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The Geological Assets of Broadford and Strath:

Statement of Significance and Identification of Opportunities

Geology and Landscape (Northern Britain) Programme

Report CR/06/075N

BRITISH GEOLOGICAL SURVEY

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Front cover

Loch Coruisk and the Cuillin Ridge from Sgurr na Stri. Photographer: David Stephenson. BGS photo P524073, © NERC 1984

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Summary

This report has been prepared for the Broadford and Strath Landscape Partnership scheme, in order to identify the main geological assets of the Broadford and Strath area, pick out key sites, and suggest opportunities for interpretation.

1 A brief Geological History of Broadford and Strath

The Broadford and Strath district has a long and varied geological history, which stretches back thousands of millions of years, into the Precambrian. The presence of a number of different rock types, formed by many different processes, is dramatically reflected in the varied landscapes of the area. This section provides a summary of the geological events that formed this landscape.

The oldest rocks in the district are a small patch of Lewisian gneisses, which can be seen on the northern slopes of Beinn Dearg Mhór, and which may be almost 3000 million years old. However, the main geological story of this area started around 1000 million years ago, when Scotland was part of a major supercontinent, and was much closer to the equator than now. Rivers flowing across this continent carried sand and pebbles, eroded from mountains in the centre of the continent. At that time, there was no vegetation, and so the rivers spread out across wide flood plains, depositing huge thicknesses of mud, sand and pebbles. These sediments were eventually compressed and cemented together to form a sequence of rocks known informally as the ‘Torridonian’. In fact, they include two rather different units: the Sleat Group, which only occurs in the very eastern part of the Broadford and Strath district; and the Torridon Group, which is made up of red sandstones and can be seen mainly to the south-east of Broadford and on the island of Scalpay.

Around 600 million years ago, the supercontinent began to break up, and a new ocean developed. Scotland now lay on the very edge of a continental mass that also included Greenland and North America. During the Cambrian Period, about 540 million years ago, pure quartz sands were deposited in the intertidal zone along this continental margin. These now form quartzites of the Eriboll Formation, which can be seen at a few localities near Boreraig.

Scotland remained on the continental margin into the early part of the Ordovician Period, and during this time a thick sequence of carbonate sediments formed in shallow seas on the continental margin. The carbonate rocks are dolostones (composed of the magnesium carbonate, dolomite), and they are termed the Strath Suardal Formation. They crop out in the lower ground to the north and south of Kilchrist, where they form areas that are covered in lush green grass and trees rather than heather and bracken.

Carbonate deposition was halted by massive tectonic movements related to the collision of other continental fragments with Scotland. This continental collision led to the formation of a great mountain range, and to intense deformation of the rocks of most of the Highlands. However, the Broadford and Strath district lay just far enough to the west to avoid this deformation. Following

the continental collision, volcanoes erupted in many locations across Scotland, but the only evidence for this volcanic activity in Skye is the presence of a few dykes of igneous rock.

The next important phase in the history of this district began during the Triassic Period, when Skye had a warm tropical climate, and sands and pebbles were deposited from rivers in low-lying valleys. These sedimentary rocks are known as the Stornoway Formation, and they crop out to the south of Broadford.

By the start of the Jurassic Period, about 205 million years ago, shallow seas had flooded much of western Scotland. These seas were teeming with life; corals, bivalves, and ammonites have been found as fossils in the sandstones, limestones and mudstones that were formed at this time. Dinosaurs were also present in the area, and dinosaur bones have been found in Strath. These Lower Jurassic rocks crop out around Broadford Bay, and form an arc extending down to Rubha Suisnish; they also occur on the island of Pabay.

Fossil-rich sands and muds continued to be deposited in shallow waters and deltas throughout the Middle and Upper Jurassic (180 to 140 million years ago). These rocks are well exposed around Elgol and on the eastern side of the Strathaird peninsula. During the Cretaceous Period, from 140 to 65 million years ago, much of Britain was covered by a shallow sea, in which the Chalk of Southern England was deposited. Most deposits formed at this time in Scotland have been eroded away, but in Broadford and Strath a few small outcrops of Cretaceous limestone and sandstone occur around the slopes of Beinn Leacach, and to the south of Strollamus.

At the beginning of the Palaeogene Period, 65 million years ago, a major change occurred in the Broadford and Strath district. The Earth’s crust began to be stretched and thinned, as North America and Greenland began to move slowly away from Europe; a process that would eventually lead to the formation of the North Atlantic Ocean. Magma (molten rock) welled up from deep in the earth, rising to the surface along fractures that developed in the stretching crust. About 61 million years ago, this magma was erupted from volcanoes to form lava flows. Most of the erupting lava was basaltic in composition, very similar to the lava that is erupted from volcanoes on Iceland or Hawaii today. In the Broadford and Strath area, the lavas are best exposed on the hills to the south and east of Bla Bheinn, including Belig, An Stac, and Beinn Leacach.

Beneath the erupting volcanoes, large volumes of magma were present in magma chambers, probably a few kilometres below the surface. When the volcanoes ceased to erupt, the magma cooled slowly in these magma chambers to form coarse-grained igneous rocks called gabbros. These are iron- and magnesium-rich rocks that have a similar chemical composition to some of the erupted basalts. The jagged Cuillin ridge is composed of gabbros, which form a series of

arcuate intrusions that contain different minerals; for example, most gabbros contain the minerals plagioclase, pyroxene and olivine, but gabbros that are simply composed of plagioclase and olivine are known as troctolites. Several different types of gabbro are well exposed on the hills around Loch Coruisk and on Bla Bheinn. These gabbros are cut across by many sheets of finer grained igneous rock, formed when ascending basalt magma cooled in fractures. These sheets take on two forms: dykes, which are almost vertical; and cone-sheets, which have the form of an inverted cone and so appear roughly circular on the ground. They are typically eroded away to form notches and ledges in the gabbro rock-faces.

The last volcanic activity in Broadford and Strath seems to have been very explosive in nature, with the rocks surrounding the volcanic vent being broken up and fragmented by the explosion of gases from within the magma. This activity formed breccias, composed of angular fragments of basalt and gabbro surrounded by fine-grained volcanic ash. These breccias can be seen in Strath na Creitheach and at Kilchrist.

The youngest of the important rock units in the Broadford and Strath area are granites, formed when silica-rich magma cooled and crystallised at depth in a magma chamber. Three separate areas of granite magmatism have been distinguished; from oldest to youngest, these are the Strath na Creitheach, Western Red Hills, and Eastern Red Hills centres. The granites form rounded red hills, including Ruadh Stac, Glas Bheinn Mhór, Beinn na Caillich and Beinn an Dubhaich. In some places, the silica-rich granitic magma mixed with basaltic magma to form a suite of hybrid igneous rocks; these are best seen on Marsco.

Intrusion of so much hot magma led to metamorphism of the rocks immediately surrounding the magma chambers. This metamorphism is most distinctive around the Beinn an Dubhaich Granite, which was intruded into dolostones of the Strath Suardal Formation. These dolostones were metamorphosed to form the marble which is today quarried at Torrin.

Volcanic activity on Skye ceased about 55 million years ago, when the focus of volcanism ‘jumped’ to the west of the Outer Hebrides as the North Atlantic began to open. Rapid uplift and erosion of the land surface meant that many of the igneous rocks, which had been formed at depths of a few kilometres, became exposed at the surface. From about 2.6 million years ago, the climate cooled considerably and the landscape of the area began to be sculpted by ice, with the formation of corries, knife-edge ridges, and U-shaped valleys such as the Coruisk basin. A number of cold, glacial periods occurred, separated by warmer interstadials. At the peak of the last major glacial period, about 20,000 years ago, almost all of Broadford and Strath was covered by ice; only the highest peaks, such as Bla Bheinn, formed nunataks that were not ice-covered.

Features such as glacial striae have shown that the Cuillin peaks had their own ice cap, and that the mainland ice sheet flowed around them.

About 14,700 years ago, the climate began to warm, and the ice on Skye melted rapidly. Melting of the great ice sheets released water, leading to higher sea levels, and some of the beaches formed at this time are now raised 15-30 m above modern-day tide marks. Examples can be seen to the east of Broadford. Vegetation recolonised much of the land, with the lower ground being covered in heather, birch and juniper. Pollen from these plants was washed into lochs, to be preserved in mud and peat. Much of our knowledge about the vegetational history of Broadford and Strath comes from pollen collected from Loch Ashik, to the east of Broadford.

Around 12,500 years ago, during a period of cooler temperatures known as the Loch Lomond Stadial, glaciers formed once again in the high corries of both the Cuillin and the Red Hills. These glaciers flowed out to reach the sea at several places, including Loch Slapin, Loch Scavaig and Loch Ainort. They carried large amounts of gravel and rock debris, which were deposited when the glaciers melted to form large areas of hummocky moraine, which can be clearly seen in Strath Mór and around Loch Slapin. Smaller glaciers, such as that of Coire Fearchair on Beinn na Caillich, formed sharply defined arcuate terminal moraines composed of large boulders. Where the glaciers flowed over hard and resistant rocks, such as the gabbros around Loch Coruisk, the bedrock was scoured and smoothed, and glacial striae were formed. On the hill summits above the glaciers, freeze-thaw processes broke up the rock to form boulder screes like those of Beinn na Caillich.

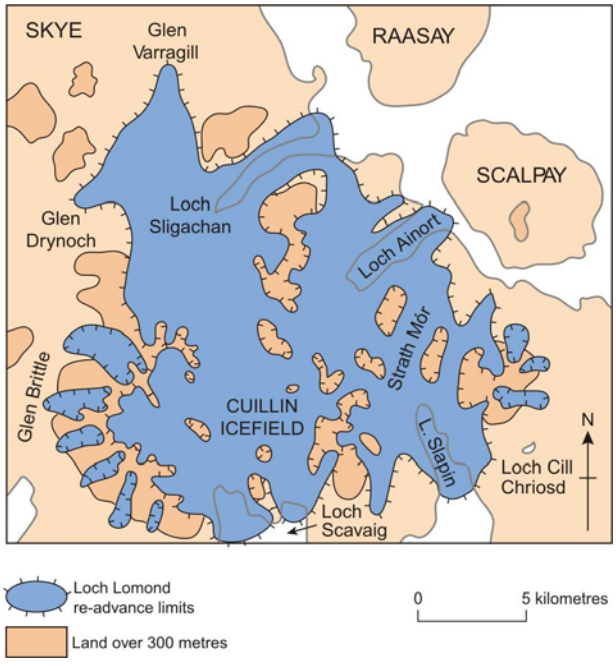

Figure 1: Limits of Skye glaciers during the Loch Lomond Stadial. Image prepared by BGS, © NERC 2005

By about 11,500 years ago, the ice had all melted. With the weight of the ice removed, the land slowly began to rise – a process known as isostatic rebound. Around the Strathaird peninsula, many of the sea stacks and caves are associated with a raised rock platform some 5 m above sea level; these features are thought to have formed during the Loch Lomond Stadial and to have been subsequently raised to their current height.

Evidence from Loch Ashik shows that after the ice had melted, birch and hazel woodland covered the lower ground, with some elm and oak trees. Scots pines were abundant around 4,000 years ago, but after that time much of the ground to the east of the main hills became covered in peat bog that still exists today. Following this, the main landscape changes in the Broadford and Strath area would have been directly related to the effects of man.

2 Geological and landscape character of distinct areas in Broadford and Strath

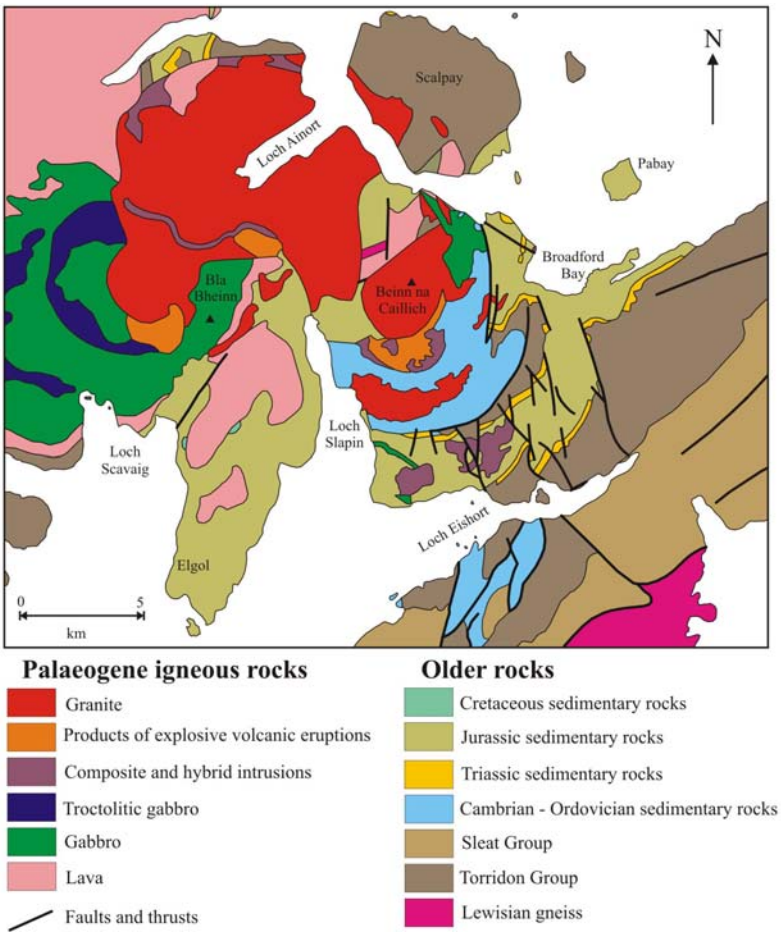

Figure 2: Sketch geological map of the Broadford and Strath area. This is highly simplified; more detail can be found in the 1:25,000 Skye Central Complex and 1:50,000 Broadford (Scotland Sheet 71W) geological maps.

2.1 DRUIM HAIN AND SGURR NA STRI

The lower hills (up to 500 m) between Loch Coruisk and Strath na Creitheach contain some of the most easily accessible exposures of the Cuillin gabbros. The central part of the Cuillin Centre comprises a series of nested, arcuate gabbro intrusions. These are well exposed on Sgurr na Stri and around the outflow from Loch Coruisk, and where the path from Coruisk crosses the Druim Hain ridge. The gabbros show spectacular layering structures, with darker layers that are rich in minerals such as olivine and pyroxene, and paler-coloured layers that are rich in plagioclase feldspar. Early workers believed that the layers simply formed by settling of crystals onto the floor of the magma chamber, but continuing research has led to a number of different theories being put forward to explain the formation of layering in igneous rocks. The outcrops around Loch Coruisk can be easily reached by boat, and so represent some of the most accessible exposures of layered gabbro anywhere in the British Isles, being regularly visited by international researchers.

Dykes and cone-sheets cut across all the gabbros in this area, but they are particularly distinctive on the slopes of Sgurr na Stri. Here, the dykes have been eroded into steep gullies, whereas the cone sheets form ledges that dip northwards into the hillside. The southern, lowermost slopes of Sgurr na Stri are formed of basalt lava.

Loch Coruisk itself is of great importance for its classic glacial features, including its steep, ice-scoured rock walls, striated and ice-smoothed slabs around the loch, and roches moutonnées that indicate the direction of ice-flow. The area is still geomorphologically active, with the scar of a recent major rock-fall visible on the cliffs on the north-east side of Loch Coruisk.

2.2 STRATH NA CREITHEACH AND MARSCO

Strath na Creitheach has a typical glaciated U-shape, with steep, rocky slopes rising above a relatively flat-bottomed valley. The area's best outcrops of rocks formed by explosive volcanic eruptions occur on the steep slopes around the northern end of Loch na Creitheach. These rocks contain large angular blocks of gabbro and basalt, surrounded by a finer grained matrix formed from volcanic ash. They are cut across by granites of the Strath na Creitheach Centre, which form the low hills of Meall Dearg and Ruadh Stac. The granites weather to white or pinkish colours, and form an obvious contrast with the darker gabbros in the view from Glen Sligachan.

The peak of Marsco is also largely composed of granite, forming the southern part of the Western Red Hills Centre. Part of the summit ridge is capped by gabbro, providing evidence that the granites were intruded into the earlier gabbros from below. However, the main geological importance of Marsco lies in a 'ring-dyke' (a dyke with a broadly ring-shaped outcrop) formed

of rocks known as the Marsco Hybrids. The ring-dyke is exposed in a prominent gully on the northern side of Marsco, known to geologists as ‘Harker’s Gully’. The rocks here were clearly formed by the mixing of basaltic magma and a more silica-rich, granitic magma. These rocks were first studied by Harker in 1904, and are internationally known as classic examples of rocks formed by magma mixing.

2.3 BLA BHEINN, GARBH BHEINN, AND BELIG

The peaks of Bla Bheinn and Garbh Bheinn form the easternmost outlier of the Cuillin Centre, separated from the main Cuillin ridge by the cross-cutting granites described above and by the deep glen of Strath na Creitheach. In contrast, the lower peaks of Belig and An Stac are composed of basalt lava, which rests upon Jurassic-age sandstones and mudstones.

The rocks of this part of the district are well exposed close to the main Bla Bheinn path. In the lower levels of the Allt na Dunaiche are outcrops of Jurassic-age sandstones, mudstones, and limestones, cross-cut by a number of dykes. Above and to the south of the path, the cliffs of An Stac are composed of basalt lavas, cut by abundant dykes that form steep gullies. Where the path begins to ascend more steeply into Coire Uaigneich, it crosses outcrops of white-weathering igneous rock, with many inclusions (xenoliths) of gabbro and basalt. These outcrops belong to a ribbon-shaped body of granitic rock, known as the Coire Uaigneich Granophyre. Higher in the corrie, it is cross-cut by a number of dykes; this shows that this is one of the oldest granitic bodies in the area, since the younger granitic centres are cut by very few dykes.

Continuing upwards, the route to Bla Bheinn crosses outcrops of basalt lavas that have been metamorphosed by the heat of intrusion of the nearby gabbro. The steep cliffs of Bla Bheinn and Garbh Bheinn are formed of layered gabbros, similar to those seen on Sgurr na Stri, with abundant cross-cutting dykes that form steep scree gullies.

2.4 THE STRATHAIRD PENINSULA

Outcrops on the southern part of the Strathaird peninsula are chiefly of Jurassic-age sedimentary rocks, together with small areas of rocks formed during the Cretaceous, capped by more resistant basalt lavas of Palaeogene age on the hills of Slat Bheinn, Beinn Leacach, Ben Cleat and Ben Meabost. Both the sedimentary rocks and the lavas dip gently westwards, so that the hills have steep eastern cliffs but gently dipping western slopes. The sedimentary rocks can be studied along the coast north of Elgol, which provides an excellent section through Middle to Upper Jurassic sandstones, mudstones, and limestones, cut by later dykes. A well-known feature is the line of cliffs of pale-coloured sandstone with conspicuous ‘honeycomb’ weathering, immediately

to the north of Elgol village. In these sandstones, hard quartz grains are cemented together by calcium carbonate, which has been dissolved away to give the honeycomb appearance. The rocks on the beach below these sandstones are mudstones, which contain fossil fish scales and other fossils such as bivalves and gastropods. Many of the sedimentary rocks in this area contain abundant fossils, including bivalves, brachiopods and belemnites. Of particular interest to palaeontologists are the mudstones of the Kilmaluag Formation, which contain fossils of small amphibians, reptiles and mammals that lived around the lagoons in which the mud was deposited.

The hills of the Strathaird peninsula have a stepped appearance known as ‘trap topography’; this forms because the top of each individual lava flow is broken up and easily weathered, whereas the central parts of the lava flows are harder and more resistant. At least 15 flows can be recognised from the ‘steps’ on Beinn Leacach; some of the flows are paler in colour because they formed from magma that was richer in silica.

Close to the village of Glasnakille is the famous Spar Cave, formed by erosion along joints and dykes in Jurassic-age sedimentary rocks. Water flowing through the rocks has dissolved calcium carbonate, precipitating it to form structures such as stalagtites and stalagmites within the cave.

2.5 THE EASTERN RED HILLS CENTRE

The hills of Glas Bheinn Mhór, Beinn na Cro, and the Beinn na Caillich group are largely formed from granites of the Eastern Red Hills Centre. These are the youngest major intrusive bodies on Skye, with the granite of Beinn na Caillich being the youngest of all. The granites form rounded, red-weathering hills, typically covered in large amounts of boulder scree.

A number of other igneous rock-types are also associated with the eastern Red Hills. An area of gabbro, known as the Broadford Gabbro, covers an area of about 3 km^2 to the north-north-east of Beinn na Caillich; it has neither the spectacular layering, nor the topographic expression, of the gabbros of the main Cuillin Centre. The north ridge of Beinn na Caillich is made up of basalt lavas. The cliffs of Creagan Dubh have Lewisian gneisses, the oldest rocks in the district, at their base; above the gneisses is a thin unit of volcanic rocks, which includes both volcanic breccias and the most silica-rich lavas in the area. These are probably related to the volcanic rocks of Kilchrist (see section 2.6).

The eastern part of the Red Hills was the eastern-most part of the district to be glaciated during the Loch Lomond Stadial. Small corrie glaciers developed in the eastern corries of Beinn na Caillich, and a particularly good example of a terminal moraine can be seen in Coire Fearchair.

To the west, particularly in Strath Mór and Coire Choinnich, the melting glaciers deposited hummocky moraines.

2.6 STRATH SUARDAL AND TORRIN

The broad glen of Strath Suardal contains the best exposures of the Strath Suardal Formation, a sequence of dolostones of Ordovician age, which are folded into a broad anticline. Dolostones are commonly associated with rich, green, grassy swards, and this area is no exception, Strath Suardal meaning ‘the dale of green pasture’. The dolostones crop out in the glen and on Ben Suardal, and also on the southern side of Beinn an Dubhaich. They have a grey weathering colour, and are commonly associated with layers or nodules of white chert. Many of the exposures show the typical weathering patterns of carbonate rocks, with deep notches (grykes) separating areas of up-standing rocks (clints). The ease of dissolution of carbonate rocks means that a number of caves are found in this area.

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 the fibrous mineral serpentine, whilst darker-coloured masses are made up of crystals of the magnesium-rich mineral, 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 zones are known as skarns. Some of the skarns consist almost entirely of magnetite, an iron oxide, and are red-brown in colour due to oxidation (rusting). At a few locations, the skarns contain a variety of rare minerals that indicate the presence of boron and fluorine in the granitic magma.

To the north of Kilbride, the lower slopes of Beinn Dearg Bheag are underlain by a variety of rocks that were produced by explosive volcanic activity. The majority of the volcanic rocks are breccias, which contain blocks of igneous rocks (including granite, gabbro and basalt) as well as blocks of the surrounding sedimentary rocks, all enclosed in a matrix of fine-grained volcanic

material. Also exposed in the area are thin layers of tuff and ignimbrite, which are the deposits of explosive volcanic activity. On the north side of Loch Cill Chriosd, the volcanic rocks are cut by intrusions that provide evidence of mixing of two magmas, as at Marsco (section 2.2).

On the northern slopes of Ben Suardal, and in Glen Suardal, red sandstones of the Torridon Group have been thrust over the dolostones. Around Broadford, the Torridon Group sandstones are overlain by much younger sedimentary rocks in a synclinal fold (see section 2.7).

2.7 BROADFORD BAY TO RUBHA SUISNISH

Triassic and Jurassic sedimentary rocks crop out around Broadford Bay, on the island of Pabay, and in a broad synclinal fold on an arcuate ridge running southwards from Harrapool to Rubha Suisnish. These rocks lie on top of much older rocks, mainly of the Torridon Group; the contact between the two units is an unconformity, representing a period of 'missing' time. On the coast just south of Camas Malag, the Jurassic rocks rest on dolostones of Ordovician age and here the cracks (grykes) in the dolostones have been infilled by Jurassic sand and pebbles. This is an excellent example of an unconformity; it provides evidence that the dolostones had been exposed on land and weathered, producing clints and grykes, and that they had then been flooded by the sea in which the Jurassic sediments were deposited.

The rocks at the base of the Broadford sedimentary sequence are thin red sandstones of Triassic and earliest Jurassic age. These are overlain by Lower Jurassic sandstones and mudstones with thin limestones, which belong to the Breakish and Ardnish Formations, and are best exposed around Broadford. These rocks contain a number of fossils, including corals, bivalves and ammonites. The fossil tibia of a carnivorous dinosaur has also been found in these rocks. Although the sediments were originally laid down in the sea, they were probably fairly close to a shoreline along which dinosaurs roamed.

The island of Pabay is the best locality for the overlying Pabay Shale Formation, a thick unit of dark-coloured mudstone with abundant fossils that include ammonites, bivalves and brachiopods. This formation is also well exposed around Rubha Suisnish, and the different ammonites found there have been correlated with others found around the world to establish the ages of these rocks in some detail.

The Jurassic rocks are cut by many igneous intrusions, including abundant dykes but also a number of sills, the largest of which form the hills of Beinn nan Carn and Beinn Bhuidhe. These sills are composite; their central parts are chemically similar to granites, although finer grained, but their margins formed from magmas that were closer to basalt in composition. The most easily accessible of these composite sills occurs at Rubh' an Eireannaich, on the west side of

Broadford Bay. This sill is approximately 5 metres thick and forms an almost flat-lying sheet of igneous rock. The upper and lower parts, which are dark grey and basaltic, grade into a central part that is much paler in colour and formed from much more silica-rich magma. This sill is internationally known and has been visited by generations of students learning about igneous processes.

At Camas Malag, the pebbles of a raised beach can be seen immediately to the north-east of the present-day beach, about 8 m above sea level. This raised beach formed between about 6500 and 8500 years ago, during a period of higher sea level that is believed to have been due to the final melting of the North American ice sheets.

2.8 EASTERN PART OF THE BROADFORD AND STRATH DISTRICT

The area south of Breakish and east of Heaste comprises relatively featureless moorland, which is chiefly underlain by red-brown sandstones of the Torridon Group. The sandstones have a moderate dip to the north-west. In the very eastern part of the Broadford and Strath district, the hills above Kinloch are formed of grey-green sandstones and siltstones of the Sleat Group.

As described in Section 1, pollen preserved in sediments in Loch Ashik has provided important evidence about the vegetation of this area following the melting of the last ice sheet.

2.9 SCALPAY AND LONGAY

The islands of Scalpay and Longay are largely composed of north-west dipping sandstones of the Torridon Group, and are characterised by open moorland. The south-western side of Scalpay has exposures of the basal part of the Torridon Group (the Diabaig Formation), which here consists of interbedded sandstones and mudstones. A small area of Jurassic sedimentary rocks (mostly the Scalpay Sandstone Formation) forms the flatter ground around Scalpay House. Dykes and small granitic intrusions related to the Eastern Red Hills Centre are scattered across the island.

3 Key geological localities in Broadford and Strath

1) **Loch Coruisk [NG 490 190] to [NG 503 220]**. Exposures around the Scavaig River and on Druim Hain provide some of the most impressive and accessible examples of layered gabbro in the British Isles, and are regularly visited by international researchers. This locality is also important as an excellent example of glaciated terrain. There are no current threats to this locality.

2) **Marsco [NG 497 260] to [NG 505 258]**. Harker's Gully on Marsco is internationally known as a classic site for studying the processes of magma mixing. The exposures are relatively restricted and so hammering and sample collection should only be allowed for *bona fide* scientific research.

3) **Coire Uaigneich and Bla Bheinn [NG 530 218] to [NG 555 215]**. This locality is important for study of the contacts between the Cuillin Centre gabbros and a variety of country rocks, as well as containing excellent exposures of gabbros, dykes, cone-sheets and basaltic lavas. The Coire Uaigneich granophyre is an important feature, since it is the only granitic intrusion that appears to be truly associated with the Cuillin Centre. There are no significant threats to this locality, although it should be noted that some exposures could be hidden if the forestry plantations at the mouth of the Allt na Dunaiche were expanded.

4) **Beinn Leacach [NG 518 180] to [NG 540 170]**. Small outcrops of Cretaceous sedimentary rocks, which are rare on Skye, occur on the slopes of Beinn Leacach. Overlying these are good exposures of lavas of the Skye Lava Group, including some more-evolved lava flows. There are no current threats to this locality, although planting of dense forestry would have a detrimental effect in that the exposures could be obscured.

5) **The Elgol Coast [NG 515 135] to [NG 520 180]**. The coast between Elgol and Camasunary contains an excellent section through the Middle to Upper Jurassic sedimentary rocks of Skye. Some exposures could be damaged by excessive hammering and fossil-collecting, and so large groups should not be overly encouraged to visit this section.

6) **The Spar Cave [NG 538 128]**. This site is of importance as a geomorphological feature, particularly for the deposits within the cave. Some damage has already occurred due to the removal of stalagtites and stalagmites by tourists; this type of damage should be discouraged.

7) **Beinn na Caillich [NG 590 240] to [NG 610 230]**. The granite of Beinn na Caillich represents the youngest major igneous intrusion in Skye. These hills are also important for their glacial features, especially the terminal moraine in Coire Fearchair. This is a popular walk, but no threats are envisaged for this locality.

8) **Kilchrist [NG 585 215] to [NG 610 205]**. The south slopes of Beinn Dearg Bheag have the most easily accessible exposures of rocks formed by explosive volcanic activity on Skye, and these provide important evidence for the occurrence of this type of volcanism as well as basalt lava flows. These outcrops could be threatened by extensive forestry, which would obscure the exposures.

9) **Beinn an Dubhaich and Ben Suardal [NG 590 180] to [NG 640 220]** . The area covered by the Strath SSSI is of great geological importance, containing the best exposures of the Strath Suardal Formation, as well as unusual skarns and other metamorphic features that occur where granitic magmas have intruded into carbonate rocks. The features displayed here are internationally known and are visited by many students and researchers. The current, relatively small-scale quarrying operations do not represent a threat to the interest of the site, but any larger quarries around Kilchrist could prevent access to, or destroy, some of the important marble exposures. The skarns are small features, and could be significantly damaged by indiscriminate hammering and sample collection; this should only be allowed for *bona fide* scientific research. Extensive forestry plantations would damage the interest of the site, obscuring the exposures and removing the link between vegetation and geology that is currently so clear in this area.

10) **Camas Malag [NG 582 192] to [NG 586 180]**. The coast around Camas Malag has many significant features, including exposures of the granite/dolostone contact and outcrops of the basal Jurassic unconformity. There is also an excellent example of a post-glacial raised beach. There are no significant threats to the rock exposures at this locality, but the raised beach could be threatened by small-scale extraction.

11) **Rubh' an Eireannaich [NG 646 248]**. The composite sill at this locality is regularly visited by students and researchers, and is widely known as a classic example of its type. The main threat comes from hammering and sample collection, which should be strongly discouraged. Any development in this area should be carefully considered to ensure that it does not damage the geological interest.

12) **Broadford Bay to Ob Lusa [NG 650 230] to [NG 700 250]**. This area represents the type locality for the Lower Jurassic Breakish and Ardnish formations. Any development

on the foreshore in this area should be carefully considered to ensure that geological interest is not damaged.

13) **Pabay [NG 670 260] to [NG 680 280]**. This island is the best locality for the Pabay Shale Formation. No threats are envisaged to this site.

14) **Loch Ashik [NG 690 232]**. Sediments in this loch have provided valuable pollen information that has allowed reconstruction of the post-glacial vegetation history of this area. Any development around the loch, especially dredging or dumping, could seriously damage the interest of the site.

All the localities listed above are considered to be of at least national importance. However, certain of these can be considered to have an element of international importance, as they are visited by students and researchers from across the world. The localities that fall into this category are Loch Coruisk, Marsco, the Elgol Coast, Beinn an Dubhaich, and Rubh' an Eireannaich.

4 Identification of interpretation opportunities

4.1 WALKING ROUTES SUITABLE FOR INTERPRETATION

Many visitors to Skye come to walk, and as a result this type of interpretation is likely to be popular. Walks that could be suitable for interpretation, e.g. in the form of leaflets, are listed below.

1) **Elgol to Loch Coruisk** (or Coruisk to Elgol, using boat to get to Coruisk; only recommended for confident scramblers). A superb walk with great geology and views, but the drawback of the need to cross the Bad Step. Jurassic sedimentary rocks of the Elgol Coast; contrast between granites and gabbros in view from Camasunary; lavas, dykes and cone-sheets around Rubha Ban; gabbros and glacial features at Coruisk.

2) **Around Loch Coruisk**. Exploring the Coruisk area as part of the boat trip, with suggestions for a longer walk to be done between morning and afternoon boat trips, or as part of the walk out. This will need some warnings about river crossings. Layered gabbros, dykes and cone sheets, glacial features, contrast between gabbro and granite from Druim Hain.

3) **Marsco**. The ascent of Marsco from Sligachan. Hummocky moraine in Glen Sligachan, granite and gabbro on the summit ridge, views of the Cuillin. The rocks that formed from mixed magmas could also be described, but this is less easy to see for non-geologists.

4) **Bla Bheinn by Coire Uaigneich**. A classic route. Jurassic sedimentary rocks, lavas, the Coire Uaigneich Granophyre, layered gabbros, dykes and cone sheets, views of the gabbro/granite contrast.

5) **Beinn na Caillich**. A popular route. Granites and glacial features.

6) **Kilchrist** – **Boreraig – Suisnish – Camas Malag**. A classic walk with excellent geology. Dolostones, marbles, Beinn an Dubhaich granite, Jurassic sedimentary rocks, dykes and sills, superb views of Bla Bheinn.

7) **Broadford Bay**. Possibly not such an obvious walking route, although undoubtedly a popular area with visitors; might be better described in a leaflet on 'the geology (or natural history) of Broadford', picking out locations such as Rubh' an Eireannaich and Ardnish.

4.2 LOCALITIES SUITABLE FOR STATIC INTERPRETATION

At some localities, particularly those with superb views, there is no doubt that static interpretation boards are a simple way of passing on some information about the landscape. The following localities would certainly benefit from interpretation boards; some have them already, but they could be up-dated.

1) **Elgol harbour**. Views of the Cuillin, Jurassic sedimentary rocks.

2) **Camas Malag**. A popular viewpoint with excellent views of Bla Bheinn, but also with good outcrops of granite and dolostones.

3) **Kilchrist.** The contrast between granites and dolostones; formation of the marble. (*An interpretive board already exists here).*

4) **Broadford central car park.** Views of Jurassic sedimentary rocks, granites of the Eastern Red Hills.

5 Further Reading

EMELEUS, C H and BELL, B R. 2005. *British regional geology: the Palaeogene volcanic districts of Scotland* (Fourth edition). (British Geological Survey, Nottingham).

STEPHENSON, D and MERRITT, J. 2000. *Skye: A Landscape Fashioned by Geology*. (Scottish Natural Heritage, Perth).

TREWIN, N H. 2002. *The Geology of Scotland (*Fourth edition). (The Geological Society, London).