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## 10 Allt Mhainisteir

[NN 546 861]–[NN 524 847]

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### 10.1 Introduction

The Allt Mhainisteir and Allt Liath nam Badan river sections, in the Ardverikie Forest area south of Loch Laggan, contain a near-continuous section through the lithologically diverse Kinlochlaggan succession of the Appin Group (Figure 5.28). The Kinlochlaggan succession is separated from the Grampian Group lying stratigraphically beneath it by spectacular shear-zones and tectonic slides, with resulting local omission of lithological units. Nevertheless, strain is low in places and this GCR site provides the framework against which to place elements of the succession recorded elsewhere in the Kinloch Laggan district (see for example the *Aonach Beag and Geal-charn* GCR site report).

The Allt Mhainisteir GCR site lies within the Geal-charn–Ossian Steep Belt, a major composite D1 synclinal structure focussed upon the Kinlochlaggan Syncline (Thomas, 1979; Robertson and Smith, 1999) (Figure 5.30), (Figure 5.31). Details of the stratigraphical and structural architecture of the steep belt are included in the report for the *Aonach Beag and Geal-charn* GCR site, which lies some 10–12 km to the south-south-west of the Allt Mhainisteir. The steep belt comprises a narrow, elongate zone of steeply dipping, varied lithologies of the Kinlochlaggan succession, which include metalimestone, kyanite semipelite, quartzite and the Kinlochlaggan Boulder Bed (see the *Kinloch Laggan Road* GCR site report). These lithologies contrast markedly with the surrounding psammites and semipelites of the Grampian Group. The Allt Mhainisteir GCR site also includes gneissose ‘basement’ rocks belonging to the Glen Banchor Subgroup of the Badenoch Group (Smith *et al.*, 1999). In addition, a well-exposed section through the NNE-trending Inverpattack Fault-zone reveals both early ductile and later brittle deformation

The results of new mapping in the area by the British Geological Survey are represented on the 1:50 000 Sheet 63E (Dalwhinnie, 2002).

### 10.2 Description

Within the area of the GCR site there are three major tectonostratigraphical units (Figure 5.28); the Kinlochlaggan succession occupying the core of the Kinlochlaggan Syncline is bound to both the east and west by Grampian Group psammites. The boundaries are defined by high-strain ductile shearing expressed as tectonic slides, the Allt Mhainisteir Slide to the east of the Kinlochlaggan succession and the northward continuation of the Aonach Beag Slide to the west. Rocks of the Glen Banchor Subgroup crop out in the eastern part of the GCR site, where they are juxtaposed against the Grampian Group by the Inverpattack Fault.

#### 10.2.1 Lithologies east of the Allt Mhainisteir Slide

Grampian Group rocks assigned to the Creag Meagaidh Psammite Formation of the Corrieyairack Subgroup are well exposed in the lower part of the Allt Mhainisteir section, immediately west of the Inverpattack Fault-zone [NN 544 859]. A succession of graded beds, typically 20 cm thick, are composed dominantly of psammite in which thin micaceous bed tops represent original muddier sediment. The rocks dip steeply to the south-east but young to the west towards the trace of the Kinlochlaggan Syncline; hence they are inverted.

The published BGS 1:50 000 sheet indicates that rocks of the Appin Group, Sron Garbh Semipelite Formation extend north-north-eastwards from the valley of the Allt Cam [NN 50 78] towards an unexposed section at [NN 542 859] in the

Allt Mhainisteir, to the west of the outcrop just described. The formation is very well exposed on Sron Garbh [NN 514 814] and on the ice-scoured slopes between Sron Garbh and Meall na Brachdlach [NN 518 824]. Across these locations, the formation comprises almost entirely gneissose magnetite semipelite with rare gradations towards micaceous psammite. The outcrop width ranges from at least 750 m immediately north-east of Sron Garbh to less than 200 m 5.5 km to the north-east around [NN 538 856]. The formation is not exposed north of the Allt Mhainisteir and has been interpreted as a local facies development within the Kinlochlaggan succession (Robertson and Smith, 1999). The formation is juxtaposed against the Creag Meagaidh Formation in the north and east of its outcrop, with no intervening older elements of the Kinlochlaggan succession (Figure 5.27). Although contacts are not clearly exposed, loose debris in the form of regolith can be traced across the boundary near Meall na Brachdlach. No highly strained material can be seen; the contacts are therefore regarded as preserving the original depositional relationships and hence provide evidence of onlap of the Sron Garbh Semipelite Formation onto the underlying Grampian Group (Robertson and Smith, 1999).

Returning to the river section, the next exposures to the north-west (at [NN 5371 8559]) comprise further graded psammites that are also assigned to the Creag Meagaidh Formation, albeit a rather coarser grained lithology than that seen to the east. At [NN 5351 8541], abundant close folds deforming the lithological banding are particularly well seen. The folds die out over short distances along their axial surfaces but a coarse schistosity, axial planar to the folds and strongly oblique to the bedding, is prominent even where there are no folds. Remnants of graded bedding are locally recognizable, although the increase in grain size due to metamorphism has modified most primary features.

Over the 80 m that intervenes between the last locality and the Allt Mhainisteir Slide, the folds become progressively tighter with the local development of discontinuities along fold limbs. Some of these discontinuities host metamorphic quartzofeldspathic segregations. Within 30 m of the slide (at [NN 5343 8535]) isoclinal folds, some of which are rootless, are exposed in the bed of the Allt Mhainisteir (Figure 5.29). Quartzofeldspathic leucosomes and thin pegmatitic veins up to 1 cm thick are also present within the pervasive gneissose foliation. At [NN 5339 8532], the slide contact is marked by an abrupt change from flaggy psammite and micaceous psammite of the Creag Meagaidh Psammite Formation to the Aonach Beag Semipelite Formation of the Kinlochlaggan succession, which here comprises micaceous psammite and psammite with 10 cm-thick, brown-weathering schistose semipelites and concordant homogeneous to banded amphibolites.

### **10.2.2 Grampian Group lithologies west of the Kinlochlaggan succession and the Aonach Beag Slide**

The Aonach Beag Slide is not exposed in the Allt Liath nam Badan but a continuous section through the contact of the Kinlochlaggan succession with the Grampian Group is exposed nearby at [NN 522 851] on the eastern slope of Meall Each. There, a medium-scale asymmetrical fold hinge preserves a low-strain area in the Creag Meagaidh Psammite Formation. The main tectonic fabric is at a high angle to bedding. Graded beds, typically up to 10 to 15 cm (and locally 30 cm) thick, range from massive psammite to micaceous psammite with thin semipelitic tops. The stratigraphy youngs to the east towards a slide that forms the contact with the Kinlochlaggan succession. Much of the Creag Meagaidh Psammite Formation to the west is flaggy and strongly attenuated with very tight or isoclinal folds. Gneissose semipelites and psammites of the Inverlair Psammite Formation form a unit a few tens of metres thick adjacent to the trace of the Aonach Beag Slide [NN 526 852]. To the east of the slide, schistose to platy semipelite with some psammite and abundant amphibolite represent the Aonach Beag Semipelite Formation of the Kinlochlaggan succession.

### **10.2.3 The Kinlochlaggan succession in the Allt Mhainisteir and Allt Liath nam Badan**

The Kinlochlaggan succession comprises a heterogeneous association of quartzite, schistose to gneissose semipelite, micaceous psammite, metacarbonate rock, calcsilicate rock and abundant amphibolite. The succession is represented by three formations in the area of this GCR site.

The oldest formation, the Aonach Beag Semipelite Formation, is well exposed in the Allt Liath nam Badan between [NN 5240 8475] and [NN 5260 8490]. It comprises a mixed succession of interlayered schistose and commonly platy semipelite and micaceous psammite with ribs of psammite. At [NN 5251 8487], more than 18 m of massive and locally gneissose psammite with streaked-out feldspar megacrysts occurs between flaggy schistose semipelite and fissile,

intensely deformed psammite and micaceous psammite. Amphibolites, many of which carry garnet, account for less than 5% to over 30% of any particular exposure and occur in concordant sheets ranging from less than 1 cm to 100 cm thick. Quartz seams and lenses together with coarse-grained quartzofeldspathic lenses are widely developed. Quartzites, which are a prominent feature of the upper part of the formation both to the south-west (see the *Aonach Beag and Geal-charn* GCR site report) and to the north-east, are not present here.

The Aonach Beag Semipelite Formation is overlain by the Kinlochlaggan Quartzite Formation. The contact is not exposed in this section, although elsewhere it is gradational, with either an increase in the proportion of interbedded quartzite or a change to more-psammitic lithologies. The formation is very well exposed in the Allt Liath nam Badan around [NN 5267 8492] and close to its confluence with the Allt Mhainisteir around [NN 5312 8513], where pebbly layers and relics of cross-bedding can be seen. It comprises massive white quartzite up to 160 m thick (see also the *Kinloch Laggan Road* GCR site report). No representative of the Kinlochlaggan Boulder Bed has been recognized in this section. At [NN 5271 8491], the quartzite is cut by an amphibolite lens, at least 35 m thick and probably less than 100 m long. This amphibolite has a sharp contact with the quartzite.

The Kinlochlaggan Quartzite Formation is overlain abruptly by the Coire Cheap Formation in the Allt Liath nam Badan at [NN 5280 8505]; pale-coloured metacarbonate rock occurs close to the base of the Coire Cheap Formation at this contact. Here, the Sron Garbh Semipelite Formation is absent, most likely as the result of original depositional variations rather than the effect of any tectonic excision. The Coire Cheap Formation is dominated by semipelite but is distinguished by the presence of calcsilicate rocks and metacarbonate rocks (e.g. at [NN 5290 8507]). The latter range up to 45 m in outcrop width.

Between [NN 5318 8516] and the Allt Mhainisteir Slide, each of the three constituent formations of the Kinlochlaggan succession are present in the stream section. However, relationships are complicated by a combination of faulting, very tight folds that repeat the succession, and a stratigraphically attenuated succession. The Aonach Beag Semipelite Formation is approximately 25 m thick adjacent to the Aonach Beag Slide (compared with 170 m on the opposite limb of the Kinlochlaggan Syncline), and the Kinlochlaggan Quartzite is only 5 m thick at [NN 5335 8527] and 7 m thick at [NN 5323 8516] where it crops out in an antiformal closure. The Coire Cheap Formation is marked by metacarbonate-rock units up to 6 m thick. At [NN 5327 8518], metacarbonate rock contains pods of cross-cutting pegmatite and is separated by 1 m of micaceous psammite from gneissose semipelite with leucosomes up to 1 cm across and 2 cm-long kyanites.

#### **10.2.4 The Inverpattack Fault**

The Inverpattack Fault is well exposed in the Allt Mhainisteir around [NN 5454 8591], where it juxtaposes Grampian Group lithologies against the Glen Banchor Subgroup. East of the fault and into the River Pattack [NN 546 861], small- to medium-scale asymmetrical and chevron folds (several metres in amplitude) occur together with fractures, many of which dip steeply to the west. Some fold limbs are truncated by the fractures, whereas in other examples semipelitic lithologies are crumpled and crenulated adjacent to discontinuities. The geometry of crumple folds suggests that displacement across the fractures has a normal sense (i.e. downthrow to the west). Microdiorite dykes cut some folds, whereas a dyke at [NN 5461 8612] might be deformed by a fold; other dykes are deformed in fracture-zones.

A zone of mixed cataclastic and mylonitic rock at least 8 m across crops out to the west of the folded and fractured zone [NN 5456 8592], deforming interbedded psammite and semipelite that is cut by microdiorite and pegmatitic dykes. The rock is typically dark grey, fissile, friable and very fine grained, with the foliation typically inclined at 70° to the east-south-east. It contains porphyroclasts of psammitic and pegmatitic lithologies up to 10 cm across that are wrapped by the foliation. In thin section, numerous angular to subrounded quartz and plagioclase grains and bent biotite flakes form both monomineralic and lithic clasts within a very fine-grained foliated groundmass in which larger clasts are cemented by carbonate minerals. Deformation might also post-date emplacement of the microdiorite dykes, as microdiorite clasts are thought to occur within the zone. Both anastomosing shear fabrics (S-C fabrics) and tails developed on porphyroclasts indicate a sinistral reverse sense of displacement (i.e. downthrow to the west). Immediately to the west, the cataclasite-mylonite zone is succeeded by 90 m of brecciated psammite. The psammite forms massive exposures, which on close examination consist of angular psammite fragments within a psammitic matrix. Thin zones of mylonite and discontinuities, some of which are gently inclined, occur throughout this brecciated zone, all of which has

been recemented and is therefore cohesive.

### 10.3 Interpretation

The Kinlochlaggan succession strata are preserved in the core of the Kinlochlaggan Syncline in the centre of the Geal-charn–Ossian Steep Belt (Figure 5.30), (Figure 5.31). The contacts with the underlying Grampian Group are affected by high-strain ductile shearing, with the Aonach Beag Slide marking the boundary in the west and the Allt Mhainisteir Slide acting similarly in the east. Grampian and Appin group rocks share a common deformational history. Good evidence for increasingly high non-co-axial strain as each of the slide contacts is approached is preserved in the lithostratigraphy. However strain is sufficiently low in places for the essential stratigraphical continuity of the sequence to be maintained.

The Lochaber Subgroup, Sron Garbh Semipelite Formation, resting directly on the Grampian Group, Creag Meagaidh Psammite Formation east of the Allt Mhainisteir Slide, represents a local facies development within the Kinlochlaggan succession. In the absence of any highly strained material at the contact this relationship is interpreted to mean that the original depositional relationships are preserved. Since distinctive older elements of the Kinlochlaggan succession are not present here e.g. the Kinlochlaggan Quartzite Formation, such details constitute an important part of the overall evidence for onlap relationships and the complex depositional framework in Appin Group times proposed for the region now disposed within the Geal-charn–Ossian Steep Belt by Robertson and Smith (1999) (see the *Aonach Beag and Geal-charn* GCR site report).

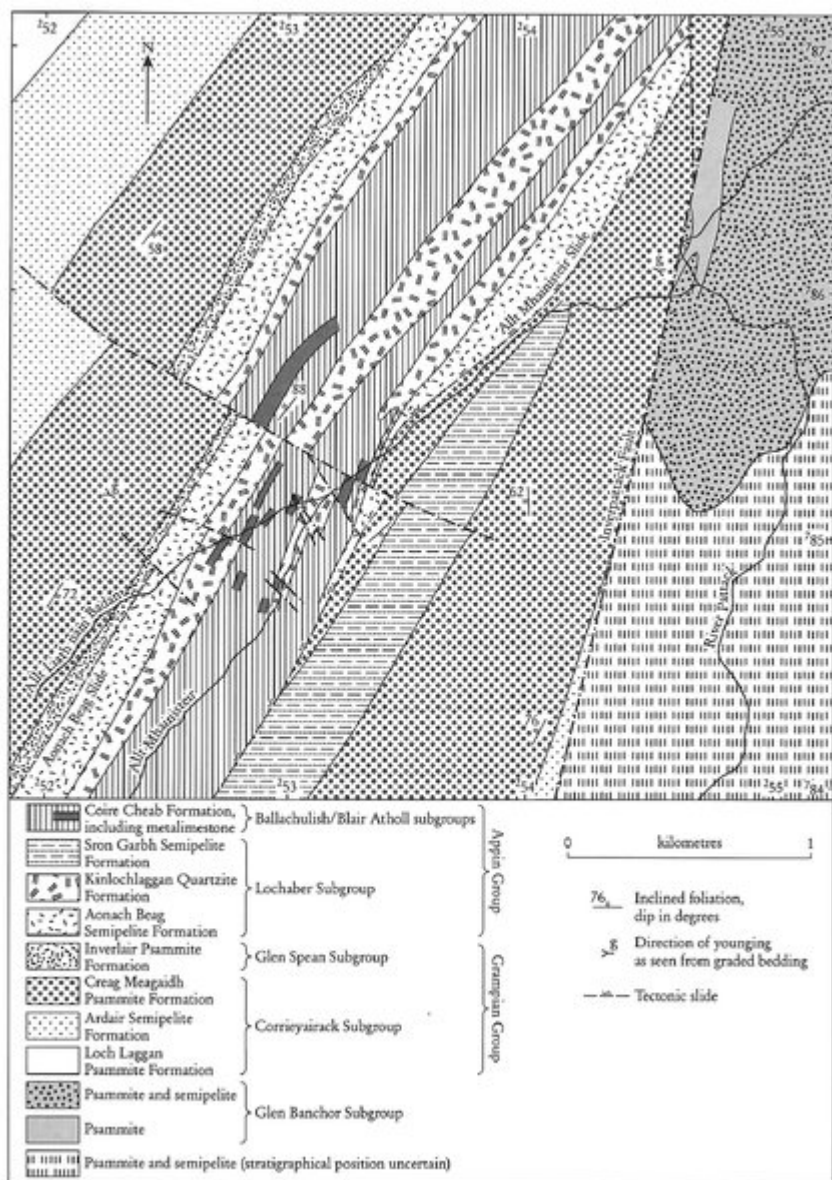
The Inverpattack Fault is one of a number of NNE-trending faults that link major NE-trending transcurrent faults in the Northern Grampian Highlands. It links the Markie Fault and the Ericht–Laidon Fault and cuts across the trace of the Geal-charn–Ossian Steep Belt. The fault separates the Grampian and Appin groups of the Dalradian from the older Glen Banchor Subgroup of the Badenoch Group, which is exposed on the east side of the steep belt. The microfabric relationships in the fault rocks are consistent with the left-lateral displacement of lithological units across the fault; c. 2.5 km of sinistral offset is observed farther north [NN 58 96]. Observed fault fabrics display evidence for both early brittle–ductile deformation and later brittle faulting, demonstrating the likely long-lived nature of this fault system.

### 10.4 Conclusions

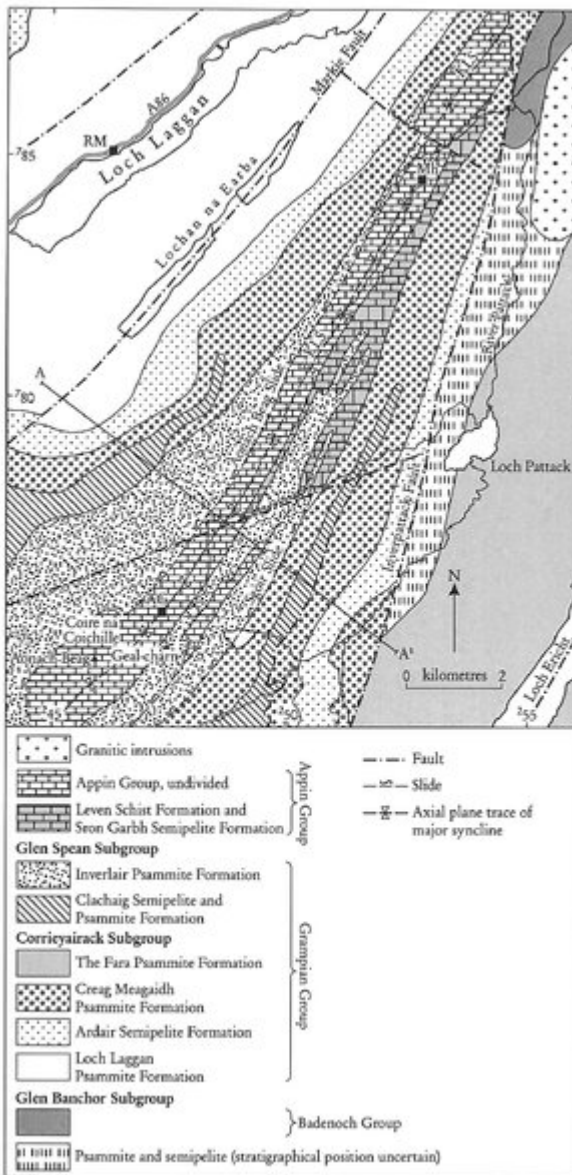
The Allt Mhainisteir GCR site provides a coherent c. 4 km-long traverse across the Geal-charn–Ossian Steep Belt, which here includes a distinctive succession of metalimestone, quartzite, semipelite and amphibolite known as the Kinlochlaggan succession. This provides the most-complete correlative framework for other sections within the steep belt. Despite the presence of high ductile strain on both the north-west and the south-east sides of the Kinlochlaggan succession, Grampian Group psammities can be seen to young consistently towards it. Hence the Kinlochlaggan succession lies stratigraphically above the Grampian Group and can be readily assigned to the Appin Group. Local stratigraphical omissions in both the Grampian and Appin group successions provide evidence for the punctuated nature of the depositional record in this sector of the Dalradian basin.

This GCR site also provides a well-exposed section through the Inverpattack Fault, revealing a complex history of ductile and brittle deformation associated with one of the sinistral strike-slip faults that have a major effect upon the outcrop pattern in the Northern Grampian Highlands, and whose effects must be compensated for in any attempt to reconstruct a depositional framework for the region.

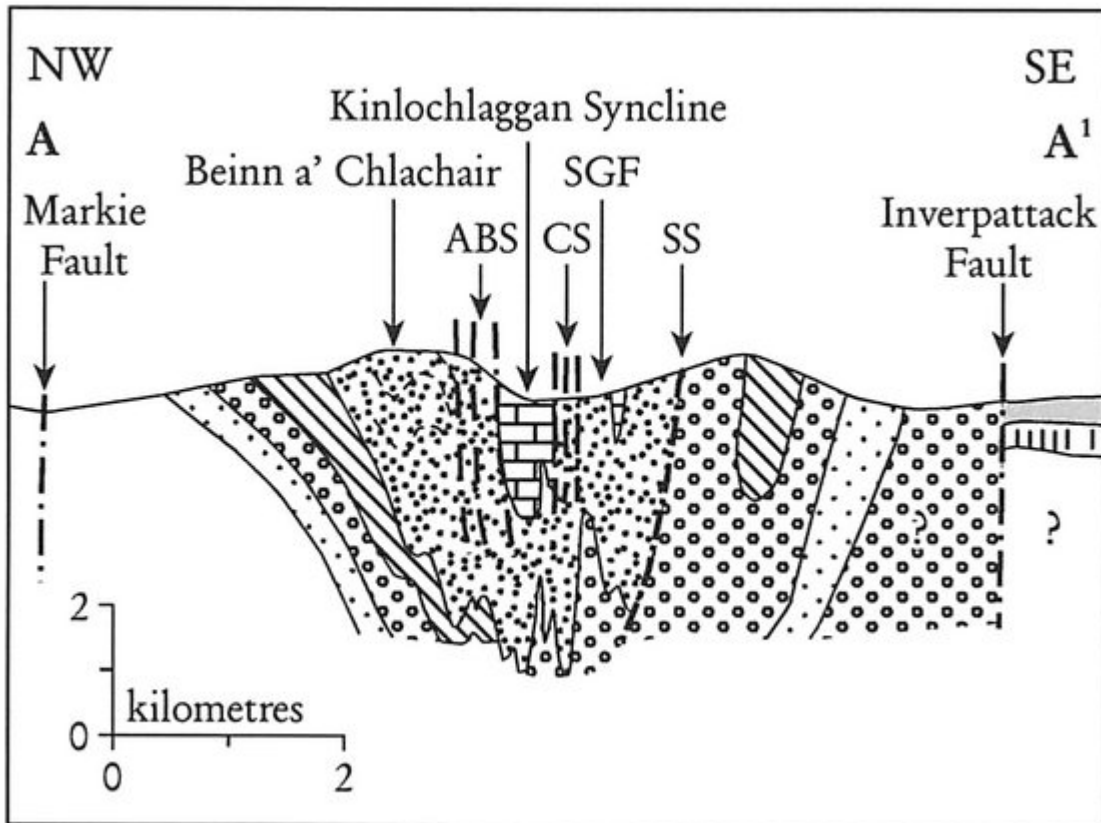
### [References](#)



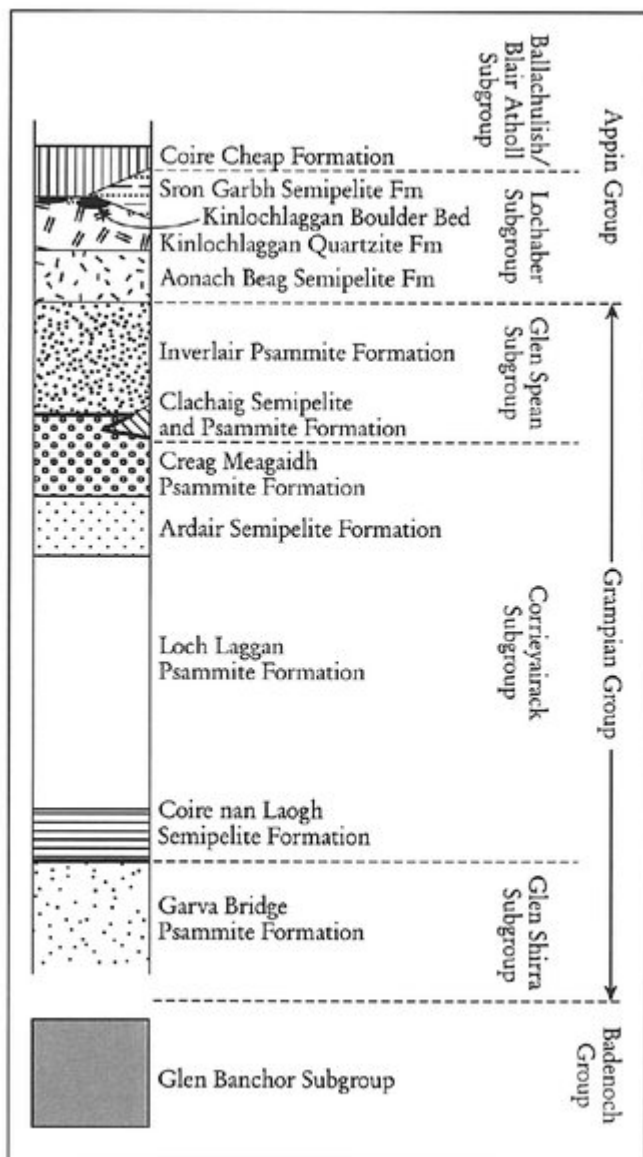
(Figure 5.28) Map of the Allt Mhainisteir and Allt Liath nam Badan sections, south of Loch Laggan. The overall geological setting is shown in (Figure 5.18).



(Figure 5.30) Map of the area around the Allt Mhainisteir, Rubha na Magach and Aonach Beag and Geal-charn GCR sites. After Robertson and Smith (1999). The line of cross-section in (Figure 5.31) is shown as A–A'. AG Aonach Beag and Geal-charn GCR site, KLS Kinlochlaggan Syncline, Mh Allt Mhainisteir GCR site, RM Rubha na Magach GCR site.



(Figure 5.31) Schematic cross-section across the Geal-charn–Ossian Steep Belt along the line A–A' indicated on (Figure 5.30). ABS Aonach Beag Slide, CC Coire Cheap, CS Coire Sgoir, SGF Sron Garbh Fold-complex, SS Sgoir slides. After Robertson and Smith (1999). Ornaments as on (Figure 5.30).



(Figure 5.27) Lithostratigraphy of the area within and west of the Geal-charn–Ossian Steep Belt in the vicinity of the Kinloch Laggan Road, Allt Mhainisteir and Aonach Beag and Geal-charn GCR sites. After Robertson and Smith (1999).





*(Figure 5.29) Intense isoclinal folding in the Creag Meagaidh Psammite Formation adjacent to the Allt Mhainisteir Slide, [NN 5343 8535]. Hammer head is 16.5 cm long. (Photo: BGS No. P 221176, reproduced with the permission of the Director, British Geological Survey, © NERC.)*