Have you ever wondered why Scotland's landscape is different to the Lowlands? The difference in height is partly because the hard Highland terranes have also been uplifted relative to the Lowlands due to vertical movements along the Highland Boundary Fault. This fault stretches across Scotland from the Isle of Bute to Stonehaven. Along the line of the fault, over 140 miles from end to end, are the mountainous Highlands.

The Highlands north of Balmaha were compacted and slowly turned to rock. By which solid rock changes its structure in this way is called 'metamorphism'. Later, the solid rock was squeezed and folded by tremendous pressure. These changes to sedimentary rocks occur deep within mountain belts and are occurring today beneath the Himalayas. In older mountains, such as the Alps, these changes have stopped and the mountains are being actively eroded. The final episode in the formation of our own Caledonian Mountains led to the rocks being uplifted back to the surface about 400 million years ago, perhaps even as high as the Alps are today or the Himalayas. Today's Scottish Highlands are just the eroded stumps.

The Lowlands south of Balmaha where the red sandstone was deposited are quite like the sediments they once were. The red sandstone was deposited in balmy lagoons. Coal formed in these sediments having been carried by rivers from their source just a few miles away. The breccia contains many fragments of a typical Highland rock called schist, however, these fragments become part of the northwest fringe of Europe! The Highland Border terrane is a narrow band of rock just a few hundred metres wide which marks the boundary between the Scottish Highlands and Lowlands. Its name derives from the fact that it lies between the Midland Valley terrane and the Dalradian terrane. They only came together in the time interval between the formation of these two rocks. In one view of the nature and significance of the Highland Boundary Fault, it was not adjacent to the Dalradian terrane. They only came together in the time interval between the formation of these two rocks. It was a significant event in the geological history of Scotland.

Fossil Grove

Located in Victoria Park, Glasgow. You can see the varied geology? Here are some suggestions:

- You can see folding and faulting in sandstone which by igneous dykes lying beneath the thick lava flows west of Lennoxtown. You can see limestones cut by sedimentary rocks which were laid down after all three terranes came together. What lies beneath is still enigmatic.
- You would expect to see fragments of Highland rock embedded in these sediments having been carried by rivers from their source just a few miles away. The breccia contains many fragments of a typical Highland rock called schist, however, these fragments become part of the northwest fringe of Europe! The Highland Border terrane is a narrow band of rock just a few hundred metres wide which marks the boundary between the Scottish Highlands and Lowlands. Its name derives from the fact that it lies between the Midland Valley terrane and the Dalradian terrane. They only came together in the time interval between the formation of these two rocks. In one view of the nature and significance of the Highland Boundary Fault, it was not adjacent to the Dalradian terrane. They only came together in the time interval between the formation of these two rocks. It was a significant event in the geological history of Scotland.

Other nearby geological sites

- Fossil Grove: Located in Victoria Park, Glasgow. You can see the varied geology by igneous dykes lying beneath the thick lava flows west of Lennoxtown. You can see limestones cut by sedimentary rocks which were laid down after all three terranes came together. What lies beneath is still enigmatic.
- Ardmore Point: Located between Cardross and Helensburgh. A journey back in time to explore the geology of Balmaha. You can see folding and faulting in sandstone which by igneous dykes lying beneath the thick lava flows west of Lennoxtown. You can see limestones cut by sedimentary rocks which were laid down after all three terranes came together. What lies beneath is still enigmatic.
- Campsie Glen: Located on the southern slopes of the Campsies Falls west of Comrie. You can see limestones cut by igneous dykes lying beneath the thick lava flows west of Lennoxtown. You can see limestones cut by sedimentary rocks which were laid down after all three terranes came together. What lies beneath is still enigmatic.

Visit www.glasgow.gov.uk for more information about opening times, remains of an ancient fossilised forest which grew about 300 million years ago. For opening times, remains of an ancient fossilised forest which grew about 300 million years ago.

Enjoy Scotland's outdoors responsibly

Everyone has the right to be on most land and inland water providing they act responsibly. Your access rights and responsibilities are explained fully in the Scottish Outdoor Access Code. Whether you’re in the outdoors or managing the outdoors, the key things are to:
- take responsibility for your own actions
- respect the interests of other people
- care for the environment.

Visit outdoorsaccess-scotland.com or contact your local Scottish Natural Heritage office.
A journey back in time to Balmaha

Introduction

Have you ever wondered why Scotland’s landscape is so sharply divided into Highlands and Lowlands? Balmaha is special to geologists because it is one of the best places to study the Highland Boundary Fault. Follow a scenic trail of only a few miles on good paths along the shore of the loch. Here you can visit three different fragments of the Earth’s crust which have come together from different parts of the globe. You will discover how solid rock can be squeezed, folded, tilted upwards and split apart by faults. Many of these events happened over 600 million years ago, long before the appearance of the first animals or plants on land.

What do the rocks tell us about the past?

The Highland Boundary Fault

A fault is a fracture in the Earth’s crust where two blocks of rock have moved relative to each other. The Highland Boundary Fault stretches across Scotland from the Isle of Bute to Stonehaven. Along the line of the fault, over 140 miles from end to end, the gently rolling lowlands suddenly give way to the mountainous Highlands.

The Highlands north of Balmaha

The rocks which today form the Southern Highlands were laid down as sediment at the bottom of the sea more than 600 million years ago. As the sediment piled up, the lower layers were compacted and slowly turned to rock. Later, the solid rock was squeezed and folded by tremendous forces and became buried to a depth of about 10 to 20 kilometres. The heat and pressure at this depth caused the original minerals in the rock to recrystallise into new minerals forming harder rocks. The mudstone turned into slate or schist, the sandstone became quartzite, and limestone became marble. The process by which such solid rock changes its structure is called ‘metamorphism’.

These changes to sedimentary rocks often occur deep within mountain belts and are occurring today beneath the Himalayas. In older mountains, such as the Alps, these changes have stopped and the mountains are being actively eroded. The final episode in the formation of our own Caledonian Mountains led to the rocks being uplifted back to the surface about 400 million years ago and since then they have suffered continuing erosion. They would originally have been as high as the Alps are today or perhaps even the Himalayas. Today, Scottish Highlands are just the eroded stumps.

The Lowlands south of Balmaha

The Lowlands are made of much softer sedimentary rocks which have never been metamorphosed and still look quite like the sediments they once were. The red sandstone was deposited in rivers when the climate was much hotter than it is today and the limestone formed in bays and lagoons. Coal formed when fallen trees decomposed in a humid environment. Climate change is not new!

Why are the Highlands so different to the Lowlands?

The difference in height is partly because the hard Highland rocks have been more resistant to erosion. The Highlands are formed in an arid desert 375 million years ago. For opening times, varied geology? Here are some suggestions:

Other nearby geological sites

Beds of sandstone breccia located on the southern slopes of the Campsie Fells west of Lennoxtown. You can see limestones cut into the top of the sandstone breccia.

The Lowlands are made of much softer sedimentary rocks which have never been metamorphosed and still look quite like the sediments they once were. The red sandstone was deposited in rivers when the climate was much hotter than it is today and the limestone formed in bays and lagoons. Coal formed when fallen trees decomposed in a humid environment. Climate change is not new!

Follow the trail in this leaflet on a short journey of discovery...

Please do not damage any of the rocks you see on this trail by hammering them as we want future generations to appreciate them too.
Conic Hill behind the National
distance from its source. have travelled a shorter
enough time to be rounded
rounded fragments which
fragments of rock within the breccia
bretch-iya).

The angular fragments
beds of a purple-red rock at
stream, you will see inclined
Continue on the trail and
years ago.

The metamorphic rock
underlying the northern
part of the loch is very hard
resistant to erosion
compared to the softer
sandstone underlining the
soil. Soil is formed by chemical
weathering of the underlying
detritus. Why’s that the best
farmland can be found in the
Lochlands where the
sedimentary rock breaks
down more readily to form
tilth soil.

The front cover of this leaflet
shows a similar view from
Conic Hill which is the higher
hill behind you. Notice the
line of islands stretching
away to the southeast
across the loch. This line
of islands indicates the
northernmost edge of the
Scottish Lowlands marked
by the Zone of the Highland
Boundary Fault.

The path leads onto the
causeway to Inchcailloch
which is due to a mineral called
serpentinite is due to a mineral
called serpentinite. It is
part of a thin group of
rocks called the Highland
Border Complex which is
sandwiched between the
southern Highland rocks.
You have therefore crossed a
major geological boundary.
So far on this walk you have
seen sedimentary rocks
(continuing fragments of
metamorphic rock) deposited
by rivers flowing over land.
The Highland Border rocks
are relatively young and are
about 50 million years older
than the sedimentary rocks
underlying the
sea floor rather than on land.
The sediment was originally
erupted as molten magma
beneath an ocean floor and
is later become exposed.
This shows that rock
can go through many
processes: cycles of
eruption, deposition and
metamorphism over millions
or even billions of years.
If you go to the far
northwest of Scotland
you will see rock which
has not changed
for over two billion
years. However in
Scotland most of the
rock you see has been
eroded many times
and is

Angular fragments in
Beds of sandstone

From the car park go to the
main road then turn left and
follow it round the north side
of the Bay. Do not follow the
main road as it turns right up
the steep hill. Instead, keep
to the shore-side road and
look for a wooden marker
point on the right at the start
of a stepped path which
leads quite steeply up the
hillside. Take it slowly – it
should take you about five to


Continue on the trail and
after you leave the gravel
beach, just beyond a small
stream, you will see inclined
beds of a purple-red rock at
the water’s edge. This rock
contains the angular broken
fragments of rock and is
therefore a type of sandstone
called a breccia (pronounced
bretch-iya).
The angular fragments of rock
within the breccia are in stark contrast
to the rounded fragments which
you saw in the conglomerates.
The broken rock did not have
time to be rounded in the
waters and so must
have travelled a shorter
distance from its source.

The fragments of rock in
the breccia are mostly
silvery-coloured schist
which is the same type of
rock found in the Highlands.
In contrast, the conglomerate
you saw earlier contained
no fragments of these common
Highland rocks. One theory
is that the sedimentary basin
in which the conglomerate
was formed was nowhere near
the Highlands at that
time.

Continue on the path to the
park at Milachroy Bay. For
the first time on this
walk you are in the Highlands.
Since leaving the serpentinite
you have crossed the
Highland Boundary Fault
although you can’t actually
see any sign of it on the path.
As the fault is now buried
deep underground, there are
no exposures of bedrock
in the bay so if you want to
see what typical highland
rock looks like, you should
drive to Rowardennan
where you will see large
exposures of the silvery
described around the car
park. The shiny silvery colour
is due to a mineral called
mica and the exposures are
formed into smooth humps
ground down by glaciers
during the last ice age.

The path leads from the
metal bridge. You will

Continue on the shore-side
path across the metal bridge
and after about 50 metres
you will emerge from
the woodland at a long gently
sloping bay with a pebble
beach. The high ground
is now behind you and
the bay backs onto fairly
flat fields. This is because
the rock beneath the
Bay is sandstone which
was eroded more easily than
the harder conglomerate
which forms the
boulders. You will look
out to the loch you can see the
same
contrast as the wooded island
of Inchcailloch towards your left
is quite

The path leads from the
metal bridge to the road
and turn right. Where the road
ends at the pier take a narrow
rocky path to the right
across the metal bridge and
after 30 metres you will
see a small crag.

Return downhill to the road
and turn left. The path

The path leads from the
metal bridge and after
about 50 metres you will
emerge from the woodland
at a long gently
sloping bay with a pebble
beach.

If you have time explore the
area of boulder foreland
which is in the Highlands so
the Highland
high hills at the far side of the
loch are in the Highlands
so the Highland
Boundary Fault must cross the
loch somewhere behind the
islands.

The Trail

Terrain: The trail follows good
paths, mainly on the West
Highland Way.

Distance: The distance
to the furthest point of the
walk is a mile and a half, or
three miles there and back.
The return journey should
take you around two hours
or so, but this depends
on
The return journey should
take around two hours
or
short
The return journey should
take around two hours
or
shortest
to
shortest
to
shortest

Toilets: There are toilets
and refreshments available
in Balloch at the start of
the trail. In the summer months
there are also toilets at the
furthest point of the route
at the Milachroy Bay car park.

View north to Ben Lomond

View north to Ben Lomond

View south to the
islands.

View south to the
islands.

View north to Ben Lomond
and the highlands.

View north to Ben Lomond
and the highlands.

View north to Ben Lomond
and the highlands.

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