Carlingill Valley, Howgill Fells, Cumbria

[NY 625 005]–[SD 656 988]

Highlights

This site includes features associated with stream capture, namely waterfalls and incised gorges. In addition, there are Late Pleistocene and Holocene stream terraces, and Holocene hillslope gully systems and alluvial fans. The modem fluvial system is represented by active badland-type gully systems, and braided and single-thread cobble/gravel-bed streams (Figure 4.8).

Introduction

The Carlingill valley is of exceptional importance for fluvial geomorphology, exhibiting a wide range of spectacular landforms related to the development of the fluvial system over three main timescales: (1) long-term (Pleistocene) development through river capture; (2) Holocene terrace, hillslope gully and alluvial fan formation; and (3) the adjustment of the modem channel system to sediment supply from currently active hillslope gullies. All have been the subjects of considerable research.

Some important early studies (Marr and Fearnsides, 1909; Hollingworth, 1929, 1931) related the capture of the Uldale headwaters by Carlingill to the regional development of the drainage pattern and glaciation during the Pleistocene; more recent summaries are given by King (1976) and Harvey (1985a).

The Howgill Fells in general and Carlingill in particular have become key areas in understanding the Holocene fluvial sequence in upland Britain (Harvey, 1985a,b). Cundill (1976) studied the vegetation sequence at Archer Moss and Carlingill, and one of his radiocarbon dates allows a major post-Roman phase of alluvial fan formation to be identified. A 10th century AD phase of gully erosion and fan deposition has been confirmed by radiocarbon dates from other parts of the Howgills (Harvey *et al.,* 1981; Harvey, 1985a) and by radiocarbon dates from a soil and sediment sequence at Blakethwaite, at the head of Carlingill (Miller, 1991; Harvey, 1992a, 1996). The Blakethwaite site complements the Holocene soil and geomorphic sequence in Carlingill itself (Harvey, 1985b; Harvey *et al.,* 1984).

Carlingill is also a key site for the understanding of the dynamics of modern upland fluvial systems. Gully erosion rates have been monitored at Grains Gill for over 25 years (Harvey, 1974, 1987a,b, 1992a), and continue to be monitored at Grains Gill and in Carlingill (Harvey and Calvo-Cases, 1991; Harvey, 1994). Coupling between hillslope sediment supply and the channel, as well as rates of channel change have been studied at these sites (Harvey, 1977, 1987a, 1989, 1992, 1994, 1997; Harvey *et al.,* 1979, 1984). Studies of Holocene sequences, soils and contemporary erosion and deposition continue, mainly by a group from the University of Liverpool.

Description

Within the Carlingill valley there is an exceptional range of upland fluvial landforms related to longer-term (Pleistocene), Holocene and contemporary timescales.

The longer-term (Pleistocene) development.

During the Late Pleistocene, probably associated with ice or meltwater, strike-aligned upper Carlingill captured the Great and Little Ulgill headwaters of Uldale Beck. The features associated with these captures include the open col at Blakethwaite at the beheaded end of Uldale, the elbow of capture on Great Ulgill, and the deep 'canyon' section of upper Carlingill, with spectacular waterfalls at The Spout and Black Force. In the field these features are beautifully clear and provide an excellent example of drainage adjustment to structure, by stream capture, albeit driven by glaciation. The gentle profile of the beheaded stream of upper Uldale near Blakethwaite, and those of the upper portions of Great and

Little Ulgill Becks, contrast with the steeper profile of Carlingill, especially in the rock-cut canyon reach at the capture site. These landforms provide the context for geomorphic development during the Late Pleistocene and Holocene.

The Late Pleistocene and Holocene Sequence

The Devensian ice sheet had probably melted from this area by *c.* 14 500 BP, and there is no evidence in the Carlingill area of any late stage readvance. Rather, the Late Pleistocene is represented by periglacial forms, which include extensive screes above the 'canyon' reach of the valley. These have locally remained active during the Holocene as the result of continued incision at their base. Elsewhere the lower parts of many of the hillslopes are blanketed by soliflucted glacial till, which forms extensive valley-side solifluction terraces. There are good exposures of these deposits in the middle reaches of Carlingill valley (Harvey *et al.,* 1984).

The Holocene valley floor landforms are inset below the Late Pleistocene solifluction terraces and include a suite of Late Pleistocene to Holocene river terraces, again especially well developed in the middle reaches of the Carlingill valley (Figure 4.8) and (Figure 4.9), where a soil chronosequence has been established to differentiate between upper and lower terraces and the modern valley floor (Harvey *et al.,* 1984). Grading into the younger terraces are Late Holocene debris cones and alluvial fans. They are particularly well-developed at Grains Gill and at Blakethwaite, as well as in the middle reaches of Carlingill valley. At Grains Gill a radiocarbon date on buried organic sediments established the main phase of sedimentation as post 2000 years BP (Cundill, 1976) and at Blakethwaite (Figure 4.8) a series of radiocarbon dates establishes and confirms a 10th century AD date for alluvial fan formation (Miller, 1991; Harvey, 1992b, 1996). These findings accord with work elsewhere in the Howgills (Harvey *et al.,* 1981; Miller, 1991), and in the Bowland Fells to the south (Harvey and Renwick, 1987).

The fans and cones were fed by a system of erosional gullies cut into the soliflucted glacial sediments. These have since stabilized and are preserved as fossil gullies. They are well developed in Upper Grains Gill, Small Gill, Great and Little Ulgills, and at Blakethwaite.

The modern fluvial system

Three types of channel characterize the modem fluvial system: (a) rock-cut channels in the 'canyon' reach of Carlingill, and also downstream of the Howgill Lane bridge; (b) narrow, single-thread, often meandering, relatively 'stable' channels; and (c) wide, often multi-thread, unstable channels. The 'stable' channels occur in valleys with little contemporary gully erosion or active hillslope sediment supply, whereas the unstable channels occur downstream of major sediment supply points or active gullies (Harvey, 1977, 1987a, 1989, 1991; Harvey *et* al., 1979).

The bedrock channels in the 'canyon' reach and below Howgill Lane bridge are steeply profiled with rapids and waterfalls. They are narrow, with little chance for sediment storage.

The channels in parts of Carlingill away from point sources of coarse sediment, and in some of the tributary valleys which drain catchments without active gullying (Harvey, 1991) have narrow single-thread stable alluvial channels.

At Grains Gill, modem active gullies of 'badlands' type dissect older 'fossil' gully systems, and supply large quantities of sediment to the stream system (Figures 4.8 and 4.10). Rates of erosion, gully development, and the coupling between gully and stream system have been monitored at this site since 1969 (Harvey, 1974, 1977, 1987a,b, 1992; Harvey *et al.,* 1979). Erosion rates measured are amongst the highest recorded in the UK (*c.* 40 kg m^{-2} yr^{-1}; Harvey, 1974). The channel of Grains Gill downstream of the gully site is an unstable braided cobble and boulder-bed channel (Harvey, 1989).

Another set of active gullies in the Carlingill valley itself (Figure 4.8), representing three stages of gully development related to three degrees of coupling with the main channel, is currently being monitored (Harvey, 1994; Harvey and Calvo-Cases, 1991). Near these gullies and further upstream, where Carlingill Beck receives coarse sediment from gullies, scars and tributary streams, the channel is locally braided and unstable (Harvey, 1991, 1997). Recent channel change has been monitored and the evolution of the valley floor over the past century has been recorded through lichenometry (Harvey *et al.,* 1984; Harvey *et al.,* 1997).

At Blakethwaite, recent re-activation of formerly stabilized gullies has caused renewed sedimentation on Blakethwaite alluvial fan. This is an excellent example of a small Holocene alluvial fan, with good sections through the (radiocarbon dated) fan deposits. The recent dissection has created a classic alluvial fan morphology with a small fanhead trench to an intersection point in mid-fan with current unconfined distal aggradation below.

There is no evidence of sustained aggradation on the main channel of Carlingill, nor on Grains Gill, despite the high rate of sediment supply to the fluvial system from active gullies. Indeed, during floods the lower reaches of Grains Gill flush away the bulk of the sediment supplied by modem gullying. That sediment reaches a small fan at the confluence of Carlingill and the River Lune.

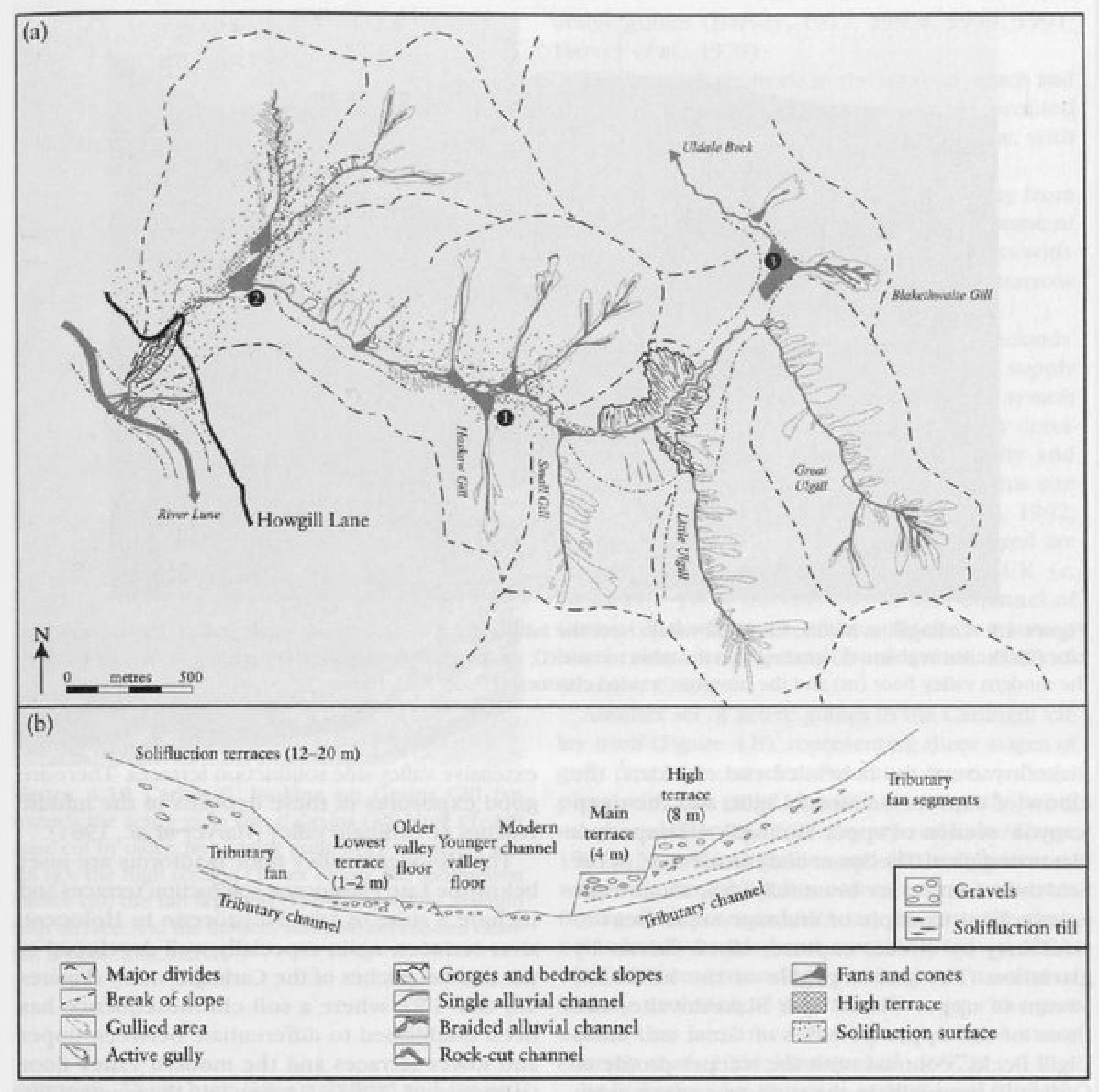
Interpretation

The Carlingill valley contains an exceptional range of upland fluvial features which relate to three main timescales: the Pleistocene, the Holocene and contemporary processes. The area is open semi-natural grassland and, apart from changes in grazing pressure, both during Holocene deforestation and at the present day, there is and has been no major direct human impact on the fluvial system. This is as near a 'natural' upland fluvial system as exists in England. Furthermore, the area has been the subject of intense study, especially by the University of Liverpool, over the past 25 years, in the contexts of both the Holocene sequence and the contemporary fluvial system. Four areas within the valley are of exceptional importance: (i) Blakethwaite (gully system and alluvial fan, important for both Holocene and contemporary studies); (ii) the 'canyon' reach of upper Carlingill (important for the longer-term development of the drainage system); (iii) the middle Carlingill reach (important for the Holocene terrace and fan sequence, and modern braided channel behaviour, (Figure 4.9)); and (iv) Grains Gill (the full range of Late Pleistocene, Holocene and contemporary landforms are present here, with gully/fan and gully/channel relationships exceptionally well shown; (Figure 4.10)). Each of these sites complements the others within the context of the Carlingill valley system as a whole. Features and sequences of deposits have been dated, thus enabling the changes, chronology and interrelationships to be understood more fully. Each of the assemblages of landforms would be distinctive and rare in their own right, but their combination makes this a very valuable site. It has become very important for the degrees and dynamics of coupling between slopes and channels.

Conclusion

Carlingill contains an outstanding assemblage of Late Pleistocene, Holocene and contemporary upland fluvial features. It is important for contemporary studies of Holocene geomorphology and modern processes in relatively undisturbed upland environments. It includes features produced by river capture, exposures of Pleistocene deposits, Holocene slope and channel forms, an alluvial fan with dated stratigraphy, active gullies and recent channel changes.

References



(Figure 4.8) Carlingill: (a) geomorphological map. (After Harvey, 1992.) (b) Stratigraphic and geomorphic relationships of features in middle Carlinghill. (After Harvey et al., 1984.)

(Figure 4.9) Carlingill, in Middle Carlingill valley. Note the hillslope cut by older, now stable gullies (h); the high terrace (I); the fan segment (f) grading into the main terrace (t); the younger fan segment (y) grading to the low terrace; the modern valley floor (m) and the unstable braided channel. (Photo: A.M. Harvey.)

(Figure 4.10) Carlingill, looking up Grains Gill fan towards the active gully site at Grains Gill. Note the hill slope cut by older, now stable gullies (h); the active gullies (g); the high terrace (P set below the solifluction surface (s); the fan segment (f) grading into Carlingill main terrace; and the modern unstable cobble-bed channel. (Photo: A.M. Harvey.)