
Carn a' Bhealaich Mhoir

[NG 826 324]

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Introduction

The escarpments of Carn a' Bhealaich Mhoir and Creag an Duiligh, overlooking Plockton on the south side of Loch Carron, expose the inverted unconformity between the Lewisian gneiss basement and its cover of Torridonian sandstones and conglomerates of the Sleat Group. This is the clearest locality in the Moine Thrust Belt where the original unconformity between these units may be traced, undisrupted by thrusting, over a distance of 1.5 km (Figure 5.52), (Figure 5.53).

The exposures on Carn a' Bhealaich Mhoir form part of the inverted limb of the Lochalsh Syncline which lies within the Kishorn Nappe, the lowest structural unit in the southern part of the Moine Thrust Belt (Figure 5.54). Highly deformed and metamorphosed Torridonian sandstone and conglomerate are overlain, without structural discontinuity, by highly deformed Lewisian gneisses, with clear affinities to the Lewisian Gneiss Complex of the foreland to the west. Eastwards, away from the contact, Caledonian deformation in the Lewisian gneisses diminishes, so that earlier structural features, such as cross-cutting amphibolite dykes, may be recognized.

The Torridonian conglomerate contains deformed pebbles of similar lithologies to those of the Lewisian, and the contact is an inverted unconformity (Figure 5.55). During Caledonian deformation a zone of high strain was localized along this unconformity. To the south of Carn an Reidh Bhric, the unconformity is truncated by the Letter Hill Thrust which carries another slice of deformed Torridonian and Lewisian rocks (Figure 5.53). The outcrop of the Letter Hill Thrust can be traced into the Balmacara Thrust and southwards as far as the Ard Hill GCR site (Figure 5.52).

The area around Carn a' Bhealaich Mhoir was originally mapped by B.N. Peach and J. Horne in 1892–1893 and their results were incorporated in the 1:63 360 map (Sheet 71, Glenelg) (Geological Survey of Scotland, 1909). In the accompanying memoir, Peach *et al.* (1910) defined the Torridonian stratigraphy, noted the deformation of the basal conglomerate, and recognized the inverted nature of the Torridonian and the unconformity. They assumed that the Lewisian gneisses are also overturned. However, Kanungo (1956) asserted that the Lewisian is not inverted, and that a substantial amount of displacement has occurred along the unconformity. Further accounts of the structure and structural development of the Moine Thrust Belt of Lochalsh, including the significance of the Lochalsh Syncline and the inverted unconformity, have been published by Bailey (1939, 1955), Barber (1965) and Coward and Whalley (1979).

Description

The site forms part of a NW-facing escarpment that rises from the wooded coastal areas up to 350 m and extends some 2.5 km from Fernaig [NG 847 338] to Gleannan Dorch. It includes the summits of Creag an Duiligh, Carn a' Bhealaich Mhoir (343 m) and Carn an Reidh Bhric (Figure 5.53). Only scattered exposures occur on the lower slopes, but the cliffs show near-continuous exposure along the steep north-western edge of the escarpment. Rounded crags with heather-covered slopes, peat bogs and small lochans form the crest of the escarpment. A plateau at about 260–300 m with several large lochs extends eastwards to the slopes overlooking Srath Askaig to the north.

On the low hills west of the escarpment, for example Torr Mòr [NG 819 327], grey-green coarse sandstones of the Beinn na Seamraig Formation (Sleat Group) are exposed. The sandstones are composed of quartz, microcline, oligoclase and some clastic mica, in a fine-grained microgranoblastic quartz-sericite matrix. Heavy-mineral layers occur locally. Clastic mineral grains and quartz-feldspar veins show a strong ESE elongation.

Structurally overlying, but stratigraphically beneath, is the Loch na Dal Formation, which is exposed by the roadside at Fernaig and intermittently on the lower slopes of the escarpment as far as Gleannan Dorch. This consists of blue-grey, striped fissile and flaggy siltstones with calcareous bands, alternating with green and grey, pebbly sandstones (Peach *et al.*, 1910). These rocks contain a strong foliation dipping eastwards at c. 20°, which locally is crossed by a second cleavage that dips at c. 40° to the east. The Loch na Dal Formation is structurally overlain by epidotic gritty sandstones and conglomerates, exposed in the upper part of the crags, immediately below the unconformity with the Lewisian. These formations form part of the Sleat Group (see Chapter 4).

The Lewisian-Torrionian unconformity is best exposed in the gully between Carn a' Bhealaich Mhòir and Creag an Duiligh, which carries the stream from Lochan Dubha through the escarpment [NG 826 327]. Above the forest, strongly foliated and lineated sandstones with concordant quartz veins are exposed. The foliation dips eastwards at c. 20° and the lineation plunges to the ESE. Higher in the crags, the sandstones contain centimetre-sized pebbles of vein quartz and are overlain by dark-green chlorite schist, some 6 m thick, with a pervasive foliation parallel to that in the underlying sandstones. The schist contains flattened blocks of vein quartz, quartzite and epidotic quartzofeldspathic gneiss, up to decimetre-size, which increase in abundance upwards through the section. The schistosity diverges around the blocks, which form augen (Figure 5.54). Small grains of epidote, epidotized or sericitized feldspar and quartz, some with a bluish tinge, occur scattered through the chloritic and sericitic schistose matrix. This schist is the metamorphosed basal conglomerate of the Torrionian, containing pebbles derived from the now overlying Lewisian gneisses.

The pebbles in the conglomerate are flattened in the foliation and are mainly elongated parallel to the ESE-plunging mineral lineation, although Soper (in Barber and Soper, 1973) pointed out that pebble elongation is commonly at a slight angle to the mineral lineation, suggesting that more than one phase of deformation was involved. Kanungo (1956) analysed the shape and orientation of the pebbles and obtained axial ratios (x:y:z) of 2.1:1:0.6. The pebbles are commonly broken into fragments by cross joints, orientated normal to the extension direction. However, a few pebbles, with axial ratios of 1.9: 1: 0.7, are elongated at right angles to the mineral lineation. The ESE and NNE directions of elongation in the pebbles may reflect deformation of undeformed pebble populations that at least locally had distinct sedimentary preferred orientations (see Ramsay, 1967, pp. 204–5).

The upper part of the crag is composed of grey hornblende-biotite quartzofeldspathic gneisses and amphibolite. Immediately above the conglomerate the gneisses are strongly foliated, with the mylonitic foliation and ESE-plunging mineral lineation orientated parallel to those in the underlying schist. In exposures towards the top of the crag, the gneisses are coarser grained and layered with lenses of amphibolite and quartz-feldspar pegmatites. They are folded and coarsely rodded, but the structural features are typical of the Lewisian gneisses in the foreland. At the top of the escarpment, by the cairn, layering in coarse-grained hornblende gneiss strikes north-west and is cut by a spaced cleavage that again dips gently eastwards, parallel to the foliation in the mylonitic rocks below.

Interpretation

The section at Carn a' Bhealaich Mhòir clearly shows the inverted unconformity between Lewisian gneisses and Torrionian Sleat Group rocks within the Kishorn Nappe, the lowest structural unit in this part of the Moine Thrust Belt. The Lewisian rocks in the nappe show features similar to rocks of the foreland west of the thrust zone, rather than to the Lewisianoid gneisses of the Glenelg–Attadale Inlier along strike to the SSW

The absence of granulite-facies rocks, the presence of potash feldspar (microcline) in the gneisses, and the occurrence of NW-trending amphibolite-facies mafic dykes with relict ophitic textures (Kanungo, 1956), identifies this as a segment of the Lewisian Gneiss Complex that has undergone amphibolite-facies metamorphism, but shows few effects of Laxfordian reworking. In contrast, potash feldspar is rare in the Lewisianoid gneisses of the Western Unit of the Glenelg–Attadale Inlier.

In the foreland the contact between the Torrionian and the Lewisian is highly irregular, representing an eroded early Neoproterozoic land surface. Any evidence of an irregular contact at Can a' Bhealaich Mhòir has been effectively erased by subsequent deformation. The Torrionian succession consists of a basal conglomerate, overlain by sandstones and siltstones, some calcareous, and then by coarse pebbly sandstones, representing deposition in terrestrial fluvial and

lacustrine environments. Although these Sleat Group rocks are confined to the Moine Thrust Belt, the overlying Torridon Group and general sequence in the thrust belt can be correlated with that of the nearby foreland (see Chapter 4).

At a late stage in the Caledonian Orogeny, during the Silurian-age Scandian Event, the Lewisian basement and its Torridonian cover were thrust westwards and folded into the large-scale Lochalsh Syncline, a large recumbent fold with a westerly vergence. During and possibly after folding, shearing and mylonitization of the Lewisian and Torridonian rocks was concentrated along the unconformity, reflecting differential movement of crystalline basement and sedimentary cover (Barber, 1965). Inversion of the Torridonian can be demonstrated in the western part of Lochalsh by abundant inverted sedimentary structures, for example cross-beds, in the less-deformed sandstones. Peach and Horne (in Peach *et al.*, 1910) presumed that the Lewisian basement was also overturned such that the overall succession was regionally inverted. However, Kanungo (1956) argued that the similar north-west trend of the amphibolite dykes in the Lewisian gneisses of the Kishorn Nappe and the Scourie dykes in the foreland implied that the basement was not inverted. He argued that if the Lewisian gneisses were inverted the dykes should now have a north-east trend. If correct, this deduction implies that substantial differential movements must have occurred along the Lewisian–Torridonian contact, giving rise to the zone of mylonitization, which is notably concentrated in the lowermost Torridonian rocks.

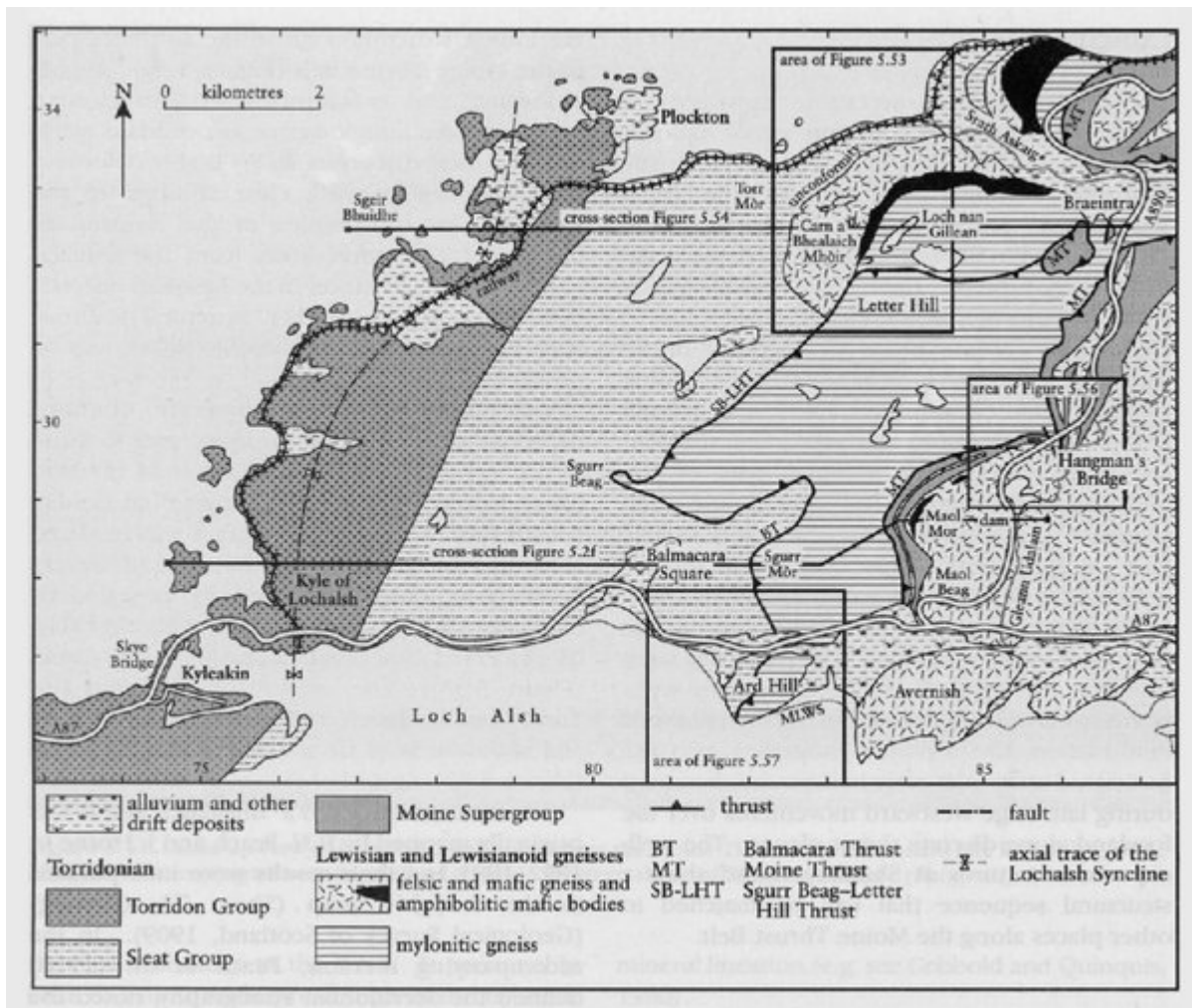
Minor asymmetrical folds with an associated axial-plane cleavage are developed in the Torridonian rocks, especially in the siltstone units within the Loch na Dal and Kinloch formations. Kanungo (1956) also reported kink folds in some flaggy units in the northern part of Lochalsh. These structures are equivalent to those described in the Ard Hill and Slumbay Island GCR site reports (this chapter). The sequence of thrusting and folding in the thrust belt is unclear in the Lochalsh area. The Letter Hill and Balmacara thrusts, which overlap the Lewisian–Torridonian contact to the south, truncate underlying structures, suggesting that they post-date the formation of the Lochalsh Syncline. It is unclear as to the nature and amount of ductile and brittle movements and their timing in this southern part of the Moine Thrust Belt. Certainly, late brittle movements to the west have occurred, but their magnitude is not known. Thus the stacking order of ductile displacements remains to be solved.

Recrystallization of the mylonites and the chlorite-sericite matrix of the deformed Torridonian conglomerate under greenschist-facies conditions implies that during mylonitization the rocks in the region of unconformity were buried to a depth of some 10–15 km. The deformational events took place at successively lower temperatures and pressures implying the progressive uplift and unloading of this part of the thrust belt until, in the final stage, the rocks were broken and transported along brittle thrust planes formed at a depth of only a few kilometres.

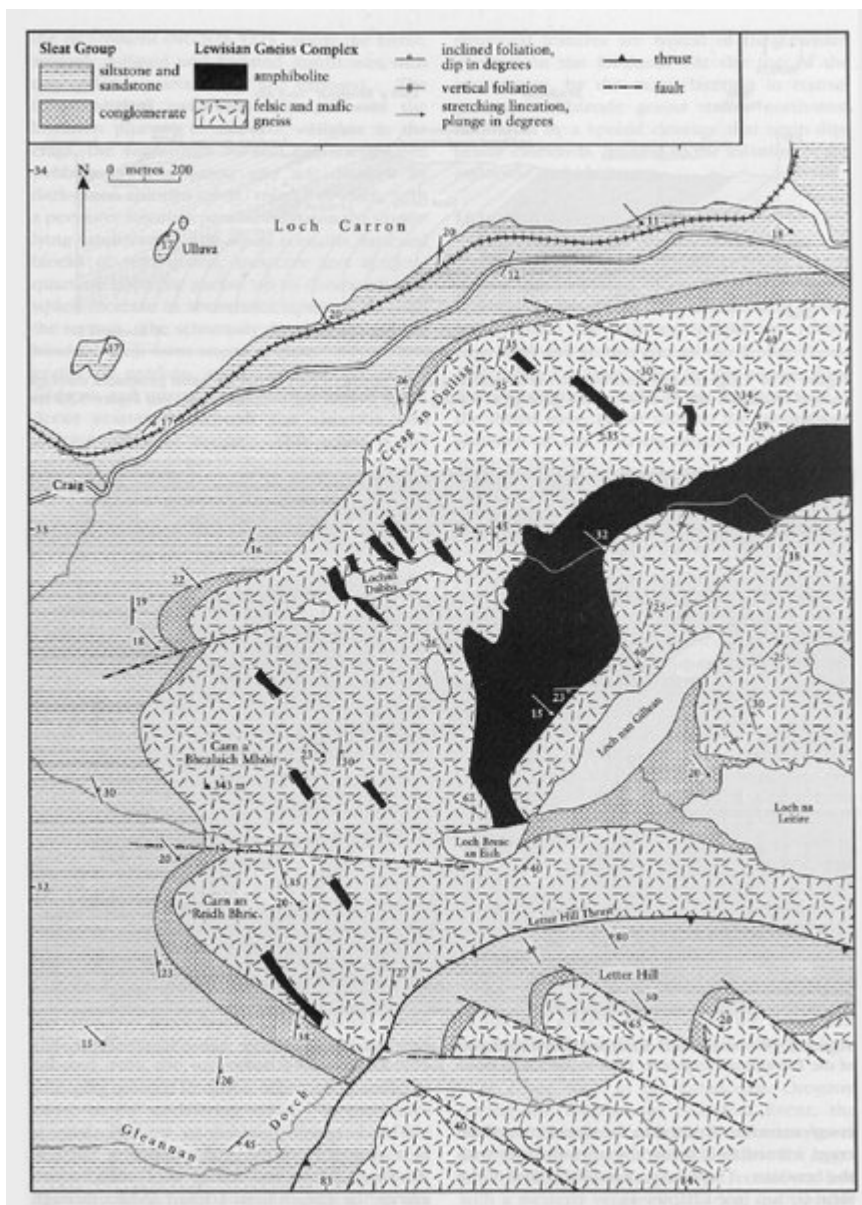
Conclusions

The Carn a' Bhealaich Mhoir GCR site lies within the Kishorn Nappe and shows a remarkable example of an overturned unconformity with fragments of Lewisian gneiss basement incorporated in the now underlying Torridonian basal conglomerate. Both Lewisian and Torridonian rocks in the immediate vicinity of the unconformity have been strongly mylonitized. The mylonitization is interpreted as the earliest Scandian tectonic event in the southern part of the Moine Thrust Belt, associated with the development of the Lochalsh Syncline, a large-scale recumbent fold developed largely in the Torridonian rocks of the Lochalsh and Sleat area. Only after a further minor phase of asymmetrical folding and the formation of brittle kink-folds, were the rocks disrupted by the formation of the thrust planes. Movement along brittle thrusts was the last event within the thrust belt. The unconformity is truncated to the east by the Letter Hill and Balmacara thrusts. The Lewisian and Torridonian rocks were transported on the Kishorn Thrust, and thrust westwards across the foreland to the Caledonian Orogen. The site is of national importance in that it is the best locality to study the Lewisian–Torridonian contact and the effects of thrusting and folding in the Kishorn Nappe.

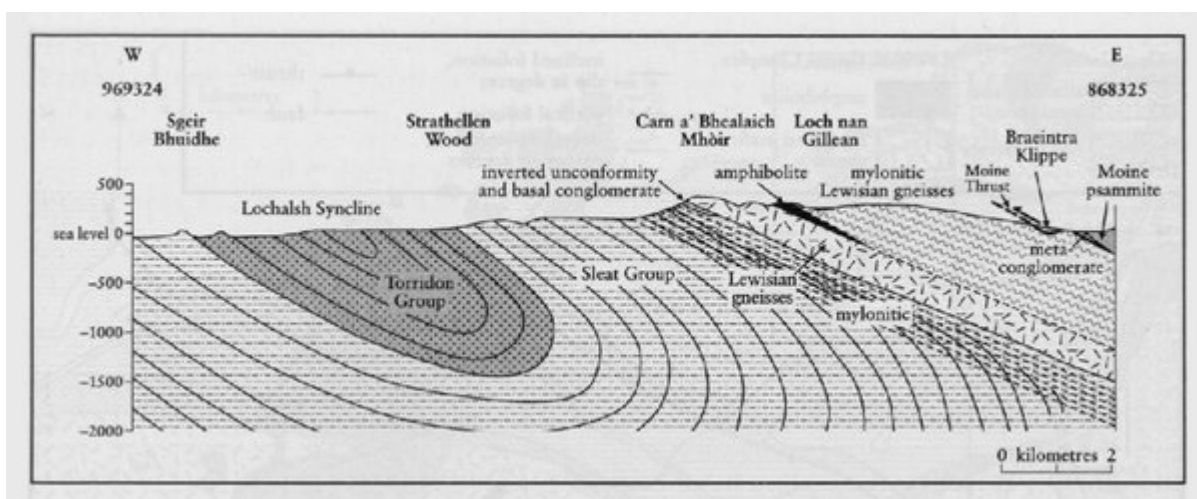
[References](#)



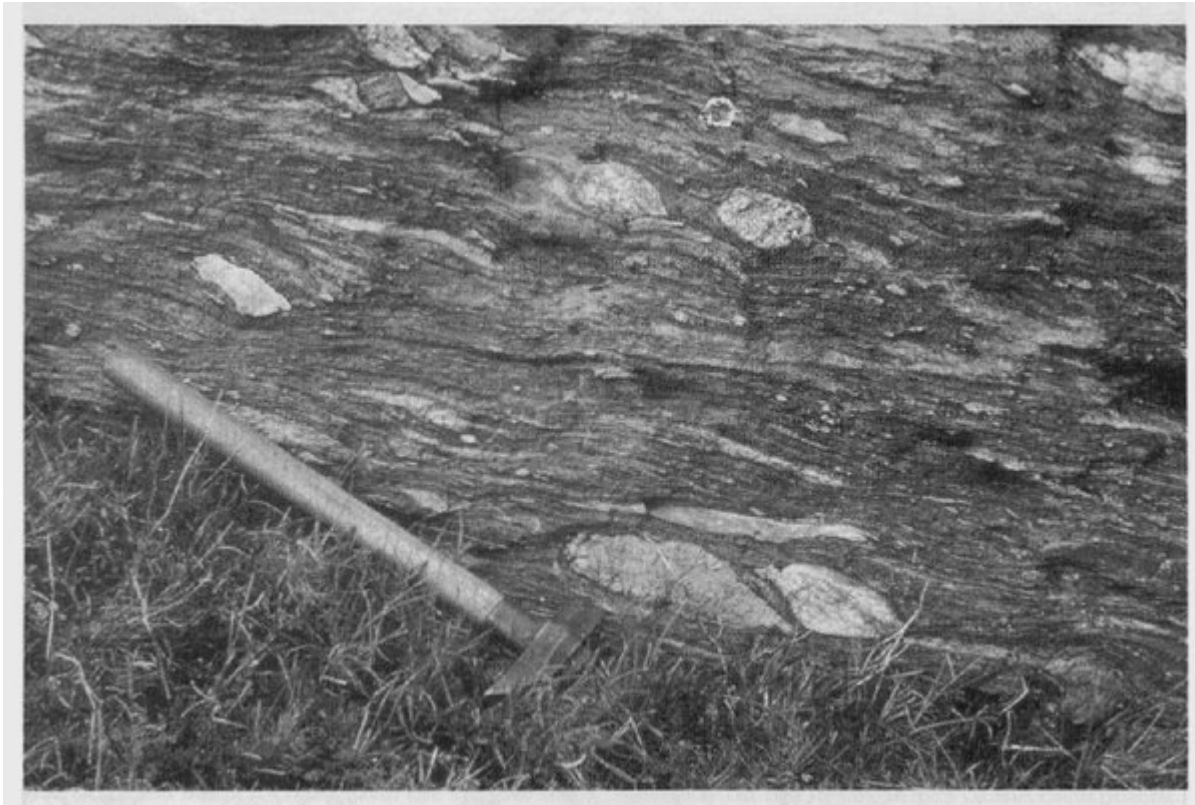
(Figure 5.52) Map of the Lochalsh peninsula, showing the overall geology. Positions of Figures 5.53, 5.54, 5.56 and 5.57 are indicated. Based on Barber and May (1976) and Institute of Geological Sciences (1976a). Trace of Lochalsh Syncline after Coward and Potts (1985).



(Figure 5.53) Map of the area around the Carn a' Bhealaich Mhoir GCR site. After Kanungo (1956).



(Figure 5.54) Diagrammatic east-west cross-section across the northern part of the Lochalsh peninsula through Carn a' Bhealaich Mhoir, showing the geological setting of the overturned unconformity. See Figure 5.52 for location.



(Figure 5.55) Sheared and disrupted quartzofeldspathic clasts in schistose chloritic matrix, basal conglomerate of the Torridonian sequence, Carn a' Bhealaich Mheir, Lochalsh. (Photo: A.J. Barber.)