Chapter 13 Western Highland Boundary

Introduction

D.G. Sutherland

The Western Highland Boundary area is taken to extend from the Teith valley, by Callander, west to the Firth of Clyde (Figure 13.1). This area has been of fundamental importance in defining the sequence of events during the closing stages of the Devensian cold phase. Lying adjacent to one of the principal centres of ice dispersal in the south-west Highlands it has been readily invaded by ice, but being outside the Highland zone, the extent of ice erosion has not been as great as in the mountains. Thus for the period since the end of the last ice-sheet glaciation there is an almost complete record of glacial events, sea-level change and environmental change, and these subjects have formed the main themes of research.

In this area there is little evidence of Quaternary events prior to the main Late Devensian ice-sheet. It can reasonably be presumed that the major ice-moulded landforms and overdeepened valleys leading out from the Highlands relate to repeated phases of ice-sheet glaciation, but no dated material has been found that pre-dates the Late Devensian. The last ice-sheet flowed to the south and south-east across this area, depositing a till, termed the Wilderness Till by Rose *et al.* (1988). Subsequently, during ice retreat, relative sea level was high, with marine invasion of the Western Forth Valley, the Firth of Clyde (see Geilston) and the Loch Lomond basin (see South Loch Lomond). Briefly, prior to marine invasion of this last area, an ice-dammed lake formed in the Blane Valley (Rose, 1980e; Rose *et al.,* 1988) as the ice retreated, but still blocked the connection between Loch Lomond and the Firth of Clyde.

At the period of maximum marine invasion, the neck of land between the Loch Lomond basin and the Western Forth Valley was the only land connection between the Highlands and southern Scotland. It is notable that whereas the early phases of retreat of the last ice-sheet were accompanied around the Scottish coast by deposition of sediments (Errol beds) containing high-arctic marine faunas, the final phase of deglaciation as the ice was retreating into the Highlands accorded with a milder marine climate and the deposition of sediments containing boreo-arctic marine faunas (Clyde beds, see Geilston). This is in accord with the radiocarbon dates on marine shells, which suggest that the head of the Firth of Clyde was deglaciated at around 13,000 BP (Sutherland, 1986).

The Lateglacial Interstadial climatic amelioration is also marked in the terrestrial record at such sites as Tynaspirit and Muir Park Reservoir (Donner, 1957; Vasari and Vasari, 1968; Vasari, 1977), where an initially open vegetation typical of disturbed ground was succeeded later in the interstadial by closed vegetation dominated by grasslands, scrub or heath with, possibly, in favoured localities, copses of tree birch. For much of the early to middle interstadial, relative sea level fell rapidly, probably to near or below 5 m above present.

The onset of the severe conditions of the Loch Lomond Stadial is pronounced in both the marine and the terrestrial records. The interstadial vegetation cover was disrupted and open-habitat vegetation again became dominant; in the nearshore waters a restricted fauna with high-arctic affinities replaced the interstadial fauna (Peacock *et al.,* 1978; Peacock, 1981b). The return to severe conditions appears to have been accompanied by increased erosion in the shore zone, and a marked rock-cut shoreline, the Main Rock Platform, was formed (Sissons, 1974d; Gray, 1978a) or at least extensively modified from a preexisting feature (Browne and McMillan, 1984; Gray and Ivanovich, 1988). The cliff associated with this shoreline can still be clearly observed around the southern shores of Loch Lomond as well as the shores of the Firth of Clyde.

Glaciers once again readvanced into the area down the principal outlet valleys from the Highlands, into Gareloch (see Rhu Point), Loch Lomond (see Croftamie, Aucheneck and Gartness), the Western Forth Valley and the Teith valley (see Mollands). It was in the southern Loch Lomond basin that the readvance nature of this local glaciation was first recognized (Simpson, 1933): hence this has become the most critical area for the definition of the Loch Lomond Readvance. The readvancing ice overrode or reworked the shelly Clyde beds, and radiocarbon dating of the included

shells has established conclusively that the glacial event occurred after 11,500 to 11,000 BP. In addition, near Callander in the Teith valley (at [NN 6379 0509]), Lateglacial Interstadial lacustrine sediments have been recorded below till deposited by the Loch Lomond Readvance glacier in that valley (Merritt *et al.,* 1990). The interstadial sediments have been radiocarbon dated to 12,750 ± 70 BP (SRR–2317) and are succeeded by 2 m of Loch Lomond Stadial lacustrine sediments that were emplaced prior to deposition of the overlying till. An implication of this sequence is that the readvance reached its maximum late in the stadial. More critically, at Croftamie, a layer of plant detritus, with a radiocarbon age of about 10,500 BP, is overlain first, by silts deposited in a lake dammed as the Loch Lomond glacier advanced into the Endrick and Blane valleys, and second, by till deposited directly by the glacier (Rose *et al.,* 1988). This indicates that the Loch Lomond glacier reached its maximum extent after 10,500 BP. This chronology is also supported in the Western Forth Valley, where a marine shoreline, termed the High Buried Shoreline, was formed following a rapid marine transgression at approximately the time of deposition of the Menteith Moraine at the maximum of the readvance. This shoreline has an inferred age of between 10,100 and 10,500 BP (Sissons, 1966, 1976b).

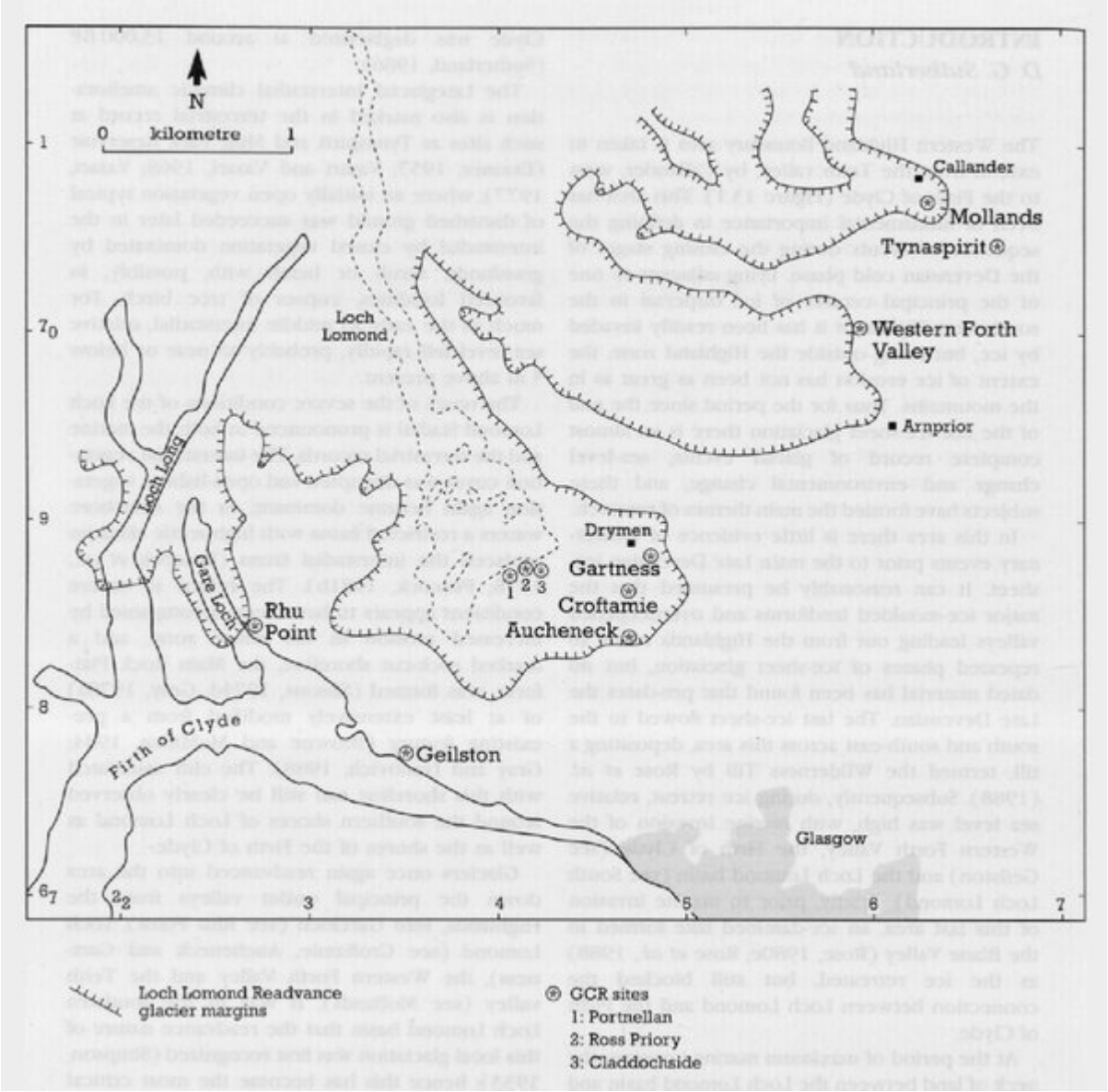
In this area there are major and instructive contrasts in the form of the moraines deposited at or close to the maximum of the readvance. In places they take the form of small, clear end moraines (Aucheneck), whereas elsewhere they are massive push moraines (Western Forth Valley). A further contrast is at Gartness where the Loch Lomond glacier terminated in an ice-dammed lake and constructed a series of large arcuate ridges.

The age and extent of the readvance are also limited by the mutual distribution of basinal sites in which Lateglacial Interstadial sediments are present or where the earliest deposited sediments are of early Holocene age (see Mollands and Tynaspirit). Early deglaciation of the Mol-lands site relative to the Highland interior is indicated by the relative changes in the pollen assemblages at the base of the sedimentary sequences (Lowe and Walker, 1981).

After retreat of the ice, sea level in the Western Forth Valley fell, with halts to form particular shorelines at approximately 9600 BP and 8600 BP (Sissons, 1966, 1983a; Sissons and Brooks, 1971). The overall regression continued, however, until about 8300 BP when a marked marine transgression began, culminating at approximately 6800 BP with the formation of the Main Postglacial Shoreline (Sissons, 1983a). Subsequently, the sea fell progressively to its present level. Similar, but less well-documented changes of sea level occurred around the Firth of Clyde, with Loch Lomond being freshwater during the early to middle Holocene; later a marine episode started around 6900 BP, continuing to 5500 BP (Dickson *et al.,* 1978). This marine event may in fact have been twofold, with a brief return to freshwater conditions (Stewart, 1987).

The Holocene vegetational history of the area has been investigated at a number of sites (Donner, 1957; Turner, 1965; Vasari and Vasari, 1968; Vasari, 1977; Dickson *et al.,* 1978; Stewart, 1979; Lowe, 1982a; Stewart *et al.,* 1984). Of particular interest is the position of the area between the pine forest zone to the north and the oak forest zone to the south (Stewart *et al.,* 1984).

References



(Figure 13.1) Location map of the Western Highland Boundary area.