Druim Shionnach, Highland

[NH 070 090]

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Introduction

Druim Shionnach is the type example of the 'Cluanie-hybrid' mode of rock slope failure identified by Jarman (2003b) and associated with steeply inclined and highly indurated metasediments in the Cluanie–Glen Shiel area and elsewhere. It has the essential characteristics of the compressional semi-intact slope deformation, with no signs of disintegration or debris mass, but it also has the pronounced headscarp and extensional spreading features found in translational slides. Such transitional character is valuable in understanding the mechanics of rock slope failure initiation and development. This failure also shows unusually clear-cut geological controls, and has produced a remarkably steep, smooth slope bulge (Figure 2.29), (Figure 2.30), (Figure 2.31).

The ridge on the south side of the Cluanie–Glen Shiel breach valley is notable for its succession of compound corries. Most of these have rock slope failures on their flanks (Figure 2.28), but not on their headwalls (as at Ben Hee); generally these failures are of Cluanie-hybrid type. The role of failure in lateral enlargement of corries is evident at Druim Shionnach, and westwards along the ridge the process has progressed further, with interfluves first being narrowed to arêtes and then reduced to rounded rumps.

Description

The failure is located on the west side of the north shoulder of Druim Shionnach, a 987 m-high peak above the head of Loch Cluanie (Figure 2.32). Its rockwall headscarp is 25 m high in the centre, quickly reducing to 10 m on either side. It confronts an impressive 'antiscarp' across a broad (50 m) trench within which lies a smooth linear island with subsidiary antiscarp. The main 'anti-scarp' reaches 14 m in height, and is steep grass with a bedrock rim (Figure 2.30). This considerably exceeds the normal height range for anti-scarps, which are generally below 5 m, and even on Beinn Fhada only locally approach 10 m.

Behind the 'antiscarp' the open valley-side descends from 850 m to 700 m OD in a series of smooth slope facets and broad benches. These are level or slightly in-dipping, and incidented with abundant minor ruckles, fissures, and anti-scarplets less than 2 m high (Figure 2.29). Only towards the north-east end does one of these contour-parallel lineaments open out into a smooth broad trench with 3 m outer antiscarp. These features fade out onto the open north shoulder, but can be traced slightly beyond its brow. Below 700 m OD, the main valley-side steepens to an angle of approximately 45° down to a springline at 500–550 m OD (Figure 2.30). This is exceptionally steep for a slope developed in foliated bedrock with no exposed crags, and is above the the typical peak friction angle for sliding (Watters, 1972). The northern extent of this over-steepened slope is diffuse.

By contrast, the southern flank of the failure is abruptly truncated by a broken slope about 100 m high which faces the compound head of Coire an t-Slugain (Figure 2.29). It is most unusual for almost the whole of a failure from headscarp to toe to be revealed in deep cross-section in this way. Some minor antiscarps and blockfalls have developed along it, but it is generally intact. Interestingly, the upper part displays block-flexural toppling, which has been widely identified as a mode of rock slope failure (Zischinsky, 1966; de Freitas and Watters, 1973; Holmes, 1984; Hutchinson, 1988), but is here only a few metres deep, and merely a process of superficial creep within an already failed mass (Figure 2.29) (inset) and (Figure 2.32).

The total area affected by rock slope failure is given as 0.33 km^2 by Holmes (1984). The 1:50 000 geological map indicates an extent of approximately 0.4 km^2, and including in-situ deformation of the north shoulder the area may reach 0.55 km^2. The failure has formed within massive gneissose psammites of the Glenfinnan Group. These

Neoproterozoic-age rocks have been deformed by several orogenic events and metamorphosed to a high grade. Here they are tightly folded, steeply dipping and strongly indurated. The bedding and main foliation strike NNE, and dips range about the vertical from 75° eastwards and westwards (May *et al.,* 1993). Locally, pelite bands create micaceous planer surfaces that are more prone to parting.

Interpretation

Geological control is strongly evident at Druim Shionnach, as in other 'Cluanie-hybrid' type rock slope failures. Here, the headscarp is coincident with the strike of the foliation, which is sub-vertical at the crest and dips 80° glenwards near the toe. Although no geotechnical analysis has been conducted, it may be inferred from the steep, intact bulge and in particular its lack of lateral restraint that joint-sets inclined valley-wards at angles conducive to sliding are not present; the main structural controls here are orientated north-west–south-east.

The major feature at Druim Shionnach is therefore interpreted as a kind of 'graben' (Jarman, 2003b), where the failed mass has moved outwards in response to decompression. The 'anti-scarp' is thus not a typical adjustment feature within a deforming mass, as at Beinn Fhada, but the face of an unusually broad tension trench, hence its exceptional height. A comparable case occurs on the Arrochar Ben Vorlich above Loch Sloy [NN 29 11]. The subsidiary feature within the 'graben' has probably not literally subsided as in a rift valley, but reflects the stepping or doubling of the trench.

Within the failed mass, a progression can be seen from tensional features in the upper half to compression in the bulge. There is no evidence of downslope sliding movement, unless the toe has been glacially trimmed, and the scale of displacement evident in the source zone has presumably been accommodated by internal deformation and creep. A schematic cross-section (Figure 2.30) suggests that such deformation may be at least 100 m deep, consistent with the assumptions of Holmes (1984) and Fenton (1991).

A peculiarity of Druim Shionnach is its discordance with the pre-failure topography. Not only do the tension features transgress onto the north shoulder, they also continue southwest across the mouth of a smooth open bowl that contrasts markedly with the typical scalloped compound corrie head. The steep south-west flank to the rock slope failure might suggest that a late (Loch Lomond Stadial?) corrie glacier has quarried the edge of a formerly more extensive failure (Jarman, 2003b), but this is seen as glaciologically less likely. The glacial/ paraglacial evolution of Coire an t-Slugain is complex, and the timing and contribution of rock slope failure to corrie development may fruitfully be explored here.

Wider landscape evolution

The south Cluanie ridge affords an instructive overview of rock slope failure as an agent of mountain landscape evolution (Figure 2.28). This is one of the longest high-level ridges in Scotland, continuously above 700 m for 15 km. The main ridge has become asymmetrical as a result of glacial trough–corrie development exploiting the strike of the schists, with its centre-line offset by up to 2 km to the south from an original median between Glen Quoich and Glen Shiel, and by up to 500 m between the extant summits, which typically lie off the main ridge out on the projecting spurs. However, failure has probably contributed less to this headward corrie erosion (by contrast with Ben Hee) than to their lateral expansion. All the extant failures are on the corrie flanks, or in their headwall angles, and display Cluanie-hybrid character, notably north-west of Aonach air Chrith. Those north-east of Sgurr Beag and Sgurr an Doire Leathain have shaped the spur crests into arêtes, the latter having progressed into a large sliding slump. Rock slope failure has therefore contributed to corrie amalgamation, creating the compound corries typical of the Moine Supergroup (Gordon, 1977), and to the reduction of the intervening ridges to a level where they have become subject to glacial scour.

By contrast, there is minimal failure on the long steep south flank of the main ridge above Glen Quoich, implying that that valley has long since adjusted to ice discharge; unlike Glen Shiel its head has not become breached.

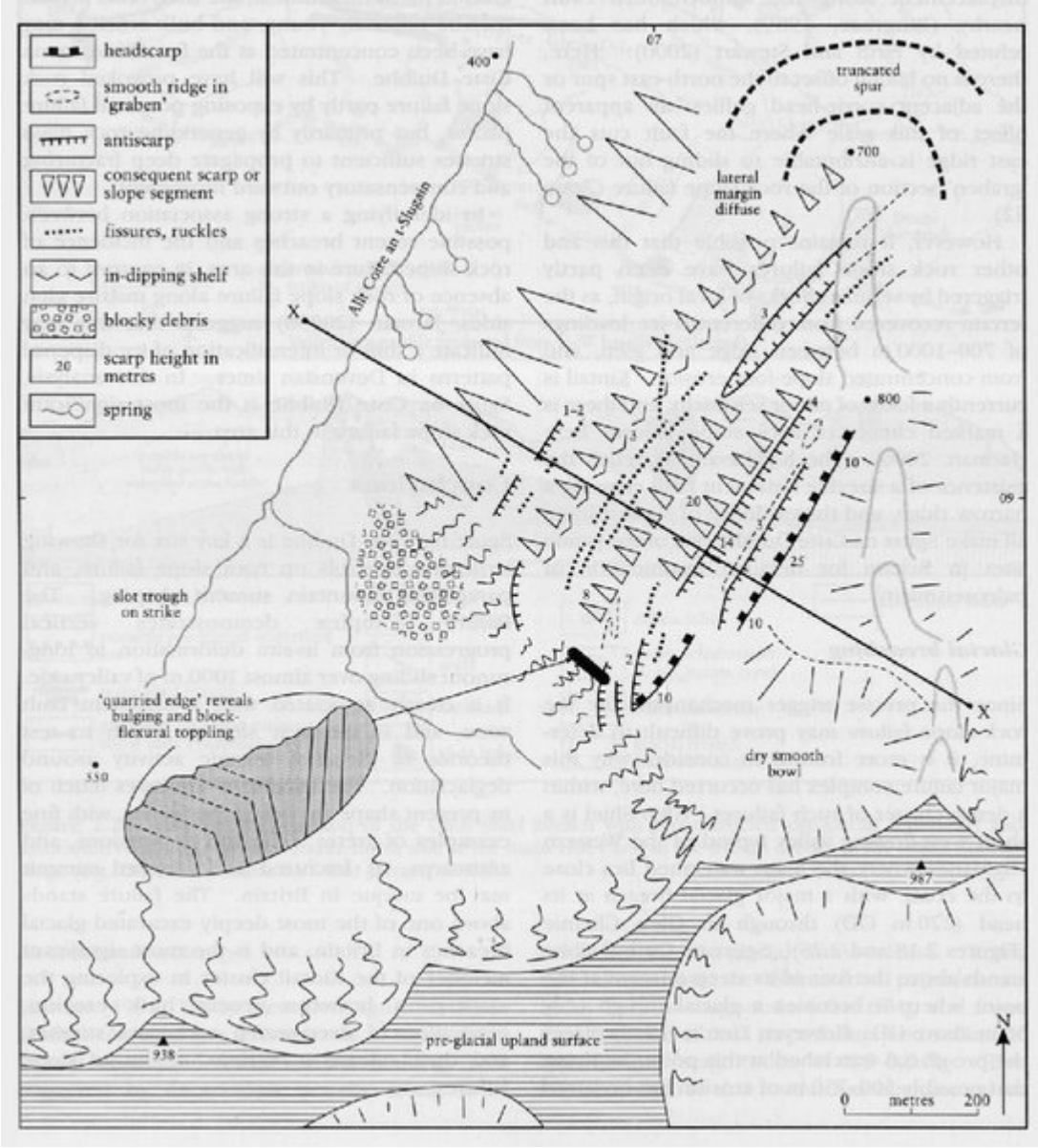
Other nearby examples of the Cluanie-hybrid type rock slope failure type occur in similar geological and topographical contexts on the northern arêtes of Sgurr a' Bhealaich Dheirg, while on its south-west flank a notable failure in the breached valley of Glen Shiel has affinities despite being orthogonal to the strike of the schists. This failure has 7 m antiscarps noted by Fenton (1991) as 'pop-ups' coinciding with the Glen Shiel Fault-swarm. 'Cluanie-hybrid' type

character can also be observed in some of the failures in the Mamores–Grey Corries cluster, again on steeply dipping schists and quartzites.

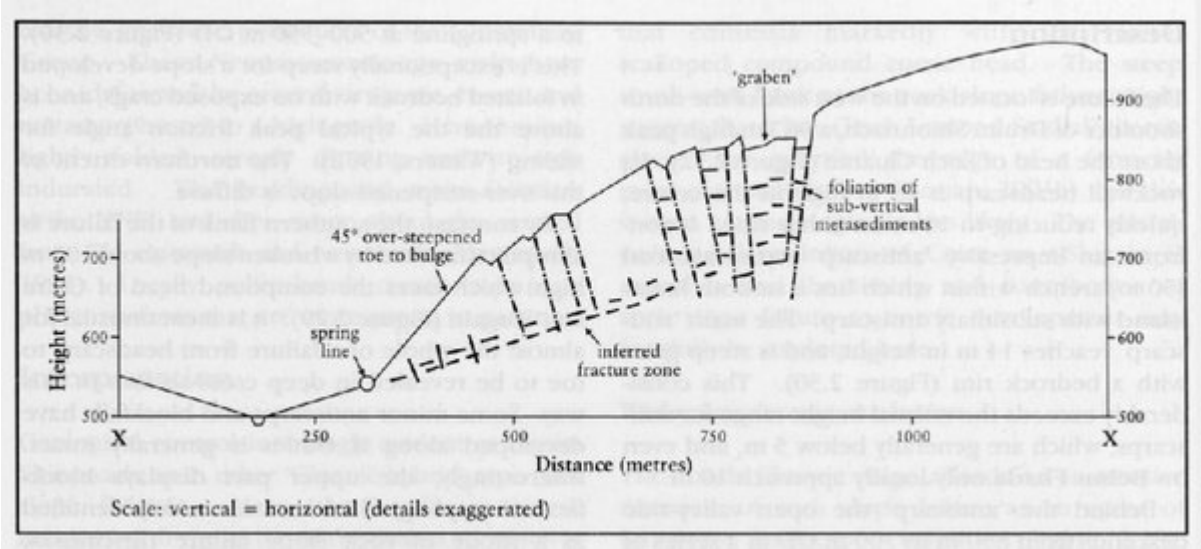
Conclusions

Druim Shionnach is a well-defined rock slope failure that illustrates transitional character between the slope deformation and the sliding mass, with both compressional and extensional elements. It has several exceptional features, notably a 14 m-high 'antiscarp' and graben structure, and a rare exposure in cross-section of block-flexural toppling. While in itself its mountain-shaping role is limited to trough–corrie widening, other rock slope failures of this 'Cluanie-hybrid' type in the vicinity clearly contribute to the evolution of the whole ridge and to arête development on its spurs.

References

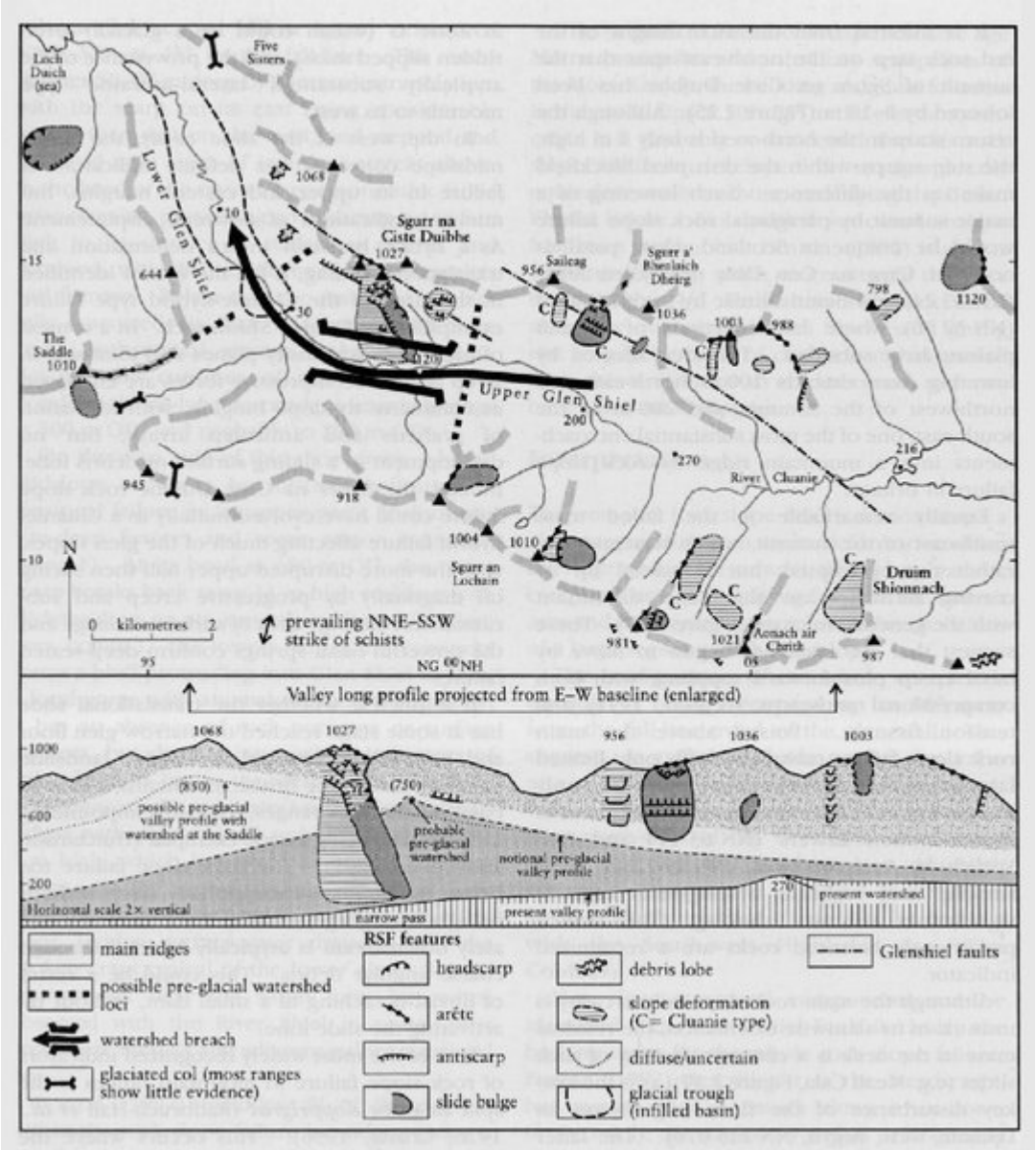


(Figure 2.29) Geomorphological interpretation of the Druim Shionnach rock slope failure based on OS 1:25 000 mapping. After Jarman (2003b).

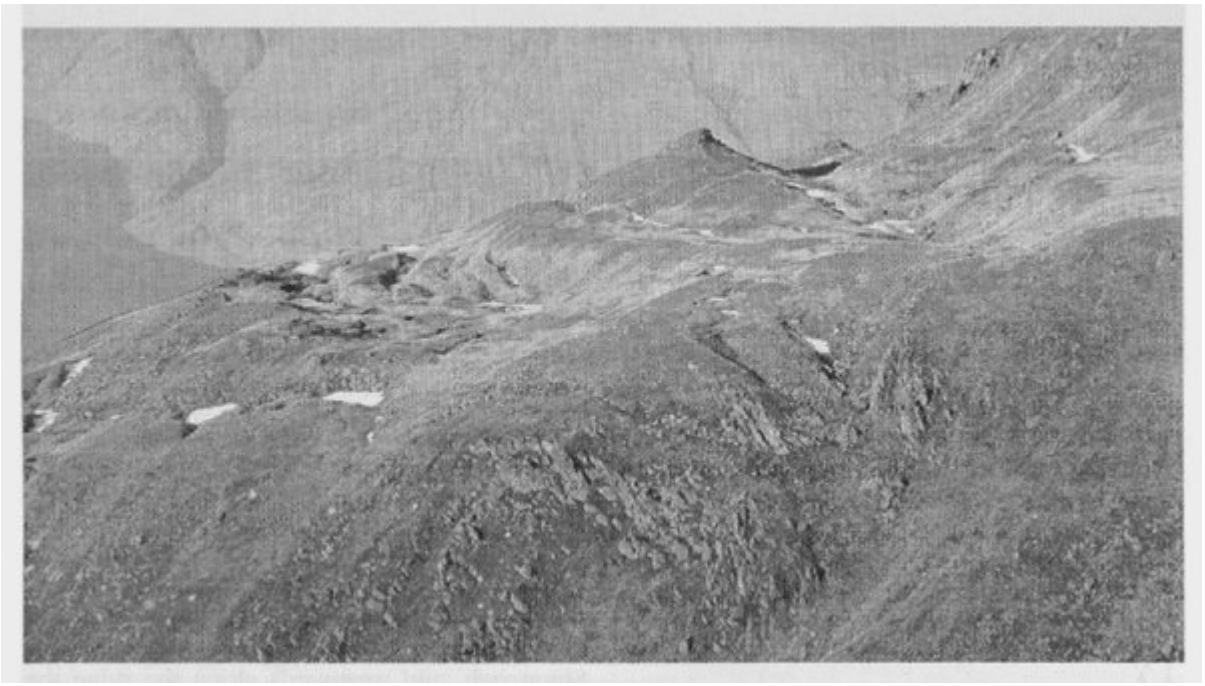


(Figure 2.30) Section X—X on (Figure 2.29), showing over-steepened bulge and graben progressively tilting failed slices away from source. After Jarman (2003b).

(Figure 2.31) The Druim Shionnach rock slope failure is on the flank of a side trough off the main Cluanie preglacial valley. The smooth and bulging failed slope is wider than the apparent source scarp and notably lacks surface drainage and a clear lateral margin. (Photo: D. Jarman.)



(Figure 2.28) Map and long-section of the Glen Shiel breach with reconstructed pre-glacial watershed and associated rock slope failures on the north side of the main valley and in the trough corries of the south Cluanie ridge (e.g. Druim Shionnach). After Jarman (2003b).



(Figure 2.32) The Druim Shionnach rock slope failure top surface, seen in close-up from the summit ridge to the south-west. The prominent peak is the 14 m-high antiscarp facing the source scarp across a half-graben. Note the block-flexural toppling in the near-vertical metasediments, revealed in section in the foreground (see inset, (Figure 2.29)). (Photo: D. Jarman.)