Bedrock Geology and Physiography of the Monadhliath Mountains

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Physiography

The Monadhliath Mountains comprise of an extensive area of plateau in the Central Highlands of Scotland, which is bounded to the north by the Great Glen and to the south by Strathspey. The region is located immediately to the northwest of the Cairngorm Mountains, to the north of Creag Meagaidh and to the northeast of the Ben Nevis Range, forming a nearly continuous area of upland from Glen Roy westwards to where the A9 crosses Slochd Summit (Fig. A).

The upland consists of rounded summits and is dissected by at least twenty-five key catchments. It is divided to an extent in two by the Corrieyairack pass, forming a much smaller area of upland in the west, to the north of Glen Roy, and a larger (main) plateau in the central and eastern part of the region. This main plateau slopes downwards towards the north, with the altitude of the plateau edge ranging from 900 m in the south, with individual summits as high as 945 m (Carn Dearg, NH 636 024), to 600 m in the north. As a result, the main watershed runs from west to east across the southern edge of the plateau, and this asymmetry is manifest in short, steep catchments on the south side of the plateau, with the majority of the plateau draining northwards or eastwards within large catchment areas. Valleys draining the plateau to the south tend to have steep backwalls separating the valley floor from the plateau above whilst catchments in the north gently rise onto the plateau, often with no backwall. This asymmetry has significantly affected the form and dynamics of glaciers in the region and is discussed further by Boston (this guide).

Bedrock Geology

Metamorphic rocks of the Dalradian Supergroup and older 'basement'

The Monadhliath Mountains occur entirely within the Scottish sector of the Caledonian orogenic belt and are underlain by a sequence of polydeformed and metamorphosed Neoproterozoic metasedimentary rocks intruded by a number of younger, early Palaeozoic granite plutons (Fig, 1). The metasedimentary rocks largely belong to the Grampian and Appin groups of the Dalradian Supergroup (Stephenson and Gould, 1995), but also include inliers of an older Pre-Dalradian 'basement', the latter now being referred to as the Badenoch Group (Stephenson *et al*., 2013; Leslie *et al*., 2013). Only a brief summary of the bedrock geology of this complex area is presented here. However, a more detailed account of the Neoproterozoic geology of the Monadhliath Mountains can be found in Stephenson *et al*. (2013) and Leslie *et al*. (2013) (and references therein).

The pre-Dalradian 'basement' rocks of the Badenoch Group (Fig. 1), previously referred to as the 'Central Highland Division', are dominated by a sequence of locally gneissose to migmatitic metasandstones (psammites) and metasiltstones (semipelites). These middle to upper amphibolite facies metasedimentary rocks (Phillips *et al*., 1999) are deformed by a series of ductile shear zones collectively known as the Grampian Shear Zone (Smith *et al*., 1999). Pegmatitic granitic veins and mylonitic rocks within this shear zone have yielded ages for this ductile deformation in the range 750 and 800 Ma (Piasecki and van Breeman, 1979, 1983; Noble *et al*., 1996). The migmatites of the Badenoch Group, however, have yielded older ages of c. 840 Ma (Highton *et al*., 1999) which are interpreted as dating the age of

metamorphism (migmatization) of these rocks and therefore providing a minimum age for this pre-Dalradian 'basement'.

The overlying Grampian Group represents the oldest part of the Dalradian Supergroup and comprises a sequence of marine to locally terrestrial (fluvial) metasandstones and metasiltstones, with some quartzites. The group has been divided into three subgroups (Glenshirra, Corrieyairack and Glen Spean; Fig. 1) which are characterised by different sedimentary lithofacies associations recording deposition within a number of broadly NE- to SW-trending sedimentary basins. These basins formed as a result of syn-rift extension occurring along the southern margin of the Laurentian continent (Glover *et al*., 1995) during the opening of the Iapetus Ocean. This early phase of rifting was followed by a more protracted period of post-rift thermal subsidence (c. 700 ma) which accompanied the deposition of a shallow marine shelf sequence represented by the Appin Group. The Appin Group comprises a highly deformed sequence of metamorphosed mudstones (pelites), siltstones, quartzites, limestones and calcareous rocks (calc-silicate rocks) (Key *et al*., 1995).

The Grampian and Appin groups were deformed and metamorphosed during the mid-Ordovician 'Grampian event' of the Scottish Highlands, this event forming part of the geographically much wider Caledonian orogeny. A possible cause for the Grampian event in Scotland is thought to be the convergence of the Laurentian continent with an intra-oceanic subduction zone and volcanic arc formed during the closure of the Iapetus Ocean (Strachan *et al*., 2002). Large-scale, northeasterly-trending recumbent folds and later upright folds developed during this orogenic event locally control the distribution of the main lithostratigraphic units within the Monadhliath Mountains (Fig. 1). Regional amphibolite facies metamorphism which accompanied deformation resulted in the complete recrystallisation of the mud-rich rocks, overprinting the primary sedimentary structures and forming a suite of highly foliated, garnet-mica-schists and biotite-mica-schists (Phillips *et al*., 1994; Key *et al*., 1997). Brittle deformation during the later stages of the Caledonian orogeny, in late Silurian to Devonian times (c. 420-390 Ma), resulted in major faulting (e.g. Sronlairig Fault, Great Glen Fault, Ericht-Laidon Fault) which offset and modified the pre-existing ductile structures, lithostratigraphy and post-tectonic granitic intrusions (Fig. 1). These large-scale, NE-SW to NNE-SSW-trending faults locally control the orientation of the main valleys and lochs (e.g. Strathspey, Glen Markie, Glen Truim) within the Monadhliath Mountains.

Granitic intrusions

The Neoproterozoic metasedimentary rocks of the Monadhliath Mountains are intruded by a number of much younger, late Silurian to early Devonian tonalite-granodiorite-granite intrusions (Fig. 1) belonging to the Argyll and Northern Highland (Foyers, Findhorn, Allt Crom and Corrieyairack granites) and Cairngorm suites (Monadhliath granite) (Stephenson and Gould, 1995; Strachan *et al*., 2002). All of these intrusions post-date the main deformation and metamorphic events recorded by the country rocks. However, a number of late-syntectonic biotite-muscovite granites and vein complexes do occur within the region, namely the Glen Kyllachy, Maol Chnoc, Strathspey and Loch Laggan granites (Stephenson and Gould, 1995). These complex granitic bodies pre-date the emplacement of the much larger tonalite-granodiorite-granite plutons and typically comprise a network of small intrusions and/or sheet-like to irregular veins of granodiorite, granite, aplite and microgranite which invade the surrounding country rock.

The post-tectonic Foyers Granite (Fig. 1) is a funnel shaped intrusion comprising irregular to locally vein-like masses of an early fine- to medium-grained tonalite which locally grades

into porphyritic granodiorite. This is cut by a later pink medium-grained nonporphyritic monzogranite. Forceful emplacement of the Foyers Granite was accompanied by the development of a broad metamorphic aureole containing sillimanite-bearing hornfelses, as well as high-grade cordierite-K-feldspar migmatites immediately adjacent to the contact.

The Findhorn, Allt Crom and Corrieyairack granites form a series of intrusions which run NE to SW across the Monadhliath Mountains (Fig. 1). The most northerly of these, the elongate, NE-trending Findhorn Complex, consists of a grey, foliated biotite-granodiorite containing mafic schlieren and flattened xenoliths of the metasedimentary country rock. To the southwest of the Findhorn Complex, the Allt Crom Granite is a complex intrusion comprising a vein complex of biotite monzogranite in the north, with a relatively more coherent body of grey, equigranular biotite-granodiorite within a marginal facies of pink leucocratic monzogranite to the south. This southern component to the Allt Crom Granite contains large rafts of Grampian Group rocks. The elongate NE-trending Corrieyairack Complex is dominated by a uniform, pink-grey hornblende-biotite-granodiorite containing very few xenoliths (Key *et al*., 1997). The south-western part of the intrusion, however, consists of a distinctive medium- to coarse leucocratic granite choked with country rock xenoliths, separated from the main granodiorite by a narrow band of black and white speckled granodiorite.

The Monadhliath Granite (Fig. 1) is the westernmost pluton within the Cairngorm Suite of I-type granites which dominate the Grampian Highlands to the east of the Monadhliath Mountains (Stephenson and Gould, 1995). This roughly circular, stock-like intrusion comprises a main phase of variably porphyritic grey monzogranite and a younger phase of more evolved finer grained biotite-monzogranite. Both of these phases are cut by sheets and irregular masses of microgranite, aplite and pegmatite.

The various granitic intrusions within the Monadhliath Mountains form the source of erratics within the much younger glacial deposits which mantle the region and have been used to aid in the reconstruction of patterns of former ice movement across the area (see Merritt et al., this guide; Jarman, this guide).

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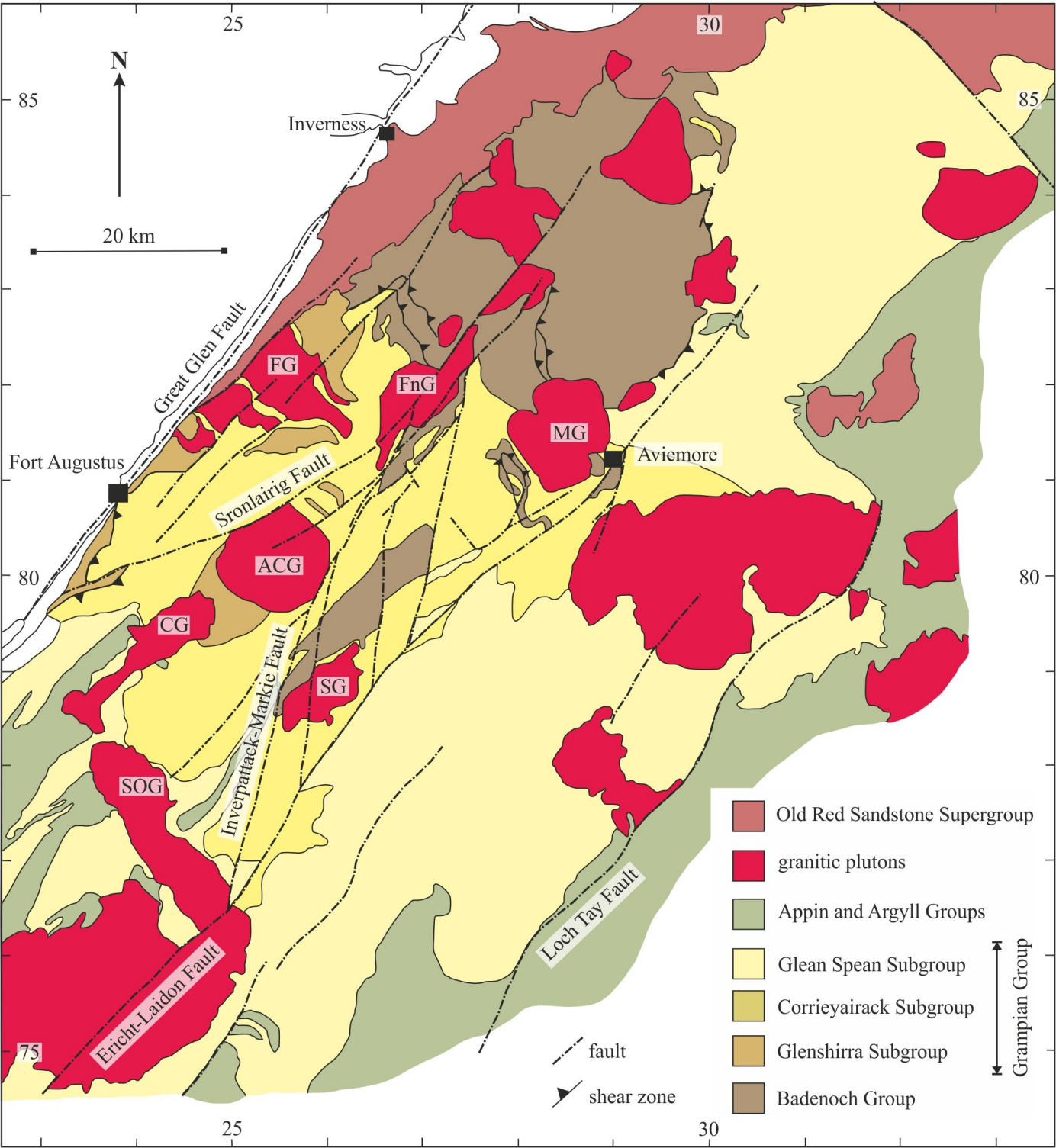
Figures

Figure 1. Simplified geological map of the Monadhliath Mountains (after Phillips et al. 1999; Smith et al. 1999). Abbreviations: SOG – Strath Ossian Granite; CG – Corrieyairack Granite; SG – Strathspey Granite; ACG – Allt Crom Granite; FG – Foyers Granite; FnG – Findhorn Complex; MG – Monadhliath Granite.


25
30
N
85
Inverness
20 km
Great Glen Fault
FG
FnG
MG
Aviemore
Fort Augustus
Sronlairig Fault
ACG
80
CG
SG
Inverpattack-Markie Fault
SOG
Loch Tay Fault
Ericht-Laidon Fault
75
fault
shear zone
Old Red Sandstone Supergroup
granitic plutons
Appin and Argyll Groups
Glean Spean Subgroup
Corrieyairack Subgroup
Glenshirra Subgroup
Badenoch Group
Grampian Group