

A glacially striated dolerite outcrop in the bank of the River Severn near Crewgreen, Montgomeryshire

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WORSLEY, P.¹ (2024). A glacially striated dolerite outcrop in the bank of the River Severn near Crewgreen, Montgomeryshire. *Proceedings of the Shropshire Geological Society*, **19**, 14–18. A rare example of a lowland glacially striated and smoothed dolerite bedrock outcrop has been rediscovered in the alluvial banks of the River Severn just inside the Welsh border next to Shropshire. It reveals a clear west to east palaeoglacier flow direction. This trend is conformable with the ice-smoothed surfaces and faint striae lying 3 km to the south west on the summit of the Breidden Hills at Rodney's Pillar, 300 m above the modern Severn floodplain. These two locations suggest an ice thickness significantly exceeding 300 m some 20 km from the Welsh readvance glacial limit during the Devensian Last Glacial Maximum in eastern Shrewsbury c. 20 ka BP.

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INTRODUCTION

The preservation of glacial striations in the lowland areas of the Cheshire-Shropshire plain is very limited, in part reflecting the relative paucity of hard bedrock outcrops. This topic, especially the mechanisms of abrasion, has been reviewed by Jenkins & Holt (2012) although they only predict that any hypothetical striae distribution per se might give greater insight into ice dynamics in Shropshire without giving any specific examples.

Striations are normally straight and parallel scratches and grooves on bedrock surfaces produced by glacial sliding. Fine debris frozen into the glacier sole acts like a coarse abrasive sandpaper aided by clasts contained within the basal ice zone where they come into contact with the bed. For sliding to occur the ice has to be at the pressure melting point. Typically, half of the total amount of temperate glacier movement is accounted for by basal sliding. An example of a basaltic bedrock surface recently exposed by glacial retreat is shown in Figure 1.

In England and Wales, the standard glacial striae map symbol utilised by the British Geological Survey has been an arrow and to avoid confusion with a dip arrow this is superimposed on a circle with the arrow tip coinciding with the striation location. Alas, BGS Digimap Superficial Geology no longer features striae on its maps. In the area covered by the 1: 63,360 scale Geological Survey map of the Shrewsbury district Third



Figure 1. A glacially striated and smoothed basalt clast lodged in till south of the glacial lake Breiðarlón, Breiðamerkurjökull, south east Iceland. This site was deglaciated c. 1905 during ice marginal recession from the 'Little Ice Age' advance limit. Scale 20 cm long.

Edition published in 1932 (Sheet 152), only two instances of striae appear to be documented. First, on the south western flank of Sharpstone Hill (SJ 493 090), where "Well marked striae on freshly exposed surfaces of the Longmyndian grits showing an ice movement from north to south" were identified by Pocock (1938) p.186. Digimap Bedrock Geology shows the locality as part of the Bayston-Oakwood Formation of undefined age. This site has subsequently been subject to extensive quarrying and the original observation point is no longer extant. Second, on the northern slope of Charlton Hill (SJ 589 083), striae on Uriconian Group (late Precambrian) tuffs and lavas were mapped by Pocock and these indicated movement towards south-south-east. A recent search at this location failed to find any bedrock

exposed, rather a till cover with characteristic Irish Sea erratics (Stockport Formation).

THE CREWGREEN (BELAN BANK) STRIATIONS

A hitherto overlooked example of striated bedrock has been found close to Crewgreen in the banks of the River Severn close to the Shropshire County boundary. Its whereabouts was revealed by one of the descriptions to the list of geological photographs in the Geological Survey Shrewsbury memoir (Appendix V p. 277). The main list relates exclusively to map Sheet 152 but is preceded by a short list of photographs from localities which fall in the remit of the Welshpool sheet 151 which lies immediately to the west. This anomaly arose since a small part of the Hanwood Coalfield extends west of the Sheet 152 boundary but was sensibly included in the mapping programme for Sheet 152. No comparable striae photographs are featured in the Shrewsbury map sheet list of photographs.

The memoir description is :-

“No. A. 4202, - Glacially smoothed and striated dolerite. Bank of the R. Severn, below Belan Bank, 2½ miles N.N.E. of Middleton.”

This is supplemented by further details given in the register of photographs lodged with the BGS library at Keyworth. It states:-

“The dolerite is exposed in the southward loop of the river below Belan Bank. It rises as a low bluff out of the water (top left-hand corner) at low summer level. The downward tilt of the camera from above accounts for the false appearance of the inclination of the striae, which trend due west-east”. Direction of view – looking east. The scale is a one-foot rule.

The original photograph is reproduced in Figure 2. The photograph clearly shows a smoothed and striated bedrock surface with the river lapping against the rock in the top lefthand corner. The top righthand corner reveals a diamict lying on the bedrock dolerite suggestive of a till. The exposed area is a minimum of 10 m². Unfortunately, during the relatively wet summer of 2024 low river levels were rare. On 11th September 2024, the river water was at a median level obscuring any striations.

Both the Welshpool Sheet 151 Bedrock and Superficial 1:50,000 scale maps and the current (2024) BGS Digimap Geology for the Crewgreen area do not show any river bank bedrock exposures of dolerite in the southward loop of the River Severn at Belan Bank. Fortunately,



Figure 2. Geological Survey photograph A 4202 taken by J. Rhodes in August 1927 of the glacially striated and smoothed dolerite in the River Severn bank exposure. This appears to show leeside fracture surfaces just above the water level, of the kind which often characterise the down glacier side of such obstructions – compare with Figure 1. Scale ‘One-foot rule’ propped up by a hammer. (OGL contains BGS materials ©UKRI 2024.)



Figure 3. Extract from the 1:10560 scale County Series field mapping slip showing the precise location of the striations (OGL contains BGS materials ©UKRI 2024)

examination of the original field mapping slip (BGS Registration number NGDC/FC/12384) held at the Library of the BGS at Keyworth has enabled the identification of the precise position of the striations, (Figure 3). Surprisingly, two striation locations are shown, one at the river bank and the other some 10-15 m to the south of it. The NGRs are SJ 31191 13590 and 31192 13589. The former is orientated east-west and the other “east slightly by south”. Only the ground north of the river channel has been mapped geologically and this was undertaken by D.A. Wray in October 1915 as part of his work for the Oswestry sheet (the sheet boundary actually lay to the north). No geological boundaries are identified since the area covered was just the Severn floodplain. His clean copy was

approved by his District Geologist T.C. Cantwell on 19/05/21. South of the river there is no geological information on the field slip apart from the two striation locations. Speculatively, the writing appears to be in the hand of C.B. Wedd, a member of the Shrewsbury mapping team and was responsible for the adjacent 40 SW Westbury County Series six-inch sheet in 1921. Wedd is known to be an accomplished glacial geology mapper and it may be that after he examined the locality out of interest and added the striae site to the field slip. In the Oswestry memoir (Wedd *et al.* 1929) p.181, he and B. Smith jointly mention the Belan Bank striations in a discussion of the buried course of the 'preglacial' Severn.

Just to the south of the river channel meander loop is a circular wooded knoll c. 20 m high of Ordovician microgabbro, the hollowed interior of which once formed a small quarry known as Belan Bank. The outcrop appears to be a sill feeder pipe intruding a host rock consisting of Stone House Shale Formation mudstones. The dolerite exposure at the river bank is probably related to this intrusion. A narrow-gauge railway line just over 100 m long, formerly led from the quarry to the river bank for transferring the excavated rock to barges, Carpenter (1999) p.28 - see Figure 4. It appears to have crossed the former standard gauge Criggion branch of the Shropshire & Montgomeryshire Light Railway via an overbridge (Gillam, 2019) p.27. Immediately to the west was a stone and iron bridge for farmland access, the retaining walls of which still survive (this line closed in 1960). Considerable amounts of dolerite debris litter the river bank in alignment with the quarry railway and are likely to be wastage during the transfer of the rock from tubs into barges. Fractured, apparently *in situ* dolerite at river level, is currently (2024) exposed some 30 m downstream of the former rail-barge transfer point at SJ 3196 1590.

The dolerite was interpreted as a sill within 'Bala beds' of the Breidden Hills (Figure 5). It is highly likely that the site was visited by C.B. Wedd c.1921 during his field mapping of the Hanwood Coalfield and later in 1927 the official survey photographer was instructed to photograph the locality in the course of making a wider photographic coverage of the map sheet 152 and the adjacent part of 151.

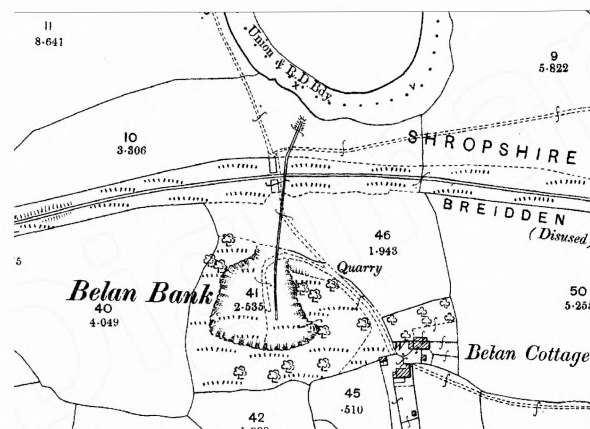


Figure 4. Extract from the 1:10,560 scale Ordnance Survey map dating from 1900, showing the Belan Bank quarry and its allied 2-foot narrow-gauge railway leading from the quarry to the river bank where the dolerite was transferred to barges.

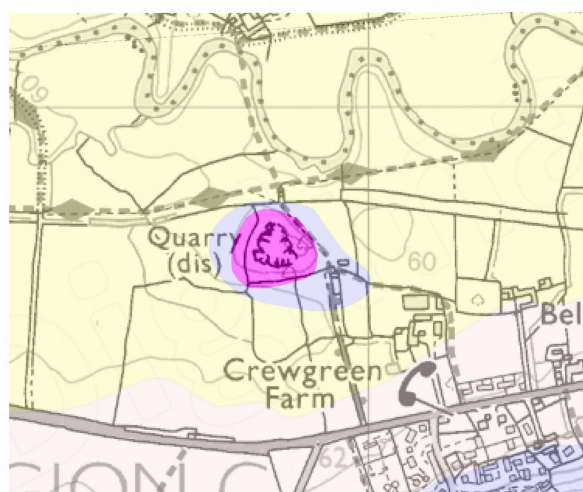


Figure 5. Extract from the Digimap Geology of the Crewgreen area. Note the former Belan Bank quarry located within the Microgabbro intrusion which penetrates the Caradocian Stone House Shale Formation mudstones which are overlain by late Pleistocene glaciolacustrine silty clays along the southern border of the map and Holocene alluvium in the north. (OGL contains BGS materials ©UKRI 2024.)

THE CONTEXT OF THE STRIATIONS

Unfortunately, no memoir covering the Welshpool sheet 151 has been published although a 'Brief Explanation' booklet was compiled by Cave (2008). Apart from a reference to Wills's classic Ironbridge - Bridgnorth paper of (1924), no more recent glacial geological papers are cited. On the upstanding Llanymynech Carboniferous Limestone c. 7 km north west of Crewgreen, at 152 m OD, striations with a WSW-ENE flow direction have been documented by Nicholson (1893) presumably where till has been stripped prior to quarrying since dissolution processes soon eradicate exposed striations on limestone. This is

indicative of Welsh ice entering the Shropshire lowlands.

The Breidden Hills extend south west of Crewgreen for some 4 km and attaining 365 m at Rodney's Pillar. The summit area displays glacial erosional moulding and faint striations are evident (Figures 6a,b). The rock morphology indicates a clear west-east ice flow event. These landforms are consistent with a glacier flowing with its basal temperature at the pressure melting point. This conclusion suggests that the last flow regime was related to Event II of Jansson & Glasser (2005) which occurred after the separation of the Irish Sea and Welsh glaciers led to ice streams guided by the major valleys. However, their 'Fan H' set of lineations suggest a south west to north east flow over the Breiddens which conflicts with the evidence provided by the summit glacial landforms and the Crewgreen striations.



Figures 6a and 6b. Ice-smoothed and faintly striated late Ordovician dolerite west of Rodney's Pillar close to the summit of the Breidden Hills. Walking poles aligned parallel with the glacier flow which was away from the camera.

The major enigmatic feature of the Severn Valley from Ironbridge to Welshpool is the presence of a series of deep bedrock depressions below the modern floodplain and flanking areas. The most comprehensive data base with over 700 boreholes relating to the buried rockhead surface and allied superficial sediment thickness has been compiled by Bridge *et al.* (2001) for the area between just east of Shrewsbury to just east of Crewgreen. Its origin is unknown although in the recent judgement of the BRITICE project workers it is primarily due to selective glacial erosion, Chiverrell *et al.* (2021). They focus on a basin 19 by 6 km which during deglaciation was occupied by a palaeo- Glacial Lake Severn (equivalent to Glacial Lake Melferley of Thomas 2005). In places the basin is filled by thick accumulations of glacio-lacustrine muds intriguingly, (their word), in an over-deepened basin <170 m. This value significantly exceeds the thickest superficial sediment sequence of 113 m (-53 m OD) at Duglands SJ 353 178 cited by Bridge *et al.* (2001). Whatever, the dolerite exposure which was subject to glacial abrasion must be on the upper slopes of a deep bedrock floored depression at least 100 m deep. Interestingly, W.B.R. King observed that in the Oswestry district to the north "Striae at low levels are usually influenced in direction by the local trend of the valleys, whilst those at higher levels indicate the general flow of the upper layers of the ice sheet" (Wedd *et al.* 1929) p.158.

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