

The Coigach Geotrail

Approach Sites 1-5

From Drumnurie take the minor road off the A835 and head west into Coigach and to either one of the car-parks near Stac Pollaigh. Coigach's impressive mountains are made of Torridonian Sandstone, the deposits of an ancient (1 billion year old) river system. These were shaped by the last of the British ice sheets as it carved its way across the region about 20,000 years ago. Stac Pollaigh became stream-lined as the ice flowed either side of it, scouring out the valley floors now occupied by lochs. Look out for ice flow direction indicators (striations and crescentic fractures) on the smooth surfaces of glaciated bedrock close to the road **1, 2** and the loch **3**. **In which direction was the ice flowing?**

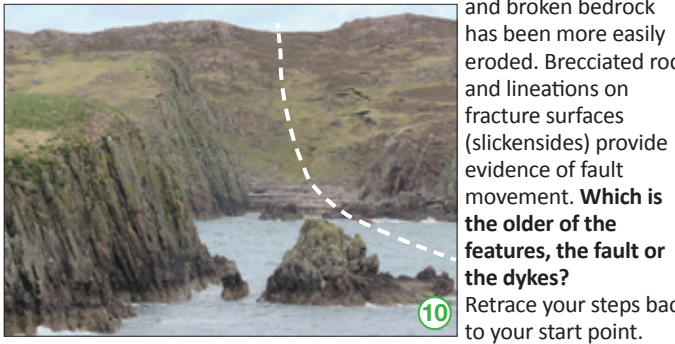
Further on, the Lewisian Gneiss forms the hummocky ground between lochs Bad a' Ghailh and Osgaig. Here, loch shoreline embayments and ravines within the gneiss outcrop mark the positions of softer-weathering dykes; intrusions of igneous rock that penetrated the gneiss long after it was formed. Outcrops of banded grey gneiss can be seen by the road **4, 5**. To access the main sections of the geotrail (which can be completed in any order) continue west down the road towards Achiltibuie.

Reiff 6-10

Park at the road-end at Reiff (limited space available). Walk back around the bend, turn left (north) on a path between buildings and continue along the east side of the loch to a boulder-strewn raised beach **6** and a beautiful bay. The rugged sea cliffs are made of strongly jointed but gently dipping layers (beds) of sandstone (Applecross Formation). The rocks can be examined among the cliff-top crags (CARE) at several locations along the coast **6, 7, 8 & 10**. The sandstones are ancient river deposits. The pebbles and cross-bedding they contain provide clues as to the source of the rivers and their direction of flow. Pebbles include vein quartz (white) and jasper (red). Contorted layers provide evidence of wet sediment disturbance. Some are water escape structures. Striations and crescentic fractures on the rocks show the direction of ice travel during the Quaternary Period.

Continue north around the bay. At a low ridge, **9**, a grey, sub-vertical dyke (igneous intrusion) 6-7m wide penetrates the ancient sandstone. Similar dykes are seen further west and at Fox Point **13**. Across the bay, at the foot of cliffs, another dyke (pink) resembles one at Garvie Bay **51**. All are offshoots from a larger intrusion to the east, injected into the crust during the Caledonian Orogeny. **Imagine hot magma extending from this larger intrusion through 30km of fractured rock to Reiff in the west!**

The steep-sided gully on the north side of the bay **10** marks the position of an underlying fault. Flanked by sub-vertical fractures on the cliff-side, the fault can be traced south across the bay, under the loch and into another bay beyond; that is, across the low ground where the faulted



and broken bedrock has been more easily eroded. Brecciated rock and lineations on fracture surfaces (slickensides) provide evidence of fault movement. **Which is the older of the features, the fault or the dykes?** Retrace your steps back to your start point.

Dornie Coastline 11-18
From Old Dornie harbour follow the coast path south to Fox Point. The route passes an ice-scoured knoll on the side of Meall Dearg **11** and crags of pink cross-bedded sandstone (Applecross Formation) at a headland **12** and by the terrace that leads through sea cliffs to the south. The sandstones contain tiny silver flakes of mica and small round pebbles, the deposits of running water (rivers). The overlying sandstones (Aultbea Formation) are similar but lack pebbles. The Applecross/Aultbea formation boundary lies close to the terrace. Above a steep rise at the end of the terrace (CARE), the path leads down to a bay. Here, on the foreshore **13**, an igneous dyke swarm 20m wide occurs in the sandstone. A similar dyke swarm occurs on the foreshore at Reiff (near **9**). **What evidence suggests that these dykes (each 0.1-4m wide) were intruded into the sandstone as hot molten rock?** Beyond, at Fox Point **14** and to the east **15, 16** sandstones with contorted layers are common. These provide evidence of sediment disturbance, most likely the product of flood-induced liquefaction events or earthquake shocks.

Beds of ripple-laminated sandstone and siltstone near Dornie **15** are ancient lake deposits. Similar beds on Tanera Beg (Summer Isles) contain the fossilised remains of ancient microbes, possibly algae and bacteria. These are among the oldest known microfossils in Britain.

Continue on the coast path around buildings and follow the road uphill, beyond a roadside cut with glacial deposits **17**, to a junction and turn left. Follow the road around a bend past more sandstone **18**. Then, beyond a loch turn left back downhill to the harbour.

Cnoc Mor 19-23

Park at the Community Hall in Achiltibuie. Directly across the main road, a faint path between buildings leads up the hillside (north-east) to a wall. Follow it to a rise and a prominent crag of Lewisian Gneiss **19** with banding that dips (slopes) north-east. Continue 200m to crags on the skyline **20**. Here is a dark-coloured, coarsely crystalline layered rock (amphibolite) with hornblende (black) and garnet (red / brown). This rock once formed part of an igneous intrusion (sill) in which crystals



Enard Bay 45-52

From Loch Raa car-park turn right down the road towards Achnahaird. After a few metres turn right through a gate and follow the path around the southern end of Achnahaird Bay. The bay marks the position of the Coigach Fault along which massive earth movements took place in the past (see geological section overleaf). Follow the shoreline 2km north to shoreline crags of sandstone with large-scale cross-bedding (Stoer Group) **45**. Continue over a fence, around a bay by a terrace (raised beach) **46** and along sea cliffs (CARE) to a headland. Turning east, go around a bay on steep ground (CARE) and over a ridge of gneiss to another bay by a 'salmon bothy'. Here on the shore (CARE) a red/grey laminated limestone (Stoer Group) rests unconformably on Lewisian Gneiss. It also coats boulders of gneiss above the unconformity surface **47**. This remarkable limestone has been described as a 'stromatolite', built by successive generations of microbes that encrusted boulders along an ancient lake shoreline. If proven, this 1.2 billion year old 'microbial' structure would represent the oldest life form known in Europe; and the microbes that formed it,

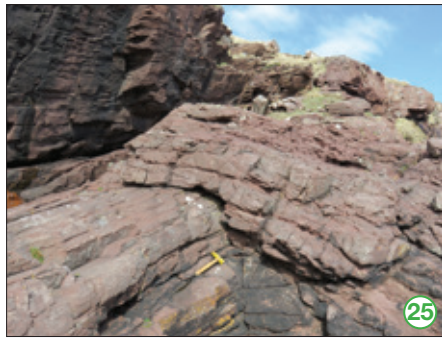
of different size and composition settled out to form layers as the magma cooled. The gneiss and amphibolite were formed by metamorphism at extremely high temperatures and pressures as the rocks were squeezed together deep (several tens of kilometres deep) within the heart of an Archaean mountain belt about 3 billion years ago. The wall leads on over high ground, 300m to the summit **21**. Here tight folds in the gneiss show the extent to which these rocks have been deformed. Close by, the gneiss contains a piece of the amphibolite with truncated layers at its margin. **What do you think has happened here? Which of the two rock types is the oldest?**

Downslope, 200m north of the summit, the gneiss is unconformably overlain by ripple-marked sandstones and conglomerates containing gneiss fragments (Torridon Group) **22**. The unconformity surface separating these units represents a massive multi-million year time gap, a period in which the Lewisian Gneiss was uplifted, stripped of its mountain cover and eroded before the deposition of the Torridon Group sediments on its flanks.

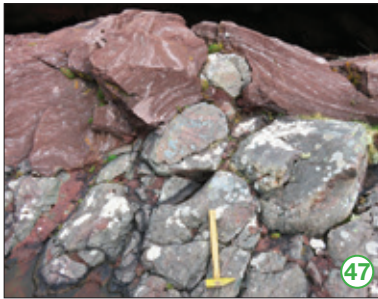
Circle back south around the summit to a smooth broad outcrop **23**, 80m west of the wall. Here, a dark, crystalline but un-layered igneous rock (dolerite) has been intruded into the gneiss - a Scourie Dyke! Follow the wall to return to your start point; or, go west over ice-scoured ground to a gated track which leads to the Summer Isles Hotel and the road back to the Community Hall.

Rubha Dunan 24-29

From the Community Hall car-park in Achiltibuie turn right along the road to Polglass. Opposite a roadside cut backed by glacial debris **24**, a clearly signposted path towards the sea leads down to the Achlochran ruins. Follow it beyond the ruins and, keeping to the shoreline continue with care across rocks to the cliffs **25**. Here, red pebbly sandstones



(Stoer Group) dip west beneath a spectacular unconformity surface. Above it, Torridon Group sandstones with boulder-sized blocks of Stoer Group sandstone dip south-east. The Stoer Group beds were uplifted, tilted and eroded before the Torridon Group beds were deposited. Remarkably, palaeomagnetic studies of core samples from this site indicate that in Stoer Group times, Coigach was located 20-30° north of the equator, but by Torridon Group times (200 million years later) Coigach had drifted 35-45° south of the equator. Such work contributed significantly to the development of concepts in continental drift and plate tectonic theory. The core holes left behind draw attention to the interest at this Site of Special Scientific Interest. **But, do you think they are unsightly?**



Possible Stromatolites, Stoer Group

blocks and angular impact 'melt' fragments. At its top are spherical pellets (lapilli) formed by fine ejecta particles attaching to moisture condensing in the atmosphere, the fallout from high dust clouds following impact.

Further on towards the eastern headland are more impressive exposures of conglomerate and the Stoer Group/Torridon Group unconformity **49, 50**. Turn right here and follow the coast south over high ground (CARE) and a fence down to a small bay. Beyond the bay a pink dyke cuts through lighter-coloured sandstones (Applecross Formation) on the shore **51**.

The dyke represents an intrusion of hot magma that penetrated a fracture in the sandstones during the Caledonian Orogeny about 430 million years ago. Continue south to Garvie Bay and follow the path inland west (right) around the loch, then by the river upstream to the road. Turn right back to the car-park passing an impressive striated (ice-scoured) sandstone slab *en route* **52**.

Retrace your steps to the cliff-top path, turn left along the coast past a fault, and ripple-marked slabs of Stoer Group sandstone **26**, out to the headland **27**. Here, at low tide (CARE), a conglomerate with gneiss boulders higher in the Stoer Group sequence can be seen in contact with the Lewisian Gneiss. **Consider the significance of this locality.**

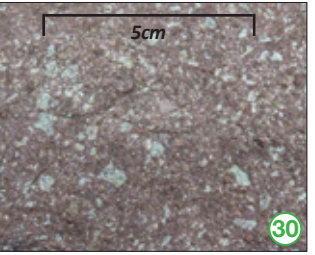
Continue around the headland and up the hill to three prominent glacial erratics perched on an ice-scoured gneiss slope close to the summit **28**. **Consider what they are made of and where they may have come from.** To the south-east are a cluster of 'whalebaks' (glacially-scoured knolls). Here, the Stoer Group conglomerate with metre-sized blocks of gneiss (an alluvial fan deposit) is banked against an ancient Lewisian Gneiss hillside (a palaeohill). The contact represents a classic 'buried landscape' unconformity. Continue north along the coast path to a track by an old shooting hut and follow it past three gneiss whalebacks **29** back uphill to the car-park.

Achiltibuie Shore 30-32

From the Community Hall car-park in Achiltibuie walk down the road past the Hotel to a track on the left that leads down to the Achiltibuie Garden. Follow it out to the coast through a gate and turn right along the cliff to an embayment in the coastline **30**.

Here, at low tide, a dark, red/brown breccia with cm-sized angular grey/green fragments can be seen on the foreshore surrounded by Lewisian Gneiss. This is the enigmatic 'Stac Fada' deposit, once thought of as a pyroclastic flow or volcanic mudflow. It is now widely regarded as the far-flung debris of a gigantic meteorite strike and the product of a hot (> 200°C), dense, ground-hugging flow that swept across the once barren landscape following impact around 1.2 billion years ago. The location of the impact site remains uncertain, although crater sites buried deep beneath younger rocks 50km to the east near Lairg and 25 km to the north-west in the Minch have both been suggested. **Imagine!**

The impact breccia occupies a hollow on top of the gneiss (another unconformity!) although the contact between the two rock-types is unclear in places and maybe faulted.



Impact Ejecta Breccia

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Polbain Hills 53-56

Park on the east side of Polbain and walk west to a turning area opposite a road junction. A sign marks the start of a hill path. Follow it to a saddle between Fairy Hill (left) **53** and Castle Hill (right) **54**. Massive crags of cross-bedded sandstone (Aultbea Formation) are seen *en route*, at the saddle and 200m to the south-east **55**. The rocks were formed by fast-flowing rivers. Contorted layers in the sandstones indicate sediment instability. Some resemble slump structures. Similar rocks occur on the foreshore below Polbain **56**.

The sandstone beds dip south-east, like most of the Torridon Group rocks in Coigach. Erosion of the gently dipping beds forms ridges and escarpments with steep north-west facing scarp slopes and gentle dip slopes. The character and beauty of the Summer Isles owes much to the existence of these features, stunning views of which can be seen from Castle Hill summit **54** and the Altandhu viewpoint **57**. Impressive views east from Fairy Hill **53** feature the low ground between Badentarbat Bay and Achnahaird Bay (position of the Coigach Fault) and the gently dipping till slopes west of Stac Pollaigh and Ben Mór Coigach formed below the Quaternary ice sheets.

From the saddle follow the marker posts south-east to a stone wall. For a shortcut back to



Sandstone (arkose), Aultbea Formation

Retrace your steps back along the coast and, passing the track back to Achiltibuie Garden, continue south above gneiss sea cliffs to a shingle bay where a boulder conglomerate (Diabaig Formation) is in contact with the gneiss **31, 32**. **Try to identify some of the boulders in the conglomerate.** Cross the bay and follow the track back uphill to the car-park.

Badenscallie - Acheninver 33-36
Park at Badenscallie burial ground and walk south around a small bay. Here **33**, blue/grey siltstones and mudstones (Diabaig Formation) with wave ripples and desiccation cracks are the deposits of a shallow sub-tropical lake. Above them are red cross-bedded sandstones introduced by rivers. Exceptionally well preserved organic-walled microfossils resembling bacteria and algae from this locality indicate that life was flourishing and considerably more diverse in Proterozoic lakes than previously thought. **Look carefully among the rocks for 'signs' of ancient life and admire the beautiful joint sets - fractures** caused by deformation of the rocks after they were deposited.



Joint Sets, Diabaig Formation

Polbain follow the wall down to the road. If continuing, follow the posts north-east around boggy ground to a track and turn right back to Polbain. Views over Achiltibuie open up to the south as you go and several hummocky Lewisian Gneiss inliers can be seen in the distance. **How many can you see?**

Badentarbat Shore 58-59

Park by the sea and walk south-east along the shore to a cliff **58** of grey Cambrian Quartzite (Eriboll Formation). In the foreshore, beds of the lower 'Basal Quartzite' unit with cross-bedding provide evidence of the ebb and flow of tidal currents. Cylindrical burrows probably formed by worms occur in the 'Pipe Rock' unit above. **Try to locate the boundary between these two units.** The rocks originally formed as quartz-rich sands in shallow shelf seas of the Iapetus Ocean which separated northern Scotland from southern Britain about 510 million years ago. The continuity of the quartzite beds is disrupted by fractures (joints and faults) and zones of broken rock (fault breccia). Continue across the rocky foreshore (CARE) which ends abruptly at a fault. Beyond it, the cliff is set back behind a shingle beach. Here **59**, the boundary referred to above re-appears and more fault breccia occurs, both in the cliff and in small pinnacles on the foreshore.

Together these features mark the presence of a shatter zone close to the Coigach Fault. The fault, which is unexposed, cuts across the foreshore by a dip in the cliff. Further on, by a stream, red sandstones and breccias of the much older Applecross Formation confirm that you have crossed over the fault. Inland, to the east, the quartzites typically occur on high ground above the Applecross Formation. Colossal earth movements along the line of the Coigach Fault brought the quartzites crashing down to what is now sea-level about 300-400 million years ago. **Imagine!**

Continue (c.150m) across the rocky foreshore (CARE) and through a gate at the foot of cliffs. Moving upslope bear right (south-east) and follow a fence (left) to avoid gullies in the sea-cliffs, the first of which marks a small fault. Continue along the coast over rough ground back down to the foreshore **34**. Here, below a thick sandstone, an erosional surface scoured out by a powerful river cuts down into the topmost beds of the Diabaig Formation. This is the Diabaig/Applecross formation boundary. Above it, cliffs of pebbly cross-bedded sandstone extend down across the foreshore.

Locate a grassy path and continue south to a stream that discharges across the shore. Close by, desiccation cracks and ripple marks reappear in the Applecross sequence **35**. For a shortcut back to Badenscallie, follow the path uphill by the stream to the road and turn left. Alternatively, cross the stream (there is a footbridge 100m upstream) and continue to the far side of the beach beyond. Scramble up a cliff (CARE) of pebbly cross-bedded sandstone **36** and on to a track that leads right to the Achduart road. Turn left uphill to a junction. Turn left back to Badenscallie and the road back down to the burial-ground.

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Achduart 37-42

From the car-park on the Achduart road, walk south towards Achduart. The route passes a glacially striated sandstone slab **37** and, south of Achnacarinan, glacial deposits (angular boulders set in sand) **38**, the debris left behind following the melting of the last ice sheet.

Later, erosion of the fault-shattered bedrock by water and ice produced the tract of low ground between Badentarbat Bay and Achnahaird Bay, a well-known bird migration route and a portage once used by travellers. The Coigach Fault has evidently had a profound influence on the landscape.

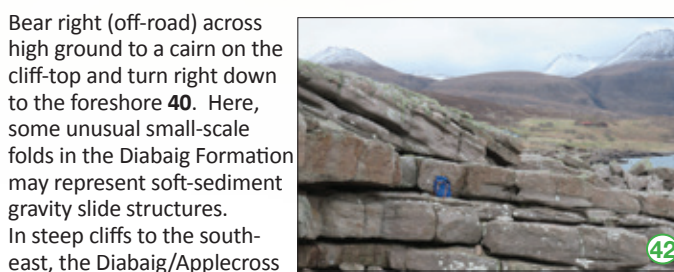
Return to the low point in the cliff and follow the path up to the road. **Consider as you go what might happen if the Coigach Fault became active again.** You are after all now walking very close to the fault line! Turn left along the road back to your start-point.

Rock Succession	
Quaternary	Recent Alluvium, peat & coastal deposits. Pleistocene 'Ice Age' deposits including glacial tills.
Cambrian	Unconformity
	Er Eriboll Formation (EF). Grey/white quartzites, cross-bedding common. Shallow shelf sea deposits. A lower 'Basal Quartzite' unit is superseded by the 'Pipe Rock' in which burrows are common.
Torridon Gp	Unconformity
	Au Aultbea (Au) and Applecross (Ap) formations. Red, cross-bedded sandstones, some pebbly (Ap). Ap Contorted layers common. Braided river deposits. Di Diabaig Formation (Di). Red conglomerates, sandstones and mudstones. Alluvial fan and lake deposits.
Mesoproterozoic	Unconformity
	MD Meall Dearg (MD), Bay of Stoer (BS) and Clachtoll (Cl) formations. Red conglomerates, sandstones, mudstones and rare limestones. Cross-bedding common. BS Debris fan, river, lake and dune deposits. Cl Stac Fada (SF) breccias - meteorite impact deposits.
Archaean	Unconformity
Lewisian Gneiss Complex	Mostly grey banded gneiss, locally folded. Associated with dark amphibolite. Formed deep in the Earth's crust, the roots of an ancient mountain belt. Later, igneous intrusions formed dolerite dykes, part of the Scourie Dyke complex.

Continue to a rise where a variety of subglacial erosion features including crescentic fractures occur on the smooth and locally polished surfaces of sandstone whalebacks **39**. **Try to identify these features and determine the direction of ice flow.**

Bear right (off-road) across high ground to a cairn on the cliff-top and turn right down to the foreshore **40**. Here, some unusual small-scale folds in the Diabaig Formation may represent soft-sediment gravity slide structures. In steep cliffs to the south-east, the Diabaig/Applecross formation boundary is exposed **41**, the same as that seen near Badenscallie **34**. A fault that defines the course of the stream south of Achnacarinan has displaced the south-eastward dipping rocks down to the north-west causing a repetition of the sequence.

Retrace your steps back to the cairn, continue along the cliff top (CARE) south to a headland **42** and turn east around the bay towards Achduart. The route passes fine sections of pebbly, cross-bedded sandstone formed by fast flowing braided rivers; typical Applecross Formation. Similar deposits occur at Altandhu **43**, Achnahaird **44** and Reiff. **Try to identify some of the pebbles and consider which way the rivers were flowing.** At Achduart, keeping to the left of trees and buildings, head inland back to the road. Turn left back to the car-park.



Cross-bedding, Applecross Formation

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The Coigach Geotrail

Drifting Continents, Early Life and Ice Age Landscapes



Introduction

Welcome to *Coigach*. This geotrail is designed to help visitors explore the region's rich geological heritage, its rocks of almost unimaginable age, its landscapes and their treasures; including some of the earliest life forms known on the planet. It should also help you to understand some of the cataclysmic events responsible for its formation through billions of years of Earth history.

The 74km (45 mile) trail highlights key areas of interest mostly along the Achiltibuie coastline but also on the approach road from Drumrunie. In view of its length, it is best completed in sections, walking from access points at, or close to, Reiff, Old Dornie,



Polbain, Badentarbat, Achiltibuie, Badenscallie, Acheninver, Achnahaird and Stac Pollaidh where limited car-parking is generally available.

Although most areas can be explored in half a day, a full day is recommended for the exploration of Enard Bay.

The walks follow a developing path network and unmarked routes over rough or boggy ground and sensitive croft land. Visitors are strongly advised to consult weather forecasts and tide timetables before setting out, wear suitable clothing and footwear, take an Ordnance Survey map and compass with you, inform others of your route and expected return time, avoid steep slopes, cliff faces and wet rock (especially on the foreshore), stay on the marked paths where indicated and keep dogs on a lead at all times. To make the most of the trail, visitors will find it useful to read the background information which follows.

Geology

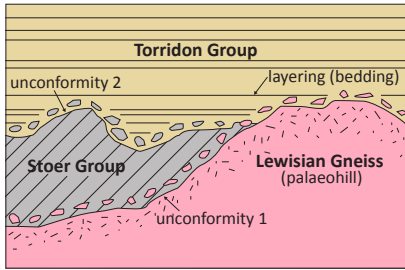
The rocks of Coigach provide a rich and diverse array of geological phenomena of exceptional quality, educational value and scientific importance. Together they provide an astonishing insight into the history and evolution of the Earth's crust and of Coigach's remarkable journey through time and across the planet, from the Archaean to the present day.

Coigach, together with the rest of northern Scotland, was once a part of the ancient continent of Laurentia, joined to North America and Greenland, and was separated from the rest of Britain for much of its 3 billion year history. The rocks of Coigach therefore have more in common with those in Greenland and Newfoundland, than they do with those of England and Wales. Scotland and England only merged

together some 420 million years ago, during the Caledonian mountain building episode. Only much later when the Atlantic Ocean opened some 55 million years ago did Scotland separate from Greenland and Newfoundland.

Coigach's bedrock units include the Lewisian Gneiss Complex (c. 3 billion years old), Torridonian Sandstone (Stoer and Torridon groups, c. 1.2 billion and 1.0 billion years old respectively) and Cambrian Quartzite (Eriboll Formation, c. 510 million years old). Each of these is separated by an 'unconformity'.

An unconformity is a rock surface that separates older rocks below from much younger rocks above. An unconformity thus represents 'missing time', a time for which, in a particular place, there is no geological record. In Coigach, the major unconformities represent 'time gaps' during which the older rocks were deformed, uplifted and eroded before the deposition of the younger ones on top. As a consequence, blocks of the older rock are often incorporated at the base of the younger series above.



Lewisian Gneiss

The Lewisian Gneiss Complex is an assemblage of highly deformed metamorphic rocks of Archaean age with a long and complex history. At around 3 billion years of age in Coigach, these are the oldest rocks in Britain. The dominant rock here is a light-coloured banded gneiss containing quartz (grey) feldspar (white) and pyroxene or amphibole (dark-coloured). The gneiss was formed by the metamorphism and intense deformation of an earlier formed granite-like igneous rock. These processes took place deep underground in the roots of an Archaean mountain belt, the result of collisions of the Earth's earliest crustal segments. In Coigach, the gneiss typically occurs in isolated outcrops or 'inliers' (outcrops completely surrounded by younger rock).



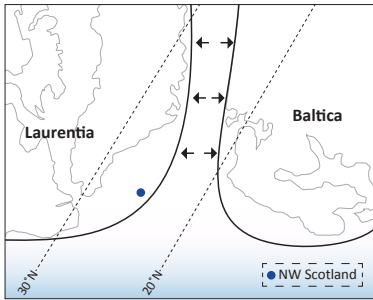
Fold in Lewisian Gneiss, Cnac Mor

Associated with the gneiss are dark bodies of metamorphosed igneous rock. These include layered amphibolites rich in hornblende (black) and garnet (red/brown). Although the origin of these rocks remains uncertain, some have suggested they represent oceanic crustal material mixed in with the early Earth's crust as it was developing. Later, fractures in the gneiss complex were intruded by magma (molten rock) forming dolerite dykes, part of the Scourie Dyke complex.

The Coigach Geotrail

Torridonian - Stoer Group

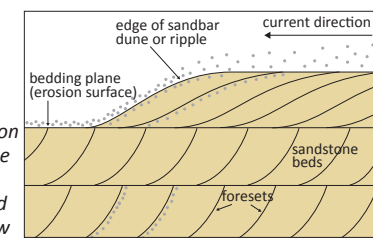
Erosion of the Archaean mountain belt during the Proterozoic eventually caused the Lewisian Gneiss to become exposed at the surface. Then, as the area subsided, the gneiss was buried under layers (beds) of sediment belonging to the Stoer Group. The erosion surface separating these two units represents a major unconformity. The Stoer Group formed in a rift valley 1.2 billion years ago when the area was located 20-30° north of the equator and part of Laurentia.



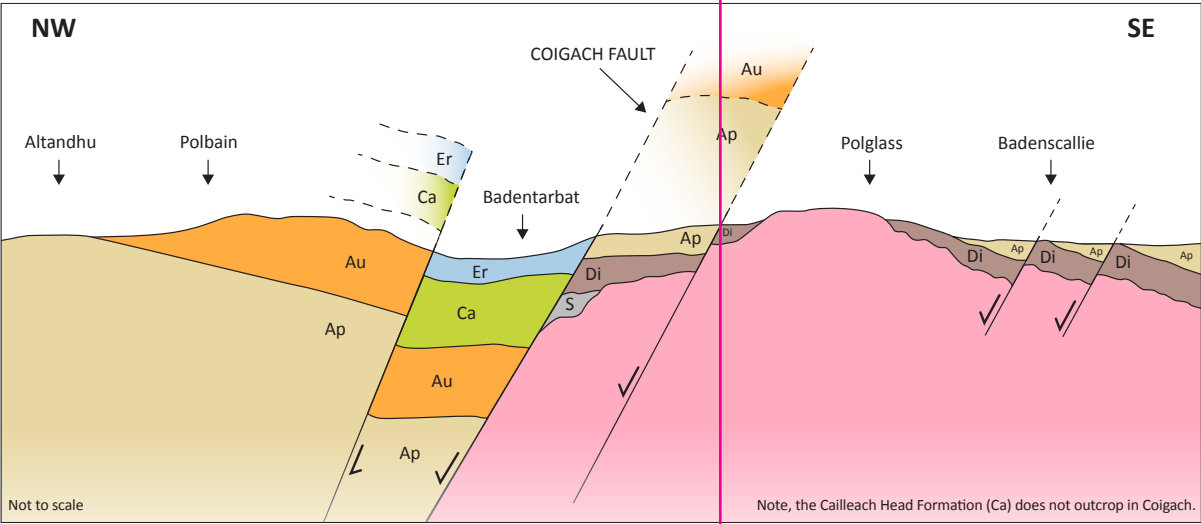
~1200 Ma, Stoer Group

Initially, conglomerates and sandstones formed in debris fans banked against Lewisian Gneiss hillsides and along the rift margins, while finer-grained sediments accumulated in temporary lakes on the valley floor. Braided rivers introduced sand, silt and mud across the region from the rift margins. Cross-bedding indicates that, at different times, the rivers flowed in different directions. In some places, sand dunes were formed by the wind.

Cross-bedding is a feature found in layered (bedded) sediments and sedimentary rocks. It consists of a series of sloping layers between the main, normally flat, bedding plane surfaces. It is formed by the deposition of sediment on the down-current side of dunes and ripples in either air or water. The sloping layers can be used to determine the direction of the flow of ancient rivers and winds.



Cross-bedding



Geological cross-section of the Achiltibuie region to show subsurface structure.

Quaternary - Ice Ages

The last 2.6 million years of Earth history, the 'Quaternary Period', has been characterised by dramatic oscillations in global climate. Within the mid-latitudes, these oscillations from cold glacials to warm interglacials have resulted in the expansion and contraction of glaciers and ice sheets. During the Last Glacial Maximum, 18-22 thousand years ago, the landscape was covered by an ice sheet thick enough to cover all but the highest summits. As recently as 10-11 thousand years ago, a shorter cold period known as the Loch Lomond Stadial resulted in the formation of smaller glaciers within the high mountains. These different phases of glaciation have played a key role in the formation of Coigach's



Whalebacks, Rubha Dunan

scales. At the large scale, glaciation by successive ice sheets has eroded substantial volumes of material to leave the mountains of Coigach standing as isolated massifs (notable examples of which include Stac Pollaidh and Ben More Coigach). The presence of frost-shattered rocks on their summits suggests that, at certain times, some of the more elevated peaks stood proud of the most recent ice sheet as nunataks. Widespread scouring of the intervening lowlands has created an undulating surface characterised by smooth whalebacks. At the smallest scale, bedrock surfaces often display striations and crescent-shaped

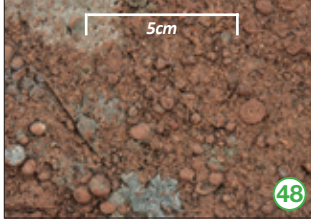


Glacial Striations, Acheninver



Fountain Glacier, Bylot Island, Canada © R Waller

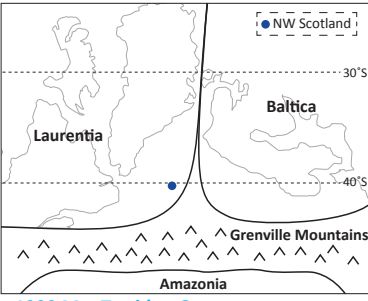
Desiccation cracks and wave ripples in the lake sediments indicate deposition in shallow water. Primitive photosynthesizing microbes released increasing amounts of oxygen into the atmosphere which combined with iron in the sediments making them red. Rare limestones formed on the lake shorelines contain fine layers interpreted by some as 'stromatolites' (microbial structures), possibly the oldest life form known in Europe. Also present is the enigmatic 'Stac Fada' deposit; a muddy breccia containing dark angular fragments and pea-shaped pellets (lapilli), once thought to be a volcanic deposit and now interpreted as a meteorite impact ejecta layer!



Accretionary Lapilli

Torridonian - Torridon Group

Between 1.2 and 1.0 billion years ago Laurentia and Baltica (Scandinavia) collided with Amazonia (South America), a collision that gave rise to the Grenville mountain belt and the birth of a new supercontinent - Rodinia! In Coigach, a consequence of this 'orogeny' (mountain building episode) was the uplift and erosion of the Lewisian Gneiss and Stoer Group rocks; the latter tilted westwards by movements along the line of the Coigach Fault at this time. Then around 1.0 billion years ago, these older rocks were buried unconformably beneath a thick pile of sediments belonging to the Torridon Group. By this time Coigach (now part of Rodinia) had drifted to 35-45° south of the equator. The unconformity separating Torridon Group from the Stoer Group represents a 200 million year time gap during which the Grenville Orogeny took place. Although previously thought to have been deposited in a rift valley, it is now thought that the Torridon Group



~1000 Ma, Torridon Group



Unconformity, Enard Bay



Ripple Marks, Acheninver

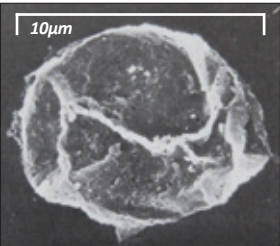
Cross bedding and pebble types provide clues as to the flow direction and source of the rivers.

Contorted beds provide evidence of the disturbance of wet sediment after it was deposited. These were most likely formed during flood-induced liquefaction events or earthquake activity. At this time, there was no vegetation on land, so mountain slopes were barren and flash floods, laden with sediment, were common. These dumped large amounts of sand on top of sodden, saturated sand. Such sediments could have turned into quicksand in which contorted layers would be expected.



Contorted Beds, Reiff

Rare grey shales also occur at different levels in the sequence. These too were deposited in lakes. Some contain exceptionally well preserved organic-walled microfossils, evidence of some of the most primitive terrestrial life forms known in Britain.



1 Ga microbe, Tanera Beg © Pol Ass

People and Places

Although Coigach has almost certainly been settled for many thousands of years the earliest remaining evidence is from Bronze Age round houses (c. 3200 years ago). More substantial are the remains of an Iron Age brooch (c. 2000 years ago) below Polglass which would originally have stood about 10 metres high although it was robbed of stone in the 19th century to build the adjacent houses.



The coastal strip of arable land is divided into crofts of about 3 to 5 acres. Everything grown here would have been used locally including potatoes, other vegetables, oats and hay. Many households would also have kept a cow for milk, butter and cheese. Today the land is mainly grazed by sheep.



Fishing has always played an important role in Coigach life with herring in particular being a staple of the diet well into the 20th century while local salmon and lobsters were sent by train to Billingsgate. Some salmon

booths, where coastal fisherman lived during the summer season, still exist in Coigach. Today the top quality shellfish landed by local boats is exported live to the continent by road and air. The very best however is reserved for the local market.

Conservation plays an important role in present day land management and a number of organisations now work to assist local communities managing and protecting the environment and supporting local development for a sustainable future. The wind turbine above Acheninver was built and is wholly owned by the community and is an example of community investment in that future.

Tourism is also a vital part of today's economy in Coigach and the area is renowned for its diverse landscape, wildlife and the coastal views of mountains, sea and islands which are exceptional.

Today Coigach continues to inspire writers, artists, photographers and musicians as it has in the past and many call it home.



A project managed by Peter Drake and Patrick Cossey on behalf of the Achiltibuie Tourist Association in collaboration with the North West Highlands Geopark and the British Geological Survey, with financial support from the Coigach and Assynt Living Landscape Partnership (Community Grants Scheme), the Heritage Lottery Fund, Scottish Natural Heritage, the Geologists' Association (Curry Fund), the Highland Council, the Coigach Community Council and the Coigach Community Development Company. Text and photos by P Cossey, R Waller and P Drake. Editing by P Harrison and M Krabbendam. Design by Hammond Gosschalk.

The Achiltibuie Tourist Association gratefully acknowledges the support of:

- Coigach and Assynt Living Landscape Partnership
- Heritage Lottery Fund
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- Geologists' Association
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For more information contact: Visit Coigach www.visitcoigach.com (Free Downloads, Glossary, GPS Files) North West Highlands Geopark www.nwhgeopark.com (Online Sales)

Recommended reading: British Geological Survey, 2004. Exploring the landscape of Assynt. A walker's guide and map of Assynt & Inverpolly.

Goodenough, K.M. & Krabbendam, M. 2011. A Geological Excursion Guide to the North-West Highlands of Scotland, British Geological Survey.

Follow the Scottish Outdoor Access Code and please do not hammer the rock surfaces. Be safe, plan ahead and follow any signs; leave gates and property as you find them; don't park in gateways, driveways or on the road; protect plants and animals and take your litter home. Keep dogs under control (on a lead) and consider other people.

Cover photograph: Rubha Dunan shoreline

