimilar to the evidence from Hunts Bay, Western Slade, Eastern Slade and Horton, which show ice-free conditions throughout the Devensian (Bowen 1970a).

Rotherslade is important for interpreting Late Pleistocene events in central South Wales; showing a sequence of raised beach sediments overlain by head and glacial deposits. The raised beach has been correlated by amino acid geochronology with Oxygen Isotope Sub-stage 5e of the deep-sea record. This shows that the overlying sediments must be Devensian. Local pollen evidence provides a minimum late-glacial age for the glacial deposits at Rotherslade and shows that the last glaciation of eastern Gower was Late Devensian in age. As such it is important evidence for establishing the maximum extent of Late Devensian ice from the uplands of South Wales.

## **Conclusions**

Rotherslade (Langland Bay) displays a sequence of deposits which represents the entire last glacial cycle. The site is also exceptional because it shows evidence for the last time Britain enjoyed conditions similar to the present, about 125,000 years ago. Then global sea-level was some metres higher than it is today (shown by the raised beach). Glacial deposits were laid down by the last great Welsh ice-sheet.

## **[References](#)**