Traligill Valley

[NC 26 21]–[NC 28 19]

Highlights

The Traligill Valley contains Scotland's finest karst scenery and is Britain's most recently deglaciated karst area. Its fine surface glaciokarst and its well documented underground drainage, developed in the Durness Limestones, provide a detailed record of landform development through the Pleistocene.

Introduction

The Traligill Valley karst lies just to the east of Inchnadamph, on the dolomites of the Durness Group, which crop out along a narrow and structurally complex belt. Drainage from the impermeable quartzites of Ben More Assynt in the east flows underground on reaching the dolomites, resurging several kilometres further down the valley. A spectacular variety of rock scars, pavements, blind valleys, dry valleys and dolines represents the progressive development of the karst drainage.

The geology of the Assynt karst and caves has been discussed by Ford (1959), Johnson and Parsons (1979) and Lawson (1988). The cave geomorphology is more fully described by Lawson (1983, 1986, 1988), and the later cave discoveries are recorded by Taviner (1993), Jeffreys (1994) and Mulholland (1994). The karst hydrology has been assessed through quantitative dye tracing (Newson and Atkinson, 1970; Smart *et al.,* 1986; Lawson, 1988), and stalagmite studies have yielded chronological and environmental data for the late Pleistocene (Lawson, 1982; Atkinson *et al.,* 1986; Baker *et al.,* 1993, 1995a).

Description

The Traligill River drains a section of wild moorland terrain dominated by the glaciated landforms which typify the Scottish Highlands. Karst features are not overly conspicuous, but a cave drainage system underlies the valley floor and distinguishes the morphological landforms of the site. About half of the 17 km^2 catchment is underlain by the Durness Carbonates (Figure 8.2). The upper basin extends onto quartzite outcrops and is an undulating plateau at elevations around 300 m, extensively mantled by peat and thick fluvioglacial sands. In contrast, the lower valley is narrower and steeper and is dry over much of its length across the carbonate outcrop. The Traligill River flows into Loch Assynt at an elevation of 70 m.

The Cambrian–Ordovician rocks are composed of basal quartzites, overlain by the 'Pipe Rock' orthoquartzites, which are in turn overlain by shales and dolomites, and finally by the calcareous Durness Group; these are bedded dolomites about 100 m thick which are host to all the karst and caves. The simple stratigraphy is complicated by later tectonic events, and thrust planes and high-angle reverse faults occur throughout the Traligill Valley (Figure 8.3). These include the Traligill Main Thrust, on which lie some steeply inclined segments of cave passage and some asymetrical subaerial ravines along part of the carbonate margin on the north side of the lower valley. Higher thrust planes cap the dolomites, and an outlying klippe of Cambrian quartzite has the cave drainage passing beneath it.

Recurrent glaciation has sculpted all the larger features of the modern landscape, and ice striae, till, erratics and outwash are widespread. Karst features are most conspicuous in the valley floor where it is dry for 2 km, broken by closed depressions, some floored with gravel deposits. Surface streams from the orthoquartzites and peat deposits sink at the contact with the carbonates (Figure 8.2), and ten sinks are known to converge on the cave streamway in Cnoc nan Uamh (Smart *et al.,* 1986). Additional input is provided from the sinks around the Lower Traligill Cave, and all the water resurges at the Traligill Rising and other adjacent risings towards the lower end of the dolomite outcrop.

Of the many caves in the Traligill basin (Jeffreys, 1984; Lawson, 1988), the largest is the Cnoc nan Uamh system which extends for a large part of the drainage line from sink to rising. It has over 2200 m of mapped passages, covering a depth range of nearly 100 m (Figure 8.4). A complex high-level series of phreatic passages, oxbows and collapse chambers, with thick gravel deposits overlain by stalagmite, has been breached at the Uamh an Tartair entrance, and upstream the water emerges from two active phreatic sections. Downstream the cave is again breached at the Uamh an Uisge entrances, immediately above the Waterslide, where the water forms a spectacular cascade down an inclined thrust plane (Figure 8.5). Short sumps at the foot of the downdip cascades lead to a gently graded streamway almost along the strike. This has sections of beautifully decorated high-level phreatic bedding planes, and ends where the water roars into a small foaming sump close to the upstream limit in the Lower Traligill Cave. The lower caves in the valley contain steep, vadose, tributary streamways, abandoned high levels and various small chambers, but none has been explored for more than a few hundred metres. The main flow resurges at the Traligill Rising, but some water escapes to the lower risings where it is joined by the cave stream from Glenbain Hole resurging from Firehose Cave.

The broad carbonate bench of Creagan Breaca has a thick peat cover, with surface drainage to the west, against the dip of the thinly bedded dolomites; the karst has many dolines but no known caves.

Interpretation

The karst landscapes of the Traligill Valley demonstrate the effects of complex geological structures and multiple glaciations on the surface morphology. Several knickpoints along the valley record the surface lowering and subsequent rejuvenation of the valley after each glacial event. This has led to a progressive lowering of the local water table, causing a series of underground drainage captures. The structurally complex nature of the limestone is reflected in the rather irregular morphology of the caves, with joints, bedding planes and thrust planes all influencing cave development. The drainage below Cnoc nan Uamh follows the Traligill Main Thrust, and a series of successive downstream resurgences further down this thrust plane have captured the water (Taviner, 1993).

The modern hydrology of the caves is complex; large streams converge on a single trunk drain in Cnoc nan Uamh, and then flow into a distributary system feeding several resurgences (Smart *et al.,* 1986). Passage morphologies are varied, and abandoned high-level passages represent earlier stages of development. The multiple resurgences and many flood overflow channels may indicate the immature and constricted nature of many of the lower conduits.

Cave underflow has caused the partial desiccation of the lower Traligill valley, which is now only active as a flood route in wet weather. Higher up, the valley is almost completely dry and dolines punctuate the valley floor. This process of progressive underground capture had resulted in a complex range of landforms, including valleys with permanent surface flow and underflow, abandoned resurgences, dry channels and closed depressions.

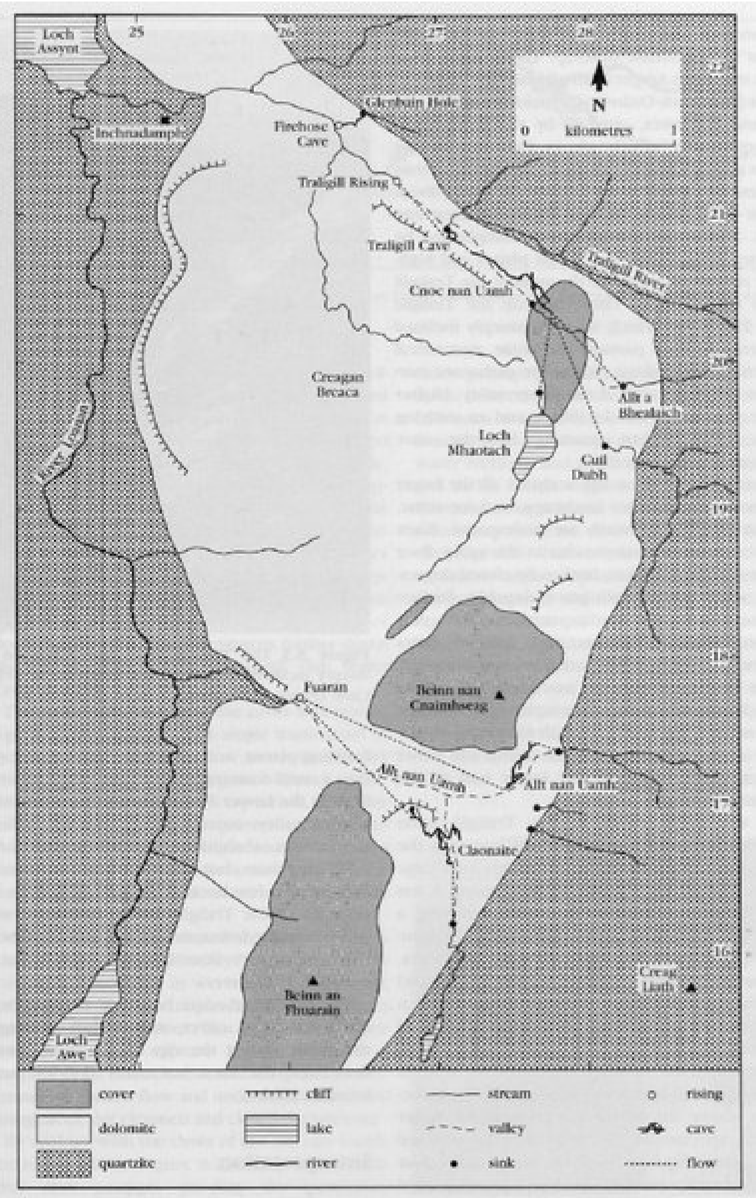
By analogy with the caves of the Allt nan Uamh, just to the south (Figure 8.2), many of the high-level cave passages pre-date the Ipswichian interglacial, and were abandoned as the drainage occupied the modern streamways. Within these older passages, calcite stalagmites have yielded dates between 38 and 26 ka, or less than 9 ka (Atkinson *et al.,* 1986). The older dates show that conditions were warm enough to permit groundwater recharge and solutional activity between 38 and 26 ka, which suggests that there was a mid-Devensian deglaciation of the valley; subglacial water may excavate caves but normally lacks the exchangeable carbon dioxide which permits extensive calcite deposition. These caves clearly survived beneath their temporary glacial covers, but how much of the older systems were destroyed is not known. Their extensive clastic fills are interpreted as the product of flooding during some stages of the glacial events, with the main influx of coarse gravels and sands probably during deglaciation.

A Holocene stalagmite from the upper level of Cnoc nan Uamh, has luminescent banding which represents annual cycles of deposition (Baker *et al.,* 1993, 1995a); the same banding reveals a short acceleration of growth around 3150 years ago, which may record the Hekla 3 eruption in Iceland. The stalagmite and clastic sequences in the caves clearly provide evidence for each glacial modification of the valley during the Devensian cold stage, and further dating may indicate rates of base-level lowering.

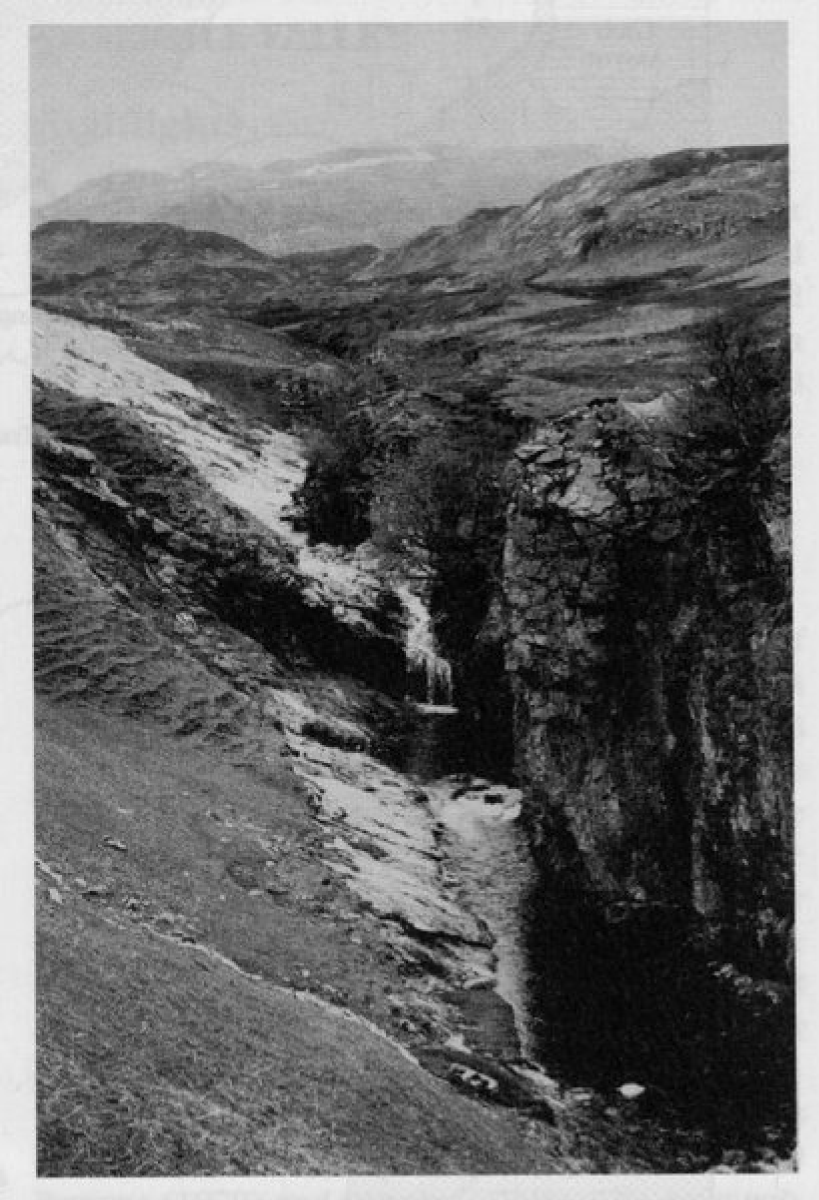
Conclusions

The Traligill valley contains Scotland's finest glaciokarst landscape. Its cave drainage is well documented and provides an excellent example of a complex network dominated by structural rather than lithological controls; the thrust plane caves are particularly unusual. Some of the caves are immature, but sediments in the abandoned caves provide a unique record of underground drainage during a warmer phase of the middle Devensian. The dry valley morphology has evolved in response to sequential lowering of base levels and associated underground captures.

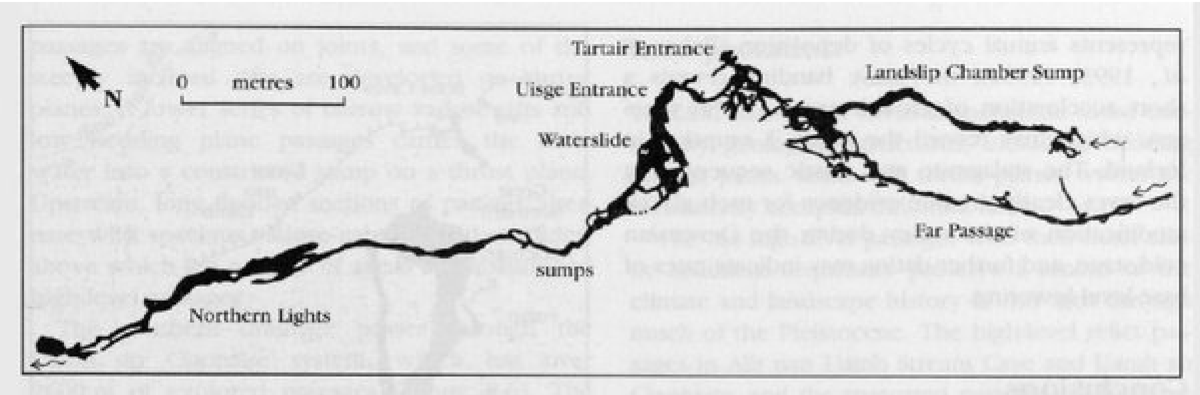
References



(Figure 8.2) Geological map of the main karst belt in Assynt, containing the caves of the Traligill and Allt nan Uamh Valleys. The dolomites belong to the Durness Group and are underlain by the Lower Palaeozoic quartzites. The cover rocks are klippe of Cambrian quartzite and Eocambrian sandstone lying over major thrust planes.



(Figure 8.3) The Traligill River entrenched on the steeply inclined Traligill Thrust, upstream of Traligill Cave. (Photo: T.J. Lawson.)



(Figure 8.4) Outline map of the cave system of Cnoc nan Uamh (from survey by Grampian Speleological Group).

(Figure 8.5) The Waterslide in Cnoc nan Uamh. (Photo: A.C. Waltham.)