Glen Coe: river and slope forms, Highland

[NN 155 575]

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Highlights

The middle Glen Coe site, in the Western Grampian Highlands, incorporates an exceptional example of a fluvial system, which displays progressive downstream change culminating in a fluvio-lacustrine environment. The slopes are recognized as displaying some of the finest examples of debris cones and fluvially-modified debris cones to be found in Scotland (Ballantyne and Harris, 1994).

Introduction

This composite site in Glen Coe has conservation interest for a number of reasons. The site incorporates three units, namely two areas of exceptional fluvially-derived slope forms (below the Aonach Eagach ridge and the Coire nan Lochan fan) and a good example of an integrated fluvial system in an upland environment. The river is believed to be reworking a former much larger ribbon lake bed (of which Loch Achtriochtan is a remnant) between two rock bars. The underlying bedrock of the lower River Coe is mica schist, but the sediments found on many of the slopes incorporate rhyolites and andesites.

Description

Unit 1: Slope forms below the Aonach Eagach ridge

In terms of slope forms, The Chancellor, the large active debris cone (site 1 in (Figure 2.35)), debouch-ing from the porphyritic dyke-controlled gullies within the andesite below Meall Dearg (951 m), is one of the largest in Scotland, its base being formerly undercut by the River Coe. In terms of evidence of past activity, it is recorded that the settlement of Achtriochtan was swept away by debris flows in the 18th century (Achtriochtan is recorded on William Roy's military survey (1747–55)). The cone surface is mainly unvegetated, indicating regular reworking. Adjacent to this cone are several gullies along the Aonach Eagach Ridge (940–60 m), from which issue fluvially modified debris cones, debris flows and taluses at varying scales.

Unit 2: Coire nan Locban fan

The Coire nan Lochan, draining Aonach Dubh (892 m) and Gearr Aonach (692 m), provides an excellent example of a large, steep fluvially-modified debris cone (site 2 in (Figure 2.35)). This landform possesses an upper fan gradient of 12.7° and a mean gradient of 9.4° and is associated with a high-energy mountain torrent environment (Brazier, 1987). In terms of fan form, the actual fan surface is characterized by very coarse bouldery deposits with poor overall down-fan sorting, which is locally confused by very coarse bar units and lobe-like structures.

Unit 3: River Coe and valley, floor

From its source to the start of the selected site, for most of its length the River Coe is incised into andesite bedrock, locally cutting a deep gorge along the lines of weakness associated with por-phyritic dykes. Below one bedrock control section above Achtriochtan Farm, the river undergoes a reduction in confinement, with the channel changing progressively downstream (see section on fluvial processes in chapter introduction) from a steep mountain torrent with a bouldery bed to a sinuous wandering channel and ultimately to a gravelly delta into Loch Achtriochtan (site 3 in (Figure 2.35)). The history of past and present channel adjustment along this reach has been reconstructed by McEwen (1994b). There are numerous palaeochannels of differing ages, proximal to the present channel.

Interpretation

Unit 1: Slope forms below the Aonach Eagach ridge

The debris cone associated with the Meall Dearg gully is probably the largest of its kind in Scotland. The unvegetated surface of much of the cone also indicates that its surface is presently being reworked and this high rate of activity makes the cone's development particularly interesting. Research on the form and development of the debris flows and fluvially-modified debris cones in Glen Coe has been reported in doctoral theses by Brazier (1987) and Innes (1982). Lichenometric analyses carried out by both authors indicate that substantial areas on these debris cones are extremely recent in origin. For example, Innes (1983) provides evidence for an increase in debris flow activity triggered by land-use changes since 1880. Comparisons can be made with research on the cones in Glen Etive, a neighbouring valley such as the Eas na Broige fan, a fluvially modified debris cone, below Dalness Chasm where a long period of relative stability ended abruptly at *c.* 550 BP, triggered by human interference (Brazier *et al.,* 1988). Ballantyne (1991b), in his review of Holocene geomorphic activity in the Scottish Highlands, confirms the importance of this site.

Unit 2: Coire nan Lochan fan

The fan is particularly interesting in that it is much steeper than most fans of purely fluvial origin in Scotland (Brazier, 1987) and the fan surface shows great variety in terms of its local relief. However, classic debris flow structures, such as levees, pressure ridges and near vertical sheared elongate clasts, are all lacking. Debris flow episodes may have been important in the past, but the deposits have since been reworked by fluvial activity (cf. Wells and Harvey, 1987).

The impact of powerful flash floods from Coire nan Lochan has clearly been very significant in that lichenometry demonstrates that a large proportion of the fan surface has been reworked over the past 200 years. There is also evidence of several abandoned channels on the fan surface, although it is the area proximal to the present main channel that has been most recently active (Brazier, 1987). Additional investigation could further elucidate the complex formative history of this noteworthy fan.

Site 3: River Coe and valley floor

The transition from a mountain torrent to a deltaic, fluvio-lacustrine environment within a distance of only 1.5 km is unusual, especially when accompanied by progressive changes in the controls on channel morphology (slope, sediment size, confinement and associated stream power). In this instance, both the D_{50} and unit stream powers are reduced from 980–<540 mm and 564–35 Wm^{-2}, respectively between Achtriochtan Farm and Loch Achtriochtan (McEwen, 1994b).

Abundant evidence suggests that this is a high-energy, fluvial environment in which high and powerful discharges are the important landforming agents (McEwen, 1994b). This evidence includes the burial of formerly vegetated bar surfaces by coarse debris and the rapid undercutting of fluvially-modified debris cones on the north-facing slopes of Aonach Dubh. In addition, there is complex interbedding of coarse and fine sediments within the incised banks and well preserved, deep scour pools and flood relief channels formed during high flows. As well as the flushing of sediment from glacigenic sources and coarse tributary inputs upstream, the sediments reworked from these undercut fan aprons and the locally eroded flood-plain are also incorporated into the sediment transport system. Progressing downstream, it is noticeable that zones of high lateral channel activity are interspersed with areas near the river which have been allowed to stabilize, thus indicating considerable spatial variation in the local rates of floodplain reworking.

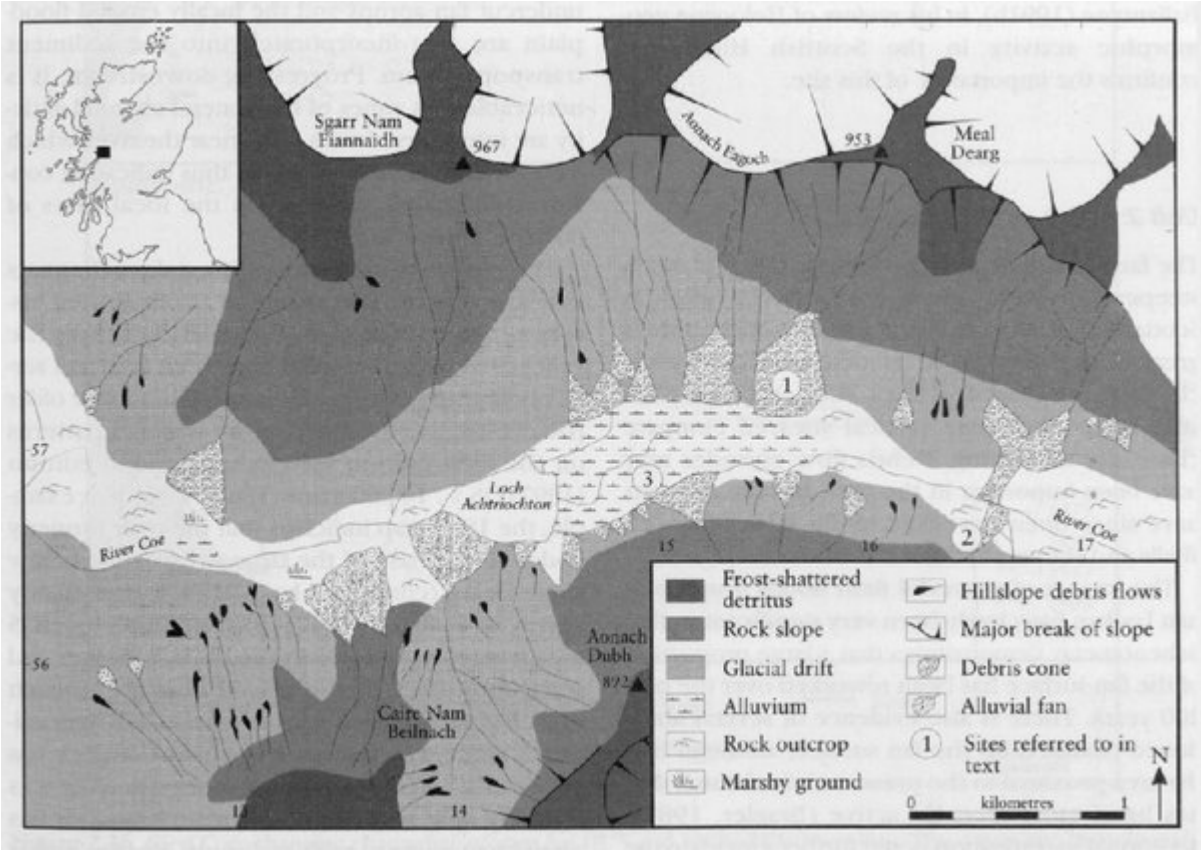
The presence of sander type palaeochannels indicates that the River Coe has a complicated history of past braiding and wandering across the valley floor, clearly evident from both field and aerial photograph evidence. It is possible to date older palaeochannels by studying the channel patterns on the First edition (1875) and Second edition (1897) OS 1 : 10 560 maps (Figure 2.36). For example, the 1875 map indicates that the river formerly undercut the base of the large debris cone below Meall Dearg (confirmed by William Roy's Military Survey of Scotland (1747–55)) although by 1875 the channel was only occupied by slackwater and some subsurface flow received from the Aonach Eagach gullies. It is difficult to assess from map evidence alone whether a major channel switch has previously taken place or whether the river was formerly split and one of the main branches has since been plugged with sediment; clearly further investigation

is required. Older palaeochannels are intermixed with more recently abandoned channels, which can be dated as less than 30 years old. Thus, aerial photographs dated 1947 indicate that the river ran along a different course from its present one at the entrance to Loch Achtriochtan. At least two channel switches have occurred within the delta in the past 150 years, probably triggered by a major flood or series of floods (McEwen, 1994b). Coring of the floodplain and associated palaeochannels would enable more detailed reconstruction as to the periodicity of floodplain reworking over a historical timespan.

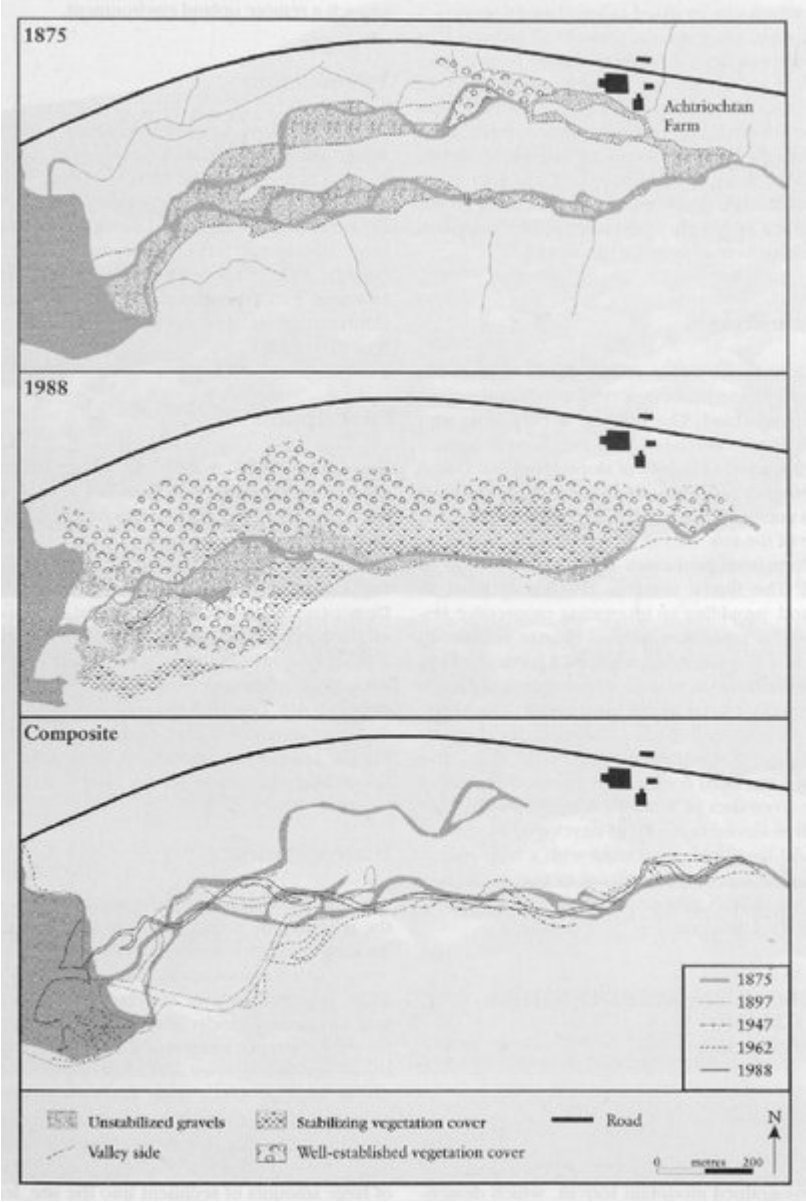
Conclusion

The slope forms within middle Glen Coe span the range of slope processes typically found across upland Scotland. The taluses, debris flows and debris cones associated with the Aonach Eagach ridge are good examples of slope forms associated with steeper gradients, while the fluvially-modified debris cone of Coire nan Lochan is noteworthy as it is one of the few sites at which the sedimentology and formative processes have been studied in detail. The fluvial reach is also exceptional in Scotland, providing an interesting progressive system with a rapid downstream change in channel form. It is also a good example of a particular kind of upland fluvio-lacustrine environment, which is in marked contrast to the low-energy delta of the River Balvag with Loch Lubnaig in the Central Highlands. It should also be noted that little research has been done to date on the dynamics of active river sites in Western Scottish basins. This excellent assemblage of well-developed fluvial and colluvial landforms associated with a high-energy environment is also significant in that it displays evidence of high past and present rates of activity during the Holocene.

References



(Figure 2.35) A geomorphological map of Glen Coe: slope forms below the Aonach Eagach ridge, including the Chancellor debris cone (1), the Coire nan Lochan fan (2), and the, River Coe valley floor (3). (After Brazier, 1987.)



(Figure 2.36) Glen Coe: changing channel planforms for 1875 and 1988 of the River Coe. The composite diagram indicates the location of the main channel at different dates between 1875 and 1988. (After McEwen, 1994b.)