Grampian Group, Grampian Caledonides

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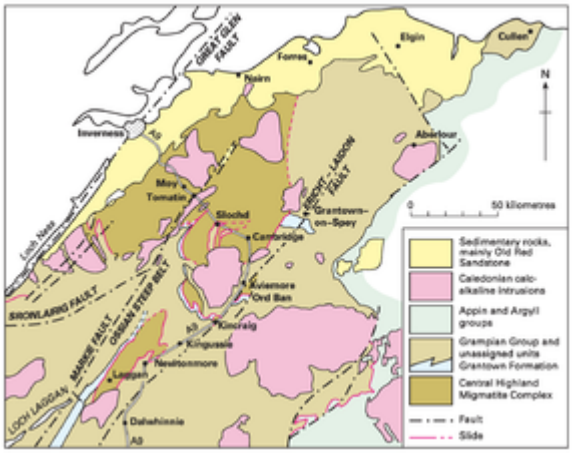
Grampian Group, introduction

The Grampian Group crops out over an area of approximately 4250 km^2 in a broad NE-trending zone extending from Glen Orchy to near Elgin, with an isolated outcrop on the Moray coast around Cullen (P915416, P001195). The group consists mainly of psammites and semipelites at amphibolite-facies metamorphic grade.



Distribution of the Central Highland Migmatite Complex (modified after Piasecki and Temperley, 1988). P915416.

The nature of the contact between the migmatitic, gneissose lithologies of the Central Highland Migmatite Complex and the essentially non-gneissose lithologies of the Grampian Group has become the subject of differing interpretations. The two groups of rocks are separated by a complex zone of high strain and ductile shears of regional extent, the Grampian Slide Zone (Piasecki and Temperley, 1988). The Slide is well exposed at Lochindorb and at Kincraig House there are thin zones of mylonite and ultramylonite. The zones of high strain are characterised by the presence of concordant, highly deformed, apparently syntectonic pegmatite and quartz-muscovite veins which have yielded Rb/Sr mineral ages of 750 Ma (Piasecki and van Breemen, 1983).

Piasecki (1980) recognised early structures only in the migmatitic rocks which led him to interpret the relationship with the Grampian Group as one of basement and cover. In the road cutting at Slochd Summit, the contact between migmatitic and non-migmatitic rocks is well exposed and has been interpreted as a locally preserved unconformable relationship (Piasecki and Temperley, 1988).

Grampian Group country. In the distance are the rounded peat-covered Drumochter Hills, formed of Grampian Group psammites. P001195.

An alternative interpretation of the contact has been made by Lindsay et al. (1989) who did not recognise the presence of early structures confined to the migmatites, instead describing an apparent continuity of stratigraphy and early tectonic structures from the Grampian Group of the Atholl Nappe through the Central Highlands area to the Great Glen. The contrasts between the Grampian Group and the migmatites was attributed to a gradualincrease in metamorphic grade from south-west to north-east, with the contact being interpreted in terms of a sedimentary passage locally modified by zones of higher tectonic strain and selective migmatisation, i.e. downgrading the role and significance of the Grampian Slide.

The upper contact of the Grampian Group, along the southern and eastern margins of its outcrop, is with the Appin Group. In part, the contact is defined tectonically by the Boundary Slide (Chapter 4). In the north-east, however, there is a gradational passage upwards from the Grampian Group into the Appin Group, so that the boundary is arbitrarily defined. A conformable upper contact is also recognised in the south-west where it is traditionally placed at the base of an impersistent quartzite (Eilde Quartzite). However, in this area, different lithologies in both the Grampian and overlying Appin groups are in contact and it is possible that local unconformities exist (Winchester and Glover, 1988; Glover, 1993). The western limit of the Grampian Group is defined by the Great Glen Fault Zone, although the stratigraphical status of some clastic metasedimentary rocks south-east of the fault zone is ambiguous. There are also some brecciated high-grade psammitic rocks within the fault zone near Fort Augustus which may be Moinian.

The Grampian Group is composed mainly of micaceous to quartzose psammites and semipelitic schists. The psammites occur as massive beds of varying thicknesses, with graded bedding developed locally. The bedding is generally accentuated by bedding-parallel mica foliation planes. The semipelites are internally more homogenous, but variably migmatitic with quartzofeldspathic segregations, and appear to be more continuous laterally than the psammites. Quartzites are widespread and, notably in the north-east, form a persistent lithology towards the top of the group. White (clinozoisite-bearing) and green (actinolite-bearing) calc-silicate lenses, mostly concordant to bedding, occur in both psammitic and semipelitic lithologies.

The association of impure diopsidic limestones, pelitic schists (locally with kyanite, tourmaline and garnet) and concordant foliated tholeiitic amphibolites forms a distinctive assemblage (the *Grantown Formation*) overlying the migmatites in the Strathspey and Strathdearn areas. This formation has now been traced, in whole or in part, from Grantown south-westwards, possibly to Kinlochlaggan (P915416).

Lithofacies identified in the psammites and semipelites include various types of turbidites, rhythmically interbedded sequences and laminated, lenticular, channel-fill and wave-rippled units, generally within micaceous psammites (Winchester and Glover, 1988). These units can be parallel sided, wedge shaped or lenticular with conformable or erosional bases. Preserved sedimentary structures are abundant locally, despite widespread ductile deformation and greenschist to amphibolite-facies metamorphism; they commonly include grading, trough and tabular cross-bedding and, less abundantly, load and water escape structures, scouring, mudflake-breccias and various types of internal lamination. Bottom structures are either absent or have been removed by bedding-parallel slip.

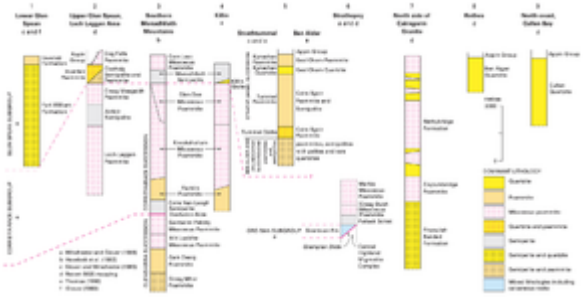
The semipelites and psammites are composed essentially of quartz, plagioclase and mica, biotite being more common than muscovite, with variable amounts of mainly detrital K-feldspar. Apatite-bearing heavy-mineral bands with various opaque phases are recognised in the psammites. The semipelites, and less commonly the psammites, are locally garnetiferous. Several hundred whole-rock analyses of the psammitic and semipelitic rocks are published (Lambert et al., 1982; Haselock, 1984; Winchester and Glover, 1988). There are slight chemical differences between semipelites at different stratigraphical levels, although as a group they are chemically distinguishable from those in the overlying Appin Group. All the psammites have broadly similar chemical compositions.

Stratigraphical successions have been established in a number of separate parts of the Grampian Group outcrop but at present no complete picture of the sedimentation and stratigraphy has emerged. Correlation between the established local successions is incomplete owing to the possible effects of lateral changes of lithofacies, of the high-strain zones and thrusts, and of penecontemporaneous faults which exerted an influence on sedimentation.

The local stratigraphies generally have been divided into formations which may be amalgamated into informal successions (P915417) such as the Ben Alder, Drumochter and Strathtummel successions for the area north of Schiehallion (Thomas, 1980). Further work is needed before a more formal stratigraphical framework for the whole of the Grampian Group is possible, although Winchester and Glover (1988) have suggested a regional tripartite subdivision, into the Ord Ban, Corrieyairack and Glen Spean subgroups.

Ord Ban Subgroup

This subgroup consists of the distinctive assemblage of limestone, pelitic schist (partly kyanite-bearing) and amphibolite immediately overlying the Central Highland Migmatite Complex in Strathspey; it was originally called the Grantown Series by Hinxman and Anderson (1915) and, in recognition of this, it has been renamed the *Grantown Formation*. It is overlain by rhythmites and thick psammites but the relationship of these units to the Corrieyairack Subgroup farther west is uncertain at present.



Lithostratigraphical units in the Grampian Group. P915417.

Corrieyairack Subgroup

This subgroup is the major component of the Grampian Group of the southern Monadhliath Mountains where it is about 4500 m thick and consists of a thick succession of psammitic rocks overlying a basal semipelite (Haselock et al., 1982; Okonkwo, 1988) (P915417, column 3). Here it is separated from the underlying Glenshirra succession, which has uncertain stratigraphical status (see next section). Southwards, towards Glen Spean, quartzite forms several distinctive units of varying thickness.

Glen Spean Subgroup

This subgroup consists of a mixed sequence of semipelite and psammite with quartzite. At Spean Bridge the subgroup is approximately 4000 m thick (Glover and Winchester, 1991) but farther south, in the River Leven, and on the Black Mount, the exposed psammites and semipelites of the subgroup are only about 100 m in thickness. The rocks of this subgroup are thought to reflect a change of depositional environment from the deep water turbidites of the Corrieyairack Subgroup to shallow marine shelf sedimentation (Glover, 1993). Similar lithologies farther north-east, exposed in the mountainous tract bisected by the A9 road (which provides excellent exposures in cuttings), have been described by Thomas (1980; 1988). Here a *Drumochter succession* of monotonously flaggy psammites and semipelites is overlain by the predominantly psammitic *Strathtummel succession* (P915417, column 5); they may be lateral equivalents of the Glen Spean Subgroup (Glover and Winchester, 1989). Shallow water sedimentary structures are well preserved in the upper psammites which are up to 3000 m thick.

In Strathspey the relations between the Grantown Formation of the Ord Ban Subgroup and the overlying succession are uncertain and the contact is at least in part tectonic. The overlying succession consists for the most part of micaceous psammites with some white quartzites but there is one distinctive unit consisting of an alternation of quartzites and semipelites. Exposure in the area is generally poor and the structure is consequently not fully understood but the succession appears to be several kilometres in thickness (P915417, column 6).

Quartzite becomes the dominant component of the upper Grampian Group succession at the north-east limit of its outcrop, around Rothes and on the Moray Firth coast at Cullen. Here, quartzites up to 2500 m thick, directly underly Appin Group lithologies (P915417, columns 8 and 9). The *Cullen Quartzite Formation* crops out along 12 km of the Moray Firth coast, between Buckpool and Logie Head. It is divided into the *Findochty Quartzite Member*, consisting of hummocky-bedded and thickly bedded quartzites with garnet-mica-schist interbeds, and an overlying *Logie Head Quartzite Member*, comprising planar-bedded, flaggy quartzites, also with finely interbanded garnet-mica-schists. Shallow water sedimentary structures are preserved in the various quartzites. Inland, the *Ben Aigan Quartzite Member* is equivalent to the Logie Head Member.

Metasedimentary rocks of uncertain stratigraphical affinity

Structurally underlying the Corrieyairack Subgroup in the area south-east of Loch Lochy and Loch Ness is a succession of arkosic psammites with meta-conglomerates and pebbly psammites that is more than 2000 m thick north-east of Fort Augustus (Parson, 1982). Near Loch Lochy thin lenses of dolomitic marble, black schist, quartzite and rare metabasite also occur. These lithologies have been grouped together with the psammites as the *Glen Buck Pebbly Psammite Formation*, which is separated from the overlying Corrieyairack Subgroup by the Eilrig Shear Zone, a zone of mylonites up to 1 km thick locally (Phillips et al., 1993). The stratigraphical affinity of a fault-bounded outcrop of gneissose micaceous psammites with minor siliceous marble at Gleann Liath, near Foyers (Mould, 1946) remains problematical.

Farther to the south-east the *Glenshirra succession* is separated from the overlying Corrieyairack Subgroup by a slide, or high-strain zone, the Gairbeinn Slide (Haselock et al., 1982) (P915417, column 3). The Glenshirra succession is subdivided into four formations in its type area between the Allt Crom Granite and the Corrieyairack Igneous Complex and is at least 2500 m thick. Psammites with interbanded semipelites are the main rock types in the succession which includes an upper unit of pebbly psammites. Rapid lateral facies changes occur and Haselock (1984) described geochemical and sedimentological differences between the Glenshirra succession and the overlying Corrieyairack Subgroup. Both the Glenshirra succession and the Glen Buck Pebbly Psammite Formation are separated from the Corrieyairack Subgroup by tectonic discontinuities and their stratigraphical relationships with the overlying Grampian Group are consequently uncertain.

On Islay, it is possible that the Bowmore Sandstone may be assigned to the Grampian Group. This problematical unit is discussed in Chapter 3.

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