Ard Ghunel

[NG 702 120]–[NG 709 117]

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Introduction

In the Lewisianoid gneisses of the Moine Nappe in the Sleat peninsula of Skye, are several ultramafic lenses that show rare and striking examples of concentric mineral zonation of talc, actinolite and biotite-bearing assemblages. The lenses are small and variable in character but type examples lie in the well-exposed coastal sections and inland crags of Ard Ghunel. Geochemical evidence indicates that the lenses originated as lenticular ultramafic intrusions, within the dominantly quartzofeldspathic orthogneisses. Metamorphic and metasomatic reactions during regional metamorphism that accompanied intense Caledonian reworking probably produced the internal zonation. Ultramafic lenses do occur commonly within the foreland Lewisian gneisses and in the Lewisianoid inliers, but rarely show well-developed zoning. Unfortunately much of the originally exposed material at Ard Ghunel has disappeared or been damaged due to the over collection of specimens.

The two principal rock units around Ard Ghunel are Moine psammites and Lewisianoid gneisses, the latter forming a probable extension of the Western Unit of the Glenelg–Attadale Inlier. All of these rocks lie within the Moine Nappe, with the Moine Thrust cropping out some 2 km to the north-west.

Clough (in Peach *et al.,* 1907) provided the first description of the rocks, and Bailey (1955), in discussing metamorphism in this part of Skye, described their petrography. The account that follows, based mainly on Matthews' (1967) study of the metamorphism, chemistry and paragenesis of the pods, describes their appearance around their time of discovery.

Description

The GCR site encompasses Druim Ban, a hill on the peninsula of Ard Ghunel that juts out from the eastern side of the Sleat peninsula. The best exposures are seen at the eastern extremity of the peninsula. The Lewisianoid gneisses range from quartzofeldspathic orthogneisses, through epidotic, hornblende-, biotite-, and garnet-bearing varieties, to garnet amphibolites and rare occurrences of almost monomineralic actinolite, diopside and orthite rocks. Discordant amphibolite sheets and quartzofeldspathic migmatitic veining also occur. The subsidiary Moine rocks that form much of the southern part of Ard Ghunel peninsula are almost exclusively gneissose arkosic psammites, which share all of their minor fold structures with the Lewisianoid rocks.

The zoned ultramafic bodies comprise about a dozen separate, mineralogically zoned pods, in groups of two or three, scattered through a relatively confined structural horizon within the Lewisianoid gneisses. In cross-section, the pods present a well-defined lenticular to circular outline, up to 3 m long, but more commonly less than 1 m, with the long axis aligned with the gneissosity outside the pods. Internally they are essentially undeformed. The best-developed examples (now destroyed) were built up of concentric, onion-like monomineralic zones (Matthews, 1967). When formed, there was some variation between the pods, dependent on their host country rock. Where the host rock is amphibolite, the lenses typically contain: a core of talc and dolomite with minor magnetite; a surrounding zone of coarser, radiating, prismatic actinolite, with crystals up to 10 cm long; an outer zone of finer actinolite rock; and finally an envelope of large, tangentially orientated biotite flakes (Figure 7.32). The crystals in each zone are clearly visible to the naked eye, and apart from the biotite and the coarser actinolite, they are randomly orientated. Each zone is typically of the order of 10 cm thick. Individual lenses show some mineralogical variation with chlorite, diopside, or fuchsite (chrome mica) moderately abundant in parts.

In the lenses that are enclosed in the quartzofeldspathic gneisses the talc-dolomite core is typically absent, but concentrations of albite-rich, untwinned plagioclase feldspar, commonly associated with an enrichment of biotite, occur in

the immediately adjacent gneisses. Otherwise, the contacts of the ultramafic lens are sharp against the host gneisses in which Baravaig generation structures are abundant (Cheeney and Matthews, 1965).

Interpretation

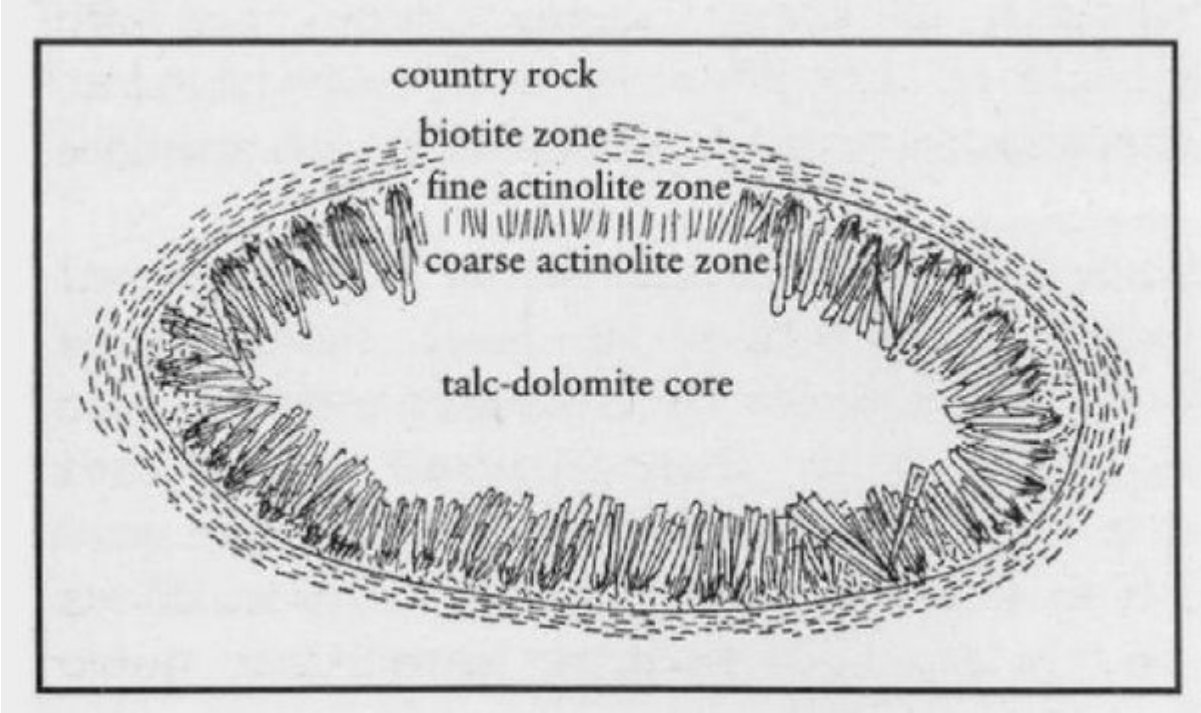
The Lewisianoid gneisses and Moine rocks in Sleat were strongly deformed during the Caledonian deformation. Caledonian metamorphism reached a peak of lower-amphibolite facies, with growth of almandine garnet, early in the deformational history of the area (Cheeney and Matthews, 1965). This metamorphism probably involved retrogression and wholesale recrystallization of the pre-existing Lewisianoid assemblages, with earlier igneous textures only preserved in local low-strain zones. In this context the ultramafic lenses within the Lewisianoid gneisses pose particular problems. Although the bulk composition of the cores to the lenses resembles that of a siliceous dolomite, the trace-element geochemistry inside the contact zone between the biotite and outer actinolite zones shows a strong ultrabasic igneous affinity, with Ni and Cr being particularly abundant. This suggests that the mineral assemblages in the lenses resulted from metamorphic and metasomatic reactions between the ultramafic rock and host felsic and mafic gneisses during Caledonian regional metamorphism (Matthews, 1967). The relative mobility of Mg in particular, as indicated by its linear concentration gradient from core to envelope, appears to have been a principal factor controlling the disequilibrium zonation. K_2O, CO_2 and H_2O must have entered the chemical system from outside the immediate vicinity of the lenses, but Si and Ca would appear to have moved relatively freely within the bodies independent of the proximal host rock, although not to equilibrium concentrations. In contrast, Al appears to have remained effectively immobile. The metamorphic condition of the pods prior to their Caledonian modification and retrogression is unclear.

The age and emplacement mechanism of the ultramafic pods is not known, although they may well represent boudinaged remnants of larger Archaean or Palaeoproterozoic intrusive masses, genetically related to an extensive, NE–SW-trending sheet of serpentinite that crops out between 1 km and 3 km to the south-west (Matthews, 1967).

Conclusions

At the Ard Ghunel GCR site small lenses of mineralogically zoned ultramafic rocks occur within Lewisianoid gneisses of the Moine Nappe. The Moine psammites and Lewisianoid gneisses near Ard Ghunel were strongly deformed and metamorphosed to almandine amphibolite facies during the Caledonian Orogeny. Where enclosed within amphibolite, the metre-sized ultramafic pods have talc-dolomite cores, surrounded by successive zones of coarse actinolite, fine actinolite and biotite. Where enclosed in quartzofeldspathic gneisses, zones of albite and biotite enrichment occur in the adjacent gneisses. The mineral zonation is probably the result of incomplete metamorphic and metasomatic reactions between original Archaean or Palaeoproterozoic ultramafic intrusive masses and the more-quartzofeldspathic country rocks. Zoned ultrabasic pods are very rare in the UK, and the only other occurrence is in Shetland. Hence the site is of national importance, but unfortunately, the pods have been severely damaged by over collection, and little remains of the original exposures.

References



(Figure 7.32) Diagrammatic representation of the mineralogical zones developed in the Ard Ghunel ultramafic body. After Matthews (1967).