GEILSTON

D.G. Sutherland

OS Grid Reference: NS341777

Highlights

The deposits exposed in stream sections at Geilston include a sequence of fossiliferous marine sediments, the Clyde beds, which provide important evidence for marine palaeoenvironmental conditions during the latter part of the Late Devensian. Geilston is one of the few sites with good exposure which have been studied in detail.

Introduction

The site (NS 341777) comprises a series of stream sections along a 0.4 km reach of the Geilston Burn at Cardross. It is one of the few localities where *in situ*, fossiliferous Clyde beds sediments can be observed in sections. Radiocarbon dates at the site also provide a limiting date on the time of deglaciation of the area and the sediments record the changing environment from glacial to glaciomarine to marine as the last ice sheet decayed and the area became ice free (Rose, 1980a).

It has long been known that certain of the silts, sands and clays exposed at low altitudes (generally below 35 m O.D.) and in many foreshore areas around the head of the Firth of Clyde contain marine fossil faunal assemblages that are indicative of a climate colder than that of the present (Smith, 1838; Jamieson, 1865; Crosskey and Robertson, 1867–1875; Brady *et al.*, 1874). Furthermore, it was also realised by these researchers that the changes in the fossil faunas reflected changes in the level of the sea (Robertson, 1883) as well as changing climates. In recent years, radiocarbon dating and quantitative analysis of the faunal assemblages have clarified the age of the sediments and the changes in climate and sea level that accompanied their deposition (Peacock *et al.*, 1977, 1978; Peacock, 1981b, 1983a, 1989b). The informal term "Clyde beds' was proposed by Peacock (1975c) for those marine sediments deposited around the Scottish coast (but known principally in the area of the Firth of Clyde) subsequent to the deposition of the arctic "Errol beds' (see Inchcoonans and Gallowflat), but prior to the establishment of a marine climate similar to that of today in the early Holocene. The Clyde beds thus cover the period from approximately 13,000 BP to around 10,000 BP.

Description

Rose (1980a) identified the following stratigraphic succession in the Geilston deposits (Figure 13.4):

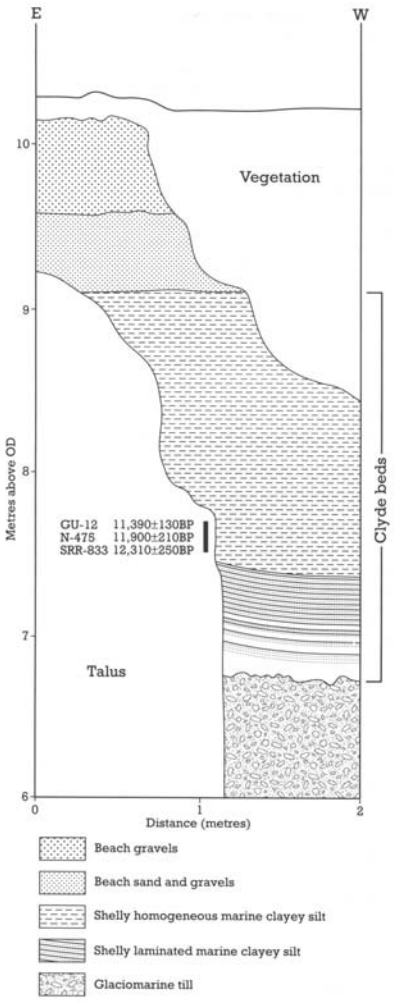

Figure 13.4: Geilston: sequence of sediments (from Rose, 1980a).

5. Beach sands and gravels unconformably overlying bed 4

Clyde beds

4. Clayey silt

3. Laminated silts}

2. Glaciomarine till

1. Lodgement till

At the base the stiff, reddish-brown lodgement till (bed 1) has a relatively high silt-clay content and a dominant NW–SE fabric. The overlying glaciomarine till (bed 2) is similar in colour and lithology to the lodgement till but has a much lower silt-clay content. It contains a marine microfauna. Resting on the glaciomarine till is a sequence of colour laminated (pale olive-brown to brown) silts (bed 3) of which 26 couplets were reported byRose (1980a). The individual laminae fine upwards and the colour change relates not to differences in particle size, but to the relative proportions of materials derived from Dalradian (pale laminae) or Old Red Sandstone bedrock. Foraminiferal remains increase in abundance through the lower half of the bed, remaining constant in frequency in the sediments above this level. Mollusc shells (*Yoldiella lenticula* (Müller)) occur in the upper part of the laminated silts. The upper laminae merge into an overlying homogeneous clayey silt (bed 4) in which shells are abundant, in particular *Arctica islandica* (L.). The clayey silts are truncated by a marked unconformity, above which are horizontally bedded sands and gravels. The clasts are generally sub-rounded and become progressively more disc-like or blade-shaped upwards.

Three samples of *Arctica islandica* from close to the base of the homogeneous clayey silt have been radiocarbon dated and have given ages (Sutherland, 1986) of 11,390 + 130 BP (GU–12) (Baxter *et al*., 1969); 11,900 + 210 BP (N–475) (Yamasaki *et al*., 1969) and 12,310 + 250 BP (SRR–833) (Harkness and Wilson, 1979).

Interpretation

The sediments were interpreted by Rose (1980a) in the following manner. The basal lodgement till was deposited by the Late Devensian ice sheet which flowed from the south-west Highlands towards the east along the Clyde Valley. The long axes of drumlins in the area accord with this direction of ice movement. During deglaciation, the tidewater ice front retreated along the Clyde Estuary, allowing deposition of the glaciomarine till beneath the floating ice margin. With further ice retreat the laminated sediments were deposited, the upward thinning of the laminae reflecting the increasing distance of the ice margin from the site. Each lamina is considered to represent the suspension fraction of sub-aequeous sediment plumes discharged from the ice margin. The homogeneous clayey silt with abundant macro-fauna was deposited after the area was completely deglaciated, and when clearer water allowed *Arctica islandica* to become established (Peacock, 1981b).

The radiocarbon dates confirm the silts to have been deposited during the Lateglacial Interstadial but the considerable range in age is either due to mixing of the sediments by bottom current activity or very low sedimentation rates (Peacock *et al*., 1978; Peacock, 1981b; Sutherland, 1986). The oldest radiocarbon date also places a minimum age on deglaciation of this area although consideration of dates from a variety of sites in the Clyde Estuary suggests deglaciation had occurred by 12,600 BP (Sutherland, 1986).

The unconformity which truncates the Clyde beds is shown by Rose (1980a) to correlate with the period of erosion responsible for the cutting of the Main Rock Platform during the Loch Lomond Stadial. Both in accord with that age for the unconformity and their altitude, the sands and gravels capping the section are considered to be part of the Holocene raised beach deposits which occur widely around the coasts of the head of the Firth of Clyde.

Despite the wide distribution of Clyde beds sediments around the coast of Scotland and, in particular, around the Firth of Clyde, there are very few localities where they can be examined in section. Geilston is one such locality and one of the few where detailed sedimentological work has been carried out and the stratigraphic sequence and origin of the sediments is well established. Furthermore, radiocarbon dating here has placed the deposits in a clear geochronometric framework. The Clyde beds are a very important sedimentary unit, not only for historical reasons related to the evolution of ideas on climatic change and the ice age, but also for the evidence they contain of climatic and sea level changes during the Lateglacial. Such evidence is an important counterpoint to the terrestrially-derived models of climatic change during the same time interval (*cf.* Peacock, 1989b; Peacock and Harkness, 1990). As a representative of the Clyde beds, Geilston is hence a particularly important site.

Conclusions

Geilston is a key reference site for the Clyde beds, a sequence of fossiliferous glaciomarine and marine sediments that formed in the period during and following the wastage of the last ice sheet (approximately 13,000–11,000 years ago). These deposits provide important evidence for changing conditions in the marine environment during the extreme cold phase at the end of Devensian times, the Lateglacial. Geilston is one of the few sites where there are both good sections available and the sediments have been studied and dated.

Reference list

Baxter, M.S., Ergin, M. and Walton, A. (1969) Glasgow University radiocarbon measurements I. *Radiocarbon*, **11**, 43–52.

Brady, G.S., Crosskey, H.W. and Robertson, D. (1874) *A Monograph of the Post-Tertiary Entomostraca of Scotland*. London, Palaeontographical Society Monograph, 229 pp.

Crosskey, H.W. and Robertson, D. (1867) The post-Tertiary fossiliferous beds of Scotland.

Transactions of the Geological Society of Glasgow, **2**, 267–82.

Harkness, D.D. and Wilson, H.W. (1979) Scottish Universities Research and Reactor Centre radiocarbon measurements III. *Radiocarbon*, **21**, 203–56.

Jamieson, T.F. (1865) On the history of the last geological changes in Scotland.*Quarterly Journal of the Geological Society of London*, **21**, 161–203.

Peacock, J.D. (1975c) Scottish late and post-glacial marine deposits. In*Quaternary Studies in North East Scotland* (ed. A.M.D. Gemmell). Aberdeen, Department of Geography, University of Aberdeen, 45–8.

Peacock, J.D. (1981b) Scottish Late-glacial marine deposits and their environmental significance. In *The Quaternary in Britain* (eds J. Neale and J. Flenley). Oxford, Pergamon Press, 222–36.

Peacock, J.D. (1983a) A model for Scottish interstadial marine palaeotemperature 13,000 to 11,000 BP. *Boreas*, **12**, 73–82.

Peacock, J.D. (1989b) Marine molluscs and Late Quaternary environmental studies with particular reference to the Late-glacial period in north-west Europe: a review.*Quaternary Science Reviews*, **8**, 179–92.

Peacock, J.D. and Harkness, D.D. (1990) Radiocarbon ages and the full-glacial to Holocene transition in seas adjacent to Scotland and southern Scandinavia: a review.*Transactions of the Royal Society of Edinburgh*: *Earth Sciences*, **81**, 385–96.

Peacock, J.D., Graham, D.K., Robinson, J.E. and Wilkinson, I. (1977) Evolution and chronology of Lateglacial marine environments at Lochgilphead, Scotland. In*Studies in the Scottish Lateglacial Environment* (eds J.M. Gray and J.J. Lowe). Oxford, Pergamon Press, 89–100.

Peacock, J.D., Graham, D.K. and Wilkinson, I.P. (1978) Late-glacial and post-glacial marine environments at Ardyne, Scotland, and their significance in the interpretation of the history of the Clyde sea area. *Report of the Institute of Geological Sciences*, No. 78/17, 25pp.

Robertson, D. (1883) On the post-Tertiary beds of Garvel Park, Greenock.*Transactions of the Geological Society of Glasgow*, **7**, 1–37.

Rose, J. (1980a) Geilston. In *Glasgow Region Field Guide* (ed. W.G. Jardine). Glasgow, Quaternary Research Association, 25–9.

Smith, J. (1838) On the last changes in the relative levels of the land and sea in the British Islands. *Edinburgh New Philosophical Journal*, **25**, 378–94.

Sutherland, D.G. (1986) A review of Scottish marine shell radiocarbon dates, their standardisation and interpretation. *Scottish Journal of Geology*, **22**, 145–64.

Yamasaki, F., Hamada, T. and Hamada, C. (1969) Riken natural radiocarbon measurements V. *Radiocarbon*, **11**, 451–62.