Beinn Liath Mhor

[NG 954 522]–[NG 988 515]

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Introduction

Culminations that bulge up the Moine Thrust to expose underlying thrust sheets range from outcrop size up to tens of kilometres wide in northwest Scotland. Assynt provides by far the largest of the examples, but a particularly instructive example crops out in the hills between Glen Torridon and Achnashellach in the Beinn Liath Mhor GCR site area (Figure 5.46). Unlike Assynt, where an array of basement-cored thrust sheets and a complex series of imbricate systems are found, at Beinn Liath Mhor the enclosed imbricate structures are considerably less complex, making it ideal for developing an understanding of how such large-scale culminations can be generated by thrust imbrication.

The structure of the Achnashellach area was first reported by Nicol (1860), who described thrust repetitions of what are now known as Torridonian sandstones and Cambrian quartzites. His key section traversed the mountain of Beinn Liath Mhor, and this transect was also used in the Geological Survey memoir of Peach *et al.* (1907), whose authors considered it to be one of the most spectacular sections through imbricate thrusts anywhere in northwest Scotland. Thrust ramps and associated folds are well picked out by the colour contrast between the red-brown sandstones and white quartzites, and by the regular bedding in the quartzites. Therefore, it is arguably the best place in the entire thrust belt for demonstrating the importance of large-scale imbrication to nonspecialists. The north-eastern part of the area was mapped by Matthews (1984) and the southwestern part by Morgan (1985), both as part of PhD studies. This work is incorporated into a larger study of thrust system geometry through the Achnashellach culmination that includes the classic central sector through Beinn Liath Mhor and the neighbouring ridge of Sgorr Ruadh (Butler *et al.,* 2007).

Description

Beinn Liath Mhor is a 3 km-long, E-W-trending ridge that has three distinct tops. The highest, at 926 m, lies at the western end of the ridge (Figure 5.46)a. Its northern and southern slopes provide a near ideal section, 300–500 m deep (Figure 5.46)b, (Figure 5.47). The structure can be well appreciated from the neighbouring summit of Sgorr Ruadh (962 m, [NG 959 505]), which itself displays fine thrust belt geology. Much of the crest of Beinn Liath Mhor is made up of cross-bedded quartzites of the Cambrian Eriboll Sandstone Formation. These form generally ESE-dipping panels, separated by narrower outcrops of Torridonian sandstones. However, Torridonian rocks dominate on the lower slopes of the mountain. These relationships are critical for understanding the structure of the mountain, for they imply that the two rock units are juxtaposed by thrust faults that dip more steeply ESE than the bedding in the sedimentary rocks (Butler *et al.,* 2007).

The most westerly thrust in the GCR site to show stratigraphical separation crops out to the west of Beinn Liath Mhor. It can be traced along a bench (e.g. at [NG 954 530]) where well-bedded gritty sandstones and conglomerates of the Torridonian Applecross Formation lie on cross-bedded quartzites of the False-bedded Quartzite Member. The quartzites are folded on a wavelength of *c.* 100–200 m and show truncations of bedding indicative of thrust repetition. Matthews (1984) and Butler *et al.* (2007) have mapped out similar structures on the neighbouring hill of Sgurr Dubh to the north-east. The Torridonian sandstones in the hangingwall to the main thrust define a large NE-trending anticline whose axial trace extends from the western part of Lochan Uaine [NG 965 525] and to the western end of the Beinn Liath Mhor ridge at Sail Gharbh [NG 958 520]. Cambrian quartzites, lying unconformably on the Torridonian rocks, can be traced from the eastern Lochan Uaine onto the summit ridge of Beinn Liath Mhor. At this higher elevation, Pipe Rock is preserved above the lower False-bedded Quartzite Member. In the highest exposed rocks the two quartzite members are repeated by imbricate thrusts (Figure 5.46). This tract of quartzites can be mapped south to Sgorr Ruadh.

The quartzites beneath the main summit of Beinn Liath Mhor lie on Applecross Formation rocks that are folded into an anticline. The hinge line of this fold can be traced through the mountain, plunging gently north-east and with an interlimb angle of *c.* 90°. Quartzites in the footwall to the thrust that carries the folded Torridonian rocks contain truncated synclines. These observations imply that buckling is an important precursor to thrusting.

The eastern top of the Beinn Liath Mhor ridge (876 m; [NG 983 515]) is capped by cross-bedded quartzites that are also folded into NW-facing structures and are cut by thrusts, equivalent to the structures on the western end of the ridge. The quartzites cannot be mapped out farther south, as deep erosion of the Coire Lair valley means that only Torridonian rocks are preserved. Where exposed on the eastern end of the Beinn Liath Mhor ridge, the Torridonian rocks dip gently in a broadly ESE direction. The same simplicity holds at deeper structural levels, as exposed in the river Lair valley. The Torridonian rocks are overlain stratigraphically by Cambrian quartzites on Carn Eite [NG 998 498], to the east of Coire Lair.

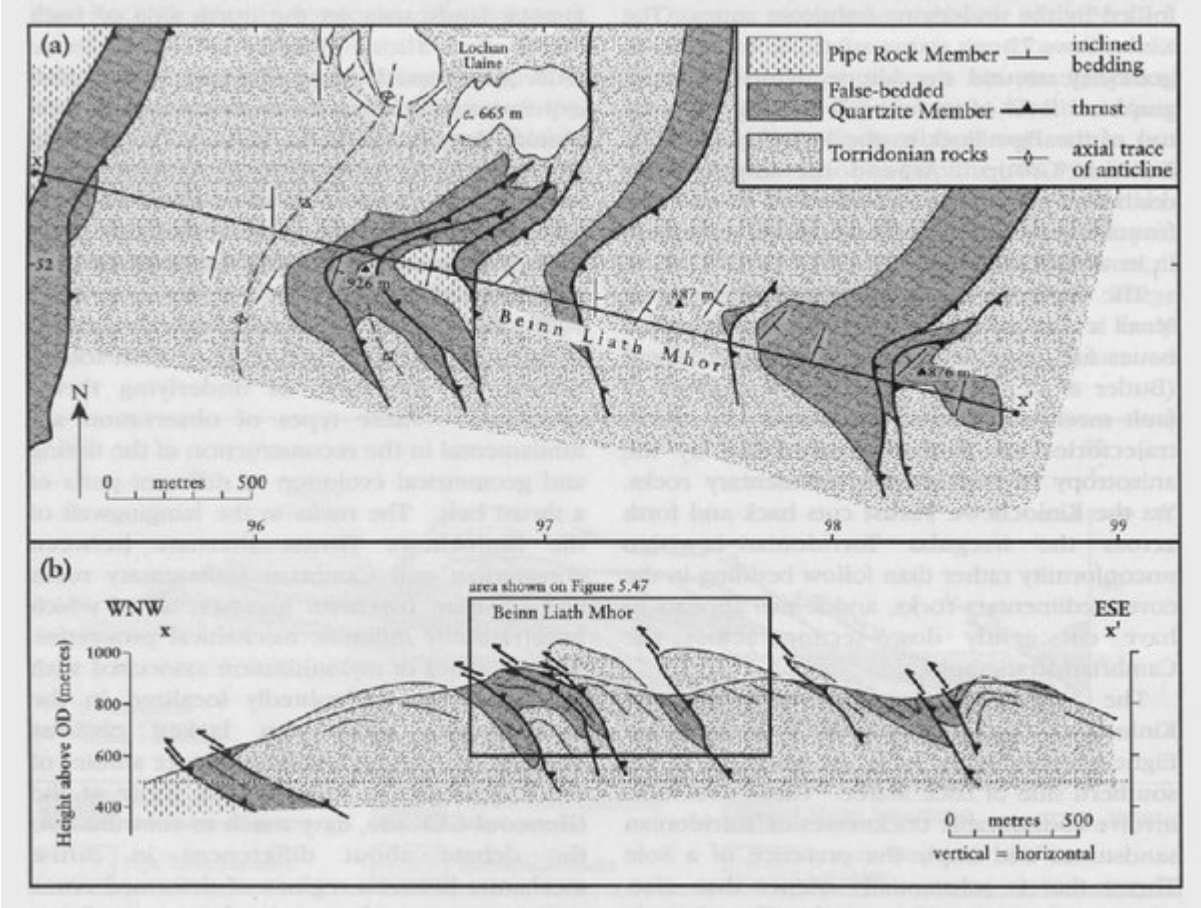
Interpretation

The thrusts in the area around Beinn Liath Mhor climb from the Torridonian up into Cambrian quartzites, and outwith of the GCR site they cut the An t-Sron Formation (Butler *et al.,* 2007). Spectacular exposures on the ridge and flanks of the mountain show that the imbricate thrusts have a simple form, with ramps cutting across the stratigraphical contacts. Here, thrusting is associated with folds, particularly of the basal Cambrian unconformity. This suggests that buckling may have preceded displacements on thrust ramps. However, in general the imbricate slices show only minor internal distortional strain, as shown by the little distorted *Skolithos* burrows in the Pipe Rock. In the Torridonian rocks, cleavage is developed locally in siltstones of the Applecross Formation and the sandstones contain weakly developed, quartz-filled fracture arrays, but otherwise thrust stacking appears to have been accomplished with very little internal deformation. This is the most southerly part of the Moine Thrust Belt to show such simplicity.

Conclusions

The steep flanks of Beinn Liath Mhor are of national importance in that they show arguably the clearest large-scale examples of imbricate thrusts and associated folds anywhere in north west Scotland. The spectacular structures are readily seen from distant viewpoints on account of extensive rock exposure and the marked colour contrast between the main rock-types involved, red-brown Torridonian sandstones and white Cambrian quartzites. Collectively the imbricate structures appear to have resulted in an updoming of the upper structures of the Moine Thrust Belt, including the Kishorn and Kinlochewe thrust sheets, consisting mainly of Lewisian gneisses, and the Moine Thrust, to form a structural inlier known as the Achnashellach culmination' (Butler *et al.,* 2007). These relationships suggest that the imbricate structures of Beinn Liath Mhor formed after movements on the higher structures. The structures can be traced north-east to Beinn Eighe and the Mean a' Ghuibhais GCR site, and south-west to the Cnoc nam Broc GCR site.

References



(Figure 5.46) Map (a) and cross-section (b) of Beinn Liath Mhor. Inset box on section shows location of Figure 5.47. Based on Matthews (1984), Morgan (1985) and Butler et al. (2007).

(Figure 5.47) The south side of the Beinn Liath Mhor ridge from Sgorr Ruadh. Steep thrusts separate imbricate thrust slices containing Torridon Group sandstones and Cambrian quartzites. A hangingwall anticline occurs left of centre. Compare with cross-section shown in Figure 5.46b. (Photo: R.W.H. Butler.)