
Excursion 2 Fort William to Glenfinnan

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<i>Purpose:</i>	A general excursion to examine the main aspects of the geology of the Loch Eil Group and easternmost parts of the Glenfinnan Group.
<i>Aspects covered:</i>	Psammites, sedimentary structures and calcsilicates in the Loch Eil Group; migmatitic gneisses in the Glenfinnan Group; the Ardgour Granite Gneiss; amphibolites and microdiorites; steep belt and flat belt.
<i>Maps:</i>	OS: 1:25,000 sheets 391 Ardgour and Strontian and 392 Ben Nevis and Fort William; BGS: 1:50,000 sheet 62W Loch Quich.
<i>Type of terrain:</i>	Roadside exposures. <i>Distance and time:</i> By car 31km (19 miles), about 45 minutes; on foot 6km, c.7 hours.
<i>Short itinerary:</i>	Localities 2.1, 2.2, 2.9 and 2.10 cover the main rock types, tectonic structures and minor intrusions present within the metasedimentary rocks and the granitic gneiss. Time may be reduced to 3-3½ hours.

The Moine rocks of this area comprise psammites and quartzites of the Loch Eil Group that are underlain by interbanded pelites and psammites of the Glenfinnan Group. Both have been subjected to a common history of deformation and metamorphism. The structural sequence involves two phases of recumbent folding (D_1 and D_2) and three phases of upright folding (D_3 - D_4) (Strachan, 1985). D_1 and D_2 folds have been recognized at least as far north as Loch Quich and Glen Garry (Holdsworth & Roberts, 1984). D_3 folds, however, are only well developed in the southern part of the Loch Eil Group and are apparently absent in the Loch Quich area where the structural sequence is generally simpler (Strachan, 1985). D_3 folds as defined above are absent west of Locality 2.5, so Barr (1983), Roberts (1984) and Barr *et al.* (1985) applied their Loch Quich structural sequence in that area, i.e. D_3 of these authors (see Excursion 4) corresponds to D_4 of Strachan (1985) and the present account. The most important set of upright folds on a regional scale are the NNE–SSW-trending D_4 structures (= D_3 at Loch Quich) that are responsible for the formation of the steep belt and the Loch Quich Line. D_1 is most likely Knoydartian in age, and D_2 - D_4 are assigned to the Caledonian orogeny (Roberts *et al.*, 1984; Rogers *et al.*, 2001; Strachan & Evans, 2008).

The first locality is reached by driving north from Fort William on the A82 road. Three kilometres north of Fort William, turn left at Lochy Bridge onto the A830. Drive through Corpach to the first locality near the Loch Eil Outward Bound Centre [NN 057 784]. Good views of the Ben Nevis range and the Mamores may be obtained by looking eastwards from this point.

Locality 2.1 Loch Eil shore section. [NN 057 784]

Loch Eil shore section (Figure 2.1). Loch Eil Psammite intruded by amphibolites. [NN 057 784]

Parking for two to three cars is available opposite the boat sheds on the north side of the road at the entrance to a small forest track. Cross the rail track at the level crossing to access the shore of the loch. Walk west for c.200 m to low-lying outcrops of quartzo-feldspathic psammites and concordant amphibolite sheets. The amphibolites carry a mineralogy of hornblende + quartz + andesine and represent basic intrusions probably emplaced prior to D_1 (Smith, 1979; Strachan, 1985). The gently-dipping to subhorizontal schistosity is interpreted as a composite $S_0 / S_1 / S_2$ fabric. Both lithologies carry a N-S-trending L_2 mineral and extension lineation defined by aligned amphiboles and quartz-feldspar aggregates. Lithological banding and the lineation are folded by upright, open folds in the core of the D_4 Loch Eil Synform (Strachan, 1985). Thin cross-cutting granitic veins are presumed to be of late Caledonian age.

Locality 2.2 Fassfern. [NN 0215 7895]

Fassfern (Figure 2.1). Sedimentary structures within the Druim Fada Quartzite; microdiorite intrusions within the Loch Eil Psammite. [NN 0215 7895]

Due to the narrowness of the access road, coach parties are advised not to visit this locality.

From Locality 2.1, drive c.3.5km further west and turn right onto the minor road signposted to Fassfern. Continue for 0.5km until reaching the small bridge over the Allt Suileag. Cars and minibuses may be parked west of the bridge on the north side of the road adjacent to a white farm building. Walk over the bridge and climb over the stile north of the road. Descend the grassy slope down to the stream with care, and examine the exposures underneath the bridge. These comprise well-bedded quartzite and siliceous psammite assignable to the Druim Fada Quartzite, dipping gently to the east. Symmetrical straight-crested ripples are common on bedding surfaces. These are considered to result from the reworking of the sediments by wave activity. The quartzites are underlain upstream by grey micaceous Loch Eil Psammite, which locally preserves small-scale cross-laminations that young to the east. Three hundred metres north of the bridge [NN 0220 7925], amphibolite sheets are cut by pegmatite veins that are in turn cut by a weakly foliated microdiorite sheet. Retrace your steps to the parking place.

Locality 2.3 Loch Eil road section. [NM 988 788]

Loch Eil road section (Figure 2.1). Calc-silicates in Loch Eil Psammite; late granite veins. [NM 988 788]

From Locality 2.3, drive westwards out of Fassfern and turn right onto the A830. Drive 2.5km further west and park in a large lay-by on the south side of the road. Carefully cross the road to the cutting where dark, micaceous psammites dip gently to the west. The locality is notable for the development of calc-silicate rocks. These are commonly white or pale grey and show every variation from large elliptical pods to small lenticles and calcareous wisps. They are considered to represent concretions formed during the diagenesis of the enclosing sediments (Tanner, 1976; Strachan, 1986). The calc-silicates contain a prograde mineral assemblage of hornblende + andesine + quartz + garnet ± biotite, broadly indicative of low-amphibolite facies metamorphism. At the west end of the locality, lithological banding (S_0 / S_1) S_1 dips gently to the west and is noticeably oblique to subhorizontal S_2 , suggesting proximity to an F_2 fold hinge. The psammites are cut by numerous sheets of granite and aplite that belong to one of the late Caledonian granite vein complexes (Fettes & MacDonald, 1978).

Locality 2.4 Kinlocheil. Psammites and hornblende schists of the Loch Eil Group. [NM 962 793]

Kinlocheil (Figure 2.1). Psammites and hornblende schists of the Loch Eil Group; pelitic gneisses of the Glenfinnan Group. [NM 962 793]

Due to the narrowness of the access road, coach parties are advised not to visit this locality. From Locality 2.3, drive c.4km further west. Slightly east of the junction with the A861 Strontian road, turn right and drive over the old road bridge over the Allt Fionne Lighe. Cars and minibuses may be parked on the hard-standing east of the bridge. A small tree-covered hillock 300 m east of the bridge exposes the lowermost levels of the Loch Eil Group, represented here by gently-dipping micaceous psammites and hornblende schists. The upper unit of the Glenfinnan Group, the Druim na Saille Pelite, is exposed 100 m west of the hillock and beneath the old road bridge. Here this unit comprises medium to coarse-grained pelitic gneisses with concordant migmatitic quartzofeldspathic segregations. The gneisses are composed of biotite + muscovite + quartz + feldspar + garnet ± fibrolite. The actual contact between the two divisions is unexposed; however, the general absence of widely developed high strain fabrics at any of these localities precludes the presence of a major tectonic break such as that which separates the Morar and Glenfinnan groups further west. The conformable nature of the Glenfinnan-Loch Eil contact is more clearly demonstrated at Loch Quoich (see Excursion 4). Return to the vehicles.

Locality 2.5 Callop road section (Figure 2.1). Flat-lying Ardgour Granite Gneiss with S_2 fabric and quartzofeldspathic lits; microdiorite sheet; D_2 folds in flat belt. [NM 925 794]

Drive westwards along the A830 for c.3km and park in the Callop track (300m past the railway bridge, on the left). The low-lying area between Loch Shiel and Loch Eil is commonly known as the 'Callop gap' and only attains a height of c.20m above sea level. It is a good example of a low level glacial breach formed by intense glacial erosion and breaching of a preexisting watershed during the movement of ice sheets from west to east. On the way to the parking place, passengers can note in roadside exposures the gentle, undulating dip of the granitic gneiss, locally interrupted by steep, NNE–SSW-trending D_4 fold limbs. The wide outcrop of the granitic gneiss is a consequence of its gentle sheet dip. Most exposures lie in the upper part of the body, which is essentially sheet-like and less than 1km thick.

The cutting on the north side of the A830 exposes the gently-dipping Ardgour Granite Gneiss. The gneiss is readily distinguished from the metasedimentary country rocks by its strictly granitic composition (subequal quartz, K-feldspar and oligoclase with lesser biotite). It is homogeneous on the scale of an exposure, but a strong foliation is defined by discontinuous biotite laminae and light-coloured veins or *lits*. This corresponds to the S_2 fabric described in the Loch Eil Group rocks (Strachan, 1985). The veins or *lits* formed by segregation from biotite-bearing granitic gneiss and often have a prominent biotite-rich selvage (restite). The gently-dipping gneissic fabric is folded by open, upright D_4 folds, but at the eastern end of the exposure is axial-planar to recumbent, isoclinal D_2 folds of the quartzo-feldspathic *lits*. Quartz in the *lits* carries an S_2 shape fabric and other *lits* form augen within the foliation. The Loch Quoich Line is defined further west by an increase in the tightness of the upright D_4 folds. This exposure demonstrates that the granitic gneiss possessed a strong fabric and had been migmatized prior to D_4 , so a genetic link between granitic gneiss and the Loch Quoich Line (e.g. Dalziel, 1966) is unlikely.

An ESE-dipping foliated microdiorite sheet has contacts steeper than banding in the granitic gneiss. In the steep belt (e.g. Locality 2.9), microdiorites have similar dips but with contacts *shallower* than banding, showing that they post-date the initiation of the steep belt and the Loch Quoich Line. If more than one vehicle is available, it is worthwhile leaving one here and another at Locality 2.10, and walking the c.1.5km of road section without interruptions. Otherwise, drive c.400m west and park opposite the track leading to Craigag Lodge, in the process crossing the open D_4 Glen Dubh Lighe Antiform of Dalziel (1966).

Locality 2.6 Craigag road section (Figure 2.1). Amphibolites and ptygmatic folds in granitic gneiss. [NM 922 796]

Cross the A830, and in cuttings observe gently-dipping granitic gneiss containing early *lits* that define intrafolial D_2 folds and rootless fold cores (Figure 2.2). A number of metabasic early Moine amphibolites, concordant with the gneissic fabric, are present within the granitic gneiss. Compare these highly foliated and lineated rocks with the late Caledonian microdiorite at Locality 2.5. To the west, a series of broadly north-south-trending, open, upright D_4 folds deform the S_2 fabric and the amphibolites, and several cross-cutting late Caledonian pegmatites are present. Walk NW along the road towards the small stream, distinguishing between early *lits* that define intrafolial folds, and later pegmatites that cut S_2 but in some cases are ptygmatically folded. D_4 structures show no overall vergence in this area which lies in the core of the Callop Synform and thus corresponds to the Loch Quoich Line *sensu* Barr *et al.* (1985). Return to the vehicles and proceed to Locality 2.7.

Locality 2.7 Allt na Criche road section (Figure 2.1). Low-strain zone in centre of granitic gneiss sheet. [NM 919 799]

Allt na Criche road section (Figure 2.1). Low-strain zone in centre of granitic gneiss sheet. [NM 919 799]

From Locality 2.6, drive c.400m west to the next lay-by. Walk east along the A830 for c.100m, to where, in a cutting on the north side of the road, a 3m-thick pegmatite sill with vertical feeders disrupts the granitic gneiss. The variably-dipping gneissic foliation is axial-planar to rootless D_2 isoclines, and is locally steepened by D_4 folds. The pegmatite cuts these

folds, and also intrudes a folded hornblende schist which is broadly concordant but has locally cross-cutting apophyses. Walk c.100m west along the road to view the outcrops opposite the lay-by, noting that the S_2 foliation has an average easterly dip and that open, NNE-plunging D_4 folds verge towards an antiform to the west. In the vicinity of the stream, S_2 is subvertical and strikes NNE–SSW; 100m beyond the stream, gentle easterly dips return. This part of the section defines an east-facing D_4 monocline that brings up the central part of the granitic gneiss sheet.

Walk further west for another 100m, noting that within this central part of the granitic gneiss, D_2 strain is low and the gently undulating but east-dipping S_2 fabric is axial-planar to open or close, ENE-plunging folds of early *lits* (Barr *et al.*, 1985, Fig. 4a). Traces of an earlier S_1 gneissic fabric can be recognized, sub-parallel to the *lits*. This fabric is also defined by discontinuous biotite-rich laminae. Locally, the S_2 fabric becomes extremely weak and sub-recumbent folds of S_1 are preserved (Barr *et al.*, 1985, figure 4b).

The *lits* and their biotite selvages cut the S_1 fabric, confirming their post- D_1 , pre- D_2 age. Both D_1 and D_2 structures are cut by a microdiorite sheet. In this lowest-strain region in the centre of the granite gneiss, the origin of the granitic gneiss is clear: it represents a deformed granite that was itself affected by segregation. U-Pb dating of zircons from samples collected at this locality of the granitic gneiss and its quartzofeldspathic *lits* has yielded an age of 870 ± 7 Ma that is thought to date Neoproterozoic high-grade metamorphism and anatexis of this part of the Moine Supergroup during an orogenic event (Friend *et al.*, 1997). An alternative interpretation is that the protolith of the granite gneiss is entirely pre-tectonic and was generated by crustal melting during extensional rifting and development of the Moine sedimentary basin (Millar, 1999; Dalziel & Soper, 2001). Return to the vehicles and proceed to the next lay-by adjacent to the abandoned roadway.

Locality 2.8 Glenfinnan road section. Loch Quoich Line [NM 916 802]

Glenfinnan road section (Figure 2.1). Loch Quoich Line; minor intrusions; western margin of the granitic gneiss; steep belt. [NM 916 802]

Cross to granitic gneiss exposed in the adjacent road cut, where an east-dipping gneissic foliation steepens westwards about a D_4 fold hinge plunging at 45° towards 030° . It is axial-planar to tight, ENE-plunging folds of early *lits* that can be seen in various stages of transposition into this S_2 fabric. At this locality the sheet-dip is steep towards the east, reflecting a general increase in the intensity of D_4 strain and upright folding towards the west. However, no transposition into an S_4 fabric has occurred, and a strong S_2 fabric is preserved in the granitic gneiss (Figure 2.2). An increase in D_2 strain towards the base of the granitic gneiss sheet is inferred on the basis that no S_1 fabric is apparent. This locality also displays a ESE-dipping, foliated microdiorite sheet and a later discordant pegmatite.

Walk westwards along the north side of the A830 for c.200m, noting that abundant upright D_4 folds in the granitic gneiss are cut by late Caledonian pegmatites. These folds verge towards an antiform to the west and their tightness, steep NNE plunge and attenuated long limbs are typical of the steep belt, west of the Loch Quoich Line. Note the uniformly steep dip of the gneissic foliation. Approaching the sign 'Glenfinnan Monument 0.5 mile', the gneiss remains steeply-dipping and planar-banded. One hundred metres past the sign, a road cut exposes typical Glenfinnan Group rocks of the steep belt. Migmatitic psammities, semi-pelites and pelites are intensely deformed and most leucosomes are transposed into the steep fabric, although some reclined, isoclinal S-folds are still preserved. These are related to the very tight D_4 Meall na Cuartaige Antiform (Barr *et al.*, 1985, figures 2, 3), although throughout most of this area, intense D_4 strain makes systematic mapping of D_4 fold vergence difficult. A large amphibolite at this locality carries an internal fabric that is deformed by the reclined D_4 folds. Return to the vehicles.

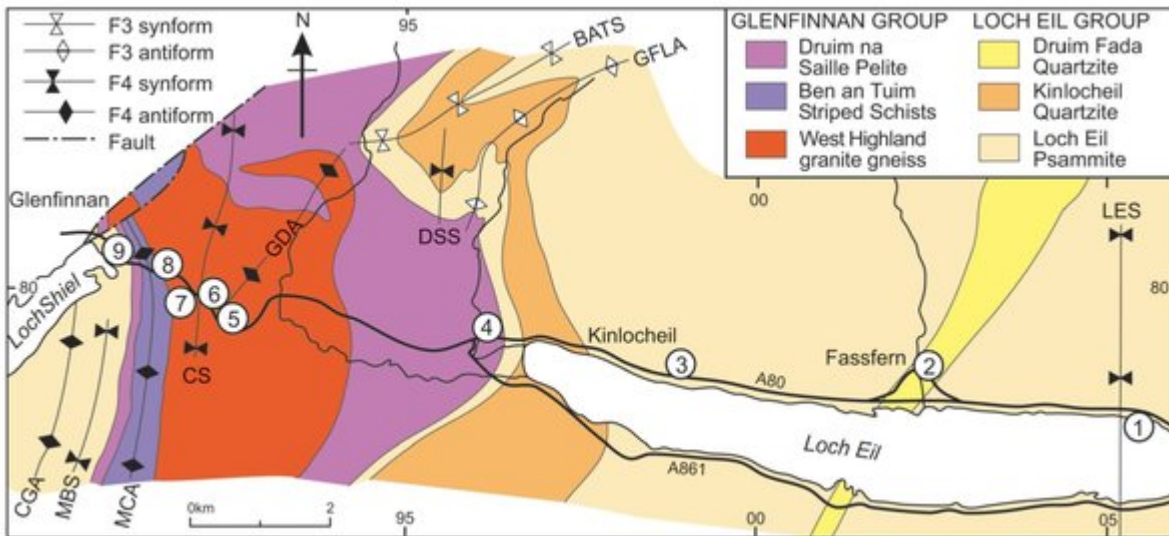
Locality 2.9 Glenfinnan road section. [NM 909 804]

Glenfinnan road section (Figure 2.1). Loch Eil Group psammities within the steep belt. [NM 909 804]

From Locality 2.8, drive c.600m west and park in the disused road immediately before a road cut through large crags north and south of the A830. The crags expose Loch Eil Group psammities similar to those seen at Localities 2.1-2.4, but

here folded into a steep attitude within the regional steep belt. The psammites occupy the core of a major D_4 fold, the Sgurr Ghiubhsachain Synform (Dalziel, 1966; Barr *et al.*, 1985), complementary to the Meall na Cuartaige Antiform. High strain associated with the D_4 folding has obliterated any sedimentary way-up evidence at this locality, and minor folds are also rare. Most foliation surfaces carry a steeply north-plunging intersection lineation that is likely to approximate to the plunge of the Sgurr Ghiubhsachain Synform in this area. The steeply-inclined foliation of the psammites is cut by numerous steeply-inclined, post-tectonic pegmatites. The westward continuation of this road section is described in the following excursion. Parties who do not intend to continue any further may, however, like to drive to the Glenfinnan Visitor Centre where there are splendid views of the Glenfinnan Jacobite Monument and Loch Shiel. The monument was erected to commemorate the 1745 Highland uprising, led by Bonnie Prince Charlie who erected his standard at Glenfinnan.

References



Map of the Loch Eil-Glenfinnan area showing the generalized geology and the localities for the excursion. BATS = Ben an Tuim Synform, D_3 ; DSS = Druim na Saille Synform, D_4 ; GDA = Glen Dubh Lighe Antiform, D_4 ; CS = Callop Synform, D_4 ; MCA = Meall na Cuartaige Antiform, D_4 ; GFLA = Glen Fionne Lighe Antiform, D_3 ; LES = Loch Eil Synform, D_4 ; MBS = Meall a Bhainne Synform, D_4 ; CGA = Coire Ghiubhsachain Antiform, D_4



Typical exposure of the Ardgour Granite Gneiss at Locality 2.6, showing abundant concordant quartz-feldspathic segregations parallel to gneissic banding.