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## Landforms

Landforms make up the landscape we see today. Geomorphology is the scientific study of landforms. Landforms provide clear evidence of the processes of erosion and deposition which have shaped the land over geological time. Most landforms are the result of processes which operated within the Quaternary period.

Interpretation of landforms and Quaternary sediments can thus provide evidence of environmental conditions and climatic oscillations in the recent geological past. This includes evidence for the spread of ice sheets in Great Britain. Such information may provide valuable insights into likely future changes as part of studies of global warming.

## Geological SSSIs

In GCR Block "Quaternary of North-East England"

SSSI Name/GCR Name/Grid Reference

Durham Coast/Shippersea Bay Easington [NZ 443 453]

There are a number of large SSSI and NNR areas, such as Moorhouse National Nature Reserve, within which numerous geomorphological features (landforms) can be found. These features benefit from a degree of protection associated with the SSSI but specific site protection is not for the landform.

## Durham County geological sites

Bollihope and Snowhope Carrs [NY 966 367]–[NY 945 355]

Castle Eden Dene [NZ 422 397]–[NZ 440 400]

Ferryhill Gap [NZ 30 34]–[NZ 30 32]

Folly House Glacial Drainage channels, Eggleston [NZ 011 231]–[NZ 027 236]

Hesleden Dene and downstream continuation [NZ 434 388]–[NZ 469 370]

Holwick Drumlins, Romaldkirk [NY 984 227]

Knotty Hills and Hoppyland Kames [NZ 084 319]–[NZ 102 321]

Sacriston Subglacial Channels [NZ 23 49], [NZ 27 49], [NZ 27 45], [NZ 23 45]

Scoberry Bridge to Dine Holm Scar [NY 910 274]–[NY 866 282]

Sharnberry Meltwater Channel [NY 9907 3070]

Sheraton Drumlins [NZ 438 353]

Part of Sheraton Kame moraine [NZ 440 367]

St Johns Chapel Drumlins [NY 875 384], [NY 877 384], [NY 879 384]

Thornley-Kelloe [NZ 349 368]–[NZ 304 383]

Wear River Gorge [NZ 273 426]–[NZ 276 426]

# Landforms in County Durham

The landforms within the county can be divided into several categories based on the processes that formed them.

## Glacial landforms

Landforms produced during stages of the Quaternary when ice sheets covered parts of northern England may be the result of various processes:

### Glacial erosion

This is the removal of rock and superficial material due to the movement of ice. Glacial erosion coupled with the deposition of glacial sediments had an influence on the general landscape and affected the landforms present today. Although Northern England is known to have been covered by ice during several glacial episodes during the Quaternary, the erosion features seen in today's landscape almost invariably result from the most recent, Devensian, glaciation.

### Glacial deposition

This involves the deposition of a varied range of sediments, mainly debris transported by ice sheets and glaciers. Deposition may have occurred beneath an ice sheet, at its margins or at the end of a glacier, or as a result of water released from the ice as it melted.

### Erosion features:

#### Glaciated valleys

These are valleys whose form has been significantly modified by the erosive power of moving ice. Whereas glaciers do not normally create valleys, they are known to be capable of causing substantial changes to the form of an existing valley. These effects include the truncation of spurs and the creation of a characteristic 'u-shaped' profile. Although all the major valleys within the county have been modified by glacial action, the area lacks the spectacular characteristics of the glaciated valleys of the nearby Lake District and the Pennine escarpment.

County Durham includes a number of valleys, which were modified by glacial action, but are today concealed beneath thick deposits of glacial and post-glacial superficial deposits (see Quaternary Deposits).

#### Glacial drainage channels

Also known as meltwater channels, these are channels of variable scale, usually steep-sided and flat-floored, cut by large volumes of water during the melting of ice sheets and glaciers. They may be unrelated to the present drainage pattern. Good examples may be seen at several places within the county such as the channels near Eggleston, Ferryhill Gap, Kelloe, and at Hown's Gill near Consett.

#### Denes

The Durham Denes are conspicuous features of the landscape in the eastern part of the county. These west-east orientated steep-sided coastal valleys are incised through the cover of Quaternary Deposits into the Magnesian Limestone. The 'denes' are in part glacial meltwater channels, cut rapidly by streams flowing to the North Sea at the end of the Devensian glaciation. The distinct morphology of these channels in this coastal area is due to the rapidity of the erosion.

#### Asymmetric valley profiles

A feature of several North Pennine valleys is their markedly asymmetric profile. This reflects strong glacial erosion, or scouring, on one side of the valley, with deposition of substantial spreads of glacial debris on the opposite side. Such valleys thus exhibit a stepped profile on the scoured side, with a much smoother profile on the side covered by glacial

debris. Although this feature can be seen in some valleys in the western part of the county, better examples are seen further west around Alston.

## **Depositional features:**

### **Drumlins**

These are ovoid mounds of glacial debris, mainly till, which were deposited beneath an ice sheet and smoothed into a streamlined shape by the passage of the over-riding ice. The term drumlin is derived from druim, a gaelic term for a mound or rounded hill. Typical drumlins exhibit an extremely distinctive 'half egg' shape. They commonly occur in large groups. The term 'basket of eggs' topography is sometimes applied to areas of well-developed drumlins. Good examples of drumlins are present in Teesdale and Weardale.

### **Crag and tail**

This refers to features formed where a resistant mass of rock has withstood the passage of an ice sheet, thereby protecting an elongated ridge of less resistant rock or debris on the leeward side. Several small knolls, or 'crag', of Whin Sill dolerite are associated with such elongated 'tails' of till in Teesdale.

### **Moraine**

This is a term which was originally used to define the ridges of rock debris that were found around Alpine glaciers. This definition has since been expanded to include the rock debris deposit as well as the landform and is described as morainic drift on BGS maps. Several types of moraine may be recognised. These reflect both their form and the process by which they formed. In the county some landforms have been interpreted as lateral moraines, such as those at the foot of Cronkley Scar in Teesdale, formed as accumulations of debris at the margin of a valley glacier. Hummocky moraine is also present. This is caused by thinning of the ice, possibly during melting of the ice sheet and results in a strongly undulating surface with steep slopes and deep depressions. An area of hummocky moraine is identified between Easington, Elwick and Hart on the east coast of the county.

### **Kames**

These are conical hills, usually composed of stratified sands and gravels, formed from a crevasse filling in an ice sheet, or as accumulations of such materials on the surface of an ice sheet. Undulating kame terraces are found in the Wear lowlands around Durham City.

### **Kettle Holes**

These are often found in the surfaces of kames or moraines. These closed depressions result from the melting of a body of ice that was included within the glacial deposit. They are typically filled with water forming small lakes. In places in the east of the county some kettle holes have been filled with peat.

## **Periglacial features**

These are formed in environments characterised by freeze-thaw action in areas bordering ice sheets.

### **Blockfields or Felsenmeer**

These are accumulations of angular frost-shattered blocks, usually adjoining rock exposures, examples of which can be seen on the ground around Snowhope and Bollihope Carrs, in Weardale.

### **Stone stripes**

Stone stripes and circles are types of patterned ground. They comprise linear or circular accumulations of stone fragments on the ground surface, formed as a result of disturbance of the ground by repeated freezing and thawing.

## **Post-glacial landforms**

These are landforms developed after the retreat of the ice sheets formed mainly during the Holocene period of Earth History. These landforms have also developed through processes of erosion and deposition but are unrelated to bodies of ice and associated meltwaters and are similar to the processes operating today.

### **Incised valleys**

These are river valleys cut deep into the surrounding landscape due to accelerated down-cutting resulting from a lowering of sea level, or an increased volume of drainage during immediately post-glacial times. County Durham includes one of Great Britain's best known and most spectacular examples of an incised meander. The Durham meander on the River Wear is a 30 metre deep incised gorge cut into Coal Measures strata. The present drainage course is very different from the preglacial as the topography was buried and modified by the deposition of substantial thicknesses of glacial sediments, mainly till. The meandering course became fixed when incised into the Coal Measures rocks.

### **Landslips**

These are masses of rock or earth which have moved downhill as a result of the failure of those materials. They may result from the physical properties of the failed materials, or the geological conditions of their occurrence. A great variety of landslide types are recognised, reflecting the nature of the slipped material and the processes which caused the slipping. Small to medium sized landslips are common on valley sides throughout the county, though they may not have been mapped. Several landslips are prominent in the upper slopes of Blunts Dene, Castle Eden.

### **Floodplains**

The part of the river valley that is periodically flooded and built up from sediment deposited by the river both during a flood and when the channel migrates laterally is known as the floodplain. Alluvial deposits of this sort may comprise sediment from coarse gravel to clay grade.

### **River Terraces**

These are part of the river valley that stands above the level of the present floodplain. Terraces develop due to a fall in the sea level, uplift of the land or a change in climate. River terraces are typically composed of sediments comparable to those in alluvial floodplains.

The 'peninsula' at Durham, enclosed by the meander provided a naturally defensive position for the Castle and an imposing site for the Cathedral, a World Heritage Site.

Very similar deeply incised meanders are present in the Derwent valley near Castleside.

### **Solifluxion terraces**

These are small terraces found on hillsides, formed by downhill movement of soil and superficial materials as a result of either seasonal freezing and thawing, or permafrost conditions. They may be difficult to distinguish from gelifluxion terraces.

## **Coastal landforms**

In addition to numerous important exposures of Permian rocks and Quaternary deposits, the Durham coast includes a number of characteristic coastal landforms.

### **Sea cliffs**

Sea cliffs extend almost continuously along the coastline of the county. Typically the cliff profile reflects the nature of the geological deposits exposed. The 'solid' limestones of the Magnesian Limestone generally stand as vertical or near

vertical cliffs. Overlying this, a more gently inclined profile marks the exposure of a variety of Quaternary deposits, mainly till and sands and gravels. Variable erosion along cliff sections has produced a series of bays and headlands that characterize most of the Durham coastline.

It has been estimated that until the beginning of the 20th century parts of the Durham coast were eroding at an average rates of between 2 and 3 metres per year. Progressive accumulation of large volumes of colliery waste, dumped onto the beaches, resulted in a marked reduction in this rate of coastal retreat. With the ending of tipping, and the clearing of much of the accumulated spoil from sections of the coast, erosion rates of between 0.3 to 0.6 metres per year have been predicted.

### **Sea stacks**

These are residual masses of rather more resistant limestone created by the retreat of the cliff line.

Good examples may be seen in the Seaham and Horden areas.

### **Sea caves**

Caves of varying sizes are present within the Magnesian Limestone cliffs at many places along the coast. The Magnesian Limestone is locally extremely variable in its resistance to erosion. Caves are readily developed by wave action where the limestone is highly fractured by collapse brecciation, or adjacent to joints.

### **Natural arches**

These typically develop by the progressive collapse of caves, forming a natural bridge or arch.

### **Wave cut platforms**

These are more or less flat areas of bare rock cut by marine erosion at beach level. Examples include the expanses of Magnesian Limestone exposed on the beach between Hawthorn Hive and Horden Dene, and near Blackhall Rocks.

### **Beach deposits and Storm beach deposits (see Quaternary Deposits)**

## **Wider importance**

The landforms of the county contribute important evidence to the understanding of the Quaternary evolution and geomorphology of Northern England. Study of the morphology and sediments of various landforms may allow the glacial history, including the environmental conditions, climatic oscillations and movement of ice sheets, to be understood.

The incised meander of the River Wear gorge at Durham, which provides the imposing site for the Cathedral and Castle, is well-known and powerful images of this site are recognised worldwide.

## **Threats**

Natural weathering and erosion inevitably modify and ultimately destroy many landforms. Coastal erosion is particularly potent. Deterioration of some landforms, particularly coastal cliffs and sea stacks, may impact upon public safety, and may necessitate remedial action. Advanced erosion of the arch, known locally as 'The Chair', at Blackhall Rocks resulted in the feature becoming unsafe. It was therefore demolished in February 2004.

## **Selected references**

Boulton et al. 1985; Brigland et al. 1999; Burgess and Holliday, 1979; Forbes et al. 2003; Gregory, 1997; Gregory et al. 2002; Huddart and Glasser, 2002; Johnson, 1970, 1995; Johnson and Dunham, 1963; Mills and Holliday, 1998; Mills and

Hull, 1976; Pounder, 1989; Scrutton, 1995; Smith, 1994; Smith and Francis, 1967; Taylor et al. 1971.

## Figures and photographs

(Figure 25) Distribution of major landforms in County Durham.

(Photo 61) Hown's Gill, Consett. A large glacial drainage channel. DJD Lawrence, BGS, ©NERC, 2004.

(Photo 62) Kelloe meltwater channel, Kelloe. Photographed 1960. BGS, ©NERC, 2004.

(Photo 63) Harwood, Teesdale. The River Tees cuts through a large drumlin. B Young, BGS, ©NERC, 2004.

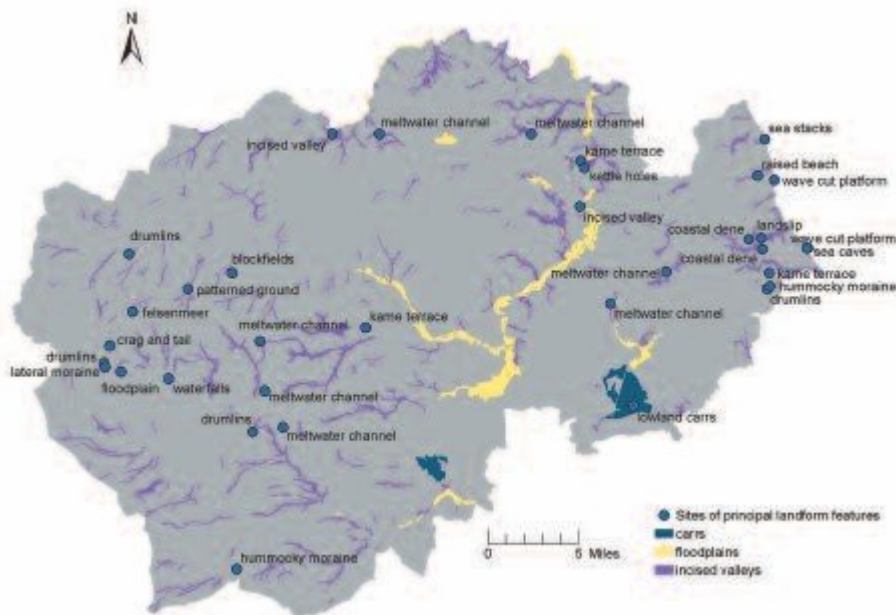
(Photo 64) Cronkley Fell, Teesdale. Morainic deposits mantle the lower slopes. B Young, BGS, ©NERC, 2004.

(Photo 65) The incised meander of the River Wear, Durham City. Aerial photograph by ukperspectives.com.

(Photo 66) The Durham Coast at Easington. Charlie Hedley, ©Countryside Agency.

(Photo 67) 'The Chair', Blackhall Rocks, a natural arch in Magnesian Limestone, immediately prior to demolition for safety reasons in 2004. DJD Lawrence, BGS, ©NERC, 2004.

### [Full references](#)



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