Dovedale, North Yorkshire

[SE 872 911]

Highlights

The valley fill deposits along Dovedale Griff and Jugger Howe Beck provide important evidence of alluviation and terrace formation that are likely to have been caused by accelerated slope erosion. Wetter conditions during the Atlantic period and the effects of forest clearance since the Mesolithic have been suggested to explain sedimentation in these small headwater catchments of the North York Moors.

Introduction

Together with other palynological and pedological evidence from the North York Moors, the valley fill deposits at these two sites record environmental conditions during the Atlantic period, coincident with known human vegetation disturbance. The sedimentary deposits, palaeochannels and terrace and fan sequences of the two sites exemplify Holocene valley alluviation and the difficulties involved in the explanation of the causes of alluvi-ation. Support for interpretation is derived from organic material from a number of locations within the sites.

Description

The North York Moors constitute a broadly anticlinal Jurassic upland with mean annual rainfall of 700–1200 mm and mean annual temperature of 8–9°C. At the southern edge is an escarpment at 200–350 min the south-dipping upper Jurassic Corallian Sandstone and Oolitic Limestone Series. Northwards is a central core of heather-covered moorland at 300–450 m underlain by middle Jurassic Estuarine Sandstones. Dovedale is in the Corallian Series and Jugger Howe Beck in the Estuarine Series.

In upland catchments, gullies, fans and low terraces of sand and gravel are often attributed to vegetation disturbance (e.g. Crampton, 1969; Harvey *et al.,* 1981). However, upland valleys constitute high-energy sediment sinks in which reworking, removal and replacement of sediment are continually occurring. Furthermore, small headwater valleys are more susceptible to the effects of localized meteorological events, and the marginal nature of upland agriculture may result in more frequent abandonment and re-use. Further data are required before a common pattern of response to human influence can be discerned comparable to that emerging for lowland valleys, and before conceptual models of that response can be evaluated. Although Late Holocene hillslope destabilization may be a common feature in the history of upland valleys, its precise timing and cause may be more variable than is the case in lowland valleys. For example, Iron Age forest burning is invoked as the cause of aggradation in south-east Wales (Crampton, 1969), while overgrazing by sheep is thought to have triggered gully-and-fan development in the Howgill fells (Harvey *et al.,* 1981).

Atherden (1976) has correlated palynological evidence from several bog sites within 10 km of both Dovedale and Jugger Howe Beck, to produce a regional picture dominated by three phases of woodland clearance, each separated by forest regrowth: (1) 2280 ± 120 BP; (2) 1060 ± 160 BP; (3) 390 ± 100 BP.

On the moors, surface erosion is presently very sensitive to the state of the heather biomass. There is evidence of culturally induced hillslope instability and erosion, which might be expected to have influenced the evolution of valley floor sediment storage. Inevitably, however, the history of sediment accumulation and erosion in a relatively high-energy valley floor environment is difficult both to date and to relate unambiguously to causal influences.

Interpretation

Dovedale is a deeply incised north-south-trending valley, cut in the Corallian Series. The 1 m wide Dovedale Griff drains the valley, on the eastern slopes of which are found the tors and free faces of the Bridestones (Palmer, 1956). It joins the east-west flowing stream at Staindale at [SE 8725 9046], on the southern side of the main valley after crossing valley fill sediments. The amplitude of the meander bend 30 m upstream from this junction is increasing as the Dovedale Griff incises into the fill, and migrates laterally; bank collapse is evident at the apex (Richards, 1981). Here it has exposed sub-fossil wood at the base of the bank. The wood includes oak driftwood and, apparently, *in situ* stumps of willow and alder. An alder stump is dated at 6200 BP. Fluvial gravels approximately 1.5 m thick have accumulated above the wood (Richards, 1981).

The stratigraphy (Figure 6.40) consists broadly of two units. At the base, at the present stream elevation, is a unit consisting of the sub-fossil wood in a mixture of sand, pebbles and clay lenses which appears to be a slough deposit. Three samples of 50 sandstone pebbles from the upper unit show significant differences between the two coarser outcrops in this unit: the median intermediate axis lengths were 37, 38 and 43 mm. The fluviatile (rather than colluvial or solifluvial) origin of the pebbles is suggested by their rounded edges and imbricated structures. The observed directional properties suggest that deposition by a prior Dovedale Griff is more probable than by Staindale stream. The Holocene sediments burying the dated wood correlate with the terrace within Dovedale, which itself represents the remnants of alluviation probably associated with the slope erosion which formed the Bridestones (Palmer, 1956).

The valley floor sediments are fluvial sands and gravels underlying three distinct small-scale terraces with traces of palaeochannel on their surfaces (Figure 6.41). At the junction of Dovedale and Bridestone Griffs, a west-bank gully has deposited a pronounced alluvial fan which has experienced dissection and renewed deposition. The outer fan correlates morphologically with the upper terrace surface, and the inner fan of coarser sediment grades to the middle terrace. The multiple terrace sequence and hypothesis of basal stream rejuvenation together suggest that complex response mechanisms may have been significant in Dovedale, in addition to environmental disturbance.

Although the available evidence indicates that sedimentation in Dovedale occurred in the Late Holocene, it is sufficient to associate this unambiguously with human impact, to pinpoint the ages of the three terraces, to relate them to successive causal influences, or to define the cessation of the valley filling.

Further evidence of environmental disturbance and catchment instability is provided by a small peat bog at the head of Bridestones Griff, where 2.6 m of peat rests on a broken and weathered bedrock surface. Similar small bogs occur in hollows on the watersheds nearby, and all show evidence of disturbance such as sandy inwash layers, charcoal and cereal pollen, with low percentages of arboreal pollen at the base. Basal dates for the Bridestones Griff bog suggest that the peat accumulation began, presumably in association with increased runoff and waterlogging, about 1500 years ago. Peat accumulation appears to postdate the main Iron Age deforestation, and is considerably more recent than the date of initiation of valley filling implied by the buried alder stumps at the valley mouth.

The problem of interpreting morphological development can be illustrated using the Dovedale terraces. A terrace surface is a morphological discontinuity, the upper limit of an aggradation phase, but this does not mean that the process creating the terrace is inherently discontinuous or non-linear. However, change in floodplain elevation is a continuous variable when integrated over sensible time periods.

The interpretation of small multiple terraces, as the product of a complex response to a single external stimulus, usually involves downstream control by base-level change (Born and Ritter, 1978), as envisaged by Palmer (1956). This is then followed by coupling of main and tributary streams, with tributary sediment supply steepening the main valley fill gradient, until renewed incision is triggered. However, the response of the valley floor to hill-slope erosion, which is evidently more important in Dovedale with its active hillslope scars and upper slope tors, requires a different conceptual model. If sediment supply is delivered directly to narrow headwater valley floors from adjacent hillslopes, areal rather than linear sources, then after basal rejuvenation the downvalley reaches receive accelerated sediment input before the upvalley ones, and the mechanism for floodplain steepening which then triggers renewed downcutting is less obvious. Under such circumstances, and more generally when there is catchment-wide control of the erosion processes, it may be more appropriate to interpret valley fill development as a continuous response to varying hillslope conditions.

The reach of Jugger Howe Beck is at and below the entrance of the right bank tributary, Hollin Gill, a narrow and deeply incised stream with unstable bare hillslope scars and no floodplain development. A low-angle fan of coarse, flaggy, angular sediment exists at the junction, and at least two palaeochan-nel alignments are visible on its surface (Figure 6.42). The fan is clearly a compound feature, and intensely podzolized soils on its surface suggest that its general structure may be Late Devensian or Early Holocene in age. The main valley floor has a well-defined floodplain, with degraded marginal terraces and meander scars at the base of the hillside.

One palaeochannel alignment on the Hollin Gill fan is now intersected obliquely by the present channel, and organic-rich clays succeeded by angular gravels have been deposited in the palaeochannel. The dates correspond with that defining the Viking-early Medieval vegetation disturbance seen in the fen bogs, 5 km to the west, and the nature of the Hollin Gill catchment suggests that rapid response to such disturbance was likely. Thus there is evidence of a phase of sedimentation in an abandoned channel on the existing fan surface, during a period of known vegetation disturbance. Nevertheless, evidence of more continuous floodplain sedimentation rates would be more useful than such a discrete episode.

Two hundred metres downstream from the Hollin Gill junction there is a small peat bog on the right-bank floodplain surface of Jugger Howe Beck. This is one of several such bogs, some of which are associated with palaeochannels and are now spring-fed. This bog appears to have been more extensive, since peat outcrops as a continuous layer in the river bank for about 10 m downstream, having been exposed by lateral migration, bank undercutting, and compensatory bank-attached bar growth opposite.

Evidence from Jugger Howe Beck supports and complements the evidence from Dovedale. Maximum ages of 1150 years BP and 260 years BP are indicated for two soils in Jugger Howe and Hollin Gill Becks. These suggest that the middle Dovedale Terrace is likely to have a maximum age of around 1500 years BP.

Episodes of rapid sedimentation evident in the bank exposure ((Figure 6.40), units B and D) are replicated in the stratigraphy of a core taken from the centre of the bog, as are the peats forming units A and C. The site therefore provides evidence of more general floodplain accretion. Floodplain sediments and soils exposed in the river bank upstream towards Hollin Gill junction display similar buried organic horizons and immature surface soils.

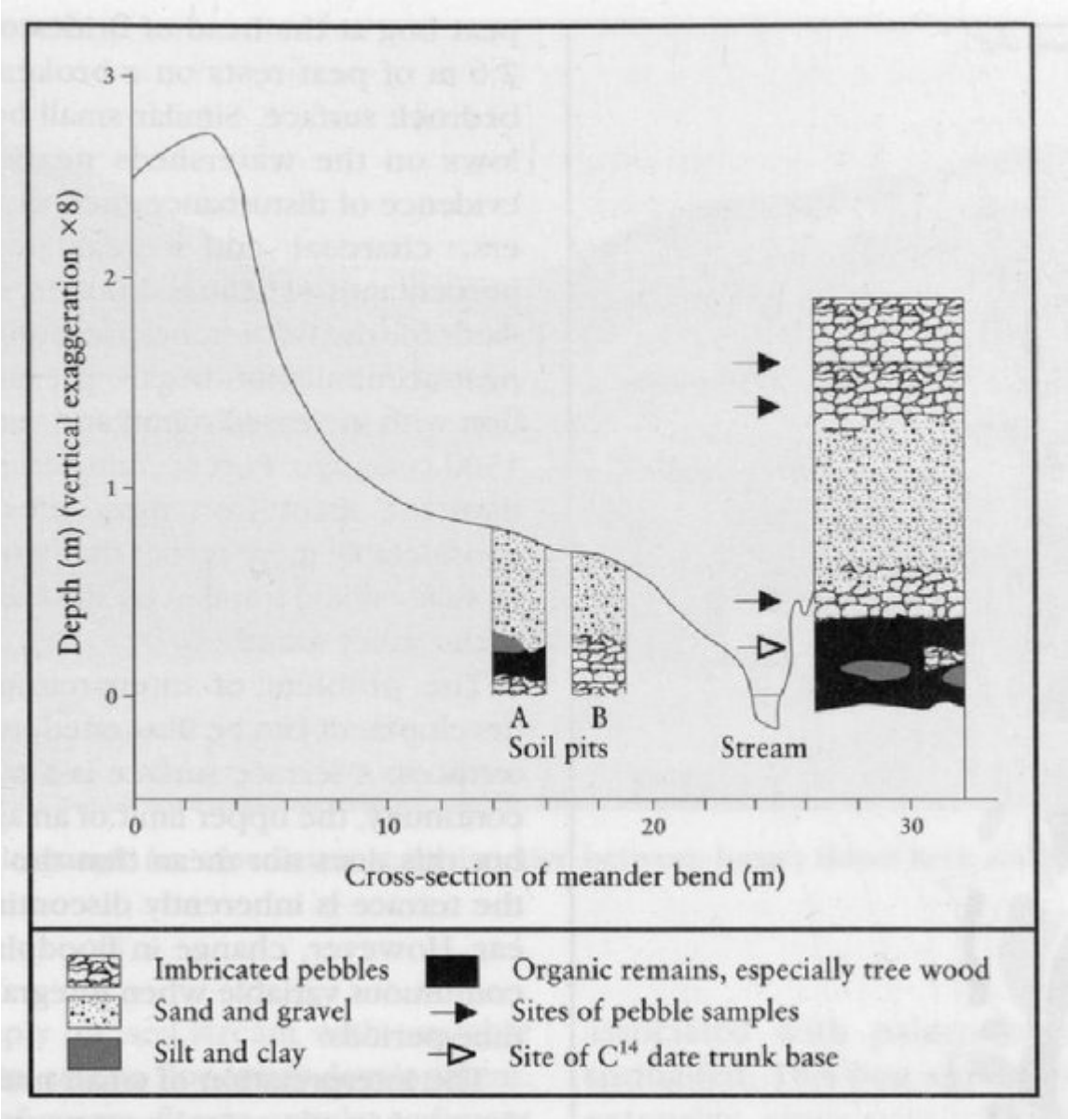
The evidence for rapid phases of sediment accumulation and floodplain development from this site appears to coincide with the last and very rapid vegetation disturbance evident in the regional pollen diagrams at about 250 years BP. This is associated with significant development of moorland management practices involving heather burning, which Imeson (1974) has shown strongly accentuate sediment delivery from the hillslopes today. Results indicate that 1 m of floodplain accretion occurred over about 50–100 years.

Evidence of slope erosion correlates with the indication of alluviation provided by the Dovedale site, although these deposits do not permit inference of the time span over which sedimentation occurred.

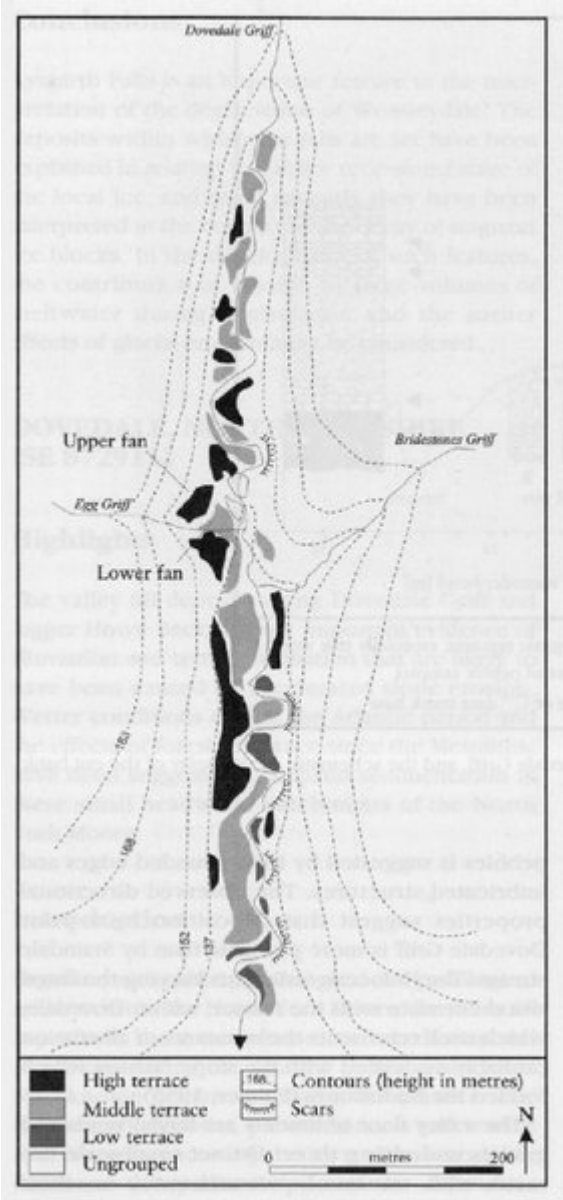
Conclusions

Until recently there have been comparatively few sites at which the Holocene history of landform development has been related to phases of human activity. At these two sites, valley fill morphology and sedimentology have been dated and related to archaeological evidence to link human vegetation disturbance with sediment movements within the catchments. They represent rare cases in which the human impact on upland valley sedimentation has been investigated and show similar patterns of response to those that have been found in lowland Britain. The geomorphological features of interest in the sites also include alluvial fans, palaeochan-nels and multiple terrace sequences.

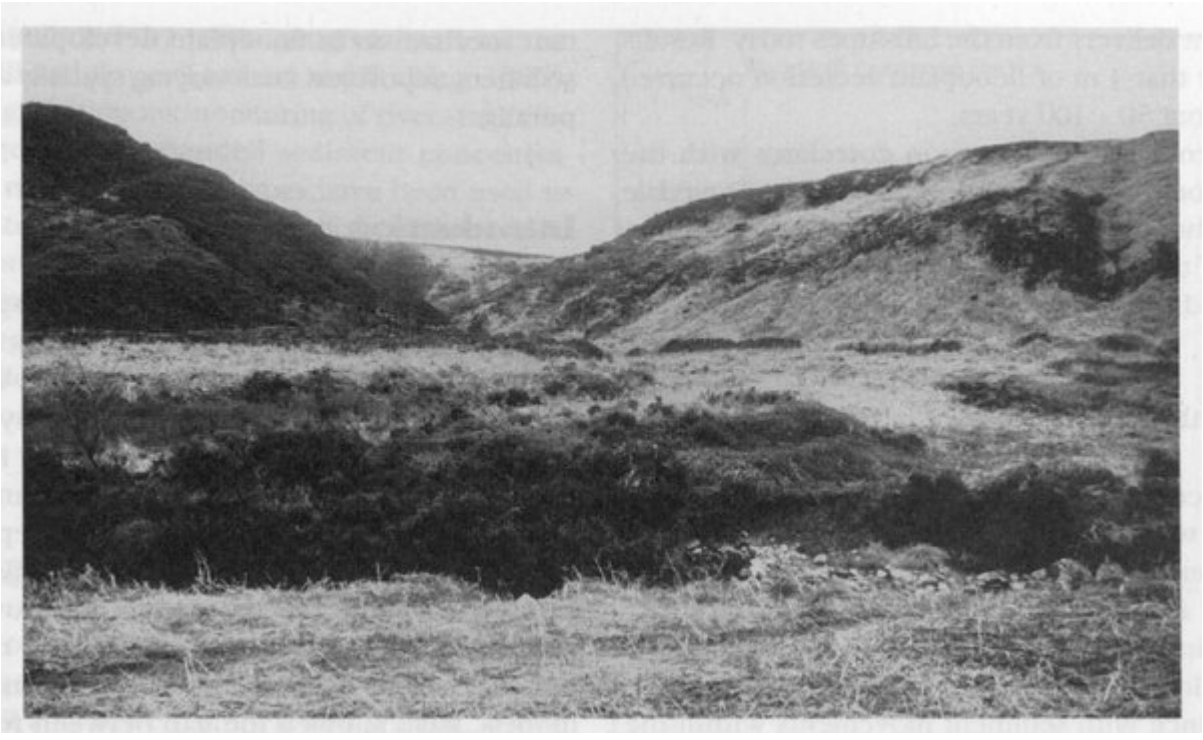
References



(Figure 6.40) A cross-section of the meander bend on Dovedale Griff, and the schematic stratigraphy of the cut bank deposits. (After Richards, 1981.)



(Figure 6.41) Dovedale: a morphological map of the terrace and fan fragments based on air photograph analysis and field survey. (After Richards, 1981.)



(Figure 6.42) The low-angle fan of sediment at the junction between Jugger Howe Beck and Hollin Gill. (Photo: R.J. Davis.)