The ‘glaciolacustrine’ and ‘roches moutonnèes’ sites at Dulnain Bridge.

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Glaciolacustrine site.

This interesting section [NH 9910 2482] on the south bank of the River Dulnain became exposed after a flood event in 2003. The back-scar of this 22 m-high, active slip may be viewed safely from the layby beside the B938 road, 600 m west of Dulnain Bridge village (Fig. 129). The following log was recorded in 2005.

Upper Diamict (2.5 m). The uppermost unit comprises densely packed, matrix- to clast-supported, very poorly sorted diamict containing sub-angular to subrounded clasts (<80 cm) composed chiefly of psammite and grey granite (Fig. 130 & 131). The matrix is formed of crumbly silt, sand and gravel. The deposit is mainly unstratified with a chaotic fabric, but includes some crude sub-horizontal sandy lenses. The base of the diamict is gradational over a depth of about 10 cm, where it is mixed with material from the underlying unit. The contact is gently undulating and cross-cuts lamination in the unit below.

Upper Laminated Unit (<2.5 m). The upper laminated unit comprises pale olive (10YR6/2), locally rusty-stained, horizontally stratified silt, clay and very fine-grained sand, with lenses of coarser sand up to 10 cm thick and sparse pebbles of granite and semipelite that are commonly decomposed. The silty layers display poorly-developed, horizontal lamination with lonestone clasts up to 30 cm. One such lonestone is illustrated in Fig. 132 B, where it is enclosed within an irregular lens of clayey diamict. The sharp, sub-horizontal base of the unit is locally associated with a stone line of pebbles (Fig. 130).

Lower Laminated Unit (12 m). This thick unit is noticeably finer grained and more regularly and clearly laminated, comprising graded couplets of pale yellowish brown silt and dark yellowish brown silty clay (Fig. 132). Individual laminae are normally graded (very fine-grained sand fining up into silt and then clay) with wisps of orange silt. The sand/silt-clay couplets are generally 10-15 mm thick towards the top of the sequence (Fig. 133), becoming thicker downwards, where some are 50 to 80 mm thick and include fine-grained sand at the base (Fig. 134). Lenses (<20 mm) of fine-grained sand occur locally throughout the sequence.

Towards the top of the unit a large granite loanstone (Fig. 135), 50 cm in diameter, has warped lamination beneath it. Soft-sediment deformation structures are not common, but laminae of silt have locally broken up and sunk into underlying layers of sand. There are sparse beds (< 20 cm) of coarse-grained sand and granitic, granule gravel. There is poorly-developed rhythmic bedding within packages of couplets dominated by dark silty clay. A discrete seam (<2 cm) of brown clay lay above a 40 cm-thick bed of compact, silty, fine-grained sand at the sharp, uneven base of the sequence.

Lower Diamict (>0.5 m). This poorly exposed basal unit crops out some 2 m above river level, where it comprises pale brown, extremely compact, massive, matrixsupported diamict with a clayey, silty, sandy matrix (Fig. 129). The clasts are sub-angular to subrounded and composed mostly of psammite, granite and semipelite. Wisps of finely laminated, greyish orange pink silt are prominent.

Interpretation. The origin of the 'Upper Diamict' is not entirely clear on present evidence. The absence of stratification suggests that the unit is not a mass flow deposit (as identified in Fig. 136). Its base is roughly horizontal and slightly unconformable, which is suggestive of subglacial processes, but no unequivocal subglacial shearing and deformation has been observed at the top of the underlying laminated deposits. However, the diffuse sub-horizontal stratification and irregular lenses of clayey diamict within the 'Upper Laminated Unit', together with the discontinuous stone-line at its base, suggests that the upper diamict is indeed a subglacially-deposited till overlying penetrative glacitectonite formed by ice as it over-rode the lacustrine sequence below. Unfortunately this crucial part of the section is difficult to study at close hand.

The laminae within the 'Lower Laminated Unit' are very likely indeed to be true varves, which indicates that an ice-dammed lake existed at this location for at least 200 years. The relatively undisturbed nature and regularity of the varves together with the general absence of coarse-grained lenses suggests that the lake had been extensive, standing at about 240 m OD. However, the glaciolacustrine deposits have been observed only to crop out locally on the northern flank of an elongate, glacially-streamlined hill formed of bedrock (BGS, 2013) (Fig. 136). This suggests that the laminated sequence has been removed by subsequent erosion elsewhere, but preserved serendipitously in the lee of the hill, effectively within the 'tail' of a mega crag-and-tail feature aligned north-north-east. This regional subglacial streamlining event probably also created the whaleback forms at the **Roches Moutonnees** visitor site down the road (Fig. 136). As this event correlates with flowset 34 established by Hughes et al., 2014) (Fig. 10), the glaciolacustrine sequence thus very probably pre-dates the LGM. The colour, iron-staining and presence of decomposed clasts within the laminated sequence also suggests that it is relatively old, possibly pre- Devensian in age.

'Roches Moutonnèes' visitor interpretation site

The south-facing flanks of the valley of the River Dulnain are formed of mammillated and plucked bedrock to the east of Dulnain Bridge, where the valley joins that of the River Spey (Fig. 136). These ice-scoured slopes are situated where Strathspey ice entered the topographically more constricted reaches of the valley downstream of Grantown. Ice flowing north-eastwards down Strathspey flowed over and between the two glacially streamlined bedrock hills south-east of Skye of Curr before hitting the greater constriction posed by the hillside between Wester and Easter Laggan (Fig. 136). The 'Roches Moutonnèes' visitor site [NJ 003 250] is situated hereabout (Fig. 137), where the ice moulded features were clearly formed beneath ice flowing north-eastwards down the valley. Ironically, most of the ice-moulded features currently on display may be better described as *whalebacks* (cf. Benn and Evans, 2010), better examples of roches moutonnèes occurring to the north-east of the site within Gaich Wood. Ice-scoured knolls of rock are also widespread to the north of Grantown-on-Spey in the vicinity of Lynmacgregor Croft [NJ 0265 2905], around Creag Bheithe Mhór [NJ 020 308] and on Gorton Hill [NJ 012 295].

The north-eastward orientation of the ice-moulded features at Dulnain Bridge begs correlation with flow-set 47 of Hughes et al. (2014) (Fig. 10). However, this flow-set is thought to post-date the LGM, when ice was more constricted in extent. Considering the height of the bedrock hills around Skye of Curr over which the ice flowed, together with the preservation of the glaciolacustrine sequence in the lee of one of these features, the ice scouring is more likely to have mainly occurred beneath much thicker ice during the LGM. At this time Strathspey ice was generally flowing northwards across the Dulnain/Findhorn divide through the **Beum a Chlaidheimh Breach** and the 'Lochindorb Corridor', towards the Inner Moray Firth (Fig. 11) (Merritt et al., 2013, 2017).

References

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Figures

Figure 129. The Dulnain Bridge landslip section in June 2003, looking south.

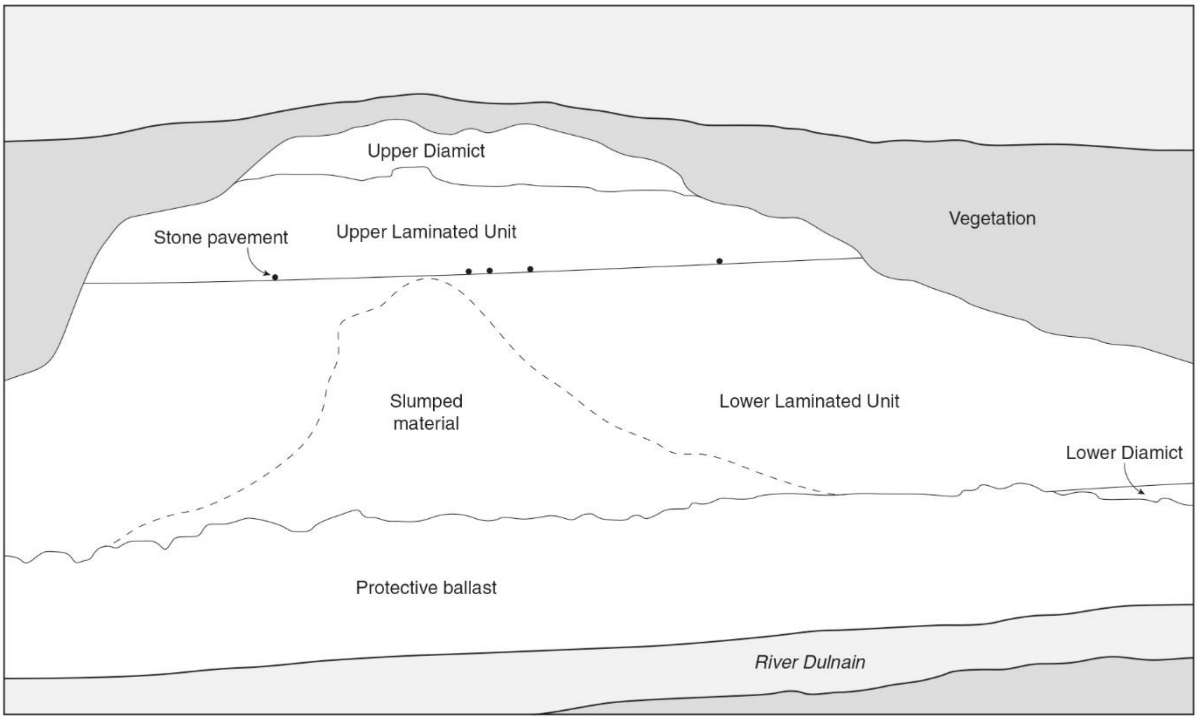
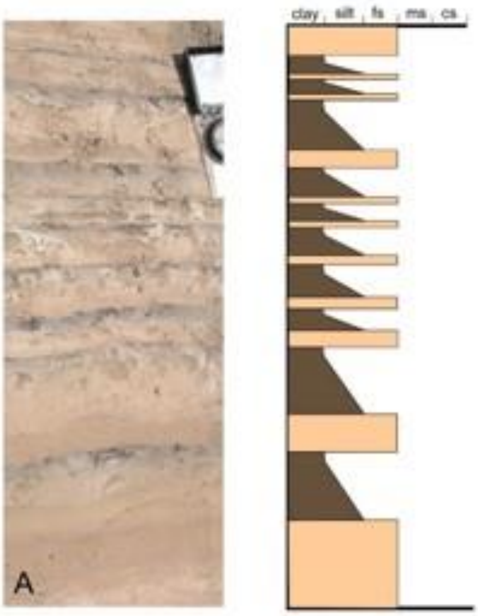


Figure 130. Sketch of the Dulnain Bridge landslip section in June 2003, looking south.

Figure 131. Upper Diamict capping the 'Upper Laminated Unit'.



Laminated glacial lake sediments near Dulnain Bridge.

A. Rhythmically laminated sediments of sand, silt and clay, possibly varves, reflecting changes in deposition from year to year. The part of the sequence shown (left) may represent 10 such cycles. Each couplet has a sharp lower (clay/sand) contact and is normally graded recording the gradual settling of progressively finer material through deep water.

B. Ice-rafted debris occurs in beds or as discreet dropstones throughout these laminated sediments. Folding and faulting has occurred beneath this large ice-rafted clast. Note the laminae draped over the dropstone. These sediments were deposited in an ice-contact lake, probably during deglaciation of the Late Devensian ice-sheet.

Figure 132. The laminated units as interpreted in 2003.

Figure 133. Close-up of laminae interpreted as varves towards the top of the ‘Lower Laminated Unit’ (beneath the base of box B shown in Fig. 132).

Figure 134. Close-up of laminae interpreted as varves within the 'Lower Laminated Unit' (as depicted in box A shown in Fig. 132).

Figure 135. A dropstone boulder towards the top of the Lower Laminated Unit.

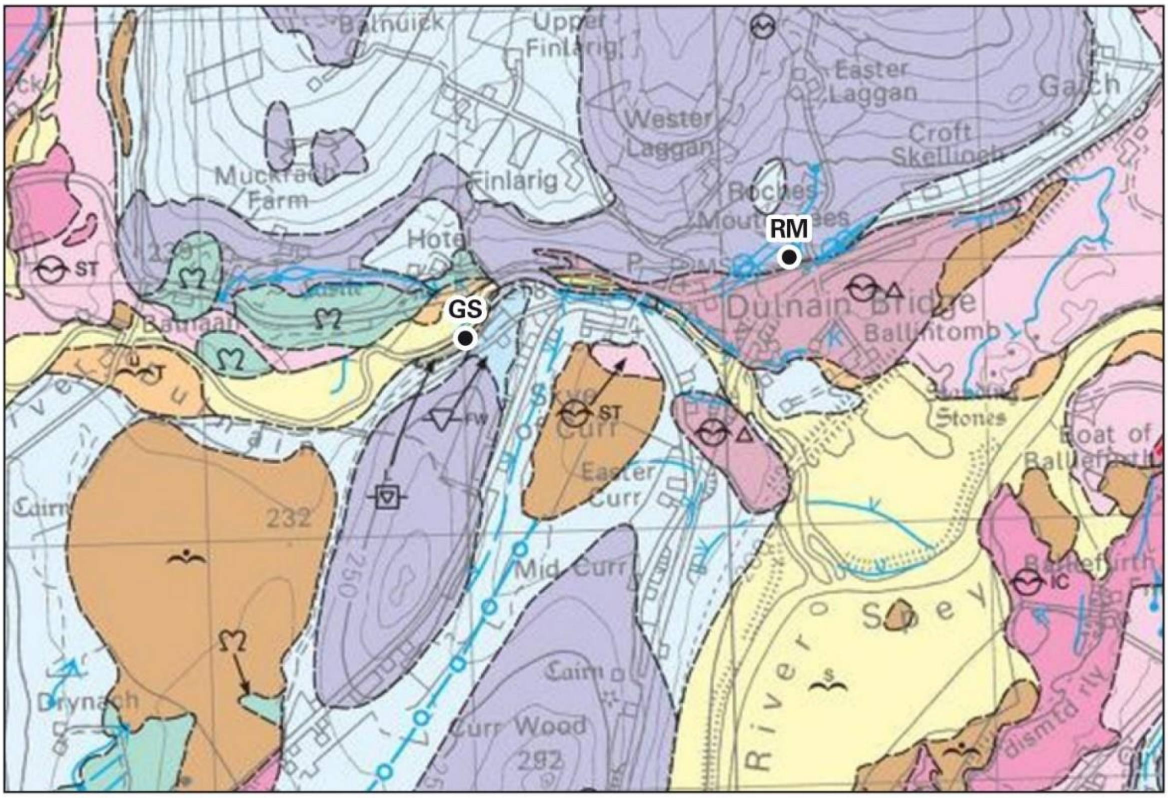


Figure 136. Clip of the 1:50k Superficial Geology of the area around Dulnain Bridge (BGS, 2013). (GS) glaciolacustrine site, (RM) 'Roches Moutonnèes' site.

Figure 137. The ‘Roches Moutonnèes’ visitor interpretation site at Dulnain Bridge.