Moss of Achnacree and Achnaba Landforms

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Highlights

This site demonstrates an outstanding assemblage of glaciofluvial landforms deposited by a Loch Lomond Readvance glacier.

Introduction

The site is located on the north side of Loch Etive and includes the major part (*c.* 4 km^2 in area) of an outwash plain underlying the Moss of Achnacree [NM 920 358] and a 2.5 km length of adjoining kame terrace fragments and related glaciofluvial features to the east near Achnaba [NM 945 365]. It forms what is arguably the finest outwash and kame terrace system in Great Britain and its importance lies in the way that it is possible to demonstrate relationships between ice-marginal glaciofluvial features, and between ice-contact and proglacial drainage systems. Moss of Achnacree and Achnaba is also a particularly good representative of a landform assemblage associated with a number of Loch Lomond Readvance glaciers which terminated near to sea level in western Scotland. The area has been described by Kynaston and Hill (1908), McCann (1961b, 1966a), Synge (1966) and Gray (1972, 1975a).

Description

Moss of Achnacree

The Moss of Achnacree outwash plain (1, (Figure 10.6)) covers an area of almost 4 km'. Most of the central part is covered by about 2 m of peat (the Moss of Achnacree), the edges having been cleared over the years for crofting and farming. Building construction and augering on these and other parts of the outwash plain have shown it to be underlain by sand and gravel. The feature forms a marked constriction at the entrance to Loch Etive. Here the loch is confined to a <0.5 km wide channel on the southern margin of the valley compared with a width of over 1.5 km a short distance to the east. When the outwash sediments were being deposited, the glacier snout lay immediately to the east and at that time the outwash plain would have been continuous across the valley. A large terrace behind Connel [NM 915 342] is a likely remnant of the same outwash plain on the south side of the loch (Gray, 1972).

The outwash plain slopes from about 25 m OD near its eastern edge at Achnacairn [NM 927 357] to about 12 m OD near the A828 Connel to Ballachullish road. This general gradient is, however, interrupted by a wide meltwater channel that runs westwards from Cairnbaan and by a number of deep, lochan-filled kettle holes (Figure 10.6). Bathymetric surveying of the three largest hollows has shown each to be complex. For example, Murray and Pullar (1910) noted that the Lochan na Beithe hollow consists of two major interlinked depressions. The deepest point lies 25 m below the terrace surface and 8 m below OD. Conacher (1932) found that Laga Beaga [NM 924 357], west of Achnacairn, consists of four interconnected hollows with a deepest point 17 m below the terrace surface. The presence of these large kettle holes in the outwash plain has been seen by several authors as indicating that the glacier originally extended beyond Connel, and during retreat large blocks of ice were left behind, to be surrounded or covered by outwash sediments when the snout became stabilized at the eastern edge of the outwash plain.

As McCann (1961b) pointed out, the margins of the outwash plain have been modified by later marine action at a level of approximately 13 m OD. Along the eastern margin the ice-contact slope has been eroded so that there is a marked break of slope at this level. Westwards, along the southern edge of the terrace, the gradient of the outwash plain carries it down to the 13 m level at North Connel, and on the west side the sea has built a 2.5 km long north–south spit which rises to over 14 m OD. The sea level concerned is probably that of the Main Postglacial Shoreline. Because of the presence of this shoreline, it is difficult to decipher the relative sea level at the time the outwash plain was deposited, but it was

certainly below the 13 m OD level. Following formation of the Main Postglacial Shoreline, relative sea level gradually fell to its present level and in doing so raised-beach sediments were deposited to the west of the spit around North Connel Airfield [NM 905 353] and North Ledaig Caravan Site [NM 907 369], as well as below the south-east corner of the outwash plain (around [NM 928 351]).

Achnaba

The Moss of Achnacree outwash plain is continued eastwards by two main terrace fragments, one at Achnacreebeag [NM 933 364] and the other 200 m to the south-east and partially built upon (2, (Figure 10.6)). At this locality the transition from a proglacial outwash plain to an ice-marginal kame terrace occurs. At its eastern end, where the kame terrace fragment rises to 26.4 m OD, it narrows into a short, sharp-crested ridge that is probably an esker. Thus it is possible to identify the locality at which a meltwater stream escaped from the ice and became an ice-marginal river contributing first to the deposition of the kame terrace and then to the outwash plain, west of Achnacreebeag.

As a glacier decays and contracts, the normal situation is for the earliest and highest kame terraces to occur along the valley sides and for later terraces to occur at lower elevations towards the valley centre. The situation at Achnacreebeag is different since fragment 2 is separated from the hill slope to the north by a channel/lower terrace (3, (Figure 10.6)) that is one of a slightly later group of kame terrace fragments. The explanation probably lies in the fact that in this case drainage was unable to flow along the front edge of fragment 2 because the glacier margin had not wasted away from it. Thus the drainage instead flowed along the back edge of the terrace and cut down into it.

The lower group of terraces is continued eastwards by terrace fragments 4, 5, 6 and 7 (Figure 10.6) extending to the western end of the site. The overall rise is from 19.3 m OD at the western end of fragment/channel 3 to 30.3 m OD at the eastern end of fragment 7. Heights along the back edges of the fragments are often anomalously high due to the presence of alluvial fans. At Achnaba, fragment 5 is 400 m wide and towards its front edge it is perforated by a remarkable series of kettle holes. These are striking features, being steep-sided hollows sometimes over 10 m deep located in a flat terrace. Many of them are complex in shape due to coalescing of hollows. As described above for the outwash plain, the front edges of the kame terraces were also eroded by the Main Postglacial sea at about 13 m OD and in places this sea washed into kettle holes, thus creating large embayments. A good example occurs 200 m north-west of the church (at [NM 943 362]).

The stream that separates fragments 5 and 6 has cut the best sections in the kame terrace sediments. Although poorly bedded sand and gravel is predominant, there are also lenses of laminated sands, silts and occasionally clays, indicating that small ponds were present on the kame terraces, perhaps in abandoned drainage channels or at points of ice-melt subsidence.

Fragment 7 is mainly confined to a narrow strip along the valley side except at its eastern end where it extends out towards a bedrock area. Between fragment 7 and the loch the terrain is very irregular. Although this may in part be due to differential kame terrace subsidence following ice-melt, the presence of two steep-sided, sinuous eskers suggests that at least some of the landforms were deposited subglacially, and that some of the mounds and hollows are kames and kettles. The downslope trend of the eskers suggests that they are examples of the subglacially engorged type, probably formed by rivers that found a route down towards the valley floor from the kame terrace above.

Interpretation

The terraces at the entrance to Loch Etive and bordering the north and south sides of the lower part of the loch were originally interpreted as marine. Thus Kynaston and Hill (1908) described the Moss of Achnacree as resting on sands and gravels of the '50 ft beach' and assigned the terraces farther east to the '100 ft beach'.

McCann (1961b) was the first to appreciate the significance of the terraces. From the slope of the Moss of Achnacree feature, the presence of kettle holes in it and its similarity with the terraces at Corran, farther up Loch Linnhe, McCann concluded that it was an outwash plain marking a halt in the retreat of the Loch Etive glacier, which he later assigned to the Loch Lomond Readvance (McCann, 1966a). He also examined the terraces along the north side of the loch around

Achnaba, and reinterpreted them as ice-marginal lacustrine infillings between ice to the south, the hill slope to the north and the outwash plain to the west. This general reinterpretation was confirmed by later authors (for example, Synge, 1966).

A more detailed survey of the Loch Etive outwash and kame terrace system was undertaken by Gray (1972, 1975a) who mapped the area and levelled all the terrace fragments. This work showed that the altitudes of the terrace surfaces on both the north and south sides of the loch generally fall within clearly defined sloping bands, with only a few surface altitudes failing to fit the scheme. The gradients of these bands (3.5–6.0 m km^{-1}) are much too steep to be due to differential glacio-isostatic rebound, and hence were interpreted mainly as original fluvial drainage gradients. Thus the kame terraces are now interpreted as ice-marginal fluvial rather than lacustrine features, while the different terrace groups are seen as being the result of contraction of the Loch Etive glacier following the maximum of the Loch Lomond Readvance bringing about changes in drainage patterns. The relationships of the kame terraces to other ice-contact landforms (kames, kettle holes, eskers) has enabled a detailed reconstruction of these changes in ice-marginal drainage, as outlined above.

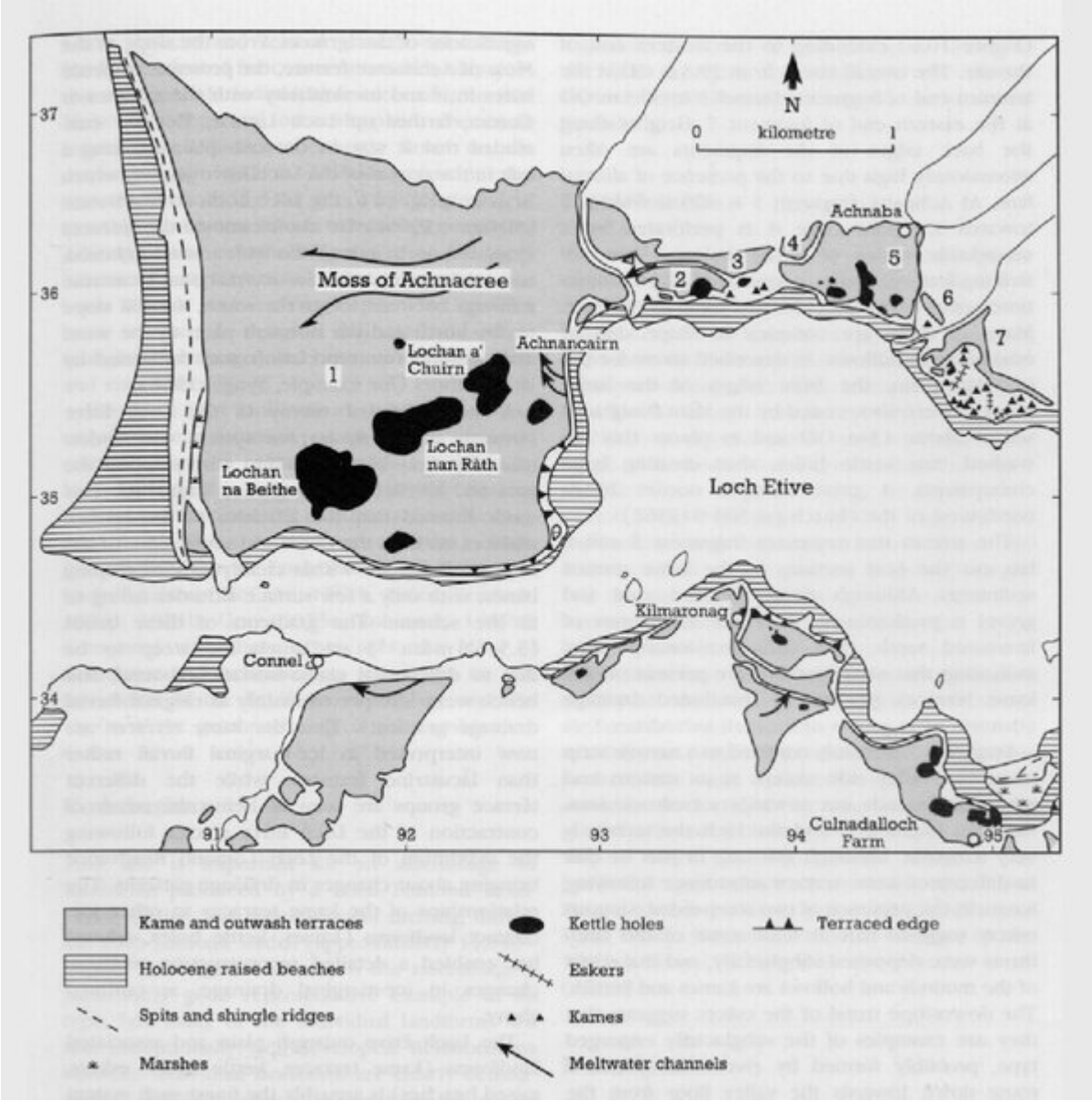
The Loch Etive outwash plain and associated landforms (kame terraces, kettle holes, eskers, raised beaches) is arguably the finest such system in Britain. The system was formed during the early stages of wastage of the Loch Lomond Readvance glacier in the Loch Etive valley, and illustrates the meltwater drainage patterns and mode of ice decay at this time. Although individual outwash spreads and/or kame terraces are commonplace, it is the excellent development of the features at Loch Etive, the clarity of the relationships between features, and the size and completeness of the overall system that makes it exceptional. The system covers an area of 7 km by 4 km, but only part of this, including the outwash plain and adjoining 2.5 km stretch of kame terraces and related glaciofluvial features has been selected for conservation. Not only does this area include individual features of note (the Moss of Achnacree outwash plain, the kame terraces at Achnaba, the kettle holes on the outwash plain and at Achnaba), but it also demonstrates clearly the geomorphological relationships between kame terrace (ice-marginal drainage) and outwash (proglacial drainage), between kame terraces of different age, between kame terrace and ice-margin position, between kame terrace (ice-marginal drainage) and eskers (subglacial drainage) and between outwash plain and raised shorelines.

The Loch Etive landform assemblage is also an excellent representative example of a series of outwash deposits associated with a number of Loch Lomond Readvance glaciers on the western seaboard of Scotland, for example at Loch Creran, (see South Shian and Balure of Shian), Mull, Ballachulish, Corran, Loch Shiel, Loch Morar and Loch Torridon (McCann, 1961b, 1966a; Peacock, 1970a, 1971b; Gray, 1975a; Robinson, 1987a). Compared with these other sites, the Moss of Achnacree and Achnaba area stands out for the fine detail of the landform assemblage and the clarity of the geomorphological relationships.

Conclusion

This site is important for an assemblage of landforms produced by a Loch Lomond Readvance glacier, and its subsequent melting, during the Loch Lomond Stadial (approximately 11,000–10,000 years ago). Not only is the assemblage a particularly good representative example of its type, but many of the individual landforms are also exceptionally well developed. Relationships between individual landforms are clearly demonstrated and have allowed the pattern of glacier wastage to be reconstructed.

References



(Figure 10.6) Geomorphology of Moss of Achnacree and Achnaba (from Gray, 1975a). See text for explanation of numbers.