

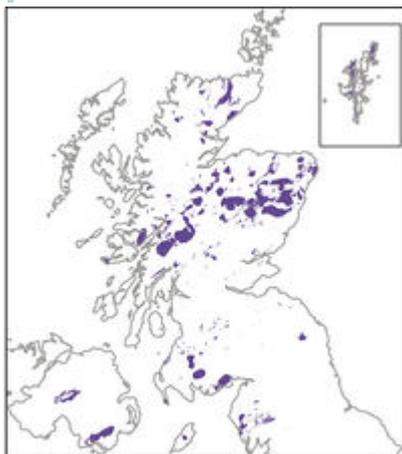
Bedrock Geology UK North: Caledonian Orogeny and associated magmatism

From Earthwise

[Jump to navigation](#) [Jump to search](#)

This topic provides descriptions of the rock types appearing on the British Geological Survey 1:625 000 scale map of the UK North and gives a brief explanation of their origins.

Author: P Stone (BGS); **Contributor:** A A Jackson (BGS)



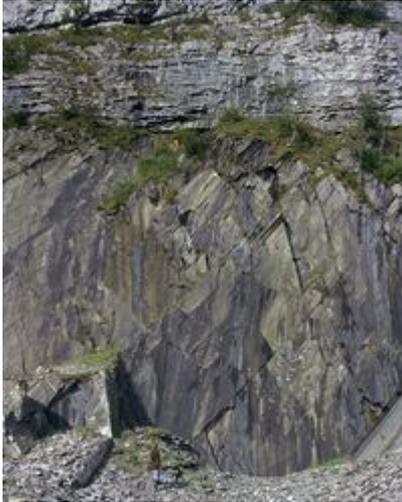
 Caledonian intrusive rocks

P785808.



A view along the Great Glen from near Fort William towards Loch Lochy.

[P000742.](#)



Inclined and cleaved sandstone-turbidite beds of the late Silurian, Horton Formation (Coniston Group, Windermere Supergroup). [P005554](#).



The Kemnay granite quarry, near Aberdeen, works an intrusion associated with the Grampian event of the Caledonian Orogeny. [P000207](#).

As the Iapetus Ocean closed various collision events occurred at its margins and caused episodes of deformation and metamorphism. These ranged in age from the earliest Ordovician through to the early Devonian, with three principal Caledonian events recognised in the northern UK: Grampian, Scandian and Acadian. The Grampian Event (which peaked at about 470 Ma) was caused by the arrival at the Laurentian margin of arc terranes represented, in part, by the early Ordovician ophiolite-complexes. The Scandian Event (about 430 Ma) resulted from the collision of Laurentia with Baltica, but the slightly later convergence of Laurentia with Avalonia, and the final elimination of the Iapetus Ocean, was a much less dramatic affair that is barely identifiable in the tectonic record. The Laurentia–Avalonia meeting was followed, some 20 million years later during the early Devonian (at about 400 Ma) by the Acadian Event, which was perhaps initiated by the arrival of another Gondwanan continental fragment at the southern margin of Avalonia.

The Grampian Event comprised several superimposed deformations and affected all of the Dalradian rocks in the Scottish Highlands and Northern Ireland where it culminated in the development of major fold and nappe complexes with much overturning of strata. Pervasive cleavages were imposed and associated metamorphism peaked at about 470 Ma. Similar Grampian effects to the north of the Great Glen are more variable and less quantifiable in the Moine rocks due to the protracted earlier history of deformation, and the locally pervasive overprinting by later, Scandian features.

Several suites of plutonic rocks were intruded during the Grampian Event, mostly to the south of the Great Glen. Mafic and ultramafic rocks are present in the Aberdeenshire area of north-east Scotland where they are variably sheared and metamorphosed. Diorite and granite plutons occur more widely, notably around Aberdeen (**Plate P000207**) and at Strichen. All of these intrusions have broadly similar ages of around 470 Ma, coincident with the metamorphic acme.

The Scandian Event caused significant regional folding and thrusting of Moine rocks and associated basement inliers to the north of the Great Glen, but Scandian tectonic effects are hard to recognise to the south. Thrusting in the Northern Highland terrane culminated in the development of the Moine Thrust Belt, which carried the deformed Moine sequence and its Lewisianoid foundation over the Lewisian basement rocks and their Cambro-Ordovician sedimentary cover (**Plate P000965**). The belt is a complex array of interconnected thrusts, with most movement occurring around 430 Ma; overall westward displacement may have exceeded 100 km. Within the Moine succession, intense folding was associated with the ductile thrusting, and the rocks were pervasively cleaved and metamorphosed. Farther north, Scandian deformation completed the structural assembly of the Shetland Ophiolite-complex with development of the Unst Phyllite Group (S1) and contemporaneous intrusion of granite bodies.

Magmatism also overlapped with Scandian deformation in mainland Scotland, where the emplacement of many intrusions was structurally controlled. A series of alkaline, syenitic plutons intruded in north-west Scotland includes one at Loch Borrallan intruded into the Moine Thrust Belt soon after its formation. These plutons contain a wide range of unusual rock types including highly potassic lithologies and Britain's only carbonatite. A second group of broadly granitic plutons is much more voluminous and widespread across the Scottish Highlands, mostly in the Grampian terrane to the south of the Great Glen. This group is calc-alkaline and its component plutons range in age from 425 to 415 Ma; representatives include the large plutons at Cairngorm, Etive and Rannoch Moor.

Farther south, slightly younger granitic plutons were intruded around 400 Ma, spanning and stitching the Iapetus Suture zone. The several plutons in Galloway, and the Cheviot granite, represent this group in the Scottish Southern Uplands terrane (**Plate P008440**) as do the Newry granodiorites, which were intruded into the equivalent Lower Palaeozoic strata in Northern Ireland. In northern England, intrusion of the Shap and Skiddaw granites enlarged the pre-existing Lake District batholith and was in part contemporaneous with the onset of the Acadian deformation event.

The Scandian to Acadian intrusions were produced mostly by melting within the lower crust, but the involvement of mantle sources is evident in some plutons and in the widespread calc-alkaline lamprophyre dyke swarms that are closely associated with them. Intrusion largely postdated the final closure of the Iapetus Ocean and took place within the regional, sinistral stress regime that was established following continental collision.

One important effect of the sinistral, post-collision tectonism was strike-slip movement concentrated on major north-east-trending faults, such as the Great Glen Fault and its northwards

extension as the Walls Boundary Fault in Shetland. On the Scottish mainland, the Great Glen Fault (**Plate P000742**) comprises a zone of fracturing and intense cataclasis, 1 to 1.5 km wide, affecting Moine and Dalradian rocks. Displacement is most likely of the order of 200 to 300 km and whilst much of this was achieved incrementally between about 430 Ma and 400 Ma, some reactivated movement also took place at much later dates. Farther south, late Silurian to early Devonian sinistral movement also took place on other major north-east-trending structures — the Highland Boundary and Southern Upland faults, the Moniave Shear Zone within the Southern Uplands, and the Iapetus Suture itself.

As the sinistral tectonic regime evolved, a measure of extension was introduced so that strike-slip, sedimentary basins opened up in which lower Devonian, Old Red Sandstone strata accumulated. Then, in the mid Devonian, deformation during the Acadian Event was probably driven by continental collision farther south, at the southern margin of Avalonia. In northern Britain, the most marked Acadian effects are seen in and around the Lake District with folding and cleavage formation throughout the Lower Palaeozoic inliers (**Plate P005554**); Lower Palaeozoic strata on the Isle of Man were similarly affected. Farther north, likely Acadian effects are the folds in Lower Old Red Sandstone strata along the margins of the Midland Valley, the most prominent of which is the Strathmore Syncline adjacent to the Highland Boundary Fault. In the Highlands there was some sinistral fault re-activation with related, localised deformation.



Within the Moine Thrust Belt, the Ben More Thrust has carried Archaean gneiss of the Lewisian Complex over Cambrian quartzite. [P000965](#).



The Kirkmabreck granite quarry near Creetown, Galloway, works an intrusion associated with the Acadian event of the Caledonian Orogeny. [P008440](#).

Bedrock Geology UK North - contents

[Introduction](#)

[Archaean and Palaeoproterozoic](#)

[Mesoproterozoic and Neoproterozoic](#)

[Lower Palaeozoic - Cambrian, Ordovician and Silurian](#)

Caledonian Orogeny and associated magmatism

[Mostly Devonian - the Old Red Sandstone Supergroup](#)

[Carboniferous](#)

[Permian and Triassic - including the New Red Sandstone Supergroup](#)

[Jurassic and Cretaceous](#)

[Cenozoic](#)

[The surface layer](#)

Retrieved from

'http://earthwise.bgs.ac.uk/index.php?title=Bedrock_Geology_UK_North:_Caledonian_Orogeny_and_associated_magmatism&oldid=6795'

Category:

- [Bedrock Geology UK North](#)

Navigation menu

Personal tools

- Not logged in
- [Talk](#)
- [Contributions](#)
- [Log in](#)
- [Request account](#)

Namespaces

- [Page](#)

- [Discussion](#)

Variants

Views

- [Read](#)
- [View source](#)
- [View history](#)
- [PDF Export](#)

More

Search

Navigation

- [Main page](#)
- [Recent changes](#)
- [Random page](#)
- [Help about MediaWiki](#)

Tools

- [What links here](#)
- [Related changes](#)
- [Special pages](#)
- [Permanent link](#)
- [Page information](#)
- [Cite this page](#)
- [Browse properties](#)

• This page was last modified on 30 January 2015, at 12:29.

- [Privacy policy](#)
- [About Earthwise](#)
- [Disclaimers](#)

