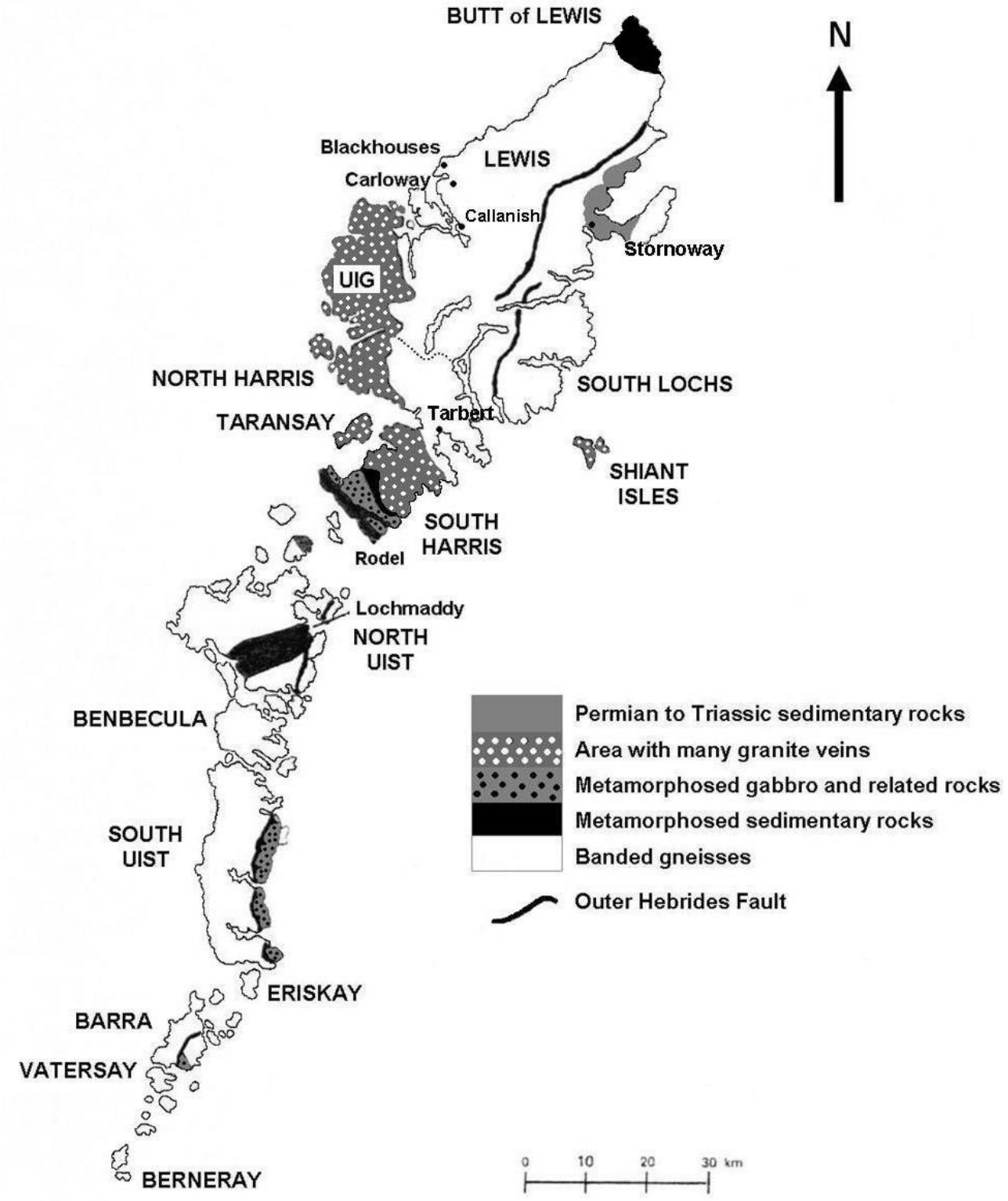
FROM THE BUTT TO BARRA

Charles Hiscock

Looking west from Ullapool on the northwest coast of Scotland, the Outer Hebrides appear as a line of hazy blue, almost mystical islands. Parts of this distant land are almost hidden beneath the horizon while others show up as mountains, often with halos of misty clouds. This insignificant appearance belies the importance of the islands and gives no idea of the unique beauty and variability of the landscapes as one travels through them.

The Outer Hebrides stretch for 125 miles off the North West coast of Scotland, from the most northerly point, the Butt of Lewis to the small island of Bernaray at the southern tip. The Isle of Lewis is the larger, northern portion of the combined island of Lewis and North Harris and attached by a narrow isthmus at Tarbert (Gaelic for neck or isthmus) to South Harris. On the south eastern side of Harris is the small island of Scalpay while on its northwest side is uninhabited Taransay (known for its starring role in the TV programme "Castaways" and now occupied by holiday makers during the summer season). South from South Harris across the islet-strewn shallow sea lies North Uist, separated from South Uist by the almost flat and low-lying Benbecula – much of the island is only a few feet above sea level! South Uist is the largest southerly island but further south still are a large number of small islands, the most famous being hilly Barra because it is the only place in the world where the airport is on the beach and the landings and takeoffs are governed by the tides. On the most southerly point of South Uist and reached by a causeway is the small island of Eriskay which suddenly became famous when, in 1941 the ship, SS Politician was wrecked on the island. When it came to the notice of the islanders that its cargo was 260,000 bottles of whisky, the locals quickly came to its 'rescue', the story of which has been told in the film 'Whisky Galore' and filmed on Barra. Surrounding Barra are many small islands ending in uninhabited Berneray.

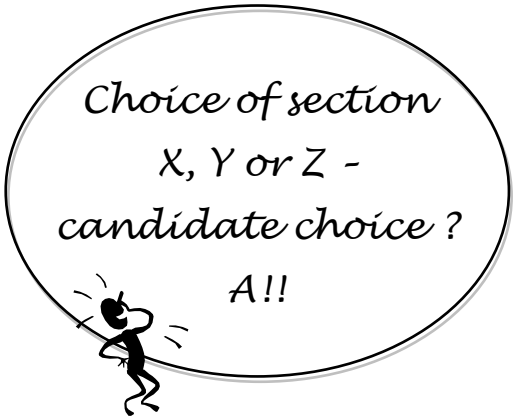
The Outer Hebrides are composed of some of the oldest rocks in Europe, having been formed nearly 3000 million years ago (Ma). They are named the Lewisian Complex after the Isle of Lewis and are predominantly ancient gneisses but the term covers a number of different types and records a number of events during 1500 million years – about one third of the age of the Earth. The gneisses also occur extensively in the highlands of North West Scotland. A few words about gneiss and the variants are appropriate at this point. Gneisses are formed at great depths in subduction zones or under the roots of fold mountains. They are subsequently brought to the surface by huge tectonic forces and then are usually seen after significant erosion. The deep burial means that the granites are subjected to very high temperatures when the minerals then melt and move freely before recrystallising. The light bands are formed from felsic minerals (quartz, feldspar, muscovite) while the black bands are usually mafic minerals (amphibole, pyroxene, biotite mica). Some gneisses form the bands in other ways such as being subjected to high temperatures when magmas force their way between layers in granites, causing local melting and sometimes, rapid cooling. Other varieties are produced by the metamorphism of alternate beds in limestones and in sandstones. The gneisses of the Outer Hebrides display all the types described as will be seen.



GEOLOGICAL MAP OF THE OUTER HEBRIDES

The gneisses of the Outer Hebrides were erupted as magma nearly 3000 mya during the Precambrian Late – Middle Archaean division and consisted mainly of granites. There are some iron and magnesium rich gabbros in South Harris and on the east coast of South Uist while small outcrops of metamorphosed limestones and sandstones are found at the Butt of Lewis, in south west South Harris and in a band across North Uist. During Precambrian Proterozoic times the rocks were metamorphosed several times by deep burial in the crust which destroyed the original features. The gneisses, formed from the igneous rocks, can be identified by the alternating dark and light bands, each being up to a couple of centimetres wide and showing intense folding, often on very small scale *(Photos 1 & 2)*. The pale bands, ranging from pink to grey are of quartz and feldspar while the dark bands which range from green to black are formed from amphibole minerals, hornblende and biotite mica. Black, granular masses formed from biotite can be found while the hornblende can be seen as dark concentrated masses in the gneiss *(Photo 3)*.

Metamorphosis of the sedimentary rocks produced marbles from the limestones and schists, with small garnets, from the sandstones. At the Butt of Lewis the bedding of the sandstones is preserved and displays tight and overturned folding *(Photos 4 & 5)*.



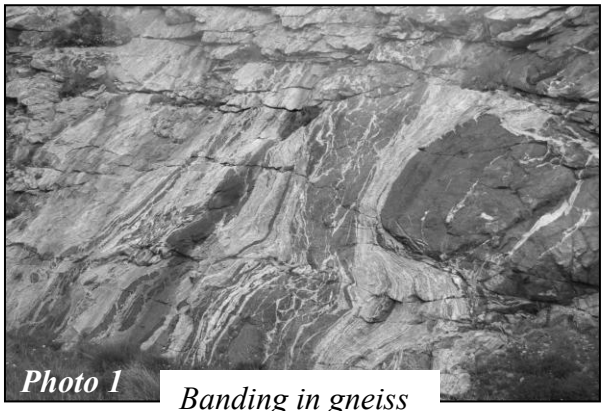


Photo 1 *Banding in gneiss*

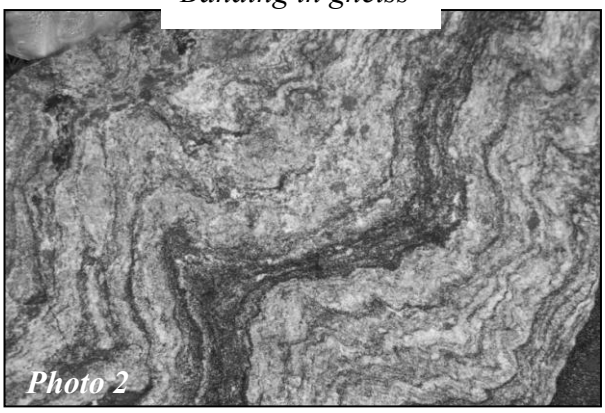
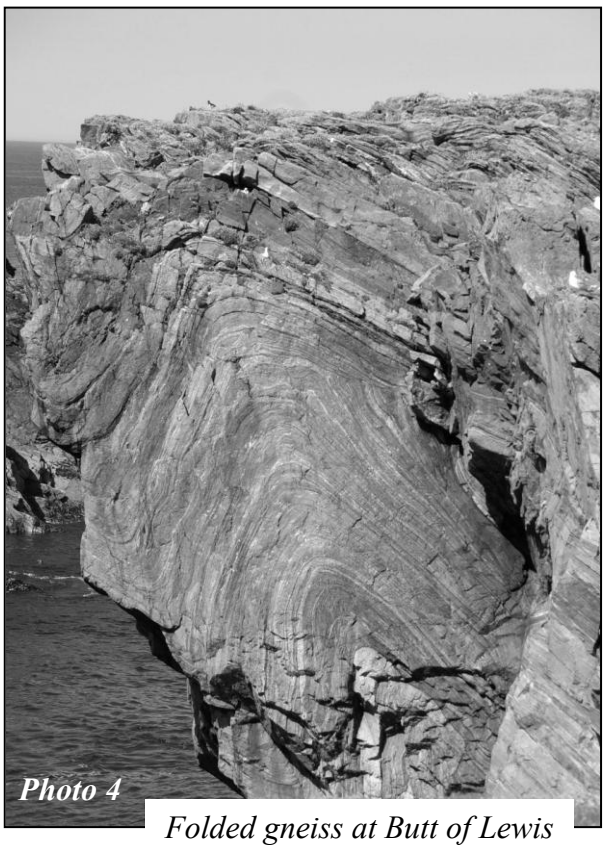
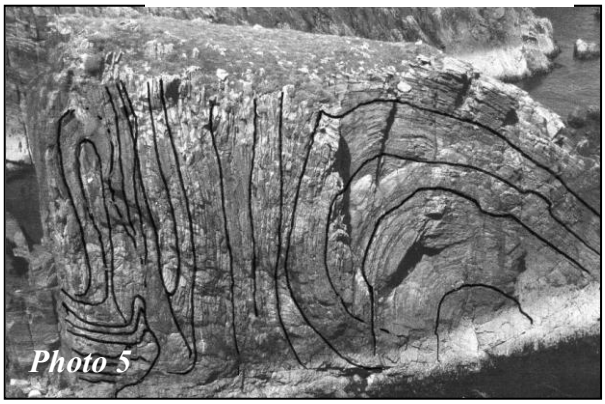


Photo 2

Photo 3: Dark inclusion in the Callanish central monolith



Folded gneiss at Butt of Lewis



The metamorphic episodes occurred sporadically through the first 1000 million years but were then followed by a volcanic period when deep magmas were forced through cracks in the crust. The magmas did not make it to the surface of the gneisses but solidified in the cracks to leave vertical sheets (dykes) similar in composition to the gabbros and now termed the Scourie Dykes after the village of Scourie in north west Sutherland where they were first described. Around 1700 Ma, the Lewisian gneisses were subjected to a second period of deep burial and intense heating, causing a second metamorphosis of the rocks and this time including the Scourie Dykes. The appearance of the rocks was not changed but new mineral suites were formed. The Scourie Dykes were changed so that they became similar in composition to the dark bands in the Lewisian gneisses. However, the dykes cut the banding in the gneisses confirming that they came later. This latest metamorphosis is termed the Laxfordian event after the sea loch, Loch Laxford on the north west coast to the north of Scourie, where it was first described. One effect of the Laxfordian event was that magma was intruded into the gneisses of western Lewis and South Harris, forming sills and dykes of hard, pink granite which stand out in the landscape and as pink veins intruding small exposures of gneiss in these two areas *(Photos 6 & 7).*

Photo 6: Gneiss with small granite vein, Carloway

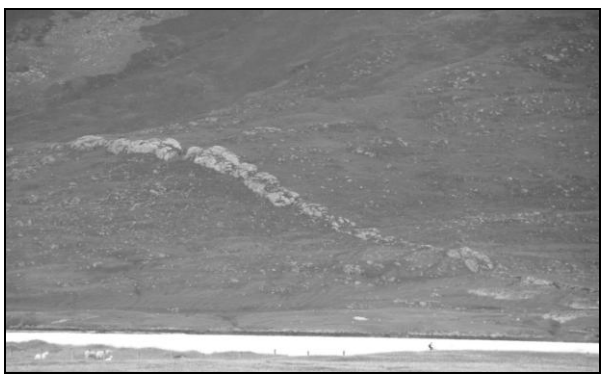


Photo 7: Granite dyke, S Harris

At the same time as the Laxfordian metamorphism occurred, a major fault, the Outer Hebrides Fault, developed as a major site of movement in the crust which has continued on and off through time. The fault, deep in the crust, caused much heat from the friction of the movement to melt the gneiss so that molten rock squeezed into the cracks. Today, this can be seen as very resistant, clear glassy veins which weld the rocks together. These more resistant rocks can be followed from Castlebay on Barra to near Lochmaddy on the eastern side of North Uist and marked by a line of low hills. Therefore it is this line of hills which also mark out the line of the fault. The fault can be traced from the South Lochs district of Lewis, to Habost and from Balallan north east to Traigh Mhor beach, north of Stornoway.

Following the Laxfordian event and the formation of the Outer Hebrides Fault, the Lewisian gneisses were enclosed within the large continent of Laurentia (roughly corresponding to present eastern America) and were isolated from mountain building and volcanic areas. This has meant that the gneiss has not recorded any activity for many hundreds of millions of years until the Caledonian Orogeny which spanned the Ordovician and Silurian periods (480-400 mya). The collision of the continents of Laurentia with Avalonia and Baltica, which included Scotland, England and Scandinavia produced a mountain chain from North America, across the Scottish Highlands to Scandinavia and were as high as the Alps or even the Himalayas. In the Outer Hebrides only minor movements occurred on the fault as the continents carrying what would be the islands lay well to the west of the zone of mountain building. The main result of the Caledonian Orogeny was the uplift of the crust on which mainland Scotland was situated and this exposed the Lewisian gneiss to erosion.

During the Permian and Triassic periods (299 – 200 Ma) Scotland lay within the supercontinent of Pangaea and had a hot, arid climate with periodic severely wet intervals. Rivers carried sand and pebbles to form conglomerate fans in the area now occupied by the Minch which is the sea between Scotland and the Outer Hebrides. Most of the fans are under the sea but a small area around Stornoway, on Lewis demonstrate the pebbly nature of the sediments.

The Jurassic period is not represented in the Outer Hebrides but sediments of this age are present in North Skye and fossils are very common in these areas. In fact, it is the rocks of this age that are the sources of oil and gas in the Atlantic west of the islands.

Very little disturbance occurred to the Outer Hebridean rocks from the end of the Triassic (200 Ma) until just after the start of the Palaeogene (60 Ma). It was soon set to change, however! 60 million years ago huge tectonic disturbances caused thinning and stretching of the crust on which Scotland was situated. Magma welled up and many volcanoes developed where it reached the surface and large areas of lava spread out over the Scottish and Irish areas. Again, the magma was not able to force its way through the ancient gneisses of the Outer Hebrides except in a few isolated places, notably the Shiant Isles, 30 km east of South Harris where the lava formed dykes very similar to the Scourie dykes. The magmas that produced these Tertiary volcanoes were later exposed by erosion and now form the Black Cuillin and Red Mountains of Skye, and mountains in Rum, Arran and Mull. Only two outcrops occur in the Outer Hebrides with the granite remnants of the inner depths of these

volcanoes forming the archipelago of St. Kilda, 65 miles west of Benbecula and Rockall which lies 185 west of St. Kilda. The volcanic activity lasted for about 10 million years but no evidence of the lavas can be seen in the island chain.

The volcanic episode was followed by erosion and weathering which continued through the late Palaeogene and much of the Neogene (60-7 Ma) but at about this time, the climate cooled and the first period of glaciation started to take hold – ice sheets began to advance from Greenland to cover Scotland and northern England down to the Midlands. In the Outer Hebrides, the ice was many kilometres thick and caused much erosion. In the southern UK it is possible to determine the number and extent of ice advances but in the Outer Hebrides all the evidence has been destroyed by the latest advances. There is, however, sediment in the sea around the islands which drill cores have shown to have originated from at least three glaciations. The ice last peaked at about 22,000 years ago, flowing off an ice-cap on south Lewis and Harris. Everywhere on the islands there is evidence of glaciation but it all dates from the latest and is typified by the classic 'cnoc-and-lochan' scenery – innumerable small ice-scoured basins filled with water and peat bog while the rock is covered by thin vegetation such as sphagnum moss, coarse grasses, bilberry and stunted gorse. The eastern sides of North and South Uist and Benbecula are typical of this scenery and north Lewis is particularly bleak with the peat bogs formed on the poorly draining glacial till that covers most of the island and North Harris. In fact, one of the enduring features of Lewis and Harris are the extensive peat diggings, most still worked using traditional cutting tools and left to drain in long lines and then stacked in 'beehive' shaped mounds so that the peat dries out in the winds that sweep the islands.

In stark contrast to the rolling peatlands of Lewis, North Harris is quite mountainous with large areas of bare rock. Although they are considered as two islands, Lewis and North Harris are one island and joined to South Harris by a narrow neck of land at Tarbert. A dotted line on the map is the boundary between Lewis and North Harris although the locals and their ways of life are very much more independent than you would expect from a dotted line! This is rooted in the geology and topography – the contrasts between Lewis and the Harris islands is quite distinct. As one travels over the 'dotted' line the terrain changes from the rolling peatlands to mountains, lochs and fjords. The mountain sides are bare of vegetation and often scree covered - the legacy of glacial weathering which has also left corries and glacial valleys.

Apart from the geology, the other dominant feature of the Outer Hebrides is the weather with the wind having an abnormally big influence on life in the Islands. The strong westerlies blow the sand that has been brought up by the sea into a low lying and gently sloping, very fertile landscape called the machair. Lines of dunes formed by extreme winds become vegetated with marram grass while the finer sand is blown further inland to form broad flat grassy areas. It is a fragile environment! During most autumns and winters, flooding of the machair is common and sand is frequently stripped off the dunes and exposed fields, taking many years to regenerate. Much of the machair is crossed by brackish streams with freshwater lochans, rhynes and ditches separating the fields and farms. Sheep are the dominant stock but dairy and beef cattle are farmed on the more fertile machair. This fragile environment supports a unique flora and fauna. Rare birds such as the corncrake can be heard in spring and summer along with the commoner wetland species while the

waterways entice many species of ducks and waterfowl. Marshland birds of prey such as Marsh Harrier and Montague's Harrier are attracted by the rich source of food particularly during the nesting and fledgling seasons. The mountains of Harris and the hills of the Uists and Benbecula provide cover for Golden and Sea Eagles. The waterways of the machair and lochans provide the ideal habitat for sea otters with only the patient, lone watcher favoured with their playful presence. The beaches of the western side of the islands are covered by long stretches of golden white sands with clear turquoise sea free of people except for the occasional lonely walker.

Photo 8: Machair on Benbecula

The hardness of the Lewisian gneiss has ensured its preservation and longevity, having survived two periods of magma attack, one at about 2000 Ma and a second at the start of the Tertiary era, 60 Ma. Its hardness was not lost on the locals either. Around 4000 years ago, Stone Age inhabitants erected a large number of standing stones throughout the islands, with the most beautiful and extensive at Callanish on the west coast of Lewis. A central monolith of gneiss *(Photo 9)* is surrounded by a circle of 13 smaller stones with avenues leading off to north, south, east and west. The stones have been split along the cleavage with the banding showing clearly on the rough sides. Some miles to the north at Clach an Trushal on the north-west coast, a single monolith of gneiss stands 20 feet high and is the tallest standing stone in Scotland *(Photo 10)*.

In the Iron Age 2000 years ago, gneiss was still the only building stone and its use is beautifully displayed in the brochs which are found all over the islands *(Photo 11)*. The most impressive is at Carloway where it occupies a defensive position overlooking Loch an Duin. It was probably the defensive

Photo 9: Callanish central monolith

Photo 10: Clach an Trushal monolith

home of a tribal leader and is built with two concentric walls with a stairway between the inner and outer walls leading to an upper floor or gallery which is considered to be the living quarters. The blocks of gneiss have been intricately shaped and fitted together to form a weather and wind-proof building. Large flat blocks have been placed over and around the entrance to form an easily protected doorway in case of attack – a not infrequent event in those turbulent times. The brochs were widespread across the islands but, once they had served their purpose and fallen into ruins, they were quarried by the population for their own houses. The traditional Hebridean dwelling is the blackhouse *(Photo 12)* of which a number exist on the islands and are in varying conditions – some are restored while some are used as outhouses. Built of gneiss blocks they are long, low narrow cottages which are thatched with reed kept in place by coarse netting weighted down along the edges of the cottages with cobbles. Originally, there was a central chimney to allow the smoke to rise from the cottage but the insides were blackened by the smoke and it is thought that this gave them the name 'blackhouses'. Often the interiors were divided with the crofters living in one end and the farm animals in the other – a cheap source of heat. The most impressive restored blackhouses are at Gearrannan where the crofting way of life, including weaving of Harris Tweed on foot operated looms in small dark rooms, has been re-created along with the interior rooms in their traditional form. It was only when the Victorians developed the rail and road network in Britain, making building stone much cheaper and easily available that alternatives became available to the Islanders.

Photo 11: Carloway Broch

Photo 12: Blackhouses at Gearannan

The Outer Hebrides, due to a couple of 'quirks' of geology – the resistance of the gneiss to two periods of magma intrusion and the position of the islands well away from tectonic activity for an immense period of time - have one of the longest histories in the world and it is entirely due to the geology. The weather is a big factor of life in the islands with storm force winds of 100 to 130 miles an hour not unknown during autumn and winter with huge mountainous seas washing over the lowest parts of the islands. Travel between islands is entirely dependent on the ferries and weather regularly disrupts the services and as a consequence, life and work, much of it to do with the sea. It is not surprising, then that the inhabitants of the Outer Hebrides are a very hardy and resilient race, proud of their way of life and traditions. The islands have been around for over 3000 million years and are likely to stay for many millions to come.

All Photographs by Charles Hiscock

FROM THE BUTT TO BARRA
An updated and alternative history of the gneisses of the Outer Hebrides

In 2005, Kinny et al. proposed a new concept for the origins of the Lewisian Gneiss Complex of the Outer Hebrides. It is proposed that it is composed of a number of terranes which became amalgamated during Proterozoic times. A terrane is a distinct group or area of rocks that has experienced a geological history different to surrounding groups or areas. Each terrane is subjected to an accretionary period, followed by metamorphic and deformational phases. During subsequent geological time through the agency of plate tectonics, the terrane joins to others so that from there on, they experience a common history. The terrane boundaries are displayed as shear zones where the detachments and collisions occurred. Some of these sutures remain active and others are reactivated in later times.

In the Outer Hebrides the concept recognises four separate terranes of Archaean continental crust and younger Proterozoic island arcs. The ages of these disparate blocks of rocks have been determined by single zircon dating and other uranium-bearing minerals, providing very precise ages, many of which have been found to differ from the ages determined by earlier workers and techniques. Another feature that has been found is, contrary to earlier proposals, the basement rocks, although similar lithologically to the mainland rocks of NW Scotland, show quite different ages. The Outer Hebrides Fault zone divides the rocks of the Lewisian Complex from north to south but the rocks on the east side of the fault suggest ties with the mainland while those on the west side, in which most of the islands lie, show similarity with the rocks of eastern Greenland.

The Outer Hebrides have been shown to consist of three terranes west of the fault zone. From north to south they are –

- Nis terrane – a narrow slice of Palaeoproterozoic plutonic rocks (1870-1860Ma) 200 metres wide at the Butt of Lewis. They show great deformation and meta-morphosis and there is a narrow band of white anorthosite near the Ness on the north east side of the Butt.

- Tarbert terrane – Archaean basement gneiss extending over most of Lewis from its boundary with the Nis terrane to the Langaval shear zone on South Harris, which lies just south of Tarbert.

- Roineabhal terrane – a number of units of volcanic and meta-sedimentary rocks which lie as two narrow belts on the north and south sides of the South Harris Igneous Complex which itself has intruded in narrow bands into the metasediments. The Igneous Complex is composed of the Roneval anorthosite and the Scarista tonalite.

- To the south of the Roineabhal terrane and to the west of the Outer Hebrides Fault Zone is the Uist block of Archaean basement gneisses which extend to the south of Barra.

Fig. 1 shows diagrammatically the terranes and blocks. The concept seeks to explain the reasons for seemingly disparate blocks of Archaean basement lying together, separated by shear zones.

P. D. Kinny et al. J. Geol. Soc. Of London Vol.162 2005 pp175-186,

Proposal for a terrane-based nomenclature for the Lewisian Complex of N.W. Scotland.

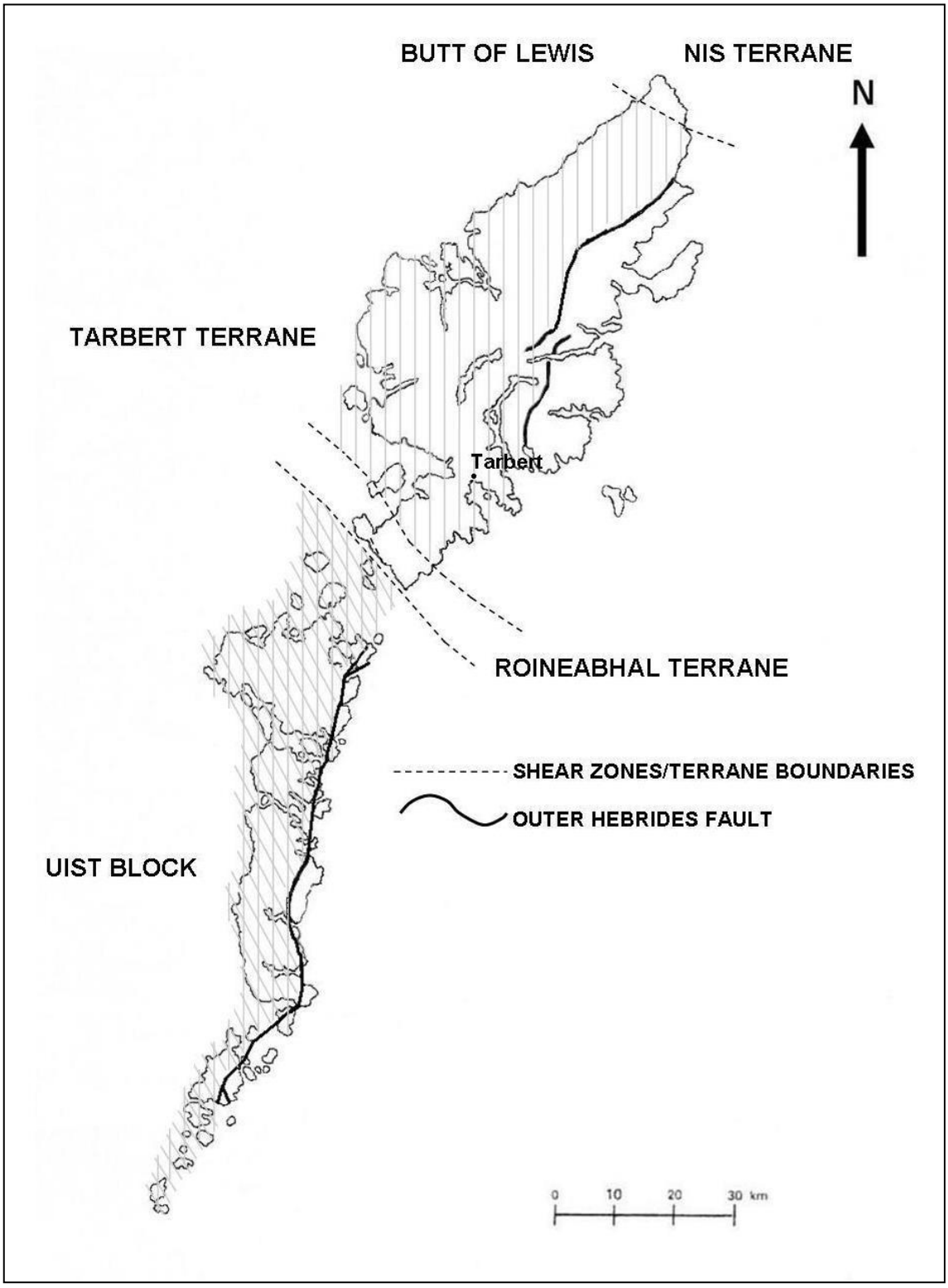


Fig. 1: Distribution of the terranes of the Outer Hebrides