



GEODIVERSITY AUDIT AND ACTION PLAN

2013 - 2016



THIS PROJECT IS BEING PART FINANCED BY THE SCOTTISH GOVERNMENT AND THE EUROPEAN COMMUNITY HIGHLAND LEADER 2007-2013 PROGRAMME.

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FOREWORD

The North West Highlands Geopark (NWHG) became Scotland's first European Geopark and Global Geopark in 2004. A 'European Geopark' is a much sought after status, endorsed by UNESCO (United Nations, Educational, Scientific and Cultural Organisation) and is a clearly defined area with a geological heritage of particular importance in terms of its scientific quality, rarity, aesthetic appeal and educational value.

The first Development and Action Plan for the NWHG was prepared for 2009-2012, with a key objective to promote conservation of the geological heritage. Through the creation of a Geodiversity Audit, an Action Plan could identify priorities and actions for geodiversity within the Geopark area. In 2010, Donald Fisher was employed as GeoRanger with funding from the Highland LEADER programme and Scottish Natural Heritage (SNH), with the task of preparing this Audit and writing the first Action Plan.

This Audit provides the first comprehensive listing of key sites within the Geopark. It should not be considered an exhaustive listing but the start of documentation of the geodiversity resource. The Audit has been written in consultation with Scottish Natural Heritage and the British Geological Survey (BGS). Further comments and guidance have been provided by members of the NWHG Steering Group, which has a range of representation from the statutory, voluntary and private sectors. The Action Plan was then created and consultation carried out in a similar manner.






It should be noted though that this version of the Audit and Action Plan has not been circulated for wider stakeholder comment. It therefore has to be regarded as a consultative draft and expresses the views of the author and not necessarily those of the Geopark or any of its partners.

This document identifies actions that indicate how partners could work together to make the most of the area's geodiversity for education, interpretation and ecotourism. It also identifies where geodiversity requires greater conservation action, particularly where this is under threat.

Thanks are due to all those that have contributed to the production of this document, particularly Maarten Krabbendam and Hugh Baron at BGS, and to Donald Fisher for researching the sites and writing the audit and plan.

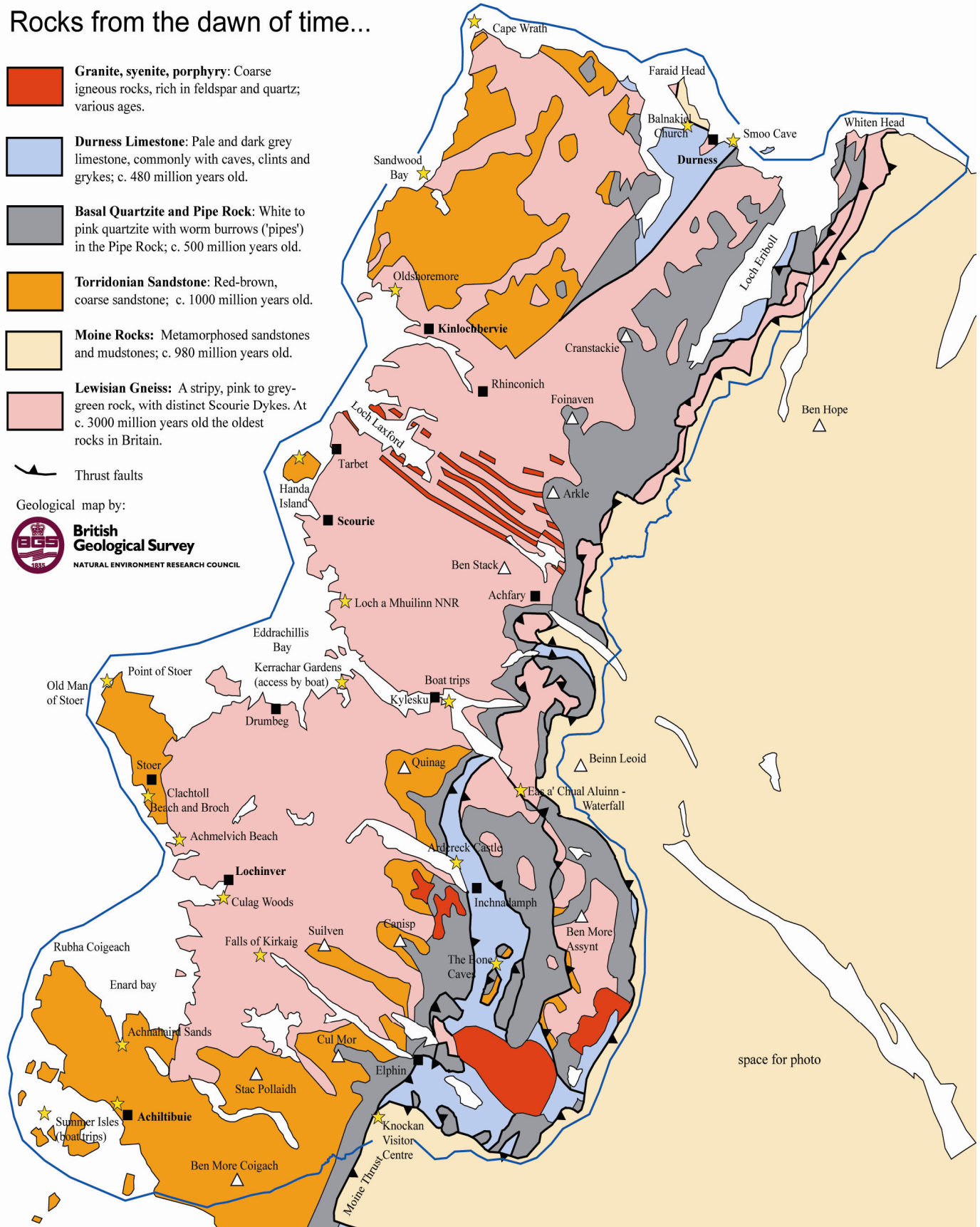
Sue Agnew, Operations Officer, Scottish Natural Heritage.

Rocks from the dawn of time...

-  **Granite, syenite, porphyry:** Coarse igneous rocks, rich in feldspar and quartz; various ages.
-  **Durness Limestone:** Pale and dark grey limestone, commonly with caves, clints and grykes; c. 480 million years old.
-  **Basal Quartzite and Pipe Rock:** White to pink quartzite with worm burrows ('pipes') in the Pipe Rock; c. 500 million years old.
-  **Torridonian Sandstone:** Red-brown, coarse sandstone; c. 1000 million years old.
-  **Moine Rocks:** Metamorphosed sandstones and mudstones; c. 980 million years old.
-  **Lewisian Gneiss:** A stripy, pink to grey-green rock, with distinct Scourie Dykes. At c. 3000 million years old the oldest rocks in Britain.

 Thrust faults

Geological map by:



space for photo

Simplified Map of North West Highlands Geopark © BGS

INTRODUCTION

The North West Highlands Geopark

Located at the most north-westerly tip of mainland Scotland, the Geopark encompasses a substantial part of the County of Sutherland and the Coigach area of Wester Ross, and it covers an area of approximately 2,000 sq.km. The boundary of the NWHG stretches from Cape Wrath and Loch Eriboll in the north to Ben More Coigach in the south. It extends eastwards from the west coast for a distance of about 30 km, to include a major geological structure called the Moine Thrust which runs along the eastern side of both Loch Eriboll and the Assynt area. The Geopark is roughly in the shape of a long, narrow rectangle, with its longer axis running approximately NNE – SSW.

The geology and landscape of the NWHG are, by international standards, outstanding. Four particular aspects of the Geopark identify it as one of the top locations for the appreciation of the Earth Sciences worldwide. These are:-

- 1) The NWHG contains some of the oldest rocks exposed today on Planet Earth. These rocks are called Lewisian Gneiss and have been dated to around 3,000 million years old.
- 2) The fundamental crustal dislocation of the Moine Thrust dominates the geology of the Geopark from north to south and is the most significant structure and best example of its type to be seen anywhere in NW Europe.
- 3) The discovery of the Moine Thrust and the early pioneering work by two 19th Century geologists, Benjamin Peach and John Horne, working from a base at Inchnadamph within the NWHG, completely transformed and advanced geologists' understanding of such structures worldwide.
- 4) The NWHG contains an outstanding suite of landforms formed during the Ice Ages which preserve an excellent record of past climate change.

The Geology and Geological Structure of the NWHG

In summary, the bedrock geology of the NWHG comprises rocks from four main distinct groups, most of which are considered to have ages in excess of 1,000 million years and occupy more than 70% of the present-day land surface of the Geopark. At the more recent end of the geological time-scale, the bedrock of the Geopark has suffered intense modification and erosion during Glacial times (around 25,000 years ago), resulting in the very dramatic (and iconic) landscape which we see today.

The oldest and most abundant group of rocks is the Lewisian Gneiss (Archaean to Proterozoic) which dates to as far back as 3,000 million years B.P. (Before Present). This is an extremely hard rock with a complex metamorphic and structural history, representing some of the earliest recorded geological rock materials still existing today at the Earth's surface, but which were originally formed by metamorphism (prolonged and intense pressure and heat) at great depths below the contemporary land surface. The Lewisian Gneisses were subsequently intruded by a group of sub-parallel dykes (the famous Scourie Dyke swarm) at around 2,400 million years B.P., followed by later

metamorphic events between 1,800 and 1,500 million years B.P. The Lewisian Gneiss is known to form the deep basement bedrock extending beneath the much later (younger) rocks occurring at the surface, further to the south and east outwith the area of the NWHG, across much of the Scottish Highlands.

Resting unconformably on the Lewisian Gneiss is the second main rock-group represented within the NWHG. This comprises relatively undeformed sedimentary strata of the Torridonian Sandstone succession (Neoproterozoic, about 1,200 to 950 million years B.P.) deposited mainly by rivers within a highly undulating contemporary landscape formed within the underlying (and now elevated) Lewisian Gneiss. The main rock-types are arkosic (feldspar-bearing) sandstones, conglomerates and mudstones/shales. Many of the dramatic and iconic mountains within the NWHG are formed of Torridonian Sandstone strata, particularly within the southern half of the Geopark. Some of the Torridonian strata preserve the oldest fossil life-forms to be found in Europe.

The third rock-group comprises much younger sedimentary strata of Cambrian and Cambro-Ordovician age (540 to 480 million years B.P.), consisting mostly of quartzites, muddy siltstones and impure (dolomitic) limestones, lying unconformably on top of the much older Torridonian Sandstone and/or the Lewisian Gneiss. The quartzitic strata typically form capping layers at the top of many of the mountains whereas the limestones have allowed a karst landscape to be developed, especially in the areas around Durness and Inchnadamph. These younger strata have, in part, been severely disrupted by later crustal dislocations along the Moine Thrust Zone, at about 430 million years B.P., when older rocks called Moine Schists (the fourth main rock-group, originating mostly as sandstones with some shales at about 1,000 million years B.P.) were pushed (or “thrust”) towards, up and over the younger strata from a starting point much further to the south-east.

It was the discovery and understanding of the Moine Thrust mechanism and its associated rock-structures, mostly by Charles Lapworth, Benjamin Peach and John Horne who were able to unravel the complex geological structures of the North West Highlands during the late 1800s, which has led to this area of North West Europe becoming a “must-see” for geologists from around the world. We now know that the Moine Thrust was the result of extreme horizontal (compressional) crustal forces which were created when a crustal plate called Laurentia (carrying Scotland) collided with two plates called Avalonia (carrying England) and Baltica at about 430 million years B.P. Also at this time, the associated crustal compression created a vast mountain chain further to the south. This Caledonian Mountain Belt stretched all the way from Newfoundland to Ireland, through Scotland and on to Scandinavia.

The present-day landscape of the NWHG is essentially a dramatic rock-scape formed as a result of successive glaciations. Long, dramatic U-shaped glacial valleys, gouged into the hardest of bedrock (Lewisian Gneiss and Torridonian Sandstone) are typical within the Geopark as are Inselbergs (or “Island Mountains”) formed by remnant ridges of Torridonian Sandstone rising above a lower platform of Lewisian Gneiss. Classic glacial moraines and fluvio-glacial features also occur.

The Purpose of the Audit and Action Plan

There is a requirement to undertake an audit of the numerous geological and related features occurring within the NWHG in order to be able to effectively manage, interpret, conserve and protect the geological heritage of the NWHG, upon which its status as a Geopark fundamentally depends. This initial audit includes all the Geological Conservation Review (GCR) sites within the Geopark, and a number of other important geological features. It should be noted that is not exhaustive, but a initial register of the key sites that creates a foundation from which to work.

Whilst there is also a related requirement to undertake an audit of the existing information (ie. interpretation, relevant scientific papers, booklets/guides, etc.), this document only identifies the key physical features that are present within the Geopark.

Geodiversity

There are several (very similar) definitions of **Geodiversity** in regular use today. The definition being adopted for the present purpose is “**the variety of geological environments, phenomena, rocks, fossils, minerals, processes, landforms and soils which underlie and determine the character of our landscape and environment and which provide the framework for life on Earth**”. Geodiversity is fundamental to almost every aspect of life. It is the bedrock of our environment and an important factor in our cultural identity. Geodiversity links people, landscape, biodiversity and culture, and is an important natural resource.

A comprehensive **Geodiversity Audit** is the most up-to-date available knowledge of an area’s geology, soils, landforms and landscapes, together with the processes and phenomena which have formed them and continue to influence them. The purposes of an audit typically include:-

- Encouraging local interest in geology;
- Increasing public awareness of Geodiversity through a range of approaches, including maps and guides, geotourism, guided walks and events, etc.;
- Engaging commerce and industry, local communities, voluntary groups and local societies in conserving the area’s Geodiversity;
- Designating and maintaining data on important local/regional geological sites;
- Identifying opportunities and recommending strategies for the conservation and enhancement of geological features;
- Ensuring that important geological sites and features are recorded, conserved and not lost to development;
- Ensuring that policies protecting Geodiversity are included in local and regional policies and strategies;
- Monitoring the condition of sites;
- Identifying and prioritising sites in need of practical conservation management;

- Improving the appearance of active and disused quarries, and managing or restoring them in a way that complements and enhances the character of the local landscape, Geodiversity and biodiversity;
- Encouraging quarry operators to prepare quarry-specific Geodiversity Action Plans and seek opportunities to report, record, conserve and enhance Geodiversity in active quarries;
- Encouraging awareness and use of local materials for repair and new-build;
- Providing education and training opportunities for local schools, higher and further education, engineers, builders and architects, local tourist guides, etc.;
- Promoting research into local Geodiversity.

The undertaking of an audit of the NWHG is clearly an important stage in the management and conservation of the Geopark. It is a pre-requisite to the development of a **Local Geodiversity Action Plan (LGAP)** which forms a vital tool in the long-term strategic management of a Geopark. This audit therefore forms the basis of the NWHG LGAP which is in Part 2 of the document. In essence, the audit provides a Geodiversity Asset Register upon which the LGAP is based.

This Audit and Action Plan has been developed in consultation with the British Geological Survey (BGS) and Scottish Natural Heritage (SNH). There may be an ongoing requirement, however, to periodically review its relevance to any local developments subsequently occurring within the Geopark and update it as is appropriate.

Part 1 – THE GEODIVERSITY AUDIT

This register of sites has been created mainly from the designated sites found in the Geopark and given a unique NWHG reference number. The maps show the location of the designated sites. There are also a number of local sites that have also been identified and included which are considered important from a geodiversity aspect. These are not identified on the maps.

Geological Conservation Review (GCR) Sites

More than 50 Geological Conservation Review (GCR) sites have been identified within the NWHG as part of the Geological Conservation Review Series undertaken between 1977 and 1990. In general, each GCR site selected is regarded as representing the best example of each aspect of geology under consideration, on the basis of its scientific value rather than its educational or historic significance. Nonetheless, GCR sites form an important component of any GA, in addition to other (non-GCR) sites which also play an important part.

Sites of Special Scientific Interest

Most of the GCR sites in the NWHG occur within Sites of Special Scientific Interest (SSSIs). It is the GCR which provides the scientific underpinning of every geological SSSI. SSSIs, supported by robust conservation legislation and protected through a range of planning measures, are extremely effective in giving legal protection to nationally and internationally important geological and geomorphological sites.

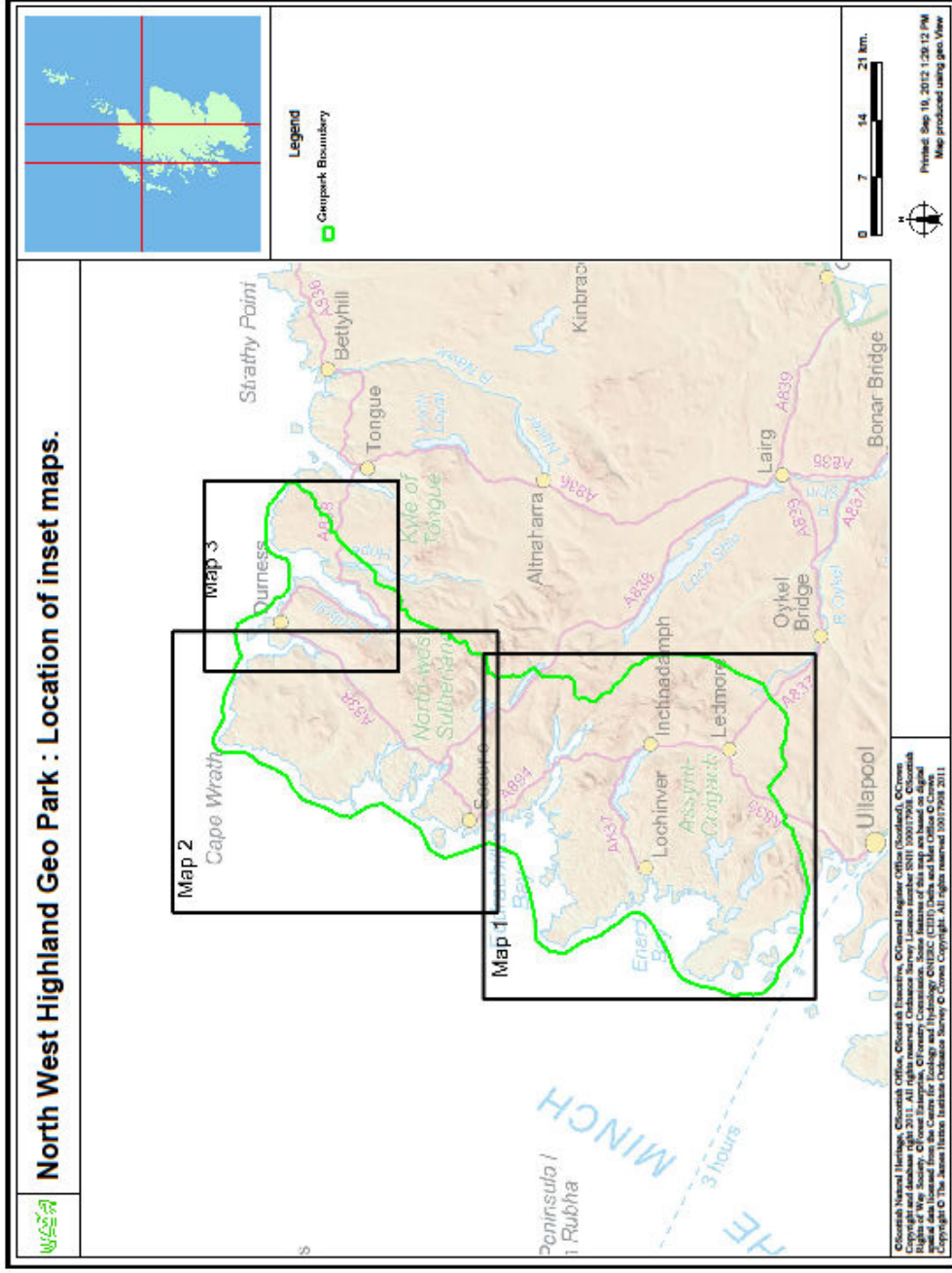
Listing and Description of Key Geodiversity Sites and Other Related Features

This audit now lists the various sites and describes their individual characteristics. Each site is considered under the following key attributes:-

- NAME OF FEATURE AND NWHG REFERENCE
- LOCATION, GRID REFERENCE AND PHOTOGRAPH (AS APPROPRIATE)
- GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?
- DESCRIPTION AND GEOLOGICAL SIGNIFICANCE: The geological significance of feature(s) displayed at the site and the importance in an Earth Science context.
- ACCESSIBILITY: Remoteness and/or difficulty in accessing the site. Proximity to any road, ease of access and all abilities access.

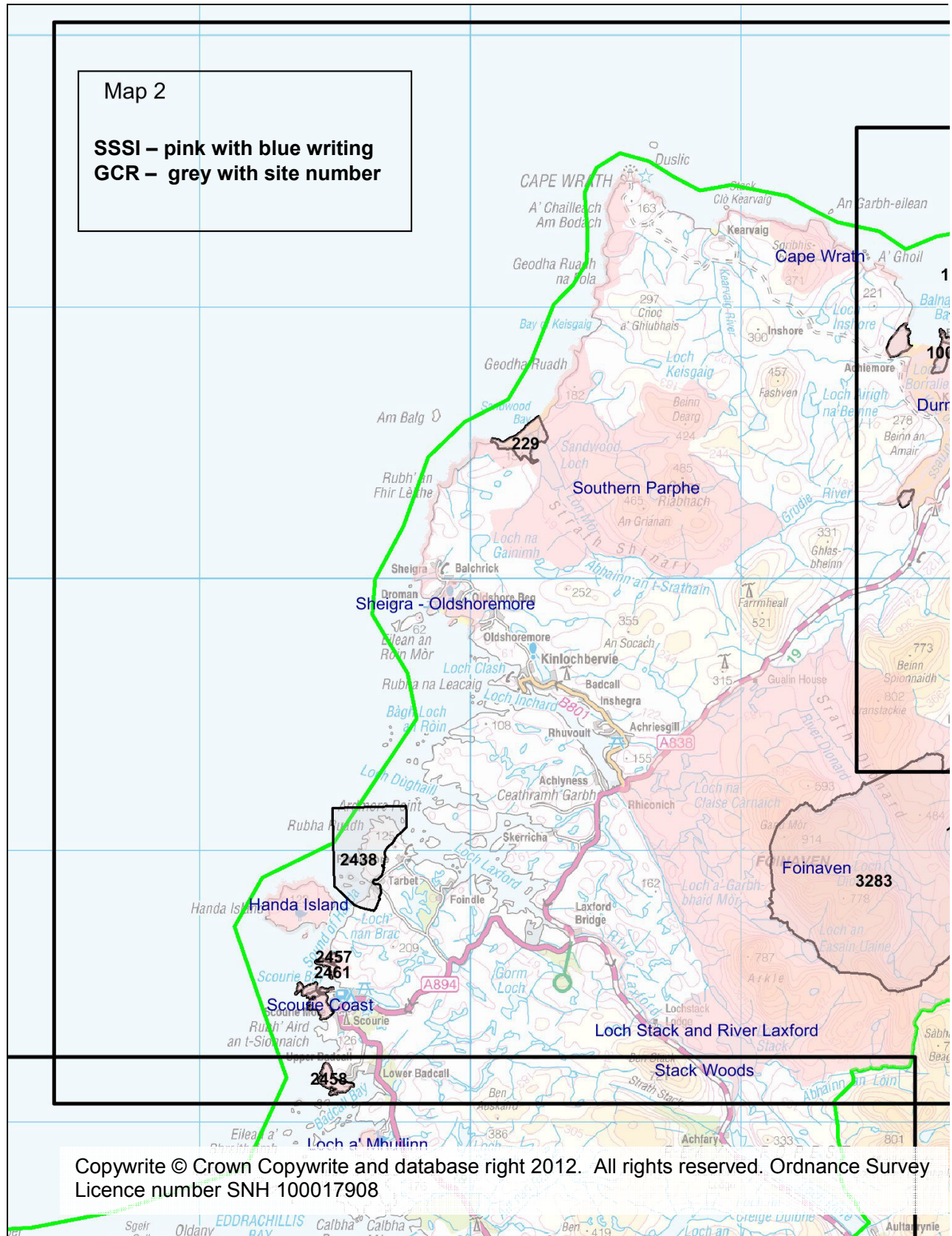
- CONSERVATION: General condition of site including fragility. Conservation requirements.
- VISIBILITY AND “CLARITY”: Overall visibility: how easy is it to see and identify the main feature(s)? What is the overall visual impact of the feature/site? How dramatic/inspiring?
- INTERPRETATION AND INTERPRETATION POTENTIAL: How is the site currently interpreted (e.g. panels, guide books, used on geological walks)? Ease of interpretation: how difficult is it to be understood by specialists or non-specialists? How can the site be interpreted in the future? Importance as an educational resource and potential.
- KEY REFERENCES

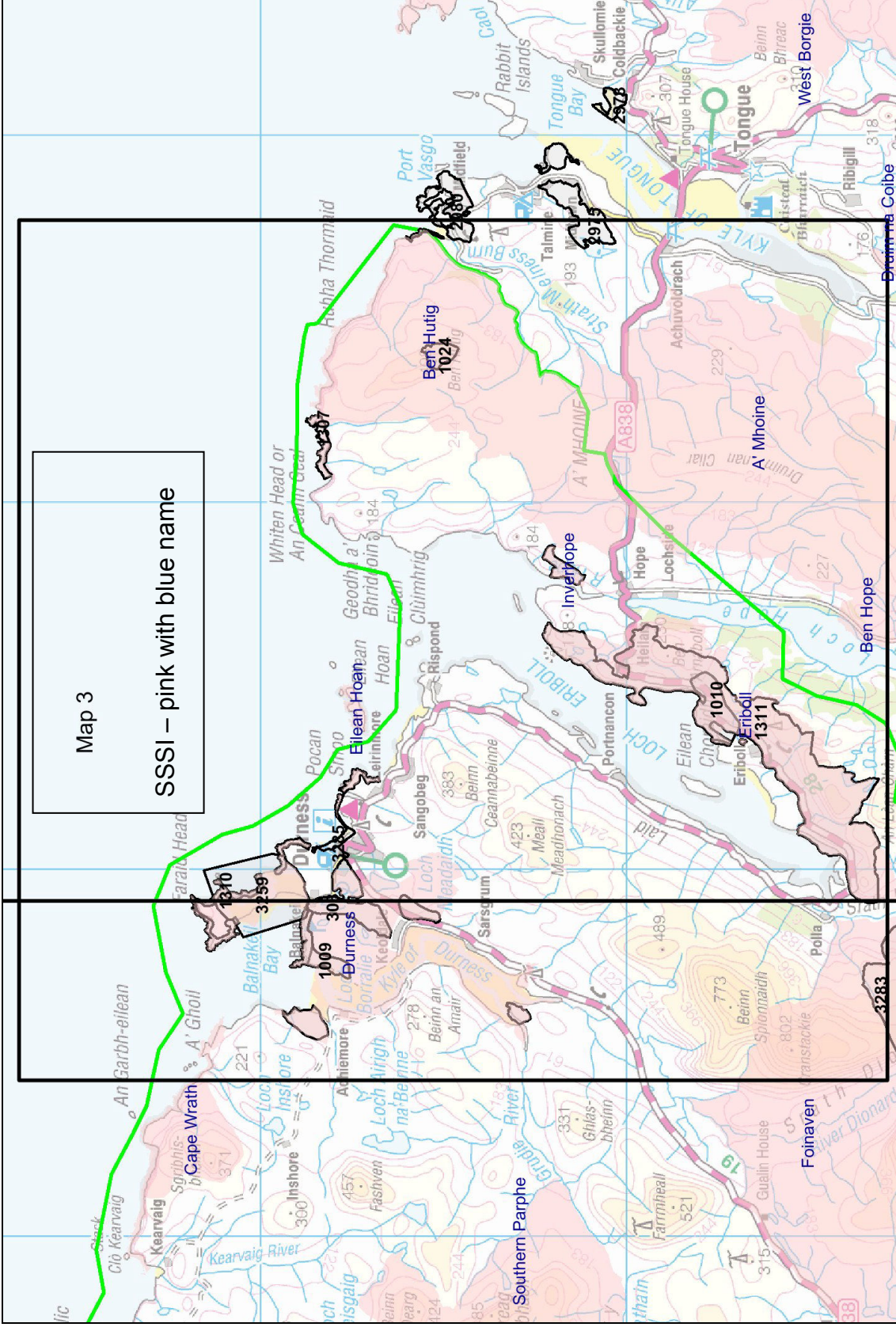
North West Highland Geopark : Location Maps



Map 2

SSSI – pink with blue writing
GCR – grey with site number





Map 3
 SSSI – pink with blue name

NWHG REF. 001 - BEN HUTIG

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The Ben Hutig site lies 3 km south of the north coast of the mainland at the north-east corner of the NWHG, some 2.5 km north-west of the community of West Strathan and 5km north of the A 838, Grid Ref. NC 540652.



Rodded and locally flattened dominantly quartz pebbles in pebbly and conglomeratic psammities of the A'Mhoine Psammite Formation. Ben Hutig, BGS Photo P552316. J R Mendum

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1024, Moine Block, Vol. 34. Notified feature of Ben Hutig SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The Ben Hutig site area represents the most north-westerly exposure of the Moine succession on the Scottish mainland, with the Moine Thrust Belt lying only about 1 km further to the west. The key geological features are the excellent examples of coarse-grained “psammities” (conglomeratic and gritty beds, showing cross-bedding), interleaved with finer-grained “pelitic” and “semipelitic” schists. These metasedimentary rocks of the Moine represent periods of rapid deposition of coarser sands and pebble beds, followed by periods of quieter mud and silt accumulation, probably in a shallow-marine or fluvial environment. There are also quartz veins of two distinct ages and two phases of deformation have been recognised. The proximity of the Ben Hutig site to the Moine Thrust Belt allows comparison of the deformation, folding and metamorphic patterns within the Moine Nappe and those of the nearby thrust belt. The Ben Hutig area is recognised as one of national importance and valuable for teaching and research purposes.

ACCESSIBILITY

The site area is in a remote location, requiring a 2.5 km walk over rough and frequently boggy terrain, north-westwards from the unclassified road terminating at West Strathan. It is not, therefore accessible to all abilities.

CONSERVATION

Low conservation requirement due to the scale and location of the site.

VISIBILITY AND "CLARITY"

The general feature of Ben Hutig is visible from the nearest road, looking north-westwards. Once the actual site is reached, exposures are clear and easily picked out by the trained geological eye.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site is visited by geology students and researchers but interpretation is not available to the general public without specialist assistance. There is no interpretation panel due to the specialised interest and the remoteness and difficulty of access. The Ben Hutig area is of considerable importance as a teaching resource for students and is an area suitable for further research. Consideration could be given to including it in a future Geopark guide and its potential as an educational resource/teaching aid for students should be developed.

KEY REFERENCES

- MENDUM, J.R. 2009. Ben Hutig. *In* Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 367-372.
- WILSON, G. 1953. Mullions and rodding structures in the Moine Series of Scotland. *Proceedings of the Geologists' Association*, **64**, 118-151.

NWHG REF. 002 - CLEIT AN T-SEABHAIG

LOCATION, GRID REFERENCE

The site is located within steep cliffs on the north coast of the Geopark to the east of Whiten Head, Grid Ref. NC 507682 – NC 524685.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1307, Moine Block, Vol. 34. Notified feature of Ben Hutig SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site contains some of the most northerly exposures of the Moine Thrust Sheet and upper Moine Thrust Belt in mainland Scotland. Representative of mylonitic rocks from the upper part of the Moine Thrust Belt and the lowermost part of the Moine Thrust Sheet. Site is of international importance as it was here in 1884 that the structure considered to be the Moine Thrust was first directly observed in the steep coastal cliffs.

ACCESSIBILITY

Very remote and extremely difficult to access. Best accessed by boat. Access by land along the coast considered hazardous and not recommended.

CONSERVATION

Extensive coastal cliff feature, massive and generally robust. Low conservation requirement due to scale and location of site.

VISIBILITY AND “CLARITY”

Best seen from a boat, looking southwards onto the coastal cliffs. Key features are easily identified by geological specialists but not by lay-public without specialist assistance. Visual impact is high and cliff exposures are dramatic. Highly inspiring to geologists in view of the historical significance of the site.

INTERPRETATION AND INTERPRETATION POTENTIAL

It was here, in 1884, that B.N. Peach and J. Horne (of the Geological Survey) first observed directly the structure which they considered to be the Moine Thrust, thus resolving the “Highlands Controversy” concerning the nature of the contact between the overlying metamorphosed rocks of the Moine and the underlying Cambro-Ordovician sedimentary succession. It was also one of the first demonstrations that large-scale horizontal movements have occurred in an orogenic belt. Due to the remoteness and difficulty of access, there is no interpretation panel. The site is, however, of international geological significance and could be included in a future Geopark guide.

KEY REFERENCES

HOLDSWORTH, R.E., STRACHAN, R. & ALSOP, G.I. 2001. *Solid geology of the Tongue district; Memoir for 1:50 000 Geological Sheet 114 E (Scotland)*, British Geological Survey, Keyworth, Nottingham.

HOLDSWORTH, R.E. 2009. Cleit an t-Seabhaig *In* Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 249-253.

NWHG REF. 003 - ERIBOLL

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site occupies much of the south-east side of Loch Eriboll, at the north-east corner of the NWHG. Grid Ref. NC 485622 – NC 380501.



View northwards from Anaboll onto the Heilam imbricates, northern Moine thrust Zone. BGS Photo P 524871 – M Krabbendam



A group of geologists at the Arnaboll Thrust, east of Loch Eriboll. BGS Photo P 524872 – M Krabbendam

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1311, Moine Block, Vol. 34. Notified feature of Inverhope and Eriboll SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The Eriboll site area, on the south-east side of Loch Eriboll, is representative of the northern part of the Moine Thrust Belt and is of international historical importance for its role as a key locality in the understanding of concepts of continental compressional (ie. thrust) tectonics. It contains exceptional examples of thrust structures, associated folds and mylonites.

ACCESSIBILITY

Although the site covers a large area, some of it is directly accessible by car but some walking is require to reach many of the features. Parts of the site are therefore accessible to all abilities.

CONSERVATION

Low conservation requirement due to the scale and location of the site.

VISIBILITY AND “CLARITY”

Many of the key features are not directly (or easily) visible from the road. Visual impact of specific features can be high to geological specialists but not the lay-public.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site is commonly visited by geology students and researchers. Interpretation is not open to the lay-public without specialist assistance. There are currently no interpretation panels. Nonetheless, it would be most appropriate to incorporate some of the features within a guided walk and certainly to include the constituent site features within a future Geopark guide.

KEY REFERENCES

- BUTLER, R.W.H., HOLDSWORTH, R.E. & MATTHEWS, S.J. 2006. Styles of basement involvement in the Moine thrust belt, NW Scotland. *In* Mazzoli, S. & Butler, R. W. H. (eds) *Styles of continental contraction*. Special Paper Geological Society of America, **414**, 133-151.
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- HOLDSWORTH, R.E., STRACHAN, R., ALSOP, G.I., GRANT, C.J. & WILSON, R.W. 2006. Thrust sequences and the significance of low-angle, out-of-sequence faults in the northernmost Moine Nappe and Moine thrust zone, NW Scotland. *Journal of the Geological Society of London*, **163**, 801-814.
- SOPER, N.J. & WILKINSON, P. 1975. The Moine thrust and the Moine Nappe at Loch Eriboll, Sutherland. *Scottish Journal of Geology*, **11**, 339-359.

NWHG REF. 004 - AN T-SRON

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The coastal headland of An t-Sron is located on the south-east side of Loch Eriboll, Grid Ref. NC 443576.



Salterella Grit at the An 't Sron peninsula, Loch Eriboll. BGS Photo P537276, - M T Dean.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1010, Cambrian Block, Vol. 18. Notified feature of Eriboll SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

This is a key site in the understanding of the Cambrian rocks of northern Britain. The lower arenaceous units of the Cambrian sequence of the North West Highlands are well exposed, relatively undisturbed by folding and faulting. The stratigraphy and sedimentary features of the Basal (False-bedded) Quartzite, Pipe Rock, Furoid Beds and Salterella Grit are well seen. The section extends up into the dolostones of the Eilean Dubh Formation of the Durness Group. Evidence at this site proved central to the resolution of the controversy over the stratigraphy and structure of the northern Highlands of Scotland.

ACCESSIBILITY

The site is close to the A 838 but requires a short walk over rough ground to reach the coastal exposures. There is no all abilities access.

CONSERVATION

Low conservation requirement due to the scale and location of the site.

VISIBILITY AND "CLARITY"

The coastal exposures cannot be seen from the roadside. Once accessed, however, the constituent strata are easily identifiable and inspiring to geological specialists.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site is commonly visited by geology students and researchers. Features are easily discerned and interpreted by specialists and may also be appreciated by some non-specialists (with assistance). There is currently no interpretation panel but the site could be included in guided walks and in a future Geopark guide. A very important educational resource for geology students and researchers.

KEY REFERENCES

PRIGMORE, J.K. & RUSHTON, A.W.A. 1999. Scotland: Cambrian and Ordovician of the Hebridean Terrane. *In* Rushton, A. W. A., Owen, A. W., Owens, R. M. & Prigmore, J. K. (eds) *British Cambrian to Ordovician Stratigraphy*. Geological Conservation Review Series, **18**, Chapman & Hall, 295-315.

NWHG REF. 005 - SANGO BAY

LOCATION, GRID REFERENCE

The Sango Bay site lies on the north coast of mainland Scotland at Durness, Grid Ref. NC 406681 – NC 412676.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. N/A, Moine Block, Vol.34. Notification proposed for Durness SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site displays exceptional examples of post-Caledonian normal faults which have downthrown Moine Thrust Belt mylonites of the Faraid Head klippe. There is a particularly well-displayed example of a normal fault scarp at the eastern end of the bay. The site also contains excellent examples of 'Oystershell rock', gneiss rocks sheared within the Moine Thrust Belt.

ACCESSIBILITY

The area is accessible by car with good parking facilities overlooking the bay close to the Visitor Information Centre. It is necessary to walk down onto the beach in order to be able to see the outcrops clearly in detail, although a general overview can be obtained when seen from the car park. Due to the steep slope above the beach, there is no provision for all abilities access.

CONSERVATION

Low conservation requirement due to the scale and location of the site.

VISIBILITY AND "CLARITY"

Visibility of most of the bay is good from the car park and excellent once the beach is reached. Specific geological features are inspiring to geological specialists, especially the dramatic fault scarp at the eastern end of the beach.

INTERPRETATION AND INTERPRETATION POTENTIAL

The bay is very popular with the general public as well as geology students and researchers. There is a sealife interpretation panel at the car park but no geological interpretation panel either at the car park or on the beach. Within the Visitor Information Centre, where the Highland Council Ranger has an office, there is an excellent display of geological maps, samples and some interpretation material. There is considerable scope for the siting of a new geological interpretation panel at the car park overlooking the bay, as a facility for the general public. The site should certainly be included in a future Geopark guide. An important educational resource for geology students and researchers.

KEY REFERENCES

BUTLER, R.W.H. 2009. Sango Bay. *In* Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 257-261.

NWHG REF. 006 - FARAID HEAD

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The Faraidh Head forms a narrow 3 km-long peninsula to the north-west of Durness on the north coast, Grid Ref. NC 378715 – NC 406687.



Cliffs with east-dipping Moine mylonites of the Moine thrust zone, , Balnakeil Bay beach, Faraid Head Peninsula. BGS Photo P 524858 - M Krabbendam

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1310, Moine Block, Vol. 34. Notified feature of Durness SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

Representative of mylonitic rocks from the uppermost part of the Moine Thrust Belt and the lowermost part of the Moine thrust Sheet, including the 'Oystershell Rock'. Exceptional example of a klippe of the Moine Thrust Sheet. The site is internationally important as one of the first localities where the kilometre-scale displacement of a major thrust sheet was recognised.

ACCESSIBILITY

The site is not accessible by car, requiring a 3 km walk from the nearest car park at Balnakeil across Balnakeil beach and the undulating sand dunes at Faraid Head. No all abilities access.

CONSERVATION

Low conservation requirement due to scale and location of site.

VISIBILITY AND “CLARITY”

Most of the Faraid Head peninsula is covered by sand dunes whereas the perimeter coastline comprises rocky cliffs with good exposures. Visibility is therefore not good until the coastal exposures along the north shore are reached.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site is visited by geology students and researchers because of the Earth Science interest whereas visitors from the general public come mainly because of the birdlife. The important geological features require to be interpreted by a specialist for the lay-public. There is currently no interpretation panel at the coastal cliffs or back at the car park at Balnakeil. Due to the popularity of this area, however, a new interpretation panel could be erected at the car park, outlining the significance of the area in general terms. The site could be incorporated within a general walk and should be included in a future Geopark guide. An important educational resource for geology students and researchers.

KEY REFERENCES

- HOLDSWORTH, R.E., ALSOP, G.I. & STRACHAN, R.A. 2007. Tectonic stratigraphy and structural continuity of the northernmost Moine thrust zone and Moine Nappe, Scottish Caledonides. *In* Ries, A. C., Butler, R. W. H. & Graham, R. H. (eds) *Deformation of the continental crust; the legacy of Mike Coward*. Geological Society Special Publications, **272**, 121-142.
- HOLDSWORTH, R.E. 2009. Faraid Head. *In* Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 253-257.

NWHG REF. 007 - BALNAKEIL

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site is located to the north-west of Durness and north of Balnakeil Craft Village, Grid Ref. NC 372688.



Large chert concretions in Sail Mhor Formation, Balnakeil Bay, BGS Photo P 530617 - M Krabbendam

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 303, Cambrian Block, Vol. 18. Notified feature of Durness SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

An historically famous geological site of international significance for its Cambro-Ordovician sedimentary rock sequence. The site is the type locality for the limestones and dolostones of the Durness Group, and includes representative portions of six of the seven Durness Group formations, notably the basal Ordovician age Balnakeil, Croisaphuill and Durine formations. It is one of Britain's outstanding earth science sites, of key importance in studies of transatlantic correlation, palaeogeography and faunas.

ACCESSIBILITY

There is a car park at Balnakeil but a moderate walk across undulating terrain is required to access the coastal exposures further west. No all abilities access.

CONSERVATION

Low conservation requirement due to scale and location of site.

VISIBILITY AND "CLARITY"

Exposures cannot be seen from the road but are very clear once the individual locations are reached.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site area is visited by geology students and researchers and forms an important educational resource for teaching purposes. Key geological features require to be interpreted by a specialist for the general public. A successful guided walk, led by a geologist, has been held. There is no interpretation panel and the site should be included in a future Geopark guide as well as included in any local guided walk.

KEY REFERENCES

- PRIGMORE, J.K. & RUSHTON, A.W.A. 1999. Scotland: Cambrian and Ordovician of the Hebridean Terrane. In Rushton, A. W. A., Owen, A. W., Owens, R. M. & Prigmore, J. K. (eds) *British Cambrian to Ordovician Stratigraphy*. Geological Conservation Review Series, **18**, Chapman & Hall, 295-315.
- RAINE, R.J. 2006. *The Durness Group of NW Scotland: A stratigraphical and sedimentological study of a Cambro-Ordovician passive margin succession*. Unpublished PhD thesis, University of Birmingham

NWHG REF. 008 - DURNESS

LOCATION, GRID REFERENCE AND PHOTOGRAPH

This extensive site covers parts of the shore of the Kyle of Durness, Balnakeil Bay and the area to the south and east of Durness, Grid Ref. NC 358687, NC 361630, NC 389657.



Basal Sangomore Formation, Durness Group. Kyle of Durness, BGS Photo P 537289 – M T Dean

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1009, Cambrian Block, Vol. 18. Notified feature of Durness SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

A key stratigraphical locality of international significance with implications for its bearing on continental drift and correlations. It shows most completely the Cambrian and Ordovician strata of a fragment of the Laurentian (North American) Plate and was historically one of the first examples of such a displaced fragment to be recognised on faunal grounds. It is mainly underlain by dolostones of the Durness Group.

ACCESSIBILITY

The site is extensive, covering parts of the shore of the Kyle of Durness, Balnakeil Bay and the area to the south and east of Durness, much of which is accessible by car with minimum of walking required. Partly accessible to all abilities.

CONSERVATION

Low conservation requirement due to scale and location of site area. Some risk of over-sampling and over-hammering.

VISIBILITY AND “CLARITY”

Visibility of key features good for specialists rather than lay-public.

INTERPRETATION AND INTERPRETATION POTENTIAL

The area is commonly used by geologists and university parties to study these important Cambrian and Ordovician strata within the context of continental drift. There are currently no interpretation panels. Inclusion in a future Geopark guide recommended. An important educational resource for geology students and researchers.

KEY REFERENCES

Geological Conservation Review Series, Volume 18: British Cambrian To Ordovician Stratigraphy, site description page 296.

PRIGMORE, J.K. & RUSHTON, A.W.A. 1999. Scotland: Cambrian and Ordovician of the Hebridean Terrane. *In* Rushton, A. W. A., Owen, A. W., Owens, R. M. & Prigmore, J. K. (eds) *British Cambrian to Ordovician Stratigraphy*. Geological Conservation Review Series, **18**, Chapman & Hall, 295-315.

RAINE, R.J. 2006. *The Durness Group of NW Scotland: A stratigraphical and sedimentological study of a Cambro-Ordovician passive margin succession*. Unpublished PhD thesis, University of Birmingham

NWHG REF. 009 - SANDWOOD BAY

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The Sandwood Bay site is located on the west coast, 8.5 km north of Kinlochbervie, at the seaward end of Strath Shinary, Grid Ref. NC 220650.



Sandwood Bay from the south, BGS Photo 637344 - M Krabbendam

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 229, Coastal Geomorphology Block, Vol. 28. Notified feature of Southern Parphe SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

Sandwood Bay is perhaps the best example on mainland Britain of a naturally unstable and dynamic beach-dune system. The beach complex consists of a highly dynamic, shingle-cored sand dune and machair bar impounding a freshwater loch at the mouth of Strath Shinary. The main geomorphological interest lies in the very high current activity of the beach, dune and machair landforms, in a situation where human interference has been minimal. It offers a rare opportunity to study natural rates of coastal change.

ACCESSIBILITY

Access is limited. The nearest (small) John Muir Trust car park is on the unclassified Kinlochbervie to Sheigra road at Blairmore. There is an old peat track and waymarked path along the 6 km walk to the site. No all abilities access.

CONSERVATION

Despite the scale and remote location of the site, there is a conservation requirement to ensure that the intrinsic characteristics of the beach-dune system are not affected by human activity.

VISIBILITY AND “CLARITY”

Once the site has been accessed, visibility of the various geomorphological features is excellent. Sandwood Bay is renowned for its natural, unspoilt beauty and the area has a very high visual impact on visitors. On the south side is the famous Am Buachaille sea stack – not part of the GCR site, but nevertheless a spectacular coastal feature.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site is mainly used by casual walkers interested in landscape, wildlife and photography. There is an interpretation panel available at the car park. Further information could be provided here or at the beach itself illustrating the key elements of the beach-dune system and also explaining the significance of Sandwood Bay within a national geomorphological context. Certainly the site should be incorporated within any local guided walks and also included in a future Geopark guide. The distance to the site might constrain the potential as an academic teaching aid for students.

KEY REFERENCES

Geological Conservation Review Series, Volume 28: Coastal Geomorphology of Great Britain, site description page 370.

NWHG REF. 010 - FOINAVEN

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The Foinaven site occupies a vast mountainous area extending for over 15 km from the head of Loch Eriboll to Loch Stack, Grid Ref. NC 383527 – NC 327460.



Imbricates in Cambrian quartzite, Foinaven., BGS Photo P571776 – K M Goodenough

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. N/A, Moine Block, Vol. 34. Notification proposed for Foinaven SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The Foinaven site contains some of the most continuous exposure of thrusts in the British Isles and includes the type example of duplex structure. It contains exceptional examples of thrust structures in the Moine Thrust Belt, including classic examples of duplexes involving Cambrian quartzites and subsidiary dolomitic shales (Furoid Beds). Near three-dimensional exposures of thrust geometry are some of the best to be found in Europe.

ACCESSIBILITY

Access is very limited due to the remote and mountainous nature of this area, requiring a very long walk over difficult and arduous terrain by suitably equipped and experienced people. No all abilities access.

CONSERVATION

Low conservation requirement due to scale and location of site area.

VISIBILITY AND “CLARITY”

The visibility is excellent and the key features are very clear to geological specialists, once the respective locations have been accessed. The visual impact is high and the site area is truly dramatic and inspiring to both specialists and the lay-public.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site area is commonly used by geology students and researchers to illustrate the range and complexity of structural geometries which can result from repeated imbrications and ramp-flat thrust surfaces in addition to providing excellent sections across parts of the Moine Thrust Belt. There are no interpretation panels, and such a panel would, due to the scale and remote location of the site area, not be appropriate. Nonetheless, such an important area should certainly be included in a future Geopark guide and may merit the development of a guided walk for the general public as well as for specialists. Considerable potential as an educational resource.

KEY REFERENCES

- BOYER, S.E. & ELLIOTT, D. 1982. Thrust systems. *Bulletin of the American Association of Petroleum Geologists*, **66**, 1196-1230.
- BUTLER, R.W.H. 2009. Foinaven. In Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 261-267.

NWHG REF. 011 - LOCH LAXFORD

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site is located at the head of Loch Laxford, near Laxford Bridge, Grid Ref. NC 230480.



Lewisian gneiss with mafic rocks and granite intrusions. Layby on the A838, north of Loch Laxford. BGS Photo P524837. – M Krabbendam

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

Non GCR site. Notified feature of Loch Laxford SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site displays a transition from the older Scourian-age gneisses to the slightly younger Laxfordian-age gneisses, all of which form part of the Lewisian Gneiss Complex. These rocks contain intrusions of granitic sheets.

ACCESSIBILITY

Access to most of the site is good with several laybys conveniently located on the A 838, permitting easy viewing of the adjacent roadside rock-faces and cuttings. The site is thus accessible to all abilities.

CONSERVATION

There is generally a low conservation requirement due to the scale, location and disparate nature of most of the exposures.

VISIBILITY AND “CLARITY”

Excellent visibility from the A 838 and the various features are clear and easily identified. Visual impact of these dramatic exposures is very high and, for specialists, they are inspirational.

INTERPRETATION AND INTERPRETATION POTENTIAL

At one particular location on the A 838 towards the north end, the layby is one of the recommended Rock Route stopping places (the “Multicoloured Rock-Stop”) with excellent exposures in the high rock-face across on the eastern side of the road. This attracts visits by the general public as well as geological specialists, and is widely regarded as one of the best Rock Route interpretation panels within the Geopark. The exposures are visually attractive as well as important in an earth science context. No additional on-site interpretation facilities are required. Nonetheless, the site should clearly be included in a future Geopark guide and it is of high educational value and potential which could be further developed.

KEY REFERENCES

- BEACH, A., COWARD, M.P. & GRAHAM, R.H. 1974. An interpretation of the structural evolution of the Laxford front. *Scottish Journal of Geology*, **9**, 297-308.
- GOODENOUGH, K.M., PARK, R.G., KRABBENDAM, M., MYERS, J.S., WHEELER, J., LOUGHLIN, S.C., CROWLEY, Q.G., L, F.C.R., BEACH, A., KINNY, P.D. & GRAHAM, R.H. 2010. The Laxford Front: an end-Archaeon terrane boundary? *In* Law, R., Butler, R. W. H., Holdsworth, R. E., Krabbendam, M. & Strachan, R. A. (eds) *Continental Tectonics and Mountain Building: The Legacy of Peach and Horne*. Geological Society, London, Special Publication, **335**, 101-118.

NWHG REF. 012 - TARBET TO RUBHA RUADH

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site lies on the west coast on the south side of the entrance to Loch Laxford, mostly north of Tarbet, Grid Ref. NC174506 – NC 158480.



Large body of garnet-amphibolite, cut by pale, felsic dykes. North of Tarbet. BGS Photo P593116 – M Krabbendam

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 2438, Lewisian Block, Vol. 34. Confirmed GCR site, not SSSI notified feature.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The area provides a classic section across the Laxford Front within the Lewisian Gneiss Complex, illustrating the transition from largely unmodified Archaean (Scourian) basement gneisses to the south from Proterozoic reworked gneisses (Inverian and Laxfordian) to the north. It is internationally important as one of the first locations at which an episode of mafic dyke emplacement (ie. the Scourie Dyke Swarm) was used to separate tectonic events, creating a type of “pseudo-stratigraphy”.

ACCESSIBILITY

Access requires a walk over very rough and frequently boggy and difficult terrain, either from Tarbet at the southern end, or westwards over steep and rocky slopes from the unclassified Tarbet–Fanagmore road. There is no access for all abilities.

CONSERVATION

Low conservation requirement due to scale and location of the site area.

VISIBILITY AND “CLARITY”

The key features are not visible from the roadside and specialist assistance is required to identify them. Many of the features are still under scientific discussion.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site area is an important one for geology students and researchers and should be included in a future Geopark guide. It is important as an educational resource for university geology parties. An interpretative panel for the general public is not appropriate.

KEY REFERENCES

- DAVIES, F.B. 1974. A layered basic complex in the Lewisian, south of Loch Laxford, Sutherland. *Journal of the Geological Society of London*, **130**, 279-284.
- PARK, R.G. 2009. Tarbet to Rubha Ruadh. In Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 141-144.
- GOODENOUGH, K.M., PARK, R.G., KRABBENDAM, M., MYERS, J.S., WHEELER, J., LOUGHLIN, S.C., CROWLEY, Q.G., L, F.C.R., BEACH, A., KINNY, P.D. & GRAHAM, R.H. 2010. The Laxford Front: an end-Archaeon terrane boundary? In Law, R., Butler, R. W. H., Holdsworth, R. E., Krabbendam, M. & Strachan, R. A. (eds) *Continental Tectonics and Mountain Building: The Legacy of Peach and Horne*. Geological Society, London, Special Publication, **335**, 101-118.

NWHG REF. 013 - BADCALL

LOCATION, GRID REFERENCE

The site is located on the west coast near Scourie which lies further north, Grid Ref. NC 145421 – NC 157413.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 2458, Lewisian Block, Vol. 34. Notified feature of Scourie Coast SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site area is representative of the Scourian features of the Mainland Lewisian Gneiss Complex. It includes some of the best-preserved examples of gabbroic and tonalitic granulite-facies gneisses on Mainland Britain. It is also representative of the Scourie Dyke Swarm. The site is historically important for lithological, geochemical and geochronological investigations of basement gneiss complexes. It is internationally important as the type locality for the Badcallian event and as one of the first places to be studied in detail using isotopic dating techniques.

ACCESSIBILITY

Access is over rough and frequently boggy ground south-westwards from Upper Badcall, towards the rocky coast. There is no access for all abilities.

CONSERVATION

Low conservation requirement due to scale and location of the site area.

VISIBILITY AND “CLARITY”

There is no visibility from the nearest road but exposures are excellent and very clear once reached.

INTERPRETATION AND INTERPRETATION POTENTIAL

The area is important as a potential teaching locality for geology students and researches. An interpretation panel would not be appropriate, but the area should be included in a future Geopark guide.

KEY REFERENCES

- KINNY, P.D., FRIEND, C.R.L. & J, L.G. 2005. Proposal for a terrane-based nomenclature for the Lewisian Complex of NW Scotland. *Journal of the Geological Society of London*, **162**, 175-186.
- FRIEND, C. 2009. Badcall. In Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 126-130.

NWHG REF. 014 - SITHEAN MOR

LOCATION, GRID REFERENCE

The site is located on the north side of Scourie Bay, Grid Ref. NC 150460.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 2457, Lewisian Block, Vol. 34. Notified feature of Scourie Coast SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site is representative of metasedimentary gneisses of the Mainland Lewisian Gneiss Complex which have been metamorphosed to granulite facies.

ACCESSIBILITY

The site is accessed via a 1.2 km walk around the north side of Scourie Bay, from the nearest car parking area at Scourie Pier, over very rough and frequently steep terrain. There is therefore no all abilities access.

CONSERVATION

Low conservation requirement due to scale and location of the site.

VISIBILITY AND "CLARITY"

The area of rock-exposure is not visible from the Pier car park.

INTERPRETATION AND INTERPRETATION POTENTIAL

Specialist assistance is required to interpret the features. There is little potential for general interpretation due to the remote location and the specialised subject matter. Consideration could be given to including the site in a future Geopark guide, but it is not one of the more important sites.

KEY REFERENCES

- BARNICOAT, A.C. 1987. The causes of the high-grade metamorphism of the Scourie complex, NW Scotland. In Park, R. G. & Tarney, J. (eds) *Evolution of the Lewisian and comparable Precambrian high-grade terrains*. Special Publication of The Geological Society of London, **27**, 73-79.
- FRIEND, C.R.L. & MENDUM, J.R. 2009. Sithean Mor. In Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 134-136.

NWHG REF. 015 - SCOURIE BAY

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site comprises two localities on the north and south sides of Scourie Bay, Grid Ref. NC 148448 and NC 146461 – NC 149453.



Scourie Dyke, Scourie Bay, BGS Photo P 530617 – K M Goodenough

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 2461, Lewisian Block, Vol. 34. Notified feature of Scourie Coast SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site areas are representative of the “Scourie Dyke Swarm” which is of international importance. The type locality for the mafic and ultramafic Scourie Dyke Suite occurs on the north side of Scourie Bay, where a thick quartz dolerite intrusion (the “Geologist’s Dyke”) is exposed on the beach at Poll Eorna and in the crags of Creag a Mhail. A second important, more accessible, quartz dolerite dyke (the “Graveyard Dyke”) is exposed on the south side of Scourie Bay, just north-west of the cemetery.

ACCESSIBILITY

There are good car parking facilities at Scourie Pier (north side) and Scourie Cemetery (south side), only a short walk from the site. No all abilities access to the main rock-exposures on either side of the Bay, although rock-faces adjacent to the Pier can be seen from a car.

CONSERVATION

Low conservation requirement due to the scale and location of the site.

VISIBILITY AND "CLARITY"

The exposures and field relationships of the Scourie Dykes are well displayed and clear. The Geologist's Dyke on the north side of the bay is a very dramatic feature and is truly inspiring to a geologist.

INTERPRETATION AND INTERPRETATION POTENTIAL

There is currently no interpretation panel at either the north or the south side of Scourie Bay. An informal display is shown in the Bird Hide hut at the Parking. Guided walks have been held by the Highland Council Rangers, and have proved to be popular. The key features of the Scourie Dykes require specialist interpretation but it is considered that a suitable interpretation panel could be located on the south side at the cemetery car park, catering for the general public as well as specialist interest. The site is regularly visited by geology students and researchers. Certainly, the two main Scourie Dykes should be included in a future Geopark guide. The area has considerable potential as a teaching resource for universities and students of geology.

KEY REFERENCES

- FRIEND, C.R.L. 2009. Scourie Bay. *In* Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 137-141.
- O'HARA, M.J. 1961b. Petrology of the Scourie dyke, Sutherland. *Mineralogy Magazine*, **32**, 848-865.
- TARNEY, J. & WEAVER, B.L. 1987b. Mineralogy, petrology and geochemistry of the Scourie dykes: petrogenesis and crystallisation processes in dykes intruded at depth. *In* Park, R. G. & Tarney, J. (eds) *Evolution of the Lewisian and Comparable Precambrian High Grade Terrains*. Geological Society Special Publication, **27**, 217-233.

NWHG REF. 016 - SCOURIE MOR

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site encompasses the peninsula to the west of Scourie Mor, Grid Ref. NC 144450 – NC 144437.



Geologists from across the globe discuss the Lewisian gneiss at Scourie Mor, Peach & Horne field meeting 2007. BGS Photo P 667681 – K M Goodenough.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 2459, Lewisian Block, Vol. 34. Notified feature of Scourie Coast SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site area is representative of the Scourian features of the Mainland Lewisian Gneiss Complex, including exceptional examples of mafic and ultramafic bodies which have undergone granulite-facies metamorphism.

ACCESSIBILITY

A walk of up to 1 km from the unclassified Scourie More road, over rough and frequently boggy ground, is required to reach the main exposures. No all abilities access, therefore.

CONSERVATION

Low conservation requirement due to the scale and location of the site.

VISIBILITY AND “CLARITY”

Exposures are not visible from the nearest road but key features are well displayed to the specialist eye once accessed.

INTERPRETATION AND INTERPRETATION POTENTIAL

The area is important for geology students and researchers and could be developed as a teaching resource for universities. There is no interpretation panel for the general public and it would not be appropriate to erect one. The site could be included within a guided walk and should certainly be included in a future Geopark guide.

KEY REFERENCES

- FRIEND, C.R.L. 2009. Scourie Mor. *In* Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 130-134.
- O'HARA, M.J. 1961a. Zoned ultrabasic and basic gneiss masses in the early Lewisian metamorphic complex at Scourie, Sutherland. *Journal of Petrology*, **2**, 248-276.

NWHG REF. 017 - CAMAS NAM BUTH

LOCATION, GRID REFERENCE

The site occupies an area on the north side of a small coastal bay west of Scourie, Grid Ref. NC 143447.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 701, Mineralogy Block, Vol. 42. Notified feature of Scourie Coast SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site shows an excellent example of layered intrusive within the Lewisian Gneiss consisting mainly of garnet-pyroxene rock. The site is important petrographically and yields the best garnets seen anywhere in Britain and probably also the only example of a pure pyroxene rock.

ACCESSIBILITY

There is no all abilities access to the site which is accessed via a walk of about 600 m over rough ground, westwards towards the coast, from the far end of the unclassified Scourie Mor road.

CONSERVATION

Moderate to high conservation requirement due to the relatively small area of exposure and the very high importance of the site as a locality rich in the highest mineralogical quality garnets which is easily accessed by the public and regularly visited by students of geology. Potential risk of over-sampling and over-collecting.

VISIBILITY AND "CLARITY"

The actual location of the garnetiferous rock can be difficult to locate for those visitors unfamiliar with the site area. Nonetheless, the occurrence of garnets is a dramatic feature to the non-specialist and is visually inspiring, once they are identified.

INTERPRETATION AND INTERPRETATION POTENTIAL

This is an important site for geology students and researchers as well as being of fascination to the general public. There is currently no interpretation facility but consideration should be given to erecting an appropriate panel, probably at the Scourie Cemetery car park, leading visitors to the correct location. The site is presently included in a guided walk of the surrounding area undertaken by the Highland Council Countryside Ranger and it should certainly be included in a future Geopark guide.

KEY REFERENCES

SILLS, J.D., SAVAGE, D., WATSON, J.V. & WINDLEY, B.F. 1982. Layered ultramafic-gabbro bodies in the Lewisian of northwest Scotland: geochemistry and petrogenesis. *Earth and Planetary Science Letters*, **58**, 345-360.

NWHG REF. 018 - GLENCOUL

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site occupies a large area to the south-east of Kylesku and includes the whole of Loch Glencoul and surrounding areas to the north-east, south-west and south-east, including the prominent Stack of Glencoul. Grid Ref. NC 236304 – NC 295288.



Loch Glencoul. Glencoul Thrust to the left, the Stack of Glencoul with Moine mylonites to the far right. From near Unapool. BGS Photo P5135921 – M Krabbendam

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 902, Moine Block, Vol. 34. Notified feature of Loch Glencoul SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The Glencoul site area is representative of the northern part of the Assynt Culmination in the Moine Thrust Belt and contains exceptional examples of thrust exposures. It is of international importance because it provides unrivalled opportunities for viewing and understanding the large-scale structure of thrust belts, particularly the incorporation of crystalline basement. At the Stack of Glencoul, mylonitic rocks associated with the Moine Thrust are well exposed and have been used for numerous structural studies.

ACCESSIBILITY

The best view of the Glencoul Thrust is obtained from a layby on the A 894 near Unapool (NC 235320) which is accessible to all abilities. Otherwise, a long walk of

between 3 and 8 km from the A 894 is required to access the main features across very rough and undulating terrain, frequently steep and/or boggy. Alternatively, the head of Loch Glencoul can be reached via boat during the main visitor season.

CONSERVATION

No conservation requirement due to the scale and location.

VISIBILITY AND “CLARITY”

The Glencoul Thrust is best seen from the layby on the A 894 where there is a large interpretation panel installed by SNH as part of the Rock Route. The important features are easily discerned from the lay-public and this view point attracts many visitors. The Stack of Glencoul is rather remote and is generally only visited by university parties. The access by boat from Kylesku is commonly used.

INTERPRETATION AND INTERPRETATION POTENTIAL

The view across Loch Glencoul from the A 894 layby is undoubtedly one of the most dramatic geological views in the British Isles and the Rock Route interpretation panel is an extremely important facility. The features of the site are commonly explained to visitors on the ‘Statesman’ boat trip from Kylesku. This boat trip is also featured in the guidebook “Exploring the landscape of Assynt” No additional interpretation is required and the viewpoint and the Glencoul Thrust should certainly be included in a future Geopark guide.

KEY REFERENCES

- BUTLER, R.W.H. 2009. Glencoul. In Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 268-273.
- LAW, R.D. 1987. Heterogeneous deformation and quartz crystallographic fabric transitions; natural examples from the Moine thrust zone at the Stack of Glencoul, northern Assynt. *Journal of Structural Geology*, **9**, 819-833.

NWHG REF. 019 - LOCH DRUMBEG

LOCATION, GRID REFERENCE

The site occupies a relatively small area west of Drumbeg near the shores of Loch Drumbeg, Grid Ref. NC 114329.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 2439, Lewisian Block, Vol. 34. Confirmed GCR site, not SSSI notified feature.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

This small site area is of national importance as it contains Lewisian early mafic-ultramafic igneous intrusions which are thought to represent the oldest parts of the Lewisian Gneiss Complex.

ACCESSIBILITY

The site lies close to the B 869 on the north side of Loch Drumbeg and there is car parking provision close-by. A short walk over rough and boggy ground is required to access the main exposures, otherwise limited all abilities access is possible.

CONSERVATION

Low conservation requirement.

VISIBILITY AND "CLARITY"

The key features are not directly visible from the road. Features are difficult to interpret.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site requires specialist interpretation and does not lend itself to general interpretation for the wider public. There is some potential for developing the site as a teaching resource for geology students.

KEY REFERENCES

- BOWES, D.R. & PARK, R.G. 1964. Layered intrusive rocks in the Lewisian of the North-West Highlands of Scotland. *Quarterly Journal of the Geological Society of London*, **120**, 153-192.
- PARK, R.G. 2009. Loch Drumbeg. In Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 145-146.

NWHG REF. 020 - STOER

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site includes three localities in the Clachtoll, Stoer and Culkein areas of Assynt, close to the west coast of the NWHG, Grid Ref. NC 041283 – NC 027291, NC 041266 – NC 039281, NC 045328.



Stoer Group sandstone at Clachtoll. BGS Photo P661222 – M Krabbendam

GCR SITE REFERENCE/VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1604, Torridonian Block, Vol. 34. Confirmed GCR site, not SSSI notified feature.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site areas are representative of the internationally important Stoer Group of the Torridonian Sandstone deposits. These include the only unmetamorphosed Mesoproterozoic stratigraphical group in Britain and an exceptional example of a sedimentary and volcanic sequence formed in a Proterozoic rift environment. Various sedimentary features are very well exposed. It also contains the Stac Fada rocks, interpreted alternatively as a volcanic mudflow deposit or as a putative meteorite ejecta blanket deposit.



Well-preserved 1200 million year old ripple marks in Stoer group siltstone, Bay of Stoer. BGS Photo P518651 – K M Goodenough

ACCESSIBILITY

The area is accessed from the B 869 Lochinver–Drumbeg road but nearly all the sites require lengthy walks over rough and locally steep or boggy terrain in order to reach them. There is, therefore, effectively no all abilities access apart from distant viewing of the coastal features from a few roadside locations.

CONSERVATION

Low conservation requirement due to the scale and location of the site localities.

VISIBILITY AND “CLARITY”

The general features are quite easily seen. Many sedimentary features can be seen from the various beaches or the coastal path. The coastal cliffs (and Clach Toll itself!) and beaches are visually attractive.

INTERPRETATION AND INTERPRETATION POTENTIAL

There are currently no on-site interpretation facilities serving the three localities but interpretation panels could be erected at judicious locations for the general public. The site areas have considerable potential for development as a teaching resource for geology students and should certainly be included in a future Geopark guide. The site features as a walk in the “Exploring the Landscape of Assynt” guide book. Some individual locations are presently included in guided walks undertaken by the Highland Council Countryside Rangers.

KEY REFERENCES

AMOR, K., HESSELBO, S.P., PORCELLI, D., THACKREY, S. & PARNELL, J. 2008. A Precambrian proximal ejecta blanket from Scotland. *Geology*, **36**, 303-306.

- STEWART, A.D. 2002. *The later Proterozoic Torridonian rocks of Scotland: their sedimentology, geochemistry and origin*. Geological Society Memoir, The Geological Society.
- SANDERS, I.S. & JOHNSTON, J.D. 1989. The Torridonian Stac Fada Member: an extrusion of fluidized peperite? *Transactions of the Royal Society of Edinburgh, Earth Sciences*, **80**, 1-4.
- STEWART, A.D. 2009. Stoer. In Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 187-193.

NWHG REF. 021 - AN FHARAID MHOR – CLACHTOLL

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site encompasses the peninsula of An Fharaid Mhor, Achmelvich Bay and northwards to Clachtoll, on the west coast of Assynt, Grid Ref. NC 038270 – NC 069245.



Rugged coastline north of Achmelvich. BGS Photo P 513583 – M Krabbendam



Structures in Lewisian gneiss, beach north-west of Achmelvich. BGS Photo P513591 - M Krabbendam

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 2444, Lewisian Block, Vol. 34. Confirmed GCR site, not SSSI notified feature.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site is of international importance as it is the type locality for the Inverian event which occurred in the mainland Lewisian Gneiss Complex. It also encompasses part of the 1.5 km-wide Canisp Shear Zone, an exceptional example of a shear zone initiated during the Inverian event and subsequently partly reactivated during the Laxfordian. Many structures, although difficult to interpret, are visually attractive and occur in a scenic coastal area..

ACCESSIBILITY

The area is accessed via the B 869 Lochinver-Drumbeg road but requires a considerable amount of walking over rough and remote terrain in order to reach most of the exposures. There is therefore no all abilities access.

CONSERVATION

Low conservation requirement due to the scale and location of the area.

VISIBILITY AND “CLARITY”

Key exposures are not visible from the nearest road. Some exposures are visible on popular beaches.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site is of interest to geological specialists rather than the general public. The site features as a walk in the “Exploring the landscape of Assynt” guide book. There is no on-site interpretation which would be inappropriate in this situation. Nonetheless, the site area could be developed as a teaching resource for universities and students and it should certainly be included in a future Geopark guide. Guided walks would also be likely to be successful.

KEY REFERENCES

- ATTFIELD, P. 1987. The structural history of the Canisp Shear Zone. *In* Park, R. G. & Tarney, J. (eds) *Evolution of the Lewisian and comparable Precambrian high-grade terrains*. Geological Society Special Publication **27**, 165-173.
- PARK, R.G. 2009. An Fharaid Mhor to Clachtoll. *In* Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 147-151.

NWHG REF. 022 - AN FHARAID MHOR

LOCATION, GRID REFERENCE

The site occupies the small coastal peninsula of An Fharaid Mhor to the south of Achmelvich, Grid Ref. NC 060244.

GCR SITE REFERENCE/VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 3165, Caledonian Igneous Block, Vol. 17. Potential (proposed?) GCR site, not SSSI notified feature.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site contains a dyke of nepheline syenite (“ledmorite”) cutting the Lewisian Gneiss basement in the Foreland and trending towards the Loch Borralan intrusion.

ACCESSIBILITY

A short walk from the unclassified Achmelvich road over locally steep and rough ground is required. No all abilities access, therefore.

CONSERVATION

Low conservation requirement due to the scale and location of the site.

VISIBILITY AND “CLARITY”

The actual exposure of the dyke is difficult to locate without guidance.

INTERPRETATION AND INTERPRETATION POTENTIAL

Interpretation potential is not high although the site could be listed in a future Geopark guide.

KEY REFERENCES

PARSONS, I. 1999. Late Ordovician to mid-Silurian alkaline intrusions of the North-west Highlands of Scotland. *In* Stephenson, D., Bevins, R. E., Milward, D., Highton, A. J., Parsons, I., Stone, P. & Wadsworth, W. J. (eds) *Caledonian Igneous rocks of Great Britain*. Geological Conservation Review Series, **17**, Chapman & Hall, 345-393. (site description page 393).

NWHG REF. 023 - THE LAIRD'S POOL, LOCHINVER

LOCATION, GRID REFERENCE

The site is located within the course of the River Inver at the Laird's Pool, 1 km upstream from Lochinver, Grid Ref. NC 103235.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1224, Caledonian Igneous Block, Vol. 17. Confirmed GCR site, not SSSI notified feature.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The exposure is representative of "Canisp Porphyry" and is seen as a 4 m thick dyke cutting the Lewisian Gneiss basement, indicating the western extent of this suite of nepheline-syenite dykes in the Foreland.

ACCESSIBILITY

Some scrambling over rough ground is required to access the exposure from the north side of the River Inver which is close to the A 837 Lochinver-Inchnadamph road at this point. Alternatively, the site can be reached via the path on the south side of the river, requiring a much longer walk. There is no access for all abilities.

CONSERVATION

Low conservation due to the location of the site.

VISIBILITY AND "CLARITY"

The dyke is easily seen from the river bank.

INTERPRETATION AND INTERPRETATION POTENTIAL

There is no on-site interpretation and none is required. The exposure has a potential value as a teaching resource for geology students and could be included in a future Geopark guide.

KEY REFERENCES

PARSONS, I. 1999. Late Ordovician to mid-Silurian alkaline intrusions of the North-west Highlands of Scotland. *In* Stephenson, D., Bevins, R. E., Milward, D., Highton, A. J., Parsons, I., Stone, P. & Wadsworth, W. J. (eds) *Caledonian Igneous rocks of Great Britain*. Geological Conservation Review Series, **17**, Chapman & Hall, 345-393 (site description page 384).

NWHG REF. 024 - SKIAG BRIDGE

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site extends south-eastwards from the junction of the A 894 with the A 837 at Skiag Bridge, along the north-east side of Loch Assynt, Grid Ref. NC 234256 – NC 240237.



Monocraterion and Skolithus burrows in Cambrian Pipe Rock, Skiag Bridge. BGS Photo P524489 – E R Phillips

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 901, Moine Block, Vol. 34. Confirmed GCR site, not SSSI notified feature.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site is representative of the Cambro-Ordovician foreland succession, the Sole Thrust of the Moine Thrust Belt and the lowest imbricate systems in the Assynt Culmination. It contains exceptional examples of stratigraphical repetition due to thrusting. The site is internationally important as a teaching site for basic thrust concepts.

ACCESSIBILITY

There is a layby on the west side of the A 894 and the site is thus accessible to all abilities.

CONSERVATION

Due to the proximity to the road, the high level of importance of the site, the popularity with geology students and the rather restricted and fragile nature of some of the individual exposed rock surfaces, there is a high conservation requirement.

VISIBILITY AND "CLARITY"

The majority of key features are visible from the A 894 road. The Pipe Rock is particularly well displayed. Identification of individual thrust features does, however, require specialist assistance for the general public.

INTERPRETATION AND INTERPRETATION POTENTIAL

There is currently no on-site interpretation facility. A new roadside interpretation panel would, however, be of great benefit, interest and value for the public but would need to be sited carefully to avoid creating a hazard. Certainly, the site should be included in a future Geopark guide. The site is frequently visited by geologists and university parties and used to demonstrate typical Pipe Rock characteristics, imbricate thrusting and an introduction to the stratigraphic sequence in the NW Highlands.

KEY REFERENCES

- BUTLER, R.W.H. 2009. Skiag Bridge. *In* Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 273-276.
- COWARD, M.P. 1984. The strain and textural history of thin-skinned tectonic zones: examples from the Assynt region of the Moine thrust zone. *Journal of Structural Geology*, **6**, 89-99.

NWHG REF. 025 - BEINN GHARBH

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site occupies the area of Beinn Gharbh which rises above Loch Assynt on its south-west side, Grid Ref. NC 227222.



Close-up of Canisp porphyry, Beinn Garbh, BGS Photo P531559 – K M Goodenough

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1225, Caledonian Igneous Block, Vol. 17. Confirmed GCR site, not SSSI notified feature.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The view onto Beinn Gharbh, looking southwards from the north side of Loch Assynt, is one of the most important in British geology and displays the “double unconformity” of basal Lewisian gneisses rising up from the shore of Loch Assynt and being unconformably overlain by horizontally bedded Torridonian sandstone strata, both of which are unconformably overlain and overstepped by Cambrian quartzites dipping at about 15° to the east. The differences in dips of the Torridonian and Cambrian strata are visually highlighted by two parallel major sills of Canisp Porphyry on Beinn Gharbh, both of which clearly follow (and emphasise) the bedding planes of the two different strata, the sills changing dip as they cross the upper unconformity. The site therefore

serves to clearly illustrate a double unconformity within the flank of the north-facing slope as well as providing exceptional exposures of Canisp Porphyry, the largest development of Caledonian magmatism in the Foreland terrane.

ACCESSIBILITY

The main features are easily seen from laybys on the A 894 as it rises northwards from its junction with the A 837 at Skiag Bridge. The site is therefore accessible to all abilities.

CONSERVATION

There are no conservation requirements due to the scale and location of the site.

VISIBILITY AND "CLARITY"

The essential geological features are best seen from a distance from the A 894 to the north. The view is both dramatic and spectacular and also inspirational once the significance of the features is explained to the casual viewer.

INTERPRETATION AND INTERPRETATION POTENTIAL

There is currently no interpretation panel but this is certainly one instance where a new panel erected at the layby at the top of the Skiag hill, looking south towards Loch Assynt, would be of significant interest and benefit for the general public. There is considerable potential for development of an appropriate viewpoint as an educational resource for university parties and researchers as well as the public. Certainly, the double unconformity should be listed in a future Geopark guide and the viewpoint from Skiag included in any guided tours.

KEY REFERENCES

PARSONS, I. 1999. Late Ordovician to mid-Silurian alkaline intrusions of the North-west Highlands of Scotland. *In* Stephenson, D., Bevins, R. E., Milward, D., Highton, A. J., Parsons, I., Stone, P. & Wadsworth, W. J. (eds) *Caledonian Igneous rocks of Great Britain*. Geological Conservation Review Series, **17**, Chapman & Hall, 345-393 (site description page 383).

NWHG REF. 026 - CNOC AN DROIGHINN

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The hill feature of Cnoc an Droighinn is located about 2km north-east of Inchnadamph, Grid Ref. NC 263226.



Guided walk group on a porphyry sill, Cnoc an Droighinn. BGS Photo P669289. K M Goodenough

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1227, Caledonian Igneous Block, Vol. 17. Notified feature of Ben More Assynt SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site exhibits numerous hornblende porphyrite sills within a setting of great structural geological complexity. The sills are structurally repeated by imbrication.

ACCESSIBILITY

The site is located on rising ground on the north side of the River Traligill valley, requiring a walk of about 1.5 km east-north-east from the A 837 at Inchnadamph. There is effectively little or no all abilities access, depending upon circumstances.

CONSERVATION

Low conservation requirement due to scale and location of site.

VISIBILITY AND "CLARITY"

The key features cannot be seen from a distance, necessitating close access to exposures.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site is mainly of interest to geology students and researchers and has low interpretation potential. It could be listed in a future Geopark guide.

KEY REFERENCES

PARSONS, I. 1999. Late Ordovician to mid-Silurian alkaline intrusions of the North-west Highlands of Scotland. *In* Stephenson, D., Bevins, R. E., Milward, D., Highton, A. J., Parsons, I., Stone, P. & Wadsworth, W. J. (eds) *Caledonian Igneous rocks of Great Britain*. Geological Conservation Review Series, **17**, Chapman & Hall, 345-393 (site description page 386).

NWHG REF. 027 - TRALIGILL BURN

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site lies within the course of the Traligill Burn, 2km east-south-east of Inchnadamph, Grid Ref. NC 265213 – NC 271209.



The Traligill Thrust Plane at Traligill Burn. BGS Photo P530634

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1308, Moine Block, Vol. 34. Notified feature of Ben More Assynt SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site is representative of thrusting within the Sole Thrust Sheet in the Assynt Culmination. The seasonally-dry river bed has revealed an exceptional exposure of an actual thrust plane within the lower imbricate zone of the central Assynt area. This is one of the best-known localities within the Moine Thrust Belt. The site is also famous for its karst geomorphology and the course of the Traligill Burn runs underground for 400m.

ACCESSIBILITY

This section of the Traligill valley is accessed via a rough track/path from Inchnadamph, running along the north bank of the Burn. It is not suitable for all abilities.

CONSERVATION

Low to moderate conservation requirement due to the scale and location of the site area.

VISIBILITY AND “CLARITY”

The thrust plane is highly visible once the site location is reached and is very easily recognised with specialist assistance. The exposure of the thrust surface is very dramatic and inspirational to students of geology.

INTERPRETATION AND INTERPRETATION POTENTIAL

This is one of the most frequently visited localities within the Moine Thrust Belt and is commonly used by geologists and university parties to demonstrate the nature and geometry of a thrust surface. It is also included in a guided walk undertaken by the Highland Council Rangers to demonstrate the disappearance of the Burn and the reasons for its underground flow beneath the limestone surface. There is currently no interpretation panel, and consideration could now be given to erecting one. Traligill valley features as a walk in the guidebook “Exploring the landscape of Assynt” The site should certainly be included in a future Geopark guide and its potential as a teaching aid for students and educational resource for the wider public should be developed.

KEY REFERENCES

- BUTLER, R.W.H. 2009. Traligill Burn. *In* Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 279-280.
- KRABBENDAM, M. & LESLIE, A.G. 2010. Lateral variations and linkages in thrust geometry: the Traligill Transverse Zone, Assynt Culmination, Moine Thrust Belt, NW Scotland. *In* Law, R., Butler, R. W. H., Holdsworth, R. E., Krabbendam, M. & Strachan, R. A. (eds) *Continental Tectonics and Mountain Building: The Legacy of Peach and Horne*. Geological Society. London, Special Publication, 333-356.

NWHG REF. 028 - TRALIGILL CAVES

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The Caves are located within the valley of the Traligill Burn, 2.5 km south-east of Inchnadamph, Grid Ref. NC 272209.



Entrance of the Uamh an Uisge cave, Cnoc nam Uamh, Traligill Valley, taken during guided walk. BGS Photo. P530601 – M Krabbendam

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 549, Karst and Caves Block, Vol. 12. Notified feature of Ben More Assynt SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site comprises outcrops of limestones and dolostones of the Durness Group which contain a series of caves extending to a total of more than 2 km of passages. They have a complex hydrology and transmit drainage from multiple sinks to multiple risings, reflecting the geological structure. The caves' passage morphology and deposits contain evidence of sequential glacial rejuvenations of the Traligill valley. Significantly, they contain a stalagmite dated to around 28,000 years BP, indicative of mid-Devensian deglaciation of the valley.

ACCESSIBILITY

The caves are located within steep ground on the south side of the valley and can be accessed via a rough track from Inchnadamph. There is no all abilities access. Effectively no direct access for the general public to the underground passages. This is restricted to specialist cavers and speleological groups.

CONSERVATION

Moderate to high conservation requirement due to importance of cave features and accessibility by specialist cavers/potholers.

VISIBILITY AND "CLARITY"

Low visibility of cave entrances from access path.

INTERPRETATION AND INTERPRETATION POTENTIAL

There is no current interpretation facility above/below ground and interpretation potential is low due to the intrinsic nature/low accessibility of the features. Nonetheless, they should be mentioned in a future Geopark guide. Traligill valley features as a walk in the guidebook "Exploring the landscape of Assynt"

KEY REFERENCES

Geological Conservation Review Series, Volume 12: Karst and Caves of Great Britain, site description page 302.

LAWSON, T.J. 1988. *Caves of Assynt*, Grampian Speleological Group.

NWHG REF. 029 - TRALIGILL VALLEY

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The Traligill Valley extends south-eastwards from Inchnadamph, Grid Ref. NC 280200.



Clint and grykes: karst weathering of the Durness dolostone, Traligill Valley, BGS Photo. P531595 – M Krabbendam

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1129, Karst and Caves Block, Vol. 12. Notified feature of Ben More Assynt SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The Traligill Valley is acknowledged as the finest area of glaciokarst landscape in Scotland and the most spectacular karstic scenery developed anywhere in Britain on limestones of other than Carboniferous age. The site area is important as it is the most recently deglaciated karst in Britain. Within the site there are a number of sinkholes feeding to multiple resurgences via extensive cave systems. The valleys are mostly dry and show features of progressive rejuvenation, providing a detailed record of landform development through the Pleistocene.

ACCESSIBILITY

A rough path leading from Inchnadamph offers good access to the main valley but is unsuitable for all abilities.

CONSERVATION

Low to moderate conservation requirement due to importance of protecting surface features from irresponsible sampling and relative ease of accessibility.

VISIBILITY AND “CLARITY”

The key aspects of the glaciokarst landscape are easily seen from the access path.

INTERPRETATION AND INTERPRETATION POTENTIAL

There is currently no interpretation panel serving the main access path although interpretation boards covering a wide range of subject matter are located at the main car park adjacent to the entrance to the Inchnadamph Hotel on the east side of the A 837. There is considerable potential for erecting new interpretation panels at strategic locations up the valley and the area should certainly be included in a future Geopark guide. It is used regularly during the main visitor season by the Highland Council Countryside Rangers who conduct guided walks up the valley. Traligill valley features as a walk in the guidebook “Exploring the landscape of Assynt” The area is an important educational resource which has considerable potential for future development.

KEY REFERENCES

Geological Conservation Review Series, Volume 12: Karst and Caves of Great Britain, site description page 302.

LAWSON, T.J. 1988. *Caves of Assynt*, Grampian Speleological Group.

NWHG REF. 030 - STRONCHRUBIE CLIFF

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The Stronchrubie Cliff rises above the A 837 along its eastern side, due south of Inchnadamph, Grid Ref. NC 254213 – NC 250193.



Imbricated Eilean Dubh Formation dolostones in the cliffs at Stronchrubie, Traligill Valley, BGS Photo. P667674 – K M Goodenough

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1133, Moine Block, Vol. 34. Notified feature of Ben More Assynt SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site is representative of imbricate thrusts within the Sole Thrust Sheet associated with the Moine Thrust Zone in the Assynt Culmination. Exceptional examples of sections which can be used to study the three-dimensional geometry of an imbricate system. A very important site for Earth Science studies. Extremely important as an educational resource with considerable potential as an international geological teaching aid.

ACCESSIBILITY

Easily accessed by car. The site can be viewed from the roadside and there is a convenient layby for parking on the west side of the road. The site is thus accessible to all abilities.

CONSERVATION

Extensive massive cliff feature is generally robust. Low conservation requirement due to the scale and location of the site.

VISIBILITY AND “CLARITY”

Visibility is excellent from roadside except when cloud level or any mist is very low. Visual impact of the site is high and becomes inspiring once the imbricate structure is recognised and understood.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site is commonly used by geologists and university parties to illustrate imbricate thrusting and associated structures. These structures are not easily discerned and understood by the lay-public without specialist assistance and interpretation. There is currently no interpretation panel specifically for this feature and, given the proximity of an existing interpretation panel dealing with glaciation and related landscape features further over to the west, another interpretation panel might be inappropriate. Nonetheless, the site should be included in a future Geopark guide. It is already described in the Excursion Guide to the Northwest Highlands.

KEY REFERENCES

BUTLER, R.W.H. 2009. Stronchrubie cliff. *In* Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 276-279.

An Excursion Guide to the Northwest Highlands (Goodenough et al. 2011).

NWHG REF. 031 - ALLT NAN UAMH

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site is located within the valley of the Allt nan Uamh, about 1.5 km south of Stronchrubie on the east side of the A 837, Grid Ref. NC 256179.



Waterfall over vogesite sill, Allt nan Uamh. BGS Photo P512707 – T Bradwell

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1230, Caledonian Igneous Block, Vol. 17. Notified feature of Ben More Assynt SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

This small site lies within the course of the Allt nan Uamh and displays a 20 m thick sill of fresh vogesite (hornblende-rich lamprophyre), containing a high proportion of large prismatic hornblende crystals set in pink feldspar, running across the stream and dipping gently eastwards. Vogesite occurs widely within the Moine Thrust Zone of Assynt and Ullapool but is otherwise a rare rock-type. It is the most widespread hypabyssal intrusive rock-type occurring in Assynt and offers an excellent example of the lamprophyre family for teaching purposes.

ACCESSIBILITY

The site is easily accessed from the “Bone Caves” car park (NC 253179) on the east side of the A 837, 2km north of the northern end of Loch Awe. A short walk up the

unsurfaced path, past the former fish-farm building, would, unfortunately, prove very difficult for all abilities.

CONSERVATION

Low conservation requirement due to the nature of the exposure.

VISIBILITY AND "CLARITY"

The sill of vogesite is clearly exposed at a conspicuous waterfall feature formed in the course of the Allt nan Uamh.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site is important for geologists but probably of limited interest to the general public. Nonetheless, it is excellent for specialist geological teaching purposes as an example of the lamprophyre family. The area of the waterfall, with the vogesite sill underlying the main rock ledge of Salterella Grit, is a very photogenic one and attracts many visitors on their way further up the valley to the Bone Caves. The site is featured as part of a walk in the guidebook "Exploring the landscape of Assynt" Although there is currently no interpretation panel, consideration might be given to erecting one which would explain why the waterfall feature is there (i.e. due to the baking effect of the hot sill on the immediately overlying Salterella Grit strata which were therefore locally hardened and resistant to subsequent erosion). The site should be included in a future Geopark guide.

KEY REFERENCES

PARSONS, I. 1999. Late Ordovician to mid-Silurian alkaline intrusions of the North-west Highlands of Scotland. *In* Stephenson, D., Bevins, R. E., Milward, D., Highton, A. J., Parsons, I., Stone, P. & Wadsworth, W. J. (eds) *Caledonian Igneous rocks of Great Britain*. Geological Conservation Review Series, **17**, Chapman & Hall, 345-393 (site description page 388).

NWHG REF. O32 - CREAG NAN UAMH CAVES

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The Caves are located on north-facing slopes rising above the valley of the Allt nan Uamh on its southern side, Grid Ref. NC 268170.



The cave entrance of the Caeg nam Uamh caves. BGS Photo P531624 – M Krabbendam

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1490, Quaternary Block, Vol. 6. Notified feature of Ben More Assynt SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

This is the richest Pleistocene site in Scotland and the most northerly such site in the British Isles. Extensive in-situ deposits here and in adjacent caves afford much potential for future research at these important vertebrate localities.

ACCESSIBILITY

Access is from the large “Bone Caves” car park on the east side of the A 837 (NC 253179) via a 1.7 km long unsurfaced path over rough and undulating terrain, sometimes traversing steep sidelong ground. No all access for all abilities.



Limestone crags, bone caves and Allt nan Uamh, seen from Beinn nan Cnaimsheag. BGS Photo P530477 – T Bradwell

CONSERVATION

High conservation requirement due to nature, fragility and accessibility of this very important site.

VISIBILITY AND “CLARITY”

The caves are not visible from the main car park but present a dramatic feature once their location is reached.

INTERPRETATION AND INTERPRETATION POTENTIAL

There is an interpretation panel at the main “Bone Caves” car park and another interpretation panel would therefore not be necessary. The site is featured as part of a walk in the guidebook “Exploring the landscape of Assynt”. The site is regularly used for guided walks led by Highland Council Countryside Rangers and should certainly be included in a future Geopark guide.

KEY REFERENCES

Geological Conservation Review Series, Volume 6: Quaternary of Scotland, site description page 127.

LAWSON, T.J. 1988. *Caves of Assynt*, Grampian Speleological Group.

- LAWSON, T. 1995. The Creag nam Uamh caves. *In* Lawson, T. (eds) *The Quaternary of Assynt and Coigach; field guide*. , Quaternary Research Association, Cambridge, 87-103.
- LAWSON, T.J. 1993. Creah nam Uamh. *In* Gordon, J. E. & Sutherland, D. G. (eds) *Quaternary of Scotland*. Geological Conservation Review Series, **6**, Chapman and Hall, London, 127-133.

NWHG REF. 033 - CREAG NAN UAMH

LOCATION, GRID REFERENCE

The hill feature of Creag nan Uamh rises above the Allt nan Uamh on its southern side, about 1.5 km east of the A 837, Grid Ref. NC 268170.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 3044, Quaternary Block, Vol. 6. Notified feature of Ben More Assynt SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The unique assemblage of deposits and fossil animal remains preserved in the caves at Creag nan Uamh provides an important record of environmental conditions and changes in Scotland during at least the last 125,000 years. Of particular importance is the detailed evidence for the range of sub-arctic mammalian species present in the area at the end of the most recent ice age (i.e. about 10,000 years ago).

ACCESSIBILITY

Access is from the "Bone Caves" car park on the east side of the A 837 (NC 253179) via an unsurfaced path over rough and undulating terrain, sometimes steep. No all abilities access.

CONSERVATION

High conservation requirement due to nature, fragility and accessibility of this very important site.

VISIBILITY AND "CLARITY"

The site is not visible from the main car park.

INTERPRETATION AND INTERPRETATION POTENTIAL

An interpretation panel is currently located at the main "Bear Caves" car park. The site is used by the Highland Council Countryside Rangers for guided walks and should be included in a future Geopark guide.

KEY REFERENCES

LAWSON, T.J. 1988. *Caves of Assynt*, Grampian Speleological Group.

LAWSON, T. 1995. The Creag nam Uamh caves. *In* Lawson, T. (eds) *The Quaternary of Assynt and Coigach; field guide*. , Quaternary Research Association, Cambridge, 87-103.

LAWSON, T.J. 1993. Creah nam Uamh. *In* Gordon, J. E. & Sutherland, D. G. (eds) *Quaternary of Scotland*. Geological Conservation Review Series, **6**, Chapman and Hall, London, 127-133.

NWHG REF. 034 - ALLT NAN UAMH CAVES

LOCATION, GRID REFERENCE

The caves are located within higher ground forming the southern slopes above the Allt nan Uamh valley, Grid Ref. NC 273170.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 548, Karst and Caves Block, Vol. 12. Notified feature of Ben More Assynt SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site contains two of Scotland's most extensive and complex cave systems, as well as some of Britain's longest caves developed in non-Carboniferous limestone. They provide excellent examples of the nature of karst hydrology and geomorphology in structurally complex thrust sheets of Cambrian-Ordovician Durness dolomitic limestone and also contain valuable evidence concerning the repeated glaciations of the area.

ACCESSIBILITY

Access is the same as for 033 Creag nan Uamh. Access into the caves is restricted to specialist cavers.

CONSERVATION

Moderate conservation requirement.

VISIBILITY AND "CLARITY"

The cave systems require local knowledge in order to locate them and visibility is therefore very poor.

INTERPRETATION AND INTERPRETATION POTENTIAL

Detailed interpretation is restricted to specialists and caving experts/speleologists. There is, however, some limited potential for general interpretation to be added to the existing panel located at the "Bone Caves" car park adjacent to the A 837. The site should also be included in a future Geopark guide.

KEY REFERENCES

Geological Conservation Review Series, Volume 12: Karst and Caves of Great Britain, site description page 306.

LAWSON, T.J. 1988. *Caves of Assynt*, Grampian Speleological Group.

LAWSON, T. 1995. The Creag nam Uamh caves. *In* Lawson, T. (eds) *The Quaternary of Assynt and Coigach; field guide*. ,Quaternary Research Association, Cambridge, 87-103.

LAWSON, T.J. 1993. Creah nam Uamh. *In* Gordon, J. E. & Sutherland, D. G. (eds) *Quaternary of Scotland*. Geological Conservation Review Series, **6**, Chapman and Hall, London, 127-133.

NWHG REF. 035 - BEAR CAVE

LOCATION, GRID REFERENCE

The cave, one of several, is located on the southern slopes of the Allt nan Uamh valley, Grid Ref. NC 276171.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1491, Quaternary Block, Vol. 6. Notified feature of Ben More Assynt SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

This is a key site of importance for studies of Pleistocene vertebrate faunas. This and the other caves contain predominantly undisturbed Pleistocene deposits with great potential for finds of vertebrate fossils. Bear cave was evidently used by brown bears for winter hibernation during post-glacial times.

ACCESSIBILITY

Access requires a 2.5 km walk from the A 837 eastwards up the valley of the Allt nan Uamh over rough and locally steep and boggy terrain. No access for all abilities.

CONSERVATION

Moderate to high conservation requirement due to nature, fragility and accessibility of this very important site.

VISIBILITY AND "CLARITY"

Visibility poor, requiring local knowledge.

INTERPRETATION AND INTERPRETATION POTENTIAL

There is considerable scope here for interpretation with potential for a leaflet describing the formation of the cave(s) and the range of vertebrate faunas found so far. The site may be incorporated within a guided walk up the valley and should certainly be included in a future Geopark guide. There is considerable scope for developing the site as a teaching aid for schools and universities.

KEY REFERENCES

LAWSON, T.J. 1988. *Caves of Assynt*, Grampian Speleological Group.

LAWSON, T. 1995. The Creag nam Uamh caves. In Lawson, T. (eds) *The Quaternary of Assynt and Coigach; field guide*. Quaternary Research Association, Cambridge, 87-103.

LAWSON, T.J. 1993. Creah nam Uamh. In Gordon, J. E. & Sutherland, D. G. (eds) *Quaternary of Scotland*. Geological Conservation Review Series, **6**, Chapman and Hall, London, 127-133.

NWHG REF. 036 - BEN MORE ASSYNT, CONIVAL AND NA TUADHAN

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The mountains of Ben More Assynt, Conival and Na Tuadhan form the highest ground in central Assynt, approximately 7 km east and south-east of Inchnadamph, Grid Ref. NC 300220 – NC 324198.



Na Tuadhan, from the Conival - Ben More Assynt ridge. A hanging-wall anticline is clearly visible. BGS Photo P530512 – M Krabbendam

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1309, Moine Block, Vol. 34. Notified feature of Ben More Assynt SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

These mountain areas are representative of the central part of the Assynt Culmination and contain excellent exposures of the Ben More Thrust and its associated structures. There are exceptional large-scale exposures of thrusts and related folds. The area is internationally important as a classic location for the demonstration of thrust structures.

ACCESSIBILITY

The area lies within a very remote and mountainous area of Assynt requiring an initial entry walk of about 6 km and some steep climbs up mountainous slopes. No all abilities access possible, therefore.

CONSERVATION

No conservation requirement due to the immense scale and location of the site area.

VISIBILITY AND "CLARITY"

The majority of key features can be seen from a distance but it is still necessary to walk to selected viewpoints.

INTERPRETATION AND INTERPRETATION POTENTIAL

The area is renowned as a teaching and research area for the study of the Ben More Thrust and its associated structures. There is considerable further potential to develop the area as an educational resource for universities, students and researchers. The site is featured as a walk in the guidebook "Exploring the landscape of Assynt". Selected localities within this vast area should certainly be included in a future Geopark guide and guided walks for both geological specialists and also the general public could be planned.

KEY REFERENCES

- BUTLER, R.W.H. 2009. Ben More Assynt - Conival - Na Tuadhan *In Mendum*, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 281-285.
- ELLIOTT, D. & JOHNSON, M.R.W. 1980. Structural evolution in the northern part of the Moine thrust belt, NW Scotland. *Transactions of the Royal Society of Edinburgh: Earth Sciences*, **71**, 69-96.

NWHG REF. 037 - GLEN OYKEL NORTH

LOCATION, GRID REFERENCE

This very small site is located in the floor of the Oykel valley, about 4.5 km north of Loch Ailsh and within the area of Benmore Forest, Grid Ref. NC 312161.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1231, Caledonian Igneous Block, Vol. 17. Notified feature of Ben More Assynt SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site occupies a very small area about 22 m x 15 m straddling the course of the River Oykel. It is an exceptional locality at which an enigmatic diatreme of brecciated dolomitic limestone in a fine carbonate matrix is associated with a vogesite sill. It may represent the only example of transport by gas in the Caledonian alkaline suite.

ACCESSIBILITY

There is no vehicular access and a walk of about 5 km from Benmore Lodge further up the valley of the River Oykel is required, over remote and undulating terrain. There is therefore no all abilities access.

CONSERVATION

Low conservation requirement due to the location of the site.

VISIBILITY AND "CLARITY"

The key features are only visible once the site has been accessed.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site is located in a very remote area and is unlikely to be visited by the general public other than geological specialists/ students. Interpretation potential is therefore limited. However, in view of the historical and current importance of the site from a geological perspective, it should be listed in a future Geopark guide.

KEY REFERENCES

Geological Conservation Review Series, Volume 17: Caledonian Igneous Rocks of Great Britain, site description page 389.

NWHG REF. 038 - GLEN OYKEL SOUTH

LOCATION, GRID REFERENCE AND PHOTOGRAPH

This small site is located in the bed of the River Oykel c .750 m north of its confluence with the Allt Sail an Ruathair, Grid Ref. NC 327136.



'Grorudite' (peralkaline rhyolite) dyke cutting Loch Ailsh syenites, Glen Oykel. BGS Photo P506430 – K M Goodenough

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1222, Caledonian Igneous Block, Vol. 17. Notified feature of Ben More Assynt SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site comprises rock-slabs exposed in the bed of the River Oykel and is representative of the “grorudite” (peralkaline rhyolite) suite of dykes which are emplaced only in the Ben More Nappe. At this site, a 4 m thick dyke of grorudite (one of a swarm exposed elsewhere) cuts through the syenite of the Loch Ailsh intrusion, demonstrating that the Loch Ailsh was emplaced prior to movements on the Ben More Thrust and the associated emplacement of the grorudite intrusions.

ACCESSIBILITY

The site is located in a remote part of Glen Oykel but can be accessed via a rough, unsurfaced track to the north of Benmore Lodge. Moderately difficult access, therefore, but no all abilities access.

CONSERVATION

Low conservation requirement due to the location of the site.

VISIBILITY AND "CLARITY"

The key features are only visible once the site has been accessed.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site is located within a very remote area and is unlikely to be visited by members of the general public other than geological specialists/students. Interpretation potential is therefore very limited.

KEY REFERENCES

PARSONS, I. 1999. Late Ordovician to mid-Silurian alkaline intrusions of the North-west Highlands of Scotland. *In* Stephenson, D., Bevins, R. E., Milward, D., Highton, A. J., Parsons, I., Stone, P. & Wadsworth, W. J. (eds) *Caledonian Igneous rocks of Great Britain*. Geological Conservation Review Series, **17**, Chapman & Hall, 345-393 (site description page 381).

NWHG REF. 039 - LOCH AILSH INTRUSION

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site covers an area of about 10 km² extending from within 750 m of the northern shore of Loch Ailsh and on either side of the Oykel valley for some 3 km, Grid Ref. NC 330115 – NC 360150 – NC 330160 – NC 310140 – NC 310125.



Complex cross-cutting relationships in the Loch Ailsh syenites Glen Oykel. BGS Photo P506429 – K M Goodenough

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1221, Caledonian Igneous Block, Vol. 17. Notified as feature of Ben More Assynt SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The Loch Ailsh intrusion is important because it includes a suite of unusually sodium-rich syenites considered to be unique in the British Isles. It is internationally important as it includes the type-locality for alkali feldspar syenite, or “perthosite”. The radiometric age and structural relationships are important for the timing of movements in the Moine Thrust Zone.

ACCESSIBILITY

The intrusion occupies a huge area of about 10 km² and can be accessed to some extent via unsurfaced forestry tracks within Glen Oykel. A considerable amount of walking over rough terrain and within forestry areas is required. There is no all abilities access.

CONSERVATION

Low conservation requirement due to the scale and location of the site area.

VISIBILITY AND "CLARITY"

General views only of the associated terrain and mountainous landscape can be had from the north-east side of Loch Ailsh. Specialist knowledge is required in order to associate individual landscape features to the particular rock-types occurring within the intrusion.

INTERPRETATION AND INTERPRETATION POTENTIAL

The Loch Ailsh intrusion lies in a very remote area and is unlikely to be of interest to the general public as it requires specialist knowledge to interpret it. Nonetheless, it does represent an important locality for petrological studies and for examining the detailed timing of movements in the Moine Thrust Zone. There may be some potential, therefore, for developing the area as a teaching resource for geology students. The area should be listed in a future Geopark guide but guided walks specifically to see the key features would be inappropriate.

KEY REFERENCES

PARSONS, I. 1999. Late Ordovician to mid-Silurian alkaline intrusions of the North-west Highlands of Scotland. *In* Stephenson, D., Bevins, R. E., Milward, D., Highton, A. J., Parsons, I., Stone, P. & Wadsworth, W. J. (eds) *Caledonian Igneous rocks of Great Britain*. Geological Conservation Review Series, **17**, Chapman & Hall, 345-393 (site description page 366).

NWHG REF. 040 - SGONNAN MOR, DUBH LOCH BEAG, UPPER GLEN OYKEL

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site comprises three separate areas located within upper Glen Oykel, Grid Ref. NC 295145 – NC 298132, NC 316155 – NC 320160, NC 308180 – NC 312185.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1160, Moine Block, Vol. 34. Notified feature of Ben More Assynt SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The three separate areas contain exposures of the Ben More Thrust and its associated structures. The site areas are considered representative of the Ben More Thrust and associated fold and thrust structures in the Assynt Culmination. They are also representative of the relationships between Lewisian and Torridonian units in the Ben More Thrust Sheet.

ACCESSIBILITY

The site areas lie within a very remote and mountainous area, many kms from the nearest road, requiring a long walk over undulating and challenging terrain. There is therefore no all abilities access.

CONSERVATION

Low conservation requirement due to the nature, scale and location of the site areas.

VISIBILITY AND “CLARITY”

The main features are visible to the specialist eye once this very remote area is reached.

INTERPRETATION AND INTERPRETATION POTENTIAL

The very remote and difficult nature of the site areas and the specialised aspect of their geological significance rule out any meaningful interpretation potential for the general public. The areas could be developed as an educational resource and included in a future Geopark guide.

KEY REFERENCES

- BUTLER, R.W.H. 2009. Sgonnan More - Dubh Loch beag - Upper Glen Oykel. *In* Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 286-288.
- ELLIOTT, D. & JOHNSON, M.R.W. 1980. Structural evolution in the northern part of the Moine thrust belt, NW Scotland. *Transactions of the Royal Society of Edinburgh: Earth Sciences*, **71**, 69-96.

NWHG REF. 041 - LUBAN CROMA

LOCATION, GRID REFERENCE

The site lies approximately 2 km to the north-east of the Altnacealgach Inn on the north side of Loch Borrallan, Grid Ref. NC 281135.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1228, Caledonian Igneous Block, Vol. 17. Notified feature of Ben More Assynt SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site represents the variety of sills of the “hornblende porphyrite” suite and is important as an example of the range of minor intrusive rocks in Assynt which were emplaced prior to movements on the Ben More Thrust Plane.

ACCESSIBILITY

The site requires a 2 km walk over rough and frequently boggy ground. There is therefore no all abilities access.

CONSERVATION

Low conservation requirement due to the scale and location of the site.

VISIBILITY AND “CLARITY”

The site cannot be seen from the nearest road. Once reached, however, the various rock types are well exposed.

INTERPRETATION AND INTERPRETATION POTENTIAL

There is very limited potential here for interpretation to the general public. The site is effectively only of interest to geology students and researchers.

KEY REFERENCES

PARSONS, I. 1999. Late Ordovician to mid-Silurian alkaline intrusions of the North-west Highlands of Scotland. *In* Stephenson, D., Bevins, R. E., Milward, D., Highton, A. J., Parsons, I., Stone, P. & Wadsworth, W. J. (eds) *Caledonian Igneous rocks of Great Britain*. Geological Conservation Review Series, **17**, Chapman & Hall, 345-393. (site description page 386).

NWHG REF. 042 - ALLT NA CAILLICHE

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site is located close to where the Allt na Cailliche flows into the south-east corner of Loch Ailsh, Grid Ref. NC 320102.



Outcrop of nordmarkite sill in the Allt na Cailliche, E of Loch Ailsh. BGS Photo P531459 – K M Goodenough

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1229, Caledonian Igneous Block, Vol. 17. Confirmed GCR site, not SSSI notified.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The exposure is representative of a suite of quartz-syenite (nordmarkite) sills which occur just above the plane of the Moine Thrust. It demonstrates that emplacement of the sills was controlled and localised by the thrusts themselves and that subsequent deformation and recrystallisation of the nordmarkites was caused by late movements on the thrust plane.

ACCESSIBILITY

Access to the site is by driving along unsurfaced forestry roads on the north-east side of Glen Oykeil, followed by a short walk, in part along and through a heavily vegetated river gorge. There is, therefore, no access for all abilities.

CONSERVATION

Low conservation requirement due to the scale and location of the site.

VISIBILITY AND "CLARITY"

The site is visible within the course of the Allt na Cailliche but is difficult to find and to interpret.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site is of very limited interest for the general public.. The site is effectively only of interest to geology students and researchers.

KEY REFERENCES

PARSONS, I. 1999. Late Ordovician to mid-Silurian alkaline intrusions of the North-west Highlands of Scotland. *In* Stephenson, D., Bevins, R. E., Milward, D., Highton, A. J., Parsons, I., Stone, P. & Wadsworth, W. J. (eds) *Caledonian Igneous rocks of Great Britain*. Geological Conservation Review Series, **17**, Chapman & Hall, 345-393 . (site description page 391).

NWHG REF. 043 - LOCH BORRALAN INTRUSION

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The Loch Borralan intrusion lies towards the south of the Assynt region and is centred on Loch Borrolan, Grid Ref. NC 235110 – NC 277081 - NC 297085 – NC 306107 – NC 298140 – NC 260150 – NC 235150.



Oblique aerial view taken from above Ledbeg, looking south-west onto the hill of Cnoc na Sroine forming the bulk of the Loch Borralan Pluton. BGS Photo P000784, A Christie

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1220, Caledonian Igneous Block, Vol. 17. Confirmed GCR site, not SSSI notified.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The Loch Borralan intrusion is internationally important for petrological reasons. It contains the only known British examples of several rock-types, including nepheline-syenite, pseudoleucite-syenite and carbonatite. The local term “Borolanite” was coined by Horne and Teall (1892) for the syenite. Radiometric Age and structural relationships are important for the timing of movements within the Moine Thrust Zone. The Loch Borralan Intrusion contains some of the most extreme potassium-rich igneous rocks

found anywhere on Earth. It is historically of great importance in the development of hypotheses for the evolution of igneous rocks.

ACCESSIBILITY

The Loch Borrallan intrusion occupies a large area of elevated ground, mostly covered with surface vegetation and the bedrock is poorly exposed. In some areas it has been afforested. As a rock-controlled landscape feature, however, it is easy to discern the main outcrop from the roadside, especially when viewed from a distance. In that sense, therefore, it is accessible to all abilities.

CONSERVATION

Low conservation requirement due to the scale and location of the site area.

VISIBILITY AND "CLARITY"

The main area of the intrusion, forming a conspicuous area of high ground on the north-east side of Loch Borrallan, is easily seen from a distance.

INTERPRETATION AND INTERPRETATION POTENTIAL

The scale of the Loch Borrallan intrusion and its widespread outcrop, coupled with the specialised geological interest, make it inappropriate to provide interpretation facilities for the general public. However, there is clearly a potential for some interpretation suitable for geology students and petrologists, and consideration might be given to developing the area for teaching purposes. Certainly, the site should be included in a future Geopark guide.

KEY REFERENCES

- PARSONS, I. 1999. Late Ordovician to mid-Silurian alkaline intrusions of the North-west Highlands of Scotland. *In* Stephenson, D., Bevins, R. E., Milward, D., Highton, A. J., Parsons, I., Stone, P. & Wadsworth, W. J. (eds) *Caledonian Igneous rocks of Great Britain*. Geological Conservation Review Series, **17**, Chapman & Hall, 345-393. (site description page 353).
- GOODENOUGH, K.M., MILLAR, I., STRACHAN, R.A., KRABBENDAM, M. & EVANS, J.A. 2011. Timing of regional deformation and development of the Moine Thrust Zone in the Scottish Caledonides: constraints from the U-Pb geochronology of alkaline intrusions. *Journal of the Geological Society of London*, **168**, 99-114.

NWHG REF. 044 - LOCH AWE QUARRY

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site is located on the east side of the A 837 towards the north-east corner of Loch Awe, north of Ledmore Junction, Grid Ref. NC 250158.



A fossil specimen of *Olenellus lapworthi* Peach trilobite, collected at Loch Awe quarry,. BGS Biostratigraphy Collection number GSM 102270, BGS Photo P521151.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1023, Cambrian Block, Vol. 18. Confirmed GCR site, not SSSI notified.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The potash-rich (Lower Cambrian age) Furoid Beds are well exposed in the Quarry face and contain well-preserved and age-diagnostic faunas of olenellid trilobites, including the type (and only) locality for *Olenellus hamoculus*, in exceptional abundance. These dolomitic shales have provided very useful information on the Early Cambrian age and palaeogeography of the Furoid Beds, enabling correlation with areas in Greenland, Canada and Spitsbergen.

ACCESSIBILITY

The entrance to the Quarry is located at the eastern edge of the A 837 and there is limited parking provision immediately on the opposite side of the road on an unsurfaced verge. There is a larger, surfaced layby a short distance further north on the west side of the road (NC 250161). The Quarry faces and the constituent strata are visible, at a distance, from the entrance off the A 837. The floor of the Quarry is, however, at a higher level than the A 837 road surface, and it is necessary to negotiate both a deep ditch and a steep slope from the road. The Quarry area is locally strewn with rock boulders and it is not presently possible to gain unimpeded access to the main Quarry faces without having to negotiate accumulations of broken rock dumped on the Quarry floor. At present, therefore, all abilities access to the actual rock faces is not possible but this can be improved with some judicious clearing of the Quarry floor and entrance.

CONSERVATION

In the light of the palaeontological significance of the site, and its proximity to the A 837, there is a moderate to high conservation requirement.

VISIBILITY AND "CLARITY"

Visibility of the stratified Furoid Beds is excellent from the entrance to the Quarry.

INTERPRETATION AND INTERPRETATION POTENTIAL

The Loch Awe Quarry site currently does not have any interpretation facilities on-site. However, there is considerable potential for new interpretation aimed at both the general public and geological specialists. The immediate area is a popular one for both visitors and fishermen using Loch Awe and the Quarry could be usefully developed as an excellent interpretation locality, with exhibits of the fossiliferous strata being displayed and the implications for palaeogeographical reconstruction explained. However, it should be borne in mind that this is a working quarry. Certainly, the site should be included in a future Geopark guide and it could also be included in any future guided walk of the Canisp area, as it is close to a suitable starting point

KEY REFERENCES

PRIGMORE, J.K. & RUSHTON, A.W.A. 1999. Scotland: Cambrian and Ordovician of the Hebridean Terrane. *In* Rushton, A. W. A., Owen, A. W., Owens, R. M. & Prigmore, J. K. (eds) *British Cambrian to Ordovician Stratigraphy*. Geological Conservation Review Series, **18**, Chapman & Hall, 295-315.

NWHG REF. 045 - CNOC AN LEATHAID BHUIDHE

LOCATION, GRID REFERENCE

The site is located about 1 km due west from Loch Awe, Grid Ref. NC235154.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1226, Caledonian Igneous Block, Vol. 17. Confirmed GCR site, not SSSI notified.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The quality of exposure at this locality is poor. Nonetheless, the site is important because it contains a sill of Canisp Porphyry which occurs close to, but not above, the Sole Thrust, thus suggesting that Canisp Porphyry magmatism preceded movements on the Sole Thrust. Canisp Porphyry is therefore only found in the Foreland rocks to the west of the main Moine Thrust Belt, including the Sole Thrust.

ACCESSIBILITY

The site is located within rough and undulating terrain requiring a 2 km walk westwards from the A 837 which runs along the eastern side of Loch Awe. There is no access for all abilities.

CONSERVATION

Low conservation requirement due to the scale and location of the site.

VISIBILITY AND "CLARITY"

The actual site cannot be seen from the A 837 and visibility is poor once the actual exposure is reached.

INTERPRETATION AND INTERPRETATION POTENTIAL

There is very limited potential for interpretation as the feature is of specialised interest only to students and researchers.

KEY REFERENCES

PARSONS, I. 1999. Late Ordovician to mid-Silurian alkaline intrusions of the North-west Highlands of Scotland. *In* Stephenson, D., Bevins, R. E., Milward, D., Highton, A. J., Parsons, I., Stone, P. & Wadsworth, W. J. (eds) *Caledonian Igneous rocks of Great Britain*. Geological Conservation Review Series, **17**, Chapman & Hall, 345-393 . (site description page 384).

NWHG REF. 046 - CAM LOCH KLIPPE

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site occurs close to the north-east side of Cam Loch north of Elphin, Grid Ref. NC 225148 – NC 233126.



View from Elphin. Foreland and The hill of Cnoc Leathaid Bhig – forming the Cam Loch Klippe, seen from Elphin. BGS Photo P571727- M Krabbendam.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1159, Moine Block, Vol. 34. Notified feature of Cam Loch SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site is representative of thrust klippen and thrust-propagation folding in the Assynt Culmination. The Cam Loch Klippe is the largest and best known of at least ten klippen in the Assynt Culmination and lies the farthest west. Its correlation with the Ben More Thrust Sheet by Peach *et al.* (1907), is somewhat controversial.

ACCESSIBILITY

The site is in a remote location requiring a 2 km walk over rough and boggy terrain along a rough path starting at the north-east side of the A 835 road bridge over the Ledbeg River. It is not, therefore, accessible to all abilities.

CONSERVATION

Low conservation requirement due to the scale and location of the site.

VISIBILITY AND “CLARITY”

The site is not visible from the nearest road and features require specialist knowledge to identify them once the site is reached.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site is not suitable for interpretation to the general public, in view of its specialised nature. Nonetheless, it could be developed as a teaching site for geology students and researchers. It should be included in a future Geopark guide.

KEY REFERENCES

- BUTLER, R.W.H. 2009. Cam Loch. In Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 288-293.
- ELLIOTT, D. & JOHNSON, M.R.W. 1980. Structural evolution in the northern part of the Moine thrust belt, NW Scotland. *Transactions of the Royal Society of Edinburgh: Earth Sciences*, **71**, 69-96.

NWHG REF. 047 - CREAG NA H-INNSE RUAIDHE

LOCATION, GRID REFERENCE

The site is located on rising ground to the north-east of Cam Loch, closer to its eastern end, Grid Ref. NC 224140.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1223, Caledonian Igneous Block, Vol. 17. Notified feature of Cam Loch SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site contains an exposure of a red “grorudite” dyke, about 1 m thick, which is representative of the grorudite suite of dykes in one of the outliers (klippen) of the Ben More Nappe, demonstrating an important structural relationship.

ACCESSIBILITY

The site is located on a remote hillside on the north-east side of Cam Loch and is accessed via a rough track leading from the A 835 road bridge over the Ledbeg River, 2 km north-east from Elphin. There is thus no all abilities access.

CONSERVATION

Low conservation requirement due to location of site.

VISIBILITY AND “CLARITY”

The grorudite dyke outcrop is not visible from the nearest road or the access track.

INTERPRETATION AND INTERPRETATION POTENTIAL

There is no interpretation facility and the significance of the grorudite dyke is meaningful only to geology students and researchers. Interpretation potential is therefore low although the feature could be included in a future Geopark guide.

KEY REFERENCES

PARSONS, I. 1999. Late Ordovician to mid-Silurian alkaline intrusions of the North-west Highlands of Scotland. *In* Stephenson, D., Bevins, R. E., Milward, D., Highton, A. J., Parsons, I., Stone, P. & Wadsworth, W. J. (eds) *Caledonian Igneous rocks of Great Britain*. Geological Conservation Review Series, **17**, Chapman & Hall, 345-393 . (site description page 381).

NWHG REF. 048 - CAM LOCH

LOCATION, GRID REFERENCE AND PHOTOGRAPH

Cam Loch is situated just north of Elphin, Grid Ref. NC 224140.



Cam Loch, Suilven in the back ground. BGS Photo P000792 -

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1529, Quaternary Block, Vol. 6. Notified feature of Cam Loch SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

Cam Loch is a site of the highest scientific importance for Quaternary stratigraphy, palaeoclimatology and palaeoecology. Sediments deposited on the loch bed are important for reconstructing the environmental history of north-west Scotland from about 13,000 to 10,000 years ago. It is a major reference site in north-west Scotland for studies of the Devensian Lateglacial, is one of the most intensively studied sites of Lateglacial age in Scotland and is therefore a key locality for this area.

ACCESSIBILITY

The loch can be reached from the A 835 at Elphin Cemetery (NC 220122) but requires a boat to reach the more remote parts at its north-western end. No access for all abilities.

CONSERVATION

Low conservation requirement due to the scale and location of the feature.

VISIBILITY AND “CLARITY”

The loch is easily seen from the A 835 to the north-east of Elphin.

INTERPRETATION AND INTERPRETATION POTENTIAL

Despite the fact that the key features are sediments lying on the loch bed, there is considerable potential for erecting an interpretation panel, suitable for the general public, at the Elphin Cemetery access point which is regularly used by fishermen. The site should certainly be included in a future Geopark guide and it also has considerable potential as an educational resource.

KEY REFERENCES

BIRKS, H.J.B. 1993. Cam Loch. *In* Gordon, J. E. & Sutherland, D. G. (eds) *Quaternary of Scotland*. Geological Conservation Review Series, **6**, Chapman and Hall, London, 134-137.

NWHG REF. 049 - KNOCKAN CRAG - MOINE THRUST EXPOSURE

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site is located on the east side of the A 835 at Knockan Crag National Nature Reserve (owned and managed by SNH), about 2.5 km south of Elphin and 21 km north of Ullapool, Grid Ref. NC 186083 – NC 221093.



A geologist from Mauritania at the Moine Thrust locality at Knockan Crag NNR. BGS Photo P512002 - R M Key

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 890, Moine Block, Vol. 34. Notified feature of Knockan Cliff SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site is one of the most important localities at which the Moine Thrust and the Moine mylonites can be viewed. Here, mylonites derived from the Moine Supergroup directly overlie much younger carbonate rocks of the Durness Group and the two rock-types are separated by the near-horizontal surface of the Moine Thrust plane which daylights at the base of the upper cliff. The locality is of international geological significance and importance as it is one of the first locations at which the Moine Thrust was observed and as a world-famous locality for the study of thrust structures. It is also one of the best places at which to view the Moine Thrust and make detailed examinations of the structure.

ACCESSIBILITY

The Knockan Crag NNR visitor centre (with good car parking and toilet facilities) and well-signposted trails permit easy access to the exposures. All abilities access is, however, restricted to the areas closer to the car park and is not available on the main trail leading along and up the steep slopes to the actual Moine Thrust exposures.

CONSERVATION

In view of the high importance of the site and the significant numbers of visitors it attracts each year, whilst the fragility of the site is low, management for safety requirements are very high with biennial cliff face inspections and rock scaling where and when necessary. SNH staff undertake weekly path checks and 6 monthly cliff face inspections.

VISIBILITY AND “CLARITY”

The Moine Thrust plane is very easily seen and visitors to the Knockan Crag NNR facility can examine the structure in very close detail, as a viewing facility has been constructed by SNH for this purpose. The visual impact is very high and the site is inspirational for specialists and lay-public alike.

INTERPRETATION AND INTERPRETATION POTENTIAL

The standard of existing interpretation of the Moine Thrust is already very high at Knockan Crag NNR and illustrative/interpretative panels and inscribed rock slabs are used extensively, especially at the Rock Room located close to the main car park facility. Numerous guided walks are held annually, and the site is often used for educational visits. The site is featured as part of a walk in the guidebook “Exploring the landscape of Assynt”. Of course, the site must be included in a future Geopark guide and perhaps it could be further developed as an educational resource for schools, students of geology and landscape, and the general public. This is a key site of the highest importance and significance within the Geopark.

KEY REFERENCES

- BUTLER, R.W.H. 2009. Knockan Crag. *In* Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 292-295.
- COWARD, M.P. 1985. The thrust structures of southern Assynt, Moine thrust zone. *Geological Magazine*, **122**, 596-607.

NWHG REF. 050 - LOCH SIONASCAIG

LOCATION, GRID REFERENCE AND PHOTOGRAPH

Loch Sionascaig is a large remote loch lying within Inverpolly, roughly halfway between the A 835 and the west coast, Grid Ref. NC 120140.



Classic Lewisian gneiss cnoc-and-lochan landscape around Loch Sionascaig viewed from the summit of Cul Beag. The Torridonian sandstone inselbergs of Cul Mor and Suilven are seen on the right. BGS Photo P530413 - T Bradwell

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 2747, Quaternary Block, Vol, 6. Notified feature of Inverpolly SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The sediments on the bed of Loch Sionascaig and in a bog on the central island of Eilean Mor provide detailed pollen records, supported by radiocarbon dating, of vegetational changes in Scotland during the Lateglacial and Holocene (particularly important for the environmental changes it demonstrates). Loch Sionascaig is therefore an important reference site for reconstructing the environmental history of north-west Scotland during the last 13,000 years.

ACCESSIBILITY

The site is many kilometres distant from the nearest road and is effectively inaccessible to the general public, requiring a very lengthy walk over difficult and arduous terrain.

CONSERVATION

The important features occur on the loch bed and on the central island. There are no conservation requirements.

VISIBILITY AND “CLARITY”

The key features are only visible to specialists with suitable facilities and sampling equipment.

INTERPRETATION AND INTERPRETATION POTENTIAL

There are no current interpretation facilities and the remote location and nature of the key features do not lend themselves to interpretation panels. Nonetheless, the site could be incorporated within a Geopark long-distance walking guide. There is a potential as an educational resource for students of Quaternary geology and physical geography.

KEY REFERENCES

BIRKS, H.J.B. 1993. Loch Sionascaig *In* Gordon, J. E. & Sutherland, D. G. (eds) *Quaternary of Scotland*. Geological Conservation Review Series, **6**, Chapman and Hall, London, 137-143.

NWHG REF. 051 - ENARD BAY

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site extends along a rocky shoreline from Achnahaird Bay in the west to Garvie Bay in the east, Grid Ref. NC 021140 – NC 039140.



Large-scale cross-bedding in Stoer Group sandstone, Achnahaird Bay. BGS Photo P668334 - M Krabbendam.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1612, Torridonian Block, Vol. 34. Confirmed GCR site, not SSSI notified.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site is of prime stratigraphical importance because it is the only place where the unconformable relationship between the Mesoproterozoic Stoer Group (identified by the presence of the Stac Fada Member) and the overlying (younger) Neoproterozoic Torridon Group can be proved unequivocally. Together with the Stoer site, it provides an excellent section through the Stoer Group, containing very well exposed sedimentary structures and the oldest life forms in Europe. It is also representative of the unconformity between the Lewisian Gneiss and the Stoer Group. The site displays

evidence of two distinct phases of Precambrian landscape formation and burial by Torridonian sediments. The Enard Bay site is of international significance and importance for continued research into Proterozoic depositional environments.

ACCESSIBILITY

The coastal exposures lie about 1.5 km to the north of the nearest road across undulating rough terrain, frequently boggy inland. Alternatively, access can be made by walking around the rocky coastline from Achnahaird Bay further to the west. Access is therefore moderately difficult and not suitable for all abilities.

CONSERVATION

The existing coastal exposures are generally robust and require little or no practical conservation measures. However, in view of the significance and importance of this site, it would be prudent to monitor the condition of the exposures every 5 years, especially the stromatolitic limestones which occur near the Salmon Bothy.

VISIBILITY AND “CLARITY”

Exposures are too far away from the existing road to be visible and also cannot be seen from the landward side, requiring to be viewed by walking to the low coastal strip. Key features are easily identified by geological specialists but not by the lay-public without specialist assistance. The site contains a great variety of features. Very inspiring to geologists in view of the significance of the site.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site is commonly used by geology students and researchers as it condenses much of the sedimentary history of the Torridonian into a small and accessible area. It is of international importance for teaching purposes and continued research. There is currently no interpretation panel and it would not be considered appropriate to have one, given the specialist geological context of the site. Nonetheless, the site should certainly be included in any future Geopark guide and it would also form the basis of a guided walk, led by a geologist, for both public and specialists alike. The potential for further interpretation/explanation is considerable.

KEY REFERENCES

- DAVISON, S. & HAMBREY, M.J. 1996. Indications of glaciation at the base of the Proterozoic Stoer Group (Torridonian), NW Scotland. *Journal of the Geological Society of London*, **153**, 139-149.
- GRACIE, A.J. & STEWART, A.D. 1967. Torridonian sediments at Enard Bay, Ross-shire. *Scottish Journal of Geology*, **3**, 181-194.
- STEWART, A.D. 2002. *The later Proterozoic Torridonian rocks of Scotland: their sedimentology, geochemistry and origin*. Geological Society Memoir, The Geological Society.
- STEWART, A.D. 2009. Enard Bay. In Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 211-216.

NWHG REF. 052 - CAMAS EILEAN GHLAIS

LOCATION, GRID REFERENCE

The site is located within a coastal bay about 1 km north of Reiff on the Coigach peninsula, Grid Ref. NB 967157.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref, 3164, Caledonian Igneous Block, Vol. 17. Proposed GCR site, not SSSI notified.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The exposure is of two sub-parallel nepheline syenite (“ledmorite”) dykes within tilted Torridonian sandstones, emplaced in the Foreland yet clearly trending towards the Loch Borralan intrusion. There are implications for timing of thrust movements. The site is internationally important historically in demonstrating that alkaline magmatism did not involve reactions with limestone.

ACCESSIBILITY

The site is accessed via a 1.2 km walk over rough ground, northwards along the coast from Reiff, and is therefore not accessible to all abilities.

CONSERVATION

Low conservation requirement due to remoteness of the location.

VISIBILITY AND “CLARITY”

The site and the dykes are not visible from the termination of the nearest road (unclassified) at Reiff. Due to similarities in colour, however, between the dyke rock and the host Torridonian sandstone, the dykes do not stand out very clearly when viewed from some distance away.

INTERPRETATION AND INTERPRETATION POTENTIAL

There is very limited potential for interpretation of the site to the general public, outwith geological students and researchers. Nonetheless, it could be included in a future Geopark guide.

KEY REFERENCES

PARSONS, I. 1999. Late Ordovician to mid-Silurian alkaline intrusions of the North-west Highlands of Scotland. *In* Stephenson, D., Bevins, R. E., Milward, D., Highton, A. J., Parsons, I., Stone, P. & Wadsworth, W. J. (eds) *Caledonian Igneous rocks of Great Britain*. Geological Conservation Review Series, **17**, Chapman & Hall, 345-393 . (site description page 392).

NWHG REF. 053 - RUBHA DUNAN

LOCATION, GRID REFERENCE

The site lies on a coastal promontory, west of Polglass in the Coigach area, Grid Ref. NC 018069 – NC 030069.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1614, Torridonian Block, Vol. 34. Notified feature of Rubha Dunan SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site contains excellent exposures of the unconformities between the Stoer Group and the much older Lewisian Gneiss basement, and between the younger Torridon Group and the Stoer Group. The site is also of historical interest as it was here that a major change in the relict palaeomagnetic direction was detected within the Torridonian succession which was later correlated with a major unconformity and time-gap. The site is of national importance.

ACCESSIBILITY

Access to the coastal exposures requires a 1.3 km walk from the unclassified road at Polglass over rough and frequently boggy ground. There is no all abilities access.

CONSERVATION

Low conservation requirement due to the scale and location of the site area.

VISIBILITY AND "CLARITY"

The excellent exposures within the high coastal cliff along the southern edge of the Rubha Dunan peninsula cannot be seen from the nearest road.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site is used mainly by geology students and researchers and requires specialist interpretation. An interpretation panel for the general public is considered inappropriate. However, the site has considerable potential for development as a teaching aid for students and should be included in a future Geopark guide.

KEY REFERENCES

- STEWART, A.D. 2002. *The later Proterozoic Torridonian rocks of Scotland: their sedimentology, geochemistry and origin*. Geological Society Memoir, The Geological Society.
- STEWART, A.D. 2009. Rubha Dunan. In Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 208-211.

NWHG REF. 054 - ACHDUART

LOCATION, GRID REFERENCE

The Achduart site lies on the coast about 5 km south-east of Achiltibuie, Grid Ref. NC 046044 – NC 055034.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1608, Torridonian Block, Vol. 34. Confirmed GCR site, not SSSI notified.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The Achduart site contains the type sections for the lower units of the Applecross Formation of the Torridon Group. It is considered the best site for examination of two extensive sandstone units, interpreted as sections through large alluvial fans or as deposits from a large-scale braided river system. The site is of international importance in relation to the study of the environment of deposition of the Torridon Group rocks.

ACCESSIBILITY

This rather remote area can be accessed by car but requires a short walk over rough ground to reach the site location at the coast. Not recommended for all abilities.

CONSERVATION

Low conservation requirement due to the scale and location of the site.

VISIBILITY AND “CLARITY”

Only visible once the coastline is reached. Key geological features require specialist knowledge.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site is used by geologists studying aspects of the environment of deposition of the Torridon Group and requires specialist interpretation. There is no interpretation panel, and none is recommended. The site is important as an educational resource, and could be included in a future Geopark guide.

KEY REFERENCES

- STEWART, A.D. 2002. *The later Proterozoic Torridonian rocks of Scotland: their sedimentology, geochemistry and origin*. Geological Society Memoir, The Geological Society.
- STEWART, A.D. 2009. Achduart. In Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 217-219.

NWHG REF. 055 - TRAIGH ALLT CHAILGEAG

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The beach of Traigh Allt Chailgeag lies on the north coast of the Geopark at Ceannabeinne, some 4.5 km east of Durness, Grid Ref. NC 443654.



Vertical foliation and boudins of dark amphibolite in Lewisian Gneiss, Traigh Allt Chailgeag beach. M Krabbendam

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI

The site is not GCR-listed and does not lie within a SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The c. 500 m long beach looks out towards the north-east with rocky headlands at the western and eastern ends. It represents a stunning example of a beach feature containing accumulations of wind-blown sand forming dunes along much of the beach, with excellent exposures of Lewisian Gneiss forming the headlands and, locally, along the beach. The metamorphic foliation (or mineral banding) of the Gneiss is almost vertical and is exposed in the face of the first of the headland features encountered at the western end. Here, there are classic examples of boudinage, with isolated “boudins” (or sausage-shaped lenses) of dark grey/black igneous rock interleaved within the main gneissic foliation. These are cut by later veins of pink pegmatite. The exposure demonstrates very clear age-relationships between the host Lewisian Gneiss, later dolerite intrusions and even later cross-cutting pegmatites, all occurring within the very expansive Lewisian time-scale. It is also an excellent locality for demonstrating the repeated phases of extreme shearing along the foliation planes during the history of formation of the Lewisian Gneiss, one consequence of this being the stretching (and final rupturing) of what were originally doleritic intrusions, resulting in the formation of

boudins. The main beach feature is also important in the study of beach formation and associated geomorphological processes.

ACCESSIBILITY

There is a large car park on the landward side of the A 838 (NC 443653) with a good outlook over the beach area. A fairly steep path leads down to the beach over wind-blown sand features and it is important to note that tidal conditions can restrict access to the further-out rocky headland features. There is no access for all abilities.

CONSERVATION

Low conservation requirement due to the scale and nature of the site area.

VISIBILITY AND "CLARITY"

The key features of the Traigh Allt Chailgeag beach are very easily seen from the car park and road, although the rocky headland and faces at the western end are too far away to be able to distinguish the finer details of the examples of boudinage. Once the beach has been accessed and the rock exposures are reached, the boudins within the vertically banded Lewisian Gneiss are very dramatic and the whole Lewisian Gneiss exposure is truly inspiring.

INTERPRETATION AND INTERPRETATION POTENTIAL

Although the beach and associated Lewisian Gneiss exposures are visually attractive, there is no interpretation panel for these either at the car park or at the beach itself. The features require specialist interpretation and the site area has considerable potential as an educational resource both for the general public as well as students of geology and physical geography. A new interpretation panel at the car park and one closer to the beach are recommended and the area merits the running of a guided walk for visitors. The site should also be included in a future Geopark guide.

KEY REFERENCES

RAMSAY, J.G. 1997. The geometry of a deformed unconformity in the Caledonides of NW Scotland. In Sengupta, S. (eds) *Evolution of geological structures in micro- to macro-scales*, Chapman & Hall, London, 445-472.

NWHG REF. 056 - STRATH DIONARD

LOCATION, GRID REFERENCE

The valley of Strath Dionard extends for about 10 km in a south-easterly direction from Gualin on the A 838, 15 km south-west of Durness, Grid Ref. NC 310570 – NC 360485.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI

Strath Dionard is not GCR-listed but lies within the Foinaven SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

This very long, straight Strath is a classic example of a U-shaped glaciated valley with steeply rising high sides and a relatively flat, broad floor. It is probably one of the best examples of such a feature anywhere in UK and provides an excellent opportunity for studying this important aspect of Quaternary geology and landscape development.

ACCESSIBILITY

There is a car park 200 m north of Gualin House on the north-west side of the A 838 (NC 308568). Access to the Strath is via a rough unsurfaced track, heading south-eastwards from Gualin House, which eventually reaches Loch Dionard, some 8 km further up the Strath. No all abilities access off the main A 838 road, therefore.

CONSERVATION

No conservation requirement due to the scale and location of the site.

VISIBILITY AND “CLARITY”

Visibility of the Strath Dionard glaciated valley is excellent from the roadside. Key features are easily seen. Due to the considerable length of the Strath, however, and the sight distances involved, features can be difficult to see, or completely obscured, during poor weather. Otherwise, Strath Dionard is a very dramatic feature and highly inspiring for all visitors, including hill-walkers, photographers/artists, students of physical geology/geomorphology as well as geologists.

INTERPRETATION AND INTERPRETATION POTENTIAL

There is currently no interpretation panel. The Strath should certainly be included in a future Geopark guide and it also merits a guided walk all on its own. It provides a very important educational resource for students of geology, geomorphology and physical geography.

KEY REFERENCES

None.

NWHG REF. 057 - LOCH GLENDHU

LOCATION, GRID REFERENCE AND PHOTOGRAPH

Loch Glendhu extends due eastwards from the Kylesku Bridge, from its confluence with Loch Glencoul, for a distance of about 4.5 km, Grid Ref. NC 245335 – NC 290335.



Loch Glendhu, seen from near Kylesku. BGS Photo P 517103 – R M Key

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

Loch Glendhu is not GCR-listed and does not lie within a SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

Loch Glendhu is a classic glacial fjord formed within and through the rocks occurring within the lower structural levels of the Moine Thrust Belt. It transects the Loch Glencoul Thrust Plane which is exposed on both sides of the Loch towards its eastern end near Glendhu Bothy. The area is important as it demonstrates classic features of glacial erosion and fjord development. Post-glacial scree slopes formed of large rectangular blocks of Cambrian Quartzite occur on the north shore about 1.5 km west of Glendhu Bothy and demonstrate classic features of scree deposits. Joint patterns in the Quartzite crags directly above the scree are important for understanding the process of scree development.

ACCESSIBILITY

The site is accessed via a very rough unsurfaced track heading eastwards along the north shore from a small car park adjacent to the A 894 at Kylestrome (NC 217346). There is no access for all abilities. Loch Ghlendhu can be seen well from the parking place and viewpoint at the southern end of Kylesku bridge – accessible to all abilities.

CONSERVATION

No conservation requirement due to the scale and location of the site.

VISIBILITY AND “CLARITY”

Loch Glendhu can be seen in the far distance when viewed from the car park on the A 894, on the north side of the Kylesku Bridge, but most features cannot be seen from the car park at Kylestrome which is the starting point for the long entrance walk. Once Loch Glendhu is reached, key features on both sides of the Loch are easily seen from the rough track and the landscape is truly dramatic and inspirational. The Cambrian Quarzite scree slopes are particularly dramatic when viewed from the point at which they encroach upon the Loch shore.

INTERPRETATION AND INTERPRETATION POTENTIAL

There is currently no interpretation panel but consideration could be given to positioning one at the main car park on the north side of the Kylesku Bridge. The area should certainly be included in a future Geopark guide and its importance as an educational resource for students of geology, geomorphology and physical geography should be developed with academic institutions. It also merits the creation of a guided walk on its own.

KEY REFERENCES

None.

NWHG REF. 058 - SUILVEN

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The mountain of Suilven lies in a very remote location, roughly midway between the A 837 and Lochinver on the west coast, Grid Ref. NC 159180.



Suilven from Fionn Loch. BGS Photo P512915 - T Bradwell

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

Suilven is not GCR-listed and does not lie within a SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The mountain of Suilven is undoubtedly the iconic image of Assynt and, quite probably, of the Geopark as well. Its very steep sides and long narrow summit ridge with two distinct summits make it immediately recognisable. It represents one of the best examples of an inselberg within UK and Western Europe and it is therefore important to students of geomorphology, physical geology and landscape development within a glacial context.

ACCESSIBILITY

Excellent access for distant viewing from a variety of roadside points. However, Suilven's very remote location means that a long walk of approximately 8 km over a mixture of terrain is required in order to reach the base of the mountain. The easiest

route is from Lochinver, past Glencanisp Lodge using the stalking track and approaching the northern side of the massif. An alternative route is from Inverkirkaig to the south, following the river track then branching northwards along a less obvious path across some rough and difficult terrain. There is no all abilities access off-road.

CONSERVATION

No conservation requirement due to the scale and location of the feature.

VISIBILITY AND "CLARITY"

The key features of Suilven are easily seen from numerous distant viewpoints. The mountain presents a very dramatic and inspiring image and attracts hill-walkers, photographers/artists and students of physical geography/geomorphology as well as geologists.

INTERPRETATION AND INTERPRETATION POTENTIAL

A guided walk to and up Suilven is led once a year by Rangers from the Highland Council Ranger Service. The running of more frequent guided walks for the general public would require careful consideration of the safety implications and the appropriate guide requirements. The site is featured as a walk in the guidebook "Exploring the landscape of Assynt". There is currently no interpretation panel explaining the geological circumstance of Suilven but it is included at the rock route panel at Elphin. New panels could be located to the west and east of the mountain (at Lochinver and Elphin, respectively) within suitable laybys. There is limited potential for developing the area as a teaching resource for academic courses at school and university levels.

KEY REFERENCES

KRABBENDAM, M. & BRADWELL, T. 2010. The geology and landscape of the Northwest Highlands: an introduction. In Lukas, S. & Bradwell, T. (eds) *The Quaternary of Western Sutherland and adjacent areas: Field Guide*, Quaternary Research Association, London, 3-12.

NWHG REF. 059 - QUINAG (SPIDEAN COINICH, SAIL GHARBH, SAIL GHORM)

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The three-fingered mountain feature of Quinag lies about 4 km west of the A 894 between Kylesku to the north and Loch Assynt to the south, Grid Ref. NC 200290.



Quinag massif from Kylesku. BGS Photo P 514946 – M Krabbendam

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

The site is not GCR-listed and does not lie within a SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The mountain of Quinag displays, on a massive scale, the Applecross Formation of the Torridon Group within the Torridonian Sandstone strata which sit on a basement of much older Lewisian Gneisses and are unconformably overlain by a capping of much younger Cambrian Quartzite on the highest parts of the summit ridge at Sail Gharbh and at Spidean Coinich. The mountain also illustrates an excellent example of bedrock control on glacial erosion and landscape development in general.

ACCESSIBILITY

There are two convenient large car parks, one on the north side of a hairpin bend on the A 894 (NC 240292) and the other on the east side of the A 894 further south (NC 232273) from which an excellent view of the east side of the mountain and its key features can be had. The west side of the mountain can be conveniently viewed from

the A 837 Inchnadamph to Lochinver road which runs along the shore of Loch Assynt and continues further westwards. The view of the mountain is thus accessible to all abilities. Detailed examination, however, requires a long walk over difficult terrain. There is a formal path from the John Muir Trust car park at NC 232273, which covers the more boggy ground before rising steeply onto the mountain slopes.

CONSERVATION

No conservation requirements due to the scale and location of the feature.

VISIBILITY AND “CLARITY”

Depending upon weather conditions, visibility of the main south-east facing slopes of Quinag is excellent from the two car parks and from various other roadside locations on the A 894 over the top of the Skiag Bealach. The mountain presents a most dramatic and inspiring image, making it a “must see” visitor attraction.

INTERPRETATION AND INTERPRETATION POTENTIAL

There is a small interpretation panel on the east side at the start of the formal path. However, new interpretation panels are recommended for both the Lochinver (west) and Skiag (east) sides and the feature certainly merits the running of a guided walk on its own. The site is featured as part of a walk in the guidebook “Exploring the landscape of Assynt”. It should also be included in a future Geopark Guide.

KEY REFERENCES

- BALLANTYNE, C. 2010. Relic talus slopes on Quinag and Stac Pollaidh. *In* Lukas, S. & Bradwell, T. (eds) *The Quaternary of Western Sutherland and adjacent areas: Field Guide*, Quaternary Research Association, London, 131-135.
- KRABBENDAM, M. & BRADWELL, T. 2010. The geology and landscape of the Northwest Highlands: an introduction. *In* Lukas, S. & Bradwell, T. (eds) *The Quaternary of Western Sutherland and adjacent areas: Field Guide*, Quaternary Research Association, London, 3-12.

NWHG REF. 060 - STAC POLLAIDH

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The mountain of Stac Pollaidh lies about 1 km north of the unclassified Drumrunie – Achiltibuie road, Grid Ref. NC 108107.



Rock towers on the summit ridge of Stac Pollaidh. BGS Photo P 512989 – M Krabbendam

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

The site is not GCR-listed but lies within the Inverpolly SSSI, although it is not a notified feature.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The iconic and dramatic mountain of Stac Pollaidh is an excellent example of an inselberg, resulting from directional glacial erosion of the Torridonian Sandstone bedrock. Highly weathered and jointed rock surfaces close to the elongated narrow summit ridge show evidence of repeated freeze-thaw processes during the most recent episode of glaciation, indicating that the summit was not actually covered by the ice at that time. Excellent examples of post-glacial scree slopes form the lower half of the mountain.

ACCESSIBILITY

A car park for hill-walkers and visitors to the mountain is located at NC 108096 on the unclassified Drumrunie – Achiltibuie road. The mountain can be easily viewed from this

car park or at many other stopping points along the road. The mountain is thus accessible to all abilities from the point of view of appreciating its form from a distance.

CONSERVATION

Generally low conservation requirement due to the nature and scale of the feature. However, significant numbers of hill-walkers visit the mountain each year and SNH have reconstructed the access path along a new alignment around the southern end in order to avoid further human-induced erosion/degradation of the scree slopes on the south-west face. This aspect will require future monitoring.

VISIBILITY AND “CLARITY”

The essential characteristics of the inselberg and the peripheral scree slopes are easy to see from a distance. Stac Pollaidh is a very dramatic mountain feature which is inspiring for hill-walkers and photographers/artists as well as students of physical geography/geomorphology, geology and landforms in general.

INTERPRETATION AND INTERPRETATION POTENTIAL

An interpretation panel is currently located at the main car park for hill-walkers. The story of the formation of the mountain feature, associated scree-slopes and its biodiversity is well covered. The site is featured as part of a walk in the guidebook “Exploring the landscape of Assynt”. The site is suitable for developing a guided walk. Clearly, the mountain should be included in a future Geopark guide and a programme of guided walks around the mountain could be a successful development.

KEY REFERENCES

- BRADWELL, T. & KRABBENDAM, M. 2003. Stac Pollaidh: A Late Devensian Nunatak? *Quaternary Newsletters*, **100** 19-25.
- BALLANTYNE, C. 2010. Relic talus slopes on Quinag and Stac Pollaidh. In Lukas, S. & Bradwell, T. (eds) *The Quaternary of Western Sutherland and adjacent areas: Field Guide*, Quaternary Research Association, London, 131-135.

NWHG REF. 061 - LEDMORE ESKER

LOCATION, GRID REFERENCE

The site is located at the north-west corner of the junction between the A 835 and A 837 at Ledmore, Grid Ref. 246126.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

The site is not GCR-listed and does not fall within a SSSI.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The site contains a particularly good example of an esker – a ribbon-like elongated low ridge of sand and gravel deposited within a melting ice-sheet by fluvio-glacial processes during the Quaternary. The Ledmore esker is testament to the glacial and late-glacial history of this area and its influence on the final evolution of the landscape we see today. The Ledmore esker is the only well-developed and easily accessible esker in the NW Highlands Geopark.

ACCESSIBILITY

The site can be viewed from a layby on the west side of the A 837, about 500 m to the north of its junction with the A 835 at Ledmore. The site is thus accessible to all abilities.

CONSERVATION

Low conservation requirement due to the scale and nature of the feature, although its potential commercial value as a source of aggregate for construction should be borne in mind.

VISIBILITY AND “CLARITY”

The esker is easily seen from the roadside and forms a dramatic feature on the grassy land surface.

INTERPRETATION AND INTERPRETATION POTENTIAL

There is currently no interpretation panel and it is considered unlikely that the site is visited by students or researchers. There is considerable potential, therefore, for developing this site as an appropriate place at which to see an important aspect of the legacy of the wider area’s glacial history. An interpretation panel should be erected and the site should be included in a future Geopark guide.

KEY REFERENCES

None.

NWHG REF. 062 - ELPHIN MEGAGROOVES

LOCATION, GRID REFERENCE AND PHOTOGRAPH

The site is located about 1.4 km west-south-west of the A 835 at Elphin, on the west side of the valley, Grid Ref. NC 200105.



Megagrooves near Elphin, carved out in a dip slope of quartzite. BGS Photo P571859 – K M Goodenough.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

The site is not GCR-listed but lies within the Inverpolly SSSI, although not as a notified feature.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

A number of very conspicuous long parallel grooves, or gullies, cut into the surface of an area of Cambrian Quartzite exposure, have recently been interpreted as the result of a fast-moving ice-stream moving across the Quartzite surface from east to west. There is some debate regarding the precise mechanism of formation of these “megagrooves” but they were probably caused by sub-glacial meltwaters operating directionally at the ice-bedrock interface under very high confining pressures, facilitating an increase in the velocity of the glacial ice. Their discovery has provided an excellent opportunity for examining in detail the inter-relationship between glacial ice and the underlying bedrock and has thrown new light on our understanding of aspects

of glaciation across the North West Highlands. The site is a very important one for Quaternary geologists.

ACCESSIBILITY

The megagrooves can be best viewed from a large layby on the west side of the A 835 at Elphin (NC 212108). The site is thus accessible to all abilities. Direct access, however, requires a 1 km walk over rough and boggy ground from the main Cul Mor walking track which can be accessed further to the south-west, just north of the entrance to Knockan Crag NNR.

CONSERVATION

Low conservation requirement due to scale and location of site.

VISIBILITY AND “CLARITY”

The megagrooves are highly visible from the large layby at Elphin and the visual impact is both dramatic and inspiring to both general public and specialists alike.

INTERPRETATION AND INTERPRETATION POTENTIAL

There is an interpretation panel at the large layby at Elphin as part of the Rock Route which mentions and identifies the megagrooves. The megagrooves provide an excellent opportunity for geology students and researchers to examine important sub-glacial features and also for the lay-public to learn about the processes of glaciation and the influence on landscape development. The megagrooves site should certainly be included in a future Geopark guide and merit the creation of a guided walk.

KEY REFERENCES

- BRADWELL, T. 2005. Bedrock Megagrooves in Assynt, NW Scotland. *Geomorphology*, **65** 195-204.
- BRADWELL, T. 2010. Elphin Megagrooves. In Lukas, S. & Bradwell, T. (eds) *The Quaternary of Western Sutherland and adjacent areas: Field Guide*, Quaternary Research Association, London, 137-144.

NWHG REF. 063 - STAC FADA "METEORITE SITE"

LOCATION, GRID REFERENCE

The site is located on the west coast about 0.5 km north-west of the beach at the Bay of Stoer, Grid Ref. NC 033284.

GCR SITE REFERENCE, BLOCK, VOLUME AND NOTIFIED FEATURE OF SSSI?

GCR Ref. 1604, Torridonian Block, Vol. 34. Confirmed GCR site, not SSSI notified.

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

The Stoer Group, which forms the coastal exposures at the Bay of Stoer, is the oldest member of the Torridonian Sandstone sequence and contains the 11 m thick Stac Fada Member, originally interpreted as a very extensive layer of volcanoclastic sandstone. However, recent studies initially published in 2008 by the Universities of Aberdeen and Oxford, have re-interpreted this layer as representing a layered ejecta deposit, formed when a meteorite hit the ground 1.2 billion years ago. Nonetheless, there is some debate amongst geologists about this new interpretation and researches are still ongoing. The site is therefore very important as it represents the possible near-location of a major meteoritic impact during Mesoproterozoic times as well as being the subject of current (slightly controversial) re-interpretation of an important older member of the Torridonian Sandstone sequence.

ACCESSIBILITY

The nearest car park is located at Stoer cemetery and a short 500 m walk is required across undulating and locally steep grassy coastal slopes to access the outcrop below on the rocky shore. Some scrambling is required at the outcrop. No all abilities access.

CONSERVATION

Due to the potential importance of the site and the relatively narrow width of the Stac Fada outcrop, there is a moderate conservation requirement to ensure that key features are not damaged by over-eager rock-hammering.

VISIBILITY AND "CLARITY"

The location of the site on the coast can be recognised in the distance from the roadside at Stoer. Once the site is reached, features are very easy to identify with specialist assistance.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site is currently used as the basis of guided walks led both by the Highland Council Ranger Service and by the Geopark Geo-Ranger. An explanatory sheet has been prepared for visitors but there is no interpretation panel at the Bay of Stoer. Although some basic features can be discerned by the lay-public, it requires the assistance of a specialist to accurately locate and explain the key geological features. There is

considerable potential here to locate a new interpretation panel at Bay of Stoer and the site should certainly be included in a future Geopark guide. The site is also important as an educational resource for geology students and researchers, especially as it is a good example of a recent geological re-interpretation which, so far, is not conclusive.

KEY REFERENCES

- AMOR, K., HESSELBO, S.P., PORCELLI, D., THACKREY, S. & PARNELL, J. 2008. A Precambrian proximal ejecta blanket from Scotland. *Geology*, **36**, 303-306.
- SANDERS, I.S. & JOHNSTON, J.D. 1989. The Torridonian Stac Fada Member: an extrusion of fluidized peperite? *Transactions of the Royal Society of Edinburgh, Earth Sciences*, **80**, 1-4.
- STEWART, A.D. 2009. Stoer. In Mendum, J. R., Barber, A. J., Butler, R. W. H., Flinn, D., Goodenough, K. M., Krabbendam, M., Park, R. G. & Stewart, A. D. (eds) *Lewisian, Torridonian and Moine rocks of Scotland*. Geological Conservation Review Series, **34**, Joint Nature Conservation Committee, Peterborough, 187-193.

NWHG REF. 064 - SMOO CAVE

LOCATION, GRID REFERENCE AND PHOTOGRAPH

Smoo Cave is located on the north coast, c.1.5 km. south-east from the village of Durness on the north side of the A 838 road, where the Allt Smoo flows into the sea. Grid Ref. NC 418672.



The entrance to Smoo Cave. The cave is a large limestone dissolution cavern connected to the sea, via Geodha Smoo, at high tide. BGS Photo P530460 – T Bradwell

DESCRIPTION AND GEOLOGICAL SIGNIFICANCE

Smoo Cave is one of the largest (former) sea caves in Europe, developed within the Sangomore Formation of the Durness Group of sediments (mostly well-bedded dolomites and limestones) of Cambro-Ordovician age. It is particularly significant as an example of the interaction of coastal erosional processes and dissolution processes with a large karst drainage system. Smoo Cave is also important as an archaeological site and contains an example of a prehistoric midden.

ACCESSIBILITY

There is a large car park and toilet block adjacent to the A 838 road. Access is via a relatively steep and winding flight of steps taking visitors down to the cave on the west side and via a narrow winding path, locally steep, on the east side of the cave. Access from the west side continues via a narrow timber footbridge across the Allt Smoo. No access, therefore, for all abilities. Once in the cave, there is a guided tour by boat run by a local operator.

CONSERVATION

Although the main outer cave feature and its approaches are on a large scale, there is certainly an important conservation requirement in relation to protection of both the innermost parts of the main cave and also the smaller inner cave feature, which is accessed via a wooden footbridge.

VISIBILITY AND “CLARITY”

Smoo Cave is a most attractive feature of significant proportions. The large outer cave entrance is very dramatic as it is approached from both west and east sides of the Allt Smoo. Once the cave is reached, internal features are easily distinguished but do require interpretation.

INTERPRETATION AND INTERPRETATION POTENTIAL

The site is presently used by the Highland Council Ranger Service and by the Geopark GeoRanger. Existing interpretation panels located at the car park cover the geology, wildlife and archaeology but there are no interpretation panels located near the entrance to the cave or within the cave itself. The site is an important resource for students, researchers and the general public and there is considerable potential here for developing an interpretation facility to be located close to, or within, the cave entrance. The site should certainly be included within any future Geopark guide.

GENERAL SOURCES OF FURTHER INFORMATION IN RELATION TO THE GEODIVERSITY AUDIT

Exploring the landscape of Assynt. Goodenough, KM, Pickett, E, Krabbendam, M, Bradwell, T. (2004). British Geological Survey. *A walkers guide to some geological features in the Assynt area.*

Northwest Highlands: A landscape fashioned by geology. Mendum, JR, Merrit, J, McKirdy (2001). Scottish Natural Heritage. *A well-illustrated introductory text to the landscape and geology of the NW highlands.*

The Highlands Controversy. Oldroyd, D (1990). University of Chicago Press, Chicago. *A historical account of the scientific controversy surrounding the Moine Thrust in the 19th century.*

Classic landforms of the Assynt and Coigach area. Lawson, TJ. (2002). *A guidebook on the geomorphological features in the southern part of the NWH Geopark.*

The Quaternary of Western Sutherland and adjacent areas: Field Guide, Lukas, S & Bradwell, T (2010) Quaternary Research Association, London. A Quaternary geological excursion guide aimed at university and geological society parties, covering parts of the Geopark.

A geological excursion guide to the North-West Highlands of Scotland, KM, Pickett, E, Krabbendam, M,. (2011). Edinburgh Geological Society, Edinburgh. A geological excursion guide aimed at university and geological society parties, covering most of the Geopark.

LIST OF ACADEMIC REFERENCES TO BE USED IN RELATION TO THE GEODIVERSITY AUDIT

AMOR, K., HESSELBO, S.P., PORCELLI, D., THACKREY, S. & PARNELL, J. 2008. A Precambrian proximal ejecta blanket from Scotland. *Geology*, **36**, 303-306.

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Part 2: LOCAL GEODIVERSITY ACTION PLAN

This LGAP has been developed as a consequence of, and is based upon, the Geodiversity Audit for the North West Highlands Geopark (NWHG).

The primary aim of this LGAP is to enhance recognition and understanding of geodiversity and also to identify appropriate actions to conserve and develop the geodiversity of the NWHG, whilst promoting and managing its sustainable use. Furthermore, to assist in the development of a regional strategy for the conservation of geodiversity and the sustainable use of geological resources for amenity, education and research.

The key objectives are:-

- To ensure the future maintenance of the Geodiversity Audit of the NWHG.
- To facilitate the protection, conservation and promotion of the geodiversity of the NWHG.
- To facilitate the inclusion of geodiversity in relevant plans, strategies and policies of all appropriate local authority departments and other relevant organisations.
- To raise awareness of geodiversity among local authority elected members and relevant personnel, government agencies, professional partners, landowners/estates and their managers, across all levels of education and throughout the general public.
- To create a positive and sustainable feedback system enabling reporting, monitoring and review of the LGAP to partners and other relevant/interested parties and organisations.
- To create a sustainable LGAP which will actively assist the NWHG in pursuing funding to enable it to achieve its aim.

Partners

It is envisaged that the partners listed below may be involved in helping the North West Highlands Geopark to develop and deliver the actions listed in this LGAP:-

ACC - Assynt Community Council

BGS - British Geological Survey

CCC - Coigach Community Council

DCC - Durness Community Council

GCUK - GeoConservation UK

SDCC - Scourie & District Community Council

SGF - Scottish Geodiversity Forum

SNH - Scottish Natural Heritage

SP - Sutherland Partnership

GSS – Grampian Speleological Society

HGS - Highland Geological Society

HIE - Highlands and Islands Enterprise

JMT - John Muir Trust

KCC - Kinlochbervie Community Council

LE - Landowners/Estates

SWT - Scottish Wildlife Trust

THC - The Highland Council

TSG - The Scottish Government

UHI - University of the Highlands & Islands
Millennium Institute

UKU - Other UK Universities (Earth
Sciences, or related Departments)

VS - Visit Scotland

NB. This is not intended as an exclusive list of those partners involved, but those who are central to help the NWHG implement the recommended actions. It may be added to during the life of this LGAP. It is also not implicit that these partners either agree with or have signed up to the actions listed in this plan.

ACTION PLAN

This indicative action plan is intended to guide the work of the NWHG and its partners in achieving the recommended objectives contained within each of the following four **themes**:-

Theme 1 – Understanding more about the Geodiversity of the NWHG

Theme 2 – Conserving the Geodiversity of the NWHG

Theme 3 – Interpreting the Geodiversity of the NWHG

Theme 4 – Education and lifelong learning about the Geodiversity of the NWHG

Within each theme, a series of **objectives** is listed (numbered consecutively from the start of the action plan), identifying what is required to be achieved over the period 2013-2016. Each objective contains a series of **actions** (numbered consecutively for each objective) identifying any work required towards meeting that objective, plus listing of relevant **partners** (see abbreviations above), **priority** (i.e. high, medium or low) and **timescale**.

Theme 1 – understanding more about the Geodiversity of the NWHG				
Objective	Action	Partners	Priority	Timescale
1. to create a sustaining LGAP which will actively pursue funding to enable it to achieve its aim	1: Have all partners signed up to deliver and assist in delivering this LGAP, as appropriate	All as listed above	High	Immediate
	2: Secure sustainable funding for the delivery of this LGAP	BGS, HIE, JMT, LE, SNH, SP, SWT, THC, TSG, UHI, VS	High	Immediate.
	3: Appoint a qualified Geoscientist for NWHG who can represent the interests of NWHG in the delivery of this	BGS, HIE, SNH, THC	High	Immediate

	<p>LGAP and who can fulfil the role of Geodiversity officer</p> <p>4: Continue to hold membership of the European Geoparks Network (EGN) and the Global Geoparks Network (GGN) and proactively develop the already well-established links between NWHG and the EGN, GGN and the scientific division of UNESCO. Attend meetings of these organisations and network extensively in order to experience best practice in:- communication of Geodiversity to society; sustainable implementation of LGAPs; and researching appropriate funding streams.</p> <p>5: Represent the interests of the NWHG and play an active role within the Scottish Geodiversity Forum.</p>		<p>BGS, HIE, SNH, THC, TSG.</p>	<p>High</p>	<p>2013-2016</p>
<p>2. To maintain and update existing data, acquire improved data and support new research into the Geodiversity of the NWHG</p>	<p>1: Ensure regular updating and maintenance of the Geodiversity Audit (or Geodiversity Asset Register)</p> <p>2: Establish links with academic institutions and support studies linked to their research priorities</p> <p>3: Acquire, maintain and keep updated sets of maps, books, reports, scientific papers, studies and create, maintain and keep updated a photographic library on the Geodiversity</p> <p>4: Establish and maintain a master database of all sites and features and other relevant information and records on a GIS, including management and interpretation records</p>	<p>High</p>	<p>BGS, SGF, SNH, TSG</p>	<p>High</p>	<p>2013-2016</p>
<p>Theme 2 – conserving the Geodiversity of the NWHG</p>			<p>BGS, HGS, SNH</p>	<p>High</p>	<p>Annually</p>
			<p>UHI, UKU</p>	<p>Medium</p>	<p>2013-2016.</p>
			<p>HGS, JMT, SNH, SWT, THC, UHI</p>	<p>High</p>	<p>2013-2016</p>
			<p>: BGS, SNH, THC, UHI</p>	<p>High</p>	<p>2013-2016.</p>

<p>3. to ensure that important sites and features are protected from the adverse impacts of any new developments</p>	<p>1: Plan and deliver a series of seminars/workshops to THC planning officials and landowners/estates and their managers, highlighting the GA and LGAP and raising awareness of the Geodiversity of the NWHG, its importance as a resource, significance and relevance within the planning system and relevant conservation issues.</p> <p>2: Promote the Scottish Geodiversity Charter to THC planning officials and landowners/estates and their managers</p> <p>3: Provide information to landowners/estates and their managers on the location and importance of geological features (especially those listed in the GA) on land which they own or control.</p> <p>4: Promotion of specialist advice available from NWHG</p>	<p>: BGS, LE, SGF, SNH, THC</p>	<p>High</p>	<p>2013.</p>
<p>4. to monitor the condition of GCR sites</p>	<p>1: Undertake bi-annual survey of condition of listed GCR sites by qualified geoscientist and incorporate findings in updated GA and LGAP.</p>	<p>BGS, SNH, THC, TSG</p>	<p>High</p>	<p>2013-2016</p>
<p>5. to conserve the geological interest and significance of individual sites and features having high conservation requirements</p>	<p>1. Durness (NWHG ref 008). There is generally a low conservation requirement. There is however, a degree of risk of over-sampling and over-hammering by geologists/students. This may be helped by promoting greater awareness of the relevant codes among geologists and education of students via a leaflet to be produced and made available through the NWHW.</p> <p>2. Sandwood Bay (NWHG ref 009). A notice is required</p>	<p>BGS, SNH, UHI, UKU</p>	<p>Low</p>	<p>2015 onwards</p>
		<p>SNH, THC, JMT</p>	<p>Medium</p>	<p>2013-16</p>

	<p>to be erected at the start of the walkers' path to Sandwood Bay outlining the fragility of the beach-dune system and asking walkers to be respectful in their activities. Also, a leaflet highlighting the key aspects of the site, its significance and its susceptibility to human activities should be commissioned and subsequently made available in a dispenser at the start of the walkers' path.</p>			
<p>3. Loch Laxford (NWHG ref 011). The existing Rock Route location at a layby on the A 838 ("Multicoloured Rock-Stop") requires a further notice detailing the significance and importance of the roadside exposures here (a series of high rock-faces on the eastern side of the road). Periodic monitoring (annual) by a geoscientist is required.</p>	<p>SNH, UKU</p>	<p>Medium</p>	<p>2013-16</p>	
<p>4. Camas nan Buth (NWHG Ref 017). The relatively small area of extremely important garnet-bearing rock-exposure requires protection against over-hammering and over-collecting. Prepare a leaflet outlining the significance and fragility of the exposure.</p>	<p>BHS, SNH, UKU</p>	<p>High</p>	<p>2013-14</p>	
<p>5. Skiag Bridge (NWHG ref 024). The rock-face is presently suffering the effects of over-hammering and sampling and is becoming fragile in its general condition, and very fragile where pipe rock is exposed. There is an immediate requirement for a sign to be located at the roadside, outlining the importance and fragility of the site. Period monitoring (every 6 months) is also required.</p>	<p>BGS, SNH, IUKU</p>	<p>High</p>	<p>Immediately/6 monthly</p>	
<p>6. Trailgill Caves (NWHG ref 028). Regular monitoring</p>	<p>BGS, GSS,</p>	<p>Medium</p>	<p>Annually</p>	

of the cave features required.	SNH, THC		
7. Trailgill Valley (NWHG ref. 029). Moderate risk of irresponsible hammering. Regular monitoring of the karst features required. Requirement for a sign to be erected at the start of the walkers' path	BGS, SNH, THC	Medium	Annually
8. Creag nan Uamh Caves (NWHG refs. 032 and 033). Regular monitoring required plus erection of a sign highlighting the significance and fragility of the exposures	BGS, GSS, SNH, THC.	Medium	6 monthly.
9. Allt nan Uamh Caves (NWHG ref 034). Regular monitoring required plus erection of a sign highlighting the significance and fragility of the exposures.	BGS, GSS, SNH, THC	Medium	6 monthly
10. Bear Cave (NWHG Ref 035). Regular monitoring required plus erection of a sign highlighting the significance and fragility of the exposures.	BGS, GSS, SNH, THC	Medium	6 monthly.
11. Loch Awe Quarry (NWHG Ref 044). Regular monitoring required plus erection of a sign highlighting the significance and fragility of the exposures	BGS, SNH, THC.	Medium	Annually
13. Enard Bay (NWHG ref 051). The exposures of stromatolitic limestones require to be monitored occasionally	BGS, SNH, THC	Low	2016.
14. Stac Pollaidh (NWHG ref 060). Long-term monitoring of scree slopes on south-west face where these are close to the existing walkers' path	BGS, SNH, THC	Low	bi-annually
15. Stac Fada (NWHG ref 063). Requirement to ensure that over-hammering and over-sampling do not occur	BGS, SNH,	Medium	6 monthly.

	and that key features of the relatively narrow exposure are not damaged. Regular monitoring required plus erection of a sign highlighting the significance and fragility of the exposures.	THC		
	16. Smoo Cave (NWHG ref 064). Regular monitoring required of the innermost parts of the main (outer) cave plus the smaller inner cave, plus erection of a sign at the main cave entrance highlighting the significance and fragility of the exposures.	BGS, GSS, SNH, THC	Medium	6 monthly
Theme 3 – interpreting the geodiversity of the NWHG				
6. To increase awareness of the geological heritage of the NWHG	1: Produce a general introductory leaflet about the NWHG, suitable for wide distribution to visitors at appropriate facilities within the NWHG and at VICs, both within and outwith the NWHG.	ACC, BGS, CCC, DCC, HIE, KCC, LE, SDCC, SGF, SNH, SP, THC, VS	Medium	2013-2014
	2: Produce a geological (Geodiversity?) guide specifically designed for the NWHG, suitable for people with very little or no knowledge of geology and filling the gap in level/understanding between that of the recently published Geological Excursion Guide to the North West Highlands of Scotland and nothing at all. Aimed at the majority of visitors, geotourists, local communities.	ACC, BGS, CCC, DCC, GCUK, GSS, HGS, HIE, JMT, KCC, LE, SDCC, SGF, SNH, SP, SWT, THC, VS	Medium	2013-2015
	3: Research and develop a series of 10 separate geotrails, each featuring different key aspects of the Geodiversity of the NWHG, and prepare an accompanying leaflet (to include maps, photos, etc.) for	ACC, BGS, CCC, DCC, GSS, JMT, KCC, LE,	Medium	2013-2015

	<p>each geotrail. Geotrails to be suitable for the general public (include some with all abilities access).</p> <p>4: Plan and hold a one-day seminar and public launch event for all the partners and members of the public, introducing them to the NWHG and this LGAP.</p> <p>5. Employ two part-time geo-guides to help with the delivery of programmes of guided walks during the main visitor season and support the work of the Geoscientist in other ways. These posts could be filled by undergraduate students pursuing courses of study in the Earth Sciences and represent valuable employment opportunities especially for local people residing within the NWHG.</p>	SDCC, SNH, THC, VS	all as listed	High	Immediate
<p>7. To interpret key sites and features of geological interest.</p>	<p>1. SANGO BAY (NWHG REF. 005). Provide an interpretation panel at the car park adjacent to the VIC, overlooking the bay. Consult closely with the Highland Council Countryside Ranger based at the VIC</p> <p>2. FARAI DH HEAD (NWHG REF. 006). Provide an interpretation panel, to be located at the car park at Balnakeil beach, which will also provide interpretation for BALNAKEIL (NWHG REF. 007). Consult closely with the Highland Council Countryside Ranger based at Durness.</p> <p>3. SANDWOOD BAY (NWHG REF. 009). Provide an interpretation panel at the approach to the beach, illustrating the key elements of the beach-dune system and explaining the geomorphological significance of the</p>	BGS, SNH, THC	BGS, SNH, HIE, UHI, UKU	High	2013-16
		BGS, SNH, THC		Medium	2013-2015
		BGS, SNH, THC.		Medium	2013-2015
		BGS, SNH, THC, JMT		Medium	2013-2015

site.	4. SCOURIE BAY (NWHG REF. 015). Provide an interpretation panel at the south side of Scourie Bay, adjacent to the cemetery car park, highlighting the Scourie Dyke swarm (in general), the “Graveyard Dyke” (south side bay), the “Geologist’s Dyke” (north side bay) and the surrounding Lewisian Gneiss	BGS, SNH, THC	High	2013
5. CAMAS NAM BUTH (NWHG REF. 017). Provide interpretation by combining with the panel recommended for SCOURIE BAY (NWHG REF. 015).	BGS, SNH, THC	High	2013	
6. STOER (NWHG REF. 020). Research suitable sites and provide interpretation panels serving the three locations of Clachtoll, Stoer and Culkein.	BGS, SNH, THC	High	2013	
7. SKIAG BRIDGE (NWHG REF. 024). Provide a roadside interpretation panel suitable for both geological specialists and the general public	BGS, SNH, THC	High	2013	
8. BEINN GHARBH (NWHG REF. 025). Provide an interpretation panel of the view looking southwards from the layby on the west side of the A 894 at the top of Skiag Hill.	BGS, SNH, THC	High	2013	
9. TRALIGILL BURN (NWHG REF. 027). Provide an interpretation panel at the start of the walk eastwards into the Trailgill valley.	BGS, SNH, THC	High	2013	
10. TRALIGILL VALLEY (NWHG REF. 029). Research suitable site locations for the erection of interpretation panels at strategic points up the valley adjacent to the	BGS, SNH, THC	High	2013	

	walkers' path			
	<p>11. STRONCHRUBIE CLIFF (NWHG REF. 030). Examine the suitability and practicability of providing an interpretation panel beside the existing Rock Route panel located in the layby on the west side of the A 837, but describing the view of the cliffs whilst looking eastwards.</p>	BGS, SNH, THC	High	2013.
	<p>12. ALLT NAN UAMH CAVES (NWHG REF. 034). Research the potential for a general information panel to be located at the "Bone Caves" car park adjacent to the A 837.</p>	BGS, GSS, SNH, THC	Medium	2013-2016
	<p>13. BEAR CAVE (NWHG REF. 035). Provide an explanatory leaflet describing the process of cave formation/development in limestone rocks and covering the range of vertebrate faunas found here</p>	BGS, GSS, SNH, THC	High	2013
	<p>14. LOCH AWE QUARRY (NWHG REF. 044). Research the potential and practicability of developing a small interpretative facility at the entrance to the quarry, displaying exhibits of the fossiliferous strata and containing an explanation of palaeogeographical reconstruction and its implications</p>	BGS, LE, SNH, THC	Medium	2013-2015
	<p>15. CAM LOCH (NWHG REF. 048). Provide an interpretation panel at the Elphin Cemetery access point.</p>	BGS, SNH, THC	Medium	2013-2015
	<p>16. TRAIGH ALLT CHAILGEAG (NWHG REF. 055). Provide 2 interpretation panels, one at the car park on the landward (southern) side of the A 838 and the other</p>	BGS, SNH, THC	High	2013

	<p>towards the western end of the beach with a good outlook westwards onto the high rock-face. Highlight the concept of boudinage and summarise the main points of the Lewisian Gneiss and its complex history.</p>			
<p>17. STRATH DIONARD (NWHG REF. 056). Provide an interpretation panel, highlighting the classic U-shaped features of this long glaciated Strath, to be sited on the east side of the A 838 at a suitable layby.</p>	<p>BGS, LE, SNH, THC</p>	<p>High</p>	<p>2013</p>	
<p>18. LOCH GLENDHU (NWHG REF. 057). Provide an interpretation panel at the main car park on the north side of the Kylesku Bridge, looking eastwards.</p>	<p>BGS, LE, SNH, THC</p>	<p>Medium</p>	<p>2013-2015</p>	
<p>19. SUILVEN (NWHG REF. 058). Research suitable locations for roadside interpretation panels at the western end (Lochinver?) and the eastern end (Elphin?) of the mountain, highlighting the processes of evolution of the Assynt mountainscape and explaining the concept of inselbergs.</p>	<p>BGS, LE, SNH, THC</p>	<p>High</p>	<p>2013</p>	
<p>20. QUINAG (SPIDEAN COINICH, SAIL GHARBH, SAIL GORM) (NWHG REF. 059). Research suitable locations and provide roadside interpretation panels on the western (Lochinver) and eastern (Skiag) sides</p>	<p>BGS, SNH, THC</p>	<p>High</p>	<p>2013</p>	
<p>21. LEDMORE ESKEER (NWHG REF. 061). Provide an interpretation panel at the layby on the west side of the A 837, 500m north of Ledmore Junction</p>	<p>BGS, SNH, THC</p>	<p>High</p>	<p>2013</p>	
<p>22. STAC FADA "METEORITE SITE" (NWHG REF. 063). Provide an interpretation panel at the Bay of Stoer, looking north-westwards along the coast,</p>	<p>BGS, SNH, THC, UKU</p>	<p>High</p>	<p>2013</p>	

	<p>identifying the location of the Stac Fada outcrop (and how to find it) and explaining the main features of meteorites and their impacts upon the Earth, in addition to the detail of the Stac Fada site itself.</p> <p>23. SMOO CAVE (NWHG REF. 064). Provide an interpretation panel close to, or just within, the main cave entrance.</p>	BGS, GSS, SNH, THC	High	2013
Theme 4 – Education and lifelong learning about the geodiversity of the NWHG				
<p>8. To create/increase opportunities for schools and university/colleges to use the geodiversity of NWHG as a resource for the study of earth sciences.</p>	<p>1. Develop and foster closer links with primary and secondary schools located both within and adjacent to the NWHG and establish a system of regular communications with head teachers.</p> <p>2. Produce geological educational resource material in consultation and partnership with teachers.</p> <p>3. Develop and deliver teacher-training days in consultation with schools located within and adjacent to the NWHG.</p> <p>4. Establish a programme of regular visits to schools by the NWHG geoscientist and assist with teaching of Geodiversity as part of a broad-based curriculum within the physical sciences.</p> <p>5. Develop the “Rock Detective Agency” as a NWHG-led initiative with all the primary schools for pupils and teachers to become further engaged with the NWHG and develop the concept of (junior) Rock Detectives as (junior) representatives/ambassadors of NWHG.</p>	<p>THC</p> <p>THC</p> <p>THC</p> <p>THC</p> <p>ACC, BGS, CCC, DCC, HGS, KCC, LE, SDCC, SGF, SNH, THC</p>	<p>High</p> <p>Medium</p> <p>Medium</p> <p>Medium</p> <p>Medium</p>	<p>2013</p> <p>2013-2016.</p> <p>2013-2016</p> <p>2013-2016.</p> <p>2013-2016</p>

	6. Engage with the Earth Sciences departments of universities and colleges within UK to further promote the NWHG as a teaching resource and facilitate closer links with, and greater awareness of, the NWHG.	BGS, UHI, UKU	High	2013.
9. To support lifelong learning about the Geodiversity and Earth science heritage of the NWHG	1. Develop and deliver an annual programme of geology-related events (e.g. guided walks, talks, etc.) within NWHG as part of lifelong learning activities for all ages, extending throughout the whole year.	ACC, BGS, CCC, DCC, HGS, JMT, KCC, SDCC, SNH, THC, UHI, VS	Medium	2013-2016
	2. Encourage the continuation and development of existing groups/organisations having an interest in Geodiversity, or the formation of new ones.	BGS, GCUK, HGS, JMT, SGF, SNH, THC, UHI.	Low	2013-2016.
	3. Engage with VS to ensure that staff are fully aware of the Geodiversity of NWHG and its relevance to Geotourism. Promote NWHG to VS as a World-class destination for lifelong learning about Earth Sciences and Earth Science Heritage.	VS	High	2013-2016.
	4. Develop a sustainable Geotourism Strategy for the NWHG.	ACC, BGS, CCC, DCC, HIE, JMT, KCC, LE, NTS, SDCC, SGF, SNH, SP, THC, TSG, UHI, UKU, VS.	High	2013-2016.

	5. Build on the recommendations of the Geo Centre feasibility study.	All partners	High	2013-2016
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SUMMARY

This LGAP will provide a good basis for the effective and strategic management of the NWHG and its very special and World-class Geodiversity. It is underpinned by the Geopark’s first GA and will require to be reviewed regularly, say at least annually, and also when changes are made to the GA.