Lithostratigraphy of the Grampian Caledonides

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Stephenson, D, and Gould, D. 1995. British regional geology: the Grampian Highlands. Fourth edition. Reprint 2007. Keyworth, Nottingham: British Geological Survey.

Introduction

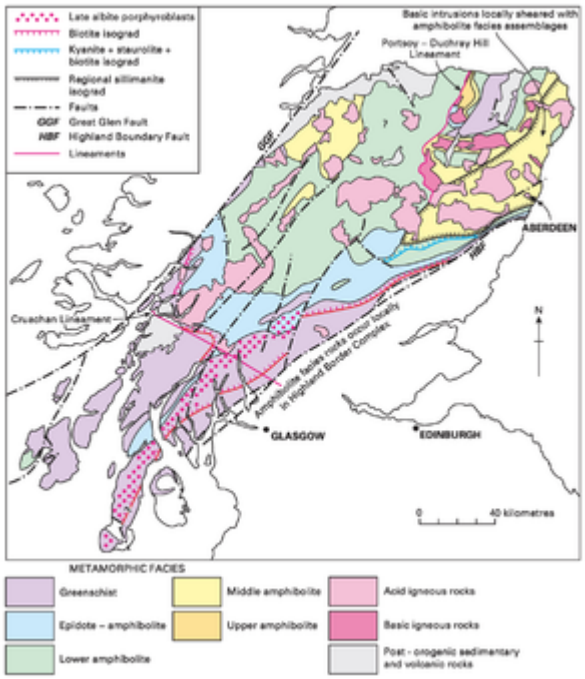
All the metamorphic rocks of the Grampian Highlands are here assigned to the Dalradian Supergroup although locally there are successions of uncertain stratigraphical position and the stratigraphical affinities of the oldest subdivision, the Central Highland Migmatite Complex, is currently a matter of debate. The succeeding Grampian, Appin, Argyll and Southern Highland groups form, in places, a continuous stratigraphical succession. The Appin and Argyll groups are divided into a number of subgroups (P915418).

Composite lithostratigraphical sections (not to scale) of the Appin, Argyll and Southern Highlands groups. P915418.

Our understanding of the stratigraphy of these rocks is still far from complete and few units at formation and member level have been formally defined. In this handbook we use formal names where these have been established (e.g. Appin Phyllite and Limestone Formation) but of necessity many existing informal names of no defined status are retained (e.g. Islay Limestone). Some of the informal names do not accord with accepted stratigraphical practice but continue to be used because the name is well established and formal alternatives have not yet been proposed. Old terms which are not in accord with modern, more specific usage are placed in parentheses and not capitalised (e.g. Portsoy 'group'). The term 'division' is used here for major coherent units of mixed lithologies which are at present not formally defined (e.g. the Stuartfield 'division' of the north-east Grampians).

The rocks of the Dalradian Supergroup are mainly metamorphosed clastic sediments (sandstones, siltstones, mudstones) and limestones and the names used to describe individual units are dependent upon metamorphic grade and the ease with which primary sedimentary features can be identified. Thus in the South-west Highlands, where metamorphic grade is low, many authors have used sedimentary rock terms (e.g. sandstone, siltstone). Where the rocks are more metamorphosed, the terms pelite, semipelite, psammite and (meta) quartzite are used to represent original compositions ranging from argillaceous to arenaceous respectively. To these may be added the textural terms slate, phyllite, schist and gneiss. Carbonate rocks are usually referred to as 'limestones' or 'dolostones' where they are relatively pure and consist essentially of recrystallised carbonate minerals, regardless of metamorphic grade. The term 'marble' is rarely found in modern

descriptions of Dalradian rocks. ‘Calcsilicate rocks’ represent originally impure calcareous (or magnesian) carbonate rocks and contain a high proportion of calcium-magnesium silicate minerals such as tremolitic amphibole, grossular garnet, epidote, zoisite and idocrase. Such rocks grade into (metasedimentary) para-amphibolites. Metamorphosed igneous rocks are classified, whenever possible, according to their nonmetamorphosed equivalents (e.g. metabasalt, metadolerite, metagabbro) or given a general compositional term such as ‘metabasite’. Where the non-metamorphosed equivalent cannot be identified general descriptive terms such as ‘hornblende-schist’ or (igneous) ortho-amphibolite have been retained. The term ‘epidiorite’, formerly used for various metabasic rocks and hornblende-schists, has been abandoned.



Metamorphic zones of the Grampian Highlands (modified after Fettes et al., 1985). P915433.

The intensity of metamorphism and deformation varies considerably through the Grampian Highlands (Chapter 7). In the South-west Highlands, and on Islay and Jura, a generally low metamorphic grade has enabled detailed studies of the sedimentology to be made which have revealed much information concerning palaeogeography, the origin of the sediments and lateral facies changes (Knill, 1963; Roberts, 1966; Hickman, 1975; Anderton, 1976; 1979; Litherland, 1980). Petrological and geochemical studies of penecontemporaneous igneous rocks have also been interpreted by comparison with nonmetamorphosed equivalents (Borradaile, 1973; Graham, 1976). As a consequence of this detailed knowledge, many reviews of Dalradian evolution have been heavily biased towards the interpretations from the areas of low-grade metamorphism (e.g. Knill, 1963; Harris et al., 1978; Johnson, 1983; Anderton, 1982; 1985; 1988). In the areas of intermediate- and high-grade metamorphism (P915433) detailed interpretations of the original nature of the rocks are more difficult, although where sedimentary structures are preserved some sedimentological studies have been made (Winchester and Glover, 1988; Glover and Winchester, 1989).

Accounts of the stratigraphical successions are now published for the South-west Highlands, the Southern Highlands and parts of the Central Highlands. Most of the North-east Highlands and substantial parts of the Monadhliath Mountains of the Central Highlands have only recently been, or are still being, mapped. Much of the following account for these areas is based upon this, as yet unpublished, mapping.

Correlation between local successions is complicated by lateral facies changes, diachronous boundaries, local unconformities, non-sequences, tectonic discontinuities and changes in metamorphic grade. However, certain key units of distinctive lithology have been traced throughout the Grampian Highlands and, in some cases, through north-western Ireland, for distances of up to 700 km. Such key units may have different names in different areas. Intervening beds are generally less traceable but they may make up distinctive lithostratigraphical sequences traceable over various distances. P915418 presents a correlation table for the Dalradian Supergroup which reflects the general consensus among current workers. This builds on the original subdivision of the Dalradian by Harris and Pitcher (1975). The Dalradian Supergroup has a total aggregate thickness of more than 25 km. Such a considerable thickness is not developed in any one continuous section or in any one area because deposition occurred in basins of different and changing morphology. The sedimentary succession at various places has been modified by tectonic thickening and thinning during the orogenic deformation which followed the original deposition (Borradaile and Johnson, 1973).

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