Buachaille Etive Beag

[NN 201 554]

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Introduction

Ignimbrites form distinctive deposits, and record episodes of explosive volcanism and pyroclastic flow generation. They are especially abundant at Glen Coe, and one of the best exposed and most accessible localities is this GCR site. The site consists of the north-eastern summit (Stob nan Cabar — *c.* 800 m) of the NE–SW mountain ridge of Buachaille Etive Beag (Figure 9.14). Here all three of the Glencoe ignimbrites (Group 2) occur together, and consequently the site preserves the complete sequence of events during this cycle of explosive volcanism.

Clough *et al.* (1909) and Bailey (1960) commented on the abundance of fragmental and welded rhyolite units at Stob nan Cabar, and classified them as the uppermost rhyolite members of Group 2. Roberts (1966a) re-examined the Group 2 rhyolites and identified ignimbrites at Stob nan Cabar with an aggregate thickness exceeding 300 m, the maximum thickness achieved by ignimbrites in Glen Coe. He called them the Upper Group 2 ignimbrite horizon, recognized various subdivisions and provided a description of the sequence (Roberts, 1966a, 1974). Following Moore (1995), the ignimbrites at Stob nan Cabar are now termed the Lower, Middle, and Upper Glencoe ignimbrites, and these are overlain by breccias of Group 3 (the Upper Queen's Cairn Breccias).

Description

The lower exposures at the base of Stob nan Cabar are undifferentiated rhyolite and andesite intrusive rocks that underlie the ignimbrites (Roberts, 1974). There are several NE- to NNE-trending dykes (3 cm to 2 m thick) in these lower exposures that show pyroclastic textures, pervasive lamination, and prominent flow structures. As some are very thin (*c.* 3 cm) and others pinch-out, they are probably indigenous to Glen Coe. Although Roberts (1966a) provided a description of the Stob nan Cabar ignimbrite sequence, Moore (1995) has added considerable detail that forms the basis for the following brief description.

1. Lower Glencoe Ignimbrite (*c.* 140 m thick). Oldest unit. Lower *c.* 40 m is a poorly welded, lithic coarse tuff that contains breccia lenses with clasts derived from the Etive rhyolites and quartzites (10–40% of the deposit). Upper *c.* 100 m is a poorly welded lithic coarse tuff grading upwards into a massive strongly welded tuff, with some inclusions of porphyritic andesite displaying ragged margins.
2. Middle Glencoe Ignimbrite (*c.* 20 m thick). Sharp contact with underlying strongly welded tuff. Bulk of deposit is poorly welded lithic coarse tuff containing abundant small fragments derived from the Etive rhyolites.
3. Queen's Cairn Fan (*c.* 10 m thick). Variable sequence of alluvial conglomerates, sandstones and tuffaceous siltstones that infill erosional features cut into the underlying ignimbrites.
4. Lower Queen's Cairn Breccias (*c.* 40 m thick). Angular clasts and blocks of Dalradian metasedimentary rocks (with subordinate andesite).
5. Upper Glencoe Ignimbrite (*c.* 180 m thick). The lower *c.* 80 m is a breccia deposit with a tuffaceous matrix, containing clasts derived mainly from Dalradian metasedimentary rocks. The next *c.* 30 m is a poorly welded lithic tuff, with clasts (Dalradian metasedimentary rocks plus andesite and rhyolite) up to 40 cm diameter, and pumice lapilli (around 10% of the deposit). The next *c.* 60 m is strongly welded lithic-rich tuff (10–20% lithic fragments). Pumice lapilli increase upwards to a maximum of 25%. The final *c.* 10 m comprises poorly welded stratified lithic tuff, with upper beds notably fine grained and well laminated.
6. Upper Queen's Cairn Breccias (*c.* 60 m thick). These are Group 3 rocks, and consist of a sequence of tuffaceous breccias, with clasts derived mainly from Dalradian metasedimentary lithologies (with minor quantities of volcanic clasts).

Interpretation

The *c.* 350 m thickness of ignimbrites at Stob nan Cabar represents the extreme development of the Group 2 Glencoe ignimbrites. Clough *et al.* (1909) mapped the Group 2 rhyolites, and their cross sections (op. cit., plate XXXIII) indicate that they were fully aware of their thickness variations across the volcano. Roberts (1966a, 1974) considered that differential subsidence of the caldera floor in this area had allowed the ignimbrites to pond. Moore (1995) developed this further and demonstrated that collapse had taken place along graben and cross-graben faults, and at the same time showed that caldera subsidence in this area accompanied the eruption of the Upper Glencoe Ignimbrite.

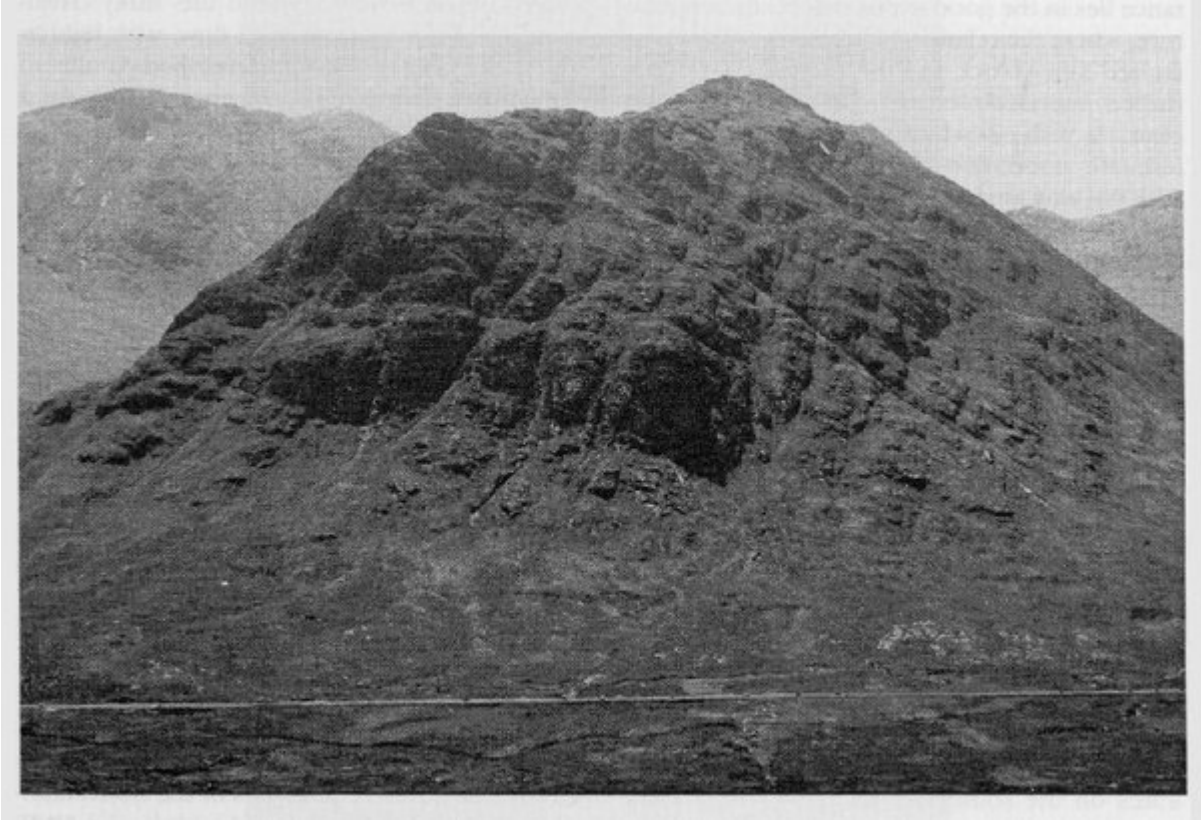
The Glencoe ignimbrites represent the second major cycle of syncaldera rhyolitic volcanism, and the widespread development of pyroclastic flows indicates that activity was generally more explosive than the first cycle (the Etive rhyolites). The following sequence of events was proposed by Moore (1995) and Moore and Kokelaar (1997, 1998). The Lower Glencoe Ignimbrite was produced by a single pyroclastic flow, which was followed by the much smaller Middle Glencoe Ignimbrite (also produced by a single pyroclastic flow). Post-eruption subsidence, a period of quiescence, alluvial fan development, and fluvial activity generated the sedimentary deposits of the Queen's Cairn Fan. The eruption of the Upper Glencoe Ignimbrite was preceded by large-scale foundering of the caldera floor and fault-scarp collapse, producing the Lower Queen's Cairn Breccias. The Upper Glencoe Ignimbrite was produced from a single pyroclastic flow, and grades upwards from a breccia-dominated lower zone through to a poorly welded lithic coarse tuff, which is strongly welded in its upper parts. The upper *c.* 10 m of fine-grained and laminated tuff may represent ash-fall tephra deposited after pyroclastic flow activity had ceased.

Based on relationships at this GCR site, Moore was able to discern a pattern in the lateral thickness variations of the three ignimbrites, and to demonstrate that topographical control on their spatial distribution was exerted by a long-standing, re-activated graben and cross-graben fault system. He also noted that the vents for these ignimbrites must have been nearby. Consequently, the unifying model of Roberts (1974), which invoked the Group 2 ignimbrites having been vented at the ring fracture, must now be discarded.

Conclusions

At Stob nan Cabar there is an unusual thickness of rhyolitic ignimbrite, a rock type formed during the eruption of evolved magma when pyroclastic (hot, fragmental) flows are generated during explosive volcanic activity. The ignimbrites exposed here reach nearly 350 m in thickness, and within this total thickness three separate units are present, representing three separate phases of pyroclastic flow generation during one major eruptive cycle (the second cycle of rhyolitic eruptions responsible for Group 2 of the Glencoe volcanic succession). Ignimbrites infill depressions and hollows, and their extreme thickness in this area indicates substantial localized graben-controlled subsidence of the caldera floor accompanying the eruptions. The pres ence of sedimentary rocks intercalated between the second and third ignimbrites indicates a period of quiescence between eruptions.

References



(Figure 9.14) Buachaille Etive Beag, Glen Coe from the NE, looking towards Stob nan Cabar from Stob Mhic Mhartuin. (Photo: D.W. McGarvie.)