Clarach

Highlights

This locality shows a complex record extending from the Late Devensian to the present. Its mainly organic sediments and forest beds, and the pollen and radiocarbon analyses have yielded evidence that prove reduced sea-levels in the latest Devensian and the subsequent drowning of the forests which developed around Cardigan Bay.

Introduction

Clarach is an important site with a sedimentary record extending from the start of the Late Devensian late-glacial to the present day. Pollen, diatoms and radiocarbon dates provide detailed evidence for environmental and sea-level changes (Taylor 1973; Heyworth *et al.* 1985).

Description

Clarach [SN 588 830] lies on the Cardigan Bay coast some 8km south of Ynyslas and Borth. The interest occurs around the mouth of the River Clarach and extends onto the modern day beach where a small area of submerged forest is occasionally exposed. The sequence and stratigraphy have been investigated by boreholes in the mainly organic sequence behind the modern beach, and by mechanically excavated sections in the submerged forest on the foreshore (Heyworth et *al.* 1985) — see (Figure 11). The trench on the foreshore (Figure 11) showed a sequence of -

4 Shingle storm beach

3 Submerged forest

2 Grey clay

1 Gravel

Borings inland (Figure 11) showed a sequence of -

7 Silt and clay

6 Peats and peaty clays

5 Silt and clay

4 Limnic peat and organic mud

3 Gravel

2 Silt and clay

1 Gravel

Interpretation

The submerged forest beds at Clarach are rarely visible and are normally covered by sand and shingle. First described by Keeping in 1878, the beds were not recorded again until 1964 and 1965, following erosion of the overlying beach deposits (Taylor 1973). He described remains of *Pinus, Alnus, Corylus, Betula* and *Quercus* from the submerged forest which rested on a thin peat, overlying grey silty clay. He thought the clay corresponded with the *Scrobiculana* clay

beneath the submerged forest at Ynyslas and Borth Bog (Godwin and Newton 1938). A radiocarbon date of 5,970 ± 90 BP (NPL-113) was obtained from an *in situ* stump of *Pinus sylvestris* L., showing a close correspondence with the ages derived by Godwin and Willis (1961) from the submerged forest at Ynyslas and Borth.

Taylor investigated the pollen biostratigraphy of the deposits at Clarach in six boreholes. His preliminary study showed that a Devensian late-glacial sequence was present. The earliest evidence from these deposits suggested an environment characterised by local pine and birch woods, in an otherwise open landscape with marsh habitats. These communities were replaced by juniper at the end of late-glacial times, which was in turn replaced by extensive alder-can with some birch at the beginning of Pollen Zone IV. The evidence indicates a rapid rise in temperature at this time along the coastal plain, leading to the early arrival of hazel *Corylus* and lime *Tilia* (Taylor 1973).

By Pollen Zone Vila, pine had become established at Clarach and it was tolerant of the windy and salty conditions imposed by the proximity of the sea. The destruction of the forest at *c.* 6,000 BP was ultimately in response to inundation by the rising Holocene sea, influenced by strong tidal action under storm conditions and the wind funnelling effects of the lower Clarach Valley (Taylor 1973). Recently, the site has been re-investigated by Heyworth *et al.* (1985), who drilled additional boreholes in the marshy area behind the storm ridge, and undertook pollen, diatom and radiocarbon analyses — see (Figure 11). The earliest organic sediments (bed 4) were radiocarbon dated to about 13,600 BP. Pollen analysis of these deposits indicates a rapid amelioration of climate at this time, with an increase in tree and shrub pollen. However, the late-glacial and early Holocene sediments at Clarach have a pollen assemblage dominated by aquatic species, sedges and grasses, and little tree and shrub pollen is present even as late as 9,000 BP. Local pollen assemblages were reconstructed for this period, but zonation and correlation with other sites is difficult (Heyworth *et al.* 1985). The pollen diagram, however, reveals the start of a cold event (within bed 4) at about 10,900 BP, with the most severe conditions at c. 10,550 BP. This can probably be correlated with the climatic deterioration of the Younger Dryas, widely documented from Devensian late-glacial sites elsewhere. The end of this cold period, estimated at *c.* 10,100 BP, is not clearly marked in the pollen diagram (Heyworth *et al.* 1985). The late-glacial sequence, therefore, comprises freshwater fluviatile gravels (beds 1 and 3), silts and clays (bed 2) and organic (largely lacustrine) deposits (bed 4) which indicate that sea-level did not influence sedimentation during this period. Even by *c.* 7,000 BP, sea-level was still probably *c.* 10m below that of the present day. At the beginning of the late-glacial, sea-level was estimated to have been at least as low as 50m below present (Heyworth et *al.* 1985).

The lacustrine and peat deposits (bed 4) were deposited over a period of almost 5,000 years in the late-glacial and early Holocene. During this period, the Clarach Valley was probably occupied by lagoons or channels with current velocities too low to cause appreciable coarse sedimentation. Evidence from the submerged forest exposure on the beach suggests that freshwater silt and clay (bed 5) began to accumulate at *c.* 6,000 BP, its surface becoming rapidly colonised by *Alnus* and *Corylus.* By about 5,400 BP quite large oaks had become established. Shortly after 5,400 BP flooding occurred as sea-level rose, and stumps and trunks of trees were subsequently buried beneath alluvial deposits or by the landward-moving storm beach (Heyworth *et al.* 1985). From about 5,100 BP a succession of peats and clays (bed 6) provides evidence for a dynamic equilibrium between the rates of water table rise and sedimentation. Sea-level rise was clearly the underlying cause of water table rises and increased sedimentation (Heyworth et *al.* 1985). By 2,650 BP sedimentation was keeping pace with, or outstripping, sea-level rise, with sediment supplied by frequent flooding at times of high tide and high river discharge. This situation has persisted to the present day (Heyworth *et al.* 1985).

Pollen, diatom and radiocarbon studies have shown that the sedimentary record can be divided into two main parts: a lower late-glacial/early Holocene sequence of freshwater deposits; and a sequence of subsequent Holocene sediments in which the influences of changing sea-levels may be clearly detected. The site provides unique land-based evidence in west Wales for sea-level conditions during the late-glacial and early Holocene: sea-level, initially as low as -50m OD at *c.* 10,000 BP rose steadily to cause the demise of successive phases of vegetation as woodland developed on the coastal margins of Cardigan Bay. The most notable phase of this vegetation development appears to have occurred at *c.* 5,500 BP when substantial woodland, including pine and oak, became established approximately at ordnance datum, both at Clarach and farther north at Borth and Ynyslas. The destruction of this forest at both sites is believed to have been in response to the rising Holocene sea, although the site records show important differences. At Clarach, the succeeding marsh and alluvial sediments show a state of dynamic equilibrium between the rates of sea-level (and therefore water table) rise, and terrestrial sedimentation. In contrast, at Borth the submerged forest is succeeded by raised *Sphagnum*

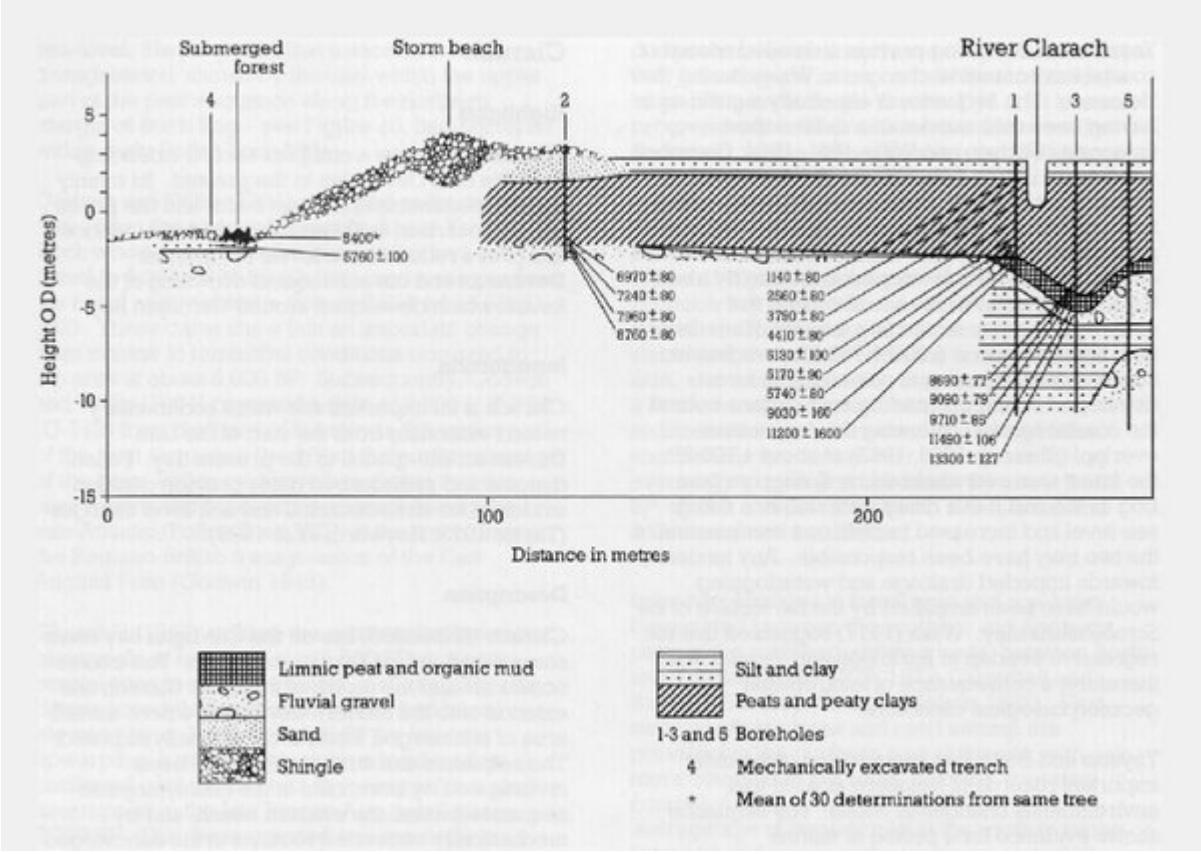
bog associated with wetter conditions, perhaps increased precipitation and rising sea-levels. The development of an extensive coastal barrier at Ynyslas and Borth appears to have minimised the direct effects of marine sedimentation during the period of Holocene bog formation, but at Clarach the influence of marine conditions during the same period of sedimentation is more clearly demonstrated.

Clarach is important in recording detailed information for changing sea-level and terrestrial conditions from the beginning of the Devensian late-glacial to the present day. It provides the most extended record of such conditions presently known from Wales. The sequence shows particularly detailed evidence for relative sea-levels during the Devensian late-glacial. It demonstrates successive phases of vegetation development on the margins of Cardigan Bay and the demise of pine and oak woodland at about 5,400 BP as Holocene sea-level rose. Marine influences are apparent in the remainder of the succession, which is therefore important in demonstrating that the extensive regressive overlap interpreted at Ynyslas and Borth is most probably the reflection of local coastal geomorphological changes, namely the development of a substantial coastal barrier.

Conclusions

Clarach provides detailed information on the nature and timing of changes in the relative level of land and sea over the past 13,000 years. It has the best record for this period in Wales.

References



(Figure 11) Quaternary sequence at Clarach (from Heyworth et al. 1985)