Moine geology from Invergarry to Kinloch Hourn, eastern end - an excursion

From Earthwise
Jump to navigation Jump to search

From: Strachan, Rob, Friend, Clark, Alsop, Ian, Miller, Suzanne (Editors). A Geological excursion guide to the Moine geology of the Northern Highlands of Scotland.: Edinburgh Geological Society, Glasgow Geological Society in association with NMS Enterprises, 2010.

By Alan M. Roberts and David Barr

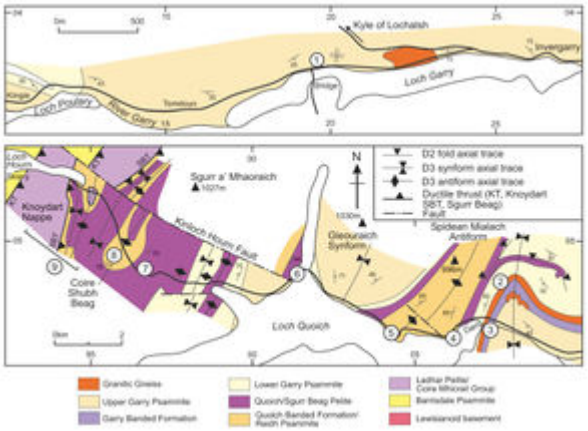

Fig. 4.1 Location map and general geology of Excursion 4.

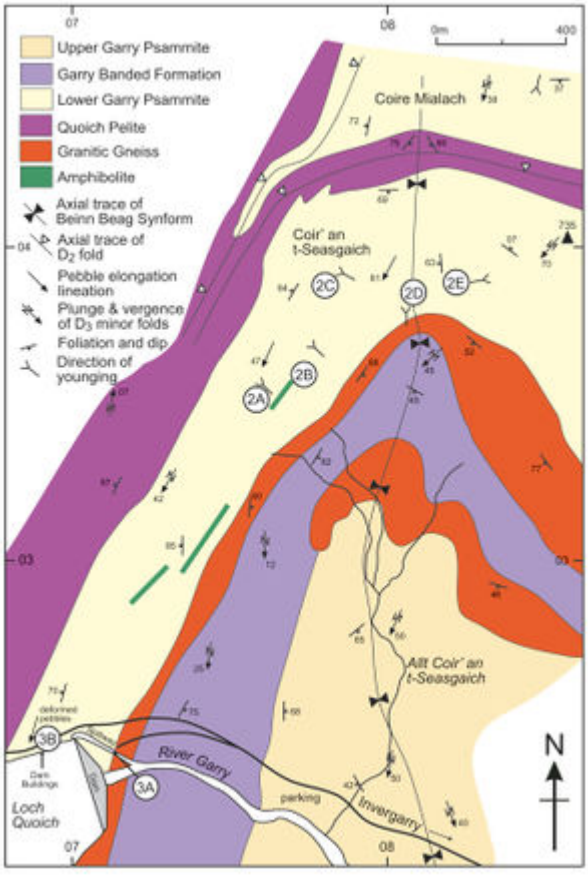

Fig. 4.2 Geological map of Locality 4.2, also

showing location of Locality 4.3.

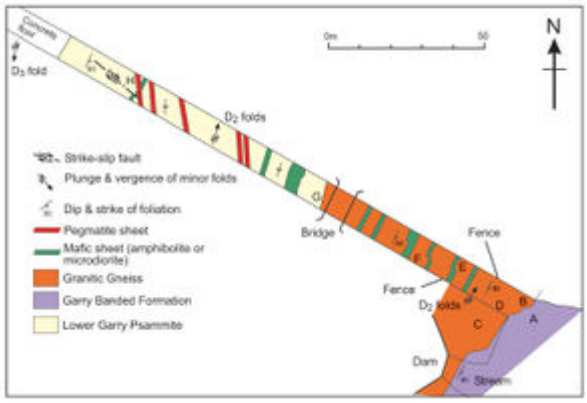

Fig. 4.3 Geological map of Locality 4.3, the Quoich dam spillway.
□

Contents

Excursion 4 Invergarry to Kinloch Hourn is composed of the following articles:

Locality 4.1 Garry Quarry [NH 196 023]

Garry Quarry (Fig. 4.1). Curvilinear, recumbent folds in Loch Eil Group psammite.

The first locality is reached by driving west from Invergarry on the A87 until the turnoff for Kinloch Hourn and Tomdoun is reached [NH 243 029]. Turn left onto the Kinloch Hourn road (single track with passing places) and continue along it for 5km until you reach a small quarry adjacent to the road, just short of the Greenfield bridge across Loch Garry. Parking is available opposite the quarry for no more than two cars. The quarry exposes Loch Eil Group psammites within the regional flat belt and allows an unequalled opportunity to examine the geometry of structures within the psammites in three dimensions. A detailed structural analysis of this quarry, including a map, 3D diagram and stereographic plot of structural elements can be found in Holdsworth & Roberts (1984).

The psammites are folded by tight, recumbent folds that can be traced laterally for some distance. Holdsworth & Roberts (1984) drew attention to the fact that the hinges of individual folds at this locality are curved rather than linear. The curvature of the hinges of the folds in the quarry is symmetrical about a very weak, north-south extension lineation. Such an extension direction is distinctly different in orientation from the usual WNW-directed extension lineations associated with overthrusting during the Scandian phase of the Caledonian orogeny, both in the Moine and the

Moine Thrust Belt. It has therefore been suggested that the folds seen in the quarry (D2 in the local deformation sequence) formed during an earlier tectonic event. Titanites aligned within the north-south extension lineation near Invergarry have yielded a U-Pb zircon age of 470 ± 2 Ma, perhaps indicating that the lineation and associated curvilinear folds formed during the Grampian phase of the Caledonian orogeny (Rogers et al., 2001). Garry Quarry also exposes post-tectonic granitic veins belonging to the Glen Garry Vein Complex (Fettes & MacDonald, 1978), together with mineralised (pyrite, haematite, calcite) faults and joints.

Locality 4.2 Coir' an t-Seasgaich [NH 076 035] to [NH 082 0390]

Coir' an t-Seasgaich (Fig. 4.1) and (Fig. 4.2). Sedimentary structures and cross-cutting amphibolite sheets preserved in a 'low-strain window' around the Loch Quoich Line.

From Locality 4.1 drive west for 12km until the road crosses the Allt Coir' an t-Seasgaich at [NH 078 023] (Fig. 4.2). Parking is available for several cars or a small coach on the southwest side of the road. About 1.5km north of here, on the east flank of Spidean Mialach, lies Coir' an t-Seasgaich, a corrie that contains many large, glacially-scoured exposures visible from the road. The corrie is best reached by walking up beside the Allt Coir' an t-Seasgaich, aiming eventually for the lower exposures in the corrie 2A (Fig. 4.2). A practised and fit hillwalker will reach these slabs in just over half an hour; others should allow longer and all should wear stout footwear. In total, a visit to this locality involves about 4km of walking and 550 m of ascent.

The walk up the Allt Coir' an t-Seasgaich takes you from the Upper Garry Psammite of the Loch Eil Group (Fig. 4.2) through granitic gneiss, the Garry Banded Formation, another sheet of granitic gneiss, and finally into the Lower Garry Psammite that forms the slabs in Coir' an t-Seasgaich. This section is part of the Glenfinnan/Loch Eil group transition zone described by Roberts & Harris (1983).

On reaching the slabs, 2A (Fig. 4.2), the most obvious difference between the psammites here exposed and those seen in the flat belt at Locality 4.1 is the common preservation of sedimentary structures. A slow traverse across the corrie from this initial location to a point on the east ridge of Spidean Mialach at 2C (Fig. 4.2) should reveal abundant cross-lamination (younging towards the SE), graded beds, slump folds, contorted bedding and pebbly beds. Such excellent preservation of sedimentary structures is unknown elsewhere in this part of the Sgurr Beag Nappe, and illustrates the low state of strain of these rocks. Also indicative of low strain are the amphibolite sheets and pods. As will be seen at Locality 4.3, amphibolites normally occur as concordant sheets; however, the low strain state in Coir' an t-Seasgaich has allowed their original cross-cutting intrusive relationships to be preserved. An excellent example of a cross-cutting amphibolite is exposed in the slabs at 2B (Fig. 4.2). Such preservation of strongly cross-cutting relationships is rare within the Sgurr Beag Nappe.

Although the psammites in the corrie are generally at a low state of strain, local areas of high strain, into which sedimentary structures are progressively deformed, can also be seen. Within these zones of higher strain, pebbles in conglomeratic horizons have been deformed to an elliptical shape.

On reaching the ridge 2C a rest should be taken to enjoy the view. Only 1km to the west is the peak of Spidean Mialach, one of many Munros (3000-foot-high mountains) in this area, to the north the view extends to the high peaks above Loch Cluanie, to the east can be seen Ben Tee adjacent to the Great Glen, and the Monadhliaths beyond, and to the south (weather permitting!) can be seen Ben Nevis and the surrounding mountains.

The psammites observed at Locality 4.1 had a nearly flat sheet-dip, while those seen in Coir' an t-Seasgaich are steeply inclined or vertical. This is because the Loch Quoich Line, the boundary between the regional flat and steep belts (Leedal, 1952; Clifford, 1957; Roberts & Harris, 1983) has been crossed (see 'Summary of Moine Geology' for regional significance of the Loch Quoich Line). The synform marking the course of the Loch Quoich Line in this area can be examined by traversing the ridge on which you are now standing. At stop 2B, and elsewhere throughout the slabs examined so far, the psammites strike approximately NE-SW and young towards the SE. At 2E, 400m to the east the psammites strike NW-SE and young towards the SW; the Beinn Beag Synform (= the Loch Quoich Line sensu Roberts & Harris, 1983) has been crossed. The axial trace of the synform, where the psammites young due south, can be seen at 2D (Fig. 4.2). The rocks immediately east of the Loch Quoich Line do not become flat immediately, but rather their sheet-dip decreases gradually across several kilometres. Walk back down the hill and rejoin the vehicles.

Locality 4.3 Quoich dam spillway [NH 071 023]

Quoich dam spillway (Fig. 4.1) and (Fig. 4.3). Quoich Granite Gneiss, metasedimentary country rock within the Glenfinnan/Loch Eil group transition zone, amphibolites, microdiorite.

From the parking place for Locality 4.2, drive west for about 1km and park in one of the large lay-bys beside the Quoich dam (Fig. 4.2). Descend SE from the lay-by, alongside the spillway, keeping to the north of the fence. At 3A (Fig. 4.3), the contact is exposed between the Quoich Granitic Gneiss and the structurally overlying Garry Banded Formation. The granitic gneiss lying west of the contact is pale pink, medium-grained and consists mainly of K-feldspar, plagioclase (An15-20) and quartz. The pervasive D1/D2 tectonic fabric is defined by discontinuous biotite-rich laminae and by concordant migmatitic lits. These have mafic selvedges and probably formed by in situ metamorphic segregation. The Quoich Granite Gneiss (part of the West Highland Granitic Gneiss) is regarded as a deformed and metamorphosed granite that was intruded at c.870 Ma (Friend et al., 1997; Rogers et al., 2001). Whether migmatization also occurred at c.870 Ma (Friend et al., 1997) or much later during the Caledonian orogeny (Dalziel & Soper, 2001) is uncertain. The gneiss-metasedimentary rock contact is sharp but lacks the platy fabrics associated with tectonically emplaced basement bodies (see Locality 4.9). No transitional rocks indicative of a metasomatic origin are developed. The migmatitic pelite adjacent to the granite gneiss grades over about 5 m into interbedded psammite and pelitic gneiss. Leucosomes within the pelites are deformed by intrafolial isoclines and an unusual, antiperthitic-bearing variety was probably formed by partial melting (Barr, 1985).

At 3B, the core of a large Z-profile fold is occupied by a patch of remobilised granite gneiss with an undeformed, granitoid appearance. An early amphibolite traced through this locally pegmatitic body is progressively deformed, and altered to biotite and feldspar. Textures within this remobilised rock suggests an origin by partial melting but its chemistry favours subsolidus segregation or re-equilibration after consolidation (Barr, 1985), perhaps related to the intense retrogression evident in its vicinity.

At 3C, a metasedimentary enclave crops out in the spillway wall. It defines an S-profile, reclined D2 fold pair, and consists of a thin but extensive band of psammite with concordant hornblende schist. At 3D, a second enclave comprising micaceous psammite and quartzite intruded by hornblende schist is also deformed by D2 folds. Barr et al. (1985) interpret these and other enclaves as deformed xenoliths within an original magmatic granite. Also at 3C, a coarse granitoid patch disrupts the D1/D2 foliation and agmatizes an amphibolite sheet (Barr, 1985, (Fig. 7.7)b). It appears to be associated with a sinistral, extensional shear zone, one of several present in this area.

Return to the spillway at 3D and proceed upslope observing a number of sinistral, NW-SE-trending

shear zones within the granitic gneiss. Pegmatitic segregations have developed within some but not all of these shear zones, destroying the foliation in the gneiss. Barr (1985) concluded that partial melting had been localized in the shear zones. This part of the section also exposes numerous isoclinal D2 folds that deform pegmatites and an earlier D1 gneissic fabric. In the SW wall of the spillway, an upright D3 fold pair indicates an antiform to the west, the Spidean Mialach Antiform of Roberts & Harris (1983).

Over the next 30m of section, numerous amphibolite sheets crop out within the granitic gneiss. The margins of these amphibolites are generally concordant with the foliation in the gneiss, but the intrusive origin of one body at 3E is confirmed by the presence of several c.10cm diameter xenoliths of granitic gneiss. In this central portion of the gneiss, D2 isoclinal folds of the earlier D1 fabric are common, transposing the foliation everywhere but in the relic fold cores. Similar structures can also be seen in the Ardgour Granite Gneiss (Excursion 2, Localities 2.7 & 2.8; Barr et al., 1985, figure 4b). Where these D2 folds deform amphibolite sheets, an axial planar hornblende fabric is produced.

At 3F (Fig. 4.3), a 2m-thick SE-dipping microdiorite sheet cuts the spillway. This sheet bifurcates and includes xenoliths of granitic gneiss. Unlike the older hornblende schists and amphibolites, the microdiorite cross-cuts the D2 fabric in the gneiss. It also cuts across an earlier concordant amphibolite and is largely post-tectonic. It retains a coarse-grained centre and a fine-grained, amygdaloidal margin, but has recrystallized to an amphibolite-facies mineral assemblage. Several smaller microdiorites are present upslope.

At 3G (Fig. 4.3), a sharp contact is exposed between granitic gneiss and a 1m-thick, antiperthite-bearing migmatitic pelite. Upslope from this pelite band, the ground to the top of the spillway is occupied by psammites and quartzites of the Lower Garry Psammite (Roberts & Harris, 1983). These psammites are along strike from those seen in Coir' an t-Seasgaich (Locality 4.2), but lack their abundant sedimentary structures. Only a few highly deformed cross-beds are preserved, and the uniform, finely banded appearance of the psammites, which contain reclined, isoclinal folds, is thought to indicate that they have been highly strained. This high strain has obliterated any original angular discordances, and Roberts & Harris (1983) attribute it to severe upright Caledonian reworking, during the D3 deformation that produced the regional steep belt west of the Loch Quoich Line.

A 4m-thick amphibolite sheet lies 10m into the psammites. Its northern margin has been interfolded with the psammites by reclined D2 structures, and the amphibolite carries an axial planar D2 fabric. Upslope, several north-south-trending pegmatites cut D2 structures within the psammites and are deformed by late, semi-brittle kink bands. They are little deformed internally, and probably late Caledonian in age.

At 3H (Fig. 4.3), a 1.5m-thick, NE-SW-trending microdiorite sheet is displaced c.2m by a NW-SE-trending fault. This fault passes along its length into a brittle, dextral kink band. Adjacent to this fault, in the NE wall of the spillway, the psammites are intruded by a fine-grained, intermediate igneous rock that may be a member of the minette suite of Smith (1979). Complete this section by walking up to the concrete-floored part of the spillway, and look up at the SW wall to observe a mesoscopic, gently-plunging D3 fold pair verging westwards to the Spidean Mialach Antiform.

Return to the bridge and climb back up to the road. Whilst walking past the dam buildings, note the presence, in psammites of the road section, of several south-plunging D3 fold pairs that verge westwards towards the Spidean Mialach Antiform. These are cut by SE-dipping microdiorite sheets but fold an earlier amphibolite sheet. At [NH 069 025], opposite the dam, a stream passes beneath the road. On the north side of the road, on the left side of the stream, a deformed pebbly unit is exposed within the psammites. The pebbles of quartz and feldspar are much more strongly deformed

than those seen in Coir' an t-Seasgaich. The quartz pebbles define a steep extension lineation and have axial ratios of approximately 3:1:0.2. They help to quantify the amount of ductile strain recorded by the enclosing platy psammites.

Locality 4.4 Quoich Quarry [NH 062 018]

Quoich Quarry (Fig. 4.1). Highly deformed Glenfinnan Group psammites; microdiorite and felsic porphyrite sheets.

Return to the vehicles and drive c.1km west to [NH 062 021], where a steep track descends to the lochside quarry. En route, check that the nearer of the two islands in Loch Quoich is connected to the shore; if not, the quarry floor may be flooded and access difficult. Coaches and minibuses should discharge their passengers on the main road and park in the large lay-by 250m further SW. Once in the quarry, examine the steeply-dipping, planar-banded psammites exposed in the south and west walls. These psammites form part of the Quoich Banded Formation, lie on the eastern limb of the D3 Spidean Mialach Antiform ((Fig. 4.1): Roberts & Harris, 1983) and are very similar in rock type to the Reidh Psammite seen later at Locality 4.9. The psammites are quite extensively migmatized and the regular, planar banding, largely unaffected by minor folding, is typical of a structural setting on the limb of a major, upright Caledonian fold. Foliation surfaces within the psammites carry a steeply-plunging mineral and intersection lineation, that is related to a cleavage lying in places at a low angle to the main lithological/metamorphic banding. The cleavage strikes clockwise of banding and is related to the north-plunging Spidean Mialach Antiform. Between here and the Quoich dam, D3 fold axes have rotated through the horizontal such that the adjacent Spidean Mialach Antiform and Beinn Beag Synform both open southwards (figure 4.1: Roberts & Harris 1983, figure 2).

Two sets of Caledonian pegmatites cut the psammites in the quarry: an early biotite-bearing, deformed set, typically dipping at 60° towards 270°, and a later, less-deformed, muscovite-rich set, typically dipping very steeply towards 250°, and comparable to those in the spillway.

At the east end of the south face of the quarry, a microdiorite sheet dipping at 45° towards 108° cuts across the psammites. It has a chilled margin and a coarse-grained core, and cuts both sets of pegmatites. It also forms a prominent feature in the north face of the quarry.

If time is pressing, return now to the vehicles. If not, the eastern side of the 'island' lying 200m SE of the quarry can be visited. The level of the loch is commonly low enough for the island to be reached on foot. The island consists of typical Glenfinnan Group migmatitic pelitic gneiss (the Quoich Pelite; Roberts & Harris, 1983), and the eastern side exposes complexly folded pelitic gneiss containing numerous pods and sheets of metabasic garnetiferous amphibolite. Having examined the pelitic gneiss and amphibolites, best exposed at the SE corner of the island, return to the vehicles.

References

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

- 2. Northern Highlands

Navigation menu

Personal tools

- Not logged in
- Talk
- Contributions
- Log in
- Request account

Namespaces

- Page
- Discussion

□

Variants

Views

- Read
- Edit
- View history
- PDF Export

□

More

Search

Search Go

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 4 December 2019, at 13:14.

- Privacy policy
- About Earthwise
- Disclaimers
- British Geological Survey NATURAL ENVIRONMENT RESEARCH COUNCIL
- Powered By MediaWiki Semantic MediaWiki