
SOUTH LOCH LOMOND: PORTNELLAN, ROSS PRIORY AND CLADDOCHSIDE

J.E. Gordon

OS Grid Reference: NS413876

Highlights

The assemblage of landforms and deposits on the south shore of Loch Lomond provides important evidence for the geomorphological changes that occurred at the end of Late Devensian in the type area for the Loch Lomond Stadial and its associated glacier readvance. These include the formation of marine shorelines, fossiliferous marine deposits and glaciation of the Loch Lomond Readvance.

Introduction

Three localities at Portnellan (NS 404873), Ross Priory (NS 413876] and Claddochside (NS 427878) on the south shore of Loch Lomond *c.* 6 km north-east of Balloch illustrate important aspects of the Lateglacial and Holocene history of the Loch Lomond area, the type area for the Loch Lomond Readvance. They provide important stratigraphic and geomorphological evidence, described by Rose (1980f), particularly for the sequence of marine and glacial events, and show that the Main Rock Platform of western Scotland was significantly developed before the time of the maximum extent of the readvance. The sediments from the floor of the southern basin of the loch also provide a record of Holocene marine incursions, vegetation history and palaeomagnetism (Dickson *et al.*, 1978; Thompson and Morton, 1979; Turner and Thompson, 1979; Stewart, 1987).

Description

The three localities on the shore of the loch have been described by Rose (1980f). Together they show a succession of marine and glacial features. One of the most distinctive is a shore platform developed extensively along the southern shore. At Ross Priory it extends for about 0.5 km offshore to about 1 m below the loch level; it is also well displayed at Portnellan and Claddochside. In places it is associated with an impressive backing cliff up to about 15 m high, for example at Portnellan. At Claddochside, the cliff is cut in Old Red Sandstone bedrock. The junction of the cliff and platform is at about 12 m O.D. At Portnellan, the platform and cliff are covered by till deposited during the Loch Lomond Readvance. This is the Gartocharn shelly till of the area, partly derived from reworked Clyde beds (see Croftamie) (Jack, 1875). Gartocharn Till also buries Clyde beds in foreshore sections at Claddochside, and a similar succession has been recorded on Inchlonaig (NS 380935) to the north (Cunningham Craig, 1901).

The sediments laid down in the Loch Lomond basin, immediately following retreat of the Loch Lomond Readvance, have been described from a borehole in the lower Endrick valley (NS 44838829) *c.* 3 km north-east of Claddochside (Elliot, 1984; Browne and McMillan, 1989). In that borehole *c.* 7 m of finely-bedded silty clay with occasional laminae of silt or sand overlay the Gartocharn Till (see Croftamie). The sediments were characterised by a marine microflora and microfauna (dinoflagellate cysts and foraminifera) and occasional shell fragments of marine molluscs and crustacea. Browne and McMillan (1989) noted the possibility that the fossils may have been derived from the underlying shelly sediments but considered that it was more likely that the fauna was contemporaneous with the enclosing sediment. These sediments were overlain in the borehole by over 13.5 m of lacustrine and fluvial deposits of presumed Holocene age.

A middle Holocene marine invasion of the Loch Lomond basin is indicated by raised shorelines around the southern part of the loch at about 13 m and 12 m O.D. The latter is the most conspicuous, its width in part reflecting exhumation of the Lateglacial shore platform (Dickson *et al.*, 1978; Rose, 1980f). It is best seen at Portnellan and Ross Priory. Rose (1980f) traced these shorelines through the Vale of Leven to the Clyde estuary, thereby confirming their

marine origin (see Dickson *et al.*, 1978: fig. 1). Shells in deposits related to the transgression have been recorded near Luss (Robertson, 1868; Brady *et al.*, 1874). A further shoreline at 9 m O.D. was considered by Rose (1980f) to be lacustrine in origin, related to present lake level.

The middle Holocene marine transgression is also represented in sediment cores from the southern basin of Loch Lomond (Dickson *et al.*, 1978). The marine deposits, interbedded with freshwater sediments, are distinguished by low remnant magnetic susceptibility and intensity and by the presence of marine plankton and absence of freshwater plants. Radiocarbon dates on organic material from one core place the transgression between 6900 BP and 5450 BP. More detailed results were presented by Stewart (1987). He showed that there had been two phases to the marine transgression, the earlier one lasting from approximately 7200 BP till about 6400 BP and the later one, following a brief non-marine period, terminated at approximately 5500 BP.

Interpretation

The three localities show a sequence of events (Rose, 1980f) beginning with a Lateglacial marine transgression and deposition of Clyde beds (see Geilston), seen at Claddochside. The existence of such marine deposits in the Loch Lomond basin has long been recognised principally on account of their fossiliferous nature (Adamson, 1823; Brady *et al.*, 1874; Jack, 1875; Cunningham Craig, 1901). Deposition of the Clyde beds was followed by the formation of the shore platform. Rose (1980f) has correlated this platform with the Main Rock Platform of western Scotland (see Isle of Lismore) (Gray, 1974a, 1978a; Sissons, 1974d). Subsequently, during the Loch Lomond Readvance, a glacier advanced across the area depositing till over both the shore platform and the Clyde beds. Together with Gareloch (Rose, 1980b) and Loch Spelve (Gray, 1974a), Portnellan is one of only a few localities providing important evidence that the Main Rock Platform was predominantly formed before the Loch Lomond Readvance reached its maximum extent. Also, the burial by till of the Clyde beds, which post-dates 13,000 BP (see Geilston), provides clear stratigraphic evidence for the Loch Lomond Readvance (Cunningham Craig, 1901; Simpson, 1933).

The evidence from the borehole in the lower Endrick valley for a marine deposit immediately overlying the Gartocharn Till deposited during the Loch Lomond Readvance, implies that the sea entered the Loch Lomond basin towards the end of the Loch Lomond Stadial (Browne and McMillan, 1989). This conclusion is dependent upon the marine fossils contained in the sediment being *in situ* and not derived from the underlying shelly deposits. Comparison may be made, however, with the Western Forth Valley where Sissons (1966, 1976b) has demonstrated that a marine transgression, culminating between 10,500 BP and 10,100 BP, was approximately contemporaneous with the maximum of the readvance.

During the Holocene, the radiocarbon dates indicate that entry of the sea into Loch Lomond was some 1100 years later than the start of the Main Postglacial Transgression in the western Forth valley (Sissons and Brooks 1971), a delay which reflects the time required for the sea to surmount the outwash fan barrier formed by the Loch Lomond Readvance across the Vale of Leven at Alexandria, between Loch Lomond and the Clyde estuary (Dickson *et al.*, 1978). This early marine phase also coincides with the maximum of the transgression (6800–6650 BP) in the Forth Valley (Sissons, 1983a).

The Holocene palaeomagnetic record from Loch Lomond shows similarities to those from Lake Windermere and Lough Neagh, but is particularly significant in providing much finer detail because of a higher rate of sedimentation (Dickson *et al.*, 1978). It provides the most precise and detailed geomagnetic record so far obtained for the last 7000 years (Turner and Thompson, 1979).

Portnellan, Ross Priory and Claddochside complement the interest at Croftamie, Gartness and Aucheneck by illustrating the sequence of Lateglacial and early and middle Holocene marine episodes and their relationships to the glacial deposits of the Loch Lomond Readvance in the type area for the Loch Lomond Stadial. The lake-bed sediments are also of considerable importance for the detailed palaeomagnetic record they preserve and for the succession showing Holocene marine transgression deposits interbedded with freshwater lake deposits.

Conclusions

The landforms and sediments at this site are important for the evidence they provide for the sequence of glacial and marine events at the end of the Devensian. In particular, they show a shore platform and fossiliferous Lateglacial marine deposits that formed before the Loch Lomond glacier readvance (approximately 11,000–10,000 years ago), the latter being represented by a shelly till. During the Holocene, raised shorelines and sediments from the loch floor indicate two episodes when the sea encroached into Loch Lomond. This sequence is important because of its location in the type area for the Loch Lomond Stadial.

Reference list

- Adamson, J. (1823) Notice of marine deposites on the margin of Loch Lomond. *Memoir of the Wernerian Natural History Society of Edinburgh*, **4**, 334–38.
- 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.
- Browne, M.A.E. and McMillan, A.A. (1989) Quaternary geology of the Clyde Valley. *British Geological Survey Research Report SA/89/1*. Onshore Geology Series, 63pp.
- Cunningham Craig, E.H. (1901) Dunbartonshire. In *Summary of Progress of the Geological Survey of the United Kingdom for 1900* Memoirs of the Geological Survey. London, HMSO, 138–9.
- Dickson, J.H., Stewart, D.A., Thompson, R., Turner, G., Baxter, M.S., Drndarsky, N.D. and Rose, J. (1978) Palynology, palaeomagnetism and radiometric dating of Flandrian marine and freshwater sediments of Loch Lomond. *Nature*, **274**, 548–53.
- Elliot, C.J. (1984) Palynology and palaeoenvironments of the BGS Mains of Kilmaronock Borehole, Loch Lomond, Scotland. Unpublished MSc thesis, City of London Polytechnic and the Polytechnic of North London.
- Gray, J.M. (1974a) The Main Rock Platform of the Firth of Lorn, western Scotland. *Transactions of the Institute of British Geographers*, **61**, 81–99.
- Gray, J.M. (1978a) Low-level shore platforms in the south-west Scottish Highlands: altitude, age and correlation. *Transactions of the Institute of British Geographers*, N.**53**, 151–64.
- Jack, R.L. (1875) Notes on a till or boulder clay with broken shells, in the lower valley of the River Endrick, near Loch Lomond, and its relation to certain other glacial deposits. *Transactions of the Geological Society of Glasgow*, **5**, 5–25.
- Robertson, D. (1868) On clay beds of Ross Arden, on the banks of Loch Lomond. *Proceedings of the Natural History Society of Glasgow*, **1**, 92–3.
- Rose, J. (1980b) Ardmore Point. In *Glasgow Region Field Guide* (ed. W.G. Jardine). Glasgow, Quaternary Research Association, 29–31.
- Rose, J. (1980f) Ross Priory and the southern shore of Loch Lomond. In *Glasgow Region Field Guide* (ed. W.G. Jardine). Glasgow, Quaternary Research Association, 49–51.
- Simpson, J.B. (1933) The late-glacial readvance moraines of the Highland border west of the River Tay. *Transactions of the Royal Society of Edinburgh*, **57**, 633–45.
- Sissons, J.B. (1966) Relative sea level changes between 10,300 and 8300 BP in part of the Carse of Stirling. *Transactions of the Institute of British Geographers*, **39**, 19–29.
- Sissons, J.B. (1974d) Lateglacial marine erosion in Scotland. *Boreas*, **3**, 41–8.
- Sissons, J.B. (1976b) *The Geomorphology of the British Isles. Scotland*. London, Methuen, 150pp.
- Sissons, J.B. (1983a) Shorelines and isostasy in Scotland. In *Shorelines and Isostasy* (eds D.E. Smith and A.G. Dawson). London, Academic Press, 209–25.
- Stewart, D.A. (1987) Further palynology and radiometric dating of Flandrian marine and freshwater sediments of Loch Lomond, Scotland. INQUA XII Congress, Ottawa, Canada, 1987. Programme and Abstracts, 269.
- Thompson, R. and Morton, D.J. (1979) Magnetic susceptibility and particle-size distribution in recent sediments of the Loch Lomond drainage basin, Scotland. *Journal of Sedimentary Petrology*, **49**, 801–11.
- Turner, G.M. and Thompson, R. (1979) Behaviour of the Earth's magnetic field as recorded in the sediment of Loch Lomond. *Earth and Planetary Science Letters*, **42**, 412–26.