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## Excursion 5 Ullapool River, Creag nam Broc and Glen Achall

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*Purpose:* To examine the Ullapool River section and the geology of Creag nam Broc; exposures within a structural window through the antiformally folded Moine Thrust into the underlying Ullapool Thrust Sheet (and Ullapool Thrust).

*Aspects covered:* Lithologies in the Ullapool Thrust Sheet; thrust geology of Creag nam Broc.

*Maps:* OS: 1:50,000 Landranger sheet 20 Beinn Dearg and Loch Broom; 1:25,000 Explorer sheet 439 Coigach and Summer Isles. BGS: 1:50,000 sheet 101E, Ullapool.

*Terrain:* The excursion comprises a number of localities close to the town of Ullapool, including some rough and pathless ground on the rocky northern slopes of the Ullapool River and around Creag nam Broc [NH 147 958].

*Time:* This is a full day excursion.

*Access:* Localities should have no problems with access at most times of the year. Good footwear is required as much of the excursion is in rough ground. Note that working quarries at Torr an Eas [NH 144 950] may provide additional material; permission for access should be obtained from the quarry manager (Tel: 01854 612336) and hard hats and high visibility jackets would be required.

The Moine Thrust is deformed across the Ullapool River by an open upright east–west trending culmination axis, such that a number of minor thrust sheets can be recognised in the footwall of the Moine Thrust, over-riding the 'normal' foreland sequence. The most significant of these thrust sheets is the Ullapool Thrust Sheet, composed mainly of metagranitoid rocks (the Ullapool Gneiss; part of the Lewisian Gneiss Complex) unconformably overlain by immature arkosic sandstone that is presumed to belong to the Torridon Group (Figure 42). This thrust sheet is displaced on the Ullapool Thrust (cf. Coward, 1988). The footwall to the Ullapool Thrust comprises a number of localised imbricate stacks composed of a folded succession of the An t-Sròn, Ghrudaidh and Eilean Dubh formations (Figure 43).

The thrust sequence cannot be interpreted as a straightforward foreland propagating sequence. Folding that pre-dates the generation of the An t-Sròn, Ghrudaidh and Eilean Dubh imbricates locally allows younger strata to be thrust over older, with resultant loss of parts of the succession. The Moine Thrust clearly truncates thrusts in its footwall, as does the Ullapool Thrust in turn. As elsewhere, the Moine Thrust is a composite structure with earlier development of several tens of metres thickness of psammitic ductile mylonite, and then a later brittle to brittle/ductile movement which truncates earlier thrusting in the footwall.

### Locality 5.1 Torr an Eas quarries. [NH 1490 9535]

Park in Ullapool and walk to the crossroads by the Ullapool River at [NH 1290 9490], then follow the track north-east up Glen Achall and past the quarry buildings. The normal foreland succession, with Torridon Group sandstones overlain by rocks of the Eriboll and An t-Sròn formations, can be seen in the hills to the north and also in outcrops along the track side. The sequence is locally disrupted by later faulting. The normal succession is maintained as far as the Ghrudaidh Formation dolostones, and above this the local Sole Thrust emplaces Eilean Dubh Formation dolostones. Continue along the track as far as [NH 1490 9535], where a view can be obtained into the quarry exposures in Eilean Dubh Formation dolostone (Figure 44).

The exposures in the quarry walls demonstrate that the sequence has been folded into upright folds with amplitudes of several tens of metres. Thrusting superimposed on these fold patterns has created younger over older thrust relationships in a number of places; folding of the dolostone succession suggests movement along a concealed lower (blind?) thrust, but the fact that thrusts cut the folded succession implies that thrust deformation is out of sequence. A higher quarry to the south-west is in felsic gneisses which have been carried over the dolostones by the Ullapool Thrust.

Continue along the track, taking the left-hand fork to cross the bridge over the Ullapool River, and then walk northwards to outcrops around [NH 1550 9560].

### **Locality 5.2 Lithologies in the Ullapool Thrust Sheet. [NH 1550 9560]**

The Ullapool Thrust Sheet comprises two components, which can be easily studied in these outcrops on the north side of the Ullapool River. Pale pinkish red to pale brown, rather massive immature arkosic sandstones are unconformable over metagranitoid rocks (the Ullapool Gneiss). The sandstones comprise angular pink feldspar and grey quartz clasts typically 1–3 m in grain size; pebbly lags are developed in places with individual sub-rounded matrix-supported clasts up to 1–2 cm. in size. Bedding tends to be rather indistinct, usually 20–60 cm. in scale and tabular to lenticular in form. A distinctive spidery network of fine, <1 m thick, quartz veins is typically seen and in places serves to help distinguish the sandstone where its massive nature tends to blur the distinction with the underlying metagranitoid rock. At [NH 1561 9565], metre-scale erosive channel bases are preserved in 20–40 cm. thick beds of coarse 'gritty' sandstone. The sandstone maps out as unconformable patches deposited on an irregular erosion surface with a relief of a few metres [NH 1518 9551]; the preserved total thickness of sandstone within the Ullapool Thrust Sheet is of the order of a few hundred metres. The sandstones have been interpreted as part of the Torridon Group, although they cannot be directly correlated with any specific formation.

### **Locality 5.3 Ullapool gneiss in the Eas Dubh Waterfall. [NH 1510 9550]**

The Ullapool gneisses are best examined in the exposures north of the Eas Dubh waterfall, (around [NH 1510 9550]). The dominant lithology is a metagranitoid, which comprises quartz and pink feldspar with minor biotite. It is typically massive with only a weakly defined foliation. Coarser-grained quartz-poor areas of syenitic rock are commonly associated with the metagranitoids. This variety comprises pink alkali feldspar and hornblende crystals up to 1 cm. the rock is typically massive and unfoliated, but in places the amphiboles show a mineral lineation plunging gently east.

The metagranitoid rocks are intruded by mafic, originally doleritic to gabbroic sheets at a variety of scales (5 cm. to 20 m thick sheets are seen) and orientations (N–S to E–W). The mafic rocks are recrystallised and granoblastic, massive and unfoliated; they now comprise plagioclase and hornblende, but in places these minerals seem to be mimetic upon an original igneous texture. The syenites are not seen to be invaded by the mafic rocks and so may also be a younger intrusive phase, but could simply be a locally developed coarser variant of the metagranitoid rock.

The Ullapool Gneiss is interpreted as part of the Lewisian Gneiss Complex and known to be Archaean in protolith age (R. R. Parrish, pers. comm.), but its relationship to the surrounding Lewisian terranes is unclear. The mafic sheets most probably represent part of the Scourie Dyke Swarm.

Continue downstream along the northern side of the Ullapool River. The Ullapool Thrust places the gneisses over Eilean Dubh Formation dolostone at [NH 1505 9550]. Below there, the local 'Sole Thrust', defining the boundary between the Ghrudaidh and Eilean Dubh formations, is clearly seen in the river at [NH 1496 9549]. The Eilean Dubh Formation dolostone in the hangingwall of this thrust typically dips at 40–45° ESE whereas the footwall succession dips at c.10–15° to the ESE. The thrust itself dips at c.20° to the ESE. From there, walk north-west towards Creag nam Broc, over outcrops of dolostone.

### **Locality 5.4 Creag nam Broc. [NH 1480 9580]**

At Creag nam Broc the Ullapool Thrust is seen again, emplacing Ullapool Gneiss and the overlying sandstone onto dolostones of the Durness Group (Figure 45). Imbrication of the lower levels of the Ullapool Thrust Sheet is seen at [NH 1483 9583], with small scale thrusts climbing upwards off the basal Ullapool Thrust to place lenses of gneiss up to a few metres in thickness over sandstone.

North of Creag nam Broc [NH 1476 9604], the Ullapool Thrust apparently cuts up section and has sandstone in its hangingwall (thrust over Cambro-Ordovician rocks), a relationship maintained to the north towards [NH 1480 9670] where

the Moine Thrust apparently cuts downwards onto the Ullapool Thrust terminating the Ullapool Thrust Sheet. Note that the point at which the Ullapool Thrust ramps up through the metagranitoid rocks to have sandstone in its hangingwall now coincides with a later steep south-east-dipping brittle reverse fault.

Along the Sole Thrust, Eilean Dubh Formation dolostone is juxtaposed on Salterella Grit Member north of Creag nam Broc, around [NH 1475 9638], and at Creagan na t-Uamha [NH 1460 9680]. Dips in the dolostone are c.40–45° in the hangingwall of the thrust; dips in the footwall are c.20°. A steeply dipping thrust slice of Eilean Dubh Formation dolostone is emplaced over Salterella Grit Member at [NH 1464 9602], but is itself overthrust by a further thrust slice comprising An t-Sròn and Ghrudaidh formations [NH 1466 9607].

The relationship of the Ullapool Thrust to these underlying dislocations is not clear. Individual thrusts in the imbricate system in the footwall of the Ullapool Thrust are never clearly truncated by the higher thrust and could be interpreted as merging upwards with the Ullapool Thrust. At [NH 1493 9593], the Ullapool Thrust does 'overstep' the thrust which emplaces Eilean Dubh Formation dolostone over Ghrudaidh Formation dolostone (succession already folded pre-thrusting to allow younger over older relationships). The separate thrust traces map out at right angles, but the geometry of the intersection is not exposed and could easily be a convergence upwards rather than truncation.

The Moine Thrust runs to the north-east of Creag nam Broc and can be seen to be an abrupt brittle discontinuity with finely laminated (1–2 m) pale to dark grey mylonitic psammite in the hangingwall. Brittle displacement on the Moine Thrust clearly truncates the underlying thrust structures; both the Ullapool Thrust and lower imbricates of the foreland succession are truncated by the Moine Thrust to the east of Creag nam Broc.

From Creag nam Broc, return to the bridge across the Ullapool River. At the track junction turn left, and then shortly afterwards take a path off to the right. This path runs above the quarries, and scattered outcrops of Ullapool Gneiss can be seen. Continue on the path as it swings south-east round the slopes of Meall Mòr, ignoring paths off on the right.

### **Locality 5.5 The Moine Thrust at Meall Mòr. [NH 1430 9470]**

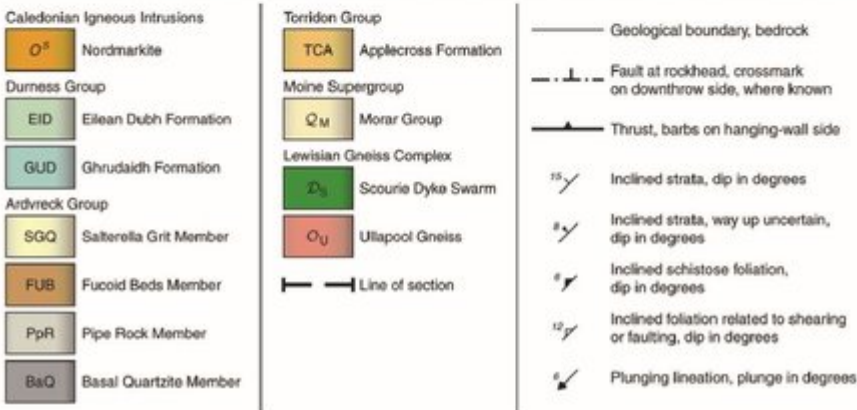
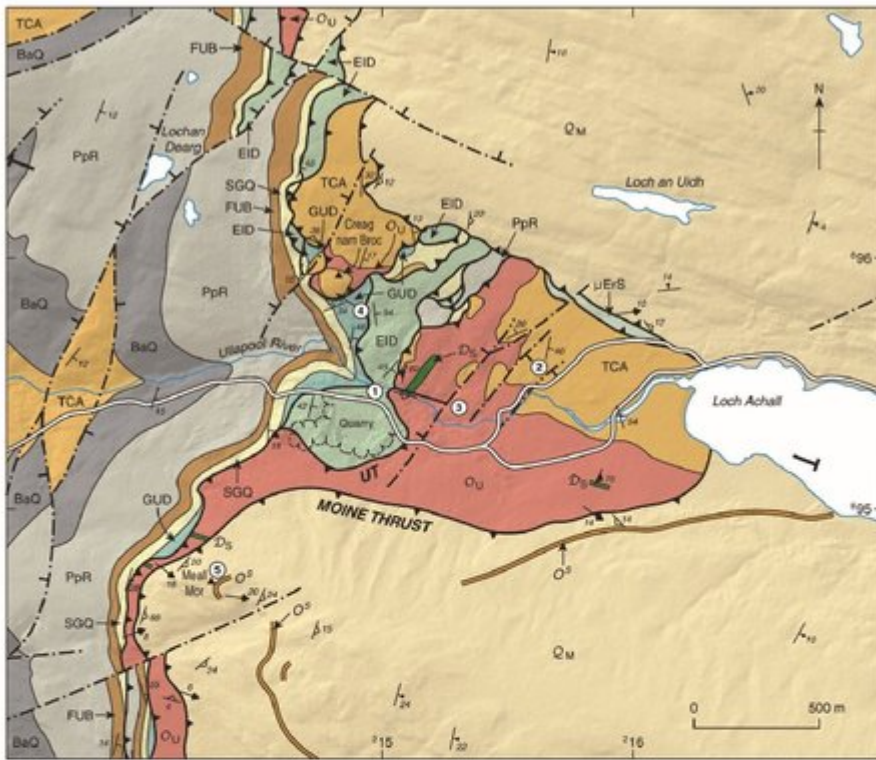
Around [NH 1425 9500] the path dips below the Ullapool Thrust and passes outcrops of the An t-Sròn and Ghrudaidh formations of the foreland sequence. Outcrops just above the path are of Ullapool Gneiss in the Ullapool Thrust Sheet, with good examples of the mafic sheets that are considered to correlate with the Scourie Dyke Swarm.

Take the path that turns off to the left to climb towards Meall Mòr. The Ullapool Thrust Sheet is only about 20 m thick in this area, and consists only of gneiss with no overlying sandstones. The path soon crosses the Moine Thrust, and good examples of finely-laminated Moine mylonites can be seen in numerous outcrops. Both the mylonitic foliation, and the associated lineation, dip gently south-eastwards.

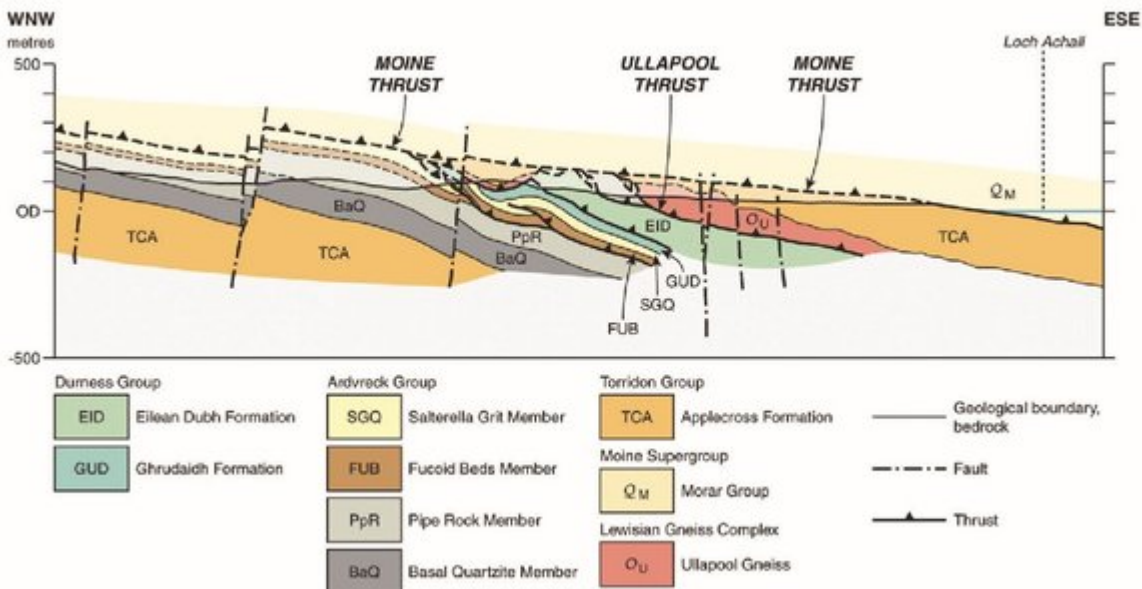
At the summit of Meall Mòr is a pink-weathering, c.2 m thick intrusive igneous sheet, belonging to the 'Nordmarkite Swarm' (Goodenough *et al.*, 2004). This intrusion is formed of abundant pink feldspar phenocrysts, up to one centimetre across, in a darker-coloured quartzofeldspathic matrix (Figure 46). The core of the sill is undeformed, but the margins show some evidence of grain size reduction and shearing of the matrix. Similar intrusions are found at a number of locations to the north of here, both close to the Moine Thrust and farther east in the Moine.

From Meall Mòr, retrace your steps down to the main path, and then pick up the path that runs almost directly west across outcrops of the foreland succession, to bring you back to Ullapool.

### **[References](#)**



(Figure 42) Simplified geological map of the Glen Achall area, after British Geological Survey (2008), showing the localities described in Excursion 5. UT = Ullapool Thrust.



(Figure 43) Cross-section through Glen Achall, along the line indicated on Fig. 42, after British Geological Survey (2008).

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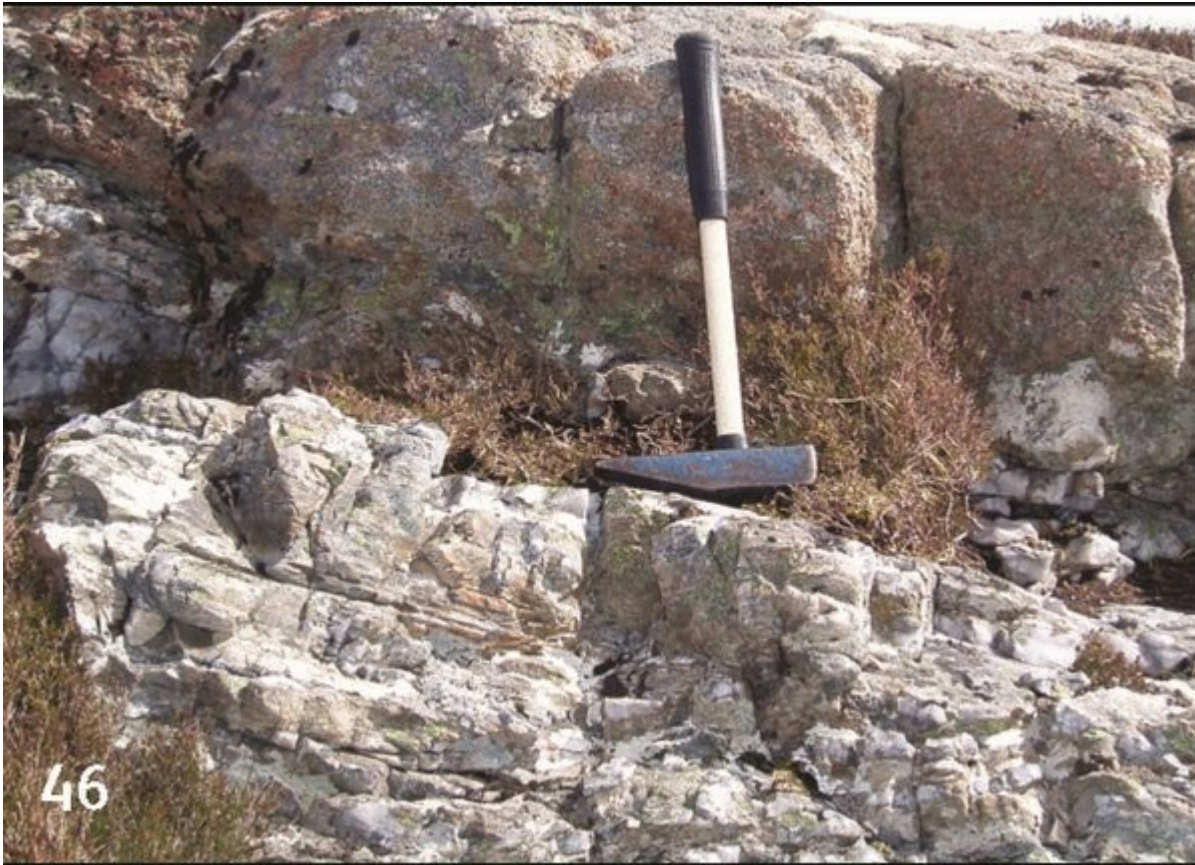


*(Figure 44) Deformed Eilean Dubh Formation dolostones in the Torr an Eas quarry. (BGS photograph P596832, © NERC)*

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*(Figure 45) The Ullapool Thrust at Locality 5.4, Creag nam Broc, with Torridon Group sandstone thrust over Ghrudaidh Formation dolostone. (BGS photograph P596850, © NERC)*



*(Figure 46) Sill of the Nordmarkite Swarm, with abundant pink feldspars, intruded into pale grey Moine mylonites near the summit of Meall Mòr (Locality 5.5). (BGS photograph P595828, © NERC)*