Eas na Broige Debris Cone, Highland

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Highlights

The deposits in the debris cone at Eas na Broige provide an important geomorphological and sedimentary record of slope and fluvial processes during the Holocene. They show successive phases of debris flow activity and alluvial fan development.

Introduction

The Eas na Broige debris cone is located in Glen Etive at the base of a near-vertical south-facing rock gully (Dalness Chasm) which drains Stob na Broige (956 m). Debris cones are fan-shaped accumulations of poorly sorted debris formed by successive debris flows at the base of steep gullies. Such debris cones have developed extensively at the margins of valley floors in upland Scotland over the past 13 000 years and have formed in response to changes in sediment supply from adjacent gullies and slopes. Collectively, these cones represent an important class of Lateglacial and Holocene land-forms found throughout upland Britain (Statham, 1976; Harvey *et al.,* 1981; Innes, 1983, 1985; Brazier *et al.,* 1988; Brazier and Ballantyne, 1989). The Eas na Broige cone is a particularly good example, and the deposits that comprise it have provided a detailed record of slope and fluvial processes during the Holocene (Brazier *et al.,* 1988).

Description

The local bedrock comprises granite on the lower slopes with rhyolite lavas on the higher ground, the Dalness Chasm having been etched from a porphyritic dyke (Bailey and Maufe, 1916). During the Loch Lomond Stadial, glacier ice extended up to 650 m in upper Glen Etive (Thorp, 1981, 1986). The debris cone is thus Holocene in age.

The Eas na Broige cone comprises two units: an upper debris cone with a concave long profile and mean gradient of 13.7°, and a lower alluvial fan with a mean gradient of 6.2°. Five discrete cone and fan surfaces can be identified within the lower alluvial surfaces, which are inset into the steeper debris cone surfaces. The respective volumes of the debris cone and alluvial fan have been estimated at 170 000 m^3 and 100 m^3; the latter being entirely derived by incision and reworking of the former (Brazier, 1987).

The stratigraphy of much of the cone has been exposed by stream incision, and at two contrasting sites clearly distinguishable debris flow and fluvial sediments have been identified (Figure 2.49). At the apex of the alluvial fan (site 1), a coarse debris flow deposit lies beneath a distinctive and strongly podzolized palaeosol, radiocarbon dated at 550 ± 50 BP (SRR-2882). The overlying sediments comprise poorly sorted alluvial gravels with only a weak soil development. Higher up the debris cone (site 2) a second palaeosol, radiocarbon dated at 4480 ± 300 BP (SRR-2884), separates two debris-flow units. The upper of these units is the continuation of the lower unit at site 1 and it appears to be the final debris flow unit which was deposited on this part of the cone (Brazier *et al.,* 1988). Pollen samples have been collected from site 1 in order to investigate possible vegetational changes associated with the onset of fluvial reworking. An initial cover of *Corylus, Alnus* and *Pinus* before 550 BP was replaced by *Gramineae, Plantago* and *Calluna* after that date. A strong presence of charcoal is also recorded in the unit above the palaeosol.

Interpretation

Three major phases in the development of this fluvially-modified debris cone can be identified. The debris cone initially developed during the first 6000 years of the Holocene, with aggradation ceasing about 4000 BP as a result of exhaustion

of the sediment supply through the Dalness Chasm. A prolonged period of stability then ensued until 550 BP, this being followed by a final phase in which the incision into the debris cone produced the inset alluvial fan. The pollen evidence strongly suggests that fluvial activity was contemporaneous with changes in the vegetation cover caused by human interference. The removal of the tree cover destabilized the cone surface and triggered fluvial incision. This instability has continued until the present day.

This site has a potentially wider significance in that it is representative of the class of fluvially-mod-ified debris cones found throughout the Highlands (Brazier *et al.,* 1988) and other parts of upland Britain (Harvey *et al.,* 1981). Firstly, the initial accumulation of debris flow deposits involved the reworking of sediment deposited during deglacia-tion. This implies that this cone, like many others in upland Britain, is 'paraglacial' in origin (cf. Ryder, 1971; Church and Ryder, 1972); that is, its formation was dependent upon an abundant sediment supply following deglaciation. Once this was exhausted, aggradation on the cone ceased. Secondly, fluvial incision at this site is attributed to recent human disturbance of the vegetation. There are many other fluvially-modified debris cones in the Scottish Highlands and upland Britain where a similar anthropogenic trigger may have initiated the same change in the debris cone process regime (see Statham, 1976; Harvey *et al.,* 1981; Innes, 1983). In this latter respect, the Eas na Broige cone contrasts with those in Glen Feshie, where natural processes are considered to have been responsible for reactivation (Brazier and Ballantyne, 1989).

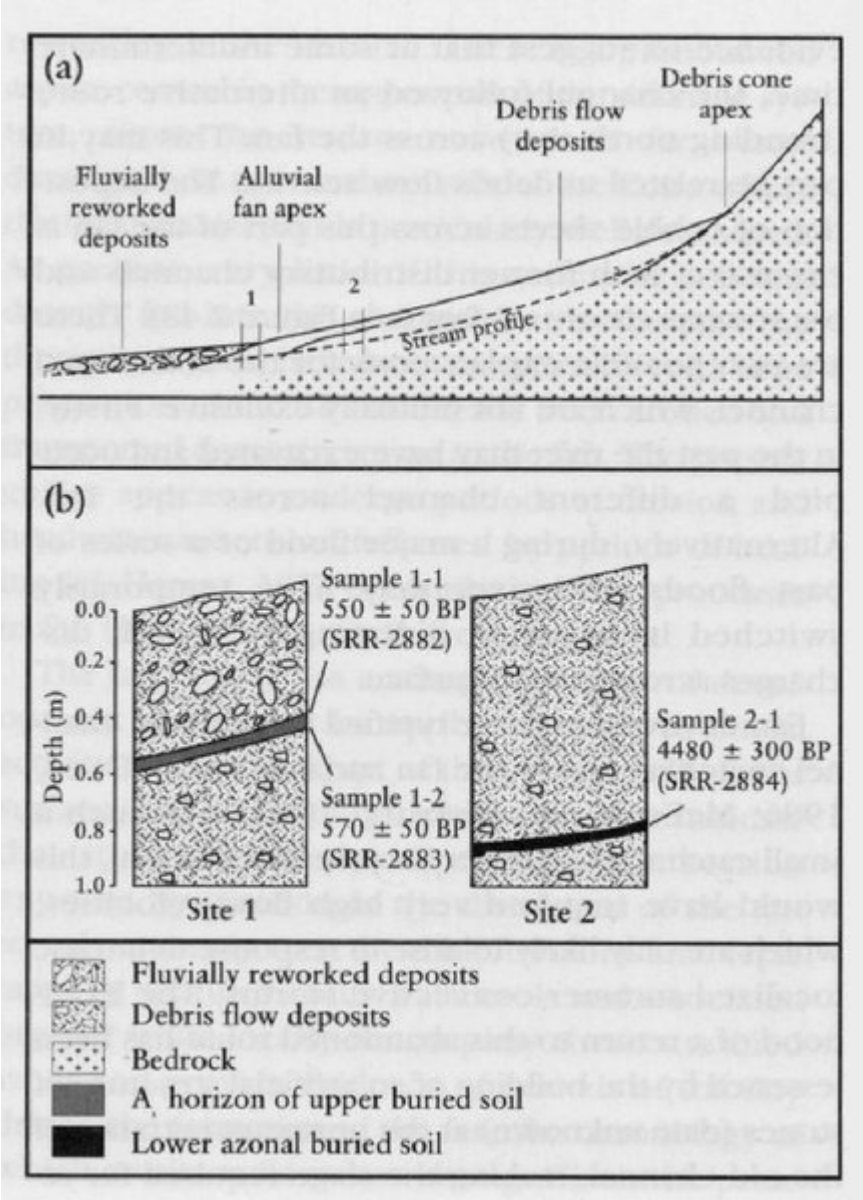
The Eas na Broige cone is a very good example of a Holocene debris cone that has been subject to fluvial modification. Although debris cones are ubiquitous throughout the Scottish Highlands, this site in Glen Etive is unique in that the date and extent of the fluvial reworking of the original cone have been precisely determined.

The Eas na Broige debris cone provides the most detailed record currently available of Holocene sedimentation at the margins of a major valley in Scotland. Following deglaciation at approximately 10 000 BP, the debris cone developed over the next 4000 years. At this time the cone surface became stabilized until about 500 years ago, when fluvial reworking of the basal part of the cone arose in response to the removal of the forest cover by human activity. The cone thus represents a particularly good example of a fluvially-modified debris cone, in which the most recent phase of develop ment has been in response to human settlement on the valley floor.

Conclusion

Eas na Broige debris cone is a fan-shaped accumulation of poorly sorted material (mixed particles of various sizes) formed by flows, from the slopes above, of rock and soil debris mixed with water. It provides an important record of slope and fluvial processes during the Holocene, and is representative of a type of landform and process system that occurs widely in the Highlands. In particular, it shows two phases of development, the first reflecting high sediment supply following deglaciation (ice melting and retreat) and the second the impact of forest clearance by Man. The site is not only a good landform example but has a well-documented history of development.

References



(Figure 2.49) (a) A schematic section along the length of Eas na Broige debris cone. (b) A detail of the section at the sampling sites (after Brazier et al., 1988).