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

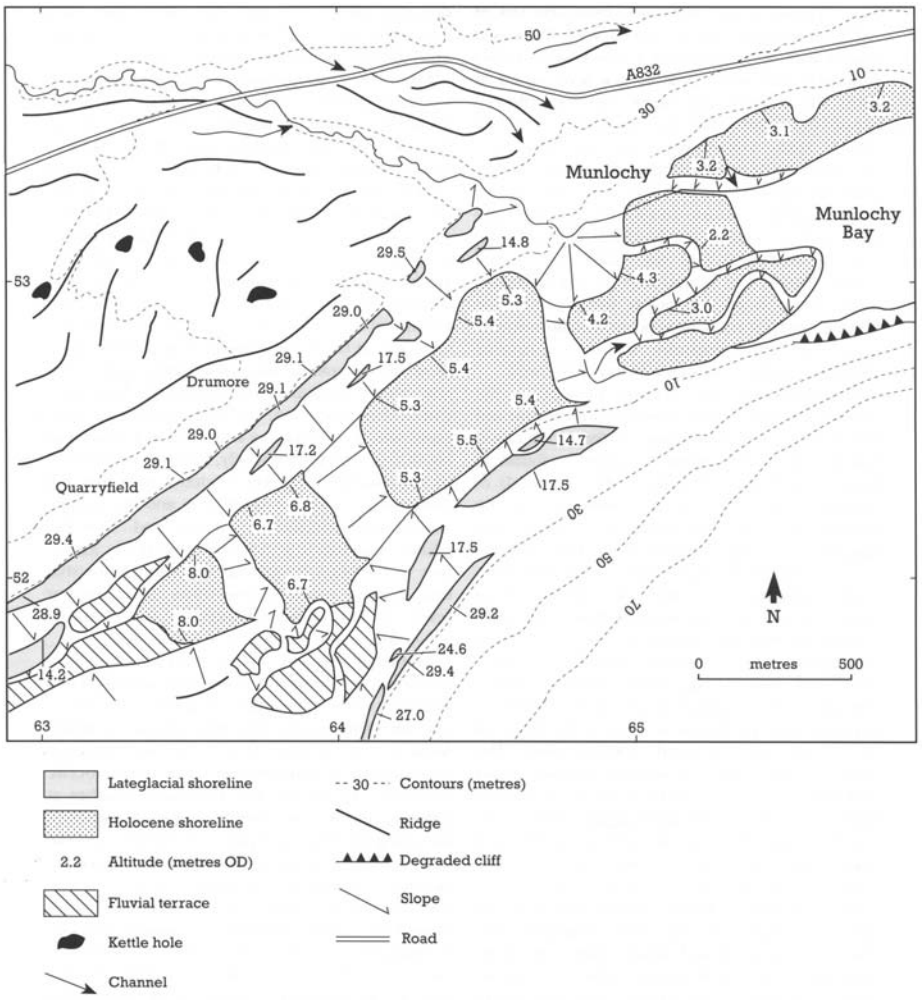

Figure 7.22: Geomorphology of Munlochy Valley (from Firth, 1984).

The floor of Munlochy 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 Munlochy Bay there is a degraded cliffline, against which, for the most part, raised shingle beaches are deposited. West of Munlochy, 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 Munlochy Valley drainage basin from the Beauly 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 Munlochy valley.

Interpretation

The glaciofluvial features which mantle the upper slopes of Munlochy Valley testify to the decay of the Late Devensian ice-sheet. Many of the meltwater channels associated with these deposits ultimately lead into Munlochy 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 Beauly Firth. This implies that ice must have occupied Beauly 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 Beauly (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 Beauly. 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 Munlochy 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 Munlochy 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 Munlochy 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 Munlochy 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 Munlochy Valley, Firth (1984) interpreted the following sequence of events. As the Late Devensian ice-sheet retreated, the sea flooded into Munlochy Valley to a maximum altitude of 29.4 m OD. While the sea stood at this level, ice occupied the Beauly Firth and meltwaters flowed over the watershed into Munlochy 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 Munlochy 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 Beauly 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, Munlochy 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 Munlochy 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

Munlochy 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.

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