



## The Dalradian rocks of the central Grampian Highlands of Scotland

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### ARTICLE INFO

#### Article history:

Received 15 December 2011

Received in revised form 8 July 2012

Accepted 14 July 2012

Available online 23 November 2012

#### Keywords:

Geological Conservation Review

Central Grampian Highlands

Dalradian Supergroup

Lithostratigraphy

Structural geology

Metamorphism

### ABSTRACT

The central Grampian Highlands, as defined here, are bounded to the north-west by the Great Glen Fault, to the south-west by Loch Etive and the Pass of Brander Fault and to the south-east by the main outcrop of the Loch Tay Limestone Formation. The more arbitrary northern boundary runs north-west along the A9 road and westwards to Fort William. The detailed stratigraphy of the Dalradian Supergroup ranges from the uppermost Grampian Group through to the top of the Argyll Group, most notably seen in the two classic areas of Loch Leven–Appin and Schiehallion–Loch Tay; Southern Highland Group strata are preserved only in a small structural inlier south of Glen Lyon.

Major F1 and F2 folds are complicated by co-axial northeast-trending F3 and F4 folding, as well as by locally important north- or NW-trending folds. In the Loch Leven area, nappe-like F1 folds verge to the north-west, whereas to the south-east the major recumbent F1/F2 Tay Nappe verges to the south-east. The trace of the upright Loch Awe Syncline lies between the opposing nappes, but in this region a large mass of late-Caledonian granitic rocks obscures their mutual relationship. Three tectonic ‘slides’ are identified that are certainly zones of high strain but which in part could be obscuring stratigraphical variations.

The regional metamorphism ranges from greenschist facies on the western seaboard of Argyll to amphibolite facies in most of the remainder of the region. The study of garnets, together with kyanite and staurolite in the Schiehallion area, has enabled a detailed history of the metamorphism and structure to be unravelled.

Stratabound mineralization occurs in the Easdale Subgroup, where there is also evidence of changes of sedimentary environment associated with volcanicity and lithospheric stretching. The region is dissected by a series of NE-trending, dominantly left-lateral, faults, subparallel to the Great Glen Fault, whose movement history is illustrated here by that of the Tyndrum Fault.

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## 1. Introduction (J.E. Treagus)

The central Grampian Highlands, as defined in this special issue, are bounded to the north-west by the Great Glen Fault between Lismore and Fort William, and to the south-east by the main outcrop of the Loch Tay Limestone Formation between the Tyndrum Fault and Pitlochry (Fig. 1). The south-western and north-eastern boundaries are essentially geographical, rather than geological, but they have been chosen to reflect to a certain extent areas studied by a distinct group of workers. The sites in this region have been selected to illustrate both the stratigraphy and the structure of the Dalradian rocks and, to a lesser extent, aspects of their mineralization and metamorphism.

### 1.1. Lithostratigraphy and sedimentary environments

Most of the formations of the Appin and Argyll groups are represented, many in their type areas, but only the uppermost of the poorly correlated Grampian Group formations are represented. Although many of the formations of the Appin and Argyll groups show remarkable similarities in facies across the overall outcrop of the Dalradian, there are significant variations in the lowermost formations of both groups within the central Grampian Highlands (Fig. 2).

The uppermost formations of the Grampian Group are well represented in the GCR site selection, as is the transition up into the Lochaber Subgroup of the Appin Group. Near the north-western section of the boundary with the northern Grampian Highlands, the contact between the Grampian Group and the Lochaber Subgroup, previously interpreted as the tectonic Fort William Slide, has been re-interpreted by Glover (1993) as a local unconformity. Although that area is not represented in the GCR site selection, in the *River Leven* GCR site, to the east of Loch Leven, this contact can be shown to be a sedimentary transition, contrary to other suggestions (e.g. Lambert, 1975); the passage from the Eilde Flags into the Eilde Quartzite is continuous, both sedimentologically and structurally (Treagus, 1974). The thick sequence of psammites and semipelites of the Lochaber Subgroup in the type area is described in detail in the reports of several GCR sites around the east and north sides of Loch Leven (*River Leven*, *Nathrach*, *Rubha Cladaidh*, *Tom Meadhoin* and *Doire Ban*, *Stob Ban*), which provide abundant evidence from sedimentary structures, especially cross-bedding, for the shallow-water environment. The lens-like bodies of coarse feldspathic metasandstones of the Eilde and Glen Coe

quartzites, seen in the *River Leven* and *Rudbha Cladaich* GCR sites respectively, are entirely local to the Loch Leven area. On the other hand, the clean metasandstones of Binnein-type quartzite, seen in the *River Leven*, *Nathrach*, *Tom Meadhoin* and *Doire Ban* and *Rudbha Cladaich* GCR sites, are widespread; they extend both along strike into the south-west Grampian Highlands as the Maol an Fhithich Quartzite of Islay and across strike as the thin quartzites seen immediately above the Grampian Group psammites in the *River Orchy*, *Allt Druidhe* and *Strath Fionan* GCR sites. Along strike to the north-east, these quartzites are regarded as members of the more dominantly semipelitic Loch Treig Schist and Quartzite Formation of the Glen Spean area (Key et al., 1997) (see Leslie et al., 2013).

The classic localities of the succeeding Ballachulish Subgroup are described in the *St. John's Church*, *Onich* and *Ardsheal Peninsula* GCR site reports and those of the Blair Atholl Subgroup in the *Ardsheal Peninsula* and *Lismore Island* GCR site reports. The type lithologies and sedimentary structures of the shallow-water Appin Group are well illustrated at these GCR sites. Most of these formations can be correlated lithologically with those of the Isle of Islay in the south-west Grampian Highlands (Tanner et al., 2013), and can be matched virtually formation by formation, with those seen at the *Strath Fionan* GCR site, in the east of the central Grampian Highlands, discussed below.

There has been controversy concerning the identity of certain formations within the Appin Group in the Loch Leven area, which has considerable implications for the structural interpretation (e.g. Treagus, 1974; Roberts, 1976; Hickman, 1978). Therefore particular attention has been paid in that area to the nature and 'way-up' evidence at the transitional junctions, in order to test the stratigraphical succession established by Bailey (1960). At the *Tom Meadhoin* and *Doire Ban* GCR site, in particular, the description here supports the contention of Roberts (1976) that the quartzite in the core of the Kinlochleven Anticline is the Binnein Quartzite and not the Glen Coe Quartzite as maintained by Bailey (1960) and Hickman (1975). This has considerable implications for the local stratigraphical and structural interpretation.

To the south-west of Loch Leven, in the Benderloch–Loch Creran area, there has also been dispute concerning Bailey's original (1922) stratigraphical attributions (Voll, 1960; Litherland, 1980, 1982). Here the Benderloch Slide, the correlative of the Ballachulish Slide seen within several GCR sites in the Loch Leven area (see below), is seen in the *Camas Nathais* GCR site (Tanner et al., 2013); it excises most of the Blair Atholl Subgroup and is now considered to be have had its origins in synsedimentary processes. To the

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