Kerrysdale

[NG 825 735]

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Introduction

The Loch Maree Group

The Loch Maree Group is a Palaeoproterozoic supracrustal sequence of metasedimentary and meta-igneous rocks, enclosed within the Archaean gneisses of the Lewisian Gneiss Complex. This stratigraphically distinct group occurs in two belts, at Loch Maree and Gairloch, but has not been identified elsewhere in the mainland Lewisian outcrop. It is represented by the Kerrysdale and Flowerdale GCR sites, both of which lie within the Gairloch outcrop.

The supracrustal assemblage at Gairloch occupies a NW-trending belt about 3 km wide, bounded on both sides by Archaean felsic gneisses and cut by Scourie dykes (Figure 3.20). Both margins of the belt are tectonic, and the whole area forms part of a steep, NW-trending, Laxfordian shear-zone about 5 km wide, called the Gairloch Shear Zone (see Creag Mhor Thollaidh GCR site report (this chapter), which includes the north-east margin of this shear zone). The south-west side of the supracrustal belt contains granitic gneisses, the Ard Gneisses, considered to represent a deformed and meta morphosed granodiorite sheet intruded into the metasedimentary rocks during the Laxfordian event (see An Ard GCR site report, this chapter). The Ard Gneisses have recently been dated at *c.* 1900 Ma (Park *et al.,* 2001).

The supracrustal sequence comprises schistose metasedimentary rocks separated by amphibolitic mafic sheets. The metasedimentary rocks consist mainly of semipelitic quartz-biotite-plagioclase schist, and are considered to represent metamorphosed greywackes. The mafic sheets are mainly in the form of hornblende schist but also occur as massive amphibolite. The thicker sheets are thought to represent basic volcanic rocks, but some of the thinner sheets were probably sills. Associated with the amphibolites are narrow bands of chlorite schist, banded-iron formation, quartzite, metacarbonate rock and calc-silicate rock, graphite schist and garnet-grunerite schist.

Park (1964) divided the Gairloch supracrustal sequence into a number of coherent mappable units. However, because of the intense deformation, these cannot be considered to represent an unmodified stratigraphical sequence, and several units have tectonic boundaries. The main part of the sequence comprises, from south-west to north-east: the 'Charlestown schists', the 'Kerrysdale basites and schists', the 'Flowerdale marble belt', the 'Flowerdale schists', and the Aundrary basite'. The Ard Gneisses lie immediately south-west of the Charlestown schists. The Charlestown and Flowerdale schists consist mainly of grey, fine-grained, semipelitic quartz-biotite-plagioclase schist, containing minor chloritic and amphibole-bearing bands. The Flowerdale marble belt contains quartz-chlorite schist with thin bands of impure metacarbonate rock, banded-iron formation and graphitic schist (see Flowerdale GCR site report, this chapter). The metasedimentary part of the Kerrysdale unit consists of siliceous quartz-biotite schist with thin bands of graphitic schist, banded-iron formation, quartzite and garnet-grunerite schist.

Because of the intense late-Laxfordian deformation, which has resulted in the near-parallelism of all rock units and structures, it is difficult to determine the nature and extent of earlier structures. Most exposures show an intense and pervasive NW-striking, steeply dipping schistosity, which is axial planar to minor tight to isoclinal folds. The schistosity developed in association with amphibolite-facies metamorphism, as indicated by the ubiquitous presence of aluminous hornblende and calcic plagioclase in the mafic rocks. These structures are attributed to either the first or second Laxfordian deformations, which cannot be easily separated in this area. The third Laxfordian deformation, associated with the development of the Gairloch Shear Zone, has also produced abundant minor folding, associated with retrogression to green-schist facies. Yet later deformation has produced localized minor folds with steep plunges and narrow brittle–ductile shear-zones containing cataclastic breccia and pseudotachylite, described by Shihe and Park (1993).

The Gairloch area was first mapped in 1889 and was described in detail by C.T. Clough (in Peach *et al.,* 1907) and subsequently by Park (1963, 1964). More-recent revisions of the structural interpretation were made by Odling (1984), Park *et al.* (1987, 2001) and Park (2002). Studies of the geochemistry and petrology of the mafic rocks were carried out by Park (1966), Power and Park (1969) and Johnson *et al.* (1987), and of the metasedimentary rocks by Winchester *et al.* (1980), Williams (1986) and Floyd *et al.* (1989).

The Kerrysdale GCR site provides a traverse across the Kerrysdale unit in the Gairloch succession of the supracrustal Loch Maree Group (Figure 3.21). It exhibits good examples of typical Kerrysdale amphibolite and siliceous schist, and also contains the most accessible exposures of graphite schist and garnet-grunerite schist in the Gairloch area. A continuation of the Flowerdale marble belt crosses the north-eastern part of the site, which also contains part of the Flowerdale schist unit. Between these latter two units is a brittle–ductile shear-zone marked by mylonitic and cataclastic rocks.

Description

The Kerrysdale GCR site forms a small roughly oblong area measuring some 620 m x 430 m immediately north-east of Kerrysdale Farm, bounded on its western side by a stream running southwards along a narrow valley, and on its eastern side by the lower slopes of Sidhean Mòr (Figure 3.21). The site is wooded in its steep lower western part and a wide sloping, partly wooded and grassy shelf area separates this lower part from the upper steeper eastern slopes that rise to over 190 m above OD.

In the south-west part of the site, an outcrop of garnet-grunerite schist forms a small knoll by the track leading from Kerrysdale Farm, just south of the footbridge [NG 824 734]. This schist forms a narrow band within the Kerrysdale amphibolite, and contains abundant mangani-ferous garnet and sheaves of grunerite (green amphibole) needles in a matrix of quartz and biotite. To the north of this outcrop is a steep, tree-covered ridge, running in a north-westerly direction, consisting of hard siliceous quartz- biotite schists with minor bands of graphitic schist, part of the dominantly semipelitic Kerrysdale schist unit. These schistose metasedimentary rocks display a very prominent rodding lineation that plunges about 30° to the southeast (Figure 3.22). This lineation is typical of the whole of the supracrustal belt, and is considered to reflect the overall movement that took place across the early-Laxfordian shear-zone. About 300 m north-west of the bridge, where the track crosses a small stream, exposures of graphitic schist can be observed in the stream [NG 822 737]. The rock is a distinctive, yellow-weathering, quartz-mica schist, containing pyrite and variable amounts of graphite in thin foliae.

To the north-east of the metasedimentary rocks lies an amphibolite sheet belonging to the Kerrysdale unit. This amphibolite is about 125 m thick and forms a belt of rough but gently sloping ground with numerous exposures, which consist of well-foliated hornblende schist with some more-massive amphibolite layers. On the north-east side of this body is an outcrop of the Flowerdale marble belt, which lies along the base of a steep slope (Figure 3.21). The marble belt is here about 80 m wide and consists of greenish-grey calcareous quartz-chlorite schist with additional bands of quartzite, calcareous schist, thin metacarbonate units, and banded-iron formation. Banded-iron formation alternates with quartz-rich units containing grunerite and some calcite. A fuller description is given in the Flowerdale GCR site report (this chapter).

The north-eastern part of the Flowerdale marble belt lies within a shear zone, about 20 m wide, which contains both brittle cataclastic rocks and more-ductile mylonites. The mylonitic rocks include a highly deformed fragmental rock consisting of flattened and elongate fragments of quartzite, up to several centimetres across, together with minor quantities of calcareous and chloritic schist, in a matrix of calcareous chlorite schist. Very high prolate strains are indicated by the shapes of the quartzite fragments, with typical axial ratios of X:Y:Z = 50:2: 1. A strong elongation lineation plunges at 50°–70° to the south-east. This rock extends for a few hundred metres in a southeasterly direction, but is not seen elsewhere in the Gairloch area. The brecciation is considered to pre-date the ductile shearing and the rock may represent an olistostrome, a sedimentary slide breccia, or a tectonic breccia, which was subjected to very high strains during early-Laxfordian shearing (Park *et al.,* 2001). The cataclastic part of the zone, which lies on the north-eastern side of the outcrop, consists of microbreccia veined by pseudotachylite. Northeast of, and above this crush zone lies a smooth, steep, featureless slope, underlain by the Flowerdale schists. The schists are uniform, fine-grained,

semipelitic schists typically composed of essential quartz, biotite, and plagioclase, with some hornblendic bands forming low ridges, marked by green grassy patches. The steep slope leads up to the prominent rocky crags of Sidhean Mòr [NG 836 740], which is formed by the Aundrary basite.

Interpretation

The exposures within the Kerrysdale site throw light on the nature and origin of the Loch Maree Group. The quartz-biotite-rich semipelitic rocks of the Kerrysdale and Flowerdale schist units are interpreted as meta-greywackes that were originally derived from a source in the continental upper crust and deposited in a continental-margin setting (Floyd *et al.,* 1989).

Whitehouse *et al.* (1997b) studied detrital zircons from the Flowerdale schists and found that they fall into two age groups, Archaean and Palaeoproterozoic. The Archaean zircons are believed to have been derived from a local continental source, but a suitable source for the younger component has not been identified; Whitehouse *et al.* (1997b) suggested that this source may have been a contemporaneous volcanic arc.

The geochemistry of the Kerrysdale amphibolites is consistent with their formation as volcanic rocks in an oceanic plateau setting, and the associated quartz-chlorite schists are thought to represent hydrothermally altered basaltic volcanic material (Park *et al.,* 2001). The banded-iron formation, garnet-grunerite schists, metacarbonate rocks, and graphitic schists associated with the amphibolites are believed to be metasedimentary rocks, the precursors of which were deposited through chemical precipitation in a shallow-marine setting, onto the basaltic substrate of the oceanic plateau. The banded-iron formation units form impersistent zones from a few centimetres up to 10 m in width. This lithology is described and discussed in more detail in the Flowerdale GCR site report (this chapter). The Gairloch occurrences are linked with stratiform sulphide deposits that occur within the Kerrysdale amphibolite along strike to the south-east. The main sulphide deposit, some 4 m wide but up to 500 m long, consists of pyrite, pyrrhotite and chalcopyrite with some sphalerite, galena and native gold (Jones *et al.,* 1987).

The association of an oceanic plateau sequence with Archaean gneisses, together with arc-like magmatic rocks (the Ard Gneisses; see An Ard GCR site report, this chapter) has been interpreted as an accretionary complex representing a possible Palaeoproterozoic collisional suture zone between two Archaean continental blocks (Park *et al.,* 2001; Park, 2002).

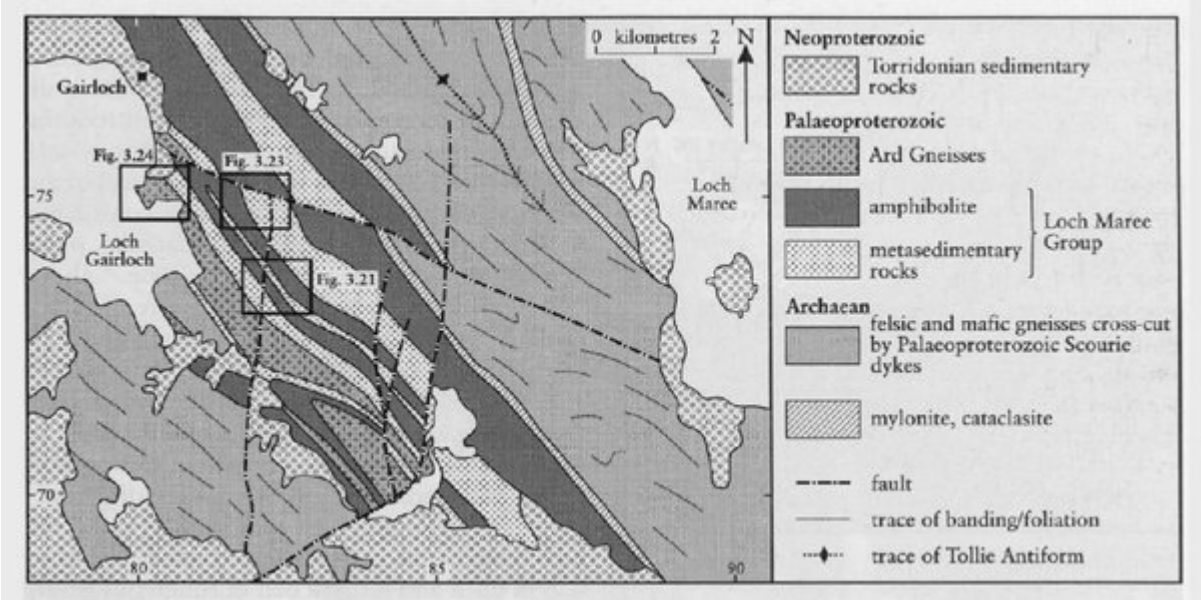
The pervasive, well-developed foliation and strong, SE-plunging, elongation lineation exhibited by most lithologies in the succession are ascribed to the early-Laxfordian deformation, (D1/D2), developed under amphibolite-facies metamorphic conditions. This deformation is thought to be responsible for the generation of a major low-angle shear-zone, subsequently rotated and reactivated in the later Laxfordian to result in the major Gairloch Shear Zone (Park, 2002). The mylonites seen at Kerrysdale are also interpreted to have developed initially during the early-Laxfordian deformation.

Conclusions

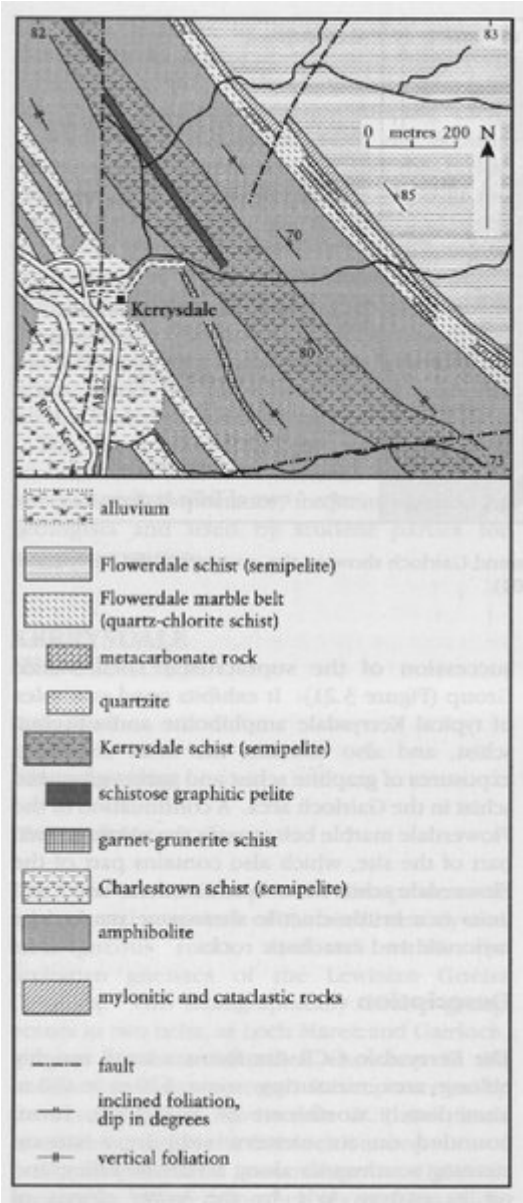
The Kerrysdale GCR site provides a traverse across the main metasedimentary and meta-volcanic rock units of the Loch Maree Group in the Gairloch area. The main lithologies are amphibolites and semipelitic rocks of the Kerrysdale unit, but subsidiary rock-types include garnet-grunerite schist, siliceous quartz-biotite schist, and graphitic pelitic schist. Calcareous rocks are found in the adjacent Flowerdale marble belt and the site also includes excellent exposures of cataclastic and mylonitic rocks in a brittle–ductile shear-zone along the boundary between the Flowerdale marble belt and the quartz-biotite schists of the Flowerdale schist unit to the north-east.

This Palaeoproterozoic supracrustal sequence occurs in only two areas of the mainland Lewisian outcrop, at Gairloch and Loch Maree, and the Gairloch exposures are more readily accessible. The significance of the Loch Maree Group lies in its providing the only evidence on the Scottish mainland of sedimentation and volcanic activity of Palaeoproterozoic age, from which attempts can be made to reconstruct the palaeoenvironment of that period. As such the GCR site is of national interest and is eminently suitable for teaching and for research purposes.

References



(Figure 3.20) Map of the Loch Maree Group outcrops around Gairloch showing the position of the Kerrysdale, Flowerdale and An Ard GCR sites. After Park et al. (2001).



(Figure 3.21) Map of the Kerrysdale area, Gairloch. Based on Park (1978) and British Geological Survey 1:50 000 Provisional Series Sheet 91, Gairloch (1999).

(Figure 3.22) Quartz-biotite-rich schistose semipelite with strongly developed rodding lineation, Kerrysdale. The hammer is 37 cm long. (Photo: R.G. Park.)