# RAMMER CLEUGH

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## Highlights

The assemblage of glacial meltwater channels and deposits at Rammer Cleugh provides a particularly clear illustration of the development and evolution of a glacial draining system during the wastage of the Late Devensian ice-sheet.

## Introduction

The Rammer Cleugh site, 8 km south-west of Dunbar, covers an area of 5 km$^2$ between Stoneypath (NT 616711) and Hartside (NT 653721). It is important for an assemblage of glacial meltwater drainage channels, including the large and spectacular Rammer Cleugh, probably formed subglacially, and a series of subglacial chutes, ice-marginal benches and small marginal and submarginal channels. Glaciofluvial deposits including kame terraces and an esker also form part of the landform assemblage. Rammer Cleugh has been described by Young (in Howell *et al.*, 1866), Kendall and Bailey (1908) and Sissons (1958a, 1961a, 1975c), the last of whom published detailed geomorphological maps of the area (Sissons, 1958a, fig. 2; Sissons, 1961a, fig. 13).

## Description

The meltwater channels at Rammer Cleugh comprise three principal sets of features (Sissons, 1958a): the large channel of Rammer Cleugh itself, channels running steeply downslope and a series of channels and benches with a much gentler gradient. The main feature called Rammer Cleugh (see plate I of Kendall and Bailey, 1908 and plate IX of Wright, 1937) occupies the col between Deuchrie Dod and Lothian Edge. It comprises a 60 m deep glacial drainage channel extending some 5 km from Stoneypath to east of Pathhead. It has an "up and down' long profile and at its western end near Stoneypath is cut on its southern side by numerous deep gullies and channels joining it at right angles (Figure 17.7). Above the main channel of Rammer Cleugh, particularly on the south side, several smaller channels and benches cut in bedrock run parallel, or at a low angle to the hillside contours. A number of these features turn steeply downslope at their eastern ends. To the west and north of Hartside Farm a complex assemblage of rock benches and anastomosing, rock-walled channels (occasionally with "up and down' long profiles – *cf.* Sissons, 1975c) occurs in a broad embayment in the hills (Figure 17.7).

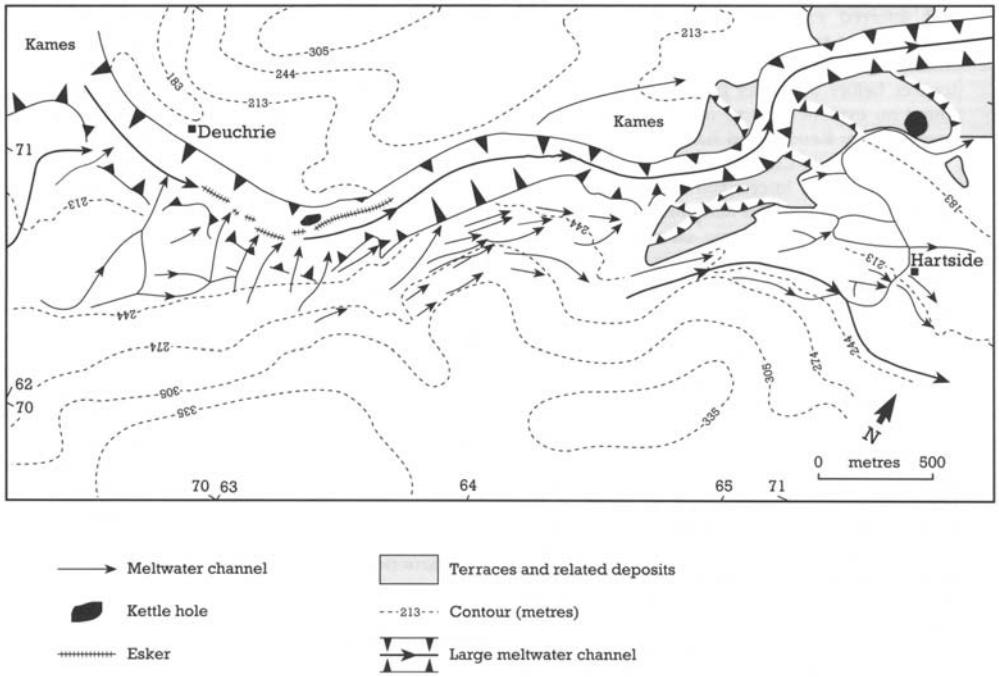


*Figure 17.7: Geomorphology of the meltwater channel system at Rammer Cleugh (from Sissons, 1958a).*

Meltwater deposits occur in two main areas within the site. To the east of Deuchrie, a series of aligned gravel mounds up to 12 m high form an esker on the floor of Rammer Cleugh. Farther east in the area between Hartside and Pathlead (Figure 17.7), kame terraces occur both to the north and south of Rammer Cleugh, locally interspersed with kame mounds. Further examples of kames occur north of Stoneypath at the west end of Rammer Cleugh.

In a wider context, Rammer Cleugh and its associated features are part of an extensive sequence of meltwater drainage phenomena along the northern flanks of the Moorfoot and Lammermuir hills (Sissons, 1958a, 1967a; McAdam and Tulloch, 1985; Davies *et al.*, 1986).

## Interpretation

Young (in Howell *et al.*, 1866) provided the first account of Rammer Cleugh and other dry valleys on the northern flank of the Lammermuir Hills. He noted that their consistent north-east orientation was discordant with the present drainage system and that they shared similarities with dry channels in Berwickshire described earlier by Geikie (1863b). Although further investigation was necessary to explain their origin, Young discounted present stream processes and direct glacial erosion. Geikie (1894) later identified deposits associated with the channels as glaciofluvial in origin.

Kendall and Bailey (1908) mapped the large drainage channels in their study of the deglaciation of East Lothian. They explained them as the product of a retreating ice sheet, applying the ideas developed by Kendall (1902) to account for similar features in Yorkshire. In their view, the channels were formed by meltwater torrents linking marginal ice-dammed lakes along the hillsides. Kendall and Bailey inferred oscillations in the receding icefront from several lines of evidence and explained the mounds at the western end of Rammer Cleugh as the result of a minor readvance. In the second edition of the Geological Survey Memoir on the geology of East Lothian Clough *et al.* (1910) drew heavily on Kendall and Bailey's work.

Charlesworth (1926b) related the meltwater channels and deposits along the northern flanks of the Lammermuir Hills to his Lammermuir-Stranraer Readvance.

Based on his detailed mapping, Sissons (1958a) re-interpreted the Rammer Cleugh features and placed them in the context of the wider pattern of deglaciation in East Lothain. Many of the meltwater channels and benches running across the slopes at low angles to the contours were largely formed by ice-marginal streams, not by glacial lake overspill as suggested by Kendall

and Bailey (1908). Some of the channels, for example those running steeply downslope on the south side of Rammer Cleugh near Stoneypath, were subglacial chutes similar to features described from Scandinavia by Mannerfelt (1945, 1949). In several cases, the marginal channels terminated abruptly at the chutes, indicating that the meltwaters turned abruptly to flow beneath the ice margin.

Subsequently, in an important contribution, Sissons (1960, 1961a) offered further detailed criticisms of the haphazard application of the lake overspill hypothesis (Kendall, 1902; Kendall and Bailey, 1908),and he elaborated on alternative processes of meltwater channel formation that agreed better with the field evidence. According toSissons (1961a) the main Rammer Cleugh channel was probably a subglacial feature, its "up and down' long profile being cut by meltwaters under hydrostatic pressure at a stage before the subglacial chutes were formed on its flanks and the esker on its floor. Subsequent work elsewhere suggests thatRammer Cleugh and the other channels with "up and down' long profiles may have been formed by superimposition of submarginal, englacial meltwaters on to the underlying topography, in the manner outlined for similar channels in southern Scotland and northern England (Price, 1960, 1963a; Clapperton, 1968, 1971b).

From his detailed mapping of benches, channels and kame terraces, including those of the Rammer Cleugh area, Sissons (1958a) reconstructed a series of former ice-margin positions and inferred extensive thinning and marginal stagnation of the last ice sheet in East Lothian. According to Sissons, the higher slopes became ice-free before the lower ground. Significantly, he found no evidence for an oscillating ice front as suggested by Kendall and Bailey.

The Rammer Cleugh site is important in demonstrating an interlinked assemblage of subglacial, submarginal and marginal meltwater phenomena, including drainage channels and kame terraces associated with a thinning and downwasting ice margin. Although meltwater phenomena are widely known throughout Scotland and northern England (Sissons, 1958a, 1958b, 1960, 1961a, 1961b, 1963b, 1974b; Price, 1960, 1963a; Clapperton, 1968, 1971b; Sugden, 1970; Clapperton and Sugden, 1972; Young, 1975a, 1975b, 1977b, 1978, 1980), the majority of features appear to have formed subglacially or submarginally and there are few accounts of ice-marginal phenomena as well-developed as those of theRammer Cleugh area. As far as individual examples of subglacial channels are concerned, arguably comparable or better examples occur elsewhere; for example at Carlops (Sissons, 1963b). Subglacial chutes are also often recorded, notably by Price (1960) near Tweedsmuir and by Sissons (1961a) near Fettercairn. However, it is the total assemblage of different types of feature and the particular component of marginal channels which distinguishesRammer Cleugh.

The Rammer Cleugh area is also significant in an historical context. It forms an integral part of the landform assemblage on the northern flank of the Lammermuir Hills. This area was one of the first to be interpreted by Sissons (1958a) in terms of a downwasting model of ice-sheet deglaciation, in contrast to earlier interpretations that involved active ice-margin recession. The downwasting model has formed the basis of most subsequent studies of the pattern of deglaciation of the last ice sheet. However, as a universal model, like those before it, it is probably an over-simplification. Deglaciation probably proceeded by a combination of downwasting and frontal recession, with considerable local variations controlled by factors such as ice dynamics, topography, debris content, and, where appropriate, calving.

## Conclusions

Rammer Cleugh is notable for an assemblage of landforms produced by meltwater rivers flowing from an ice sheet. It is especially important for the range of glacial meltwater channel types present, together with associated depositional features including kame terraces and an esker ridge. These landforms illustrate the development of a glacial drainage system which involved the meltwaters flowing at or near the margin of the last ice sheet (around 14,000 years ago).

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