

# Grampian Highlands Field Guide: Day 3 - Allt Bail a' Mhuilinn, Upper Glen Lyon, Loch an Dàim

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## Day 3 - Allt Bail a' Mhuilinn, Upper Glen Lyon, Loch an Dàim

**Aims:** to examine nature and geometry of the Ben Lui Fold Complex; to look at Grampian Group psammites structurally beneath the 'Boundary Slide'; to look at the nature of the Lochaber Subgroup succession, notably the Beinn a' Chaisteil Quartzite Formation; to visit strongly deformed semipelites of the Leven Schist Formation and a slump breccia unit which appears to lie in the basal part of the Ben Lawers Schist Formation.

### Introduction

In the central southern part of the Grampian Highlands the Dalradian outcrop is dominated by a general inverted stratigraphical sequence with overall shallow dips. This constitutes the classic 'Flat Belt' of the Tay Nappe, but the regional inversion also extends northwards across the Ben Lawers Synform, into the Tummel Steep Belt, even up to and across the 'Boundary Slide'. At first only the Southern Highland Group and upper parts of the Argyll Group are exposed, but at the deeper structural levels now exposed in upper Glen Lyon the older parts of the Dalradian succession become involved, namely the Grampian and Appin groups and lower parts of the Argyll Group. The complementary fold to the Tay Nappe, here termed the Ben Lui Fold Complex, which effectively restores the sequence to right way up, can be traced from its type area (Ben Lui) eastwards, albeit dislocated by several NE trending strike-slip faults, to the upper part of Glen Lyon and Meall Ghaordaidh. However, these areas have experienced significant secondary deformation and folding during the D2, D3 and D4 deformation events, and judging the significance of each of these structural phases can be difficult. Hence, the Ben Lui Fold Complex has been interpreted as either a dominantly D1 or D2 structure. Note that throughout the central Grampian Highlands, this critical 'core' of the Tay Nappe is mostly obscured within a zone of steeply dipping strata, a product of refolding of co-axial F1 and F2 folds by near-upright F3 and F4 folds, giving rise to the Tummel and Cairnwell steep belts. Interestingly, the discussion of the geometry and role of the Ben Lui Fold Complex in the overall structural edifice (and hence tectonic model) has been debated since Bailey's earliest work and still continues today (Bailey, 1922; Cummins and Shackleton, 1955; Roberts and Treagus, 1975; Stephenson et al. 2013).

To the north-west of this fold complex, generally SE-dipping Appin and Argyll Group strata are separated from the structurally underlying Grampian Group by a high-strain zone, which in places includes several planes of dislocation and has been termed the 'Boundary Slide'. However, beneath the 'Boundary Slide', major early folds, now interpreted as F2 structures, still face southeast (e.g. those formerly known as the Glen Orchy and Atholl nappes) (see Stephenson et al., 2013). Recent BGS mapping in Upper Glen Lyon and the Glen Orchy area has cast doubt on the interpretation of the 'Boundary Slide' as merely a tectonic structure. In this area Grampian Group psammites and micaceous psammites (Glean Spean Subgroup) are overlain a distinctive unit of quartzites and

quartzose psammites. This unit, termed the Beinn a' Chaisteil Quartzite Formation, has been traced more or less continuously from Bridge of Balgie [NN 5847], west through Upper Glen Lyon and then north to the Tyndrum Fault [NN 4952]. It also occurs farther west beyond Tyndrum on Beinn Udlaidh and in Glen Lochy. The quartzite unit is succeeded by schistose semipelites and calcareous semipelites (with hornblende schists and coarse-grained tremolitic schists) and subsidiary psammites, regarded as correlatives of the Loch Treig and Leven Schist formations, respectively. These lithologies have all been assigned to the Lochaber Subgroup (Appin Group). In upper Glen Lyon Lochaber Subgroup rocks are progressively overlapped by Argyll Group units, namely the Cairn Mairg Quartzite, Ben Eagach Schist, Ben Lawers Schist, and Ben Lui Schist formations. As a result around Meggernie and Kenknock (e.g. in burn section at [NN 548 432]), the Loch Tay Limestone Formation lies only c.100 m structurally above a thin Lochaber Subgroup sequence. By comparison with the classic Dalradian succession, this stratigraphical omission points to the presence of a regional-scale intra-Dalradian unconformity in this part of western Perthshire. The absence of several kilometres of the Dalradian succession has previously been explained by 'tectonic excision' along an inferred Iltay Boundary Slide (e.g. Bailey, 1934; Bailey and McCallien, 1937; Roberts and Treagus, 1979). The recent work suggests that a stratigraphical solution is more reasonable, particularly as there is little or no evidence of enhanced strain along some parts of the boundary in question.

## Localities

### **Headwaters of the Allt Bail a' Mhuilinn [NN 582 416]**

As per Day 2 — from Kindrogan drive to Pitlochry, take the A9 southwards to Ballinluig, and follow the A827 to Aberfeldy, past Kenmore and along Loch Tay to Edramucky. Turn right up the Lochan na Lairige road and proceed past the lochan and over the watershed towards Bridge of Balgie. A short distance down on the northern side, park on the corner at [NN 5823 4168] (or nearby). The aim here is to inspect the section below in the Allt Bail a' Mhuilinn. Overall, about a 300 m round trip with a height difference of c.30 m.

The section exposes steeply dipping, attenuated thinly bedded metalimestones with subsidiary pelitic interbeds (Loch Tay Limestone Formation) that show some tight minor F2 folding (Figure 3.1). The beds lie on the southern limb of a kilometre-scale tight syncline (?F1 + F2) that faces down towards the SSE (Figure 3.2). This fold is one of the structurally higher members of the Ben Lui Fold Complex, a zone at least 4 km thick in this area. Foliated and lineated amphibolitic mafic sheets (some now podded) are present in the metalimestone sequence in places.

As we drive down the glen we can see that the Allt Bail a' Mhuilinn has a well-exposed section for some 2 km, at least to the precarious wooden footbridge just downstream of its confluence with the Allt Breisleich at [NN 573 436]. The section exposes the Ben Lui Schist, Loch Tay Limestone and Pitlochry Schist formations with bedding dips variable from shallow (c.15°-25° SSE) to near vertical reflecting the tight F2 folding (Figure 3.2). Just below the junction with the Allt Breisleich, the Bridge of Balgie Fault (also termed the Killin Fault) enters the main valley, markedly changing the structural level exposed. Treagus (1991) matched the main structural features across the fault, and concluded that there was an oblique offset, comprising a sinistral displacement of 1.2 km plus a down-throw to the northwest of 1.5 km.

### **Allt Bail a' Mhuilinn [NN 5706 4525]**

Carry on northwards alongside the Allt Bail a' Mhuilinn and park in a large parking area (on right) at [NN 572 448]. Inspect the relatively clean section in the Grampian Group psammites exposed in the adjacent burn (**Care** — some traffic).

The lower course of the burn provides a good section in tabular bedded psammite and micaceous

psammite with only minor semipelite interbeds. In places, convincing cross-bedding and lenticular bedforms (channels?) can be seen. Indeed, the entire section down to the Bridge of Balgie is right-way-up, with bedding dipping south. Note the bedding features and level of strain. These are Grampian Group (Glen Spean Subgroup) strata, which dominate the bedrock geology of Glen Lyon west of the Bridge of Balgie Fault towards Loch an Dàimh. Note that upstream the psammite succession is overlain by a few metres of white quartzite at [NN 571 442], at which point the Grampian Group rocks are juxtaposed against Argyll and Southern Highland Group rocks marking the trace of Bridge of Balgie Fault.

### **River Lyon section below Cashlie Power Station [NN 5128 4213]**

Drive north to Bridge of Balgie and turn left (west) up the glen. Proceed up Glen Lyon past Meggernie Castle and Kenknock and park by the unfenced road at around [NN 513 423]. Inspect section in the nearby River Lyon.

Note that around Kenknock [NN 528 436] Grampian Group psammites and Lochaber Subgroup strata are in contact with Argyll Group strata. The Ben Lui Schist Formation, Loch Tay Limestone Formation and Southern Highland Group rocks dip SSE on the slopes of Meall Ghaordaidh, here forming a right-way-up succession overlying Grampian Group rocks (Figure 3.3).

Massive amphibolites are commonly spatially associated with the Loch Tay Limestone Formation (see Day 2). These intrusive mafic sheets commonly form features (e.g. cliffs, waterfalls in burn sections) that can be traced readily, both across the valley floor and higher up on the slopes of Meall Ghaordaidh, thus effectively marking out structural repetition of the metalimestone formation. The summit area of Meall Ghaordaidh is underlain mostly by Ben Lui Schist Formation with a small patch of Ben Lawers Schist Formation capping the summit. The Southern Highland Group rocks, bracketed by the Loch Tay Limestone Formation on the lower slopes, contain the trace of the major Ben Lui Fold (Figures 3.3, 3.4). Figure 3.5 portrays some idea of the scale of the Ben Lui Fold and associated structures, again over 4 km thick here.

We will inspect the outcrops by the river where grey wackes, arenites and semipelites assigned to the Pitlochry Schist Formation (basal Southern Highland Group) crop out. Some of the units are internally more massive and have a green-grey appearance. They resemble 'Green Beds' — volcanoclastic units that are common in the lower part of the Southern Highland Group farther south. Note that such lithologies are not typical of the Pitlochry Schist Formation, but this unit varies laterally in thickness and facies.

### **Giorra Dam (Loch an Daimh) [NN 5086 4615]**

Retrace your route down Glen Lyon as far as the road junction at [NN 537 454], where you turn left up the tarmac road to the Giorra Dam and Loch an Daimh (Note: gated near top). Park within sight of the dam by the start of a track at [NN 5116 4638] and then walk up the road to its south end. There, it is easy to descend onto the adjacent exposed rocks around top water level. The walk is c.1.1 km in total with a height difference of c.30 m.

Below the Giorra Dam [NN 511 464], badly stained outcrops of the Glen Spean Subgroup rocks are exposed. They have been recorded as pale-brown to grey-weathering psammite and micaceous psammite, together with pale buff weathering quartzose psammite, occurring as 5 to 15 cm thick tabular bedforms. Rare swaley bedding suggests channelling, but clear evidence of way-up (e.g. cross-bedding) is not obvious and generally ambiguous. The proportion of quartzose psammite increases upwards, but the boundary with the succeeding grey to white banded quartzite and siliceous psammite unit is sharp, forming a readily mappable boundary. This distinctive unit, termed the Beinn a' Chaisteil Quartzite Formation, is interpreted as the basal unit of the Lochaber Subgroup (Appin Group). Its outcrops by the dam are characterised by 10 to 40 cm thick tabular beds but

showing some good shallow channel features and cross-bedding (Figure 3.6). The beds are clearly right-way-up.

### **Loch an Daimh (northern side) [NN 4869 4730]**

Retrace your steps down the dam access road back to parking and then take the good track to the north that tracks above the reservoir on its northern side. The excursion route takes us as far as the burn section at [NN 4862 4736], c.6 km in total with a height difference of some 80 m.

The traverse first crosses Grampian Group psammites, before passing up into the more varied but mainly semipelitic strata of the Lochaber Subgroup (Appin Group). Note that two separate units of quartzite can be recognised north of Loch an Daimh, but they converge south of the dam [NN 510 455] (Figures 3.7, 3.8, 3.9). Uniform garnetiferous quartz- muscovite-bearing semipelites separate the two quartzite units and also typically succeed the quartzite formation in the Loch an Daimh area. This semipelite is succeeded by a more heterolithic sequence of semipelite, subsidiary micaceous psammite and tremolite-bearing calcareous semipelite. Minor occurrences of impure metalimestone also occur, e.g. at [NN 5008 4753], but are not persistent. These lithologies have been grouped into the Beinn an Dothaidh Formation (Figure 3.9). This sequence is overlain in turn by quartz- muscovite- biotite semipelite, commonly with conspicuous garnets up to 5–7 mm diameter, and numerous quartz segregations. This uppermost unit is typically dark grey in colour and contains thin (centimetre-scale) ribs of garnet-hornblende schist, e.g. at [NN 4895 4734]. It has been termed the Beinn Dorain Semipelite Formation. This coherent stratigraphical sequence can be recognised and mapped overlying the Glean Spean Subgroup attesting to its Lochaber Subgroup status, making the units equivalent to the Leven Schist Formation (Figures 3.7, 3.8, 3.9). Note that only parts of this succession are exposed near to the track.

In the lower part of the burn draining Coire Pharlain around [NN 4896 4737] typical lithologies of the mixed Beinn Dorain Semipelite Formation are exposed. The beds are now laminated to thin-bedded (attenuated?) with evidence of two phases of penetrative folding. The earlier tight to isoclinal folds, here assigned to D2, are refolded by open to tight folds (? D3); classic 'hook-shaped' fold interference patterns can be seen (Figure 3.10). Although the mapped pattern of stratigraphical units strongly suggests that there is an unconformity + overlap relationship between the overlying Ben Lawers Schist Formation and the underlying Lochaber Subgroup rocks (Figure 3.7), these semipelitic and amphibolite-bearing rocks do provide evidence of strong deformation. It seems likely that these semipelite-dominated rocks, assigned to the Lochaber Subgroup, have acted as a locus for deformation and possibly for shear movements during the Grampian orogenic event.

Some 250 m to the west a further burn section, here draining Coire Uaimh, exposes some unusual 'breccias'. In the burn at around [NN 4869 4730] there is an abundance of centimetre- to metre-scale lenses or blocks, mainly of cream-coloured pitted psammite, which occur as disorientated blocks in a pale green locally thinly banded chlorite semipelite and calcareous semipelite matrix typical of the overlying Ben Lawers Schist Formation. In parts the blocks show internal folding (Figure 3.11), whereas some more planar beds have merely been pulled apart ('boudinaged'), all apparently within a mobile matrix. The lithologies and nature of the 'breccia' suggest that it formed as a slumped unit at the base of the Ben Lawers Schist Formation. The 'breccia' is over 50 m thick and can be followed down to burn to the shore of the loch around [NN 4879 4707] where it overlies more muscovite-rich semipelites and psammites of the Beinn Dorain Semipelite Formation (Lochaber Subgroup). The underlying rocks are somewhat broken up but the contact is not the site of later tectonic movements or of high strain. In parts a rubbly layer is present in which lithified sand layers have become disrupted and entrained in a matrix of calcareous mudstone and siltstone. Note that most of the Appin Group and the lower parts of the Argyll Group are missing. Although the bedding orientations in the overlying and underlying units are difficult to discern there is no evidence at outcrop for an angular unconformity. However, the map pattern clearly shows onlap of the higher

units over the Lochaber Subgroup succession (Figure 3.7).

Return to vehicles. Return to Kindrogan via Glen Lyon, a shorter and probably quicker despite the rather narrow sinuous nature of the single-track road in parts. Thence continue via Fortingall, Aberfeldy, Pitlochry, etc.

[File:GHFGfig3.1.jpg](#)

**Figure 3.1** Tight F2 minor folding within the Loch Tay Limestone Formation, upper part of Allt Baile a' Mhuilinn.

[File:GHFGfig3.2.jpg](#)

**Figure 3.2** Abstract from the NE part of the 1:50 000 sheet 46E (Killin) showing the bedrock geology of the Lochan na Lairige and Allt Baile a' Mhuilinn area. Note the large-scale tight folds, part of the Ben Lui Fold Complex (BGS, 2013).

[File:GHFGfig3.3.jpg](#)

**Figure 3.3** Abstract from the NW part of the 1:50 000 sheet 46E (Killin) showing the bedrock geology of the Meall Ghaordaidh, Cashlie and Loch an Daim areas. The trace of the Ben Lui Fold tracks along the northern slopes of Meall Ghaordaidh and Bein nan Oighreag (BGS, 2013).

[File:GHFGfig3.4.jpg](#)

**Figure 3.4** Cross-section (NW-SE) through Meall Ghaordaidh showing the Ben Lui Syncline and onlap of Argyll Group units onto the Lochaber Subgroup succession. Note — Scale is 1:75 000 (Sheet 46E-Killin, BGS, 2013).

[File:GHFGfig3.5](#)

[P575133.jpg](#)

**Figure 3.5** View southwards across upper

Glen Lyon to Creag an Tulabhain and Creag Laoghain buttress of Meall Ghaordaidh (1039 m). The trace of the Ben Lui Fold traverses across the mid level of this slope (Photo: A G Leslie, BGS P575133).

[File:GHFGfig3.6.jpg](#)

**Figure 3.6** Cross bedding traces in quartzose psammite of the Beinn a' Chaisteil Quartzite Formation (Lochaber Subgroup). By the Giorra Dam at [NN 5086 4613].

[File:GHFGfig3.7.jpg](#)

**Figure 3.7** Abstract from SW part of 1:50 000 Sheet 54E (Loch Rannoch) (BGS, 2014).

[File:GHFGfig3.8.jpg](#)

**Figure 3.8** Cross-section (SW-NE) across Loch an Daim and Garbh Meall along line shown on Figure 3.7. Note scale — 1:62 500 (BGS, 2014).

[File:GHFGfig3.9.jpg](#)

**Figure 3.9** Lithostratigraphical units of the Lochaber Subgroup and underlying Glen Spean Subgroup that crop out in the SW part of Sheet 54E (Loch Rannoch). (BGS, 2014).

[File:GHFGfig3.10.jpg](#)

**Figure 3.10** Laminated semipelite and subsidiary psammite with thin amphibolite layers of the Beinn Dorain Semipelite Formation (Lochaber Subgroup). The attenuated bedding is folded by isoclinal F2 folds and refolded by close to tight F3 folds. In burn draining

Coire Pharlain at [NN 4896 4737].

[File:GHFGfig3.11.jpg](#)

## Figure

**3.11** Photographs illustrating the nature of the breccia unit that appears to form the basal part of the Ben Lawers Schist Formation. Note the massive appearance of the unit, the finely laminated dominantly calcareous semipelite matrix, and the variety of shapes of the entrained blocks. In burn section draining Coire Uaimh around [NN 4869 4730].

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