Loch Drumbeg

[NC 114 329]

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Introduction

This GCR site, adjacent to the Lochinver–Kylesku road just west of the village of Drumbeg, contains one of the best examples of layered mafic–ultramafic meta-igneous rocks within the Lewisian Gneiss Complex. There are many small examples of such bodies throughout the Lewisian outcrop, and they are generally believed to represent the disrupted remnants of one, or several, large, layered mafic–ultramafic intrusions equivalent to those mapped in the Archaean of Greenland (see Windley *et al.,* 1973) and in other Archaean terrains. The intrusion at Drumbeg occurs in the form of a deformed sheet, up to 100 m thick, enclosed within Badcallian tonalitic gneisses. The rocks include metaperidotite (containing olivine and two pyroxenes) and basic meta-igneous rock, in the form of garnet-pyroxene-plagioclase rock ('pyriclasite'), both of which exhibit typical granulite-facies mineral assemblages.

The mafic–ultramafic rocks were first mapped by L.W. Hinxman in 1887, and described by Peach *et al.* (1907). They were subsequently examined and described in detail by Bowes *et al.* (1964), who used the term Drumbeg 'complex', and by O'Hara (1965, 1977). These authors studied the geochemistry and mineralogy in considerable detail. The intrusion has been dated using Sm-Nd whole-rock methods at 2910 ± 55 Ma (Whitehouse, 1989).

Description

The GCR site occupies a relatively small area of rugged but low-lying ground near the shores of Loch Drumbeg. The mafic–ultramafic rocks are enclosed within typical tonalitic to granodioritic felsic gneisses exhibiting Badcallian granulite-facies assemblages, and are disposed in a broad syncline (Figure 3.11). Banded metaperidotites (Figure 3.12) overlain by garnet-pyroxene-plagioclase rocks dip gently to the SSW in the northern part of the site and reappear in the south-west part of the site, south of some unexposed ground, dipping moderately to the north-east. Around the shores of Loch Drumbeg, the structure is more complex, and it appears as though there has been some disruption of the banding, possibly due to the emplacement of the tonalitic gneisses. The garnet-pyroxene-plagioclase rocks are banded in their northern outcrop but are more massive farther south.

The maximum thickness of the mafic–ultramafic sheet as seen in the northern outcrop is about 100 m, but the sheet is thinner in the south, where disrupted by the felsic gneisses. Some small outcrops of ultramafic rock in the southern part of the site appear to be surrounded by felsic gneiss and probably represent isolated lensoid inclusions. The foliation in the felsic gneisses generally has a low dip; in places demonstrably sub-parallel to the compositional banding in the mafic rocks, but elsewhere the gneiss foliation is markedly discordant to the banding. Both banding and foliation are folded by the WNW-trending open syncline. These structures are cut by narrow, steep shear-zones, marked by belts of steep, strongly foliated rocks showing retrogressive effects; for example metaperidotite has been converted to tremolite-talc-chlorite assemblages.

The ultramafic rocks consist of recrystallized aggregates of hypersthene, clinopyroxene and olivine, and are best termed 'metaperidotites'. The olivine is generally altered, and brown-green hornblende is also present in places. The modal proportions of olivine and pyroxene define the banding in the ultramafic rocks, and individual bands typically range from 2–10 cm in thickness, although thinner bands are seen in places.

The garnet-pyroxene-plagioclase rocks are largely composed of aggregates of garnet with rims of plagioclase and interstitial clusters of clinopyroxene. Dark-green hornblende also occurs, and uralitization of pyroxene is evident. The banding in these rocks is not as well defined as that in the ultramafic rocks, and is largely the result of variations in the proportions of plagioclase and hornblende.

The mafic–ultramafic rocks are cut by sheets and irregular masses of quartz-feldspar pegmatite. The K-feldspar-plagioclase intergrowth textures in the feldspars were considered by O'Hara (1965) to indicate exsolution from high-temperature feldspar.

Interpretation

The Drumbeg ultramafic–mafic intrusion has been dated by Sm-Nd whole-rock methods at 2910 ± 55 Ma (Whitehouse, 1989), and is believed to represent one of the oldest components of the Lewisian Gneiss Complex on the mainland. Similar mafic–ultramafic bodies are found at a variety of localities in the Central Region (e.g. see Scourie Mor GCR site report, this chapter), and Park and Tarney (1987) suggested that these bodies might represent the disrupted remnants of ocean-floor material underplated at the base of the contemporary crust and subsequently invaded by tonalitic magmas.

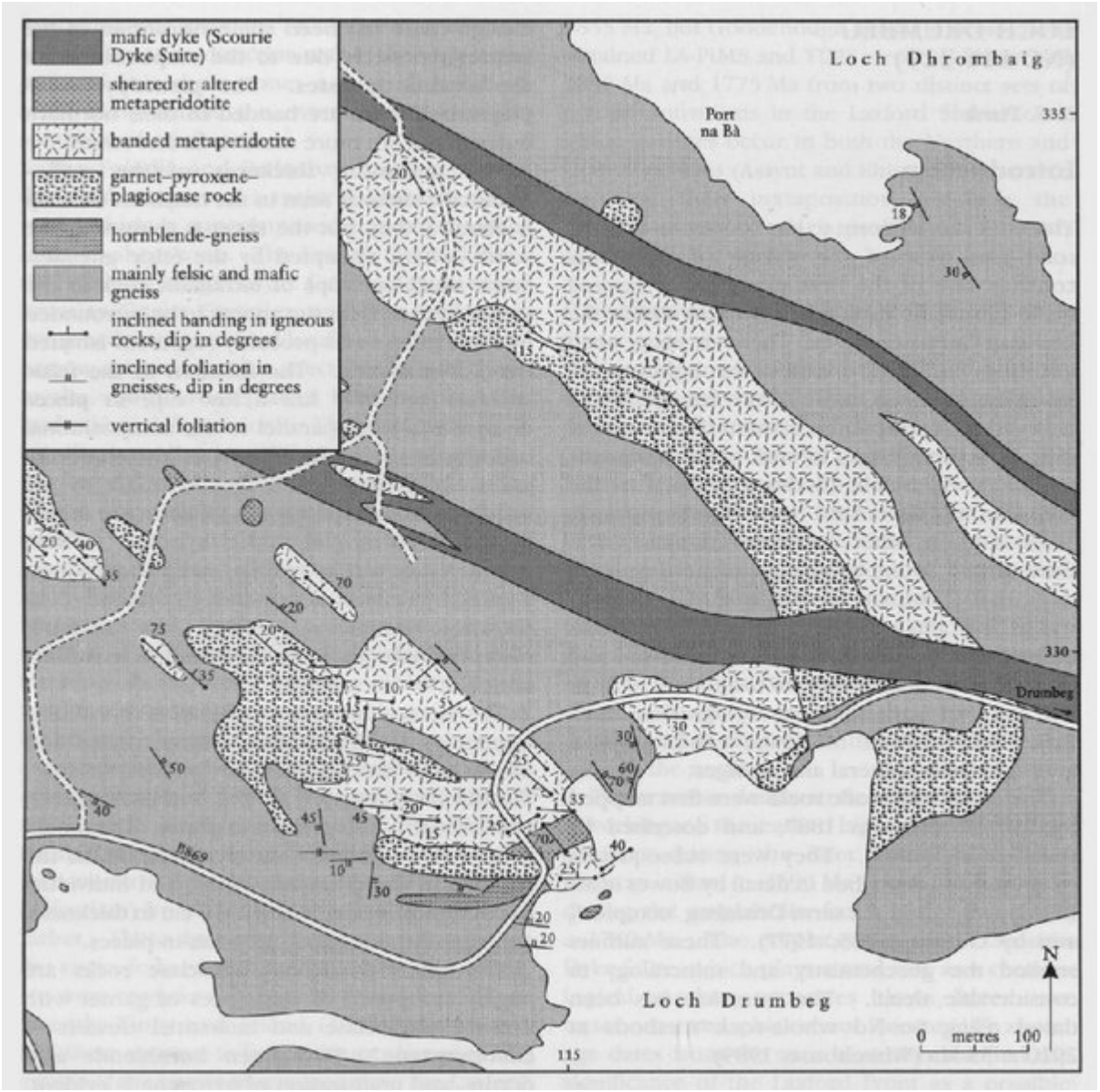
The rocks were deformed and metamorphosed in the Badcallian event, and exhibit typical granulite-facies mineral assemblages. O'Hara (1977) used the mineral chemistry of the mafic rocks to define the peak metamorphic temperatures at about 1250° C, under pressures of about 15 kbar. Whitehouse (1988) obtained a Sm-Nd whole-rock isochron (errorchron) age of 2600 ± 155 Ma from felsic gneisses from the Scourie–Drumbeg area. He interpreted this age as dating the granulite-facies event that resulted in Nd isotopic homogenization in the gneisses.

Bowes *et al.* (1964) drew attention to structures similar to current bedding and considered that they were an indication of gravitational settling in a magma chamber. However data on the mineral compositions across adjacent layers were considered to be incompatible with the gravity settling model by O'Hara (1977), and the observed wedging and truncation are now thought to be probably deformational in origin.

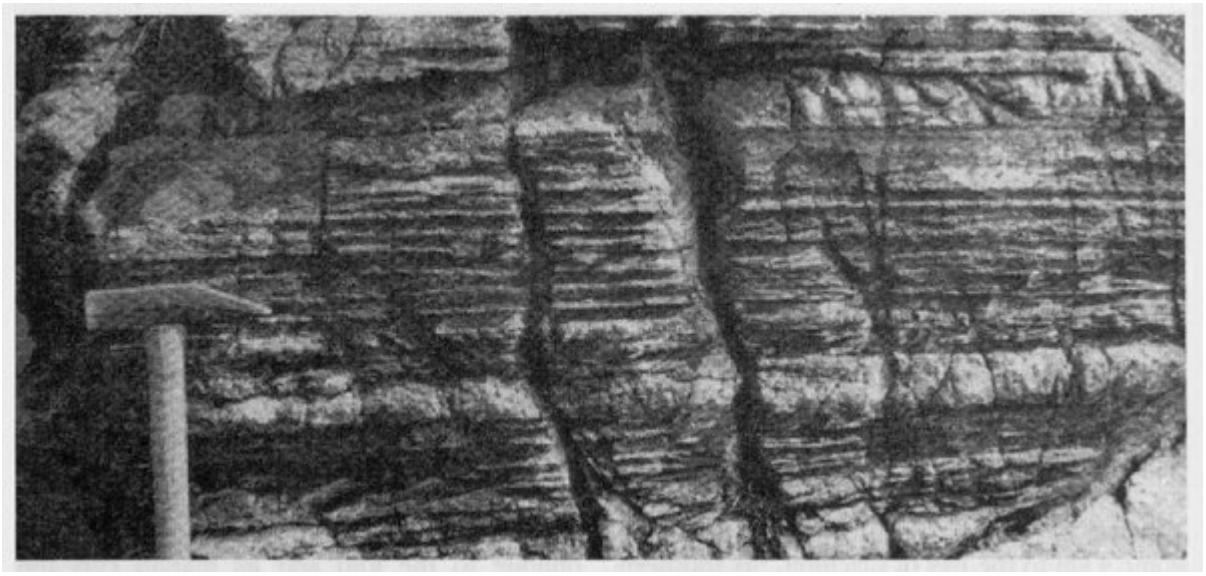
Conclusions

The Loch Drumbeg GCR site provides an accessible and well-exposed locality on the Scottish mainland at which one of the important Lewisian early mafic–ultramafic igneous intrusions can be studied. It yields good examples of metaperidotites and mafic garnet-pyroxene-plagioclase rocks, which still exhibit clear igneous banding in places. The intrusive relationship of younger felsic gneisses can also be deduced. Geothermometric, geobaro-metric and geochronological work at this site have played an important part in the evolution of ideas regarding conditions and events during formation of the Lewisian Gneiss Complex in the Archaean; typical granulite-facies mineral assemblages have yielded temperature and pressure estimates of 1250° C and 15 kbar respectively. The mafic–ultramafic rocks have been dated at 2910 ± 55 Ma, and are believed to be among the oldest components of the Lewisian Gneiss Complex. They may possibly represent the disrupted remnants of ocean-floor material underplated at the base of the contemporary crust and subsequently invaded by more-acid magmas. The site is of national importance and remains suitable for teaching and further studies.

References



(Figure 3.11) Map of the Drumbeg mafic–ultramafic intrusion. After Bowes et al. (1964) and Geological Survey 1:10 560 Sheet Sutherland 48 (1888).



(Figure 3.12) Banding in metaperidotite from Drumbeg. The hammer head is 15 cm long. From Bowes et al. (1964).