East Canna and Sanday

Highlights

The inter-lava fluvial sediments and pyroclastics exposed here are the best developed in the British Tertiary Volcanic Province, providing an essential link in a chain of sites in the study of the Tertiary volcanic history of the region. Derived clasts suggest that the Rum Complex is appreciably older than the Skye Cuillin centre.

Introduction

Agglomerates, fluvial conglomerates and other sediments closely associated with the volcanic succession of Canna, occur within this site and are the best developed and most extensive examples within the BTVP. These formations were the first such deposits within the Province to be described in detail. Geikie (1897) concluded that the conglomerates had filled a river channel cut into the lavas. The islands were later mapped by Harker (1908) who accepted the fluvial origin. Allwright (1980) has more recently interpreted coarse conglomerates on Compass Hill in terms of a nearby source of coarse pyroclastic debris which was possibly connected with a volcano which fed some of the lava flows.

Description

The spectacular sea cliffs, stacks and intertidal areas of south-eastern Sanday, Eilean a'Bhaird and eastern Canna contain good exposures of the interlava clastic sediments. In and near to the stacks of Dùn Mòr ([NG 2877 0374]; (Figure 3.19)) and Dùn Beag ([NG 2888 0375]; (Figure 3.20)), conglomerates occur beneath a thick, columnar basalt lava. On Dùn Mòr and in the adjacent cliffs, the conglomerates locally exceed 2 m in thickness and appear to blanket underlying vesicular basalts. On Dùn Beag, on the other hand, the conglomerates reach 15 m in thickness overlying amygdaloidal lavas and abutting directly against them. This important exposure was interpreted by Geikie as the wall of a river channel or gorge, against which the deposits were banked. The conglomerates of Dùn Mòr pass laterally into finer-grained tuffs and shales, the transition being accompanied by a marked reduction in overall thickness. Identical sediments and overlying lavas can be traced for some distance westwards along the cliffs of southern Sanday. The sediments are heterogeneous and comprise crudely bedded conglomerates (often exceptionally coarse, with boulders over a metre in diameter), thin-bedded, green/pink ashy shales, sandstones and tuffaceous mudstones. Carbonaceous streaks and organic remains have been reported by Geikie (1897) and Harker (1908). The clasts include Torridonian arkoses, Tertiary lavas, various types of schist, gneiss and granophyre, the last of these probably derived from the Rum western granite (Emeleus, 1973). The columnar basalt which overlies the sediments has a markedly chilled base; the occurrence of lobate structures with radial fractures and diffuse vesicles arranged concentrically, strongly suggests that the lava had flowed into and along channels occupied by waterlogged sediments. The sediments, lavas and conglomerates of south-east Sanday lie towards the base of the exposed volcanic succession (Harker, 1908; Stewart, 1965; Allwright, 1980).

The impressive hundred-metre-high cliffs and the coastal sections below Compass Hill [NG 280 063] in eastern Canna expose intercalations of basaltic lavas and pyroclastic rocks and the thickest development of predominantly waterlaid sediments on the island (Figure 3.21). These comprise conglomerates and sandstones derived largely from the erosion and transport of contemporaneous pyroclastic material. The sediments have been interpreted as deposits formed in fluvial and perhaps marginal lacustrine environments (Geikie, 1897; Harker, 1908; Allwright, 1980). Compass Hill is significant in that it shows the intimate relationships between lavas, conglomerates and agglomerates. Lithologically, the conglomerates are similar to those on Dùn Mòr, no doubt owing to their closer proximity to agglomerates, and contain a higher percentage of basic igneous pebbles, whilst granophyre and gneiss pebbles are rare. Porphyritic felsite pebbles, similar to the Rum felsites, have been found here.

The sea stacks of Alman [NG 2805 0545] and Coroghon Mor [NG 2797 0554] expose confused masses of pebble conglomerates in basaltic lavas; the lavas have tended to nose their way into the sediments which must have been

unconsolidated. No vent has been identified on Canna but the coarseness of the reworked conglomerates and 'agglomerates' suggest that one was nearby, possibly only a short distance offshore to the east, as indicated by the westwards thinning of the deposits. Large blocks of Torridonian arkose occur in the 'agglomerates' on the shore to the north-east of Compass Hill which indicates that the basal lavas may rest directly on Torridonian sediments.

Eilean a' Bhaird [NG 270 050] is a small island rising above the tidal flats of Canna Harbour. It contains the most evolved lava on Canna, a very fine-grained flow which is chemically of tholeiitic andesite rather than mugearite (Muir and Tilley, 1961; Ridley, 1973). The flow overlies a substantial thickness of very coarse conglomerates. They are identical to the others on Canna and appear to infill a small channel (Figure 3.22) and (Figure 3.23); Allwright, 1980).

Interpretation

The value of the Canna–Sanday site lies in the evidence that it provides for the development of extensive, vigorous river systems during the period of Palaeocene lava accumulation. Geikie (1897) placed particular emphasis on the palaeogeographical implications of the clasts in the fluviatile sediments; the occurrence of gneisses, schists and Torridonian clasts indicates erosion in the Palaeocene of a landmass containing lithol-ogies similar to present-day western Scotland. The abundance of Torridonian fragments in the pyroclastic-derived deposits of Compass Hill might alternatively indicate a Torridonian basement to the Tertiary lavas, although it is surprising that no Mesozoic sedimentary fragments have been recognized, since Canna overlies a Mesozoic basin (Binns *et al.,* 1974). The position of the Eilean a'Bhaird flow within the Canna sequence is problematic. Allwright argues that it must be fairly low in the stratigraphic succession of lavas; however, it could be one of the latest lavas in the area, since it overlies conglomerates filling a valley eroded in lavas and no examples of a lava of similar composition are known to be overlain by other lavas on Canna or Sanday.

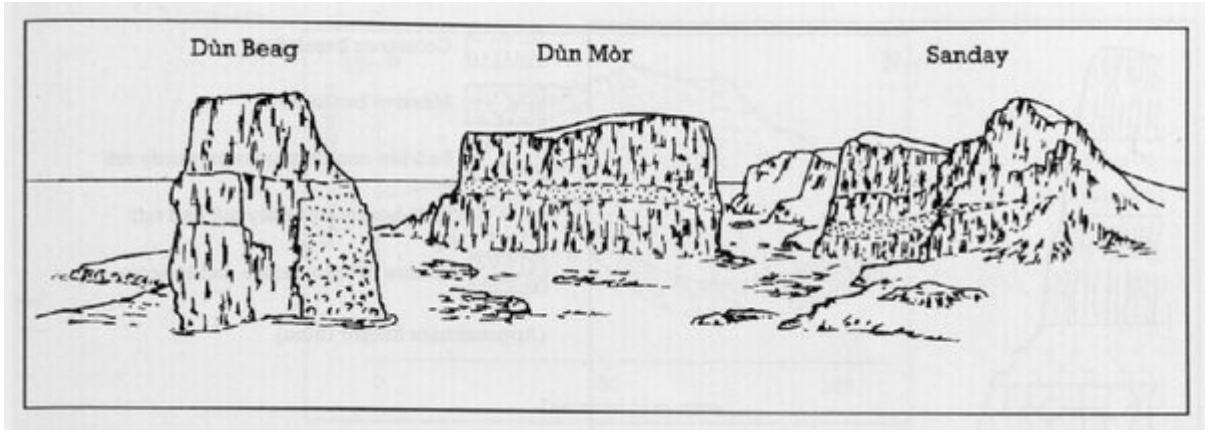
The similarity between some of the Canna–Sanday lavas and those of north-west Rum (Emeleus, 1985), and the occurrence of clasts apparently derived from the acid rocks in the Rum complex, establishes a close connection with Rum. The site is a vital link in the chain of sites from Muck and Eigg, through Rum, to southwest Skye and Ardnamurchan which enables continuous, relative dating of igneous rocks across the British Tertiary Volcanic Province to be attempted, thus aiding assessment of the evolution of the Province (Meighan *et al.,* 1981; Dagley and Mussett, 1986).

Conclusions

The intra-lava sediments in the volcanic succession of east Canna and Sanday provide unequivocal evidence that a river system draining areas of gneiss, schist and probably Torridonian sediments, was established during periods when active effusion of basaltic and intermediate lavas was occurring. The rivers also drained Rum and probably extended to Skye, the distinctive pebbles laid down in the associated fluviatile deposits make it possible to conclude that the Skye Cuillin Central Complex almost certainly post-dated the Rum Central Complex.

References

(Figure 3.19) Stack of Dùn Mòr, Sanday, formed of basalt lavas with interbedded coarse conglomerates. The conglomerates contain rare granite pebbles from the Rum Central Complex. Canna—Sanday vicinity. (Photo: A.P. McKirdy.)



(Figure 3.20) Sketch of Dùn Beag, Dùn Mòr and the cliffs of Sanday (after Harker, 1908, figure 12). Columnar basalt flows with interbedded conglomerate are seen on Dun Mar and the cliffs of Sanday. On Dùn Beag, lavas fill a steep-sided valley eroded in conglomerate.

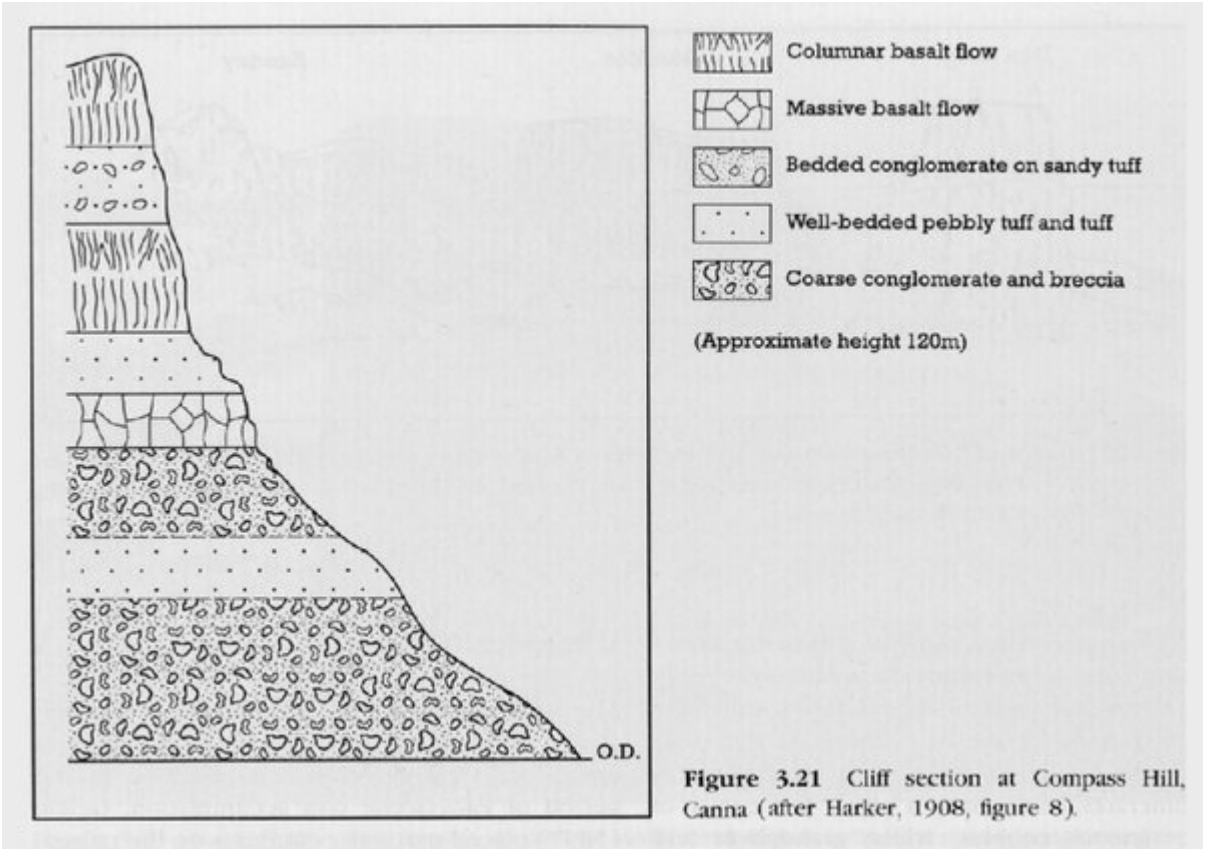


Figure 3.21 Cliff section at Compass Hill, Canna (after Harker, 1908, figure 8).

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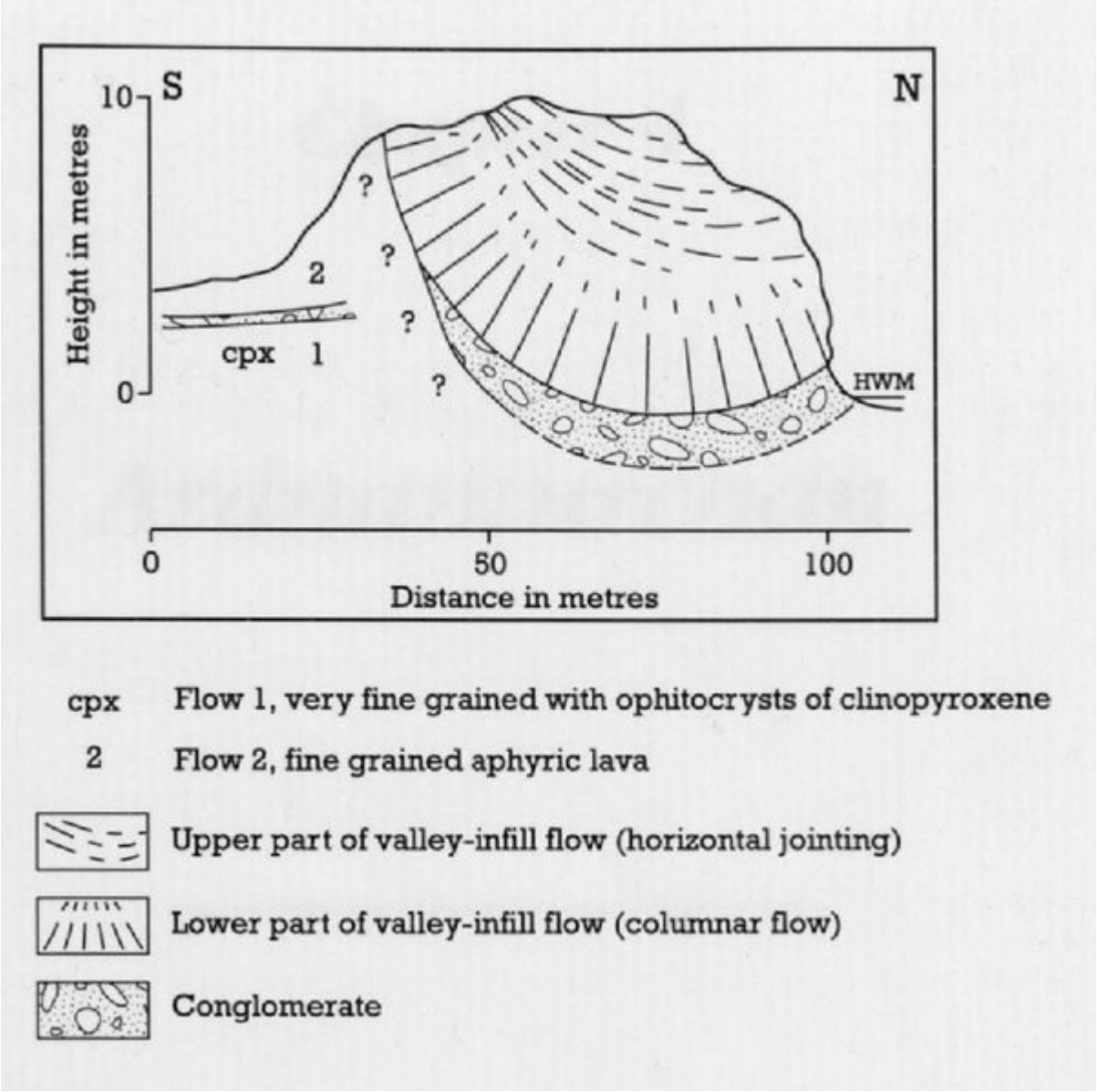
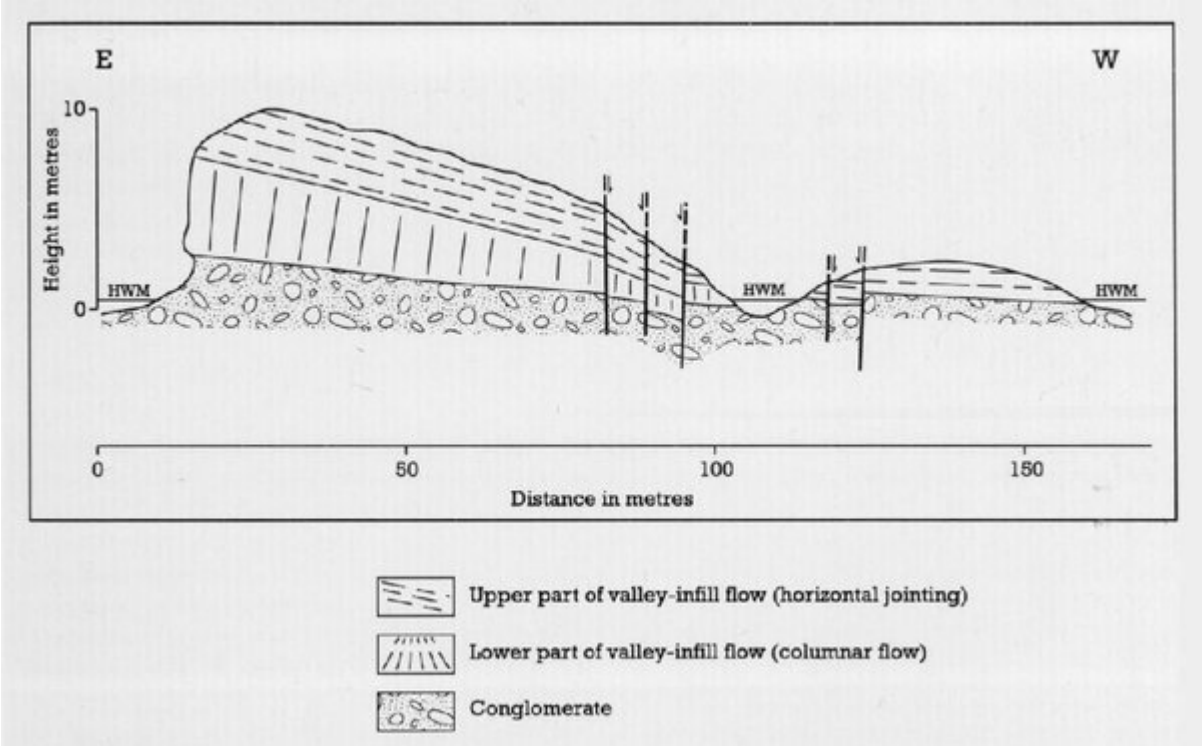


(Figure 3.22) Canna Harbour: Eilean a' Bhaird from the east (after Allwright, 1980, figure 2.4.13).



(Figure 3.23) Canna Harbour: Eilean a' Bhaird from the north (after Allwright, 1980, figure 2.4.14).