# Mullach Sgar Complex - petrology - St. Kilda: an illustrated account of the geology



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.].

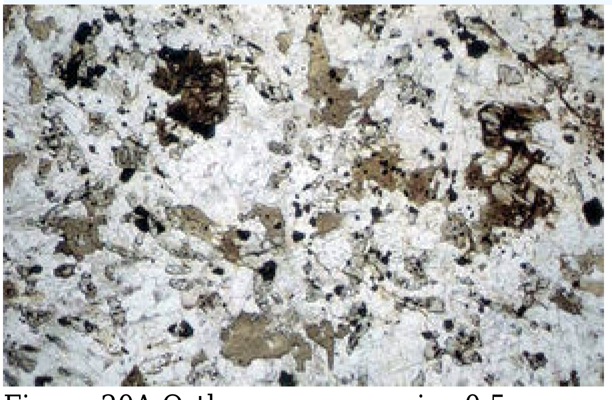

Figure 20A Orthopyroxene grains 0.5 mm across, pale grey and surrounded by yellow green alteration minerals, brown to yellow-green amphibole, smaller grey grains of clinopyroxene and specks of opaque minerals lie in a groundmass of variably turbid feldspar and a little quartz. Mafic microdiorite component of Phase 2 from Dun Passage, (S64883), plane-polarised light.

Figure 20B Zoned oligoclase platy crystals and elongate amphiboles (yellow and red interference colours) up to 1.5 mm across, are associated with subhedral quartz, opaque, sphene and interstitial turbid alkali feldspar which forms a characteristic fringe on many oligoclase grains. Microgranite component of Phase 4 from Na h-Eagan, (S65206), cross-polarised light.

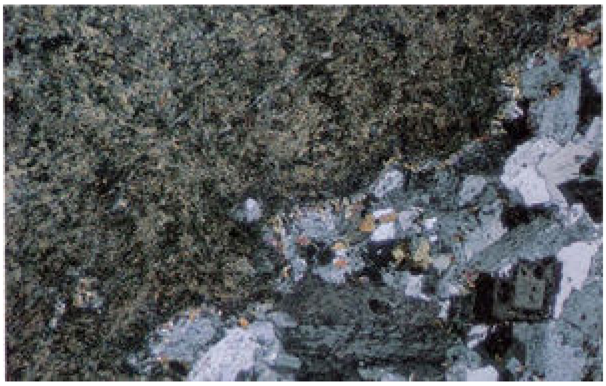

Figure 20C Basaltic dolerite chilled against microgranite. The margin of the dolerite is sinuous and very finely granular with a concentration of opaque granules and a few thin hollow (quenched) crystals of plagioclase (grey) less than 0.2 mm long. Beach boulder, (S71661A), cross-polarised light.

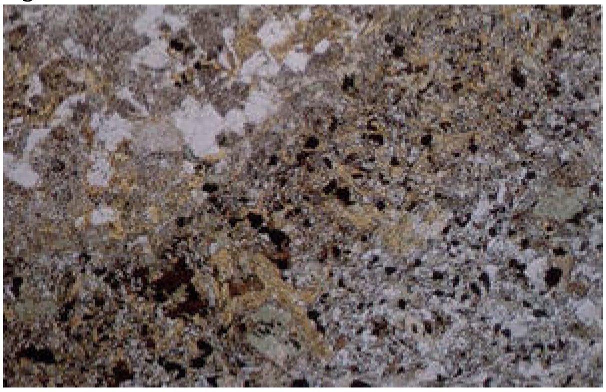

Figure 21A The contact of an angular dolerite block cut by microgranite runs diagonally across the picture. The dolerite is unchilled, and the yellow staining (with sodium cobaltinitrate) illustrates the extent to which K-feldspar, derived from the microgranite, has developed in the dolerite margin. (S64806) from quarry, plane-polarised light.

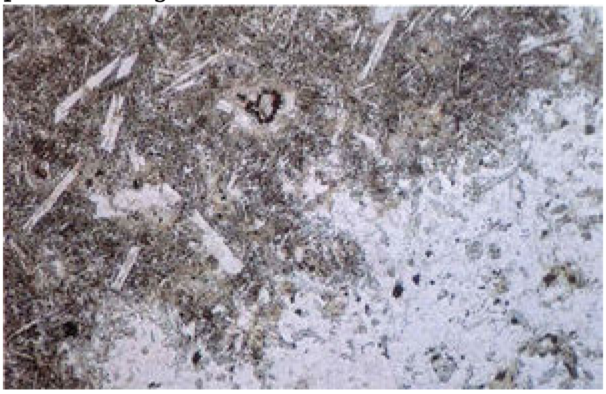

Figure 21B Margin of a basalt fragment that appears to have been shredded or torn apart. Elongate, hollow (quenched) plagioclase laths are abundant, and an olivine phenocryst partially altered to opaques and chlorite lies near the centre of the picture in a grey green groundmass of pyroxene, amphibole and chlorite. The quenched basalt has developed a granular groundmass in contact with hot microgranite. (S64809) from quarry, plane-polarised light.

# Chapter 12 Mullach Sgar Complex. Petrology

**Keywords: magmatic and metamorphic textures, chemical analysis, mineralogy.**

The mafic rocks range in composition from dolerite to microdiorite and display a variety of textures. Some are finely granular and microphenocrystic basalts, with or without olivine; others are coarser dolerites, and these grade with increasing quartz into microdiorites. Phenocrysts of plagioclase, $An_{75}$ in the basic rocks to $An_{50}$ in the intermediate ones, are common and outnumber the sparser olivine or orthopyroxene phenocrysts. The latter are commonly altered around the margins and contrast with the fresh clinopyroxene phenocrysts which occur sporadically in the dolerites but more commonly in the microdiorites. The most basic rocks typically consist of feldspar phenocrysts in a groundmass of plagioclase, augite and opaques whose textures vary between inter-granular, sheaf, and subophitic. The mafic component of Phase 2 is microdiorite ((Figure 20A) and analysis) and although fine-grained at fragment margins in the Dun Passage, is hypidiomorphic in texture. The first minerals to crystallise were orthopyroxene (Figure 20A) and plagioclase, followed by clinopyroxene, opaques and amphibole. Orthopyroxene is rimmed with chlorite and appears to have been unstable in the conditions that favoured simultaneous formation of clinopyroxene and calcic amphibole (ferrohornblende). Pockets of K-feldspar and quartz occur in the groundmass and there are patchy areas where accessory zircon or apatite are common. Olivine-dolerites, dolerites and quartz-dolerites form the mafic rocks of Phase 3. Two examples of the textures are shown in (Figure 20C) and (Figure 21B) and these and the other textures are typically fine-grained. The small grainsize and content of opaque minerals probably determine how dark the rocks appear in hand specimen. The mafic component of Phase 4 is microdiorite and pale-coloured in comparison with the Phase 3 dolerites. Its composition is given in the Table of analyses and, following Irvine and Baragar (1971), it is tholeiitic andesite. Compared with the mafic component the Phase 2 granodiorites contain less pyroxene and opaque minerals, and show a corresponding increase in K-feldspar and quartz, which is reflected in their CaO, MgO and $K_2O$ contents *(*see Table). The felsic rocks enclosing the mafic fragments of Phase 3 are indistinguishable from Phase 4 felsic rocks and both are distinctly richer in quartz and K-feldspar than are Phase 2 rocks. The texture of one of the steeply-dipping sheets on Na h-Eagan (Figure 18) is shown in (Figure 20B). Calcic amphibole (ferro hornblende or ferroedenite), opaque minerals and andesine-oligioclase were the first minerals to form, followed by biotite, K-feldspar and quartz. Accessory zircon, apatite and sphene (in small radiating sheafs associated with chlorite) are common and the rare-earth minerals chevkinite and allanite are present in some samples (although not together in the same hand specimen). Plagioclase crystals are progressively zoned from cores of $An_{35}Ab_{65}$ to margins of $An_{35}Ab_{65}$ and these are mantled by turbid orthoclase microperthite. Granophyric intergrowth of alkali feldspar and quartz is common in some parts and microgranitic texture predominates in others.

Contact between enclosed fragments and host rock in the Complex is of four main kinds: sharp and angular; lobate; torn or shredded; and gradational or hybridised. Chilled margins are found in the first three contact types but occur in mafic fragments only. Some typical contact textures are shown in (Figure 20C), (Figure 21A) and (Figure 21B). In (Figure 20C), quenched plagioclase microlites and microphenocrysts lie in a basaltic groundmass of granular pyroxene, plagioclase and an opaque mineral. Plagioclase grain size increases away from the margin indicating that the basaltic magma was chilled against the granitic material. However, in spite of the presence of quenched plagioclase microlites, there is no evidence of glass in the finely granular chilled margin of the basalt. Such textures suggest that initially glassy chilled margins have been annealed by contact with hot granitic material. Indeed the sinuous nature of the margin suggests that both rock types were plastic at the time of contact. An example of a basaltic rock cut by a granitic vein is shown in (Figure 21A). The sharp angular contact and the lack of chilling indicate that the mafic rock was brittle with a well-developed texture prior to intrusion by the microgranite. But though the vein is thin (9 mm) the microgranite is unchilled, suggesting that the dolerite was itself hot when fractured. The first stage of dolerite assimilation by granite is also shown in (Figure 21A) where K-feldspar is developed in the margin, and all gradations to dioritic hybrid rocks are present elsewhere in the complex. The shredded fragments are generally of fine-grained basaltic dolerite bounded partly by sinuous, rounded chilled margins and partly by ragged or irregular edges which are unchilled and show little if any evidence of impregnation by potassic fluids. The example shown in (Figure 21B) is an olivine-tholeiite but chilled and 'shredded' marginal features are shown by a range of mafic rocks through quartz-tholeiites to microdiorites. Two main kinds of alteration are shown by the mafic fragments. One is hybridisation by felsic material referred to above and the other results in development of biotite, hornblende and chlorite at the expense of pyroxene, plagioclase and olivine. These are features of retrogressive hydration of essentially anhydrous mafic rocks. The sustained high temperature conditions that caused formation of granoblastic textures in the Glacan Mor dolerites were evidently not achieved in the Mullach Sgar Complex, and it therefore seems that granitic magma, not basaltic, was the dominant invading liquid in the complex.

The analyses of Phase 2 and Phase 4 rocks given in the Table are broadly representative of a narrow compositional range, but in Phase 3 dolerite compositions range from olivine to quartz-tholeiite and the analysis given (of the latter) is only one example. Soda exceeds potash in the acid rocks of the Complex and this is reflected in some of the minerals found lining drusy cavities. In addition to prehnite, epidote and sphene, calcite, apophyllite, scolecite, chabazite and amethyst are present in small quantities, and represent late hydrothermal activity at temperatures possibly as low as 100°C.

**Chemical analyses. Mullach Sgar Complex**

| Major elements | Phase 2 | | Phase 3 | Phase 4 | |
|---|---|---|---|---|---|
| Oxide wt % | Mafic | Felsic | Mafic | Mafic | Felsic |
| $SiO_2$ | 57.3 | 60.4 | 55.3 | 56.3 | 69.9 |
| $TiO_2$ | 1.4 | 1.3 | 1.5 | 1.6 | 0.5 |
| $A1_2O_3$ | 14.5 | 15.4 | 14.7 | 14.2 | 14.5 |
| $Fe_2O_3$ | 3.7 | 4.3 | 6.6 | 4.2 | 2.0 |
| FeO | 5.6 | 4.5 | 4.7 | 6.6 | 1.8 |
| MnO | 0.1 | 0.2 | 0.2 | 0.2 | 0.1 |
| MgO | 3.3 | 1.9 | 2.7 | 2.8 | 0.5 |
| CaO | 5.6 | 4.7 | 6.0 | 5.6 | 1.6 |
| $Na_2O$ | 4.5 | 4.8 | 4.1 | 4.5 | 4.9 |
| $K_2O$ | 1.2 | 1.7 | 1.3 | 1.7 | 3.7 |
| $H_2O^{+110}$ | 1.1 | 1.0 | 0.5 | 1.0 | 0.4 |
| $H_2O^{-110}$ | 0.5 | 0.3 | 0.6 | 0.3 | 0.2 |
| $P_2O_5$ | 0.3 | 0.3 | 0.4 | 0.2 | 0.1 |

| | | | | | |
|---|---|---|---|---|---|
| *Total* | 99.1 | 100.8 | 98.6 | 99.2 | 100.1 |

Analyses of Mafic rocks by D. J. Rodda, S. A. Bevan, J. Griffiths and S. J. Jackson (LGC); and of Felsic rocks by A. N. Morigi, A. E. Davis and K. A. Holmes.

# References

> At all times follow: The Scottish Access Codeand Code of conduct for geological field work

## Navigation

- Main page
- Recent changes
- Random page
- Help about MediaWiki

## Tools

- What links here
- Related changes
- Special pages
- Permanent link
- Page information
- Cite this page
- Browse properties

- This page was last modified on 5 November 2019, at 20:39.