Excursion 15 The Moine Thrust Zone at Loch Eriboll

Rob Butler, Robert Raine and Paul Smith

Purpose: To examine aspects of thrust belt geometry and the evolution of fault rocks, including the classic outcrops where Lapworth worked in the 1880s, demonstrating the repetition of rock sequences by thrusting, and coining the term mylonite.This excursion also contains the type locality for the An t-Sròn Formation.

Aspects covered: Cambro-Ordovician stratigraphy in the Moine Thrust Zone; major and minor thrust structures; thrust systems and their fault rocks (cataclasites and mylonites); recognising imbricate thrust systems; deformation gradients in the thrust zone.

Maps: OS: 1:50,000 Landranger Sheet 9 (Cape Wrath); 1:25,000 Explorer sheets 445, 446 and 447. BGS: 1:50,000 Scotland sheet 114W, Loch Eriboll.

Terrain: The excursion covers a range of terrain types, from rocky coastline to rough moorland. There are no paths and the terrain is rough, which can make progress rather arduous. There are short, steep ascents and descents.

Time: The entire excursion will take a full day, and will be difficult to complete if the group is large and/or unused to walking over rough ground. However, the excursion can be undertaken in two distinct parts, visiting Localities 15.1–15.7 separately from Localities 15.8–15.10.

Access: No access problems are known. However, this excursion is entirely within a Site of Special Scientific Interest and so hammering of outcrops and collection of specimens, even from float, is strictly prohibited.

The route starts on the eastern coast of Loch Eriboll, where there is a good section through the Cambrian sedimentary rocks, before heading along the road to the viewpoint over Ard Neackie and thence to Heilam, Lapworth's base for his mapping during the 1882 and 1883 seasons. From Heilam the route goes over rough ground to Ben Arnaboll and then back down to examine the thrusting at Kempie (Figure 102).

This excursion can be followed in a long day as described, in which case it gives an ideal introduction to how geologists have built an understanding of thrust system architecture in the North-west Highlands. This is where it all began, with the work of Charles Lapworth in 1882–83, followed up by the work of the Geological Survey (Peach *et* al., 1907). It was on the north-east shores of Loch Eriboll that the tectonic emplacement of Lewisian gneiss and therefore the allochthonous nature of the Moine succession was first unequivocally demonstrated, together with the process of imbrication that caused the multiple repetition of elements of the Cambrian stratigraphy. The outcrops inspired the coining of the terms 'thrust' (Geikie, 1884) and 'mylonite' (Lapworth, 1885). Since the 19th century, the area has continued to inspire research of global interest. The outcrops of the Pipe Rock Member are most instructive because the burrows they contain, both the abundant Skolitho*s* and the rarer Monocraterion, form ideal strain markers. In undeformed strata these burrows display circular sections on bedding planes and are perpendicular to bedding in profile. Modifications of these geometries can be used to quantify the directions and magnitudes of strains in 3D (Coward and Kim, 1981; Fischer and Coward, 1982), information that bears on the evolution of thrust systems and the localisation of deformation in the continental crust. The quartz arenites were also important for the application of electron microscope techniques to understand mineral physics and rock deformation at the scale of crystal lattices (e.g. White, 1979). Current research is focused on the ways in which basement is incorporated into thrust systems (e.g. Wibberley, 2005; Butler *et* al., 2006). The route is described to give an insight into how field relationships between the rock units can be used to infer structural geometry and evolution. Some of the outcrops are amongst the most globally important in structural geology.

Locality 15.1 An t-Sròn peninsula: a stratigraphic overview. [NC 4440 5798]

The coastline at An t-Sròn is one of the localities at which Lapworth constructed his reference stratigraphy in 1882 and the section is illustrated on his field slips (Figure 103). The section along the coast runs from the Pipe Rock Member of

the Eriboll Formation (base not seen) through the Salterella Grit Member (6 m into the Fucoid Beds Member (22 m of the An t-Sròn Formation (Figure 104). The section continues into the carbonate facies of the Ghrudaidh Formation (Durness Group; 65 m and into the paler dolostones of the Eilean Dubh Formation (top not seen).

Park in the large lay-by at [NC 4440 5798]. The instructive outcrops opposite the parking place contain Fucoid Beds Member in the crest of the An t-Sròn anticline, thickened up by minor thrusts of different polarity. The Salterella Grit Member can also be observed. From the lay-by, walk north-west towards the shore of Loch Eriboll [NC 4423 5816], where cream-coloured, fine-grained quartz arenites of the Pipe Rock Member contain well-developed *Skolithos*. The generally low deformation state of the quartz arenites can be established here using the geometry of *Skolithos* burrows, which is useful for comparison with more deformed parts of the thrust belt seen later in the day.

The boundary with the overlying Fucoid Beds Member is at [NC 4416 5811], where quartz arenites of the Pipe Rock Member are overlain by fine- to medium-grained, carious weathering, orange brown sandstones; small scale hummocky cross stratification is present. These are overlain by moderately bioturbated, very fine- to fine-grained sandstones with burrow mottling and ripple lamination. The ripples are picked out by green-grey siltstone drapes, and display *Planolites* burrows on the underside. There is also some hummocky cross stratification in medium-grained sandstones, and herring bone cross-stratification.

Walk along shore and along the strike to [NC 4408 5811]; a 0.3 m marker bed comprising decimetre-scale tabular cross-bedding and swaley cross stratification can be traced around cliffs. This is overlain by several metres of rippled very fine sandstones with bioturbated siltstone drapes. These beds contain *Rusophycus*, *Cruziana* and *Planolites* reflecting the deeper water, more diverse ichnofauna that is present in the Fucoid Beds Member in comparison with the Pipe Rock Member. The arthropod tracks (*Cruziana*) and resting traces (*Rusophycus*) are most likely to have been made by trilobites and represent a variety of feeding and walking activity. On the wavecut platform below the cliff a bedding surface displaying excellent interference ripples can be observed.

Looking south, the boundary with the overlying Salterella Grit Member climbs down the cliff and can be observed on the shore at [NC 4401 5806]. The upper part of the Fucoid Beds Member is marked by a very light grey-green, silty mudstone overlain by decimetre-scale to centimetre-scale beds of medium tocoarse sandstone. The boundaryto the Salterella Grit Member is marked by a change to metre-scale beds of cross-bedded, white quartz arenites with prominent *Skolithos* towards the top; phosphatic shell debris, *Salterella*, and mud clasts are also present.

At the top of this 6 m unit is a nodular weathering, dolomite-cemented, yellow brown sandstone, and the top of this bed marks the base of the Ghrudaidh Formation (Durness Group). The base is composed of dark grey dolomitic siltstone with locally abundant *Salterella*, a small cone-shaped shelly fossil, visible on bed surfaces. Just above this, beds of quartz sand-rich dolostones decrease in thickness and abundance. Burrow-mottling becomes common, and, at some levels, spar-filled vugs containing calcite may represent a replacement of evaporite nodules.

From the boundary walk up the dip slope and grassy bank, and follow the sheep path towards the south along the top of the cliffs. Passing crags of dark grey, coarsely crystalline dolostone with few sedimentary structures (typical of the Ghrudaidh Formation), descend to a small cove at [NC 439 579], where intervals of light grey, finer grained dolostone start to become apparent in the succession (Figure 105). These beds reflect a progressive decrease in relative sea-level towards the top of the formation. Sedimentary structures indicative of deposition under intertidal to supratidal conditions include tepee structures and flat pebble conglomerates. The upper part of the conglomerate is conspicuous, with pale clasts reworked into a very dark grey dolomite matrix. A fault truncates beds at the southern end of the cove.

Exit the bay inland where the descent was made and continue southwards, past crags of highly vuggy dolomite. At [NC 4393 5787], access can be made to the beach, via a small gully. When on the beach, walk northwards to the contact between the Ghrudaidh and the Eilean Dubh formations [NC 4392 5790]. Some faulting of the section is observed, but very light grey, fine grained dolomites, typical of the Eilean Dubh Formation display crinkly microbial lamination and small stromatolites. Loose blocks on the beach commonly show a fenestral fabric and soft sediment deformation. At [NC 4393 5789] large nodules of calcite and dolomite are observed and beds containing small crystal shaped vugs can be seen. This provides further evidence of evaporate pseudomorphs within the succession and, together with the fenestrae and

planar stromatolites, allows a supratidal evaporitic setting to be deduced.

Walk southwards to [NC 4380 5774], where parasequences can be seen; these are shallowing upward successions of sedimentary rock, marked by a base that displays evidence of rapid flooding. At least three metre-scale parasequences are visible within the low cliffs. These comprise mid- to dark grey dolostone at the base, with irregular black cherts, overlain by planar, crinkly laminated mid-grey dolostone and capped by low-domed stromatolites of 10–20 cm. wavelength and 5 cm. amplitude. The cherts contain rare ooids.

Walk back (north) along the beach to a small stream at [NC 4384 5775] and follow it inland until a grassy scree bank. At the top of the bank, follow the path northwards, contouring around the hill and up to the road before walking back northwards to the lay-by at the start.

Locality 15.2 The viewpoint at Ard Neackie: Eriboll overview. [NC 4520 5990]

A lay-by [NC 452 599] on the A838 overlooking the Ard Neackie peninsula provides panoramic views down the loch to the mountain massif of Foinaven and thus gives a natural cross-section through the Moine Thrust Zone. To the south of Eriboll much of the Moine Thrust Zone is represented by imbricated quartz arenites, chiefly the Pipe Rock Member. The upper part of the thrust zone contains far-travelled sheets of Lewisian gneisses capped in turn by the Moine Thrust and its mylonites. This deceptively simple description forms a counterpoint to the apparently more complex structural geometries to be visited in this excursion. This lay-by also provides a convenient parking place for continuing to Heilam and Ben Arnaboll (Localities 15.3 and 15.4), although there are other parking places in the vicinity.

Locality 15.3 Port an Altain: imbricated Cambrian strata. [NC 4568 6133]

The ground to the north of the A838, centred on Ben Heilam, offers a generally well-exposed and accessible experience of imbricate structures, developed in the Cambrian strata (Figure 106). The well-differentiated succession, as seen at An t-Sròn, provides an ideal template for recognising thrust repetitions. This part of the thrust belt was most extensively studied by Coward (1984). Our route examines evidence for imbrication and how the structures can be traced out in the landscape. The strain state in the imbricate slices is also considered by examining the deformation of Skolithos in the Pipe Rock Member.

From the lay-by (Locality 15.2), walk NNE along the road to where it overlooks the Heilam area. Continue down the hillside to Loch Ach'an Lochaidh and follow its SW shore to the outflow (Allt a'Mhuilleir). A discontinuous path leads down to the coast at the rocky bay – Port an Altain. The first stop lies at the northern end of the bay at a low headland [NC 4568 6133].

These coastal outcrops consist of Fucoid Beds Member, Salterella Grit Member and Durness Group carbonates. In general, bedding and unit contacts are steeply dipping. These lie within the Lighthouse duplex of Coward (1984) and the outcrops give insight into the imbricate structure. This can be studied by working across strike, starting at the coast. Skerries (accessible below mid-tide) are made of Durness Group carbonates that dip at *c*.60 ESE. They are overlain by Fucoid Beds Member that dips more steeply and which is in turn overlain by Salterella Grit Member. Thus the contact between the Fucoid Beds Member and the Durness Group is a thrust. Another thrust lies above the Salterella Grit Member, repeating it and carrying a thin (50 cm. slice of Fucoid Beds Member. The steep attitude of bedding and the thrusts here is believed to be due to further imbricate thrusting at depth that has back-rotated these structures(Coward,1984). The lateral continuity of the imbricate slices can be followed by walking north along the coast for 500 m to the skeletal lighthouse. The general trend of the imbricates is picked out by ridges of Salterella Grit Member. In general the imbricate slices incorporate increasing amounts of Durness Group carbonate and lose Fucoid Beds Member, implying that the imbricate thrusts climb gradually up stratigraphic section to the north-east.

Locality 15.4 [Lighthouse. NC 4586 1779]

At the lighthouse, the gently overhanging sea-cliff (with prominent whitewash stain) is formed by a bedding plane of the Salterella Grit Member. Durness Group carbonates lie on either side of the thin sheet of these quartz arenites. Forty metres north of the lighthouse, a steep gully into the sea reveals a slice of Fucoid Beds Member thrust onto Salterella Grit Member. Collectively these outcrops display the architectural elements of imbricate thrusting, leading to repetitions of the stratigraphy, in this case on a detailed scale. Continuing NNE along the coast from the lighthouse, the imbricate structures become increasingly dominated by Durness Group carbonates. The thrust repetition of the carbonates is reflected in the landscape immediately inland as a series of NNE–SSW-trending ridges.

From the low knolls overlooking the lighthouse [NC 4595 6185] walk across strike inland. By way of diversion, the ridges of Durness carbonate may be counted as a proxy for imbricate slices. A change in vegetation to dominantly heather-cover marks the upper edge of Coward's (1984) Lighthouse duplex and the lower part of the main Heilam imbricate system, chiefly composed of Pipe Rock Member quartz arenites.

Locality 15.5 Loch na Cathrach Duibhe. [NC 4604 6160]

Outcropsof the Pipe Rock Member may be examined on the low ridge near pt.54 m [NC 4606 6160], overlooking the northern edge of Loch na Cathrach Duibhe. Bedding here dips gently ESE. The *Skolithos* burrows may be observed, nearly orthogonal to bedding (implying little bed-parallel shearing). On bedding planes, however, they show elliptical sections (ratios of up to 2:1), with long axes trending along strike, implying significant layer parallel shortening strains. There are also exposures of cataclasites, marked by strong blue/green mottling and pasty yellow seams that represent zones of intense grain fracturing. Thus the quartz arenites have experienced significant deformation as they have become incorporated into the thrust belt.

From the loch, an optional diversion up to the north coast of Heilam can be made to see further examples of deformed Pipe Rock Member. Photogenic examples of elliptical bed-sections of *Monocraterion* burrows (implying layer-parallel shortening strains) may be found in the small cove [NC 4645 6220]. At 300 m ESE of this site, in outcrops in a grassy amphitheatre [NC 468 619], there are spectacular exposures of cataclasites (with the characteristic glassy-blue appearance and pasty yellow seams) that were described by White (1979). Nearby [NC 467 620] there are also 10 m scale folds within the imbricated Pipe Rock Member in a gully – with deflected *Skolithos* indicating flexural flow associated with the prominent synform. These northern exposures also provide good views out towards Whiten Head, the northernmost extension of the Moine Thrust Zone on mainland Scotland. To rejoin the main itinerary, follow the fence line SSE and hence reach Locality 15.6.

If a shorter route is required, from Locality 15.5 cross the boggy ground north of Loch na Cathrach Duibhe and ascend the steep slope on its eastern side, to the plateau above. This ascent crosses a sheet of Pipe Rock Member, which is probably internally imbricated. This ascent arises on the shore of an unnamed lochan. From here follow the upper edge of the escarpment for about 200 m to a prominent square-cut glacial erratic.

Locality 15.6 [NC 4639 6180]

The bedrock here is Fucoid Beds Member, indicating that the main Heilam imbricates contain, at the current exposure level, both the Pipe Rock and Fucoid Beds members. The location provides good views down onto the Lighthouse duplex along the west coast of Heilam. Looking east reveals a landscape dominated by stacked up Pipe Rock Member, with rare exposures of Fucoid Beds Member.

The route now lies east, across a boggy area with sparse outcrop. Cross the fence with care and follow the northern shore of Loch a'Choire, ascending a 10 m escarpment to a ridge overlooking the Hope valley.

Locality 15.7 Folded Pipe Rock Member. [NC 4685 6124]

Locality 15.7 is a rocky tor composed of Pipe Rock Member. The structure it contains is a spectacular example of folding associated with a thrust ramp (Figure 107). The fold lies on a plinth of sub-horizontal Pipe Rock Member. The outcrop

can be explored to find examples of deformed *Skolithos* burrows that reveal shearing associated with this fold structure.

From Locality 15.7, the excursion now returns SSE to the A838, a hike of about 1200 m over rough ground. In general the route follows ridge-lines that track the general trend of the imbricated Pipe Rock Member. Before reaching the road it is worth stopping at the vantage point at [NC 4655 6065], a site marked by several large glacial erratics of Lewisian gneiss and pegmatites. This gives good views onto the next localities on the excursion, the classic thrust terrain of Ben Arnaboll (Figure 108). Suitably inspired, continue to the A838 near the road cutting [NC 464 601].

Locality 15.8 Ben Arnaboll: major thrusts and associated structures. [NC 4615 5958]

The outcrops on the north side of Ben Arnaboll are amongst the most important in global geology. They inspired Geikie (1884) to coin the term 'thrust', apparently adopting the term from the colloquial, unpublished usage of Lapworth. They are also generally considered to be the type area for Lapworth's (1885) description of mylonites (White 1998).

To access the classic exposures of the Arnaboll Thrust ascend the hillside south of the A838, from the area of the cutting [NC 464 601], to a prominent heathery spur above a west-facing cliff of Pipe Rock Member. This is

Locality 15.8 [NC 4615 5958], the type locality for the Arnaboll Thrust. Here Lewisian gneisses lie in tectonic contact upon Pipe Rock Member (Figure 109). These quartz arenites are in their correct stratigraphic orientation, as indicated by the right way-up conical burrow tops of *Monocraterion*, which can be found at the western end of the section. These burrows are sheared but the depositional lamination is still evident. The more common *Skolithos* can be found in the Pipe Rock Member below the main part of the outcrop. Here too they are deformed, forming an angle of about 45° to bedding (implying a shear strain of 1). A weak grain alignment defines a weak cleavage in the quartz arenites here. Both pipes and cleavage verge to the WNW, indicative of this shear sense on the thrust. The Lewisian gneisses above the thrust plane show varying deformation states. Two metres above the thrust plane the Lewisian Gneiss Complex retains amphibolite-facies metamorphic assemblages and coarse pegmatites, and they are only reworked and modified close to the thrust.

From its type location, it is instructive to walk out the Arnaboll Thrust, heading eastwards around the escarpment. Although the thrust plane dips eastwards here, it is repeatedly offset up the hillside so that for the most part the route contours the hillside. These offsets are achieved by small thrusts that re-imbricate the Arnaboll Thrust plane – a geometry described as 'breaching'. It is likely that these are parts of the same structure of imbricates as on Ben Heilam and indicate that at least some of this imbrication followed the emplacement of the Arnaboll Thrust Sheet. The best examples are found at the eastern edge of a rocky amphitheatre [NC 4629 5951]. From here, continue following the Arnaboll Thrust eastwards. At [NC 4641 5943] the thrust turns up and its outcrop trace heads southwards. It can be followed easily by keeping Pipe Rock exposures on the left and gneisses on the right. Bedding in the Pipe Rock Member is generally sub-vertical, parallel to the inferred thrust plane. At a few locations *Monocraterion* in the Pipe Rock Member shows the younging direction of these strata westwards, towards the Arnaboll Thrust. Traditional interpretations (e.g. Butler *et al.*, 2006) show the Arnaboll Thrust sheet to be folded. However, modern mapping by Wibberley and Butler (2010) shows no such fold in the thrust sheet itself. The contact between Pipe Rock and Lewisian gneisses is another breaching thrust.

Locality 15.9 Unnamed lochan. [NC 4620 5910] Continue along the trace of the thrust to the unnamed lochan on Ben Arnaboll, reaching it at NC 4620 5910. The outcrops on the eastern side of the lochan contain further exposures of Lewisian rocks resting tectonically upon Pipe Rock Member. These are most plausibly interpreted as representing again the Arnaboll Thrust, here dipping eastwards. Thus there is an antiform, cored by Pipe Rock, carried by a thrust that breaches and repeats the Arnaboll Thrust.

The detailed structure around Locality 15.9 is complex, consisting of imbricated alternations, on the metre-scale, of Pipe Rock Member and Lewisian basement. Both units are strongly sheared. The alternations are plausibly the result of a breaching imbrication process, albeit on a finer scale than seen further west along the trace of the Arnaboll Thrust. Unlike the outcrops at the type area of the Arnaboll Thrust, the Lewisian gneiss to the east of the unnamed lochan is strongly modified from its foreland state. This has led various workers to suggest that at this locality it is not the Arnaboll Thrust at

all, but a higher, more ductile structure. The interpretation here (following Butler 1988; Butler *et al.,*2006) is that it is indeed the Arnaboll Thrust, but that the site lies near its trailing edge. In these situations, where thrusts are closely spaced, rocks can become intensely sheared (e.g. Boyer and Elliott, 1982), a feature of these outcrops.

If time is limited, it is advisable to return to the A838. Navigationally the simplest way to achieve this is to walk north to the edge of the Heilam area. There are routes to the west, but these demand special care to find the correct way down the cliffs on the west slopes of Ben Arnaboll.

To continue the excursion, the plan now is to walk along strike within the mylonitic upper part of the Moine Thrust Zone. Outcrops are sparse, but can include spectacular deformation fabrics and folds. The protoliths to these are generally Lewisian gneisses. However, there is a narrow tract of mylonitic quartz arenite that continues southward from the unnamed lochan – plausibly interpreted as representing a strongly attenuated crest of the antiform that folds the Arnaboll Thrust. In this interpretation these quartz arenites are derived from the footwall to the Arnaboll Thrust. However, as will be evident later, not all the quartz arenites found within the mylonite belt are derived from this structural position.

Continue SSE across the open moorland from Ben Arnaboll, cross the wall and the head of a valley leading down to Kempie Bay to reach Locality 15.10.

Locality 15.10 Upper Kempie: the mylonites. [NC 4487 5726]

The easiest place from which to explore the outcrops on the plateau is a small knoll (213 m OD) at [NC 4487 5726]. These outcrops are quartzo-feldspathic mylonites plausibly derived from Moine metasedimentary rocks. They contain a strong ESE-plunging stretching lineation. These outcrops contain dramatic folds of the mylonitic foliation, traditionally interpreted as forming during progressive shearing within the ductile thrust zone.

The Moine mylonites represent the strongly sheared rocks derived from the hangingwall of the Moine Thrust. They overlie a thin (*c*.1 m strip of dark, phyllonitic rocks most plausibly derived from Lewisian gneisses. The original character of the rocks is completely obliterated as the associated dynamic metamorphism has thoroughly recrystallized the original amphibolite-facies mineral assemblages leaving a chloritic phyllonite. It is unclear whether these strongly sheared rocks were once the basement to the Moine (and therefore form the hangingwall to the Moine Thrust) or were derived from the foreland. However, other tracts of strongly sheared Lewisian gneisses can be found in the vicinity.

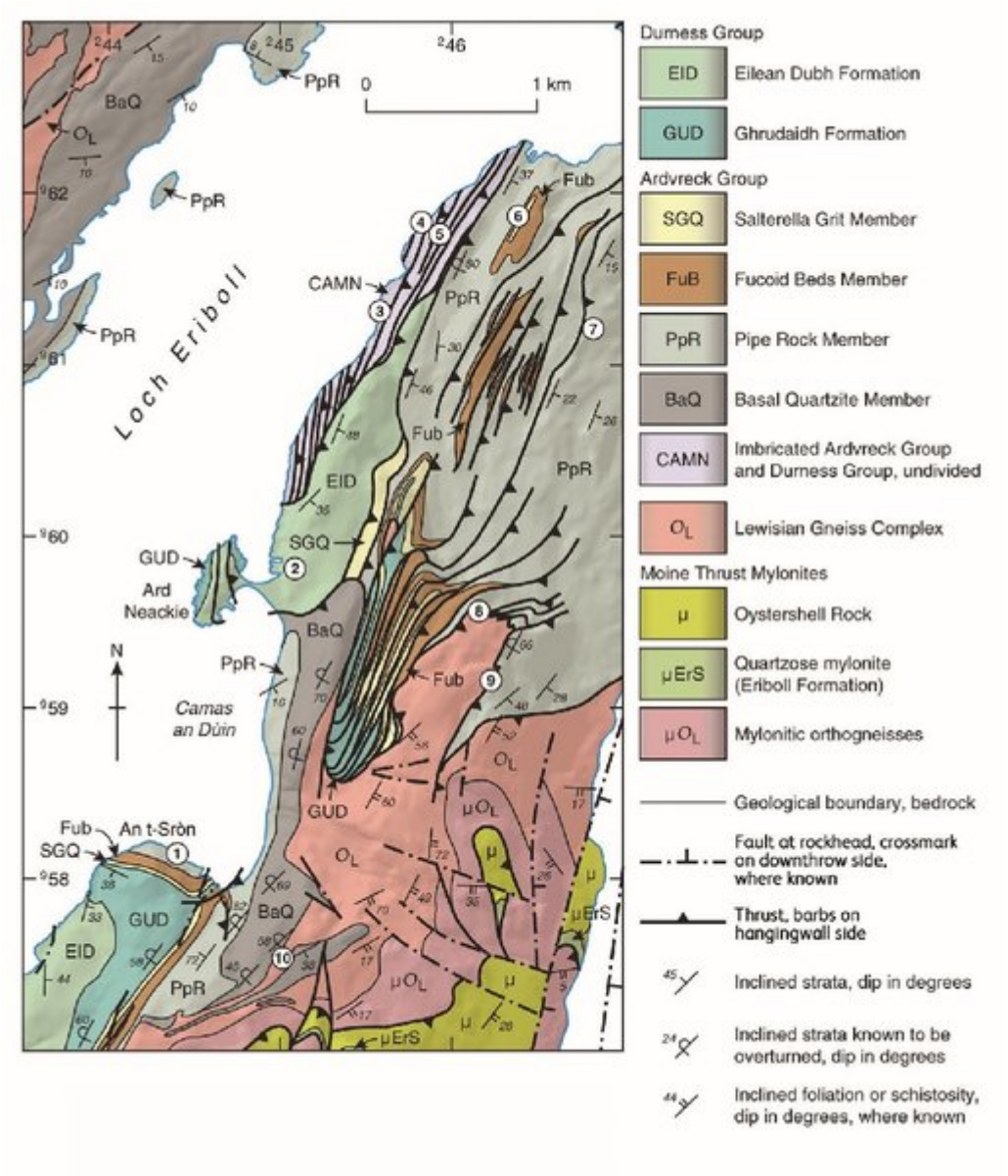
Walk about 100 m NW onto the plateau where alternations of foliated (locally mylonitic) quartzites and sheared gneisses and pegmatites crop out [NC 4491 5735]. These tracts broaden along strike to the north, back towards Ben Arnaboll, and the deformation state decreases. In these lower strain sites the depositional lamination can be found in the quartz arenites, which are part of the Basal Quartzite Member of the Eriboll Formation. Cross-bedding may be used to prove that the Lewisian–Eriboll Formation interleavings are here generated by folding. The ductile deformation fabrics relate to the folding, thus there is substantial ductile deformation in the footwall to the Moine Thrust. It is therefore probably of only semantic importance where the original discrete contact between the Moine Thrust Sheet and its 'foreland' footwall lies: the Moine Thrust here at Eriboll is a ductile shear zone.

The outcrops at Upper Kempie provide an interesting contrast to those farther north on Ben Arnaboll (Locality 15.8). Both sites contain repetitions of Eriboll Formation and Lewisian basement. At Upper Kempie the repetitions represent highly sheared folds, with the original unconformity between basement and Cambrian cover marking the contact between the units (Figure 110). At Ben Arnaboll the alternations result from breaching imbrication, such that the Lewisian was tectonically emplaced onto the Eriboll Formation before the interleaving happened. In this case all contacts are tectonic. The two sites visited on the excursion have been chosen because it is possible to deduce these differences. In more strongly sheared and dismembered settings, such distinctions are increasingly problematic.

From the mylonites the route now lies down to Kempie Bay. This descent down topography is also down structural level and provides an excellent example of a deformation gradient. The quartz arenites away from the Moine Thrust preserve good cross-bedding and depositional lamination. Folding is still evident but more open.

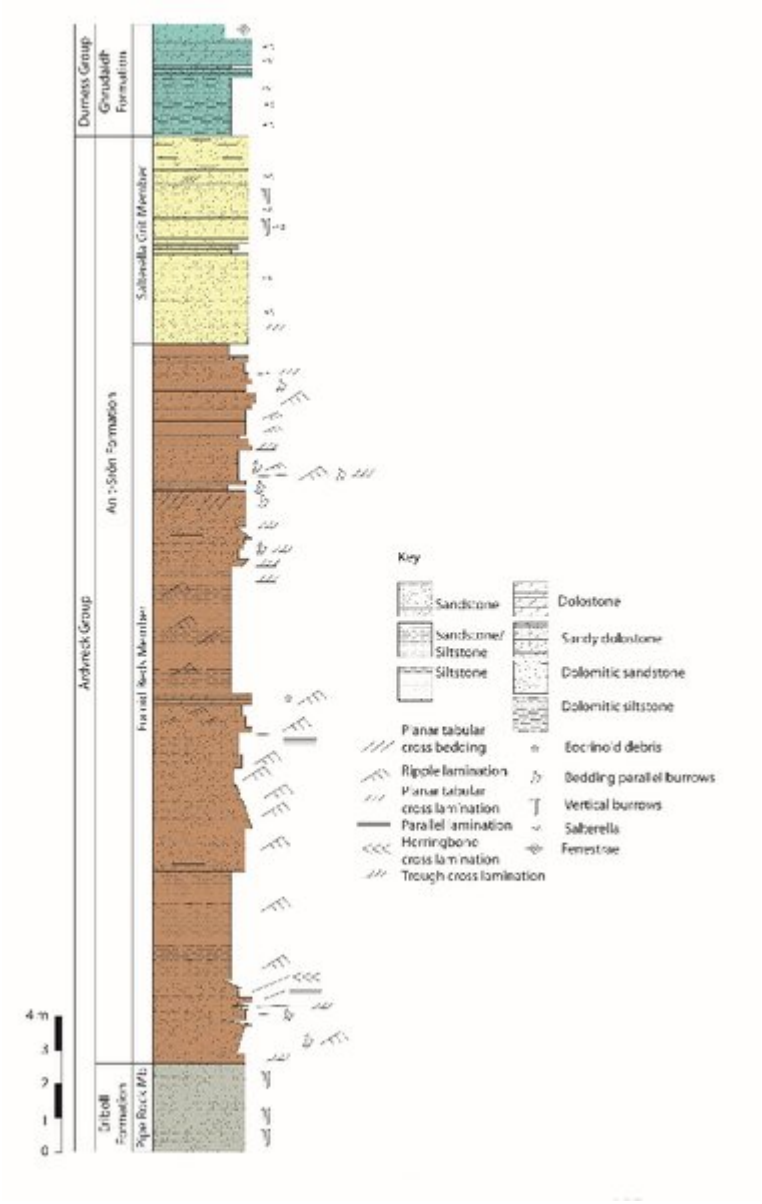
Continue down the steep slopes with outcrops of steeply-dipping Basal Quartzite and Pipe Rock members. Keep out of the narrow ravine at the foot of the slope (Fucoid Beds Member) and follow the north-running strip of more open ground that heads down to the road. The road sections are in the eastern (steep) limb of the Kempie Syncline (complementary to the An t-Sròn anticline, Locality 15.1). The road cuttings show overturned beds of Pipe Rock Member. These contain sheared *Skolithos* that display an easterly vergence. Deformation here presumably relates to the development of the Kempie Syncline, rather than to the general westward shearing that is typically displayed, for example on Heilam. Follow the road back to the car-park at Heilam Cottage. As the road climbs away from the coast at Ard Neackie the inferred position of the Arnaboll Thrust is crossed, so that, at the car-park, the rocks lie in the footwall. The road leads back to the parking sites.

References



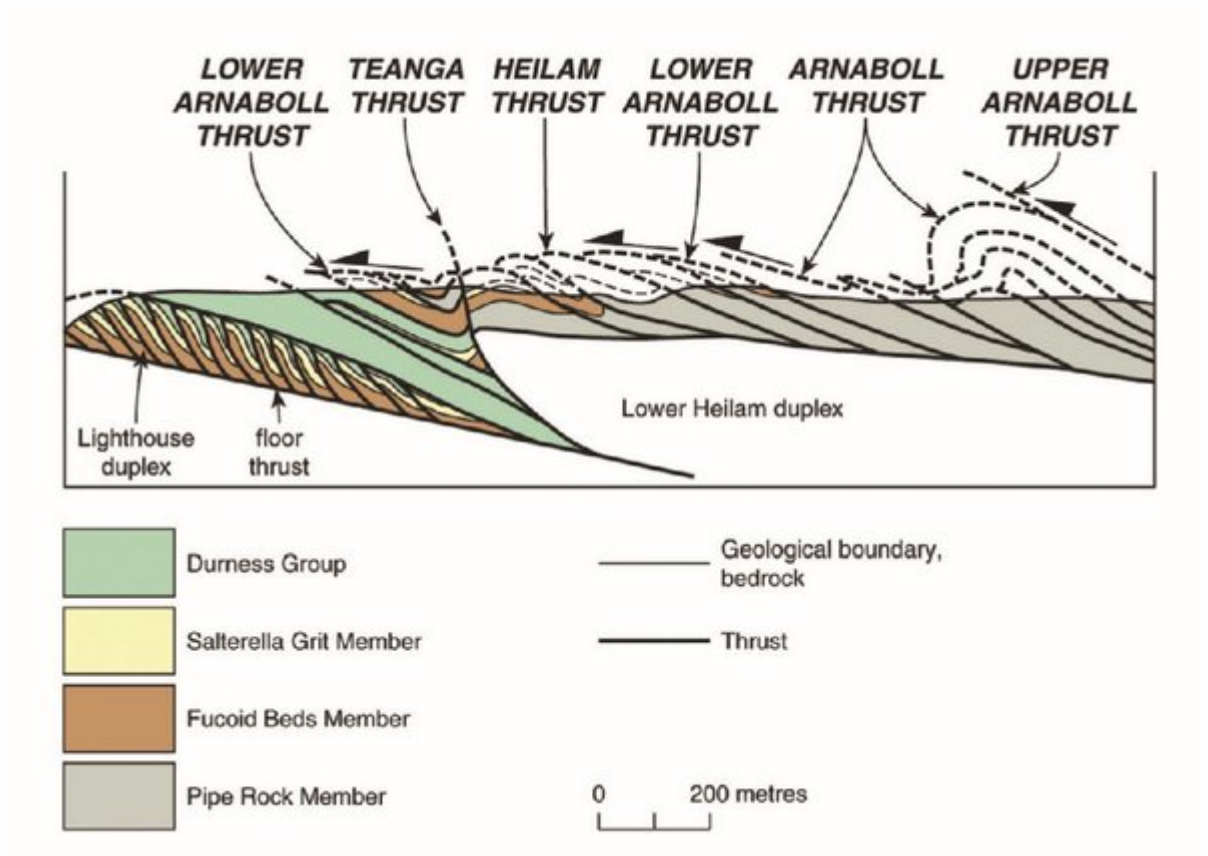
(Figure 102) Simplified geological map of the Eriboll area, after British Geological Survey (2002a), showing the localities described in Excursion 15.

(Figure 103) Extract from Charles Lapworth's 1:10,560 field slip of the An t-Sròn area from the 1882–1883 seasons, incorporating his reference sections for the Cambrian stratigraphy that are the focus of Locality 15.1. (© Lapworth Museum of Geology)



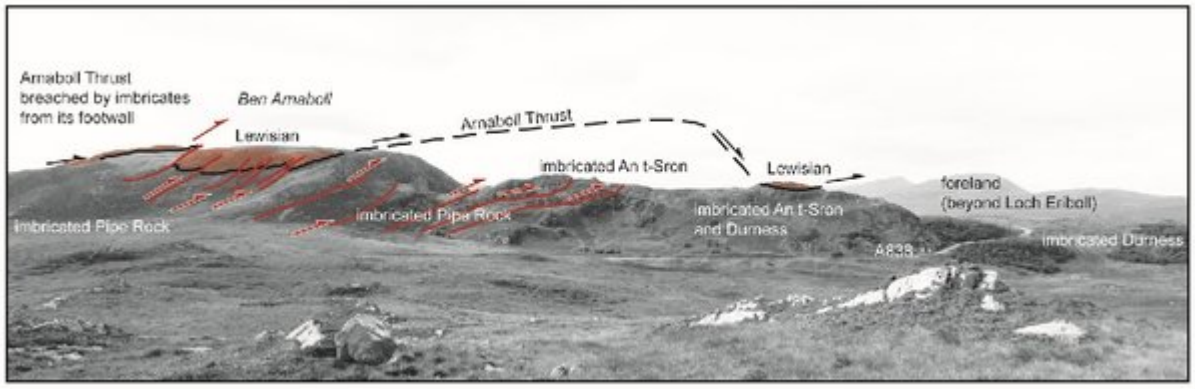
(Figure 104) Generalised stratigraphic log for the An t-Sròn section, Locality 15.1.

(Figure 105) View of the southern end of the An t-Sròn section, Locality 15.1 [NC 439 578], looking southwards. Very light grey, fine grained dolostones, typical of the Eilean Dubh Formation display crinkly microbial lamination and small stromatolites. (Photograph: © R. J. Raine)



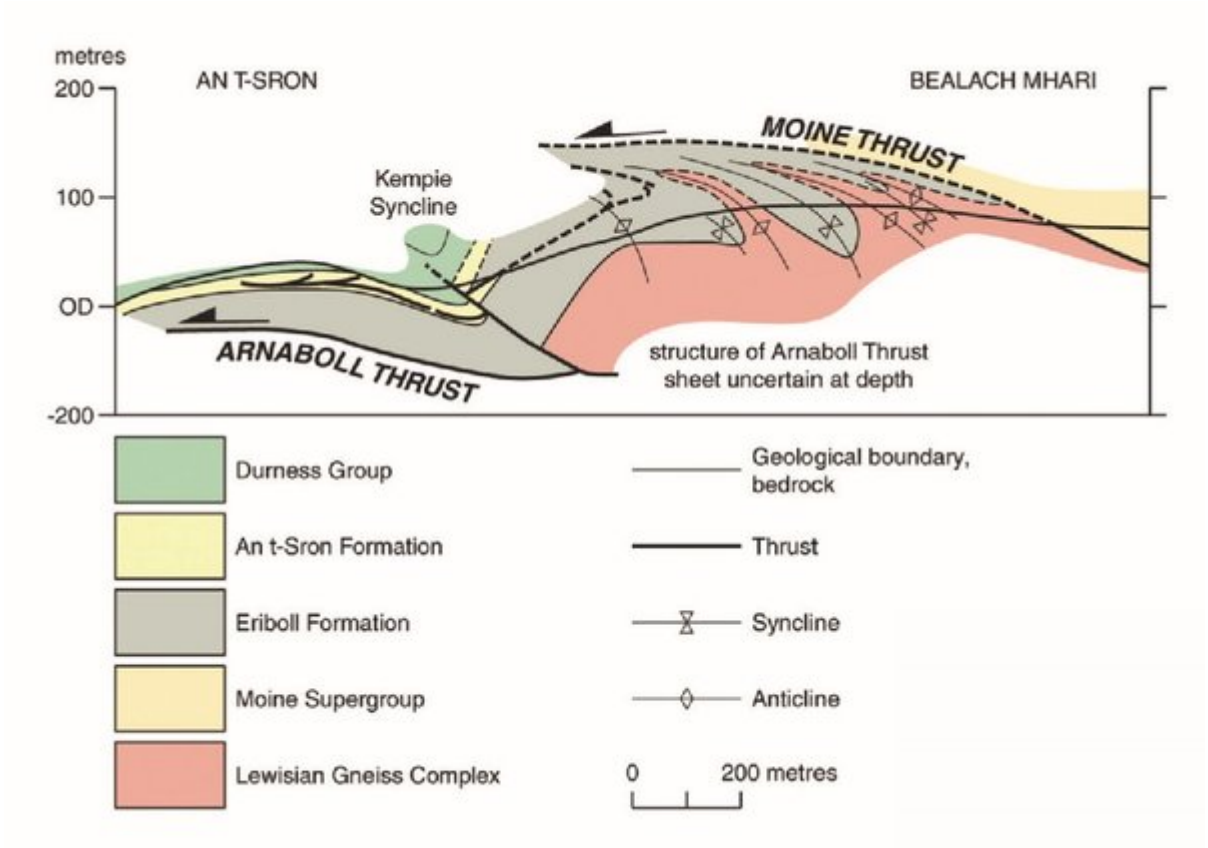
(Figure 106) Cross-section through the Heilam area, after Butler (2009), extending from the Lighthouse duplex in the WNW (left) to Loch Hope in the ESE (right).

(Figure 107) Spectacular folding in Pipe Rock Member associated with a thrust ramp, Locality 15.7. (Photograph: © R. W. H. Butler)



(Figure 108) Annotated panorama of the north side of Ben Arnaboll from around [NC 465 606]. (Photograph: © R. W. H. Butler)

(Figure 109) The type locality of the Arnaboll Thrust, Locality 15.8. Lewisian gneisses thrust over quartz arenites of the Pipe Rock Member. (BGS photograph, © NERC)



(Figure 110) Cross-section of the Kempie area, after Butler (2009), extending from An t-Sròn in the WNW to Bealach Mhari in the ESE.