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## 9 Ardsheal Peninsula

[NM 961 555]–[NN 007 579]

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### 9.1 Introduction

The Ardsheal Peninsula GCR site, on the south-east side of Loch Linnhe, gives a superbly-exposed section across five stratigraphical units in the Appin Group, from the Appin Transition Formation of the Ballachulish Subgroup, up into the Cuil Bay Slates of the Blair Atholl Subgroup. Although the whole outcrop width of the F1 Appin Syncline is represented on the peninsula, the almost continuous clean coast section described here is the on the north-west limb. Minor structures related to the major F1 fold are exceptionally well exposed, and minor structures belonging to the regional D2 phase are superimposed on the early structures in the eastern part of the GCR site.

The area of the GCR site was described in general by Bailey (1960), who was the first to recognize the major structure as an upward-, NW-facing primary syncline. It was subsequently described in detail by Treagus and Treagus (1971), after Bowes and Wright (1967) had given a very different account of the structure in their examination of the setting of the igneous rocks of the area. The latter are discussed in site reports in the *Caledonian igneous rocks of Great Britain* GCR volume (Stephenson *et al.*, 1999).

### 9.2 Description

The five most instructive areas of exposed Dalradian rocks in this GCR site are situated along the south-west and north-west coasts of the peninsula ((Figure 3.20), localities 1–5). The youngest formation, the Cuil Bay Slates, is exposed at locality 1, the type locality for this formation on the north-west side of Cuil Bay, between [NM 9763 5539] and [NM 9724 5544]. At the east end of these exposures, on a small peninsula below a fishing croft, centimetre-thick graded beds of grey silt to black mud (now slaty semipelite and pelite) are particularly well seen. These beds are folded into 3 m-wavelength, tight to open, upright folds, which plunge to the south-west, face upwards and verge to the north-west (Figure 3.21)b. They have an axial-planar slaty cleavage dipping at 50–60° to the south-east and a stretching lineation of elongate chlorite- muscovite stacks, which pitches steeply to the north-east on the cleavage. Elsewhere, the slaty cleavage is strongly affected by a second generation of open folds, particularly well seen on the south-east side of this small peninsula, Rubha Beag. These folds also plunge to the south-west and have a north-west vergence, but they are related to a crenulation cleavage, which dips at 60–70° to the north-west and cross-cuts the earlier folds. The effect of this folding is to rotate the earlier slaty cleavage into flat-lying attitudes and, locally, to refold the earlier fold-set. The first cleavage surfaces are strongly crenulated and kinked; some kinks are due to original refraction through the semipelite and pelite beds, others result from the second deformation and yet others are related to later deformation associated with the intrusion of dykes.

The junction with the next oldest stratigraphical unit, the Appin Phyllite, is not exposed; but this unit occupies the whole of the next small peninsula to the west, Rubha Meadhonach (locality 2). Bedding, which is less easy to see in these rather uniform grey phyllitic semipelites, dips steeply to the south-east and locally exhibits upward-younging graded units and ripple-drift cross-bedding, particularly on the north-west side of the outcrop. The first cleavage dips steeper to the south-east than the bedding, and intersections plunge gently to the south-west. The second cleavage and folds are not strongly developed, but the intersection of the second cleavage with the first plunges at varying angles to the north-east. Kink bands, commonly conjugate, are well developed.

The westernmost subsidiary peninsula of the GCR site, Rubha Mor, exposes a further three stratigraphical units, the Appin Limestone and the Appin Quartzite, as well as the distinctive transitional beds to the Ballachulish Slates (the Appin Transition Formation). The Appin Limestone and its steep SE-dipping junction with the Appin Quartzite are exceptionally well displayed on the south-east coast of Rubha Mor between [NM 966 557] and [NM 963 556] (locality 3). The youngest beds, on the seaward side, are mixed metacarbonate rocks, quartzites, phyllitic semipelites and psammities (Figure 3.21)b, followed downwards by a clear sequence of white quartzite, grey metacarbonate rock, cream dolomitic metalimestone and phyllitic semipelite, each a metre or two thick, before the well-exposed junction with the Appin Quartzite is reached high on the cliff. These latter beds are seen in a spectacular fold-pair in a 15 m-long section at the south-west end of their outcrop. Here, disharmonic minor folds and refracting penetrative axial-planar cleavage are beautifully displayed; the vergence of minor folds and cleavage/bedding is to the north-west and the plunge is 20–40° to the south-west (Figure 3.21)b.

The Appin Quartzite consists of thick-bedded (up to 2 m) white quartzite with quartz and feldspar pebbles up to 20 mm across in a gritty matrix; the clasts are only weakly elongated in a poorly developed cleavage in the finer grained beds. The quartzite commonly displays cross-beds younging to the south-east, which are especially well-seen near the top of the formation at [NM 9640 5565] (locality 3) and near the base on the north-west side of the promontory at about [NM 968 557] (locality 4). The Appin Transition Formation is seen on the shore of Loch Linnhe from about [NM 963 558] to [NM 971 565] (locality 5). These steeply SE-dipping beds of striped psammities, semipelites and graphitic pelites display a variety of SE-younging sedimentary structures including small-scale grading, ripple-drift cross-bedding, load structures, slump-folds and sedimentary dykes. Cleavage in the pelitic beds is penetrative. The vergence of minor folds and cleavage/bedding intersection is to the north-west and the plunge is 10–30° to the south-west.

### 9.3 Interpretation

All of the stratigraphical units that crop out at localities 1–5 exhibit the same north-west vergence of both the earliest folds of bedding and of the cleavage/bedding intersection related to those folds. According to Bailey (1960), Voll (1964) and Treagus and Treagus (1971), they lie on the north-west limb of the regional fold, the Appin Syncline, which all these authors agree is one of the early (D1) fold-set. The hinge-zone and south-east limb of this fold, affecting the Appin Phyllite and Limestone Formation, is best seen, up plunge to the north-east, in the *Onich* GCR sites. A generalized structural profile of the fold as it affects the rocks of the Ardsheal and Onich GCR sites is illustrated in (Figure 3.18), which shows the five locations discussed above. The later folds and associated crenulation cleavage, which are seen at Ardsheal on the north-west limb of the Appin Syncline, but also on its south-east limb at Onich, show a consistent north-west vergence on both limbs. These folds belong to the regional D2 phase of Treagus and Treagus (1971) and are subsidiary to the major Stob Ban Synform, seen to the east (see the *Tom Meadhoin and Doire Ban* and *Stob Ban* GCR site reports).

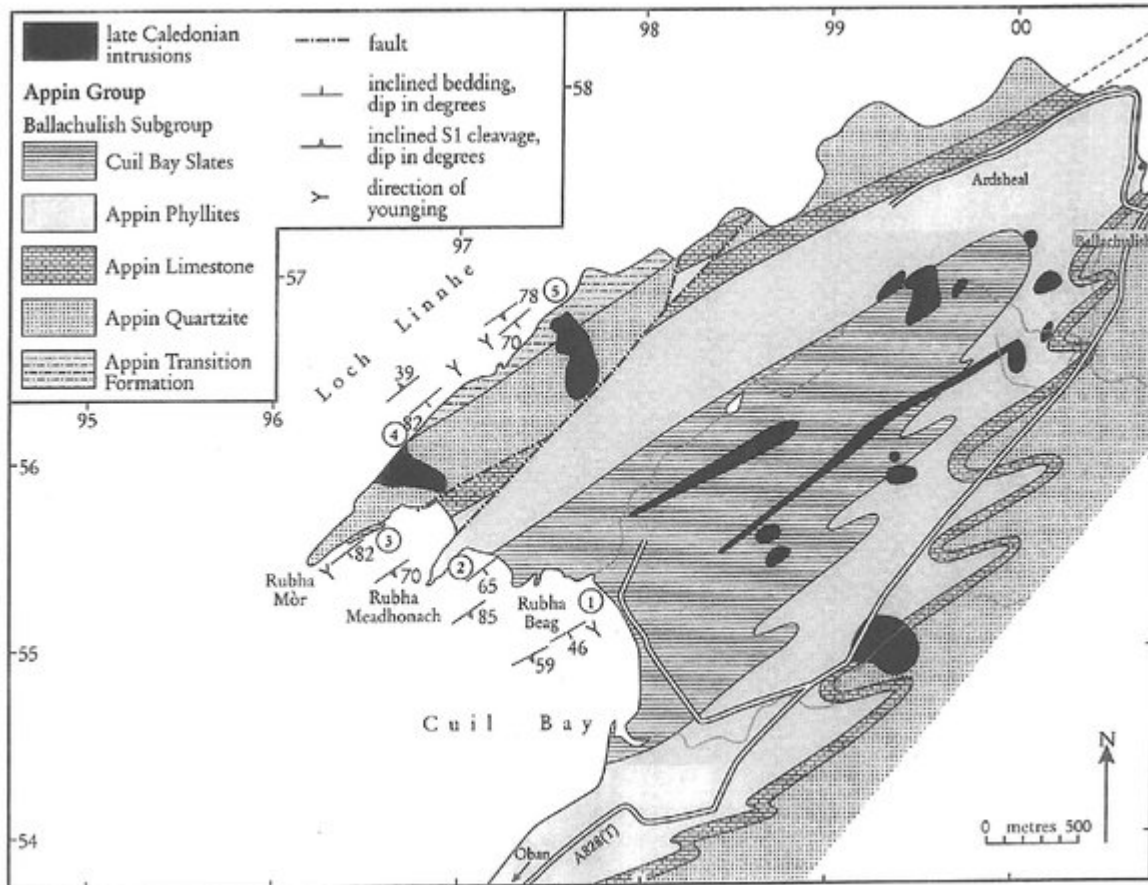
The paper by Treagus and Treagus (1971) contradicted the earlier view of Bowes and Wright (1967) that the syncline is a third-phase structure associated with the retrograde metamorphism in the area. Bowes and Wright proposed that 'elongate compositional blebs' and small isoclinal fold noses in semipelites within the Appin Phyllite are evidence of an earlier D1 phase. Mica flakes that cut across these earlier features were said to be attributable to a D2 phase. The lineation resulting from the mica flakes was said to be folded around the Appin Synform, which was therefore interpreted as a D3 phase. No locations nor detailed measurements of these structures were given and no evidence was found by Treagus and Treagus (1971), or has been found since, to support these views. Importantly, thin-section examination of the pelites from the Ardsheal Peninsula GCR site has shown that the penetrative cleavage that is axial planar to the dominant minor folds and to the major syncline was developed as part of the regional, progressive, chlorite-muscovite metamorphism.

### 9.4 Conclusions

At the Ardsheal Peninsula GCR site it can be demonstrated that the Appin Syncline, one of the major folds in the western part of the Grampian Fold-belt, was produced as part of the earliest deformation of these rocks. The site provides superlative examples of the minor folds produced by this deformation as well as evidence of the effects of a later period

of deformation, superimposed on the earlier one. The site also provides excellent clean exposures of five stratigraphical units in the upper part of the Appin Group with clear evidence of the nature of the original sediments; it contains the type locality of one of them—the Cuil Bay Slates. The site is a necessary complement to the GCR sites at Onich to give a complete cross-section of the Appin Syncline. The site is of exceptional importance educationally and is used extensively by undergraduate parties and students undertaking mapping projects.

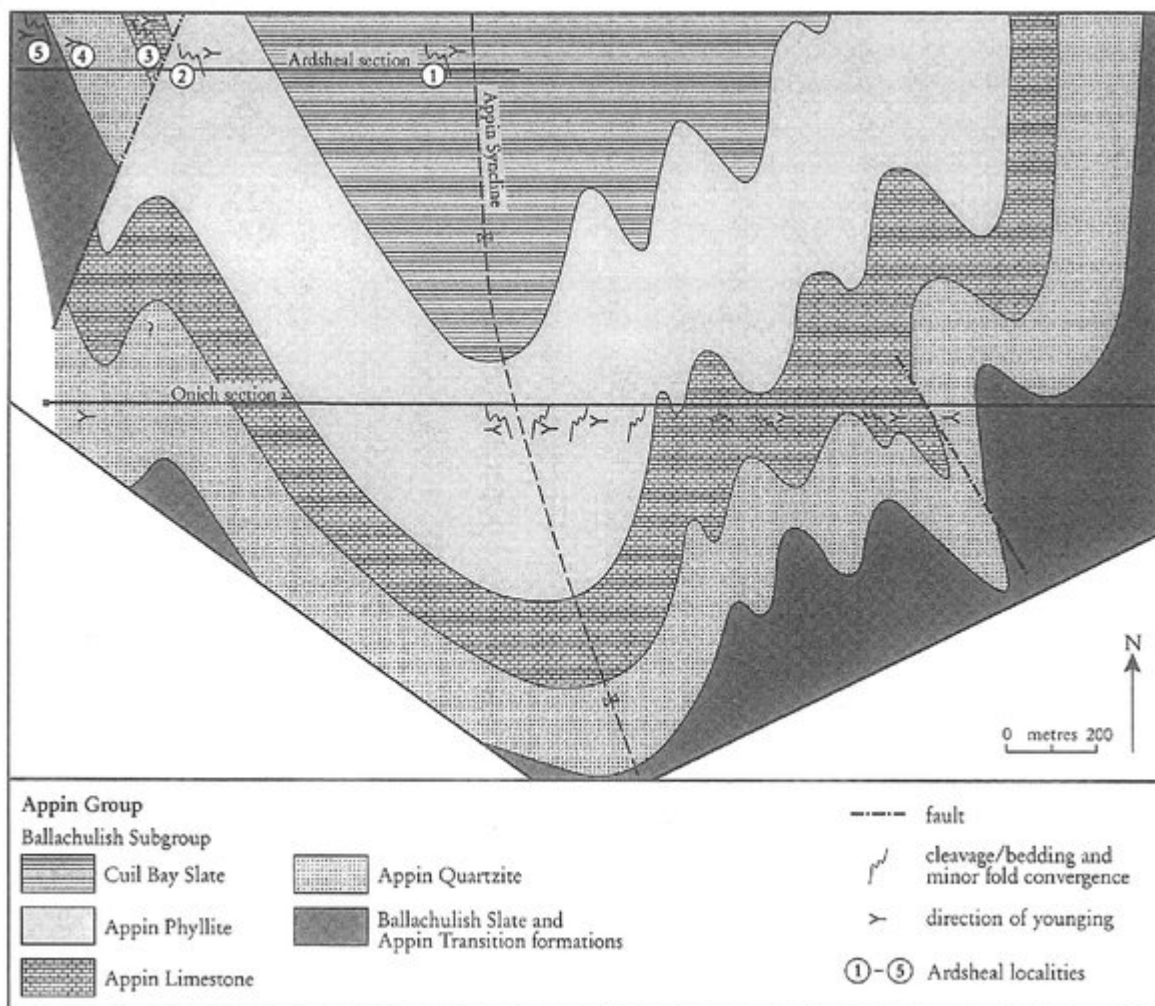
## References



(Figure 3.20) Map of the Appin Syncline on the Ardsheal Peninsula. Numbers relate to localities discussed in the text. After Treagus and Treagus (1971).



(Figure 3.21) (a) Bedding in the Cuil Bay Slates shows upward grading, crossed by upright S1 cleavage. View to the south-west, down the plunge of a F1 fold hinge from [NM 972 554], Rubha Beag, Ardsheal Peninsula. Lens cap is 5 cm in diameter. (b) F1 folds, verging north-west and plunging gently to the south-west in phyllitic semipelites and psammities near the top of the Appin Quartzite on Rubha Mor, Ardsheal Peninsula [NM 9640 5565]. The fanning S1 cleavage can be seen in the semipelite bed in the centre. Figures for scale. (Photos: J.E. Treagus.)



(Figure 3.18) Generalized structural profile of the F1 Appin Syncline for the area containing the Onich Dry River Gorge, Onich Shore Section and Ardsheal Peninsula GCR sites, looking up-plunge to the north-east at about 25°. Use has been made of data from the Onich shore section as well as the profile drawn of the Ardsheal area by Treagus and Treagus (1971, figure 2). Data from localities 1–5 of the Ardsheal Peninsula GCR site are shown in the top left corner of the profile.