

Minerals from the Tertiary Lavas and the Cambro-Ordovician Skarns on Isle of Skye, Scotland

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Location

Skye is the largest of the Inner Hebridean islands. Its location in the north-west of Scotland is both remote and isolated. The coastline is greatly indented, with sea lochs and several large bays.

The island is hilly and much land lies above 150 metres. Most of its hills are below 450 metres, but the Black Cuillins are very high and rugged with the peak of Sgurr Alasdair reaching 993 metres.

Skye is about 80km from north to south, and at its widest around 40km from west to east. No point is more than 8 km from the sea.

This dramatic coastline surrounds some of the most exceptional and varied scenery to be found anywhere. The main mountain range, the Cuillin Hills, is often said to be the home of the only true mountains in Britain. Certainly there is nowhere in the country to compare with their magnificent, dramatic and challenging peaks and ridges.

Nearby, the rounded granite humps of the Red Hills are less savage, but still offer stunning views.

In the north-east is the Trotternish Peninsula, with the world famous landslip escarpment that forms its backbone. The ridge rises to its highest point at the summit of the Storr, above the tortured landslip topography that includes the iconic pinnacle - The Old Man of Storr. The ridge is home also to the Quiraing, another landslip area of pinnacles and gullies.

To the west contrasting the jagged peaks and pinnacles to the south and east respectively are the impressive flat topped hills, Healabhal Beag (488m) and Healabhal Mor (469m), known collectively as McLeods Tables.

Geology

The rocks of Skye represent a long period of geological time. The gneisses of the Lewisian Complex, at 2,800 million years old, are some of the oldest in Europe; whereas the extensive igneous rocks, which are related to the formation of the North Atlantic Ocean, are some of the youngest in the British Isles at about 60 million years old. The overlying drift deposits and their associated landforms represent the last 26,000 years and show the effects of at least two major glaciations. Although the very oldest and the very youngest rocks are well represented, there are relatively few rocks representative of the intervening span of time, rocks which make up the bulk of mainland Britain.

Volcanic rocks of Tertiary age

At the beginning of the Tertiary Era, the area of the Hebrides was elevated above sea level and the chalky oozes deposited during the Cretaceous Period were largely eroded away leaving a peneplain surface of Jurassic and older rocks. At this time,

around 60 million years ago, an extensive system of fractures began to develop in the earth's crust as Greenland moved away from north-western Europe, creating the incipient North Atlantic Ocean. Magma welling up these fractures erupted at the surface in what was probably the most extensive volcanic episode ever experienced in north-western Europe. The products of these eruptions spread over both sides of the ever widening North Atlantic and are now found in the Inner Hebrides, Northern Ireland, the Rockall Bank, the Faroes, Jan Mayen Island, Iceland and east Greenland.

On Skye, the earliest activity was of an explosive nature resulting in deposits of basaltic ash up to 30m thick in northern Skye. The overlying main "plateau lava series" was probably over 1,200m thick prior to erosion. The eruptions are thought to have been from a series of fissures, generally elongated in a NW-SE direction. The individual lava flows are commonly 10 to 15m thick but some up to 37m have been recorded. The basaltic flows in particular, commonly have well developed columnar jointing in their central section, as in the Giants Causeway and Fingal's Cave flows. The upper and lower sections of the flows are usually more broken and slaggy, with many mineralised amygdales.

The presence of the boles indicates that terrestrial conditions prevailed during the eruptions and the rarity of intercalated ash bands suggests that the eruptions, although voluminous, were quiet with little explosive activity. Numerous local accumulations of sedimentary rocks within the main lava sequence imply that sufficient time elapsed between flows for river systems, lakes and vegetation to develop. Some sediments contain fossil plants.

The Cuillin Volcanic Centre is responsible for what is, without doubt, the most spectacular mountain range in the British Isles. The arc of jagged peaks are almost 1,000m high, The renowned Inaccessible Pinnacle on the summit of Sgurr Dearg consists of two parallel, vertical dykes forming a thin blade which rises above a surface formed by an inclined sheet.

In recent years areas containing significant amounts of "ultrabasic" igneous rocks, such as peridotite have been the focus of much mineral exploration, since they have potential for concentrations of such elements as magnesium, nickel, chromium, gold and platinum.

The smooth outlines of the granitic centres contrast markedly with the Cuillin. Some of the intrusions probably rose quite high in the crust and on G lomaig a "roof" of basalt is preserved on top of the granite. The Beinn an Dubhaich granite intrusion into 500 Ma old impure dolomitic limestones produced skarn deposits containing several rare minerals including ferrobustamite and harkerite for which it is the type locality.

Outwith the area of the Cuillin and the Red Hills, the most voluminous group of igneous intrusions are the basic sills of northern Skye. These sills are a prominent feature of the eastern and northern coastal areas of the Trotternish Peninsula. They are intruded mainly into Jurassic strata. Vertical columnar jointing is usually very well developed and is well seen, for example, at the popular 'Kilt Rock', south of Staffin.

Minerals

The skarns at Loch Kilchrist

The metamorphism of the Durness dolomite horizons in the aureole of the Beinn an Dubhaich granite of Skye has long provided one of the best known examples of dedolomitization and progressive thermal metamorphism of siliceous dolomites recorded in the literature. Harker's study (1904) concerned itself primarily with assemblages regarded as derived without notable accession of material during metamorphism and the occurrence of products of metasomatic origin at the contact of the granite has hitherto received but little notice in print. Yet as long ago as 1897, Geikie had written of this contact: "... the most abundant and interesting deposits are metalliferous. Fragments of a kind of 'gossan' may be noticed all along the boundary line of the boss, and among these are pieces of magnetic iron ore and sulphides of iron and copper. The magnetite may be seen in place immediately to the south of Kilbride. A mass of this ore several feet in diameter sends strings and disseminated particles through the surrounding granophyre and is partially coated along its joints with green carbonate of copper" (Geikie, 1897, p. 384). It is of interest to note further that a record of "a mineral resembling humite" from this same contact is made in the Annual Report of the Geological Survey for 1896 (1897).

The upper slopes of Beinn an Dubhaich are underlain by a body of granite, the southern-most granite body of the Eastern Red Hills Centre. Granite forms very acidic soils and so the area underlain by granite is covered in heather, contrasting strongly with the green grass on the dolostone. Dykes that cut through the dolostones are in turn cut themselves by the granite.

The Beinn an Dubhaich granite was emplaced into the centre of the folded dolostones, and the heat of the granitic magma metamorphosed the dolostones, producing a number of new minerals. The marble that was produced by this metamorphism has been quarried for many years, first on the eastern slopes of Beinn an Dubhaich, and latterly at Torrin. The old marble quarry close to Kilchrist is an excellent location at which to see the marbles, and the granite-marble contact. Yellow-green colours in the marbles are due to the presence of fibrous serpentine, whilst darker-coloured masses are made up of crystals of brucite. At a few locations around the granite contact, fluids associated with the granite have caused significant alteration of the dolostones, producing zones of entirely new minerals up to 3 m wide. These skarn zones consist almost entirely of magnetite. At a few locations, the skarns contain a variety of rare minerals that indicate the presence of boron and fluorine in the granitic magma. See the list below for minerals found at this locality.

Albite	Chrysotile	Forsterite	Sphalerite
'Albite-Anorthite Series'	Clinocllore	Grossular	'Stilbite'
Allanite-(Ce)	Clinohumite	Harkerite	Szaibélyite
Anatase	Copper	Hedenbergite	Talc
Andradite	Cuspidine	'Heulandite'	Titanite
Azurite	Datolite	Humite	Vesuvianite
Biotite	Diopside	Ludwigite	Wollastonite
Brucite	Ferrobustamite	Magnetite	Zircon
Chalcopyrite	Ferrohornblende	Malachite	
'Chlorite Group'	Fluoborite	Monticellite	
Chondrodite	Fluorite	Quartz	



The old marble quarry workings at Kilchrist.

The Tertiary volcanics

Arran, Mull, Ardnamurchan, Rum, Skye, St Kilda and Rockall represent the remains of volcanoes that formed as the crust between Europe and America split and drifted part with the formation of the Atlantic. Now deeply eroded by water and ice, the internal plumbing of these volcanoes has been laid bare. The Black Cuillin, the Red Hills; the Skye and Mull lava fields; the Sgurr of Eigg; and the magnificent columnar lava flow of Staffa, are all famous geological remnants of once great volcanoes.

The Skye lava field forms a substantial part of the Palaeocene Hebridean Volcanic Province of NW Scotland. It is exposed over much of northern Skye and can be mapped offshore from shallow seismic data, extending to the SW of the island of Canna.

In recent years mineral collectors have rediscovered the west coast of Skye as a source of fine zeolites and related minerals. The National Museums of Scotland have been amongst those collecting extensively from this area. Three major localities at Sgurr nam Boc, Moonen Bay and Sgurr nam Fiadh are described along with their minerals.

Sgurr nam Boc

The impressive 206m high cliffs at Sgurr nam Boc on the west coast of Skye between Loch Brittle, to the south and Loch Eynort to the north, are the sources of some of the finest zeolites to be found in Scotland. The lavas are silica rich with quartz and chalcedony (agate) abundant in the lower flows.

The descent from the cliff top is extremely dangerous and access by sea is only possible under exceptional circumstances. These factors have rendered Sgurr nam Boc virtually impregnable to all but the most skilled, dedicated or lucky mineral collectors.

This account by Scotland's most famous and prolific mineral collector of the 19th century epitomises the dangers involved –

"The special danger of the coast is, however, due to the extraordinary distances to which great masses of rock have rebounded seawards in their fall from the cliffs, which at most points are 700ft high. A maze of hidden danger has to be threaded; the altogether unexpected swell and break of a surf all around the boat has to be encountered; only on two occasions has a landing been successfully accomplished."

The National Museums of Scotland have tried to make landings several times and only been successful 50% of the time. The rewards however can be exceptional with superb specimens of stilbite in particular.

Moonen Bay

Zeolites and related minerals are abundant in cavities in the 296m high Tertiary basalt cliffs. Descent is difficult and access is normally by foot along the coastal platform at low tide. Great vigilance is needed as the tide rises very quickly and there is no escape up the cliffs at most points. The host basalts are silica poor, which accounts for the absence of quartz, chalcedony and high silica zeolites. A typical sequence in the northern part of the bay being analcime, chabazite, phillipsite, levyne and cowlesite, whilst in the south and central part of the bay heulandite, mesolite, chabazite stilbite and analcime represent a typical sequence.

Sgurr nam Fiadh

This locality is mid way between Sgurr nam Boc and Moonen Bay. Access is best by boat although climbing down the cliffs is less dangerous than at Sgurr nam Boc or Moonen Bay. The zeolite assemblages are similar to those at Sgurr nam Boc although there is a lack of quartz and chalcedony. Exceptionally fine specimens of chabazite have been found here.

Minerals found in the lavas

The following zeolite minerals have been documented as having been found in the Tertiary lavas of Skye:

Analcime, Chabazite, Cowlesite, Epistilbite, Erionite, Garronite, Gmelinite, Gonnardite, Heulandite, Laumontite, Levyne, Mesolite, Natrolite, Offretite, Scolecite, Stilbite, Thomsonite.

Other minerals, not in the zeolite group, that have been found in the Tertiary lavas include:

Gyrolite, Prehnite, Tobermorite, Celadonite, Apophyllite, Xonotlite, Epidote, Pectolite, Calcite, Gonnardite, Tacharanite, Chlorite, Quartz [occasionally as agate nodules], Reyerite, Okenite, Pectolite.

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