

Science

KS2 AT Levels 3-5		
	Sc2 1d	

Geography

KS2 AT Levels 3-6		
1abc,2abcdef,3abcde,4b,6c,7abc		

This topic also has strong links to the National Curriculum in English and ICT

Places to visit

Nose's Point and Hawthorn Dene

Castle Eden Dene
Blackhalls

Links to other sections in this pack

Geology and people 1.4
Magnesian limestone grassland 1.9
The Wooded Denes 1.10

Resources

Books

An Adventure In Time - by Brian Young and Gen Batty - Easington District Council Booklet

Robson's Geology of North East England - G. A. L.I Johnson - Northumbria Natural History Society

Minerals, Rocks and Fossils- Bishop, Woolley and Hamilton - Philips

Websites

www.talkorigins/origins/geo_timeline.html

www.dur.ac.uk follow links to Dept of Earth Sciences (see geology of Durham field trip; also has links to a geological glossary and other information)



At one time or another the place that is now Co. Durham has been subjected to every climate on Earth. This has produced the landscape we now see.

The Earth is approximately 4500 million years old. For much of this time the planet's land surface was a barren, desolate, rocky landscape. The processes that operate now however were also operating then. The present is the key to the past when looking at rocks and the forces at work that have formed our landscape. The processes of erosion and deposition we see now have been operating for billions of years and have helped produce the beautiful coastal landscape of County Durham.

Types of Rock

There are three main rock types: igneous, sedimentary and metamorphic.

Igneous rock

These were the very first rocks to form on Planet Earth as it started to cool. They are formed from the cooling of molten magma from beneath the Earth's surface. Basalt and granite are examples. We have no igneous rocks near the surface on the Heritage Coast.

Sedimentary rock

These are formed when particles of weathered or eroded rocks or remains of dead plants and animals are deposited, often underwater. The layers build up over millions of years and the deeper layers become compacted eventually sticking together to form new rock. Limestone, sandstone and coal are good examples. All of the rocks on the Durham Heritage Coast are sedimentary (with the exception of some glacial erratics, loose rocks which were carried here by ice sheets).

Metamorphic Rock

When igneous rocks or sedimentary rocks are subjected to extreme heat or pressure they can change to produce rock with a new structure and appearance.

Marble is a good example, formed from limestone. We have no metamorphic rock on the Heritage Coast with the exception of the above glacial erratics.

The Rock Cycle

Rocks at the surface are subjected to erosion and weathering. The rock fragments are broken down into smaller and smaller particles which when deposited as sediment will in time form sedimentary rock. In this way all rock is recycled when it reaches the surface.

The Rocks of the East Durham Coast

Over hundreds of millions of years the place that was to become County Durham has drifted upon a tectonic plate through a range of latitudes and so has been exposed to a wide range of climates. During this time the rocks we see today were created.

The Coal Measures

About 310 million years ago we lay on the equator and the landscape was very different. Huge rivers bigger than the Amazon flowed towards us depositing enormous amounts of sediment, creating a vast, flat, tropical swamp covered in forest. As the plants of the forest died they built up a thick layer of dead vegetation which was occasionally flooded and covered with muds and sands from the rivers. This period was known as the Carboniferous. The layers of vegetation became our coal seams as they were compacted by the growing weight above them.

Sandstone

As the tectonic plate we are on continued its journey north, the climate changed, where once was rich equatorial forest was now hot dry desert covered by sand dunes. The sandstone that they formed is present under the rock that now give Durham Heritage Coast its special character, the magnesian limestone.

Magnesian Limestone

The desert became flooded by a warm shallow sea, the Zechstein Sea. Here swam trilobites and ammonites. We even had our own barrier reef offshore made up, not of coral, but of bryozoans (moss animals) the descendants of which can still be found in the waters off our coast. Beacon Hill near Hawthorn Dene is one of these reefs. At the bottom of the sea accumulated an oozy, lime rich mud which became the magnesian limestone we see today. The cliffs all long the Heritage Coast are made up of magnesian limestone usually with a cap of boulder clay.

The period of the desert followed by warm tropical sea was called the Permian and lasted from 295-250 million years ago.

For the next 250 million years no new rocks were formed in East Durham. Rather land movements raised the rocks present into low hills where little or no deposition occurred and probably erosion was the main force at work. We did however continue our northward bound journey on the tectonic plate.

Ice Ages

For the last 2.5 million years Britain has been subjected to a series of ice ages. We are currently in a warm period between ice ages. At times Durham was buried beneath up to one kilometre of ice. As the glaciers melted at the end of each of these periods they left behind a deposit known as boulder clay (glacial till). This is an unstratified mix of all grades of particle size up to pieces of rock and boulders known as glacial erratics.

As the ice retreated torrents of glacial melt water carved deep valleys and gorges into the magnesian limestone. These are our well-known coastal denes such as Castle Eden Dene and Hawthorn Dene.

The coming and going of the ice has also led to big fluctuations in sea levels. The view from the top of Beacon Hill has changed many times over the last 2.5 million years.

Sometimes as far as the eye could see to the east was forest and you would have been able to walk across to Denmark, at other times the North Sea has flooded in and waves have lashed into the magnesian limestone to form the cliffs and caves we see on the coast, oftentopped by a layer of boulder clay left by the retreating glaciers. Remnants of the 8000 year old forest can be seen at very low tides at Hartlepool and Seaton Carew; the stumps are often under 15 metres of water.

The return of the plants and the building of soil

The last ice pack retreated about 12,000 years ago and very gradually as the climate warmed plants started to colonise the bare surface. Initially we would have been surrounded by Arctic tundra with mosses, lichens, some grasses and wild flowers and small ground hugging woody species such as dwarf willow and birches.

As these plants died they added organic matter to the mineral particles left by the ice sheets. Slowly soils developed as the climate continued to warm. They supported the growth of trees such as the pine and birch we still see in northern Scotland. The tree composition of the forest gradually changed with the continually warming climate and the trees we see today along the Heritage Coast such as ash, oak and hazel became the dominant trees.

Deep rich forest soils developed under this tree cover, which once covered the entire area. These rich forest soils are the ones that allowed our early ancestors to settle down in County Durham and start to farm the land rather than simply hunt and gather food from the forest.

Key Concepts

Erosion

Rocks can be worn away by water and by being rubbed by other materials such as sand and pebbles carried in water, wind or ice. This process of wearing away is called erosion and results in pieces being broken off the surface of the rock. By being knocked together and also off the surface of rock, these pieces are made smaller and smaller eventually becoming gravels, sands and muds.

Deposition

Eventually the water or air that is carrying the eroded bits of rock, slows down or stops and when this happens the fragments (sand etc) are dropped. This is called deposition. It is how the sand gets on to a sandy beach or the mud gathers at the bottom of a slow-moving river.

Stratification

When, for example, sand is dropped onto the bottom of a river, it will form a layer. Later on finer mud may come down the river and get laid down on top of the sand. This will form a different layer. You may get more sand laid on top of this, or if a volcano erupts nearby it may be covered with lava. Rocks are formed in different layers like this; the oldest ones are found on the bottom and the youngest on the top.

Soil

Soil is made up of a mixture of eroded rock (mineral) particles, like sand and silt, mixed up with the remains of plants and sometimes animals. As the plant and animal remains breakdown they release plant food. The plant remains also help hold water in the soil if it is sandy. Soil that is good for plant growth has a balanced mixture of both mineral particles and plant remains.

(see also the section under "Wooded Denes" titled "Nutrients Cycles")