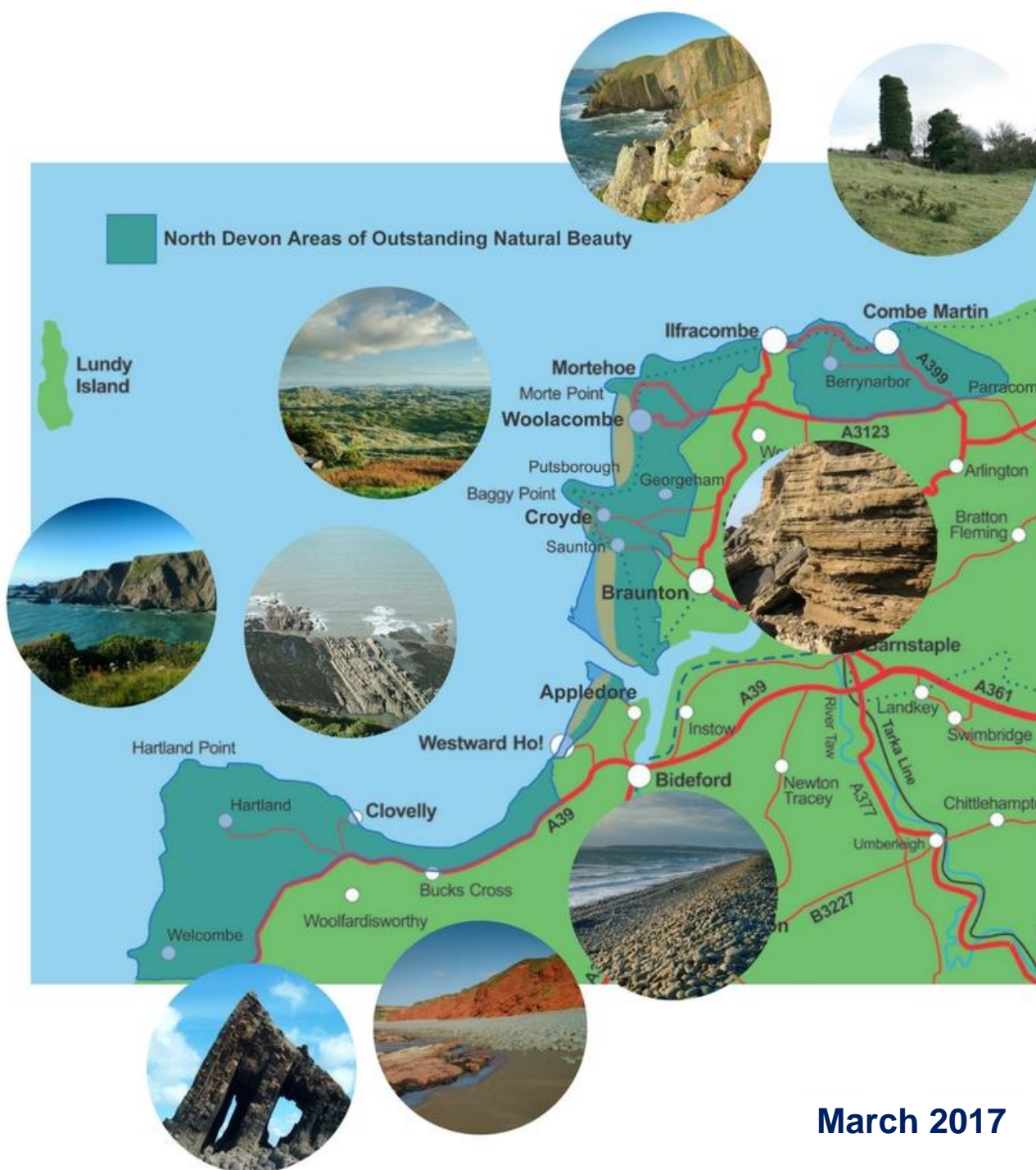


# North Devon Coast AONB



# Local Geodiversity Action Plan



March 2017

## **Introduction**

This document has been developed to assist the AONB Partnership and our many partners to make the most of the area's geodiversity for education, interpretation and conservation. The spectacular coastal scenery of the AONB is a direct reflection of the underlying geology which is further evidenced through farming, industry, the built environment, recreation and tourism across North Devon and Torridge.

This plan was produced for the North Devon Coast AONB Partnership to deliver an action in the statutory North Devon Coast AONB Management Plan 2014-2019. A Local Geodiversity Action Plan can target the work of the Partnership, working with other local partners in the statutory, voluntary and community sectors.

The report brings together information that is in the public domain related to the geodiversity of the North Devon Coast AONB, including summary descriptions of special qualities, characteristics, issues and related features, such as local stone products. The list of actions include short term and longer term aspirations for delivery through the Partnership.

## **What is Geodiversity?**

The term 'geodiversity' encompasses the variety of rocks, minerals, fossils, landforms, sediments and soils in an area, together with natural processes, such as deposition and erosion which have over geological time and up to today continue to form the features of the Earth. Geodiversity provides us with fuels, raw materials and spectacular scenery, and offers opportunities for learning, recreation and tourism.

Geodiversity is always evolving whether it is through erosion presenting new cliff face exposures, the transport of sediments to form new beach and river deposits or chemical weathering processes forming various types of soil. It is also found where local stone has been used in construction either as building blocks or for the whitewash used to paint walls that defines the character of an area and also creates a distinctive habitat for wildlife.

There is a strong link between geodiversity and the biodiversity of an area which is clearly demonstrated throughout the AONB. The UK Geodiversity Action Plan website<sup>1</sup> states:

*'Geodiversity and the way it influences landscapes, soils and climate, is fundamental to the distribution of habitats and species'.*

In North Devon this is apparent for example, in the species rich culm grassland where heavy clay overlies the Culm Supergroup (previously known as the Culm Measures) resulting in poor drainage and a predominant use of the land as grass production for cattle and sheep.

## **What is Special about the Geodiversity of the AONB?**

The geology of the North Devon coast forms the landscape that has been designated as Areas of Outstanding Natural Beauty, with much of the coastline also designated as Sites of Special Scientific Interest (SSSI) for their geological importance. The bedrock and surface deposits of the AONB were formed over approximately 400 million years (Ma), shaping the land and providing much of the spectacular scenery along the coast.

Coastal landforms provide classic examples of coastal erosion and depositional processes as well as rare and unique landscape features. Some geological structures in the AONB are particularly exceptional and in the North Devon Coast AONB Management Plan 2014-2019 were identified as the special qualities of the AONB. These can be seen in the following features:

- Hogsback cliffs of varying heights – Down End, Saunton
- Dramatic rock formations – Blackchurch Rock, Mouth Mill and the anticline at Tuts Hole, Abbotsham
- Wave-cut platforms – Welcombe and Westward Ho!
- Vast, mobile sand dune systems - Braunton Burrows
- Cobble Spit – the Pebbleridge at Westward Ho!
- Wide sandy beaches – Woolacombe, Saunton
- Rocky foreshore – Lee Bay and Mouth Mill
- Mobile sand spit – Crow Point at the mouth of the Taw Torridge Estuary
- Exposed headlands – Morte Point

### **The Geology of the North Devon Coast AONB**

The geodiversity of the North Devon coast is distinctive and in some cases, world renowned such that a major geological time period is named after the county; the Devonian 419-359 million years ago (Ma). Following the Devonian is the Carboniferous and the geological boundary between the two time periods roughly follows the Taw Torridge estuary, with older Devonian rocks to the north and younger Carboniferous rocks to the south, see Figure 1.

The AONB's geological and recent deposits range in age from the middle Devonian 392 million years ago at the northern end of the AONB to the sediment that is currently being deposited along rivers and the extensive coastline. The underlying bedrock of the AONB was deposited during the middle to late Devonian and during the Carboniferous period up to 309 Ma. A Permian 'outlier' (a section of younger rock dated from 299 to 271 Ma completely surrounded by older rock) is found at Peppercombe on the Abbotsham coast. See the North Devon Coast timeline in Figure 2.

The northern section of the AONB is comprised of sedimentary rocks deposited during the mid to late Devonian in the North Devon basin (the North Devon Basin is one of six sub-basins in Devon). These rocks were deposited in alternating extensive shallow water marine and non-marine, fluvial (river) environments. Associated sedimentary rocks include sandstones, mudstones and, in and around Combe Martin and Ilfracombe, the only substantial outcrops of limestone found in the North Devon Coast AONB. Commonly associated Devonian macro-fossils (those visible by eye) and plant remains are rare in the Devon section. Micropalaeontology (the study of micro-fossils) from the Baggy Sandstones and Pickwell Down sandstones (around Croyde) infers deposition in deltaic, swamp and river environment in a position in the vicinity, south, of the 'Old Red Sandstone' continent, which occupied northern Britain in the Devonian.

The southern section of the AONB, during the Upper Carboniferous sees a change in the type of sediments that were deposited; from open marine to ever restricting, deep water settings as large influxes of mud and sand from turbidity currents (fast moving, dense

sediment laden currents) and deltaic sediments are deposited in a rapidly subsiding basin. These sediments, initially of the Crackington Formation and later of the Bideford and Bude Formation were deposited on to the northern edge of a large basin known as the Culm Basin.

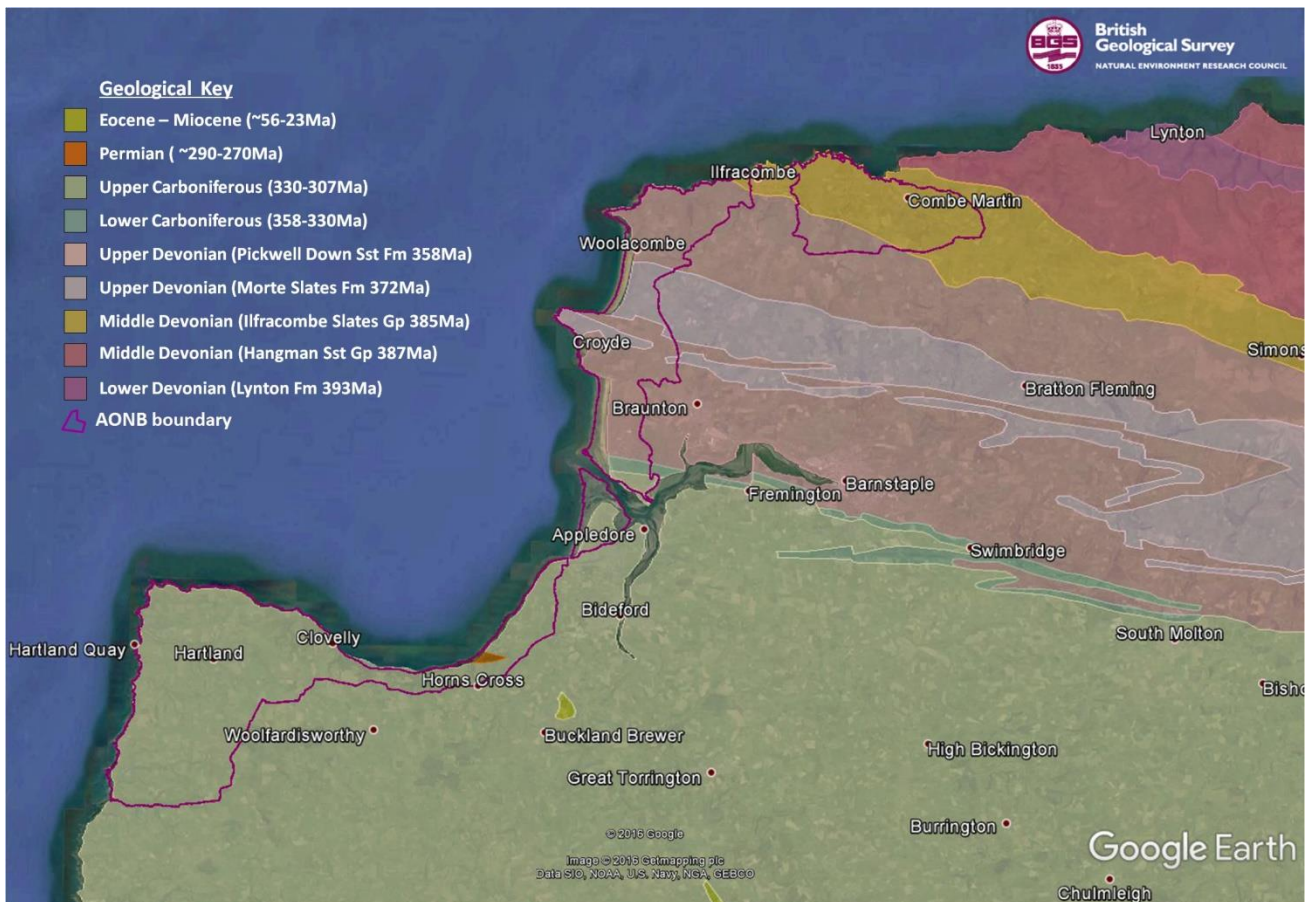


Figure 1: The bedrock of the North Devon Coast AONB map: IGI Ltd

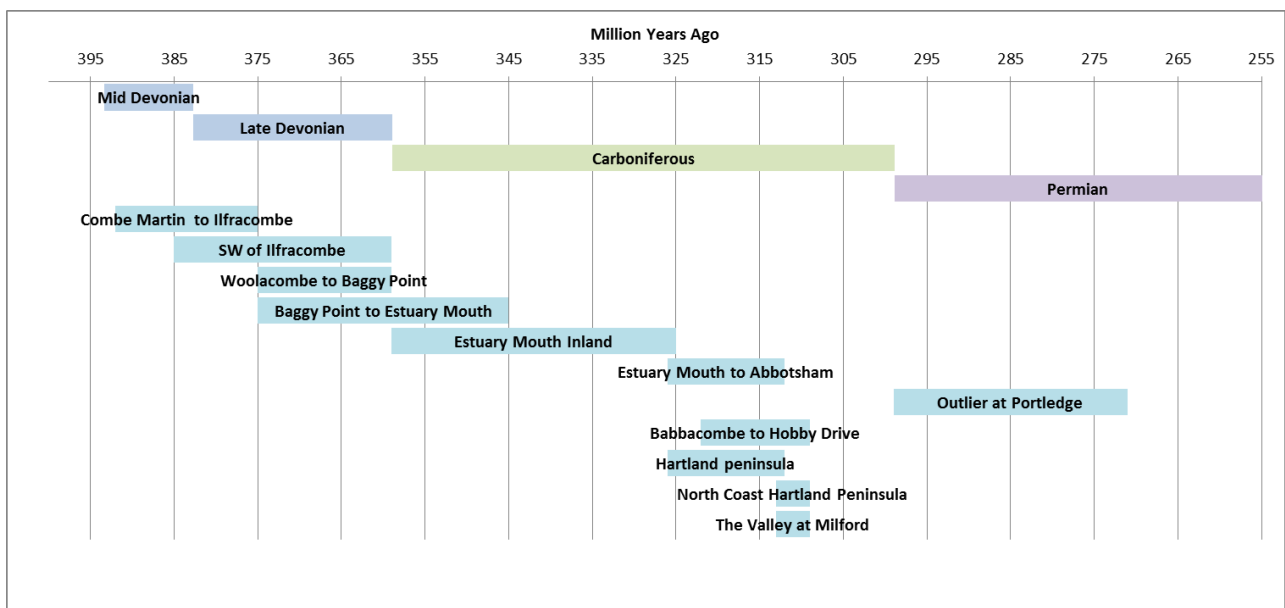


Figure 2: Geological timeline with example locations of the bedrock of the AONB

In the late Carboniferous to early Permian the Variscan Orogeny occurred. This was a mountain building event brought about by the closure of the Rheic Ocean, to the south, as Africa collided with Europe. This can be seen most dramatically in the cliffs near Combe Martin and Hartland where the Devonian and Carboniferous rocks were intensely folded and faulted.

In the cliffs at Peppercombe evidence for what followed the Carboniferous can be seen. An 'outlier' of Permian age lies unconformably atop older beds of Carboniferous age. The nature of the lithological contact represents an age gap where there is a missing sedimentary section. During the Permian, the climate was arid and subsequent coarse red beds were deposited by flash floods in wadis (valleys or channels that are dry except during the rainy season) and finer sediments deposited in temporary playa lakes within a desert environment.

There are no rocks found in the North Devon AONB of Jurassic, Cretaceous or Tertiary age as these have eroded away over time, post deposition. Evidence for initial deposition within the AONB is inferred from preserved sediments present within the Bristol Channel geological section.

More recently, during Pleistocene glacial periods, ice sheets are evidenced to have reached as far south as the North Devon coast, with erratic boulders (non-native rocks carried and dropped by ice sheets) and glacial solifluction slope deposits, or 'head' (the movement of water laden soil down slope caused by thawing and freezing) are found at Saunton and other northern sections of the AONB coastline. There is also evidence along the coastline of shifts in sea level (due to changes in ice cover) evidenced by 'raised beaches' such as that found at Westward Ho!, which are relic beaches found higher in the cliffs than the current beach level.

Geomorphological processes continue today; waves, tides and currents transport and deposit sediment to form coastal features, such as sand or gravel beaches, sand spits (e.g. at Crow Point) and the cobble spit known as the 'pebble ridge' at Westward Ho!; erosion results in coastal features such as wave cut platforms (e.g. Welcombe) and truncated rivers (e.g. Spekes Mill, Hartland); mobile dune systems gradually move (by 2 metres per year at Braunton Burrows) and river systems cut new courses. These processes continue to shape the North Devon coast added to by the influence of human activity.

## **Conservation of Geodiversity**

Geological sites have a number of different designations and levels of protection, or have been identified as important but not officially designated. These sites are identified, protected, reviewed and reported on across a number of policy documents and through several different agencies operating at different levels. These are briefly described below followed by a summary of issues and concerns that are of relevance to the AONB and its Action Plan.

- **Designations and Protections**

**Geological Sites of Special Scientific Interest (SSSI)** are sites that have been identified as of national importance. In the AONB there are 13 Sites of Special Scientific Interest that

mention geodiversity, nine of which are designated in full or part for their geological importance and are listed in appendix A. These are monitored by Natural England.

**County Geological Sites** were assessed in the AONB in 2004 by the **Devon Regionally Important Geological and Geomorphological Sites (RIGS) group**<sup>2</sup>. County Geological Sites parallel County Wildlife Sites in that they are registered for conservation purposes, although are not afforded the degree of protection brought about by CWS or SSSI status. Within the AONB there are 13 County Geological Sites as listed in appendix B.

The **Geological Conservation Review**<sup>3</sup> begun in 1977 aimed to identify and describe the most important sites for geology in Britain. The review was concluded in 1990 but there remains a requirement to periodically review those sites being considered for notification, to ensure that they are credible and robust. This process is undertaken by Natural England. There are 20 Geological Conservation Review Sites within the AONB some of which are already identified as a SSSI – see appendix C.

The North Devon **UNESCO Biosphere Reserve** designated in 2002 has Branton Burrows as its core area with a focus on its world class environment and sustainable development.

- **Planning and Monitoring**

The **Landscape Character Areas for Torridge**<sup>4</sup> and **North Devon**<sup>5</sup> and **North Devon and Exmoor Seascape Character Assessment**<sup>6</sup> have several cross-cutting themes related to climate change and sea level rise. These include coastal squeeze, which may impact on North Devon's beaches as natural retreat of the shoreline reduces the width of sandy beaches, increase in strength and frequency of storms and increased erosion of the cliff faces. Most of the coastline has low rates of erosion due to the resistance of the bedrock that forms the cliffs but higher rates of erosion are found along Abbotsham Cliffs and around Bucks Mills. One of the issues from climate change to geodiversity is the loss of key geological exposures, such as the anticline known as Tuts Hole at Abbotsham.

The **North Devon and Somerset Shoreline Management Plan review (2010)**<sup>7</sup> considers how the effects of climate change and sea level rise will be managed, with a combination of allowing the natural retreat of the shoreline at sites away from urban areas and the maintenance of 'hold the line' (sea defences) at key sites such as Westward Ho!, Clovelly and Ilfracombe.

The **Devon Biodiversity and Geodiversity Action Plan (updated 2009)**<sup>8</sup> identified four habitats that have a significant geological/geomorphological element that are found in North Devon and are a focus of concern, these are:

1. **Periglacial Landscapes** - those that are formed through processes related to freezing and thawing that are brought about by being in proximity to an ice sheet or glacier, for example the 'head' at the top section of the cliffs at the northern end of Saunton Sands beach.
2. **Rivers, Streams, Floodplains and Fluvial Processes** - North Devon's rivers and streams contain a wide range of geomorphological features such as ditches, ox-bow lakes, terraces, dry beds and secondary river channels.
3. **Caves, Karst and Limestone Habitats** - outcrops of limestone can only be found in the northern section of the North Devon Coast AONB around Ilfracombe and Combe

Martin. These outcrops with the preservation of fossil corals (Hele Bay) are significant for dating the age of the bedrock in the area.

4. **Sea Cliffs and Slopes** - key features of the AONB found most prominently at the northern and southern ends of the AONB.

## **Geodiversity and Local Products and Activities**

Geological features provide a wide range of opportunities and products for use by the local and visiting population. For many people this may be their most direct contact with geology but in an indirect way. A brief description of the main products and activities demonstrates the value of geological features as part of the natural capital of North Devon that contributes to the wider economy.

- **Historic marine aggregate extraction**

Sand and gravel extraction was undertaken in the Taw Torridge Estuary from the 18<sup>th</sup> century or possibly earlier<sup>9</sup>. Between 1960 to 1970, 600,000 tonnes of sand and gravel was removed from the Braunton side of the estuary, some of which will have been within the AONB boundary at Crow Point. Aggregate extraction continued until 1997 and, apart from an agreed protocol for maintenance dredging of the port and shipyard area (between the Harbour Authority and Natural England), there is unlikely to be any new permits issued for aggregate extraction within the estuary, given the status of the estuary as a SSSI.

- **Historic lime burning**

The proximity of the North Devon coastline to Wales has meant that limekilns are found in almost every inlet along the coast. This is because limestone was shipped across the Bristol Channel from South Wales, possibly along with coal, which was used to fire the limekilns, and after being burnt in the limekilns was spread over the fields to sweeten the acidic soil or used for lime mortar, render and wash. Inland limekilns can be found around Ilfracombe and Combe Martin where they were served by their own proximal limestone quarries. These features contribute to the historic environment which is of interest to visitors and researchers.

- **Historic mining**

A carbon based mineral or culm deposit laid down during the Carboniferous can be found in seams from Hartland and Abbotsham on the coast inland under Bideford and as far as Umberleigh. This Earth pigment, known as Bideford Black, was mined for 200 years until 1968 for use in paint for boat building for colouring rubber products, for camouflage on tanks in WWII and for the production of mascara<sup>10</sup>. Although no mining structures relating to the mining of Bideford Black exist within the AONB there are outcrops of the deposit along the coast at Abbotsham and reference to past activities can be seen in the naming of local streets in Bideford and East-the-Water (Mines Rd, Pitt Lane).

More significantly within the AONB there is still evidence of mining for silver lead ore, that took place in and around Combe Martin from as early as 1198 where it is mentioned in the feet of fines for that year (court copies of agreements following disputes over property). This includes an ivy covered engine house at Knap Down that can be seen on the skyline above Combe Martin, and mining structures and buildings that are preserved by the Combe Martin Silver Mines Research and Preservation Society, who are undertaking the work of excavating the mine shafts and structures on the land known as Mine Tenement.

The **Combe Martin and the UMBER Valley Historic Environment Action Plan (2013)**<sup>11</sup> produced by the AONB team with local partners, identifies that some of the structures outside of the Mine Tenement area and knowledge gathered by the current miners may be lost over time. There is a need to record the remaining features and knowledge as well as to identify other features in the area, such as the locations of smelting sites.

- **Quarries and building stone**

Most of the geological features of the AONB have been worked for building stone in the past, contributing to the built character of the area. The old abandoned quarries themselves, dotted across the landscape, are an historic landscape feature of importance to biodiversity and geodiversity. The Devon Mineral Plan, adopted by Devon County Council in February 2017<sup>12</sup>, includes an objective to encourage greater supply of the wide range of building stone that has been used in the past in North Devon, such as Bude Formation, Morte Slates, Pickwell Down sandstone, Pilton Sandstone, Baggy Sandstone, Cornborough Stone, and Ilfracombe Limestone. As well as the stone being used for buildings it was used in the distinctive stone walls that are found across the AONB. Within the AONB there is currently only one active quarry, which is found south of Morteheo producing distinctive Morteheo slate for use by the National Trust.

The work undertaken as part of the North Devon AONB National Mapping Programme project<sup>13</sup>, that identified historic features of the coastline of the AONB, using aerial photographs and historic maps, will be expanded during the North Devon and Cornwall Rapid Coastal Zone Assessment Survey<sup>14</sup>. This is a desk based study that may locate previously unidentified features related to geodiversity, such as historic quarrying sites. This study will be used provide the data needed to feed into Shoreline Management Plans.

A **Strategic Stone Study (2012)**<sup>15</sup> was undertaken by DCC and funded by English Heritage (now Historic England). This was part of a national programme of surveys with atlases produced for each county. The Devon-focussed survey looked at current and historic quarrying sites and known building stone uses. As this was a Devon-wide survey, only a small sample of settlements from North Devon was included. Further work could be undertaken to expand this study, if the methodology could be developed for use by volunteers and community organisations to expand the data already held by Devon County Council and Historic England.

Historically, the mineral umber, used as a pigment in paint, was quarried commercially in the UMBER Valley between Combe Martin and Berryarbour from at least 1873 and was likely the last profitable mineral exploitation in the area<sup>16</sup>. UMBER and other natural earth pigments are utilised still by local artists, sourcing from local North Devon locations, for both commercial and educational purposes.



- **Food - farming and fishing**

Agriculture forms a key part of the AONB's economy and the landforms and soils have influenced the direction that farming has taken over time. A famous example is the sheltered, south facing slopes of the steep sided Combe Martin valley that were perfect for strawberry production and other horticulture products from the mid-19<sup>th</sup> century up to the current day. The soils formed from weathering of the underlying rocks can dictate how and what grows well, such as the very productive land at Braunton, which is found on river terrace deposits. Much of the undulating and exposed coast is covered in woodland or used for livestock production with arable farming more common in the lowlands.

The rocky foreshore of the AONB is a perfect nursery habitat for lobster and crab, resulting in a thriving shellfish industry with fishing boats operating out of Clovelly, Bideford, Appledore and Ilfracombe.

- **Tourism**

Not only does the geodiversity define the landscape of the coast, making an attractive place to visit with its wide sandy beaches and beautiful landscapes and seascapes, it also defines the wildlife in the area, producing nesting sites and food for birds and supporting varying species of flora, all which brings more visitors to the area. The coast is also a focus for a wide range of leisure activities, recreation and water sports producing pressure, erosion and potential damage to some key sites if not carefully managed. The historic built environment, with settlements that were built with local stone, also contributes to the appeal of the area to visitors.

### **Issues and Concerns for Conservation Activity**

A number of issues and concerns relevant to the AONB are raised in the reporting, reviewing and monitoring activities of the agencies responsible for recording, designation and management of geodiversity sites:-

There are concerns that **inappropriate collecting of fossil specimens** outside of authorised scientific study could damage sites. Rock and fossil specimens have been collected in the past, and examples may be found in the rock collections of local museums. The Museum of Barnstaple and North Devon has a comprehensive, catalogued, rock and fossil collection and some of the smaller museums in the area, such as Combe Martin Museum, Ilfracombe Museum and Morteheo Museum also have collections. Such collections are available to the public and offer opportunities for understanding past environments and associated landscapes without removing samples from accessible sites.

There are concerns about potential conflict between **geological conservation and protection of wildlife**, such as bats in local caves. Damage may be caused by visitors to sites (such as climbers and walkers) who have a lack of awareness of the value of such sites and that key features could be lost or damaged before they are identified and recorded. Geological societies and educational institutions have guidelines for responsible use of sites, which could be used or adapted to different user groups.

Until full surveying of the North Devon AONB is achieved, **unidentified important features** may be at risk from damage, directly or indirectly. Although there has been some assessment of important sites as part of the Geological Conservation Review<sup>3</sup>, there may be other important features, both current and historic, that are still unidentified.

**Visitor pressure** on key local sites may cause erosion. This relates specifically to the Landscape Character Areas of the North Devon Coastal Downs and the Taw Torridge Estuary (covering Braunton Burrows and Northam Burrows) where visitor pressure may cause erosion to dune systems, if not managed carefully.

The scale of users on the South West Coast Path has necessitated repeated restoration work on certain sites within the AONB to reduce erosion and risks to users. Sports activities such as rock climbing and coasteering could also impact on important geological sites.

In conclusion, these issues and concerns have been taken into account to inform the objectives and actions within the action plan below. Partners have been identified to help deliver and support the actions and clear links made to the AONB Management Plan. The Local Geodiversity Action Plan is likely to be delivered during both the 2014-2019 Plan and the 2019–2024 Plan periods given the available resources among delivery partners.

## **Action plan**

<b>Objective</b>	<b>Action</b>	<b>Partners</b>	<b>Management Plan Policies</b>
<b>Understanding our geodiversity</b>			
To increase public understanding of geodiversity and how this contributes to the natural beauty of the AONB	Maintain databases and maps of key geological sites and features, to inform future management and interpretation actions	Natural England RIGS group, BGS, DBRC, Landowners,	C3, A5
	Identify and record the built environment where local stone has been used and its sources. Develop guides and interpretation.	DCC Historic Environment, local museums, AONB	C3, E2
<b>Conserving our geodiversity</b>			
To maintain and enhance geodiversity sites through appropriate management	Developing or signposting to codes of conduct for user groups such as climbers, geologists and walkers.	AONB	A1, C1, H5
To identify sites and features of Earth heritage importance and protect from adverse development or erosion.	Restore key historic features that are made from local stone or are features of the commercial activity related to geology, such as mining	Historic England, NT, NDAS, Landowners	C1, E1, E2
<b>Interpreting our geodiversity</b>			
To increase awareness of and relevance of geodiversity to different audiences and communities living in or visiting the AONB	Develop interpretation and resources that celebrate the geology and geomorphology of the North Devon Coast AONB	BGS, Devon RIGS group, Geological Society, OUGS, AONB	C3, G3
	Develop public engagement, celebration and learning events on geodiversity based on local features and resources	AONB and local partners – U3A, Coastwise	C3, H1, H5, B7
<b>Learning about our geodiversity</b>			
To provide resources for learning and engagement of different audiences	Assist museums in the AONB to identify and catalogue their rock collections, and develop learning resources for educational activities.	AONB, local museums,	C3, E2

## References

1. UK Geodiversity Action Plan (UKGAP), UKGAP partnership <http://www.ukgap.org.uk/> [accessed February 2017]
2. Devon Regionally Important Geological and Geomorphological Sites Group website <http://devonrigs.org.uk/index.html> [accessed January 2017]
3. The Geological Conservation Review (GCR), Joint Nature Conservation committee (JNCC), (29/04/2015) <http://jncc.defra.gov.uk/page-2947> [accessed January 2017]
4. Devon Character Areas – Torridge, Devon County Council [http://www.devon.gov.uk/index/environmentplanning/natural\\_environment/landscape/devon-character-areas/dca-torridge.htm](http://www.devon.gov.uk/index/environmentplanning/natural_environment/landscape/devon-character-areas/dca-torridge.htm) [accessed January 2017]
5. Devon Character Areas – North Devon, Devon County Council [http://www.devon.gov.uk/index/environmentplanning/natural\\_environment/landscape/devon-character-areas/dca-north-devon.htm](http://www.devon.gov.uk/index/environmentplanning/natural_environment/landscape/devon-character-areas/dca-north-devon.htm) [accessed January 2017]
6. North Devon and Exmoor Seascape Character Assessment (Nov 2015), Prepared by LUC on behalf of National Trust, North Devon Coast AONB, Exmoor National Park Authority, North Devon Council, Torridge District Council and Natural England. <http://www.northdevon-aonb.org.uk/projects/seascape-character-assessment> [accessed December 2017]
7. North Devon and Somerset Shoreline Management Plan Review (October 2010), North Devon and Somerset Coastal Advisory Group <http://www.ndascaq.org/finalsmp/docs/html/frameaset.htm> [accessed January 2017]
8. Devon Biodiversity and Geodiversity Action Plan, Devon Biodiversity Partnership, (revised 2009)
9. Geological Conservation Review, Vol 8 - Coastal Geomorphology of Great Britain, Chapter 7, Site: Braunton Burrows, 2003
10. The Story of Bideford Black, Burton Art Gallery and Museum. <http://bidefordblack.blogspot.co.uk/p/history.html> [accessed January 2017]
11. Combe Martin and UMBER Valley Historic Environment Action Plan, North Devon Coast AONB (September 2013) <http://www.northdevon-aonb.org.uk/resources/combe-martin-heap> [accessed February 2017]
12. The Devon Minerals Plan 2011 – 2033, Devon County Council, <https://new.devon.gov.uk/planning/planning-policies/minerals-and-waste-policy/devon-minerals-plan> [accessed March 2017]
13. North Devon AONB National Mapping Programme project , Historic England, 10<sup>th</sup> April 2014 <https://historicengland.org.uk/research/research-results/recent-research-results/south-west/north-devon-aonb-nmp/> [accessed March 2017]
14. North Devon and Cornwall Rapid Coastal Zone Assessment Survey, University of Southampton <http://www.southampton.ac.uk/coars/news/2015/03/rapidcoastalassessment.page> [accessed March 2017]
15. Strategic Stone Study, A Building Stone Atlas of Devon (September 2012) accessed via: Historic England county building stone atlases, Minerals UK British Geological Survey (BGS). [https://www.bgs.ac.uk/mineralsuk/buildingStones/StrategicStoneStudy/EH\\_atlases.html](https://www.bgs.ac.uk/mineralsuk/buildingStones/StrategicStoneStudy/EH_atlases.html) [accessed January 2017]
16. Cloughton, P. Coal, ore and metals: coastal mining landscapes of South-West Britain (United Kingdom) in: [book auth.] Christoph Bartels, et al.. Landmarks: Profiling Europe's Historic Landscapes. Bochum: Selbstverlag des Deutschen Bergbau-Museums, 2008, pp. 173 - 182.

## **Resources**

North Devon Coast AONB - <http://www.northdevon-aonb.org.uk/>  
Coastwise <http://www.coastwisenorthdevon.org.uk/>  
Devon RIGS Group <http://devonrigs.org.uk/index.html>  
Geology Educational Resources – Devon County Council <http://www.devon.gov.uk/geology>  
Geology of Britain Viewer, BGS <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>  
IGI Ltd – outreach <https://www.igiltd.com/about/outreach/>  
Open University Geological Society, South West <http://ougs.org/southwest>  
Thematic Trails <http://www.thematic-trails.org/>  
Ussher Society – Geoscience in Southwest England <http://www.ussher.org.uk/>

## **Museums**

Combe Martin Museum <http://www.combe-martin-museum.co.uk/>  
Mortehoe Museum <http://www.mortehoemuseum.org.uk/>  
Ilfracombe Museum <http://www.ilfracombemuseum.co.uk/>  
Museum of Barnstaple and North Devon <http://www.barnstaplemuseum.org.uk/>  
Burton Art Gallery and Museum <http://www.burtonartgallery.co.uk/>  
Hartland Smuggler Museum information: <http://www.hartlandpeninsula.co.uk/25-things-to-see-and-do/find-hartland-quay-shipwreck-and-smuggling-museum.html>

## Appendix A - Sites of Special Scientific Interest in the North Devon Coast AONB

SSSI Name	Grid Reference	Geological feature/aspect	Comments
Napps Cave	SS563474	Geologically important for aragonite crystals	Not accessible to general public
Hele, Samson and Combe Martin Bays	SS582479 to SS566476 & SS547484 to SS536479	National importance for Devonian stratigraphy, palaeontology and palaeogeography in addition to providing key exposures of fold structures situated on the northern edge of the Variscan foldbelt.	Incorporates three Geological Conservation Review (GCR) sites – Rillage Point, Ilfracombe Coastal Section and Combe Martin Beach
Morte Point	SS451454	Primarily designated for wildlife but mentions Upper Devonian rocks.	
Barricane Beach	SS452442	The Upper Devonian (Frasnian-Fammenian) Morte Slates. This is the best fossil locality in the Morte Slates	Listed as being of national importance in the Geological Conservation Review.
Mill Rock	SS455431	Important for understanding the ecological preferences of fossil fish. Fossil fragments of Upper Devonian fish in a tuff (a volcanic ash band) and associated shales within the Pickwell Down Sandstones.	Listed as being of national importance in the Geological Conservation Review.
Saunton to Baggy Point Coast	SS445407 to SS444377	Important locality for coastal geomorphology, sedimentary structures and Pleistocene stratigraphy of South West England; particularly noted for shore platforms, erratic boulders and a succession of raised beach and blown sand and head deposits. Providing a comprehensive record of changes in sea level and fluctuations in climate.	This site contains three Geological Conservation Review sites
Braunton Burrows	SS453375 to SS463316	Braunton Burrows is a key site for coastal geomorphology and its diversity of form. It is one of the three largest sand dune systems on the west coast of Britain, has the greatest height range of any west coast dune system and is the one least affected by underlying geology and afforestation.	Core of North Devon UNESCO Biosphere Reserve incorporates the Braunton Burrows SAC
Northam Burrows	SS448321 to SS432296	Predominantly designated for wildlife but the cobble ridge is an important landform feature noted in particular for the large size of the sediments present. Few spits in Britain are formed of large cobbles at the back of an extensive sandy intertidal zone	Part of the site is listed in the Geological Conservation Review.

SSSI Name	Grid Reference	Geological feature/aspect	Comments
Westward Ho! Cliffs	SS432296 to SS420291	Important locality illustrating several key features of the coastal geomorphology and Quaternary deposits of SW England, including multiple shore platforms and a classic succession of raised beaches and head deposits. It is particularly noted for the association of these features with an intertidal peat bed of Flandrian age resting on soliflucted and cryoturbated beach deposits.	A Geological Conservation Review site.
Mermaid's Pool to Rowden Gut	SS418290 to SS385247	The coastal exposures exhibit the best available sections through the Bideford Formation and provide detailed sedimentological and biostratigraphical information. The combination of a major lateral change from Crackington to Bideford Formation facies and the associated biostratigraphical control makes this site of very considerable importance for regional and national palaeoenvironmental and palaeogeographical studies.	A Geological Conservation Review site.
Hobby to Peppercombe	SS381243 to SS320246	Mainly The north-facing, convex seacliffs, composed of much-folded Carboniferous sandstones and shales of the Bude and Crackington Formations, rise very steeply from the intertidal rocky platform to about 150 m. They are subject to the strong, moist winds from the Atlantic, and in places fast-flowing streams have deeply incised the cliffs to form steep valley and coastal waterfalls.	Incorporates part of the Tintagel-Marsland-Clovelly Coast Special Area of Conservation (SAC)
Marsland to Clovelly Coast	SS318249 to SS212174	The site is nationally important for its geological, geomorphological and biological interest. The coastline shows unrivalled exposures through Upper Carboniferous rocks belonging to the Crackington and Bude formations affected by large-scale folds formed during the Variscan Orogeny	Incorporates part of the Tintagel-Marsland-Clovelly Coast SAC. Contiguous with the Steeple Point to Marsland Mouth SSSI. Contains four Geological Review cites (Hartland Quay, Hartland Point, Welcombe Mouth and Clovelly to Mouth Mill).
Bursden Moor	SS267201	Mainly biological but mentions Crackington formation (Culm Measures)	

## Appendix B - County Geological Sites

<b>NORTH DEVON AONB - North Devon</b>				
<b>Site Name</b>	<b>Parish</b>	<b>Grid Ref</b>	<b>Description</b>	<b>File Code</b>
Windy Cove, Morte Point	Mortehoe	SS445454	Morte Slates with good examples of bedding cleavage	SS44NW1
Putsborough Sands	Georgeham	SS448411	Good example of the more continental sediments of the Pickwell Down Sandstones	SS44SW1
Watermouth	Berrynarbor	SS555483	Lester Slates and Sandstones	SS54NE1
Hele Quarry	Ilfracombe	SS533480	Devonian features & calcareous slate and crinoidal limestone with structural features	SS54NW1
Rapparee Cove*	Ilfracombe	SS528477	Slates and sandstones of the Kentisbury Slates	SS54NW2
Hele Bay	Ilfracombe	SS535480	Limestones and slates of the Combe Martin Slates	SS54NW3
Tunnel Beach	Ilfracombe	SS513477	Good exposures of the lithology of part of the Kentisbury Slate	SS54NW4

\*changed from 'Grove'

<b>NORTH DEVON AONB - Torridge</b>				
<b>Site Name</b>	<b>Parish</b>	<b>Grid Ref</b>	<b>Description</b>	<b>File Code</b>
Colpit Quarry, Hartland	Hartland	SS279249	Carboniferous Crackington Formation. The fossiliferous Embury Shale with <i>Gastrioceras subcrenatum</i> exposed on a major fault line	SS22SE1
Hartland Quay	Hartland	SS224250	Top Crackington Formation and marine shales	SS22SW1
Clovelly Coast	Clovelly	SS310257	Devon (Culm) facies of the Upper Carboniferous through the Namurian Westphalian boundary with fossiliferous horizons containing goniatites	SS32NW1
Portledge Permian Outlier, Peppercombe	Alwington	SS383245	Permo-Triassic Formation 'red beds' unconformably overlying folded Bude Formation	SS32SE1
Appledore Tidal Flats	Northam	SS453306	Tidal mud flat and sand deposits crossed by a shifting meandering channel	SS43SE1
Embury Harbour	Hartland	SS215197	Upper part of the Crackington Formation with examples of two of the main marine shales and a slump bed	SS21NW1



## Appendix C - Geological Conservation Review Sites

Number	Locality	Grid reference*	Geological Speciality	Comments
3012	Abbotsham Coast	SS403269	Westphalian	Falls within Mermaid pool to Rowden Gut SSSI
1789	Baggy Point	SS447408 to SS434395	Marine Devonian	Falls within Saunton to Baggy Point SSSI
1790	Barricane Beach	SS454443	Marine Devonian	Coincident with Barricane Beach SSSI
2604	Braunton Burrows	SS430350	Coastal Geomorphology	Falls within Braunton Burrows SSSI
467	Bull Cove	SS482484	Marine Devonian	
3023	Clovelly Coast	SS31255	Westphalian	Incorporated in Clovelly to Mouth Mill SSSI
2934	Clovelly to Mouth Mill	SS317251 to SS295265	Variscan Structures of South West England	Incorporated in Clovelly to Mouth Mill SSSI
1788	Combe Martin Beach	SS568475 to SS575476	Marine Devonian	Falls within Hele, Sampson's and Combe Martin Bays SSSI
1532	Croyde to Saunton Coast	SS427400, SS435390 and SS438379	Quaternary	Falls within Saunton to Baggy Point SSSI
1787	Downend	SS434389 to SS445373	Marine Devonian	Falls within Saunton to Baggy Point SSSI
2924	Hartland Point	SS224264 to SS237277	Variscan structures of South West England	Falls within Marsland to Clovelly Coast SSSI
1867	Hartland Quay	SS224250	Geomorphological	River valleys truncated by cliffs
2923	Ilfracombe Coastal Sections	SS536480 to SS543486 and SS569474	Variscan Structures of South-West England	Overlaps with Rillage Point GCR
2244	Mill Rock	SS455432	Vertebrate Palaeontology (Silurian to Devonian Chordata)	Coincident with Mill Rock SSSI
560	Napps Cave	SS565475	Caves	Good example of aragonite crystals
1786	Rillage Point	SS539483 to SS545487	Marine Devonian	Falls within Hele, Sampsons and Combe Martin Bays SSSI
3025	Shipload Bay	SS248276	Westphalian	Falls within Marsland to Clovelly Coast SSSI
2719	Welcombe Mouth	SS212 179	Variscan Structures of South West England	Anomalous folding
1531	Westward Ho!	SS422291	Quaternary	Falls within Westward Ho! Cliffs SSSI
2110	Westward Ho! Cobble ridge	SS440 310	Geomorphology	Cobble spit – Falls within Northam Burrows SSSI
*This is the approximate central point of the GCR site. In the case of large, linear or composite sites, this may not represent the location where a feature occurs within the site.				