Fracturing and faulting - St. Kilda: an illustrated account of the geology

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From: Harding, R.R. and Nancarrow, P.H.A. 1984. St. Kilda: an illustrated account of the geology. BGS Report Vol. 16, No. 7. Keyworth: British Geological Survey.].

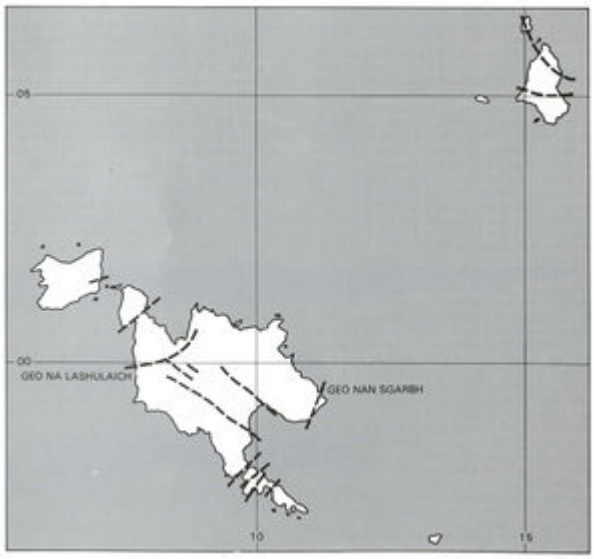

Figure 36 Major faults affecting the St Kilda igneous complex

Figure 37A Kink in the Abhainn a Ghlinne Mhoir where the stream follows a NW-trending fault

Figure 37B Fractured rocks of the Mullach Sgar Complex in the central part of the quarry below Mullach Geal

Chapter 20 Fracturing and faulting

Keywords: fracturing and faulting sequence, topographic expression, mineral coating

This section is concerned with the brittle failure of consolidated rocks in the St Kilda igneous

complex. Localised failure, commonly confined to a specific intrusion, is referred to as fracturing or brecciation, whereas more extensive failure usually affecting more than one intrusion, is treated as faulting. Auto-brecciation, the result of preconsolidational magmatic processes, is dealt with in preceding sections.

The earliest evidence of fracturing occurs in the Western Gabbro where under high confining pressures, hot, solid gabbro failed along discrete shears and resulted in high temperature recrystallisation of the mafic mineral assemblage (p. 15). This early event appears to have been the precursor to a more intensive episode of fracturing and disintegration of parts of the Western Gabbro which was accompanied by the intrusion of basaltic magma. The resulting igneous breccia EK almost certainly represents the root zone of a large basaltic volcano, parts of which have suffered collapse and further disintegration during a subsequent episode of basaltic magmatism.

In the area of Village Bay several outcrops of the Mullach Sgar Complex display brittle structures which clearly post-date auto-brecciation associated with the intrusion of the complex. Such structures are well displayed in the quarry below Mullach Geal, where the earliest are steep, eastward-dipping fractures trending 356°, with slickensides indicating movement towards the NNE at shallow plunges. These fractures are best developed at the northern and southern extremities of the quarry face and are also found farther east in the Abhainn Mhor where they appear to control the course of the stream above 140 m and also below 60 m. The more highly fractured central part of the quarry lies at the intersection of a number of differently orientated mineralised surfaces all of which post-date the north-trending fractures. Intermediate dips to the north-east and south-west characterise the earliest of the mineralised fractures, which carry alkali feldspar, calcite, prehnite, epidote, apophyllite and chabazite and a slickensided blue-green coating of chlorite and amphibole. They are cut by fractures carrying a similar mineral suite which trend east–west and dip steeply to the north; slickensides indicate movement on these planes to the north-east at intermediate plunges. The latest mineralised surfaces are less numerous than earlier ones and may be heavily coated with blue-green slickensided material, while carrying less of the whitish minerals noted above. These fractures trend NE–SW and dip steeply south-east; easterly movement at intermediate plunges is indicated by slickensides. A considerable concentration of fractures also occurs in outcrops of the Mullach Sgar Complex, west of the boulder beach in Village Bay. The earliest of these are generally north and NNW-trending surfaces with variable dips north-east and south-west, carrying pale-green to whitish mineral coatings of similar composition to those found in the quarry. A few early east–west trending, northward-dipping slickensided surfaces are also seen and have an orientation similar to fractures occurring in the Abhainn Ruaival; their relationship with the north or NNW-trending fractures is not clear. Steep or vertical, NE-trending slickensided planes appear to represent the latest episode of fracturing. Slickensides on these surfaces plunge north-east at intermediate angles, as indeed do slickensides on the other fracture surfaces.

Several structures are seen in exposures of the Conachair Granite in the cliffs and tidal rock shelves which extend south-eastwards from the jetty in Village Bay. On the rock shelves a conspicuous reddened fault plane trending at 300° and dipping 75° north-east can be followed for about 150 m up to the jetty, cutting an earlier fault trending at 330° and dipping 60° north-east. The younger fault extends into a zone of shattered Mullach Sgar Complex forming the course of the Abhainn Mhor between 60 m and 140 m. Similar 300°-trending faults coated with orthoclase and quartz are exposed in the cliffs surrounding the cave at the south-east end of the shelves, where they in turn are cut by vertical planes trending at 220° which are also mineralised with felsitic material. Post-mineralisation slickensides on the later set of fractures suggests that the most recent movement was mainly vertical with a small north-easterly horizontal component. Vertical slickensided planes with a similar orientation (220°) can be seen beside the slipway to the jetty, where again they cut the earlier faults dipping at 55° north-east and trending 305°.

In Glen Mor several drift covered NW-trending faults can be located from stream exposures of shattered rock; the kink in the Abhainn à Ghlinne Mhoir shown in (Plate 37A) follows one of these faults. They appear to be terminated by NE–SW-trending faults along which such features as the Dun Passage, Cambir Neck and probably Soay Sound have been formed by erosion. The latest set of faults appears to have developed more or less contemporaneously with the intrusion of the suite of late dykes and cone sheets. For example, at Geo na Lashulaich (Figure 36) several cone sheets converge on a pre-existing NE–SW fault, and while a similar fault cutting Conachair Granite at Geo nan Sgarbh displaces some basic sheets, another sheet appears to have been intruded along the fault plane for several metres.

Field relationships suggest that the following sequence of structural events can be distinguished on St Kilda:

1. Fracturing of the Western Gabbro associated with basaltic volcanism, ultimately resulting in the formation of an igneous breccia of mafic rocks.
2. Fracturing of the Mullach Sgar Complex along a north or NNW-trend, related to the intrusion of the Conachair Granite.
3. NW–SE faulting, particularly of the Mullach Sgar Complex and the Conachair Granite with associated mineralisation.
4. Extensive NE–SW faulting accompanying intrusion of late cone sheets and dykes.

References

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