Langdale and Bowderdale valleys, Howgill Fells, Cumbria

[SD 678 977] — [NY 675 021]

Highlights

These valleys include Holocene alluvial fans and terraces, and meandering and braided channels (Figure 4.11). Features resulting from the effects of a major storm in 1982, which had a recurrence interval in excess of 100 years, are represented by channel changes and alluvial fan and cone deposition.

Introduction

The Langdale and Bowderdale valleys of the northern Howgills are important localities for fluvial geomorphology on two counts: (1) the sequence of Late Pleistocene and Holocene terraces, and Holocene alluvial fans and debris cones; (2) the modern fans and channel systems, especially as affected by the major 1982 flood, an event with a return period in excess of 100 years. The area formed part of Marr and Fearnsides' (1909) study of the drainage evolution of the Howgill Fells and was included in Hollingworth's (1931) study of the effects of glaciation in the same area. In a general sense, the area is described by King (1976). No other studies of the Holocene fluvial landforms were made until recent studies at the University of Liverpool, of the Holocene landform sequence (Harvey *et al.,* 1981; Harvey, 1985a,b, 1992b,c; Miller, 1991), and of the dynamics of the modern fluvial system, especially its response to a major flood event (Harvey, 1985a,b, 1986, 1987a, 1991; Wells and Harvey, 1987).

The area continues to be studied today by the Liverpool group. One recent PhD thesis (Miller, 1991) is based on this area.

Description

As in most other parts of the Howgill Fells, glaciation appears to have ceased with the decay of the Devensian regional ice sheet at *c.* 14 500 BP. Only at Cautley, south of Bowderdale, is there any evidence of (undated) later persistence of glaciation. The Late Pleistocene saw periglacial processes effective throughout the Langdale/Bowderdale area, with screes developing on the steeper slopes, as on Langdale Knott in Langdale, and on Hooksey and near Thickcomb in Bowderdale, and stone stripes and garlands formed on the slopes of Hooksey in Bowderdale. There are several arcuate hollows on the north-east facing slopes of Westfell, Bowderdale which may be nivation features.

Elsewhere, as throughout the Howgills (Harvey, 1985a), the hillslopes are clad with soliflucted glacial sediments which form gently sloping solifluction terraces towards the base of the valley sides. There is a large area of moulded drift terrain near Woofler Gill in Bowderdale.

The Holocene landforms are cut into the periglacial forms and comprise a sequence of low stream terraces, hillslope gullies, and alluvial fans and debris cones (Figure 4.12) and (Figure 4.13). As in other Howgill valleys, at least one major wave of hillslope gullying and tributary junction alluvial fan/cone formation occurred during the later part of the Holocene. Most gullies and fans/cones are now largely stabilized. Gully systems are well-developed in the Langdale headwaters at West, Middle and East Grains and in the numerous small tributaries to both Langdale and Bowderdale Becks. Major alluvial fans or debris cones occur along the middle section of Langdale and at a number of locations in Bowderdale. Several show multiple surfaces, and their included sediments range from debris flow deposits in the smaller cones to fluvi-atile gravels in the larger fans (Harvey, 1992b,c). A study of the Holocene soil and geomorphic sequence includes a radiocarbon dated Holocene pollen sequence for Bowderdale, and has developed a regional correlation between the Holocene soil sequences in Bowderdale, Langdale, Blakethwaite and the established sequences in Carlingill (Miller, 1991; Harvey *et al.,* 1984).

Prior to 1982 there had been little recent hills-lope erosion or fan deposition. Most of the hillslope gully forms had long been stable, with only a few at the valley heads showing modern ero sion. Only one fan showed any signs of recent deposition. The river channels were dominantly single-thread, locally meandering channels. Most had been largely stable since the 1948 aerial photographic cover. As elsewhere in the Howgills, the alluvial stream channels in Langdale and Bowderdale are of two types: narrow, single-thread, often meandering, relatively stable channels, draining catchments of relatively low coarse sediment input; and wider, often multithread, unstable channels downstream of major zones of coarse sediment input (Harvey, 1987a, 1989, 1991). Prior to 1982 most of the Langdale and Bowderdale streams were of the first type. Only locally, at very few sites, were the channels over the threshold between the two types.

On 6 June 1982 a major storm occurred, with at least 70 mm of rain falling in about 2 hours over the Langdale and Bowderdale catchments; the storm was estimated to have a return period in excess of 100 years (Harvey, 1986). The geomorphic effects were spectacular. Slope failure occurred on many hillsides, often re-activating formerly stable gullies, and supplying large volumes of very coarse sediment to the stream system. Major deposition took place on 13 debris cones and alluvial fans, in some places completely burying the older forms. Major channel changes occurred at a number of reaches in the two valleys, involving a threshold jump from the single-thread stable to the multi-thread unstable regimes (Harvey, 1986, 1987a). Fresh valley floor sediments and the juxtaposition of old and new channels are evident at many sites along the two valleys. Since 1982 new single-thread channels are developing as the flood channels are abandoned, so the system is returning to 'normal', a process taking place at a rather faster rate in Bowderdale than in Langdale (Harvey, 1991).

Interpretation

One site at Langdale has allowed a radiocarbon dated environmental reconstruction of the main period of hillslope gullying, from sediments, pollen and mineral magnetic evidence (Harvey *et al.,* 1981). Two radiocarbon dates from this site (Harvey *et al.,* 1981), several from Blakethwaite on the Langdale/Carlingill drainage divide (Miller, 1991; Harvey, 1992c, 1996), and several from Bowderdale (Miller, 1991) suggest that the major Holocene period of erosional/depositional activity in these valleys was *c.* 1000 BP. This appears to have been a regional phenomenon, with a similarly timed phase in the Bowland Fells to the south of the Howgills (Harvey and Renwick, 1987).

The response to the 1982 flood provided evi dence of how an upland fluvial system may respond to disturbance and of the mechanisms of alluvial fan/debris cone deposition. Wells and Harvey (1987) made a study of the alluvial fan and debris cone sediments, deposited by the 1982 flood, identifying four major sedimentary facies. Four fans are of particular importance in that they represent dominance by each of these facies types covering the gradation between true debris flows and fluviatile deposits. True debris flows dominate Thrush Gill fan (Langdale); stony debris flows/transitional deposits (interpreted as deposition by hyperconcentrated flows) dominate Lodge Gill fan; fluvial cobble and boulder bar deposits dominate Leath Gill fan; and fluvial sheet gravel deposits dominate Hazel Gill fan, (the last three sites are all in Bowderdale). The controls over the sedimentary facies deposited by the 1982 flood (Harvey and Wells, 1987), are similar to those over sedimentary facies forming the 10th century AD alluvial fans and debris cones (Harvey, 1992b,c).

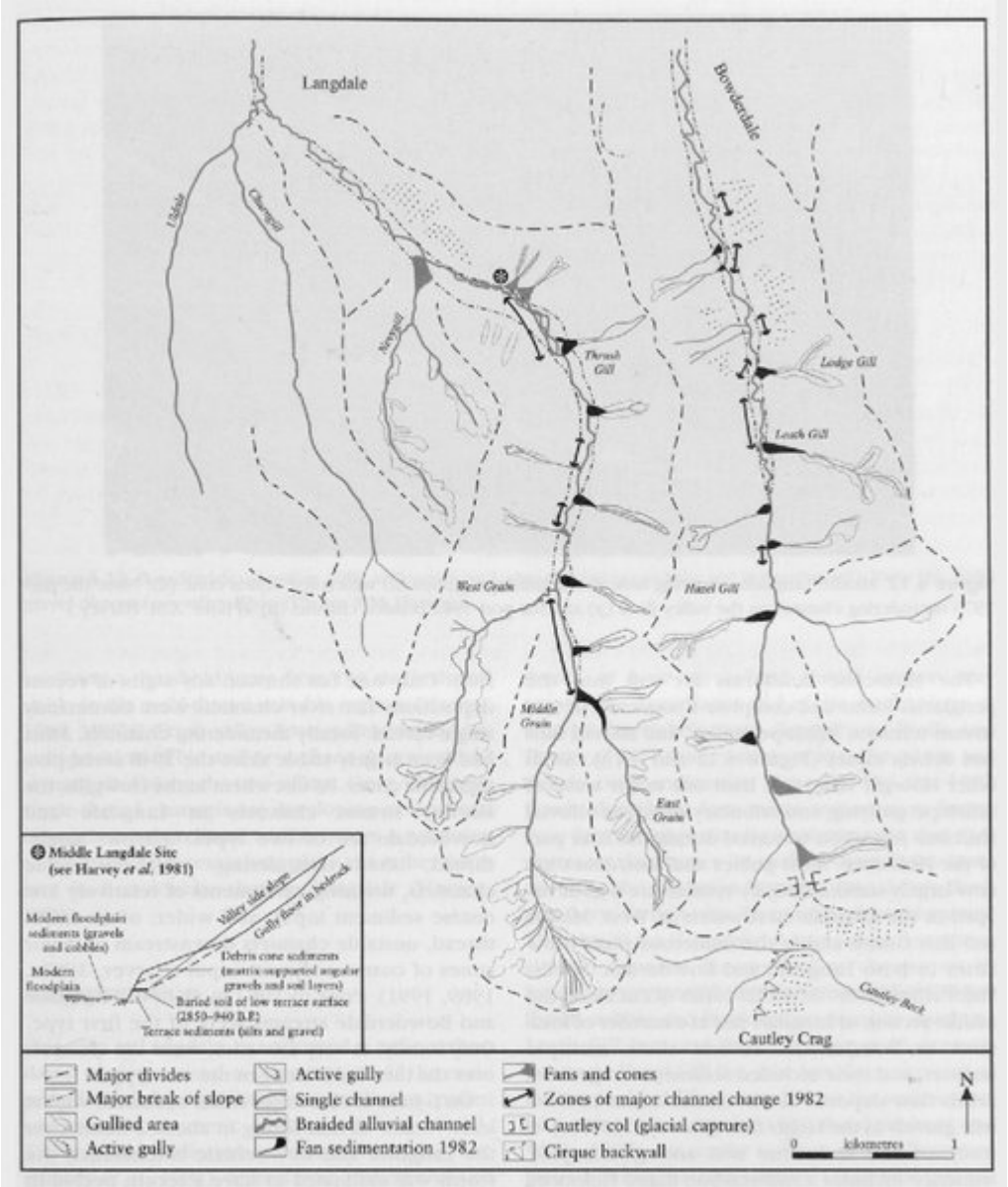
The Langdale and Bowderdale valleys are important for fluvial geomorphology for two reasons. Firstly, they preserve an excellent record of the Holocene upland fluvial sequence, characteristic of the Howgill Fells and possibly other areas of northern Britain, particularly in the well-developed gully systems and associated alluvial fans. Secondly, the 1982 flood has created an important and documented suite of contemporary alluvial fan deposits, and provides an example of flood-induced threshold exceedence between channel pattern types. Furthermore, the area has experienced very little direct human impact and represents as near a 'natural' upland fluvial system as can be found in northern England. Analysis of the impacts of extreme events is important in evaluating their role in landform development and in understanding the mechanisms of change in the landscape.

Conclusions

The Langdale and Bowderdale valleys represent important Holocene and contemporary fluvial localities, exhibiting an excellent suite of Holocene hillslope gullies and alluvial fans and providing a field example, rarely documented or

preserved so well, of flood-induced channel change about a major threshold, and recovery from that flood.

References



(Figure 4.11) Langdale and Bowderdale geomorphological map. The inset shows stratigraphic relationships of the dated sediments in Middle Langdale. (After Harvey et al., 1981.)

(Figure 4.12) Middle Langdale, showing now stable hillslope gullies (h) which fed debris cone (d). Note the pre-1970 meandering channel on the valley floor (p) and the post-1982 braided channel (b). (Photo: A.M. Harvey.)

(Figure 4.13) Bowderdale, showing 1982 sediments on Lodge Gill fan (s) and the old fan surface (f). Note the 1982 gravel deposits on valley floor. (Photo: A.M. Harvey.)