7 St John’s Church, Loch Leven

[NN 065 587]

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7.1 Introduction

The St John’s Church GCR site, on the south shore of Loch Leven 1.5 km south-east of the Ballachulish Bridge, provides a rare section across one of the ‘slides’ (synmetamorphic low-angled faults) that are a major feature of the Dalradian in the western part of the Central Grampian Highlands. An Appin Group succession from the lower part of the Leven Schists up to the base of the Appin Quartzite, is exposed across the core of one of the major recumbent nappes of the area, the Ballachulish Syncline; the Ballachulish Slide occurs on the lower limb of this fold. Here the fold core and the slide are turned into a steeply dipping attitude as a result of later folding.

The exposures were described and the structure was illustrated by Bailey (1960, pp. 58–59, figure 7G); Roberts (1976) and Roberts and Treagus (1977b) have described the general context.

7.2 Description

The exposures on the eastern side of the GCR site provide a section from the Ballachulish Slates through transitional beds (the Appin Transition Formation) at the base of the Appin Quartzite, which lies on what was originally the upper limb of the Ballachulish Syncline. To the west, two tectonic junctions bring in respectively, a thin slice of Ballachulish Limestone and the basal facies of the Leven Schists (Figure 3.15). The former lies in the core of the syncline; the latter lies on the original lower limb. The bedding and a penetrative schistosity dominantly dip steeply to the north-west, an attitude acquired during later folding. The section is described from south-east to north-west from the shore opposite St John’s church.

A group of exposures on the first peninsula on the south-east side of the GCR site ((Figure 3.15), locality A; [NN 0669 5869]) expose phyllitic graphitic pelites with thin semipelite beds, which are attributed to the upper part of the Ballachulish Slate Formation. Thin beds of gritty quartzite, typical of the transition into the Appin Quartzite Formation, occur at the north-western end of this peninsula. Strongly deformed ripple-drift lamination can be discerned, but way-up is not easily determined. The bedding, together with the penetrative schistosity, strike north-east and dip steeply north-westwards at 80–85°; rarely, the two planar surfaces can be seen at a narrow angle to one another and to be axial planar to tight folds plunging steeply to the south-west. A strongly developed stretching lineation (pyrite blebs and mica) and possibly the intersection lineation pitch down the dip of the schistosity. The schistosity is folded by minor tight folds, which plunge subvertically and dominantly have a ‘Z’ geometry and an axial-planar crenulation cleavage.

After a gap of some 50 m, the rocks at the south-eastern end of the second peninsula ((Figure 3.15), locality B; [NN 0665 5875]) are black phyllitic pelites, with a more variable strike than in the previously described exposures. They become more-dominated by beds of gritty quartzite, up to 70 cm thick, towards the north-west. Here too, the penetrative schistosity is very close to the bedding and their cross-cutting relationships and the direction of their intersection are difficult to determine. The outcrop of these transitional beds ends at a NE-trending, 4 m-thick microdiorite dyke. Between this dyke and a second 5 m-thick dyke, occurs a 10 m-thick unit of yellow-weathered, grey metacarbonate rock, which is interbanded with millimetre- to centimetre-thick beds of dark semipelite, a lithological association typical of the Ballachulish Limestone Formation. These NE-striking beds are locally strongly folded by steeply plunging minor folds exhibiting both ‘S’ and ‘Z’ geometries. A critical locality [NN 0663 5882] occurs at the junction of the metalimestone with the western dyke where, over a distance of about one metre, a few centimetres of platy quartzose schist are seen (Figure

3.16). This schist is interpreted as a slither of the basal facies of the Leven Schists, which crop out over the remainder of the peninsula to the west of the dyke. The Leven Schists here consist of quartz-rich psammite interbedded on a centimetre scale with ribs of semipelite; no way-up criteria have been established. One well-exposed minor fold has a plunge of 40° to the north-east and an 'S' geometry, but otherwise there are no well-developed minor structures.

7.3 Interpretation

According to Bailey (1960, pp.55–59) the succession of Ballachulish Slates and the Appin Transition Formation, described above, is corrugated by intermediate-scale folds subsidiary to the Ballachulish Syncline (an F1fold in modern nomenclature). The core of this syncline lies close to the junction of the transitional beds with the Ballachulish Limestone; the Ballachulish Limestone and Leven Schist exposures to the west belong to the lower limb. The minor folds and cleavage/bedding relationships, seen in the section of Ballachulish Slates and transitional beds, certainly show varying vergence directions, suggesting such intermediate-scale folds of perhaps several tens of metres wavelength. S0/S1intersections appear to be parallel to the steeply pitching stretching lineation. However, the D1 age of these structures has not been confirmed in thin section in any of the more-recent studies. In fact the existence of the syncline has not been confirmed in current studies, either from minor folds and cleavage/bedding relationships, or from sedimentary way-up structures, (although the synformal structure is clear from the regional stratigraphical context (Figure 3.15).

According to Bailey (1960) the Ballachulish Syncline, which was originally recumbent, has been rotated into its present steep, NW-dipping, upward- and SE-facing, attitude by the secondary folding of the region. Some of the folds seen in the section described above are associated with a crenulation cleavage, and their south-westerly plunge and 'Z' geometry agree with them being F2 folds on the western limb of the major F2 Stob Ban Synform, similar to those described in the *Tom Meadhoin and Doire Ban* GCR site to the north-east.

Although the junction between the Appin Transition Formation and the Ballachulish Limestone to its west is obscured by a microdiorite dyke, the increase in quartzite content towards the junction certainly supports the concept that this junction is a 'slide' (the regional Sgorr a'Choise Slide, a minor branch of the Ballachulish Slide according to Bailey (1960). The axial trace of the Ballachulish Syncline, according to Bailey, lies within the outcrop of the Ballachulish Limestone. Minor folds in this outcrop show reversals of vergence that would be expected in D1 structures.

The junction to the west between the limestone and the few centimetres of quartzitic Leven Schists, does not exhibit the usual transition from metalimestone into the pelitic top of the Leven Schists and according to Bailey represents the Ballachulish Slide on the western limb of the syncline. The exposure of the 'slide', although only one metre in length, shows a slight discordance of bedding orientation across it, between the limestone and the flaggy schist (Figure 3.16). There is no evidence that it is a much later dislocation that post-dates all the folding, but thin sections would be needed to establish the exact age of movements. On the west side of the western dyke, which obscures the remainder of the outcrop of the 'slide', schistose psammites are typical of the basal part of the Leven Schists; no 'way-up' evidence has been found. Thin-section investigation of the folds and cleavage here would be particularly useful in the delineation of the structural relationships.

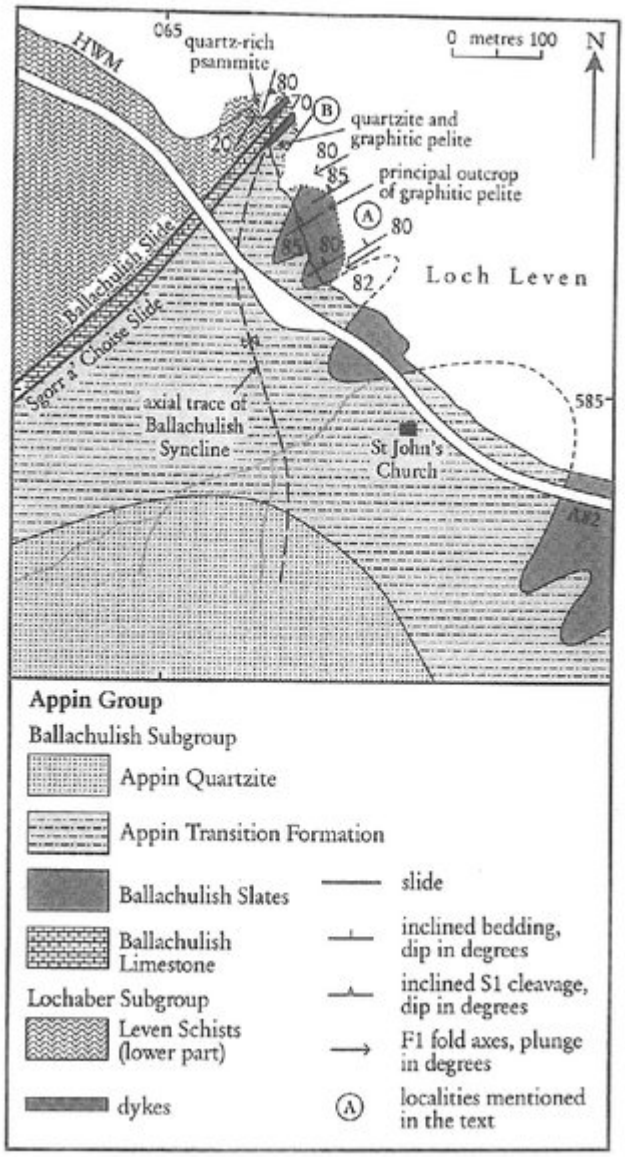
Since the Ballachulish Slide occurs on the lower limb of a once recumbent syncline and involves no repetition of strata, Bailey (1960) noted that it would have to have originated as a low-angle normal fault (i.e. a lag) and not as a thrust as would have been associated traditionally with nappe structures. This is a common occurrence in the nappes of the Central Grampian Highlands and led Soper and Anderton (1984) to suggest that such 'slides' might have originated as synsedimentary extensional faults. Further research at this locality might help to resolve this debate.

7.4 Conclusions

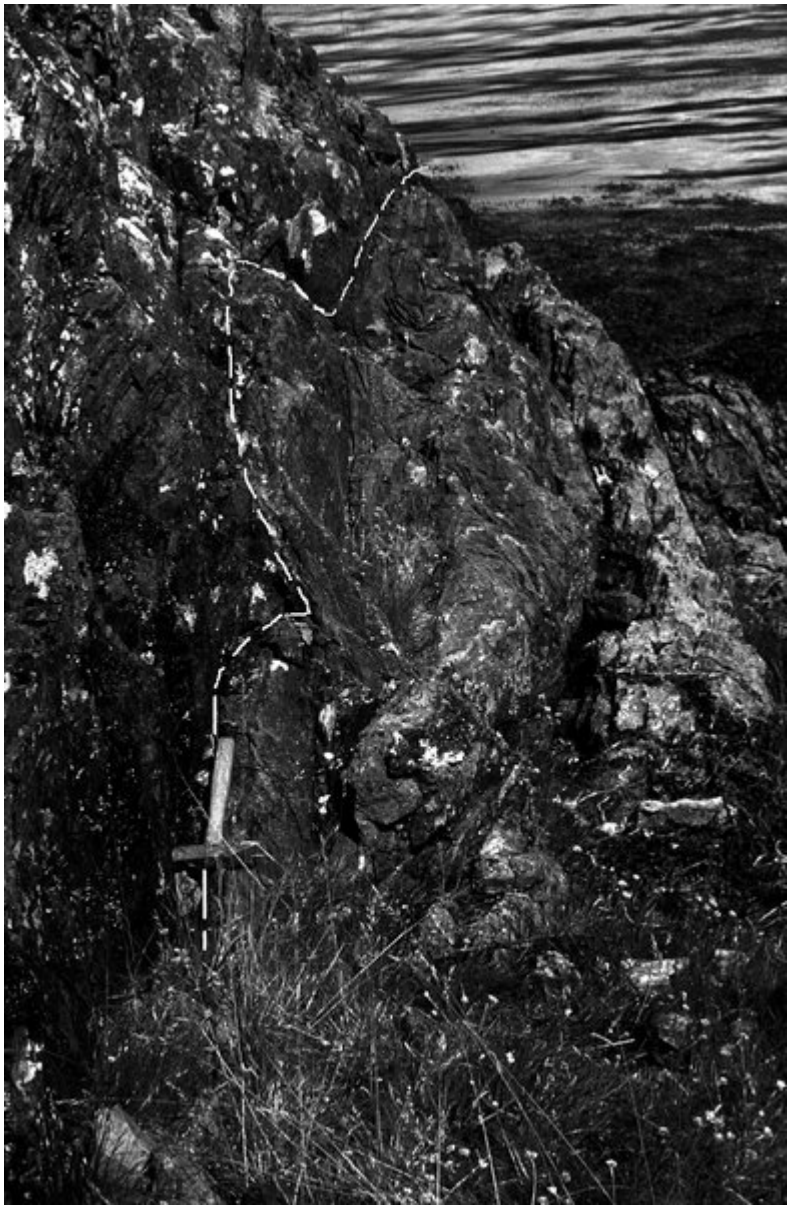
The St John's Church, Loch Leven GCR site contains one of the few exposures across a major dislocation (the Ballachulish Slide) of the type that has disrupted many of the major early folds of the Grampian Fold-belt. These 'slides' are of great interest since the faults might have been initiated at the time of sedimentation and developed further during

the onset of folding, when they translated the rocks above for many kilometres. The section is well exposed in coastal outcrops that are much visited by student and professional geologists and would benefit from further research.

References



(Figure 3.15) Map of the Loch Leven shore section at St John's church after Bailey (1960).



(Figure 3.16) View looking north-east along the outcrop of the Ballachulish Slide on the shore of Loch Leven, near St John's church. The slide occurs beneath the hammer shaft and can be traced along the black dotted line. To its right is the Ballachulish Limestone; immediately left of the hammer, and for about one metre beyond, are a few centimetres of quartzitic Leven Schists; the remainder of the exposure left of the slide is a NE-trending dyke. Hammer shaft is 30 cm long. (Photo: J.E. Treagus.)