Landforms

Landforms provide clear evidence of the physical processes of erosion and deposition which have shaped, and continue to shape, the land over geological time. Most landforms are the result of processes which operated within the Quaternary Period. The scientific study of landforms is Geomorphology.

Interpretation of landforms and Quaternary sediments can 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 known as the 'last glacial maximum'. Such information may provide valuable insights into likely future changes as part of studies of climate change.

Currently protected sites of landforms within the AONB SSSIs

SSSI Name/GCR Name Grid Ref.

Alston shingle bank/River S. Tyne at Alston Shingle banks [NY 716 441]

Moorhouse & Cross Fell/Black Burn [NY 684 411]

River Nent at Blagill/River Nent at Blagill [NY 744 467]

River S. Tyne and Tynebottom Mine/River S. Tyne at Garigill [NY 739 421]

River W. Allen at Blackett Bridge/River W. Allen at Blackett Bridge [NY 780 540]

Moorhouse & Cross Fell/Cross Fell [NY 687 344]

In addition to the above, the following have been identified as potential GCR sites for fluvial Holocene features:

Lambley, River South Tyne [NY 675 605]

Thinhope Burn [NY 645 535]

RIGS

Bullman Hills [NY 705 372]

High Cup Nick [NY 74590 26227]

Croglin Waterfall [NY 600 481]

Knock Pike–Flagdaw [NY 687 286]

Durham County geological sites

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

House glacial drainage channels, Egglestone [NZ 011 231]–[NZ 027 236]

Holwick drumlins, Romaldkirk [NY 984 227]

Knott's Hole meltwater channel [NY 995 263]

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

Sharnberry meltwater channel [NY 991 307]

St John's Chapel drumlins [NY 875 384]–[NY 879 384]

Other representative sites in the area

Ayle Common, Alston [NY 71 50] Ice-scoured slopes

East of Eggleston [NZ 027 228] Drainage channel

Great and Little Heaplaw, Alston [NY 685 487] Drainage channel

Whitfield Moor, West Allendale [NY 772 528] Drainage channel

Nenthall, Nent Valley [NY 769 452] Asymmetric valley profile

West Allendale [NY 772 528] Asymmetric valley profile

The Eden valley (viewed from parts of the Pennine Way and Cross Fell) — Drumlins

Teesdale valley [NY 853 288] and [NY 860 297] Drumlins

North-east of Watch Hill [NY 631 467] to [NY 633 464] four 'whaleback' drumlins

Seven Hill, Sleightholme [NY 970 106] Hummocky moraines

Fieldhead [NY 581 480] Kames

Busk [NY 610 425] to [NY 611 418] Esker

Mason's Holes, Scordale [NY 755 220] Landslip

Sparty Lea in Allendale [NY 847 485] Landslip

Ouston Fell [NY 762 518] Landslip

Hillbeck Wall End [NY 780 168] Landslip

River Allen between Cupola Bridge and Allenbanks [NY 880 591]–[NY 798 634] Incised valley

River Derwent Gorge at Castleside [NZ 055 491] Incised meander

River Tees [NY 868 280] Floodplain

Whitewalls burn, Ninebanks [NY 776 521] River Terraces

Landforms within the AONB

A variety of landforms may be recognised within the AONB. They can be dividied into several categories based on the processes that formed them.

Glacial erosion is the removal of rock and superficial material due to the movement of ice. Although northern England is known to have been covered by ice during several glacial episodes during the Quaternary, the features seen in today's landscape are mainly the products of processes that operated during the most recent, Devensian, glaciation and subsequent times.

Distinctive landforms related to glacial erosion, recognisable in the North Pennines include:

Glaciated valleys are those 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 a valley's original form. These effects include the truncation of spurs and the creation of a characteristic 'u-shaped' profile. The dramatic valley headed by High Cup Nick provides a good example of a glaciated 'U-shaped' valley.

Buried valleys are the pre-glacial valleys of the modern rivers which are now choked by, and concealed beneath, substantial thicknesses of till and other glacial deposits. The area's most striking example of such a buried valley is clearly visible at Cauldron Snout, where the till-choked pre-glacial valley of the River Tees lies a few tens of metres west of the present river course. The pre-glacial valley of the River East Allen lies a short distance to the west of the present course of the modern River Allen.

Glacial drainage channels, also known as meltwater channels, 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 are commonly unrelated to the present drainage pattern. Many are today dry and devoid of any stream, though some may carry disproportionately small, 'misfit' streams. Within the AONB good examples may be seen on parts of the North Pennine escarpment, in Teesdale and at several places in the Alston area.

Asymmetric valley profiles are a common feature of many North Pennine valleys. The North Pennine landscape is characterised by the stepped appearance of many hillsides, resulting from differential erosion of alternately resistant and less resistant beds of limestone, sandstone and shale. However, erosion by the Quaternary ice sheets has profoundly affected the form of many valleys, creating markedly asymmetrical profiles. These reflect strong glacial erosion, or 'plucking', on one side of the valley, with deposition of substantial spreads of glacial debris, mainly till, 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. The Nent and East Allen valleys are good examples.

Glacial striae, or striations, are grooves or scratches formed on bed-rock surfaces caused by the scouring effect of stones or boulders in the base of a moving ice sheet or glacier. Such striations are commonly exposed beneath sheets of boulder clay or till. Fine examples were formerly exposed beneath till exposed in the eroding sides of a drumlin at Haugh Hill, Upper Teesdale.

Glacial deposition involves the deposition of a range of sediments, mainly debris transported by ice sheets and glaciers. The nature of these Quaternary deposits is discussed above (see Quaternary deposits). Characteristic landforms resulting from deposition of glacial materials within the AONB include:

Drumlins 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. Within the AONB fine examples of drumlins occur in Teesdale, Weardale and in the Vale of Eden. The latter area includes concentrations of drumlins which, immediately beyond the AONB, exhibit typical 'basket of eggs' form.

Crag and tail 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 its leeward side. Within the AONB several small knolls, or 'crags', of Whin Sill dolerite in Teesdale, east of Langdon Beck, are associated with elongated 'tails' of till.

Moraine is a term which was originally used to define the ridges of rock debris found adjacent to 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. Several types of moraine, which reflect both the form and the process by which they formed, may be recognised. In the AONB some landforms have been interpreted as lateral moraines, formed as accumulations of debris at the margin of a valley glacier.

Hummocky moraine is also present. This results from the thinning of the ice, possibly during melting of the ice sheet, and results in a strongly undulating surface with steep slopes and deep depressions. Striking examples of morainic drift occur at the foot of Cronkley Fell in Teesdale.

Kames are steep-sided ridges or 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. Good examples occur at Fieldhead, north of Melmerby.

Eskers are narrow, sinuous ridges, typically composed of stratified sands and gravels formed either at the margin of a melting glacier or ice sheet, or within drainage channel beneath the ice sheet. That at Busk, north of Melmerby, is a typical example.

Periglacial features are those formed in periglacial conditions. The term periglacial is usually applied to the climate, processes and features created by freeze-thaw action in areas bordering ice sheets.

There is evidence that during parts of the Quaternary a few of the very highest points in the North Pennines may have been free of ice and stood up as ice-free peaks, or nunataks. These would have been subject to freezing temperatures and thawing cycles that progressively broke down the rock and caused heave of the ground surface. Examples of the features formed in this environment include:

Blockfields or Felsenmeer are accumulations of angular blocks of frost-shattered rock , usually adjoining rock exposures (see Quaternary deposits above).

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

Gelifluction terraces are small terraces, 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 similar solifluction terraces. Examples may be seen near the summits of Cross Fell, Knock Fell and Great Dun Fell.

Solifluction terraces are small terraces found on hillsides, formed by from downhill movement of soil and superficial materials. They may be difficult to distinguish from gelifluction terraces.

Holocene landforms have developed through processes of erosion and deposition operating since the melting of the last ice sheets.

Incised valleys and incised meanders are deep river valleys resulting from a lowering of sea level, or an increased volume of drainage during post-glacial times. The River Derwent Gorge at Silvertongue is a superb example of a deeply incised meander cut during post-glacial times.

Landslips are masses of rock or earth which have moved downhill as a result of the failure of those on the underlying materials. They may result from the physical properties of the failed materials, or the geological conditions of their occurrence. A great variety of landslip types are recognised, reflecting the nature of the slipped material and the processes which caused the slipping. Mason's Holes in Scordale is a fine example of a large landslip.

Floodplains are 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. Wide flood plains flank the lower courses of the main rivers of the AONB.

River Terraces 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.

Wider importance

Study of the morphology and constituent sediments of the various landforms within the AONB enables interpretation of the history of glacial and post-glacial environments and processes both in the context of the North Pennines and more widely within Great Britain and Europe.

A number of alluvial deposits, including river terraces, in the area have been extensively studied and are recognised as giving important insights into a variety of Holocene fluvial processes. Studies have correlated the influence of mining in the AONB on fluvial systems and allow dating of relevant river terrace deposits. The first British site at which valley floor erosion and major flood events were related to sharp variations in climate is found within the AONB at Thinhope Burn.

Conservation issues

Landforms within the AONB are generally robust features within the landscape. However, more delicate features such as the blockfields and patterned ground on Knock Fell, Dun Fell and Cross Fell have suffered erosion by walkers and have sustained further damage caused by construction and repair of footpaths.

The large landslip at Mason's Holes, Scordale. © B.Young, BGS, NERC

Selected references

Figures

(Figure 51) The Great Whin Sill at High Cup Nick above Dufton on the Pennine Way © Countryside Agency.

(Figure 52) Stone Stripes, Knock Fell. © C. Vye, BGS, NERC.

(Figure 53) The large landslip at Mason’s Holes, Scordale. © B.Young, BGS, NERC.

Arthurton and Wadge, 1981; Burgess and Holliday, 1979; Duff and Smith, 1992; Forbes, Young, Crossley and Hehir, 2003; Gregory, 1997; Huddart and Glasser, 2002; Mitchell, 2007; Pounder, 1989; Mills and Hull, 1976; Stone et al, 2010; Trotter and Hoillingworth, 1932; Waltham, Simms, Farrant and Goldie, 1997.

Full references

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