Minor intrusions - petrology - St. Kilda: an illustrated account of the geology

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Figure 26A Serpentinised olivine, laths of zoned labradorite (2 mm long), intergranular clinopyroxene and irregular grains of magnetite and ilmenite from an inclined sheet below Mullach Bi. Cockburn Collection K402. Cross polarised light.

Figure 26B Partially serpentinised olivine phenocrysts (FO75) with purple-brown titanaugite, magnetite and labradorite (An66). Inclined sheet SE of Bioda Mor, Dun. The largest olivine is 0.35 mm across. HMTS 20532; plane polarised light.

Figure 26C Large twinned plagioclase grain with a core composition An61, a zone of pyroxene granules, and a rim of An67 lies in a groundmass of intergranular plagioclase (An66), clinopyroxene and opaque minerals. Porphyritic basalt from An Fhaing, Dun; HMTS 20535; cross polarised light.

Figure 27A Glomeroporphyritic cluster of pyroxene (Wo40En42Fs18) and plagioclase (An80 in basalt sheet from Glen Bay. Compositional zoning is visible in the largest pyroxene which is 1 mm across. HMTS 20503; cross polarised light.

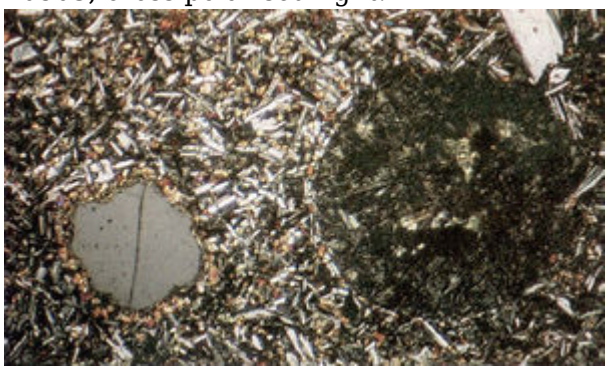

Figure 27B Quartz xenocryst, 0.75 mm across, rimmed with pyroxene, lies next to an amygdale filled with chlorite and clay minerals in a groundmass plagioclase laths with granular pyroxene and opaques. Cockburn Collection K411; cross polarised light.

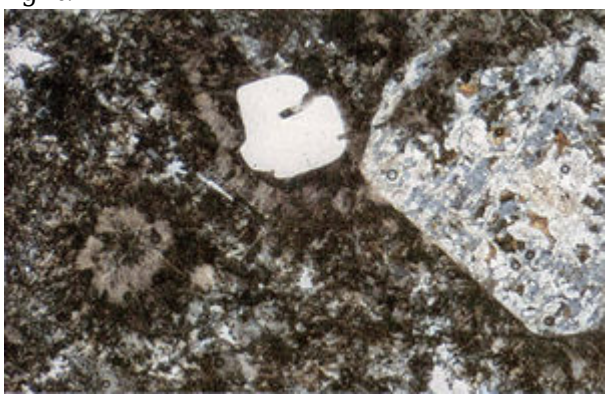

Figure 27C Altered feldspar and corroded ß-quartz grains form some of the nuclei for

spherules in the centre of a composite dyke at Mol Ghiasgar. S72419, field 4 mm wide, cross polarised light.

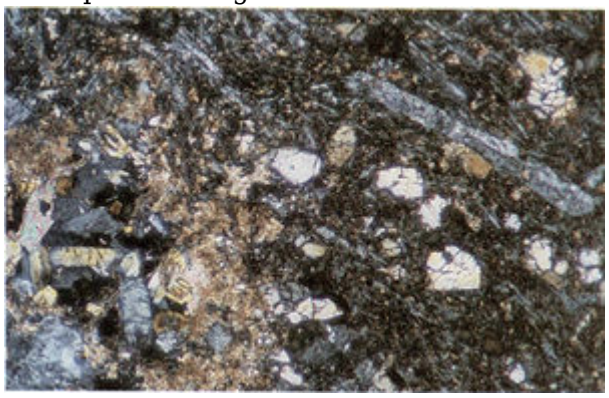

Figure 27D Trachytoid basalt lying between spherulitic felsite (Figure 27C) and marginal dolerite of composite dyke. Patches of albite-epidote-calcite are present in the dolerite. S72420, field 1 mm wide, cross polarised light.

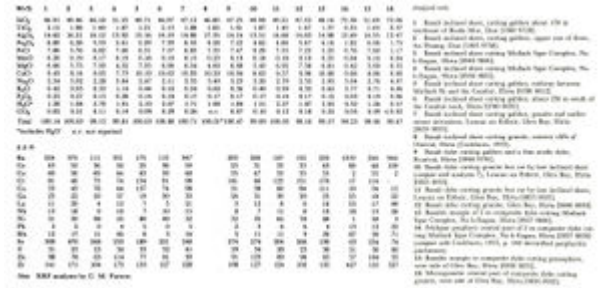

Table 29 Analyses of inclined sheets and dykes from Hirta, and Dun, St Kilda.

Chapter 15 Minor intrusions. Petrology

Keywords: textures, composite dykes, metamorphic effects

The dykes and sheets show considerable textural and compositional variation and although most of them can broadly be described as basaltic or doleritic, in detail these consist of glassy, variolitic, intersertal and ophitic ground-mass textures, with or without phenocrysts. Andesite or microdiorite sheets are much less common than dolerites but felsites, microgranites or pitchstones are relatively common, principally in dyke form but also in gently inclined sheets north of Mullach Bi, on Glacan Mor and on Soay.

A selection of textural types is shown in the photomicrographs. In (Figure 26A) and (Figure 26B) laths of plagioclase lie adjacent to irregularly shaped grains of pyroxene in an intergranular or subophitic texture. Sparse rounded grains of olivine have been altered to serpentine and saponite with the dark cracks across the grains occupied by iron oxides. In (Figure 26B) the pyroxene is pale brown with the lilac hue typical of members of this mineral group that contain appreciable contents of TiO_2 (an analysis of this rock is given in (Table 29), col. 1). Purplish augitic pyroxene ($Wo_{45}En_{36}Fe_{19}$) with 2.75% TiO_2 occurs in the groundmass of a basalt sheet from An Fhaing, Dun (Figure 26C) where it is associated with labradorite laths (An_{64-66}), grains of magnetite and interstitial chlorite and clay minerals. Feldspar phenocrysts in this rock show reverse zoning with

cores of labradorite (An_{61}) and relatively calcic rims (An_{66}). These may either have crystallised from the same basaltic magma, in which case they have failed to equilibrate during changes of temperature of water pressure (that is, they are phenocrysts), or have been picked up by the magma from the country rocks during its ascent (that is, xenocrysts). The rounded shape of the feldspar indicates that the part with composition An_{61} was unstable in the basaltic magma and was being resorbed, but enough survived to form the nucleus for crystallisation of a rim of granular pyroxene and magnetite, and for the formation of new feldspar (An_{66}) which grew in crystallographic continuity with the core. In a basalt sheet from Glen Hay (denoted by 'R' in (Figure 24B)) clusters of plagioclase (either An_{64} ?xenocrysts or An_{73}–An_{82} oscillatory-zoned phenocrysts) and pyroxene form glomeroporphyritic aggregates in an intersertal groundmass (Figure 27A). The clinopyroxene phenocrysts are slightly zoned with a compositional range $Wo_{42-36}En_{46-41}Fs_{19-15}$ and are richer in MgO and SiO_2 and poorer in TiO_2 (1.7 %) than the groundmass pyroxenes. The latter ($Wo_{44}En_{39}Fs_{17}$) are richer in $A1_2O_3$ and TiO_2 (2.2%) and occur with plagioclase (An_{66}), magnetite, ilmenite and interstitial alteration products (analysis in (Table 29), col. 7). A basaltic sheet which cuts the Mullach Sgar Complex on Na h-Eagan ((Table 29), col. 3) consists of extensively serpentinised olivine ($Fo_{78–81}$) and plagioclase (An_{77}) phenocrysts resting in a ground-mass of less calcic plagioclase ($An_{70–58}$), augite ($Wo_{44}En_{29}Fs_{27}$; TiO_2 1.2–2.2%) and opaque minerals.

Possible contamination by foreign material in some sheets has been referred to above in connection with very calcic plagioclase grains, but more positive indications are provided by quartz xenocrysts. One example is shown in (Figure 27B) where the quartz has been rounded and corroded and has formed the nucleus for precipitation of pyroxene. Nearby, a spherical amygdale filled with dark greenish brown chlorite and clay minerals is surrounded by a tangential arrangement of feldspar laths, suggesting that the vesicle expanded during the crystallisation of the groundmass.

Above the boulder beach at Mol Ghiasgar, a 3 m-wide composite dyke cuts the Conachair Granite and also a late basic sheet cutting the Granite. The dyke consists of a thick (up to 2 m) central portion of spherulitic felsite in an envelope of dolerite. Corroded phenocrysts of sodic plagioclase and inverted β-quartz have acted as nuclei for spherulitic devitrification of the felsite (Figure 27C). As an result the original glassy groundmass now consists of finely intergrown orthoclase, albite and quartz, which together with the phenocrysts gives this rock the modal composition of an alkali rhyolite. The felsite is intruded centrally into an earlier, poorly vesicular feldsparphyric granular dolerite dyke, originally 1–2 m wide, which contains rare epidotised xenoliths of coarser mafic rock. In places a trachytoid-textured basalt occurs between the felsite and the dolerite, and this appears to represent a basic fluid that lubricated the intrusion of the more viscous rhyolitic magma (Figure 27D). Both the basalt and the dolerite show patchy development of epidote, chlorite and calcite resulting from contact alteration by the felsite. In contrast, alteration in the olivine-dolerite sheet cut by the dyke is characterised by replacement of groundmass olivine and interstitial material by smectite. This zeolite grade alteration and the glassy nature of the felsite indicate that both minor intrusions were emplaced at a high level into essentially cold (<150°C) granite.

References

- 2. Northern Highlands

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