Thornsgill and Mosedale

[NY 355 235], [NY 381 242]

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Introduction

Thornsgill and Mosedale Beck, in Cumbria, are north-flowing tributary streams of the River Glenderamackin (Figure 4.4). They incise up to 30 m into Quaternary deposits and Skiddaw Slate bedrock and occupy the southern flank of a broad glaciated trough, the Vale of Threlkeld, along which ice moved from west to east during the Devensian glaciation. In the region of Mosedale ice was moving to the north-east (Figure 4.5).

Although no site displays the full stratigraphy, numerous exposures in Thornsgill and Mosedale (Figure 4.6) reveal a sequence of deposits associated with three glacial events of pre-Devensian, Devensian and Loch Lomond Stadial age and referred to as the Thornsgill, Threlkeld and Wolf Crags formations respectively (Table 4.3). The relationship between the tills of these three formations is shown in (Figure 4.7). The primary interest in the site has been the unique sequence of glacial deposits and evidence for severe weathering of the lower, Thornsgill Till, forming what has been referred to as the Troutbeck Palaeosol (Boardman, 1985c). In recent years interest has turned to the sequence of fluvial terrace deposits in Mosedale; which have been interpreted as a response to a Loch Lomond Stadial snow-melt-related event (Rose and Boardman, 1983) or, from age assessment and soil development evidence, a late Holocene episode (Smith and Boardman, 1989).

Description

The Thornsgill Till is a glacial diamicton containing erratics from the west. At all sites it is severely weathered so that its original texture, clast composition and colour is difficult to establish. At Caral Gully (Figure 4.6) the till is 14 m thick and severe weathering occurs throughout its depth. At some sites the degree of weathering diminishes toward the base where relatively unweathered till is exposed, whereas at others the upper horizons of the weathered profile have been removed by subsequent glacial erosion and incorporated into overlying till as sheared blocks and weathered clasts. On the east side of Mosedale Beck (Figure 4.6) about 3 m of till overlies bedrock. The weathered zone here shows a downward decrease in intensity and textural variability, together with clast angularity, which suggests that the till has suffered frost shattering and reworking under periglacial conditions. In the weathered portion the matrix appears largely to be a response to in-situ chemical breakdown of mudstone, volcanic and granitic clasts, with many of the volcanic clasts heavily pitted and bleached. The weathering profile in the till is identified as the Troutbeck Palaeosol (Boardman, 1985c) (Figure 4.8).

In Mosedale Beck (Figure 4.6), a thin compressed peat bed overlies the Thornsgill Till and is itself overlain by reworked till and terrace gravels. Plant pollen and macroscopic plant remains (dominated by willow) are described by Boardman (1981). The cellulose fraction of Salix twigs from the peat gave a radiocarbon date of >54 200 years BP (SRR-2316) and two samples using the uranium-series dating method gave ages of *c.* 77 000 ka and 91 ka (Gordon and Andrews, pers. comm.). The peat bed is tentatively ascribed to an early Devensian interstadial or the end of the last (Ipswichian) interglacial.

The Threlkeld Till is found over most of the north-eastern Lake District. It generally forms the ground surface and on low ground drumlins are the characteristic landform (Figure 4.6). Its geographical distribution and relationship to other deposits and landforms implies that it is the till of the last major regional glaciation (Late Devensian). Its character varies with bedrock but in the Mosedale area it contains erratics from the central Lake District and from the Threlkeld microgranite outcrop, 3 km to the west. The Threlkeld Till stratigraphically overlies the Thornsgill Till but between the two, and overlying the weathered palaeosol, are sequences of unweathered gravel, of probable proglacial origin. The junction between the palaeosol and the gravels is erosional, and at a higher level, blocks and clasts from the palaeosol are

incorporated into the Threlkeld Till.

The Wolf Crags Till underlies the moraine ridge fronting Wolf Crags corrie. The till is a bouldery diamicton, oxidized in its upper part. Beyond the moraine, in the main Mosedale Beck valley, are two gravel terraces; the upper of which, 4 m above present stream level, grades into the moraine. The lower comprises large boulder bars, truncated soils and abandoned channels, indicative of a large recent event (Carling, 1997).

Interpretation

The development of a weathering profile, the severity of which diminishes towards the base, demonstrates that the Thornsgill Till was weathered *in situ.* The presence of friable clasts also argues against transport of weathered material to the site. Two possible explanations have been put forward for its survival.

1. Parts of the outcrop lie within a buried bedrock valley that runs at right angles to the direction of Devensian ice movement, and therefore it was protected from erosion by subsequent ice movement (Figure 4.5).
2. Devensian ice in the Vale of Threlkeld may have been cold-based and therefore non-erosive, at least until a late phase of lower ice velocities and sediment deposition.

Whichever explanation is correct, the Thornsgill Till undoubtedly pre-dates the late Devensian glacial stage, as the peat that overlies it is dated to the early Devensian or Late Ipswichian. The depth and character of the weathered zone in the till, the Troutbeck Palaeosol, however, suggests a long period of temperate weathering and contrasts with relatively shallow soil profiles on Holocene deposits. It is tentatively suggested that a period of perhaps 100 000 to 150 000 years of temperate conditions is required to develop the Troutbeck Palaeosol. This is likely to have included Oxygen Isotope Stages 5, 7 and 9 (Boardman, 1985c, p. 257). The age of the Thornsgill Till therefore must pre-date this age assignment.

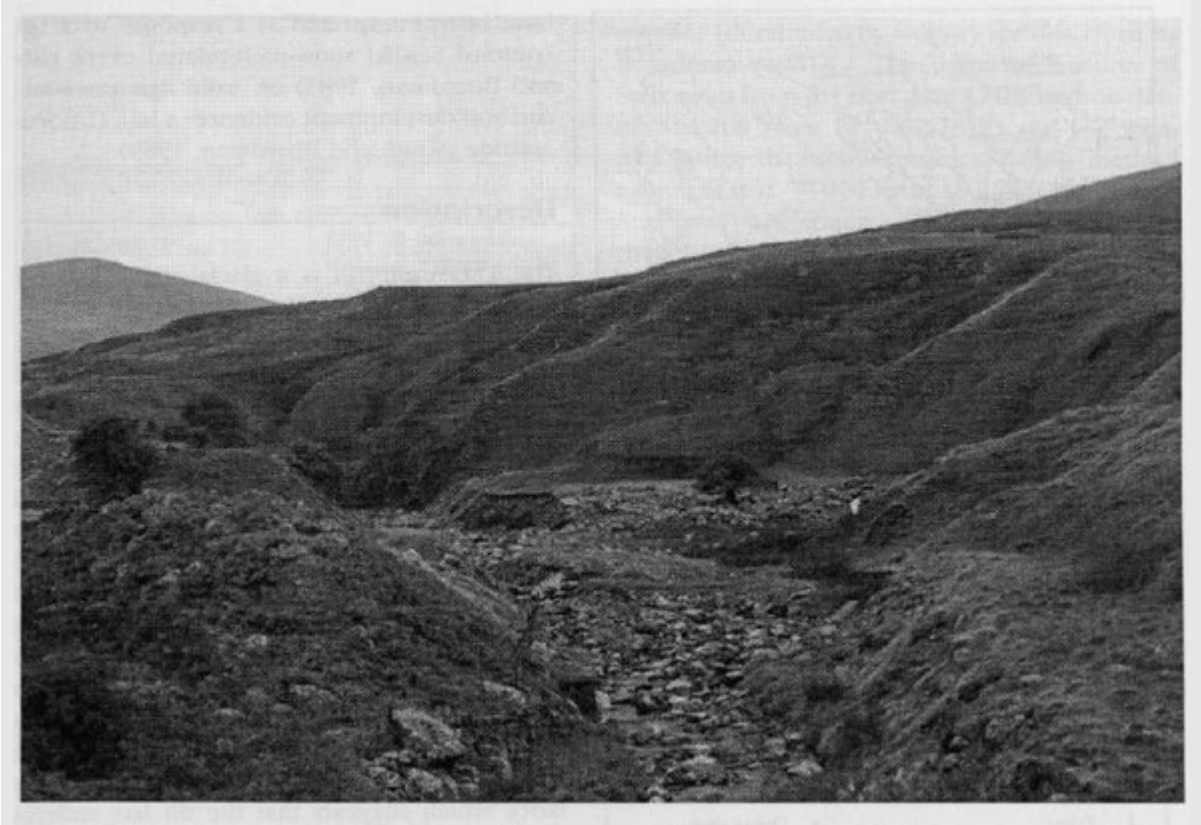
There is little doubt about the age of the Threlkeld Till as this is regionally well known and equivalent to other locally named units associated with the late Devensian ice sheet. (Figure 4.9) Quaternary landscape evolution in the Mosedale area: a reconstruction (after Boardman, 1985a).

The stratigraphical relationships suggest that the Wolf Crags Till, and the outwash deposits of the higher terrace fronting the moraine, relate to the reoccupation of the corrie during the Loch Lomond Stadial. The lower terrace therefore must be Holocene. Analysis of soil characteristics of this terrace suggests that this is recent (Smith and Boardman, 1989, 1994) and documentary evidence describing a large flood in the area in August 1749 provides a possible candidate.

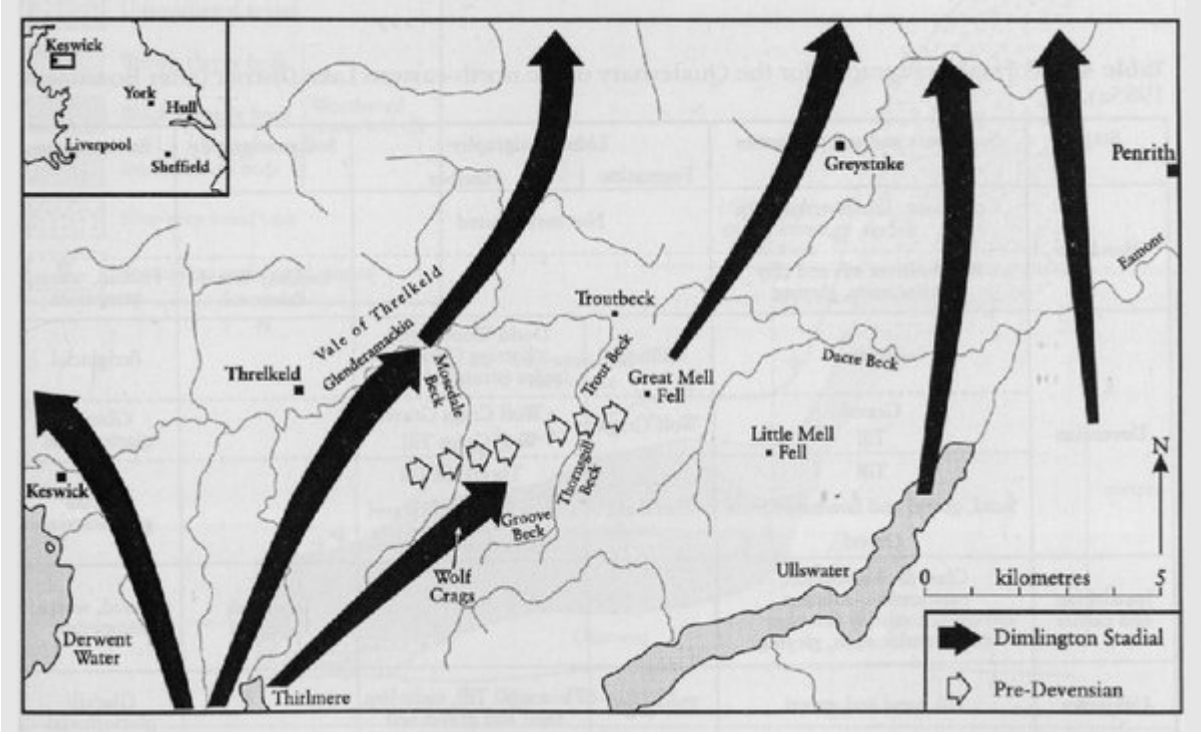
Conclusions

Glacial deposits in the Thornsgill–Mosedale area constitute a unique British record of three glacial events. Because the deposits occur in close proximity the relationship between events can be clearly seen. Of particular importance is the weathering of the lower glacial till to form the Troutbeck Palaeosol. Survival of well-developed weathering features in pre-Devensian glacial deposits is extremely unusual. Holocene fluvial erosion in the Mosedale Beck valley is itself of interest as evidence of large-scale recent flooding.

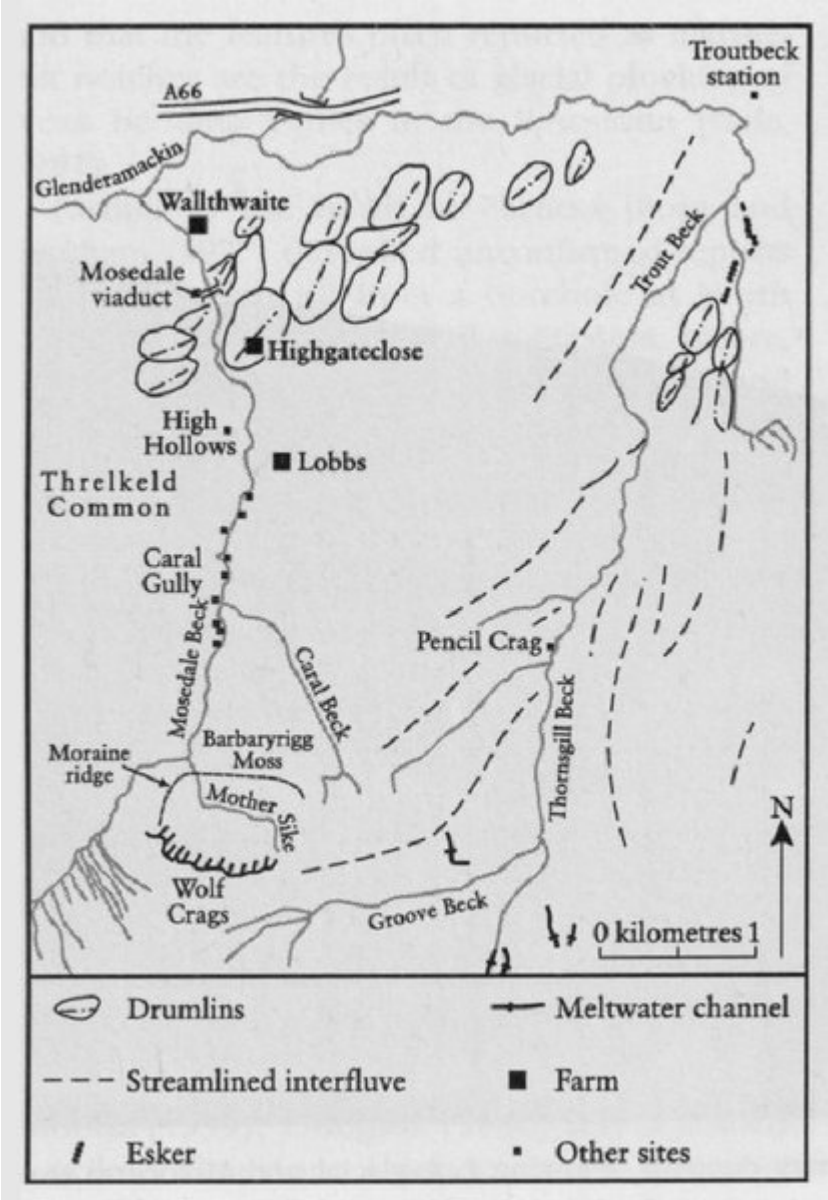
References



(Figure 4.4) Incision of Mosedale Beck into Quaternary deposits, showing Late-glacial and Holocene river terraces and landsliding. (Photos: J. Boardman.)



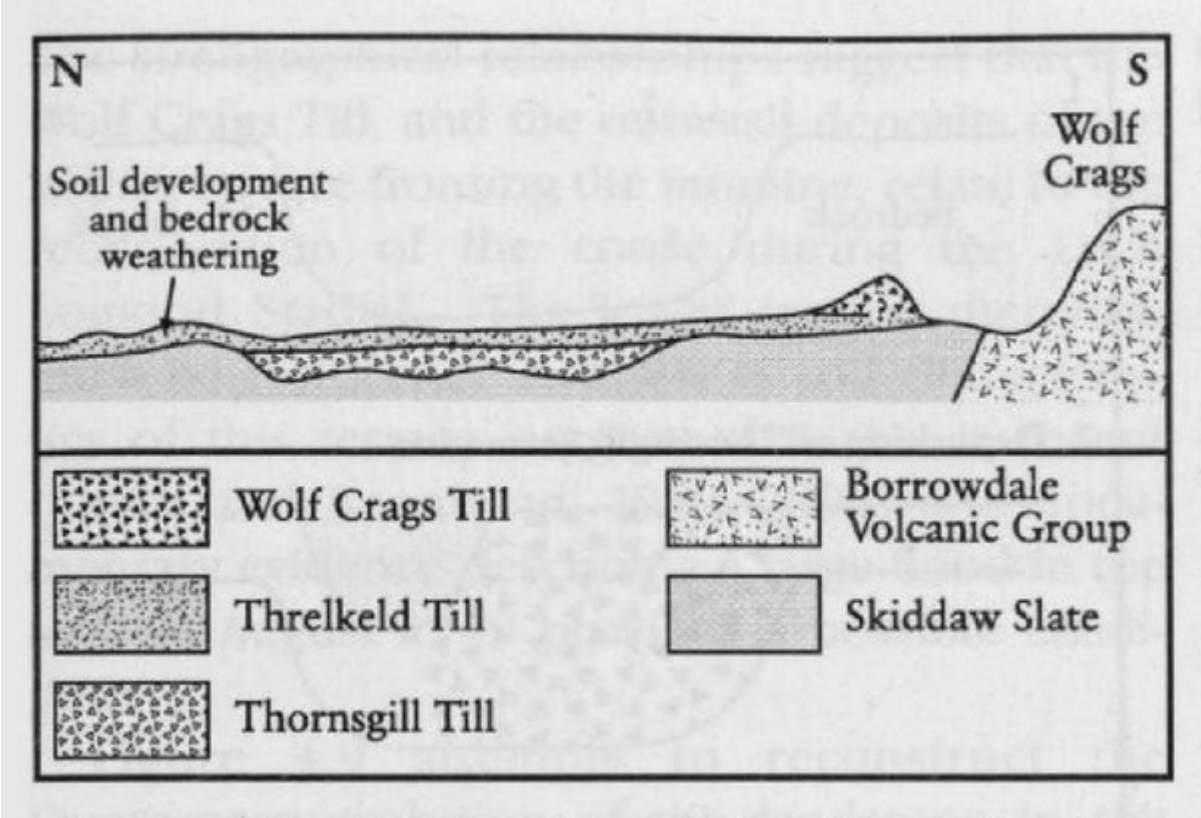
(Figure 4.5) Direction of ice movement in the north-eastern Lake District (after Boardman, 1991).



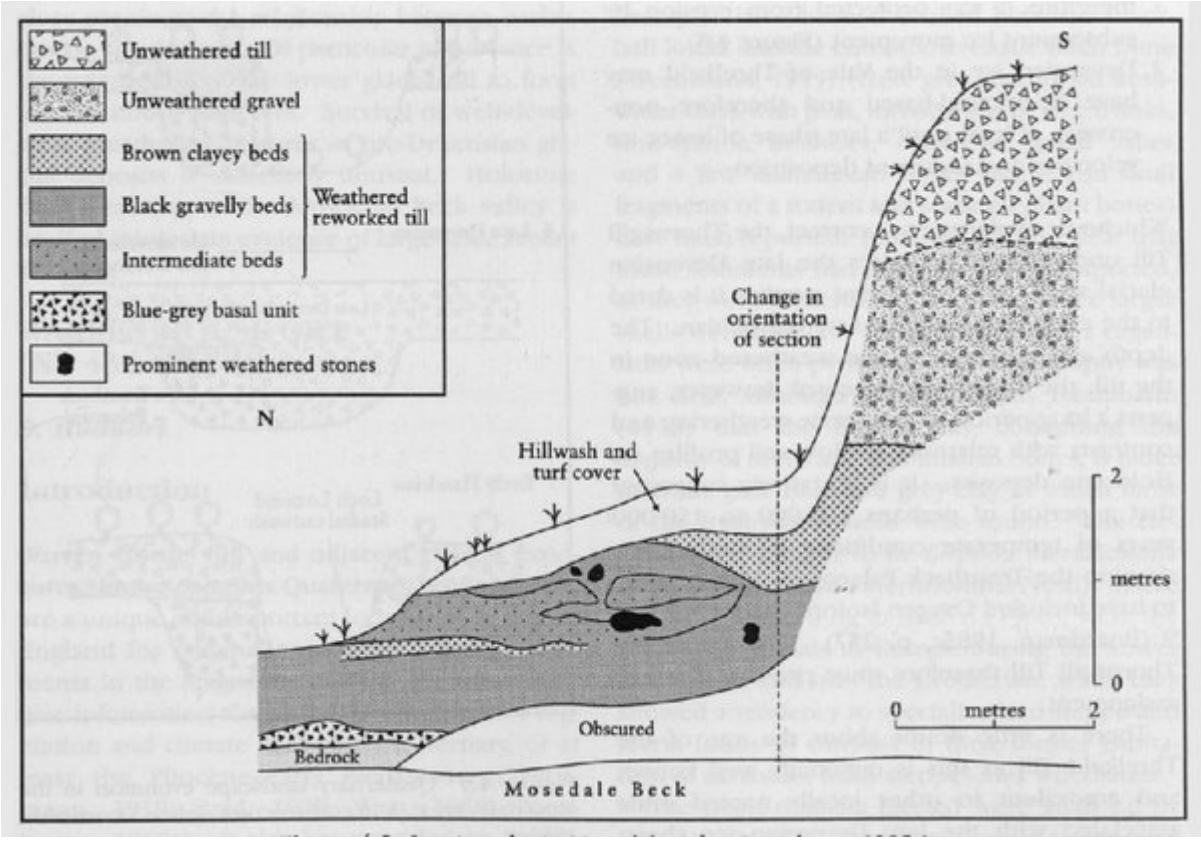
(Figure 4.6) The valleys of Mosedale, Thornsgill Beck and Wolf Crags, showing exposed sites (after Boardman, 1985a).

Stage	Sediments and soil properties	Lithostratigraphy		Soil stratigraphy	Environment
		Formation	Member		
Flandrian	Colluvium, alluvium, landslip debris, etc.	Not investigated			
	Rubification, silt and clay translocation, gleying			Laddray Wood Palaeosol	Humid, warm, temperate
Devensian	Scree	Millbeck	Dodd Wood Scree Latrigg Grèzes Litées (stratified scree)		Periglacial
	Gravel Till	Wolf Crags	Wolf Crags Gravel Wolf Crags Till		Glacial/ glaciofluvial
	Till Sand, gravel and laminated beds Gravel	Threlkeld	Threlkeld Till Lobbs Sand and Gravel Mosedale Gravel		Glacial/ glaciofluvial
Ipswichian and earlier	Clast decomposition, rubification, solution, oxidation, clay flowage, clay translocation, gleying			Troutbeck Palaeosol	Humid, warm, temperate
Unknown	Till, sand and gravel	Thornsgill	Thornsgill Till, including sand and gravel bed		Glacial/ glaciofluvial

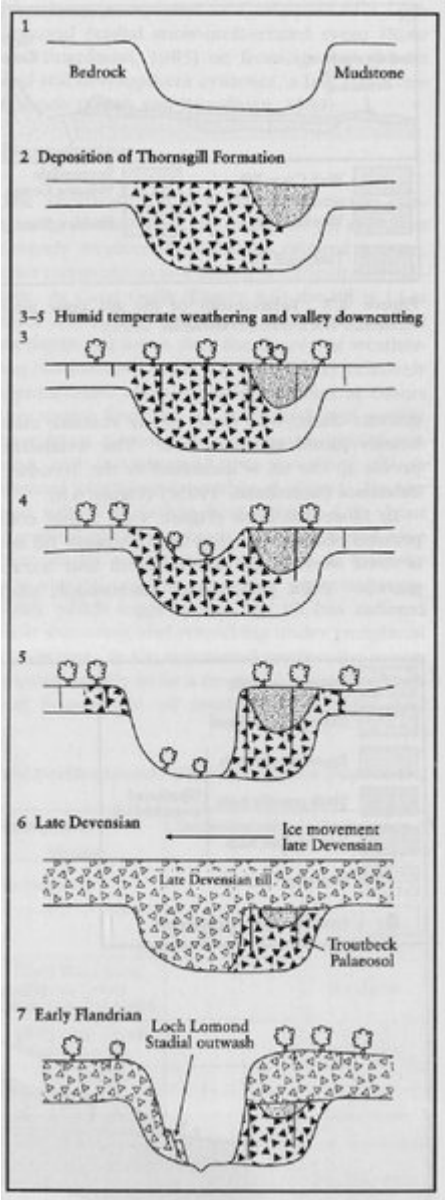
(Table 4.3) Formal stratigraphy for the Quaternary of the north-eastern Lake District (after Boardman, 1985a).



(Figure 4.7) Relationship of the till units along Mosedale Beck (after Boardman, 1991).



(Figure 4.8) Stratigraphy in Mosedale (after Boardman, 1985c).



(Figure 4.9) Attempts to reconstruct the Quaternary evolution of the landscape in the Thornsgill–Mosedale area. A bedrock valley is filled by pre-Devensian glacial deposits, which are then weathered and incised over a long period or periods of temperate conditions. Late Devensian glacial deposits then bury the landscape. During Late-glacial and Holocene times river incision occured to create the present topography.