KILDRUMMIE KAMES

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OS Grid Reference: NH830530

Highlights

This site demonstrates an outstanding example of a system of braided eskers formed by the Late Devensian ice-sheet. It shows particularly clearly the morphology of the landforms and is also important for interpreting the development of glacial drainage during the wastage of the Late Devensian ice-sheet.

Introduction

The Kildrummie Kames (also known as the Flemington Kames or more properly as the Flemington Eskers) extend over a distance of about 10 km to the south-west of Nairn (from approximately NH 783502 to NH 874540). They are probably the best example of large, braided eskers and one of the longest continuous esker systems in the country that remains essentially unmodified by sand and gravel extraction. TheKildrummie Kames form part of an extensive system of glaciofluvial deposits, including eskers, kames and kame terraces that occupies the low ground on the south side of the Moray Firth from the north end of Great Glen to near Elgin. They were formed by glacial meltwaters during the wastage of the Late Devensian ice-sheet and have been mapped and described in various publications (Jamieson, 1866, 1874; Horne, 1923; Ogilvie, 1923; Gregory, 1926; J.S. Smith, 1968, 1977; Harris and Peacock, 1969; Small and Smith, 1971; Synge, 1977b; Mykura *et al*., 1978; Synge and Smith, 1980; Firth, 1984, 1990b). The eskers are illustrated in Sparks and West (1972, plate 15). The most detailed maps available of the eskers are those recently published by the British Geological Survey (1:10,000 Sheets NH 85 SW, SE and 75 SE). Although the Kildrummie landforms are clearly eskers, they are widely known as "kames' following the historical usage of the latter term.

Description

The Kildrummie Kames comprise a series of up to eight braided ridges, 5–10 m high, with intervening kettle holes often partially infilled by peat or waterlogged silt and sand which is several metres deep in places. The braided forms occur in three distinct groups, linked together by a single discontinuous ridge (Figures 7.11 and 7.12). To the west of the B9090 the form of the esker ridges is less distinct and their exact morphology is masked by thick coniferous woodland. However, the system extends almost unbroken as far as Culaird (NH 782500). A number of eskers, separated from, but aligned with the main group, occur to the south of Tornagrain (NH 769499). According to Small and Smith (1971) these are "fed' by a series of meltwater channels at the western end of the system, between High Wood and Balnabual (NH 776490). To the north-east of Meikle Kildrummie (NH 856539), the esker system terminates in a broad, flat-topped and steep-sided ridge, which is pitted by small kettle holes and slopes regularly towards the east (Figure 7.13). To the north-west of the ridge, terraces slope down northwards into a large depression almost entirely enclosed by stagnant-ice terrain. This depression drains northwards through a channel south of Tradespark (NH 869568) (Figure 7.13).

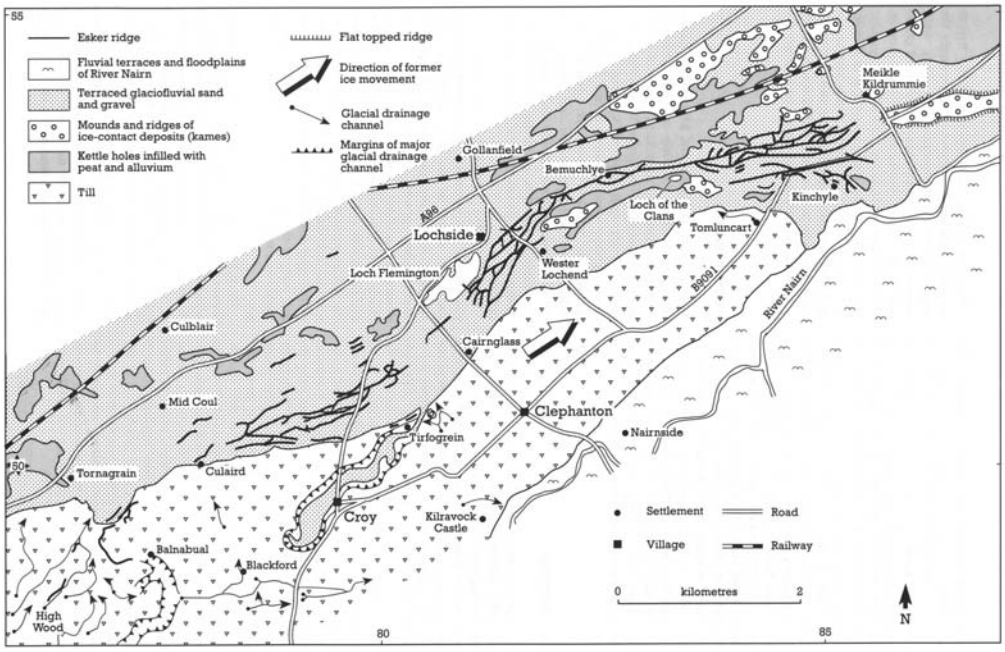

Figure 7.11: Geomorphology of the Kildrummie Kames esker system between High Wood and Meikle Kildrummie (from mapping by C. A. Auton for the British Geological Survey 1:50,000 Geological Sheet 84W (Fortrose), in press).

Figure 7.12: The Kildrummie Kames esker system viewed towards the east. Two areas of braided ridges (right foreground and centre distance) are linked by a single ridge. (Cambridge University Collection: copyright reserved.)

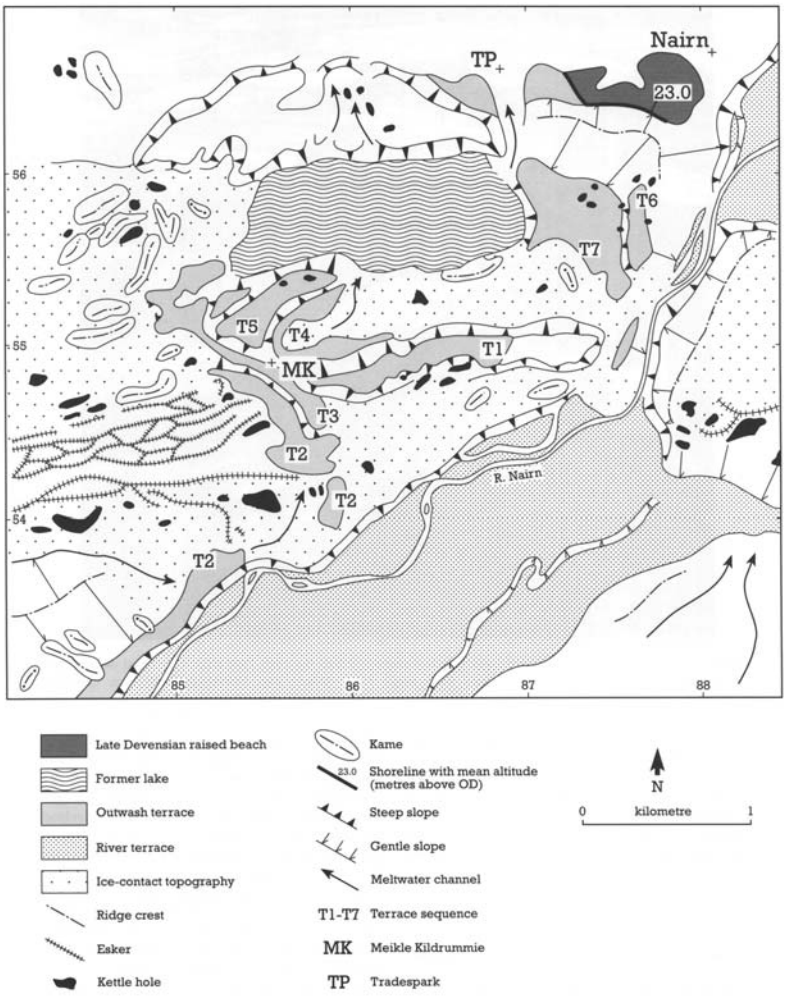

Figure 7.13: Geomorphology of the eastern part of the Kildrummie Kames in the vicinity of Meikle Kildrummie (from Firth, 1984).

Mapping of the eskers by staff of the British Geological Survey has shown that although the ridges are principally composed of sandy, well-rounded coarse gravel, lenses of claybound gravel and brown sandy diamicton are also present, notably within exposures to the east of Bemuchlye (NH 827531). These show up to 8 m of diamicton, which appears to overlie finely interlaminated sand and silt, suggesting that this part of the esker system may have been laid down in a body of standing water ponded within or beneath the ice.

Interpretation

Most accounts recognize the Kildrummie Kames as classic features. As early as 1866 Jamieson described them as a "remarkable series of ridges' and the "finest of all' the gravel hills in the Moray Firth area. He again referred to them in 1874, believing they were moraines of the last glacial episode in Scotland. However, despite their striking landscape appearance and classic lines, the Kildrummie Kames feature only infrequently in published literature, generally in a descriptive context or in discussions of relative sea-level change.

Horne (1923) recognized the deposits as glaciofluvial and described them briefly as part of the "kame series' of the area, noting the anastomosing forms and composition of sand and well-rounded gravel. Ogilvie (1923) in his descriptive account of the physiography of the Moray Firth coast presented a topographic map of the eskers east of Loch Flemington. He noted that the eskers terminated abruptly in what might be a sea cliff, cut during the maximum submergence of the land following deglaciation. To the north and east of the eskers he recognized a zone of kames that had been washed and trimmed by the sea.

Gregory (1926), in his review of similar features throughout Scotland, provided the most detailed account to date. Notably, he described a section which he considered to show marine trimming of the esker and also beach deposits banked against it. He also recorded sections showing beds of coarse cobbles and smaller pebbles, and coarse gravel overlying sand and gravel layers, with coarse gravel again at the base.

J.S. Smith (1968, 1977) and Small and Smith (1971) referred to the eskers in the context of the extensive suite of meltwater channels and glaciofluvial deposits associated with the melting of the Late Devensian ice-sheet on the south side of the Moray Firth. The landforms indicate easterly flow of subglacial meltwater, controlled by the ice-surface gradient, and demonstrate a continuous phase of ice-sheet downwasting (Smith, 1977). Small and Smith (1971) noted that the esker system had been washed on its seaward side near Gollanfield (NH 815533) by the Lateglacial marine transgression. This latter theme was developed more fully bySynge (1977b) and Synge and Smith (1980) (see also Synge, 1977a). According to these authors, the highest Lateglacial shoreline in the area (`Kildrummie Shoreline' at 37–42 m OD) is represented by the flat-topped ridge east of Meikle Kildrummie at 36–38 m OD. This ridge was interpreted as a form of marine delta deposited in association with decaying ice, when the roof of the subglacial esker tunnel collapsed. The steep eastern ends of the individual esker ridges west of Meikle Kildrummie were thought to reflect wave trimming and to represent a lower shoreline at 33 m OD, part of the "Culcabock Shoreline' at 28–34 m OD. Beach ridges associated with this shoreline were also identified between the ridge ends (Synge and Smith, 1980). Below the altitude of these shorelines, the steep slopes of the eskers and kettle holes were degraded by the marine transgression.

Firth (1984) mapped in detail the eastern part of the Kildrummie Kames (Figure 7.13), the adjacent glaciofluvial deposits and the terraces of lower Strath Nairn. During the downwasting of the ice-sheet, marginal and submarginal glacial meltwaters formed a series of kame terraces and meltwater channels on the southern slopes of Strath Nairn; at the same time subglacial meltwaters drained eastwards forming the Kildrummie esker system. As deglaciation progressed, meltwater from the kame terraces drained into the eskers, and as the ice thinned at the eastern end, the main tunnel roof collapsed forming an open crevasse in which the large flat-topped ridge east of Meikle Kildrummie formed. Firth's (1984) interpretation of the terrace sequence indicates that, while the lower valley remained blocked by stagnant ice, meltwater in Strath Nairn drained both across the esker system, forming a gap and terraces between the main esker and the flat-topped ridge, and around the eastern end of the latter and into a proglacial lake occupying the depression to the north of Meikle Kildrummie. Drainage from the proglacial lake was northwards past past Tradespark (Figure 7.13), where the the highest shoreline fragment in the area is at 23 m OD. Firth (1984) found no evidence that either the esker system or the glaciofluvial deposits immediately to the north had been washed by the sea. Ice remained in the area until relative sea level fell below 21 m OD

Kildrummie Kames are important in several respects. They are an outstanding example of a braided esker system, one of the finest and largest in Britain. They have largely escaped sand and gravel extraction and other large-scale modifications and therefore demonstrate landform morphology in a particularly clear fashion. Kildrummie Kames offer significant potential for further research on subglacial hydrology and the controls on meltwater routes and sedimentation (see Shreve, 1985a). Recently Shaw *et al*. (1989) have suggested that anastomosing channel patterns, similar to that indicated by the Kildrummie Kames, reflect major subglacial floods. Alternatively, each braided area may represent a series of channels on an ice-cored fan surface developed in front of a receding ice margin (*cf.* Jenkins, 1991); the total assemblage of landforms therefore represents three successive stages in the ice recession. The well-preserved landforms of Kildrummie Kames offer good opportunity for testing such ideas and for applying the theories of glacier physics and hydrology to reconstruct Late Devensian ice-sheet characteristics and drainage conditions.

In their braided forms, the Kildrummie Kames share morphological similarities with the Carstairs Kames (see below). Proposed origins for the latter have included subglacial and proglacial processes, and recent work (Jenkins, 1991) has suggested that the ridges formed on the suface of buried ice or in englacial tunnels near the ice margin under conditions of high energy flows (large floods). Detailed comparative investigation of the two sites should help clarify the respective origin of their landforms and their implications for patterns of

deglaciation. Morphologically, Kildrummie Kames differ from the system of parallel esker ridges at Littlemill and the assemblage of single eskers and kame terraces at Torvean. The interpretation of such differences and their implications for glacier hydrology during deglaciation await resolution.

Conclusions

The Kildrummie Kames represents a classic site for geomorphology, showing a large system of braided esker ridges formed by meltwater rivers during the wastage of the last (Late Devensian) ice-sheet (approximately 14,000–13,000 years ago). The landforms are largely intact and display particularly clearly the surface forms of the eskers. TheKildrummie Kames have significant potential for developing an understanding of glacial drainage systems and patterns of ice decay.

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