BEINN SHIANTAIDH

A.G. Dawson

OS Grid Reference: NR521749

Highlights

This site is of geomorphological interest for one of the best examples in Scotland of a fossil rock glacier formed at the base of a talus accumulation. It is believed to have been active during the Loch Lomond Stadial and provides information about slope processes and environmental conditions at that time.

Introduction

The site (NR 521749) is located on the island of Jura at the foot of the eastern slopes of Beinn Shiantaidh, one of the Paps of Jura. It is notable for one of the most spectacular fossil rock glaciers in Scotland. The only detailed account of the feature is given in Dawson (1977).

Description

The rock glacier consists of a lobate accumulation of poorly-sorted quartzite debris and has an area of 0.045 km2, the maximum width along the foot of the hill being 380 m and the maximum length 180 m (Figure 11.7). It is located between 355 m and 400 m OD on the margin of the exposed col that separates Beinn Shiantaidh (755 m OD) from its neighbouring summit Corra Bheinn (569 m OD). The constituent boulders, many of which exceed 0.5 m in diameter, are arranged in a nested series of arcuate ridges and depressions which terminates in a sharply defined frontal margin. On the eastern margin of Beinn Shiantaidh, above the mass of debris, a talus of angular quartzite blocks rises by as much as 200 m towards the mountain summit.

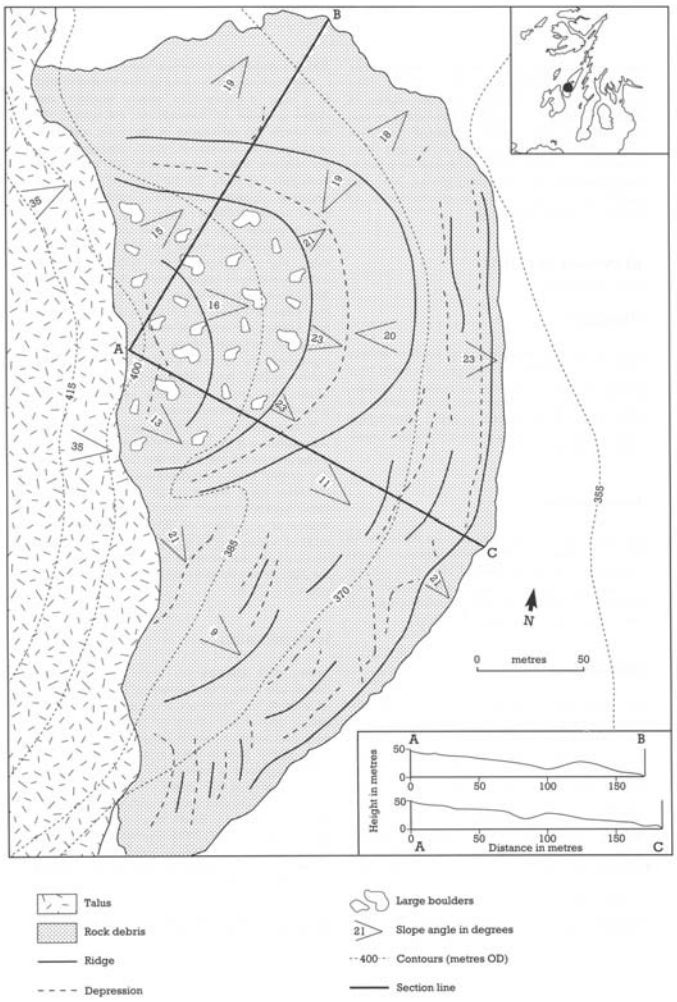

Figure 11.7: The Beinn Shiantaidh rock glacier (from Dawson, 1977).

The front edge of the rock glacier is represented by a ridge of unvegetated, angular boulders and slopes at about 20° towards the col surface. To the north, the continuity of the front margin is interrupted by numerous, small, transverse boulder hollows which are generally less than 1.5 m deep and 3 m wide. To the south, the outer rim becomes progressively more subdued. Here, there occurs a distinct outer ridge, the crest of which stands 5 m above the col surface. An arcuate depression flanks the inner edge of the ridge, but is replaced farther north by shallow hollows within a higher front ridge that stands 20 m above the col floor. The inner margin of this ridge descends to a semicircular depression that follows the ridge for most of its length. The radius of curvature of the ridge is 85 m and it represents the largest such feature upon the debris surface. Both ridge ends are overlain by taluses that slope consistently upwards at 35° towards the mountain summit.

Perhaps the most notable feature of the debris accumulation is the deep semicircular depression along the inner margin of the outermost ridge. The central area of the depression lies 6 m below the ridge crest and abuts an area of extremely large boulders which rises abruptly above the hollow at a gradient of 20–25°. The boulders, most of which exceed 0.5 m in diameter, comprise an upper surface slope which, measured from the base of the talus to the frontal ridge crest, is generally 10–16°.

Interpretation

Active rock glaciers are composed of coarse debris that is moved downslope by deformation of internal ice. Many are elongated and tongue-like in plan form; others are small and arcuate with low length-to-width ratios (Wahrhaftig and Cox, 1959; Barsch, 1969). The latter type is widely regarded as forming through the deformation of internal ice lenses or ice-rich frozen sediment and is unrelated to glaciers. The Beinn Shiantaidh feature is of this latter type

(*cf.* Wahrhaftig and Cox, 1959; Outcalt and Benedict 1965; Lindner and Marks, 1985) and may be described as a protalus lobe (Martin and Whalley, 1987; Whalley and Martin, 1992).

During the formation and decay of the rock glacier, the persistence of snowbeds at the foot of the talus may have resulted in the accumulation of small protalus ramparts that were incorporated within the rock glacier. Indeed, in front of the talus slope that flanks the high north-facing buttress of Beinn Shiantaidh there is an arcuate ridge, 50 m long and composed of angular boulders, that was interpreted by Dawson (1977) as a fossil protalus rampart that formed contemporaneously with the rock glacier.

The east-north-east aspect of the fossil rock glacier would appear to have favoured the accumulation and persistence of snow and ice. Its development may have been assisted by the presence of permafrost which is thought to have last occurred in Scotland during the Loch Lomond Stadial (Sissons, 1974c). Although permafrost may not have been essential if the debris cover was sufficient to insulate the internal snow and ice, it is nevertheless reasonable to infer that the feature was formed (or at least last active) at that time.

Dawson (1977) estimated that the average rate of debris supply to the rock glacier from the cliffs upslope during the stadial was about 185 m3a-1, assuming a maximum duration of 1000 years for the period of formation. He also calculated that the average cliff retreat rate behind the rock glacier was approximately 9 mma-1. This inferred cliff retreat rate is much larger than cliff retreat rates that can be inferred for other locations in Scotland during the Loch Lomond Stadial (Ballantyne and Kirkbride, 1987).

It is not known with complete certainty, however, that the material comprising the Bheinn Shiantaidh rock glacier was produced entirely during the cold climate of the Loch Lomond Stadial. For example, it is entirely possible (although not proven) that talus production on the slopes of Bheinn Shiantaidh may have commenced during ice-sheet deglaciation (*cf.* Chattopadhyay, 1984; Wilson, 1990a, 1990b). Under such circumstances the inferred rates of cliff retreat and talus production would be significantly lower than stated above.

The Bheinn Shiantaidh fossil rock glacier is one of the few such landforms in Great Britain and it represents a classic example of the lobate type (compare with Beinn Alligin). The almost complete lack of vegetation cover makes the detailed surface morphology resulting from former debris flowage particularly clear and impressive. The rock glacier is also potentially of palaeoclimatic significance, possibly indicating the former presence of permafrost in the mountains of the Inner Hebrides, probably during the Loch Lomond Stadial. If this is confirmed, it corroborates other lines of evidence of permanently frozen ground at low levels in western Scotland (Sissons, 1974c, 1976b). Similar landforms occur on granite in the Cairngorms (Sissons, 1979f; Chattopadhyay, 1984; Maclean, 1991), but at much higher altitudes (*c.* 800–1000 m OD). Although smaller, the Beinn Shiantaidh rock glacier also resembles the excellent examples on quartzite at altitudes of 150–400 m OD on Errigal Mountain and Muckish Mountain in County Donegal in north-west Ireland (Wilson, 1990a, 1990b). Together, such sites provide an opportunity to assess the relative roles of climate and debris supply factors in rock glacier (protalus lobe) formation.

Conclusions

Beinn Shiantaidh provides one of the best examples in Scotland of a "rock glacier' formed at the foot of a scree slope. This lobate landform developed through the slow deformation of ice that formed within the scree during the cold climatic conditions of the Loch Lomond Stadial (about 11,000–10,000 years ago). The feature is important in demonstrating geomorphological processes during the stadial, and its presence may support the suggestion that permanently frozen ground existed at relatively low altitudes at that time in western Scotland.

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