Orkney and Shetland: A Landscape Fashioned by Geology

Orkney and Shetland are the most northerly British remnants of a mountain range that once soared to Himalayan heights. These Caledonian mountains were formed when continents collided around 420 million years old.

Whilst the bulk of the land comprising the Orkney Islands is relatively low-lying, there are spectacular coastlines to enjoy; the highlight of which is the magnificent 137m high Old Man of Hoy. Many of the coastal cliffs are carved in vivid red sandstones – the Old Red Sandstone. The material is also widely used as a building stone and has shaped the character of the islands’ many settlements. The 12th Century St. Magnus Cathedral is a particularly fine example of how this local stone has been used.

Shetland is built largely from the eroded stumps of the Caledonian Mountains. This ancient basement is pock-marked with granites and related rocks that were generated as the continents collided. The islands of the Shetland archipelago are also fringed by spectacular coastal features, such as rock arches, plunging cliffs and unspoilt beaches. The geology of Muckle Flugga and the Holes of Scraada are amongst the delights geologists and tourists alike can enjoy.

About the author
Alan McKirdy has worked in conservation for over thirty years. He has played a variety of roles during that period; latterly as Head of Information Management at SNH. Alan has edited the Landscape Fashioned by Geology series since its inception and anticipates the completion of this 20 title series shortly. He has written books or book chapters on the geology of Scotland, environmental geology, engineering geology, mineral resource management, geology and landscapes, geo-tourism, geo-conservation, the Enlightenment figure, Dr. James Hutton and books for children that introduce younger readers to the rocks, fossils and the landscapes of Scotland.
Orkney and Shetland
A Landscape Fashioned by Geology
Scottish Natural Heritage
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All of nature for all of Scotland
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Broch of Mousa, Shetland.
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by
Alan McKirdy
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1 The Holes of Scraada, a partly roofed cleft, where the sea extends 300 metres inland from the cliff line, Esha Ness, Shetland.
Introduction

These northerly outposts of Scotland, best known for their wildlife, hospitality and historic remains, also hold a fascination for the geologist. Reading the buckled and fractured rocks of Shetland tells of colliding continents and a history dating back almost 3,000 million years. By contrast, the distinctive red sandstones of Orkney were formed in more recent geological times, laid down in a long-disappeared freshwater lake. These strata hold the fossilised remains of bizarre early life forms that are now long extinct. Between about 2.6 million and 11,500 years ago, these islands, along with much of the northern hemisphere, were held in an icy thrall, known as the Ice Age, and it was these most recent events that helped to shape the landscape we see today.

Further modification of the landscape continues to this day, as the roaring Atlantic breakers incessantly pound the coastline. Wind and rain have also played their part; as has the hand of Man, who has occupied this ancient place for over three millennia.

In this booklet, we also trace the changing environments to which the land that was to become Scotland was subjected as it drifted northwards from a position close to the South Pole to its present location. On this epic journey, this chunk of the Earth’s crust has travelled through all the Earth’s climatic zones and each has left its mark. All these environments are recorded faithfully, albeit incompletely and sometimes enigmatically, in the record of the rocks.

1 Looking across from Stoura Pund to Hillswick; granite cliffs on left, with lower coastline in distance carved from Dalradian metamorphic rocks.
# Orkney and Shetland through time

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Geologic Events</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>QUATERNARY</strong></td>
<td>7,900 years ago. A tsunami temporarily submerged part of the Shetland Islands. 11,500 to the present day. The ice re-advanced briefly and then the climate warmed abruptly and the glaciers melted for the last time. Sea level around the islands gradually rose. Coastal landforms, such as the Old Man of Hoy and the linear beach linking St Ninian’s Isle to the Mainland were formed during these recent times. 12,500 to 11,500 years ago. The climate was very cold again with freeze-thaw processes affecting the landscape. 14,700 years ago. The climate warmed rapidly with summer temperatures like those of today and the ice sheets temporarily melted away. 18,000 years ago. Shetland was entirely engulfed by ice at this time. By contrast, Orkney was entirely ice-free 18,000 years ago. Before 29,000 years ago. There were prolonged cold glacial periods, separated by shorter, warmer interludes.</td>
</tr>
<tr>
<td><strong>NEOGENE</strong></td>
<td>The area basked in warm, temperate conditions, but the temperature gradually dropped at about 2.6 million years ago when the Ice Age started.</td>
</tr>
<tr>
<td><strong>PALAEOGENE</strong></td>
<td>Around 60 million years ago, the western seaboard of Scotland was pock-marked with erupting volcanoes, as Europe drifted away from North America. The Atlantic Ocean widened rapidly during this period.</td>
</tr>
<tr>
<td><strong>CRETACEOUS</strong></td>
<td>Warm, shallow seas covered most of Scotland, including the Orkney and Shetland islands.</td>
</tr>
<tr>
<td><strong>JURASSIC</strong></td>
<td>Great thicknesses of sediment accumulated in the Viking Graben structure – a huge gash on the floor of the North Sea. These sediments were oil-bearing and many millions of years later, proved to be the basis of a very lucrative oil and gas industry.</td>
</tr>
<tr>
<td><strong>TRIASSIC</strong></td>
<td>Orkney and Shetland formed a small part of the Pangaea super-continent.</td>
</tr>
<tr>
<td><strong>PERMIAN</strong></td>
<td>Scotland sat at around 10 degrees north of the Equator and desert conditions were dominant across the area.</td>
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<tr>
<td><strong>CARBONIFEROUS</strong></td>
<td>Huge movements took place on some of the major faults that sliced through Shetland – on the Walls Boundary Fault particularly.</td>
</tr>
<tr>
<td><strong>DEVONIAN</strong></td>
<td>Orkney is predominantly built of rocks from this period. They accumulated as sediments at the bottom of the long-disappeared Lake Orcadie. Later sediments were wind-blown and built up as desert sand-dunes beside the lake. There are occasional lava flows in Orkney of this age and more extensive areas of igneous rock on Shetland in the form of granite intrusions and lava flow.</td>
</tr>
<tr>
<td><strong>SILURIAN</strong></td>
<td>The ocean floor and mantle rocks of Unst thrust up from the deep.</td>
</tr>
<tr>
<td><strong>ORDOVICIAN</strong></td>
<td>The ocean in which the Dalradian strata of Mainland were deposited closes and mountains begin to form.</td>
</tr>
<tr>
<td><strong>CAMBRIAN</strong></td>
<td>The basement rocks of PreCambrian age lay within a major continental landmass. No rocks of this age preserved in either Orkney or Shetland.</td>
</tr>
<tr>
<td><strong>PRECAMBRIAN</strong></td>
<td>Much of the Shetland bedrock, but none of Orkney, is built from rocks of this age. These rocks are of a variety of ages and composition, described as Lewisian, Moine and Dalradian in affinities. The period of their formation spans much of the age of the Earth from almost three billion years.</td>
</tr>
</tbody>
</table>

Brown bars indicate periods of time represented by the rocks and loose sediments of Orkney and Shetland.
Main geological divisions of Orkney and Shetland (Quaternary deposits not shown).
Setting the scene

The island groups of Orkney and Shetland are the northernmost British remnants of a range of mountains that, at one time, rose to Himalayan heights. These uplands were created as continents collided, driven by forces deep within the Earth. Today, what remains of these Caledonian Mountains stretch across two continents. It is an extraordinary story, and Orkney and Shetland were at the heart of it all.

Over most of Shetland, the rocks we see were formed in the roots of these mountains, now exposed by erosion. By contrast, over nearly all of Orkney, these roots are covered by sedimentary rocks laid down during the Devonian era around 400 million years ago. Similar strata are also found in south-eastern and western Shetland. At this time, and for some time afterwards, Shetland was disrupted by movements on a number of large faults that sliced the bedrock into a patchwork.

Layer upon layer of sediments have been laid down in basins that developed around Orkney and Shetland from Permian times to the present day. In more recent times, the islands may well have been completely submerged by the sea on more than one occasion. Uplift of the land through earth movements resulted in any sedimentary rocks younger than 400 million years being eroded from the area.

The effects of glaciation during the last 2.6 million years are more marked in Shetland than in Orkney. Lowering of sea level during several glaciations enabled the ice to gouge out valleys to well below present sea level. After the glaciations, water from the melting continental ice caps raised sea level to flood these valleys, creating the voes so characteristic of Shetland. Sand barriers, formed by sediments carried along the coastline, developed across some of the voes and sounds off the coast of Shetland.

Looking towards Eynhallow from Evie, Mainland Orkney.
Ancient rocks

The oldest rocks in Shetland are the Lewisian gneisses (pronounced *nices*) – rocks forged deep within the Earth. They are part of the original crust of the ancient continent of Laurentia, of which Scotland was formerly part. These rocks are of unimaginable antiquity, probably formed between about 3,000 and 1,500 million years ago. They are amongst the oldest rocks to be found anywhere on Planet Earth.

The Lewisian rocks we can now see at the surface were buried deep in the Earth’s crust for much of their history. At several times between 2,900 and 1,700 million years ago, they were folded and recrystallised at high temperatures and pressures – a process known as metamorphism. They are coarsely-layered rocks made up of pale-coloured granite layers and darker layers.

Related rocks, derived from ancient muds, limestones and volcanic lava flows are best seen on Foula and the southern side of St Magnus Bay on Shetland. They were intensely folded and metamorphosed some 1,200 to 1,000 million years ago and again when the Caledonian Mountains were formed in more recent times.

Moine rocks, forming most of Yell and nearby parts of Mainland Shetland, originated as sandy sediments laid down by rivers and flash floods on the Laurentian continent around 1,000 to 800 million years ago. As a result of the folding and metamorphism associated with the development of the Caledonian Mountains, the sandy sediments were converted to tough, coarsely layered gneisses and mica schists. They are rich in quartz and feldspar and contain veins and pods of granite.

The largest group of metamorphic rocks described from Shetland is the Dalradian, formed from sediments laid down at the edges of an ancient ocean some 700 to 600 million years ago. They occur on Mainland, Unst and Fetlar and total about 12 km in thickness. Similar rocks form much of the Grampian Highlands of mainland Scotland. The contact between the Moine and Dalradian is defined by a fault or crack in the Earth’s crust and marked by the distinctive and spectacular Valayre Gneiss.

The Middle Dalradian contains several thick metamorphosed limestones, now picked out by a series of valleys.

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1 Dalradian limestone, Weisdale.
Remains of an ancient ocean floor

Parts of Unst and Fetlar are built from material that is dense and dark in colour, comprised mainly of peridotite and gabbro. These rocks are made from minerals with a high iron and magnesium content. They represent fragments of the crust and mantle underlying an ancient and long-disappeared ocean – the Iapetus Ocean.

Laurentia, of which Scotland was a part, had been separated from what we now recognise as the rest of Britain by a stretch of water – the Iapetus Ocean – that was wider than the present North Atlantic. The continents are continually moving in response to currents within the Earth’s mantle and head-on collisions between continents are inevitable. The geological record is littered with the consequences of these cataclysmic events. We see clear evidence for just such an occurrence in the bedrock of Shetland. As three continents collided during a period of continental re-arrangement, the Caledonian Mountains were formed. During this event, ocean floor rocks were thrust westwards onto the edge of the Laurentia.

Keen of Hamar on Unst is of huge significance to the geologist. The bedrock underlying this part of the island is a slice through the Earth’s crust and upper mantle from beneath an ancient ocean. As continents collided over 420 million years ago, a section of the rock flooring the ancient ocean was thrust, by way of a low-angle fault, to a position closer to the Earth’s surface. Erosion has subsequently planed off the overlying strata to expose these previously deeply buried rocks at the surface. The rocks we see here represent the uninterrupted passage from the top kilometre of the Earth’s upper mantle to the lower reaches of the crust.

The unique flora of this part of Unst is directly related to the chemical make-up of the rocks and soils that supports them. Many of the plants that grow here are national rarities. The soils are deficient in calcium, phosphorous, nitrogen and potassium, but contain high levels of the heavy metals such as chromium, magnesium and nickel. Sea plantain, scurvy grass, stone-bramble, northern rock-cress and Norwegian sandwort are amongst the plants that thrive in this unusual environment. But the star attraction is Edmondston’s chickweed – a plant that grows here and nowhere else in the world.

1  Edmondston’s chickweed – a national rarity that thrives in the soils with an unusual chemical composition.

2  View across the serpentine rocks near Haroldswick, Unst.
Granite and gabbros

Large volumes of magma were injected into the ancient metamorphic sequence of folded, buckled and faulted Moine and Dalradian rocks. These additions of molten rock took place over many millions of years and all were related to the closure of the Iapetus Ocean.

In Shetland, granites east of the Walls Boundary Fault were punched into their present position before the local Devonian rocks were deposited, but those west of the Fault are younger than the sedimentary strata. These observations indicate the granites and related rocks were intruded over a protracted period. From this molten state, the magma cooled to form igneous rocks of different types. Granites predominate, although some rocks of rather more basic composition, such as gabbros, were also created.

The main bodies of intrusive rocks east of the Walls Boundary Fault are the Brae, Graven and Spiggie Complexes. Each consists of several different rock types, though granite is most commonly found.

The Sandsting and Northmaven Complexes occur over large areas west of the Walls Boundary Fault. The Sandsting Complex in the southern part of the Walls Peninsula was introduced as several sheet-like bodies of molten rock, which metamorphosed, or ‘cooked’, the Devonian sedimentary rocks for up to 1.5 kilometres from contact. The Northmaven Complex consists largely of granite, some parts of which have a special texture with tiny cavities that indicates intrusion at shallow depths in the Earth’s crust.

The Skaw Granite in north-east Unst is intensely sheared, and was transported to its present position along a thrust fault.

Granite underlies the highest point in Shetland – the summit of Ronas Hill. Spectacular cliffs have been carved into this granite west of Hillswick at Heads of Grocken. The other granites do not form significant landscape features but are generally more resistant to erosion than the enclosing metamorphic rocks. Soils on the granites are thin, acidic and poorly vegetated.

Granite, enclosing patches of metamorphic rocks, appears in Orkney in and around Stromness, on Graemsay and near Yesnaby. These form a ‘basement’ on which the local Devonian rocks were deposited.

1 Skaw Granite, showing large pink feldspar crystals, Skaw, Unst.
The Earth continues to move

After the Caledonian Mountains were formed, the new landmass remained an unstable place for many millions of years to come. Many fault systems remained active, sending shockwaves across the Devonian landscapes with every movement along their length. The principal dislocation is the Walls Boundary Fault, which is the northern extension of the Great Glen Fault on mainland Scotland. There are also a number of important splays, or offshoots, from the main fault.

In Shetland, the metamorphic rocks either side of the Walls Boundary Fault are quite different in character. They were brought into their present juxtaposition by movements along the fault. Together with the granites and the Devonian sedimentary rocks, they have been shattered and weakened for several hundred metres on either side of the fault. Erosion by rivers and glaciers has exploited this belt of weakened rocks, so many of the voes now follow this grain of the landscape. Movements responsible for this shattering probably occurred throughout Devonian and into Carboniferous times; the western block possibly moving some 170 km south in relation to the eastern block. Later movement, during Jurassic times, caused a displacement of some 65 kilometres in the opposite direction.

At the same time, significant movement took place along the Nesting Fault. This is another major dislocation, that sliced Shetland in two. It runs from the southern tip of Shetland to the west coast of Yell.

1 The Devonian strata at Whitaloo Point on Orkney Mainland were folded by continuing movements within the Earth's crust.
2 The Funzie conglomerate on Fetlar demonstrates the powerful forces at work. These lumps of quartzite and granite were at one time roughly spherical in shape but most have been stretched flat by earth movement.
Devonian landscapes

About 400 million years ago, Britain was positioned approximately 10° south of the Equator, and lay within a supercontinent incorporating what is present-day Europe and North America. Much of the Scottish area was mountainous, hot and arid with scattered depressions containing freshwater lakes in which enormous volumes of eroded debris were deposited. The Devonian rocks of Orkney and Shetland originated as river-laid sand and gravel, beach and dune sands, and lake-deposited sand, silt and mud. They accumulated in a large depression known as the Orcadian Basin that lay beside the Caledonian Mountains. Lake Orcadie, an extensive freshwater lake, occupied this low-lying ground. The lake shoreline fluctuated with significant changes of the climate. As the area of the lake expanded, so the fringing desert was inundated. At least 1.5 kilometres of sand and mud were deposited in the shallows and deeps of the lake, which teemed with primitive life-forms, including fish of the most bizarre construction. The deeper lake sediments formed typically grey rocks, but those of the lake margins here and elsewhere in Scotland formed red rocks, that resulted in the name ‘Old Red Sandstone’ for these Devonian rocks as a whole.
Many of the fossil fish are to be found within particular intervals of strata, known as ‘fish beds’. These special layers of very finely-laminated limy mudstone indicate a very slow rate of sediment accumulation, probably associated with periods of rapid evaporation from the lake. Each lamina, or layer, is thought to represent the input of sediment for one year. So, like counting the rings on a tree-stump, the length of time represented by a particular fish bed can be established.

Lake Orcadie eventually dried up and desert conditions were re-established across the area and this brief interlude of peace and tranquillity passed. Earth movements subsequently folded and faulted the sediments laid down in the lake, molten lava flowed across the Earth’s arid surface and clouds of ash were thrown high into the air. The close of the Devonian period was marked by the accumulation of sands and gravels that were carried into the area by rivers. Finally, the plains of the Orcadian Basin were exposed to drying winds, and sand dunes built up in a climate that is comparable to that of sub-Saharan Africa today.
Life on Earth

In the land that was to become Orkney and Shetland, the earliest traces of life are found in rocks of the Old Red Sandstone. This was the ‘Age of Fishes’, but also the time when plant life diversified following the initial colonisation of land by plants and vertebrates.

Cyanobacteria and planktonic algae were the most primitive life forms in the lakes of the Orcadian Basin. Algal colonies, represented by bun-shaped masses of banded rock called stromatolites, occur near Stromness. Stromatolites usually indicate marine conditions; their occurrence at Stromness probably indicates that the Orcadian lakes were at times quite salty.

Invertebrates are poorly represented by fossils in the Old Red Sandstone succession. Only the small bivalve shells and trace fossil tracks, possibly made by eurypterids (water scorpions), are known.

Fish were by far the most important and diverse form of life that existed in the area during this time. Periodically, a connection existed with the sea, so marine fish were able to reach Lake Orcadie. They adapted rapidly to their new freshwater environment. The species diversity ranges from small herbivores, mud-grubbing scavengers and omnivores to large carnivorous predators. It is most likely that these fish inhabited shallow, oxygenated lakes and streams. When they died, their carcasses drifted to the bottom of the lake. If the remains were covered quickly by sediments the fish would change, through time, from flesh and bone to rock as the lake sediments hardened under the weight of succeeding layers.

From time to time, the fish population suffered mass mortality, probably caused by increased salinity in hot, evaporating conditions. Fresh colonisation took place when renewed access from sea to lake was established during wetter periods.

Although body remains of higher vertebrates have not been found within the region, zigzag arrangements of paired fossil foot-prints are preserved in desert sandstones, which indicate the presence of four-footed amphibians.

1 Gyroptychius agassizi was first collected by Professor Trail from Edinburgh University. He corresponded with the famous Swiss scientist, Louis Agassiz and named the new discovery after him.

2 Fish in Lake Orcadie lived in shallow water. After death their bodies were transported by currents into deeper waters where they sank below the warm oxygenated surface water into deeper, cooler un oxygenated water where their bodies were preserved.
Fair Isle

Fair Isle lies halfway between the archipelagos of Orkney and Shetland. The island is almost entirely comprised of Devonian sandstones that have affinities with the rocks of the same period in Shetland. These sediments are partly made of conglomerates, made up of rounded pebbles and cobbles, laid down by ancient rivers that criss-crossed the area. These layers are succeeded by sandstones and muds that originated in a deeper-water lake environment.

Fair Isle is sliced by a series of six faults that run west-north-west across the island. Some of these fault planes were later exploited by molten rock that flowed from depth along these weaknesses in the crust. And more recently, these fault zones have been exploited and the action of the waves has created the indented geos of the west coast of the island.

The great diversity of coastal landforms – the cliffs, geos, stacks, skerries and beaches – support the designation of a National Scenic Area that extends across much of the Shetland Islands as far as Fair Isle. The most iconic of the island’s natural features is the Sheep Rock, located on the eastern coast. It is almost detached from the main island and forms an upstanding promontory of distinctive form.

Fair Isle has many other notable natural assets. For example, the island supports the entire world population of a unique subspecies of wren – *Troglodytes troglodytes fridariensis*. As befits an area that teems with birdlife, there has been a bird observatory on the island since 1948. The internationally important seabird populations have been studied from this site for many years. Some 100,000 pairs of breeding birds, including fulmars, shags, Arctic skuas, great skuas, kittiwakes, razorbills, puffins and guillemots patrol the offshore stacks, seacliffs and adjacent moorland, creating a whirlpool of noise and aerial activity.

In 1982, Fair Isle became the home of Europe’s first commercial wind turbine, which has produced electricity for the island community since that date. This power source is augmented by a diesel generator on the few occasions that the wind does not blow.

The distinctive feature of Sheep Rock dominates the eastern coast of Fair Isle.
The Atlantic opens

A geological inheritance from over 200 million years ago secured for Shetland a key role in exploiting the oil and gas riches from the North Sea. As Pangaea, the only landmass that existed during Permian times, split asunder, so a jigsaw of new continents charted their separate courses across the surface of the globe. The North Atlantic Ocean was born at this time and Scotland split off as part of the European continent. It parted company with North America, which had been its unlikely bedfellow for the previous few billion years.

The crust that floors the present-day North Sea was also a place of considerable tension. A yawning chasm developed on the sea-floor, opened by force that powers all movement of the continents – currents in the upper mantle of the Earth. But, for whatever reason, these movements that had presaged the creation of a new plate boundary stopped. The resultant deep gouge on the floor of what was to become the North Sea, was, over time, filled with sediments shed from the surrounding land. The majority of the principal oil and gas fields are located within this narrow strip, known as the Viking Graben. The source of the hydrocarbons is known to be organic-rich clays of Middle Jurassic age that accumulated deep within the trench. Once the oil was distilled from these organic-rich sediments, it migrated into porous sandstones of younger age, known as reservoir rocks, from which the oil was recovered by deep drilling and then piped ashore for refining. Shetland is the convenient landfall for much of the production of the fields in the northern part of the North Sea.

Exploration for new reserves has now focused on the area west of Shetland where new oil and gas fields have been discovered.

The first oil discovery was made in 1969 in what was to become the Arbroath Field. This first phase of exploration was phenomenally successful and many economically viable fields were subsequently identified. By 1980, production was over half a million barrels a day and this contributed hugely to the country’s economy. In fact around 4% of the UK’s gross domestic product was derived from the hydrocarbons recovered from the North Sea at that time.

Three of the oil fields in the northern sector are named after famous Scottish geologists – the Hutton field after Dr. James Hutton – the founder of modern geology and Scottish Enlightenment figure; the Lyell field after Sir Charles Lyell, who produced the hugely influential textbook *Principles of Geology* in nine editions; and the Murchison field after Sir Roderick Impey Murchison, an early Director General of the Geological Survey.

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1 Convection in the Earth’s mantle causes continents to split apart and oceans to form.

2 The earliest stages of stretching and thinning of the Earth’s crust near the margin of the emergent ocean allowed molten lava to break through the crust to form a line of volcanoes running from St Kilda to Arran. To the present day, we continue to move farther and farther away from America as volcanic eruptions along the Mid-Atlantic Ridge add new ocean floor, thus forcing the continents apart.
Ice and tundra

Glaciers covered Orkney and Shetland many times during the last two and a half million years. Although they sculpted the landscape, the broad outline of the islands owes much to the action of the wind, rain and sea over the last 150 million years.

About 100,000 years ago, both groups of islands were covered by ice from the Scandinavian ice cap, extending across the floor of the North Sea. This ice transported rocks such as the Dalsetter Stone – weighing over two tons – from southern Norway to Shetland. About 25,000 years ago, a local ice-cap produced glaciers that carried rock and soil away from the hilly spine of Shetland, and glaciers from the Scottish mainland flowed into the Moray Firth and north-westwards over Orkney.

The Shetland glaciers laid down a veneer of glacial till, but peat layers lie buried within older and thicker accumulations of sediment at Fugla Ness and Sel Ayre on the western coast of the Mainland. Remains of pine trees, and fossil pollen grains, found in the Fugla Ness peat show that perhaps as long as 380,000 years ago it was locally wooded and had a warmer climate than at present. In contrast, peat layers at Sel Ayre occur in gravel, formed when the climate was much colder than today. They contain fossil pollen which indicates that between 100,000 and 50,000 years ago, vegetation on the island changed from grassland to heathland with trees. But, as the climate became more extreme, these habitats were buried by debris washed down from the adjacent slopes.

Although the climate was cold, there is little to suggest that large glaciers existed on Orkney and Shetland at the time they last developed in the Northwest Highlands of Scotland, about 11,500 years ago. Nevertheless, Enegars Corrie, on the north tip of Hoy, held a small glacier and the ice-dumped moraines at nearby Dwarfie Hamars also formed at that time. The blockfields of granite boulders mantling Ronas Hill and the stone stripes on top of Ward Hill on Hoy show, however, that high ground on the islands bears the imprint of intensive wind and frost action, rather than recent glacial erosion. Some of these features, that continue to form today, are similar to those seen in sub-Arctic tundra areas, such as northern Norway.

1 Blockfield formed by weathering in arctic conditions, Ronas Hill.
The Dalsetter Stone, a two-ton piece of Norwegian rock transported across the North Sea by an ice-sheet.

Possible ice and land limits about 18,000 years ago.
Of ‘Men’ and ‘Castles’

The erosive power of sea and wind has dominated the development of the outer, rocky coastline of the islands. These forces greatly influenced the formation of the hugely impressive sandstone cliffs of Hoy and the exposed rugged western coastline of Mainland Orkney. On Shetland, sheer cliffs have been eroded into the ancient crystalline granites, schists and gneisses as well as into sandstone. There are few sandy beaches at the foot of these cliffs because the material eroded from the cliffs is rapidly removed by the power of the waves.

The sea has cut ‘geos’, which are long narrow slots following faults and joints, into the cliffed coastline and also eroded ‘gloups’ (blow-holes), caves and natural arches. As erosion continues, the rock-spanning arches protruding from the retreating cliffline often collapse, leaving vertical rock pillars as sea stacks. The most famous of these are the Old Man of Hoy and the Castle of Yesnaby, both formed of sandstone.

The power of the sea during westerly gales is vividly illustrated by the high-level storm beaches, formed of large blocks of rock, torn from the cliff by the waves and piled up in crescent-shaped ridges behind the clifftop. Excellent examples are found at Esha Ness, on Mainland Shetland and Sacquoy Head on Rousay, where boulders lie as much as 80 metres inland at the top of 18 metre-high sea cliffs.
The Old Man of Hoy

The Old Man of Hoy is perhaps the most iconic image of the Orkney Islands. It is located on the west coast of the island of Hoy, which itself is amongst the most dramatic seascapes in Britain. The cliffs, carved from sandstones and ancient lava flows, plunge some 137 metres from cliff top to the surf zone. The Old Man and adjacent cliffs are also of interest for the insights these rock exposures provide into the changing environments of the area some 380 million years ago. The Old Man sits on a plinth of lava and volcanic ash deposits. These are overlain by sandstones laid down alternately by rivers and finally by wind-deposited sands, whipped up into ancient dunes. By careful study, the direction of the prevailing wind that blew across the scorched deserts lying beside Lake Orcadie can even be discerned.

The Old Man of Hoy has a special place in the annals of outside broadcasting as it was in 1967 that Joe Brown and his team tackled a climb that was broadcast live on the BBC. As the intrepid climbers inched their way up the sea-stack, so a nation held its breath, willing them onwards towards the summit.

But its solitary existence as a sea stack is a relatively recent phenomenon. Around 250 years ago, the area is portrayed on an antiquarian map as a headland and some 60 years later the headland had been eroded by the sea into an arch that was supported by twin legs that gave the feature its name – the Old Man. But early in the 19th century, a severe storm washed away one of the legs and the landform that we are familiar with today was fashioned. It is seldom that we can chart the creation of landforms or indeed geological phenomenon of any sort though historic maps, as the operation of these processes largely predates any systematic observations being made.

But the Old Man of Hoy is a temporary feature – a transient landmark in a rapidly changing and dynamic scene. In the not-too-distant future, the cracks that are now beginning to appear in the upper sections of the sea stack will fatally weaken its structural integrity and it will return to the waves below, from whence it came. But there are many others in the making – headlands will be undermined to form rock arches and then the connecting rock will fall to create another sea stack. And, within a few hundred years, their race will also be run and they too will fall to earth. What goes around comes around.
Voes, ayres and beaches

A rise in sea level following the melting of the glaciers about 15,000 years ago has been responsible for the drowned landscape of the inner coasts of Orkney and Shetland. The clearest signs of this drowning are the many long open inlets, or ‘voes’, of the Shetland islands. These voes mark the former courses of river valleys, later hollowed out by the glaciers, before being flooded by the sea. The steeply sloping and indented character of this drowned landscape has generally hindered the formation of large, sandy beaches around Shetland. In contrast, flooding of the more gently undulating Orkney landscape has formed broad open bays, generally backed by sand dunes. Layers of peat, some containing tree trunks and roots, occur beneath the sand and shingle of some modern beaches. Some peat layers are submerged to depths of 8 to 9 metres in several of Shetland’s sheltered voes, illustrating the extent of sea-level rise in the last 5,000 to 6,000 years or so.
Narrow spits of shingle, called ‘ayres’, are commonly found cutting across the landward and seaward ends of shallow bays and voes. These spits may partly, or completely, cut off a sheltered stretch of water from the sea to form a shallow freshwater loch or ‘oyce’, which may silt up to become a stretch of fertile land. Some spits form tombolos, joining islands to offshore isles. Outstanding examples are the triple tombolos joining Fora Ness to Mainland Shetland in Delting and the sand-capped gravel tombolo linking St Ninian’s Isle to the south-western coast of Shetland. The St Ninian’s tombolo has probably existed since the Dark Ages when a church was sited on the isle.

During the Second World War, man-made causeways were constructed and ships were scuttled to block many of the narrow tidal entrances to the eastern end of Scapa Flow, the deep-water harbour in Orkney used by the Royal Navy to protect the fleet from submarine attack. These causeways, known as the Churchill Barriers, now carry roads linking islands such as Burray and South Ronaldsay to Mainland Orkney. During the last sixty years, they have altered the currents in tidal inlets, allowing sand flats and even low dune systems to build out from the barriers or shores of the islands into the sea.

1 Tombolo connecting St. Ninian’s Isle to the Mainland, Shetland.
As the sea gently laps against the shore at Sullom Voe today, it seems almost inconceivable that the coastal areas of the Shetland Islands were engulfed by a tsunami as recently as 7,900 years ago. Evidence for this assault by a series of colossal waves is provided by marine fossils and other debris swept from the sea floor, which are now to be found on the cliffs on both shores of Sullom Voe. Recent research has also revealed that there may have also been significant tsunami events around 5,500 and 1,500 years before the present day.

But the most significant event was the first, around 7,900 years ago. This, the Storegga tsunami, was triggered by the movement of huge quantities of sands and muds that built up on the continental shelf just offshore from Norway. An expanse of sediment larger in area than Scotland slipped from the continental shelf and slid into the deeper waters of the North Sea. This slippage, perhaps triggered by an earthquake, caused vast quantities of sea water to be displaced and fast-moving waves radiated from the epicentre of the slide. The sediments dumped by the crashing waves as the wall of sea water made landfall are found a staggering 9 metres above current high water mark. Sea level at this time around 8,000 years ago was between 10 and 15 metres lower than it is today, so the size of the waves that deposited these layers almost beggars belief.

The deposits that provide the evidence for this event are around 30 cm in thickness and consist largely of sands, lumps of peat, twigs and pebbles. These layers have a sharp boundary with the underlying strata and contain the remains of sea creatures, such as marine shells and sea urchins. These finds confirm that these deposits were dumped there by the tsunami.

The scale of this event is also reinforced by the widespread nature of deposits of a similar age and origin that are scattered across the east coast of Scotland, the west coast of Norway and the Faroe Islands.

The most recent ‘big wave’ occurred in 1750, supposedly related to an earthquake in Lisbon. An unusually large wave was spotted off the coast of Yesnaby by a quarryman, who alerted his workmates to the danger. The wave flooded the quarry, but a human tragedy had been averted.
Early occupation

Long before the Great Pyramid of Egypt or Stonehenge were constructed, a vibrant community of hardy souls set up home in the Bay of Skaill on the west coast of Orkney. Skara Brae is now recognised as the best preserved village of Neolithic age in northern Europe, dating back over 3,000 years.

There are many other monuments to the early occupation of Orkney and Shetland. The craftsmanship of these early settlers is preserved in stone. They used locally-won materials to build a simple infrastructure that helped them live their lives and mark the passing of their dead. Heavily fortified Iron Age dwelling-houses, known as brochs, stone circles and places of burial have all left their mark of the contemporary landscape.

Skara Brae came to light in 1850 when a ferocious storm ripped through the sand dunes that had entombed the settlement for over three millennia. A network of houses, a workshop for the production of stone tools and a rubbish tip were all unearthed. The stone used to construct the houses was the local Old Red Sandstone. It split easily into workable slabs that could be readily stacked to create walls and lintels. Even the internal fixtures and fittings were constructed from stone; likewise the kitchen dresser, shelves and the sleeping areas were fashioned from the local flagstones.

Other significant stone-built monuments cast in stone on the Orkney Islands include Maes Howe, which is recognised as the finest chambered tomb in northern Europe. This burial mound stands seven metres high and measures 35 metres across and is constructed almost entirely from flagstone megaliths – great slabs of sandstone.

Great defensive fortresses were constructed across Scotland around 2,000 years ago. These broch towers, as they were known, were built as a living space that was relatively secure from attack. Although brochs were double-walled defensive structures that had no windows, some also had home comforts, such as water cisterns, fireplaces and partitioned rooms. Of the 500 or so constructed across Scotland, the broch on the tiny uninhabited island of Mousa, off the east coast of Shetland, is the most complete. It is almost intact, standing almost thirteen metres high. Author and broadcaster Magnus Magnusson linked the Broch of Mousa with one of the famed Icelandic stories – Egil’s Saga – where eloping lovers were shipwrecked and spent the winter in the broch whilst their ship was being repaired.

Standing stones are also an important feature of the contemporary Orcadian landscape. The Ring of Brodgar in Orkney is one of the most impressive circles of standing stones to be found anywhere in the country. Around 60 stones were originally erected in a circle of more than 100 metres in diameter. This wonder of ancient engineering is linked to the nearby Stones of Stenness by a ceremonial walkway.

1 Broch of Mousa, Shetland.
In 1850 a storm revealed the Neolithic settlement of Skara Brae, Orkney.
The coastlines are varied throughout the islands. The cliffs of north-west Hoy are amongst the highest in Britain. Shetland is renowned for its cliffed coastline and it has a fascinating variety of geos, stacks, arches and skerries. Both island groups have notched and indented coasts – from the long, deep Shetland voes to the smaller, but often resonantly named, gloups and holes around the hard, rocky coasts.

At Yesnaby, in Orkney, the power of the sea is exhilaratingly demonstrated by the storm-flung rocks along the cliff tops. In contrast, the area also supports the tiny, delicate Scottish primrose.

The main towns in the islands act as gateways and administrative centres. The town cores all have distinctive, narrow stone-flagged streets. Lerwick’s grey stone centre is edged by more colourful harbour buildings. The red sandstone of St Magnus Cathedral stands tall in the midst of Kirkwall. Stromness distinctively rises in huddled ranks from the sheltered voe.
An industrial landscape – Sullom Voe

Sullom Voe on Shetland's Mainland is the site of one of Europe's largest oil and liquefied gas terminals in Europe. In such a remote and rural setting, this is an industrial plant on a truly epic scale. It was built between 1975 and 1981 and receives oil produced from 24 fields in the northern sector of the North Sea.

Two pipeline systems – the Brent and the Ninian – deliver crude oil to the site from the North Sea and a third pipeline brings oil from the Clair field to the west. The oil is then stored temporarily in huge tanks and subsequently exported from the site in sea-going tankers that take the crude for refining to create useable products such as petrol and diesel.

In January 1985, the site had its biggest throughput of crude in one day. Some 1,503,417 barrels of oil came ashore during a 24 hour period.

There were understandable fears at the outset that the impact of such a major development on the natural environment would be significant. But nature has found a way of co-existing with its new neighbour. The Shetland Oil Terminal Environmental Advisory Group was established to ensure that the impact of this oil giant was kept within acceptable bounds. In a recent report, the marine environment around the terminal was considered to be better than at any time since the terminal opened.
Shetland's Sullom Voe provided a natural sheltered bay for the on-shore operations of the oil and gas industry. These overhead shots taken in 1944 and 1989 show the extensive changes that industry brought to the landscape.
One of the country’s most remarkable living landscapes is the machair-lands of northern Britain. This is one of the rarest habitats in Europe and a much valued natural resource. The west coast of the Outer Hebrides, rather than the Northern Isles, is regarded as the ‘home of machair’. But small pockets of machair stretch from almost the northern tip of Unst to the east coast of mainland Orkney; not in a continuous strip, but as a series of discrete areas.

Machair is a Gaelic word meaning an extensive low-lying fertile plain. A complex of sand dunes, which move in response to the prevailing winds and tides, define the seaward side of the machair-lands, giving way inland to a gently-sloping coastal plain.

The machair sand has a high content of broken shells, so is rich in calcium carbonate; in contrast to the mineral sands that comprise the beaches of much of Britain’s coastline. The inbye lands that lie adjacent to the sea have an in-built fertility, but this natural productivity can be augmented by the addition of seaweed used as a fertilizer.

This unique landscape was created at the end of the Ice Age. Glaciers had swept great quantities of sands and gravels into the sea, which at that time stood many metres lower than current levels. Sea levels rose as the ocean swelled with the addition of copious quantities of glacial meltwater, so these sediments, along with the shells deposited along the shoreline, were swept back onshore to form the beaches we see today.

The machair plain is rich in wildlife. The wildflower meadows that bloom in summer are a dazzling tableau of colour and movement.

This vegetation cover is home to countless birds including dunlin, twite, redshank and corncrake.

This is a landscape that has endured since time immemorial; where people and nature live, cheek by jowl, in harmony.

1 The redshank is one of the birds that benefits from the cover provided by shoreline vegetation.
2 Machair – a remarkable living landscape.
Protected areas of Orkney and Shetland

A system of protecting areas of particular natural value has been in place for over 60 years. Sites of Special Scientific Interest (SSSIs) were established by the National Parks and Access to the Countryside Act, enacted in 1949. The forerunners of SNH were required by law to identify and designated a series of sites that were representative of the key habitats, species and geological features of Britain. A systematic review of geological and landform SSSIs throughout Britain was undertaken as part of the Geological Conservation Review and the resultant descriptions of key sites were published in a series of 50 scientific volumes by the Joint Nature Conservation Committee.

Subsequently, European legislation required Special Areas of Conservation and Special Protection Areas to be identified and classified, which added a further tier of protected areas. National Scenic Areas have also been designated to reflect the outstanding quality of the landscapes. These sites are a key strand of SNH’s effort to protect and enhance the nature and landscapes of Scotland.

On Orkney and Shetland, a combined total of 117 SSSIs have been designated to reflect the important geological, habitats and species features to be found here. SNH own few of these sites, so effective conservation is only possible where a genuine partnership exists between landowners and managers, local people and local authority planners.

If you would like to find out more about these sites or protected areas in Orkney and Shetland or indeed, across Scotland, please visit the SNH website on www.snh.gov.uk/SiteLink. The SiteLink application gives details of each protected area, its location, size and the reasons for conservation. The optimum management regime required to maintain the special nature interest of the site is also described. For SSSIs, we also record the condition of the site, so that the effectiveness of site management programmes can be monitored. Our target is for 95% of all SSSIs to be in favourable condition at the earliest opportunity.

The most recent accolade was the declaration of Geopark Shetland. Over the last ten years, UNESCO have declared a network on such sites across the globe in recognition of the value of each place as a scientific and cultural resource. Shetland joins, amongst others, the Petrified Forest of Lesvos in Greece; Stone Forest Geopark, China; and closer to home, the Northwest Highlands and Lochaber in receiving this international recognition. The Geopark is run by the Shetland Amenity Trust on behalf of the local community.

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1 The Lochs of Harray and Stenness are designated as a Site of Special Scientific Interest.
Places to visit

Orkney and Shetland have a great deal to offer those with an interest in nature and there are many easily accessible places that tell an eloquent story of the geological past. The rocks beneath also partly determine the diversity of the ecosystems that the area supports and this wider ecological context will also be of interest to the visitor.

The three National Nature Reserves (NNRs) on Shetland are an excellent starting point, although they are by no means the only places to see the rocks, landforms, plants and animals of these beautiful islands.

**Hermaness NNR** is located on the far-flung northern extremity of Unst. The underlying geology is comprised of Dalradian schists, which is of note because of the interesting mineral assemblages described from here. The Reserve is primarily famed for its seabird colonies of puffins, numbering up to 50,000 individuals, and also significant populations of gannets, fulmar and guillemots. Inland from this cliffed seabird city, the blanket bog and mires provide nesting habitat for more than 750 pairs of great skua, with smaller numbers of Arctic skuas, golden plover, twite and red-throated divers.

**Noss NNR** – the island of Noss covers some 350 hectares and is built from sandstone of Upper Devonian age, which has been eroded into a spectacular coastline. Plunging cliffs almost 200 metres high provide a home for over 80,000 birds of 13 different species. Recent monitoring has revealed mixed fortunes for the seabirds of Noss. Gannet and great skua populations are considered to be in favourable condition, but puffins and guillemots are faring less well.

**Keen of Hamar NNR** is described on page 8.

Other places that are worth a visit include:

**West coast of Hoy** provides a slice through the thick pile of red sandstones that predominantly build the Orkney Islands. The sandstones are of mixed origin. Most were deposited at the bottom of the great freshwater lake that occupied this area during Devonian times, but some deposits were laid down by streams and larger rivers that criss-crossed the area. But some of the oldest layers are perhaps of most interest, as they are built from volcanic rock. Basalts and ash layers associated with the eruptions of the lavas form an important part of this rock layer-cake that is so well-exposed along this coast.
section of coastline. Of course, the star attraction is the Old Man of Hoy itself, iconic of this part of the world. But there are other just as impressive stacks and castles to be viewed.

**Cruaday Quarry on Mainland Orkney** provides excellent exposure of important fossil fish-bearing strata, known as the Sandwick Fish Bed. Four hundred million years ago, Lake Orقادie was home to myriad species of early fish, none of which survive to the present day. But we know of their appearance and can reconstruct something of the way they lived from their fossil remains. Around 15 different species of fish have been recovered from this site. The site is currently disused and the collecting of fossils on a modest scale will not exhaust the supply of fish material. It is recommended that only a single specimen should be removed at each visit. Stromness Museum has many fine specimens collected from this area.

Colossal geological movements and subsequent erosion have left Noss with wonderful cliff scenery. The coastal scenery on Noss doesn't only consist of splendid cliffs. Stony beaches and tranquil bays offer a dramatic contrast.
Climate change

These days, no book on the natural world would be complete without reference to climate change. There can be no doubt that human activities are affecting climates on a global scale. But we inhabit a highly dynamic planet, where, as we have seen in this book, natural changes, some on a cataclysmic scale, have occurred throughout geological history. Orkney and Shetland have been subjected to climates that varied from the furnace heat of the desert, experienced during Devonian times, to life in the freezer that gripped the planet during the recent Ice Age. So climate change is not a recent phenomenon. But what is new is that our day-to-day activities are contributing to the rate and potency of these natural environmental changes. The Intergovernmental Panel on Climate Change observed that ‘most of the warming over the last 50 years is likely to have been due to increasing concentrations of greenhouse gases’. And it is our activities that have made a significant addition to these levels.

But natural change continues to this day, as, for example, we drift further from America in response to the widening North Atlantic Ocean. These natural changes occur on a variety of scales and at different rates. Some are interminably slow, such as continental drift, whilst other processes are almost instantaneous, such as the occurrence of a tsunami or a catastrophic landslide. No place on Earth – or indeed, any species – is untouched by these natural changes.

Many of these natural systems are inter-connected. So a melting ice cap in Greenland, for example, will, in time, feed through to an increased high-water mark recorded in Lerwick Harbour. We cannot isolate ourselves from these global systems and we must act as good environmental neighbours and expect a good standard of behaviour from other communities, both near and far, in return.

In the much longer term, our journey across the globe will continue, as the Earth’s tectonic plates bump and grind on their way. So, 50 million years hence, the Mediterranean Sea will be no more; replaced by a mountain range as the African continent collides with Europe. And life on Earth will have a very different look. The fossil record shows us that only one percent of all species that have existed since life started on Earth are with us today. So species will continue to come and go. It is impossible to predict so far ahead what lies in store for Orkney and Shetland, but we can be sure that these islands will not be immune from change.

1
Lerwick Harbour, a jewel in Shetland’s crown.
Minerals and building materials

Orkney and Shetland have a rich mineral legacy. Ores of copper, lead, iron, chromium and manganese have all been extracted. Uranium ore has also been found in the Stromness Flags of West Mainland, Orkney, but it is probably not present in commercial quantities. A considerable amount of the mineral talc has been extracted from the ancient ocean-floor rocks of Unst. A quarry was in operation from 1945 onwards, producing at its peak around 9,000 tons per year. Earlier talc workings, of Norse age, lie along the Burn of Catpund in South Mainland and in several locations on Unst, Fetlar and Northmaven.

The bedrock provides much of the building material for the vernacular architecture of the islands. The flagstones of Orkney are have been used for building purposes over three millennia and the buildings of Kirkwall and Stromness are testament to the suitability of this material for the construction of structures of all shapes, sizes and purposes. The most spectacular by far is the dazzling St Magnus Cathedral. The story of the founding of the cathedral is well documented in the Orkneyinga Saga. The structure was built on the instructions of Earl Rögnvald Kolsson, who was advised to ‘build a stone minster at Kirkwall more magnificent than any in Orkney’. Construction started in 1137 and it took many decades to complete.

One of the world’s greatest mineral collectors hails from Melsetter on Hoy. Dr. Matthew Forster Heddle was born in 1828 and he went on to assemble the greatest collection of its day of minerals from Scotland and farther afield. His collection still forms the core of the exhibits on display at the National Museum of Scotland in Chambers Street, Edinburgh. He was a medical doctor by training and after a few years plying his trade on the impoverished streets of Edinburgh’s Grassmarket, he followed his real passion – collecting minerals. In 1856, Heddle was appointed Assistant to the Professor of Chemistry at the University of St Andrews and he eventually succeeded to the Chair six years later. Heddle’s energy in pursuit of his quarry was legendary. In a contemporary account, he was said to have ‘explored nearly every mountain and glen, and almost every part of the coast of Scotland, in search of minerals’. His crowning glory came when the refurbished upper floor of the west wing of the Museum of Science and Art, later to become the National Museum of Scotland, was opened in September 1895. As reported in The Scotsman newspaper of the day, Heddle’s minerals collected from ‘the Shetland Isles to the Cheviot Hills, ranging over the breadth of Scotland…’ It has since become one of our national treasures.
Finding out more – some further reading

Much of the literature on the geology of Orkney and Shetland is published in academic journals, which may be inaccessible to the general reader. So here is a list of more general books and some specialist titles that will add to the knowledge that we hope you have gained by reading this book:

*Geology and Landscapes of Scotland.* Con Gillen. 2003. Terra Publishing, Harpenden. (A more technical account of the geology of Scotland for the more knowledgeable reader.)


*Land of Mountain and Flood.* Alan McKirdy, John Gordon and Roger Crofts 2007, Birlinn, Edinburgh. (A popular account of the geology and landforms of Scotland that contains many references to the Orkney and Shetland Islands.)


*The Geology of Scotland (4th edition).* Nigel Trewin (ed.). 2002. The Geological Society, London. (The most authoritative and comprehensive academic text on the geology of Scotland that acts as a gateway to the key scientific publications of the last hundred years.)

...and for younger readers


Useful addresses and contacts

Scottish Natural Heritage, 
Great Glen House, Leachkin Road, 
Inverness, IV3 8NW 
Tel 01463 725000

The SNH website has been re-launched and is full of useful information about our activities across Scotland, including the news and updates on the work happening in Orkney and Shetland. www.snh.gov.uk

Scottish Natural Heritage, Ground Floor, Stewart Building, Alexandra Wharf, Lerwick, Shetland ZE1 0LL.

Scottish Natural Heritage, 54 – 56 Junction Road, Kirkwall, Orkney KW15 1AW.

Shetland Amenity Trust, 
Garthspool, Lerwick – The Amenity Trust has a broad environmental remit, including managing the local biological records centre, the Geopark and the Shetland Museum and Archives.

Museums and heritage centres: 
Shetland Museum and Archives, Hay’s Dock, Lerwick, Shetland ZE1 0WP
Tangwick Haa Museum, Eshaness, Shetland ZE2 9RS
Old Haa, Burravoe, Yell, Shetland ZE2 9AY
Unst Heritage Centre, Haroldswick, Unst, Shetland ZE2 9ED
Fetlar Interpretive Centre, Beach of Houbie, Fetlar, Shetland ZE2 9DJ
Fossil & Heritage Centre, Viewforth, Burray, Orkney KW17 2SX
Westray Heritage Centre, the Lodge, Pierowall, Westray, Orkney KW17 2BZ
Stromness Museum, 52 Alfred St, Stromness, Orkney KW16 3DH
Orkney Museum, Tankerness House, Broad St, Kirkwall, Orkney KW15 1DH
Eday Heritage & Visitor Centre, Eday, Orkney

The Joint Nature Conservation Committee publishes the Geological Conservation Review series. (www.jncc.gov.uk)

The Scottish Fossil Code can be accessed at www.snh.gov.uk
Scottish Natural Heritage and British Geological Survey

Scottish Natural Heritage is a government body. Its aim is to help people enjoy Scotland’s natural heritage responsibly, understand it more fully and use it wisely, so it can be sustained for future generations.

Scottish Natural Heritage
Great Glen House, Leachkin Road,
Inverness IV3 8NW
T: 01463 725000
E: enquiries@snh.gov.uk

Scottish Natural Heritage
Dualchas Nàdair na h-Alba
All of nature for all of Scotland
Nàdar air fad airson Alba air fad

The British Geological Survey maintains up-to-date knowledge of the geology of the UK and its continental shelf. It carries out surveys and research.

The Scottish office of BGS is sited in Edinburgh. The office runs an advisory and information service, a geological library and a well-stocked geological bookshop.

British Geological Survey
Murchison House,
West Mains Road,
Edinburgh EH9 3LA
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