Geoconservation (in Action)

Lesley Dunlop

Northumbria University

Geoconservation Committee, GSL

English Geodiversity Forum

GeoConservationUK

Berkshire Geoconservation Group

Oxfordshire Geology Trust

About this talk

- **Geoconservation**
- **Examples**

'We cannot take one step in geology without drawing upon the fathomless stores of by-gone time.'
Adam Sedgwick, 1842 in letter to William Wordsworth

Hannah Townley, Lyme Regis

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Geodiversity

Geodiversity is the variety of rocks, minerals, fossils, landforms and soils, together with the natural processes that shape them.

Geodiversity is a foundation for life and our society. It influences landscape, habitats and species as well as our economy, historical and cultural heritage, education, health and well-being.

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Why is the UK important?

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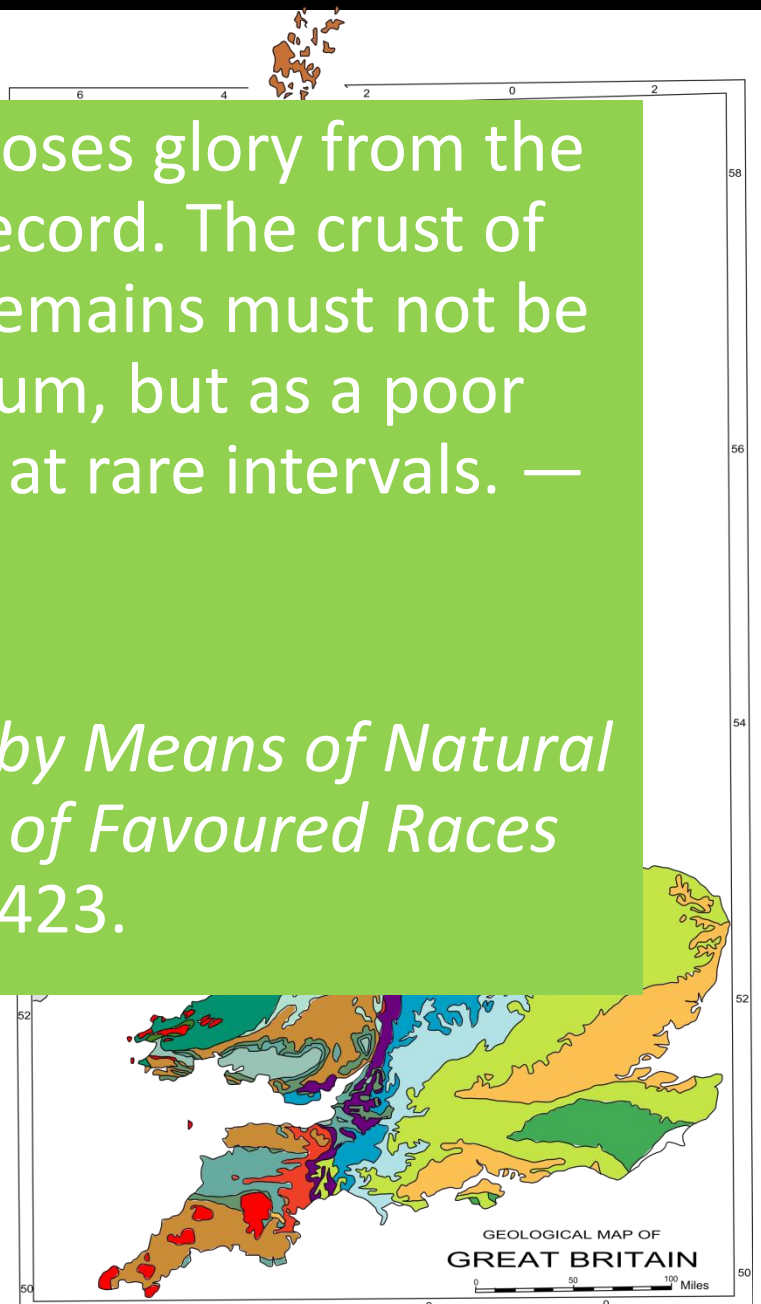
The noble science of Geology loses glory from the extreme imperfection of the record. The crust of the earth with its embedded remains must not be looked at as a well-filled museum, but as a poor collection made at hazard and at rare intervals. — Charles Darwin

From *On the Origin of Species by Means of Natural Selection; or, The Preservation of Favoured Races in the Struggle for Life* (1861), 423.



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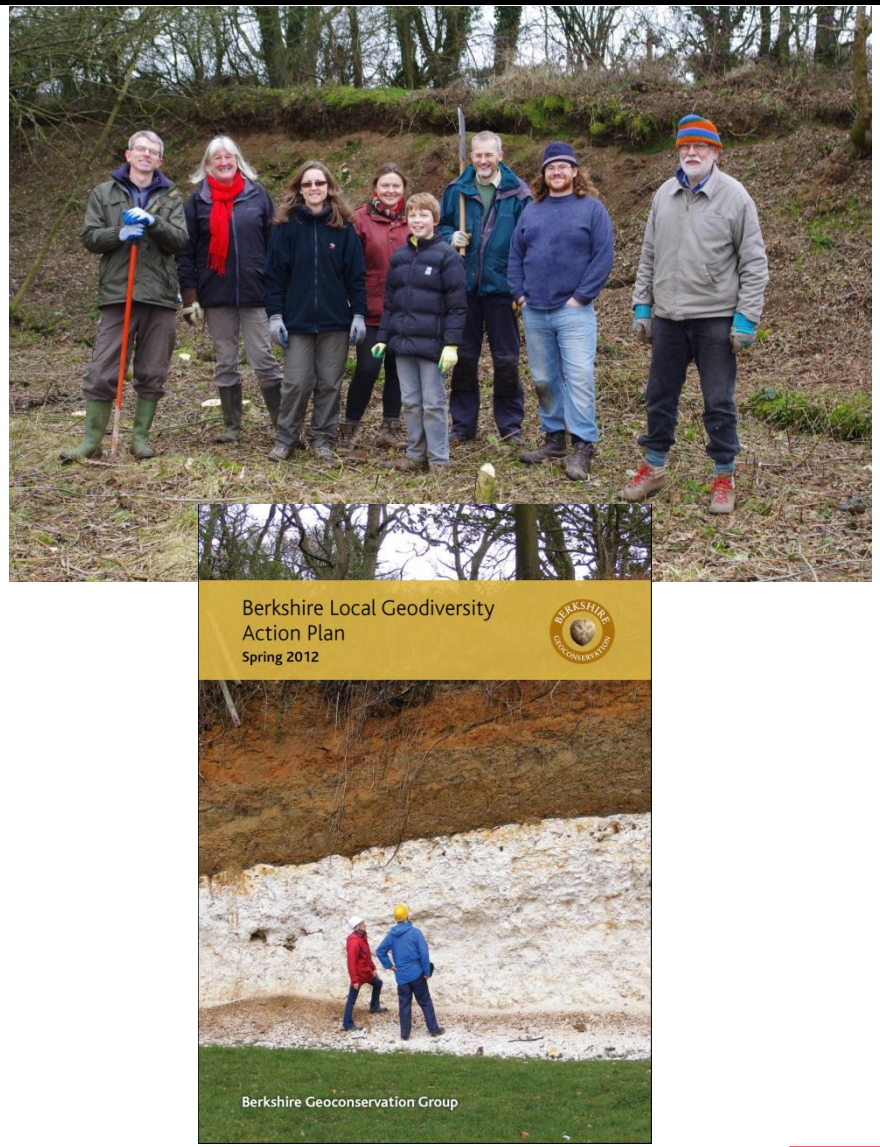

Geoconservation - what is it?

Set of actions aimed at informing the management of geological sites comprising inventory and assessment, conservation, statutory protection, interpretation, and monitoring of sites.

The management of geoheritage is also a geoconservation action. Geoconservation is considered an emergent domain of the geosciences.

ProGEO, 2017

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Significance of Sites

The successive series of stratified formations are piled on one another, almost like courses of masonry.

<u>William Buckland</u>

***Geology and Mineralogy, Considered with Reference to Natural Theology* (1836), Vol. 1, 37.**

If part if the story is missing does it make sense?

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Conservation can start with designation

SSSI – Carley Hill with Cannonball Limestone, Sunderland

- Local Geological Site
- Marine Protected Areas
- National Nature Reserve (NNR)
- National Park
- National Scenic Area (NSA)
- Natura site
- Ramsar site
- Regional Park
- Site of Special Scientific Interest (SSSI)
- Special Area of Conservation (SAC)
- Special (local) Landscape Area (SLA)
- Special Protection Area (SPA)
- World Heritage Site

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Geological Conservation Review

- Geodiversity features in SSSI are underpinned by the Geological Conservation Review (GCR).
- Only GCR sites are considered to qualify for designation as SSSIs.
- The Geological Conservation Review selected the best and most representative geological and geomorphological features of Britain.
- There continues to be additions to and deletions from the GCR site register.

Fognam Quarry Berkshire

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Sites of Special Scientific Interest

- Areas of land and water that best represent our biodiversity and geodiversity.
- The essential building blocks of protected areas for nature conservation in Britain.
- Legislative origins date back to 1949.
- UK Conservation Agencies designate SSSI.
- SSSIs are protected by law.
- It is an offence for any person to intentionally or recklessly damage the protected natural features of a SSSI.

Kirtlington Quarry, Oxfordshire

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Sites of Special Scientific Interest

- Conservation Agencies work with SSSI owners and managers to ensure appropriate site management.
- SSSI owners and occupiers must apply for consent to carry out certain operations.
- Conservation Agencies must be notified beforehand of any operation that may affect a SSSI with consent being sought.
- Consent may or may not be given and conditions may be set.
- The condition of SSSIs is monitored.
- Sites in an unfavourable condition may be restored.

Kirtlington Quarry, Oxfordshire

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SSSI and LGS (RIGS, any other name)

SSSI statutory but can take a long time

Local Sites

Can be proposed by local groups and the process of adopting of these varies

Work with people where ever possible

High Force Waterfall, Teesdale

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Why should we designate?

Who is it for?

Local/regional/national/ international importance

Research

Teaching

Historic interest etc

Perhaps the question is ‘Why shouldn’t we?’

Warfield Church, LGS in Berkshire Berkshire Geology summed up in one building!

Chalk (Cretaceous)
Sarsen (Palaeogene)
Iron cemented gravel (Quaternary)

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Local Geological Sites

- As developed by UKRIGS
  - Educational
  - Scientific
  - Historical
  - Aesthetic

  (Reynolds, 2001)

Don't stop there

Interpret

Let people know

Celebrate!

Identify – eg audit, list of features, gaps

Site visit and research

Propose

Designate

Monitor

Conserve

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100 Great Geosites – Geological Society Project

Hadrian's Wall & the Great Whin Sill

Northumberland, England

Long lines of crags capped by Hadrian's Wall (Figure 1), the Farne islands, the rocky hills topped by Lindisfarne (Figure 2), Bamburgh and Dunstanburgh (Figure 3) castles, the waterfalls of High Force (Figure 4) and Cauldron Snout, Holwick Scar (Figure 5) and Cronkley Fell (Figure 6), and the spectacular amphitheatre of High Cup Nick are all popular destinations for visitors to north east England.

All have one thing in common. All are expressions of one of the region's, and one of the UK's, most significant geological features – the Great Whin Sill.

Figure 1. Housesteads Crags
Hadrian's Wall here tops the prominent north-facing scarp of the Whin Sill. Although founded on Whin Sill dolerite, because this rock is so difficult to shape into regular blocks, the Roman builders used Carboniferous sandstones, quarried nearby, to build the wall.

The Great Whin Sill

So resistant to erosion is this dense hard black dolerite that almost wherever it reaches the surface it forms such distinctive landscape features. These were the features appreciated by the Roman engineers when planning the northern boundary of their empire, and by later rulers when seeking prominent and easily defended sites for their castles. Yet its importance in giving so much character to the region is not limited to its geological or landscape interest.

100 Great Geosites

The UK and Ireland feature some of the most diverse and beautiful geology in the world, spanning most of geological time, from the oldest Pre-Cambrian rocks to the youngest Quaternary sediments. As part of Earth Science Week 2014, The Geological Society and partner organisations celebrated this unique geo-heritage by launching a list of 100 Great Geosites across the UK and Ireland.

Categories

We split the sites into ten categories, although many sites fit into more than one! The winner of the public vote in each category has pride of place as the 'People's Favourite'.

Please click on the links below to find out more about the ten sites in each category:

Landscape

Industrial & Economic Importance

Historical & Scientific Importance

Educational

Adventurous

Human Habitation

Coastal

Outcrops

Folding and Faulting

Fire & Ice

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How can designation protect a site

Valentia Tetrapod Trackway

The Geological Society
serving science & profession

Site details

Name: The Valentia Tetrapod Trackway,
Location: Valentia Island, Cahirciveen, Co. Kerry, Ireland
Protections/Designations: State owned geological heritage site but not designated as any specific category
Statutory Body? National Parks and Wildlife Service

Background to the site

The Tetrapod Trackway on Valentia Island was first identified in 1993 by a geology student doing their mapping project, an essential part of most geology degrees. He published on the find in 1995, demonstrating that it was the footprints of a very early amphibian animal – with four feet – a tetrapod. The interest aroused led to many visitors trying to find the site, on an exposed cliff edge, on private farmland. There was also a serious fear that without any protection the slabs could be lifted and removed by private or commercial fossil collectors without concern for the wider community value.

As there was no functional designation that could protect a geological heritage site, a case was made by the Irish Geological Heritage Programme in the Geological Survey of Ireland (GSI), for the State to buy the site and put in place safe public access. This includes some on-site interpretation, but a more detailed booklet explaining the site was also published by GSI. The National Parks and Wildlife Service completed this work in around 2003.

Any statistics/facts about the site

- Was defined as the oldest in situ tetrapod trackway in the World when first found and published
- It is dated as 485±0.X million years old
- Despite a later find in Poland, which it is claimed is older by a few million years, but this is not universally accepted
- In the Republic of Ireland, this is the only State owned 'monument' specifically for geology, developed to allow public access and interpretation.

The main trackway section meanders across a bedding plane in flood deposits of siltstone, but there are many more very subtle prints to be seen if the light is right.

Uniqueness of the site

Why is the site so important?
It is possibly the oldest in situ record of a major evolutionary step of our own very distant vertebrate ancestors. It records the earliest known example in the fossil record of the transition of vertebrates onto land, breathing air and walking on four limbs. In short, it is the first in situ fossil record of an amphibian animal.

(Link to more information here)

Valentia Tetrapod Trackway

The Geological Society
serving science & profession

Benefits of designation/protection

The Trackway site is owned by the Government, on behalf of the people, and managed by the National Parks and Wildlife Service of the Department of Environment, Heritage and Local Government to allow safe visitor access to this important national geological monument. A car park is provided and a steep footpath leads the visitor about 200m to overlook points on the cliff top and right next to the footprints.

Regrettably, due to steepness, the path to the footprints is not recommended for wheelchair access or for those with restricted mobility. Please exercise common sense and do not attempt to visit in unsuitable weather conditions.

The Valentia Island road is narrow and unsuitable for coaches. Please do not block the road for local residents and especially for the Marine Radio Station which must be accessible at all times in case of emergency.

If at all possible, you should try to visit the trackway on a sunny day, either in the early or mid-morning, or else in the late afternoon. The trackway footprints are subtle features which show up best when the natural light is at a low angle and throws a shadow into the footprint depressions in the rock.

At other times they should still be clear to see, but not at their best, and photographs may not show them well. However, there may be small pools of water in them, from rain or sea splash, which do pick the trackway out well.

The site is of international importance, being well dated at older than 385 million years; the oldest in situ trackway in the world. About 200 prints represent the passage of one or more tetrapods, primitive four legged vertebrates, across the soft sediment of a large river floodplain in Devonian times. It is a key record of the important evolutionary step of vertebrates leaving aquatic environments and breathing air on land. This site has the scope to fire people's understanding and appreciation of geology that ranks with the best the world has to offer.

Sections of the trackway include a distinct groove where the body of the tetrapod dragged in the wet sediment.

In the immediate vicinity of the trackway site there is a large underground slate mine, also worth visiting. The Valentia slab slate was sawn to order and exported to Britain, the USA and even to Patagonia. The Slate Mine is an operational business today.

(Link to more information here)

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Is it just about sites?

No definitely not!

Local character

Local industry

Buildings

Landscapes

Artefacts

Even people!

Warfield Church, LGS in Berkshire Berkshire Geology summed up in one building!

Chalk (Cretaceous)
Sarsen (Palaeogene)
Iron cemented gravel (Quaternary)

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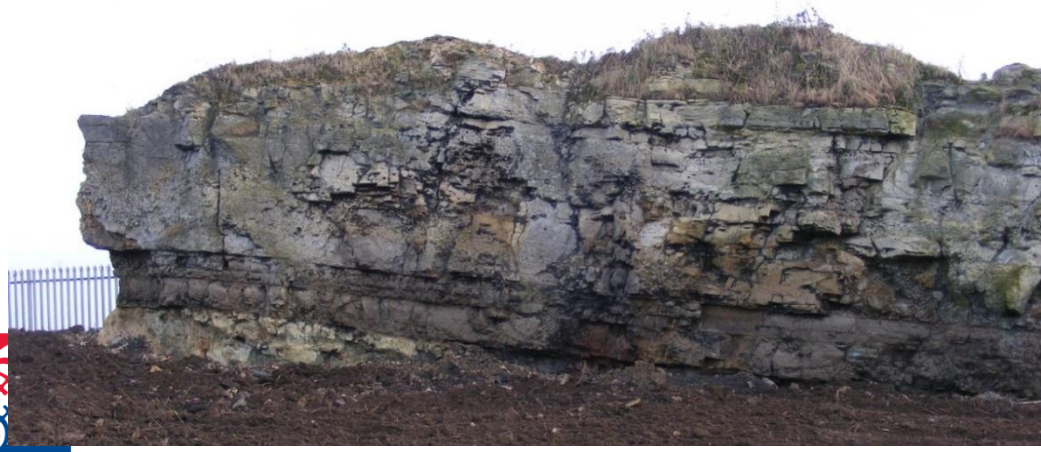
Site Monitoring and Clearance

- Needs to happen
- Often popular
- Can attract those more usually involved in other conservation
- Record
- Take images



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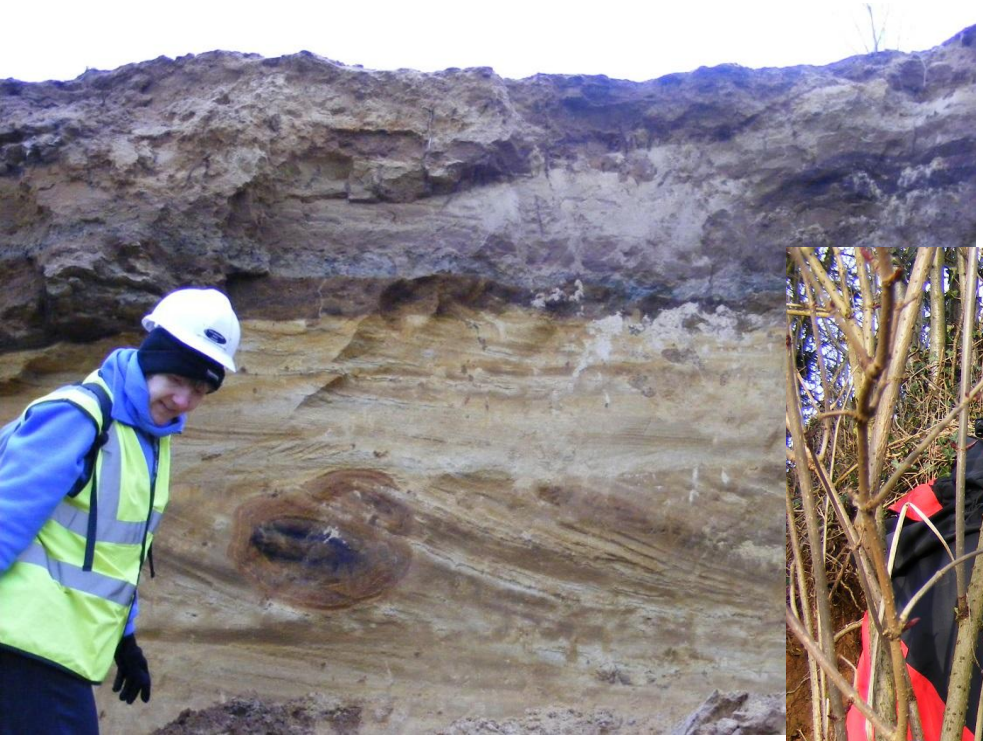
Monitoring



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Geoconservation in Action

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Local Groups

Dorset's Important Geological Sites Group

DIGS

Preserving Our Geological Heritage

Latest News!

- More Conservation October 20, 2016
- Conservation Work at Red Lane, Abbotsbury September 3, 2016
- Community Liaison Meeting – Swanworth Quarry July 15, 2016

Pages:

Events

- Tuesday 8 November

  Meeting on Tuesday 8 November at 7pm at D.W.T. HQ Forston.

- Tuesday 11 October

  Tuesday 11 October conservation session at Crack Lane, Langton Matravers, Purbeck, starting at 10.30 am.

- Saturday 1 October

  Saturday 1 October conservation session at Kingbarrow Quarry, Portland (DWT site) starting at 10.30 am. This is to prepare the site for visit a during the Geologists' Association conference on geological conservation based on Portland Heights Hotel later in the month (21 and 22 October)

Heritage Lottery Fund

Local Heritage *initiative*

Dorset's Geological

Preserv
Geologica

Latest News

- More Conserv 2016
- Conservation Abbotsbury S
- Community L Swanworth Q

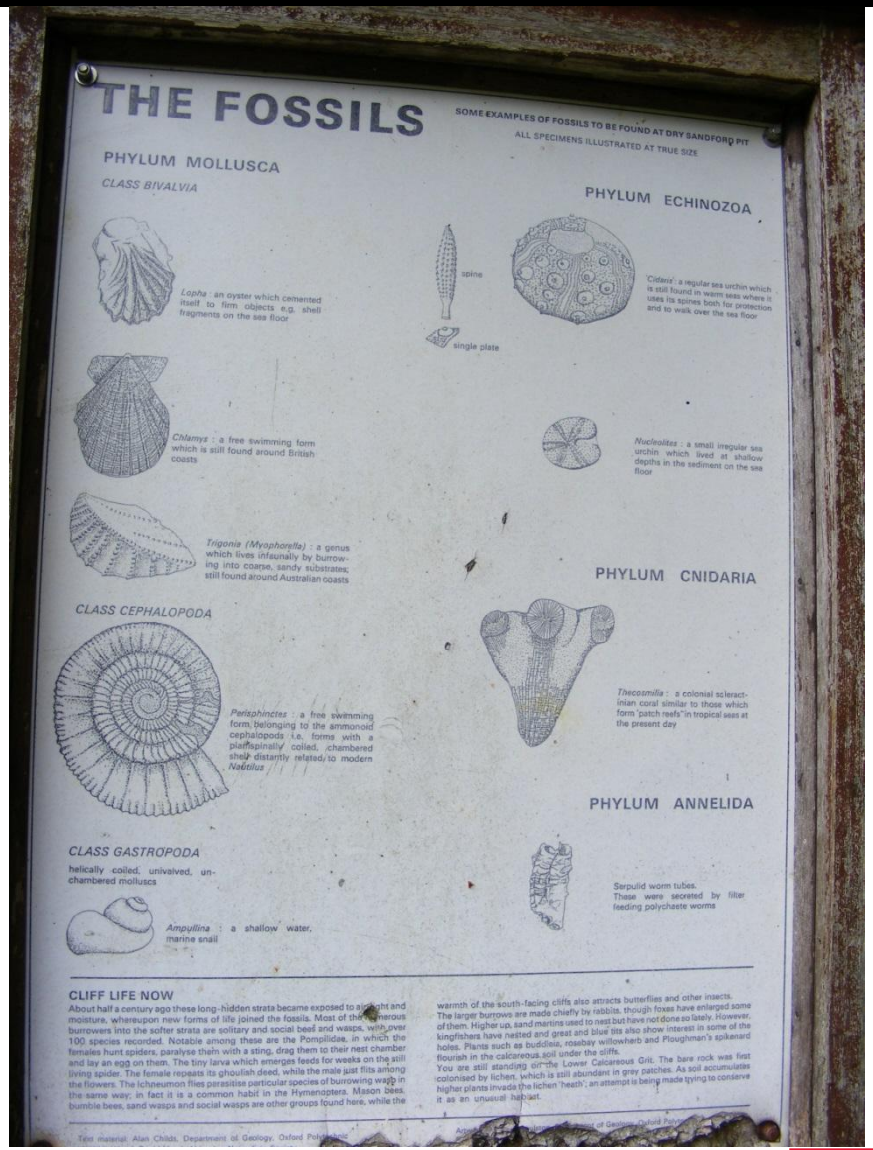
Pages:

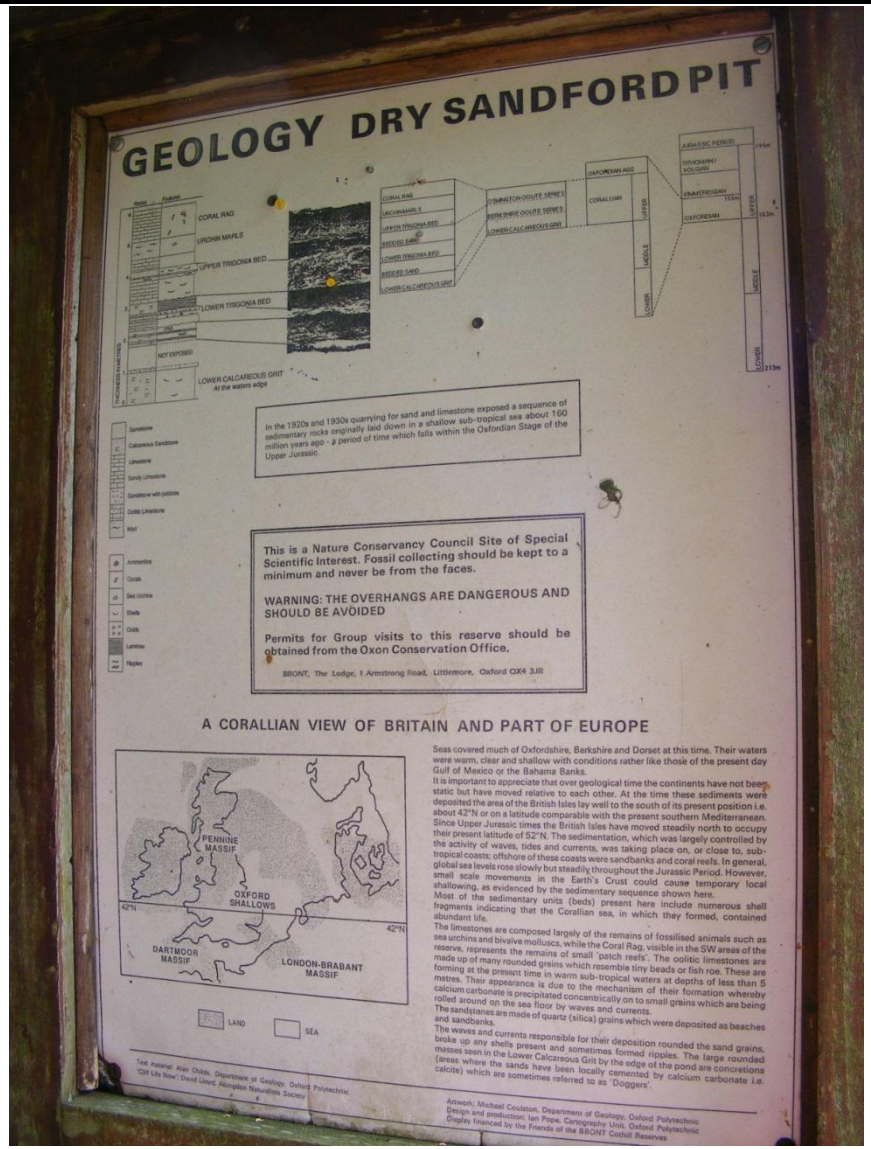
- Join Us
- Events
- News
- RIGS Sites In Dorset
- Publications

ortant
osen on the basis
orical value in the
dscape,
especially in promoting public awareness of geology. To this end some sites have interpretation boards describing the local geology and landscape.

Some members also work with the Dorset Geologist's Association, the Open University Geological Society to lead geological walks and give talks to the general public.

Interpretation (1)





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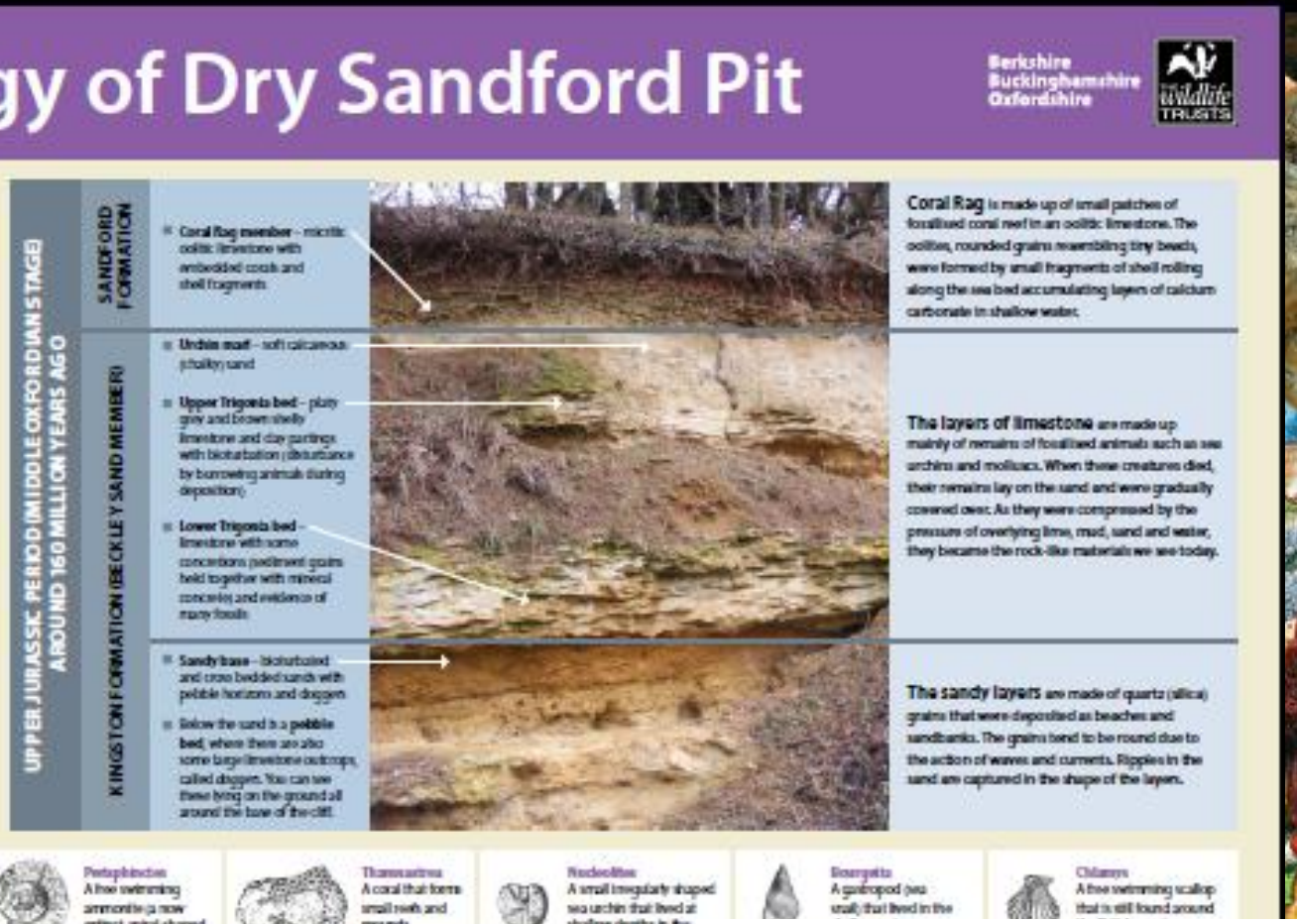
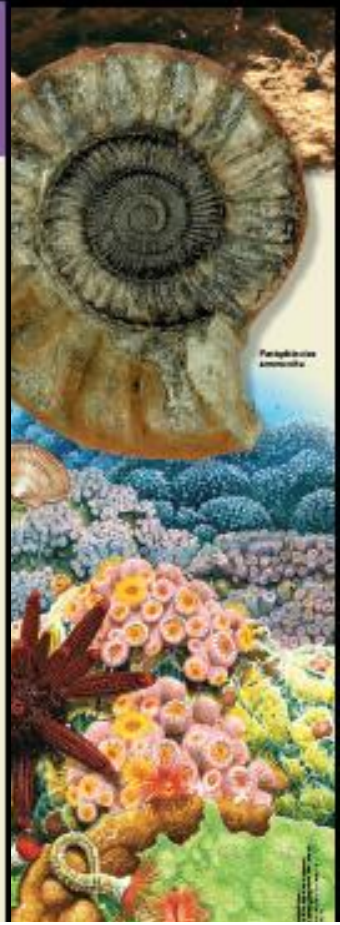
Interpretation (2)





'We cannot take one step in geology without drawing upon the fathomless stores of by-gone time.'
Adam Sedgwick, 1842 in letter to William Wordsworth

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Site investigation

Iron Rich Streams, Barkham

Site Investigation

Part of this area, Rooks Nest Nature Reserve is a Local Geological Site.

Berkshire Geoconservation Group have done several site investigations looking at variation in pH, levels of iron, temperature and conductivity in the streams.

There are many orange streams in this area and although they can look polluted, with a petrol-like film on the surface, they are a result of natural processes. The orange colouration indicates the presence of iron loving bacteria feeding on iron dissolved in the water.

Where does the iron come from?

The geology of the area as well as more recent processes gives rise to the landscapes we see today. The oldest bedrock here is London Clay. It is a marine clay, 56—50 million years old, formed when the area was covered by seawater and contains fossils of bivalves, gastropods and shark teeth. It gives rise to a flat landscape with poorly-drained soils. About 49 million years ago the sea became shallower and sand deposits were formed. These are the sands of the Bagshot Formation and they lie on top of the London Clay. These free-draining sediments give rise to nutrient-poor acidic soils which support characteristic local vegetation types such as oakbeech woodland and heathland. The yellow-brown sands contain iron. Groundwater moves easily through the sands, dissolving the iron salts as it goes, and emerging as springs when it gets to a clay layer which it cannot penetrate. The spring water is colourless at first, but on exposure to air the iron salts are oxidised (a process rather like rusting), colouring the water orange. These particles dissolve less easily and tend to make the water cloudy. They are deposited on surfaces, staining stream beds

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Site Investigation

Hogmoor Field

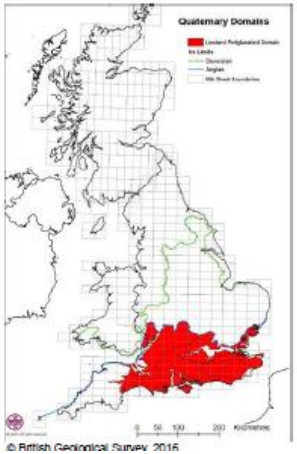
Site Investigation

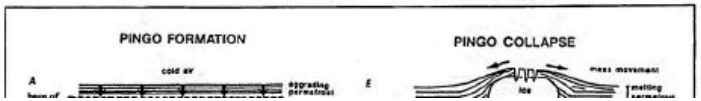
Hogmoor Field is a Local Geological Site in Berkshire.

The site contains several depressions which are often water filled. These depressions relate to periglacial conditions and original formation of a pingo type feature. This has now collapsed leaving several hollows. There is a raised rim to the depressions.

The group wished to learn more about the location of the features and their subsurface profile so carried out one day of field investigation in June 2016.

General view of the site looking south east—this large feature is nearly always water filled.





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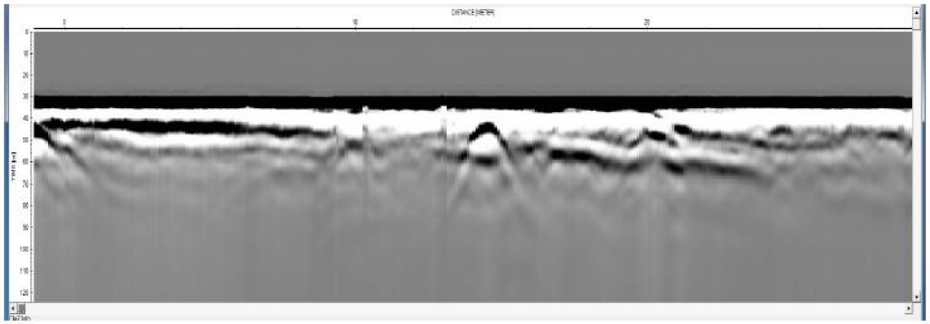
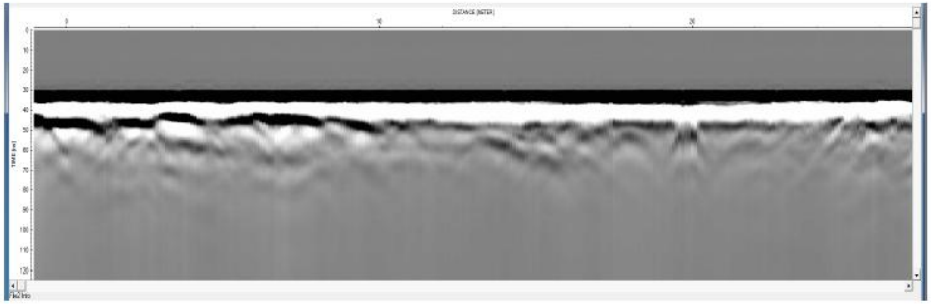
GPR





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Case Study Pincents Kiln SSSI, Reading

This disused quarry provides the best and only remaining permanent exposure of the Tertiary Reading Beds in the area from which they were first described, and is therefore a key locality for study by all those geologists working on rocks of this age in Britain. The Reading Beds at this locality provide evidence that a shallow sea spread over this area some 60 million years ago, before retreating and being replaced by riverine conditions. Within the sands and clays which were deposited in these rivers is found a well preserved fossil flora of higher plants, with a number of species of fossil fruits and seeds which are new to science.

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Pincents Kiln SSSI

Figure 7.18 The
with the bottom

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Pincents Kiln 2

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Rushall Farm (Owl Pit), LGS

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Ditchley Quarry, Charlbury

Ditchley Quarry, Charlbury

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Ditchley

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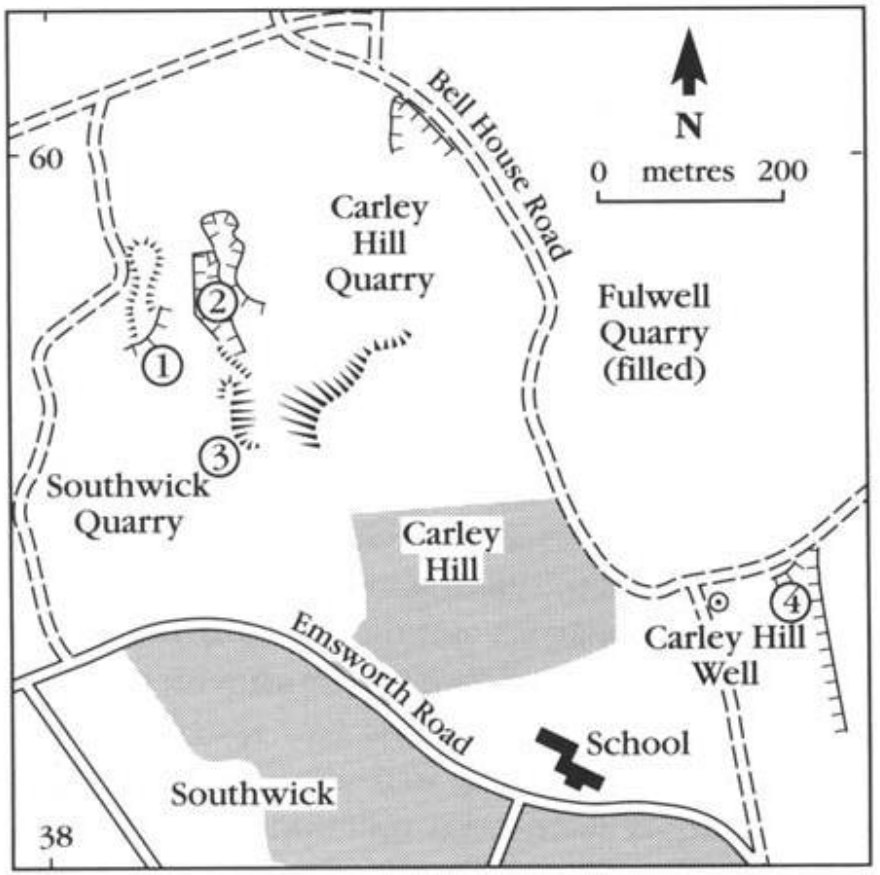
Case Study Fulwell and Carley Hill

- vast complex of quarries in the Concretionary Limestone
- northwestern outer suburbs of Sunderland
- famous for its bewildering array of bizarre calcite concretions
- quarrying started before 1746 and ceased in 1957
- almost all the concretion-bearing beds were removed
- largely for lime burning and building purposes
- much of the output was transported by wagonways to ships on the River Wear, 2 km to the south



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Carley Hill

Scope was to clear back vegetation from faces, removes trees, make safe etc

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Carley Hill

Following clearance the area in front to be grassed over so that it can be easily maintained

Some areas of the face needed to be removed and made safe

Some pieces retained behind a fence at rear

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Carley Hill

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Case Study - Hartlepool Headland LGS

- This site is a Local Geological Site (LGS)
- Designated as it offers and opportunity to study part of the Zechstein cycles of the Permian
- Different to that further north
- Has been described as monotonous thinly bedded magnesian limestone (dolomite)

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Hartlepool Headland LGS

The existing sea defences are in poor condition and the Headland area is under threat if they fail

Proposal
To reinforce existing wall and use rock armour to protect

Problem
How much will this affect the local geological site?

Benefits?

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The existing sea wall

Has been breached in many places and is becoming unsafe

The cliffs are currently protected from erosion by seawall defences. The existing vertical walls on the Headland were constructed between 1855 and 1930 and are formed of large concrete or masonry blocks that have been mortared together. These defences were further reinforced in the 1980s, however some of the sections have since collapsed into the sea. The majority of these sections have been colonised with algae species.

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The survey - When the tide is in …..

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The survey - When the tide is out….

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Compromises and Benefits

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Example of working with others

Developers, industry and business sector

Discovered as part of regeneration of Sunderland North Dock in 1992, this actively forming tufa was incorporated in the new Marina Activities Centre, rather than being removed.

Design modification to the original plans provided a viewing area within the building and stabilising posts to prevent collapse of the tufa which continues to grow today.

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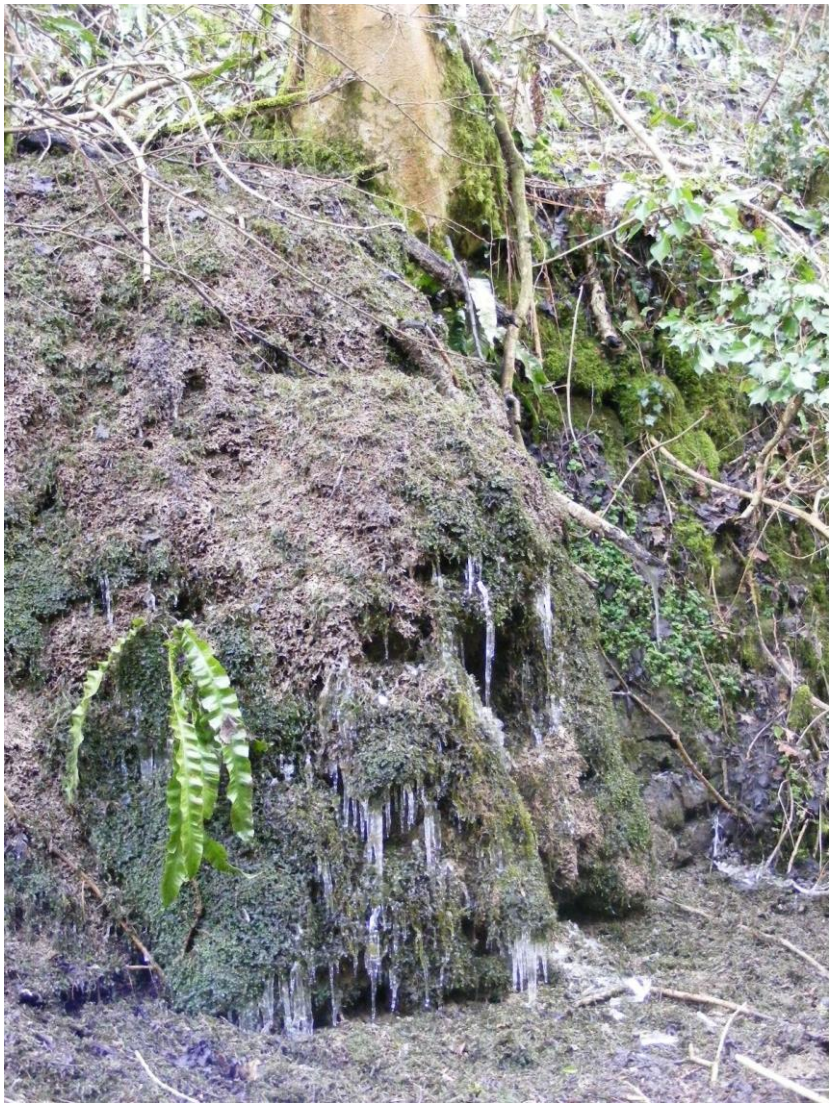
Other tufa examples ….



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Working with people - Rescue Geology

The Queensferry Crossing – Geodiversity in a major infrastructure project

- **Geology important in the siting of the bridge – dolerite and sediments**
- **New road exposure through Carboniferous sediments gained**
- **Instead of the tendency to make road cuts 'safe' with netting or slopes**
- **Good liaison with geotechnical engineers and promotion of good practice**

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Scottish GEODIVERSITY Forum

Elwick – Telling a story
Building Stone Atlas – use of Till as building material

In this image several different types of stone have been used.

Some are local bedrock

Others are from the Till eg the dark ones which are igneous rocks probably from the Whin Sill

A typical wall in Elwick

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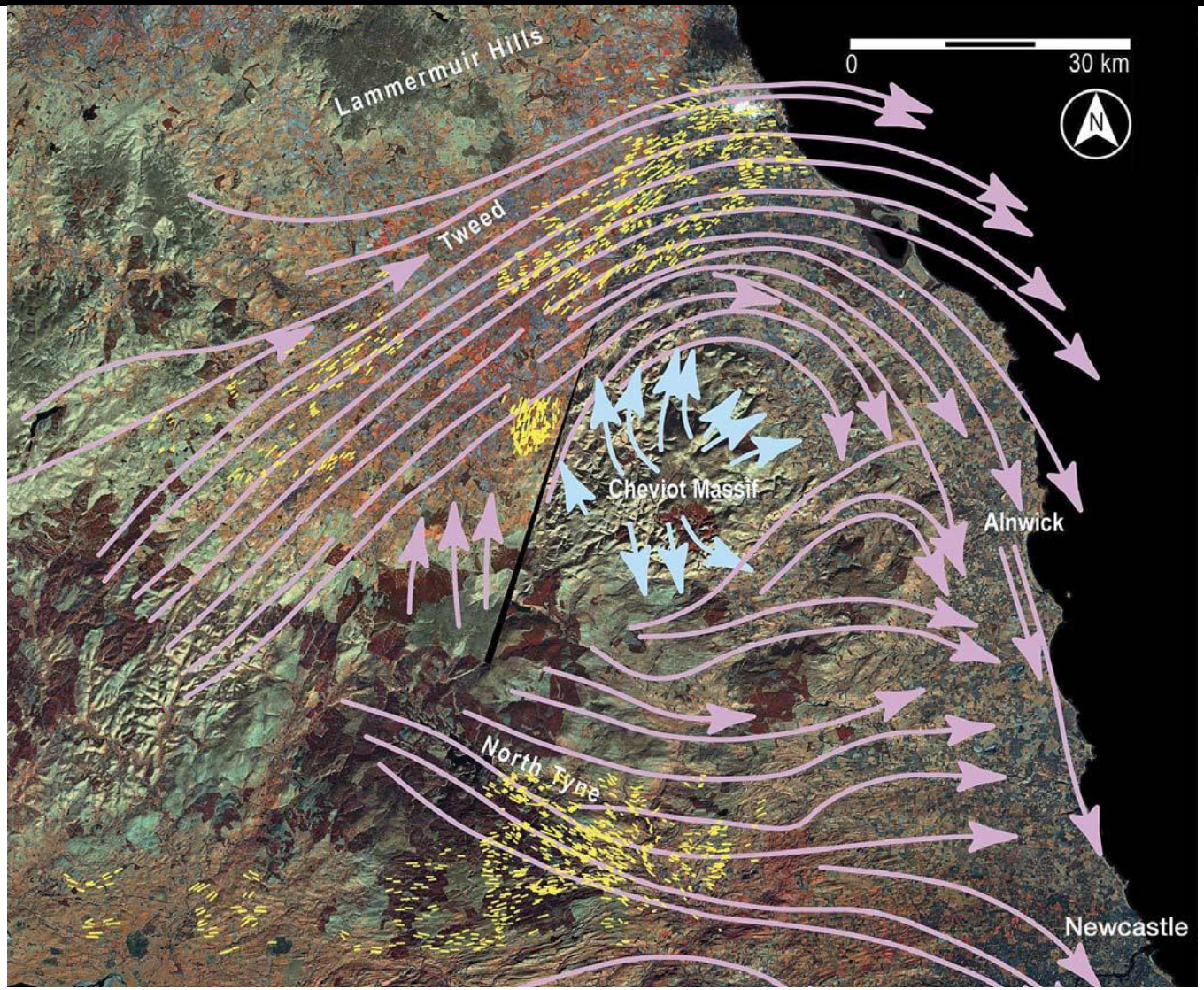
Elwick story - Ice Flow around the Cheviots



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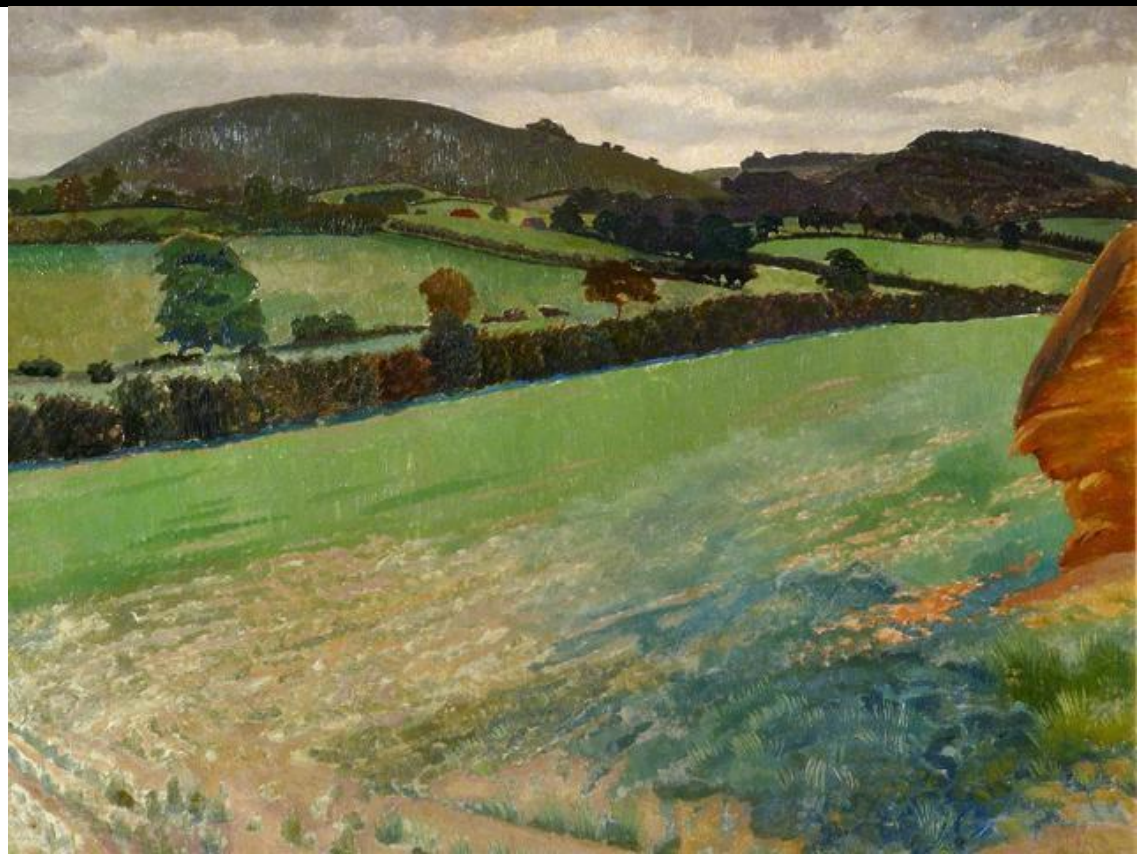
Geologists' GeoConservationUK

Geodiversity as Inspiration for Art and Literature

Chalk of Southern England

Close to Swindon the view from the top of the chalk escarpment influenced Richard Jefferies (1883):

'By the time I reached the summit, I had entirely forgotten the petty circumstances and annoyances of existence. I felt myself, myself.'



Stanley Spencer (1891-1959) spent most of his life in Cookham in the Chilterns but there are several paintings of the North Wessex Downs around Burghclere and Beacon Hill.

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Whin Sill – High Force

Igneous intrusion from 295 million years ago

Underlies much of Northumberland

Used as an aggregate and building

Inspiration for the arts

JMW Turner 1816

Northumbria University NEWCASTLE

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Thank You