
MUNLOCHY VALLEY

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OS Grid Reference: NH645528

Highlights

Munlochy Valley is notable for a series of raised shorelines. In conjunction with a succession of estuarine and peat deposits buried beneath the valley floor, these provide a detailed record of coastline changes during the Lateglacial and Holocene.

Introduction

The site (NH 645528) lies 0.5 km south-west of Munlochy and comprises an area on the north-west side of Munlochy Valley and part of the valley floor. It is the most representative area for a series of raised shoreline fragments at the head of Munlochy Bay. Munlochy Valley has long been recognized for the detailed morphological evidence it provides of changes in relative sea level. Horne and Hinxman (1914), Ogilvie (1923) and J.S. Smith (1966, 1968) all noted the highest raised marine shoreline in the valley at 90–100 ft (27–30 m) OD. However, only Ogilvie (1923) proposed that this feature was formed in close association with a downwasting ice-sheet. These same authors also indicated that other raised marine features are present lower in the valley, although the only description provided was by Horne and Hinxman (1914), who identified raised shoreline fragments at 50 ft (15 m) and 25 ft (8 m) OD. In contrast, Firth (1984) has identified eleven raised marine levels, six of these being Lateglacial in age and five Holocene. Firth (1984, 1989a) also suggested that the highest shorelines in the valley were formed in close association with a downwasting ice mass.

Description

Within Munlochy Valley and on the slopes above Munlochy Bay there are a series of raised marine shoreline fragments and glaciofluvial features (Firth, 1984, 1989a) (Figure 7.22). The highest and most distinctive of the marine terraces occurs at an altitude of 28.9–29.4 m OD and extends for 2 km along the northern slope of the valley. The lower marine terraces are only poorly developed, occurring in a "staircase", one feature above another. They indicate four marine levels at 27.0 m, 24.6 m, 17.2–17.5 m and 14–15 m OD

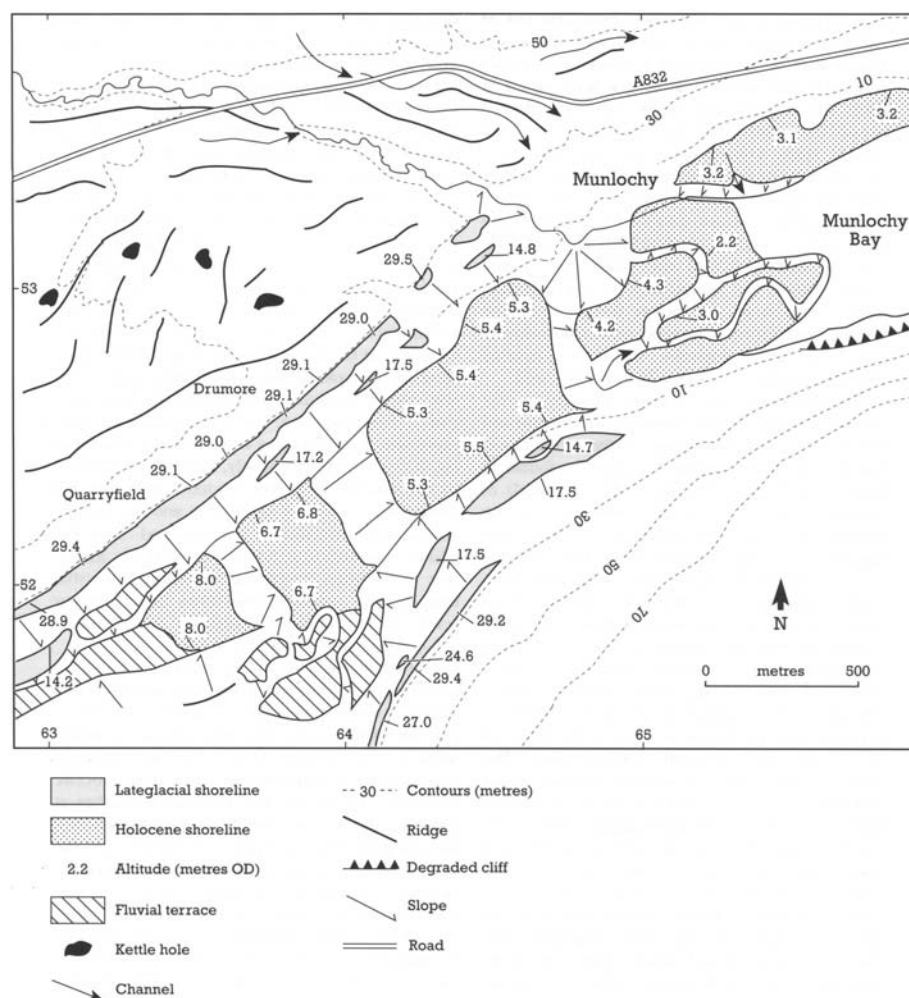


Figure 7.22: Geomorphology of Munloch Valley (from Firth, 1984).

The floor of Munloch Valley is composed of grey, silty clays up to 2 m thick, which contain shell fragments and overlie sands and gravels. Towards the head of the valley the silty clay deposits become peaty. These sediments underlie a series of horizontal surfaces, former salt marshes, linked by gently sloping ramps, former mudflats. The horizontal surfaces are interpreted as raised marine shoreline fragments and they occur at five distinct levels (8.0 m, 7.7–6.8 m, 5.3–5.5 m, 4.2–4.3 m, 3.0–3.2 m OD).

Around the shores at Munloch Bay there is a degraded cliffline, against which, for the most part, raised shingle beaches are deposited. West of Munloch, however, fine-grained estuarine deposits lie adjacent to the cliffline. Stratigraphical investigations by Firth (1984) indicate that the cliff is fronted by a steeply sloping surface, which descends from c. 5 m to 0 m OD. Beyond this there is an extensive planar surface which can be traced throughout the bay and is interpreted as a platform of marine erosion.

Above the highest marine terrace the slopes comprise kame and kettle topography and are dissected by meltwater channels indicative of a downwasting ice mass. The meltwater channels can be traced westwards, either to kame and kettle topography or to cols that separate the Munloch Valley drainage basin from the Beaully Firth. The clearest of these meltwater channels descends from the col near Ashley (NH 633502) past Bogalian Church (NH 635505) to an altitude of 30 m on the southern slopes of Munloch valley.

Interpretation

The glaciofluvial features which mantle the upper slopes of Munloch Valley testify to the decay of the Late Devensian ice-sheet. Many of the meltwater channels associated with these deposits ultimately lead into Munloch Valley, but only one channel, which descends from the

col at Ashley, has been directly linked with the raised marine features (Firth, 1984, 1989a). Firth (1984) proposed that while relative sea level stood at 29 m OD in Munloch Valley, meltwater flowed across the Ashley col into the valley from Beaully Firth. This implies that ice must have occupied Beaully Firth up to an altitude of 55 m while the highest marine terrace was being formed.

The marine terraces, down to 14 m OD, were produced as relative sea level fell and after the flow of meltwater into the valley had ceased (Firth, 1984). The occurrence of the shoreline fragments as steps, one below the other on the hillside, has facilitated identification of altitudinally close but chronologically distinct Lateglacial shorelines within the inner Moray Firth area.

The grey, silty clay deposits present on the floor of the valley were considered by Horne and Hinxman (1914) to be part of the "25 ft raised beach". These are similar to deposits found at Beaully (see Barnyards) and in the carselands of Scotland. Such deposits are considered to be estuarine in origin and Holocene in age, a view supported by Haggart (1982, 1986, 1987, 1988b) in his study of the carse clays at Beaully. Firth (1984) proposed that the 8 m OD surface in these silty clay deposits is equivalent to the Main Postglacial Shoreline which has been identified throughout eastern Scotland (Sissons and Smith, 1965b; Morrison *et al.*, 1981; Sissons, 1983a). The four lower marine levels in the estuarine deposits were produced as relative sea level fell in response to continued isostatic uplift. The inferred storm surge or tsunami deposit, about 7200 BP, is also represented in the succession at Munloch Valley (Firth and Haggart, 1989) (see also Barnyards, Maryton, Silver Moss and Western Forth Valley; Smith *et al.*, 1985a; Dawson *et al.*, 1988; Haggart, 1988b; Long *et al.*, 1989a).

The degraded cliffline which borders the shores of Munloch Bay was originally considered to have formed when relative sea level stood at 8 m OD (J.S. Smith, 1968). In contrast, Firth (1984) proposed that the erosional feature was produced at the same time as the extensive surface of marine planation that occurs throughout Munloch Bay, and which rises to 0 m OD. This erosional feature has been equated to the Main Lateglacial Shoreline and is thought to have formed during the Loch Lomond Stadial (Sissons, 1981c; Firth, 1984; Firth and Haggart, 1989).

Limited investigations of the estuarine deposits in Munloch Valley indicate that buried marine deposits, which possibly date from the early Holocene, may be present and worthy of further investigation (Firth and Haggart, 1989).

From the morphological and stratigraphical evidence in Munloch Valley, Firth (1984) interpreted the following sequence of events. As the Late Devensian ice-sheet retreated, the sea flooded into Munloch Valley to a maximum altitude of 29.4 m OD. While the sea stood at this level, ice occupied the Beaully Firth and meltwaters flowed over the watershed into Munloch Valley. Subsequently, relative sea level fell and formed Lateglacial marine depositional terraces at 27.0 m, 24.6 m, 17.5 m and 14–15 m OD, and then continued to fall to some unknown level below 0 m OD. During the Loch Lomond Stadial there was a slow marine transgression combined with extensive marine erosion which formed the Main Lateglacial Shoreline at 0 m OD. There followed a more rapid rise in relative sea level that culminated at about 6 m OD. Subsequently, relative sea level fell to an unknown level. The evidence indicates that during the Holocene there was another marine transgression between 7100 BP and 5510 BP, which culminated at 8.0 m OD with the formation of the Main Postglacial Shoreline. Since that time relative sea level has fallen to its present level via intermediate shorelines at 7.7–6.8 m, 5.3–5.5 m, 4.2–4.3 m and 3.0–3.2 m OD.

The landforms and deposits in Munloch Valley provide a key record of Lateglacial and Holocene relative sea-level changes in northern Scotland. The site demonstrates the best Lateglacial shorelines in the Beaully Firth area and provides morphological representation of all the Holocene shorelines. It contains five Lateglacial beaches at different levels, five distinct Holocene beaches, including the Main Postglacial Shoreline, and the buried Main Lateglacial Shoreline. In providing detailed morphological evidence for relative sea-level changes in the inner Moray Firth area, Munloch Valley therefore complements the stratigraphic record represented at Barnyards (see above). The features indicate a close relationship between Lateglacial raised marine terraces and ice-sheet decay and illustrate the fall in relative sea level

associated with deglaciation in Scotland. The area also provides evidence of a period of marine erosion during the Loch Lomond Stadial and of a major marine transgression during the Holocene, which culminated in the formation of the Main Postglacial Shoreline. The four lower Holocene shorelines demonstrate temporary stillstands in the fall of relative sea level to its present position.

The features in Munloch Valley are important for a number of reasons. First, the relatively high number of raised marine levels recorded in the valley are of regional significance in determining the number of shorelines and patterns of isostatic uplift in the inner Moray Firth. Second, the area is a key reference site demonstrating changes in relative sea-level during the Lateglacial and Holocene in northern Scotland. Third, the area is an integral member of a national network of Quaternary sites which together represent relative sea-level movements in Scotland, and as such demonstrate national patterns of isostatic uplift (see for example Barnyards, Milton Ness, Dryleys, Western Forth Valley and Glenacardoch Point) (see Barnyards for further discussion of the wider significance of the inner Moray Firth area in this context, and also Firth, 1989a; Firth and Haggart, 1989; Haggart, 1989; Shennan, 1989).

Conclusions

Munloch Valley provides an important geomorphological record of sea-level changes during the Lateglacial and Holocene (approximately the last 13,000 years). The evidence comprises a combination of both shoreline terraces and buried estuarine and peat sediments. In particular, the site is noted for the high number of raised marine levels, the majority represented as clear landscape features. Such a detailed geomorphological record complements the sedimentary record at Barnyards and makes this a key reference area in the network of localities for studies of sea-level change.

Reference list

- Dawson, A.G., Long, D. and Smith, D.E. (1988) The Storegga Slides: evidence from eastern Scotland of a possible tsunami. *Marine Geology*, **82**, 271–6.
- Firth, C.R. (1984) Raised shorelines and ice limits in the inner Moray Firth and Loch Ness areas, Scotland. Unpublished PhD thesis, Coventry (Lanchester) Polytechnic.
- Firth, C.R. (1989a) Late Devensian raised shorelines and ice limits in the inner Moray Firth area, northern Scotland. *Boreas*, **18**, 5–21.
- Firth, C.R. and Haggart, B.A. (1989) Loch Lomond Stadial and Flandrian shorelines in the inner Moray Firth area, Scotland. *Journal of Quaternary Science*, **4**, 37–50.
- Haggart, B.A. (1982) Flandrian sea-level changes in the Moray Firth area. Unpublished PhD thesis, University of Durham.
- Haggart, B.A. (1986) Relative sea-level change in the Beaully Firth Scotland. *Boreas*, **15**, 191–207.
- Haggart, B.A. (1987) Relative sea-level changes in the Moray Firth area, Scotland. In *Sea-level Changes* (eds M.J. Tooley and I. Shennan). Oxford, Blackwell, 67–108.
- Haggart, B.A. (1988b) The stratigraphy, depositional environment and dating of a possible tidal surge deposit in the Beaully Firth area, north-east Scotland. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **66**, 215–30.
- Haggart, B.A. (1989) Variations in the pattern and rate of isostatic uplift indicated by a comparison of Holocene sea-level curves from Scotland. *Journal of Quaternary Science*, **4**, 67–76.
- Horne, J. and Hinxman, L.W. (1914) The geology of the country round Beaully and Inverness: including part of the Black Isle. (Explanation of Sheet 83). Memoirs of the Geological Survey of Scotland. Edinburgh, HMSO, 108pp.
- Long, D., Smith, D.E. and Dawson, A.G. (1989a) A Holocene tsunami deposit in eastern Scotland. *Journal of Quaternary Science*, **4**, 61–6.
- Morrison, J., Smith, D.E., Cullingford, R.A. and Jones, R.L. (1981) The culmination of the main postglacial transgression in the Firth of Tay area, Scotland. *Proceedings of the Geologists' Association*, **92**, 197–209.
- Ogilvie, A.G. (1923) The physiography of the Moray Firth coast. *Transactions of the Royal Society of Edinburgh*, **53**, 377–404.
- Shennan, I. (1989) Holocene crustal movements and sea-level changes in Great Britain.

Journal of Quaternary Science, **4**, 77–89.

Sissons, J.B. (1981c) Lateglacial marine erosion and a jökulhlaup deposit in the Beaully Firth.

Scottish Journal of Geology, **17**, 7–19.

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.

Sissons, J.B. and Smith, D.E. (1965b) Peat bogs in a post-glacial sea and a buried raised beach in the western part of the Carse of Stirling. *Scottish Journal of Geology*, **1**, 247–55.

Smith, J.S. (1966) Morainic limits and their relationship to raised shorelines in the east Scotland Highlands. *Transactions of the Institute of British Geographers*, **39**, 61–4.

Smith, D.E. (1968) Post-glacial displaced shorelines in the surface of the carse clay on the north bank of the River Forth, in Scotland. *Zeitschrift für Geomorphologie*, NF, **12**, 388–408.

Smith, D.E., Cullingford, R.A. and Haggart, B.A. (1985a) A major coastal flood during the Holocene in eastern Scotland. *Eizeitaler und Gegenwart*, **35**, 109–18.