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# Kinloch Hourn

[NG 944 069]

E.K. Hyslop

## Introduction

The GCR site at Kinloch Hourn is the type locality for the Sgurr Beag Thrust, one of the most significant tectonic structures within the Moine succession. The site incorporates a wide zone of ductile shearing of Moine psammities and pelites, which encloses lenticular bodies of Lewisianoid gneisses.

Tanner (1971) identified two distinct metasedimentary sequences in the Moine rocks of the Kinloch Hourn area, separated by a narrow linear psammitic zone containing pods of Lewisianoid rocks. Despite the apparent continuity of structural history across this zone the two sequences differ in terms of metamorphic facies. The overlying assemblage to the east is gneissose and migmatitic, whilst the western sequence appears lower grade and contains well-preserved sedimentary structures. This led Tanner to postulate the presence of a tectonic break, which he termed the 'Sgurr Beag Slide', along the western edge of the Lewisianoid rocks. Rocks of the western sequence were attributed to a different sedimentary and tectonic succession to those in the east, the two divisions subsequently being recognized as the Morar Group and Glenfinnan Group respectively (Holdsworth *et al.*, 1994; see Fassfern to Lochailort Road Cuttings GCR site report, this chapter).

Following the recognition of the 'Sgurr Beag Slide' at Kinloch Hourn, the structure was traced both to the north (see Fannich GCR site report, Chapter 7) and to the south, and became established as a major regional tectonic boundary with a lateral extent of over 150 km. In recent times, it is realized that the shear zone has an overall westward thrust movement and it is generally termed the 'Sgurr Beag Thrust'. Deformation was mainly ductile, and apparently contemporaneous with the local D2 deformation and folding. Although on outcrop scale the thrust zone appears concordant with the lithological layering, on a more-regional scale stratigraphical units are cut out.

## Description

Kinloch Hourn lies at the head of the remote sea loch of Loch Hourn, a roughly E–W-trending fjord that extends inland for almost 20 km. The Sgurr Beag Thrust passes in a NNE–SSW direction only a few hundred metres from the end of the loch (see (Figure 8.9)). The rocks are well exposed on the southern shore where a footpath provides access.

Glenfinnan Group rocks with a steep easterly dip lie to the east of the Sgurr Beag Thrust. The lowest unit, the Reidh Psammite, varies from siliceous and coarse-grained to feldspathic and migmatitic, and contains abundant quartz-feldspar lenses. The overlying Sgurr Beag Pelite (Figure 8.3), correlated with the Lochailort Pelite of Powell (1974), is a highly garnetiferous and gneissose rock, commonly containing early quartz-feldspar migmatitic leucosomes. Psammitic layers are common, locally giving the rock a ribbed appearance. No sedimentary structures are seen in these rocks.

Westwards towards the Sgurr Beag Thrust the contact between the Sgurr Beag Pelite and the Reidh Psammite is repeated by a series of S-plunging, tight F3 folds. As the Sgurr Beag Thrust is approached an intense planar fabric obscures the transitional contact between the two units. Early-formed leucosomes, quartz veins and pegmatite lenses become intensely deformed and 'shredded', with porphyroblasts wrapped by a quartz ribbon fabric.

At the shoreline on the south side of Loch Hourn at [NG 9462 0688] a small lenticular pod of Lewisianoid gneisses is present near the thrust contact. It consists mostly of layered hornblende schist with boudins of more-uniform amphibolite, but grades into felsic gneisses on its eastern side (Figure 8.10). Much of the hornblende is replaced by biotite, and epidote is common, unlike in most Moine lithologies. The Lewisianoid body is enclosed to the south and west (near an F3 fold closure) by migmatitic Reidh Psammite, with a sharp contact separating the two lithologies. Tanner (1971)

interpreted this body as a Lewisianoid inlier, one of several lenticular fragments of a once larger sheet that lay along the Sgurr Beag Thrust. A similar body is exposed at the same stratigraphical level in Coire Shubh, about 3 km to the south, and more-extensive gneiss outcrops occur some 7–10 km to the NNE in Glen Shiel (Rathbone and Harris, 1979). Although subsequent work has extended the Sgurr Beag Thrust throughout Inverness-shire and Ross-shire where thicker Lewisianoid inliers are present (Tanner *et al.*, 1970; Powell, 1974), no Lewisianoid slices are found associated with the thrust in the Lochailort area to the south.

On the west side of the Sgurr Beag Thrust is a psammite and semipelite unit, the Coire Mhicrail 'Group' (Tanner, 1971), that represents the Morar Pelite–Upper Morar Psammite transition (see 'Introduction'). The Sgurr Beag Thrust is defined by the contact between the westernmost outcrop of Reidh Psammite and the Coire Mhicrail 'Group'. An intense foliation is developed in a narrow zone either side of the contact. F2 axial planes are parallel to this foliation, and minor F2 folds tighten and become sheared out as it is approached. The shear plane is concordant with the compositional layering on the local scale, though on a larger scale (> 100 m) there is attenuation of fold limbs and the Coire Mhicrail 'Group' is regionally cut out against the Reidh Psammite to the north. The shear zone strikes NNE with a steep dip to the east but is itself affected by F3 folds. Despite their attenuated appearance, in thin section the shear-zone rocks show no obvious indication of mylonitization or significant grain-size reduction, implying that widespread recrystallization and grain recovery has occurred.

Immediately west of the thrust zone the Coire Mhicrail 'Group' retains an intense planar fabric, lacking any angular features such as crosscutting veins or cross-bedding. However, over several hundred metres the lithology becomes more psammitic, and tight F2 folds of quartz veins, pegmatites and calc-silicate ribs are apparent, indicating a reduction in ductile strain. Psammitic layers carry a strong mica fabric, apparently related to the Sgurr Beag Thrust, as well as an earlier oblique S1 schistosity, showing that the Sgurr Beag Thrust is primarily a D2 structure (Roberts and Barr, 1988). Approximately 200 m to the west of the shear plane, deformed sedimentary structures can be seen in the psammites, and a further hundred metres west the psammites are little deformed and young towards the east.

## Interpretation

At Kinloch Hourn the boundary between the distinct Morar Group and Glenfinnan Group rocks has been interpreted as a major tectonic break termed the 'Sgurr Beag Thrust'. The thrust is the most important of the regional NNE-trending ductile dislocations that affect the Moine succession. It represents an early ductile thrust, probably with a displacement comparable to the Moine Thrust, which together with the Knoydart Thrust cuts up-section to the NNW forming part of a series of regionally extensive thrust nappes (Barr *et al.*, 1986).

Elsewhere in the Moine outcrop, the Sgurr Beag Thrust forms a several hundred metres wide ductile high-strain zone, (Rathbone and Harris, 1979; Kelley and Powell, 1985; see also Fannich GCR site report, Chapter 7). However, at Kinloch Hourn it lies within a narrow zone of concentrated strain. The presence of lenses of Lewisianoid gneisses (upon which the Glenfinnan Group Moine is considered to have been deposited) is significant, and suggests significant movement along the thrust. The continuity of the geometry of F2 fold structures across the thrust, limited grain-size reduction, and absence of mylonitization, suggests that thrusting occurred under amphibolite-facies conditions during regional D2 deformation and metamorphism.

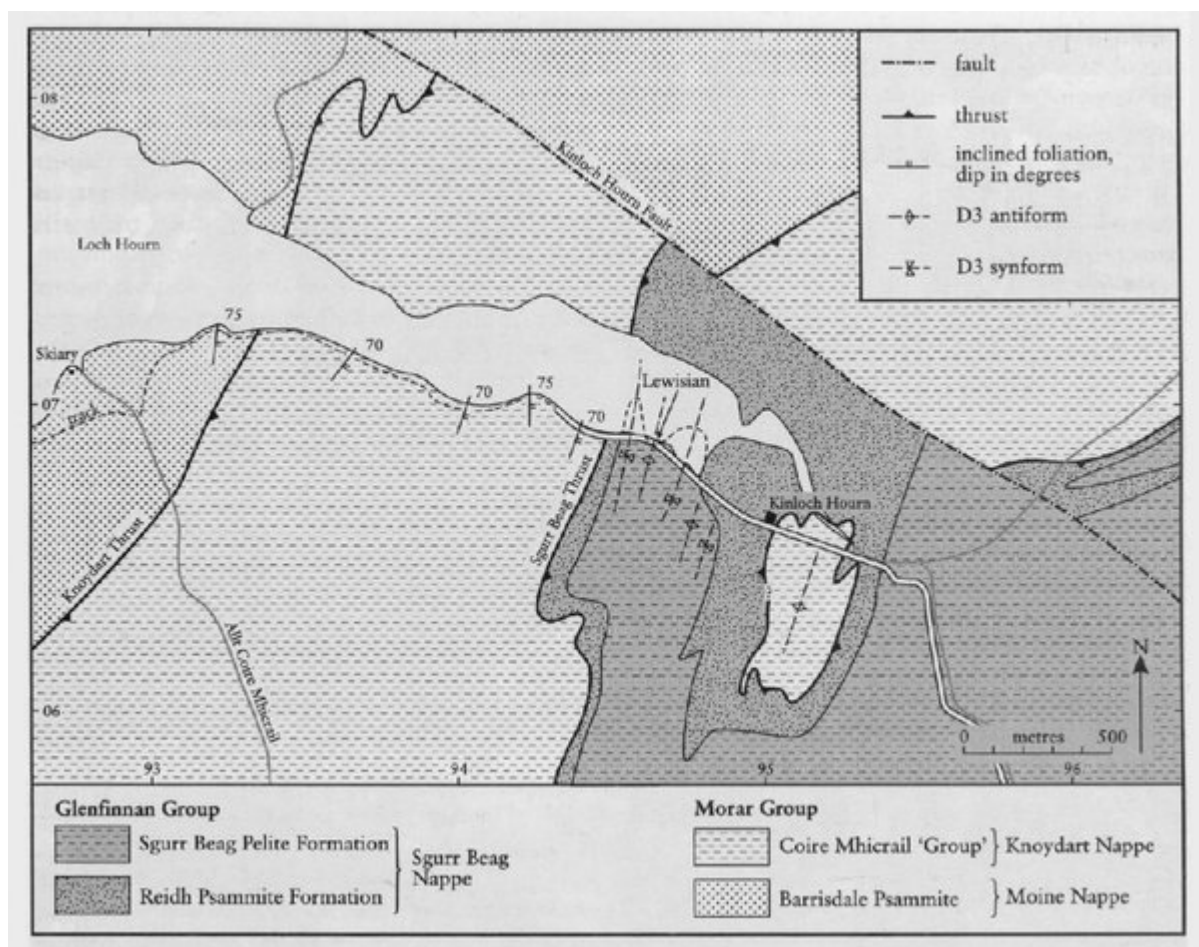
The age of the Sgurr Beag Thrust and its relationship to peak metamorphism has long been a contentious issue. The main translation on the thrust has been inferred to occur before (Tanner, 1971), coeval with (Powell *et al.*, 1981; Tanner and Evans, 2003), or after (Baird, 1982; Rathbone *et al.*, 1983) peak metamorphism. This movement has been interpreted to be Caledonian (Barr *et al.*, 1986) or Knoydartian (Piasecki and van Breemen, 1983; Tanner and Evans, 2003) in age. Piasecki and van Breemen (1983) obtained a Rb-Sr age of  $755 \pm 19$  Ma from muscovite in a coarse-grained quartz-feldspar-muscovite pegmatite lens from the Reidh Psammite, about 80 m east of the Sgurr Beag Thrust at Kinloch Hourn. They interpreted this early pegmatitic lens as part of a regional syn-tectonic Knoydartian/Morarian pegmatite suite, developed during Neoproterozoic ductile thrusting, (see Rogers *et al.*, 1998). However, Barr (1985) included such bodies in the regional migmatitic leucosome suite, and suggested that their isotopic age represents partial resetting of an even earlier (possibly Grenvillian) metamorphic event during Caledonian

movements on the Sgurr Beag Thrust. Soper *et al.* (1998) rejected the evidence for a Knoydartian orogeny and suggested that the 'slide zone' may have had an earlier history, possibly as an extensional low-angle fault, and was then reactivated as a ductile thrust during Caledonian D2 and D3 events.

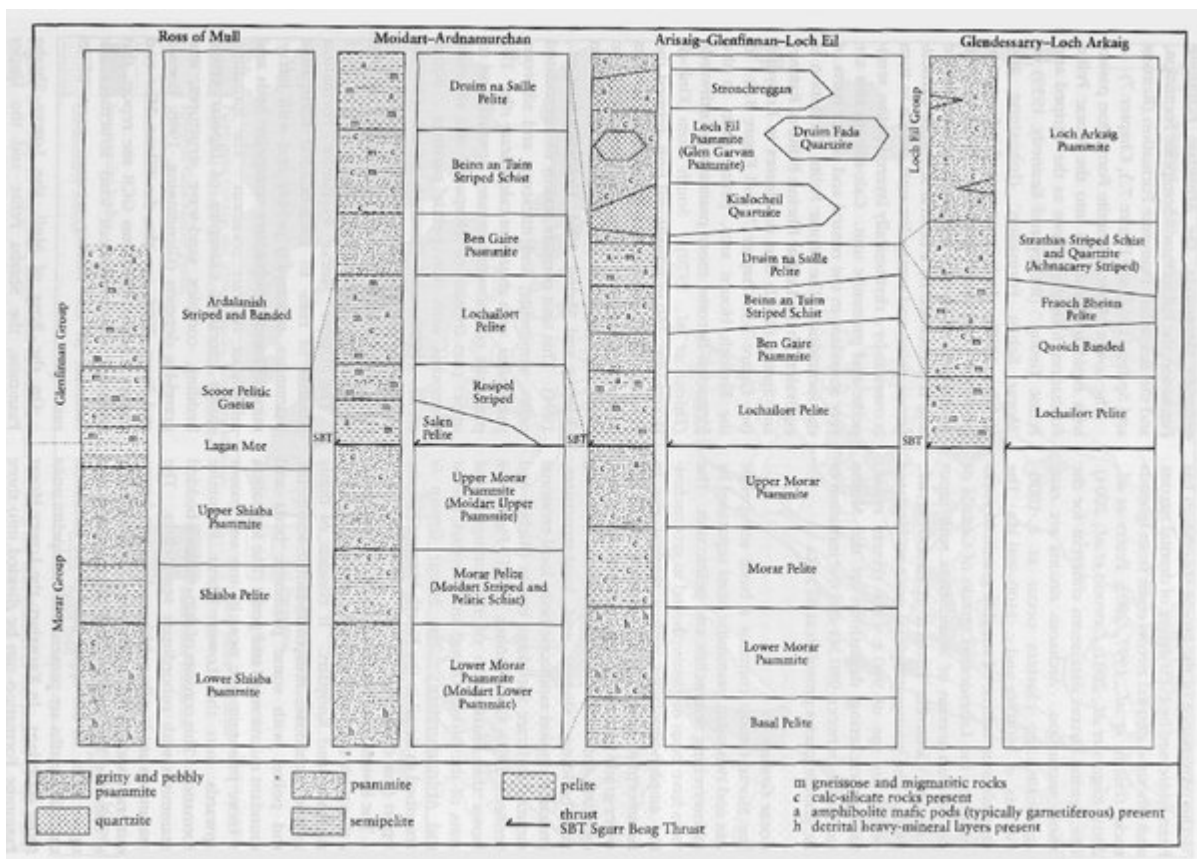
## Conclusions

On the shore section at Kinloch Hourn, slivers of Lewisianoid gneiss are present within a narrow ductile high-strain zone, the Sgurr Beag Thrust. This structure was first recognized at Kinloch Hourn and is one of the most significant, regional, large-scale tectonic boundaries in the Moine succession, separating the Morar and Glenfinnan groups. Muscovite age dates from pegmatites at Kinloch Hourn suggest that the Sgurr Beag Thrust was originally a Knoydartian structure, providing further evidence of pre-Caledonian orogenic activity in Scotland. The site is of international significance as it is one of the major ductile structures in the Moine outcrop of Scotland and one of the first such structures to have been recognized.

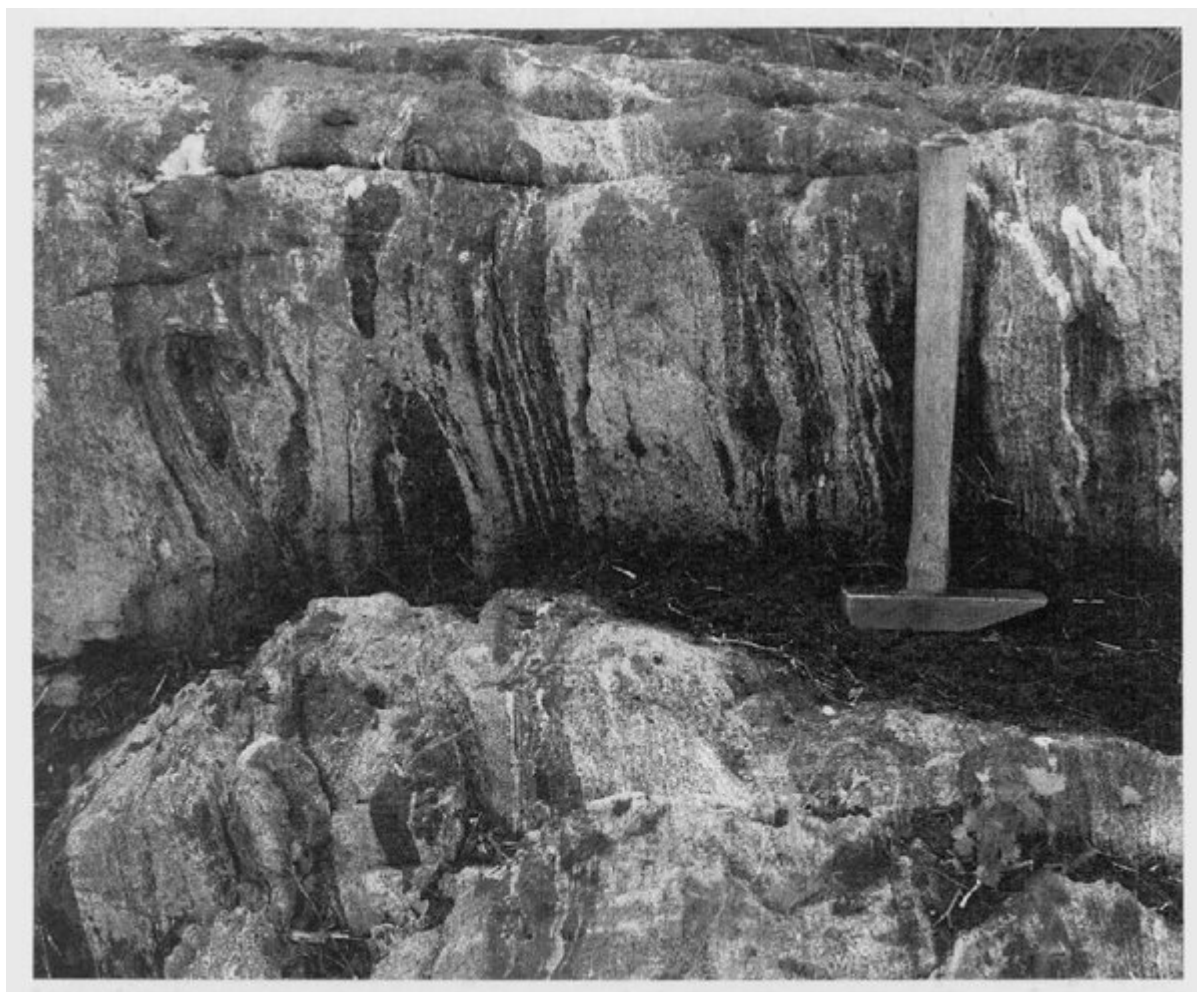
## References



(Figure 8.9) Map of Kinloch Hourn GCR site and surroundings. After Roberts and Barr (1988).



(Figure 8.3) Tectonostratigraphy of the Moine succession within the Moine (South) area, showing the main formations.



(Figure 8.10) Photograph of layered hornblende gneisses with small boudins of amphibolite from Lewisianoid rocks in the Sgurr Beag Slide at Kinloch Hourn. The hammer is 37 cm long. (Photo: British Geological Survey, No. P218788,

