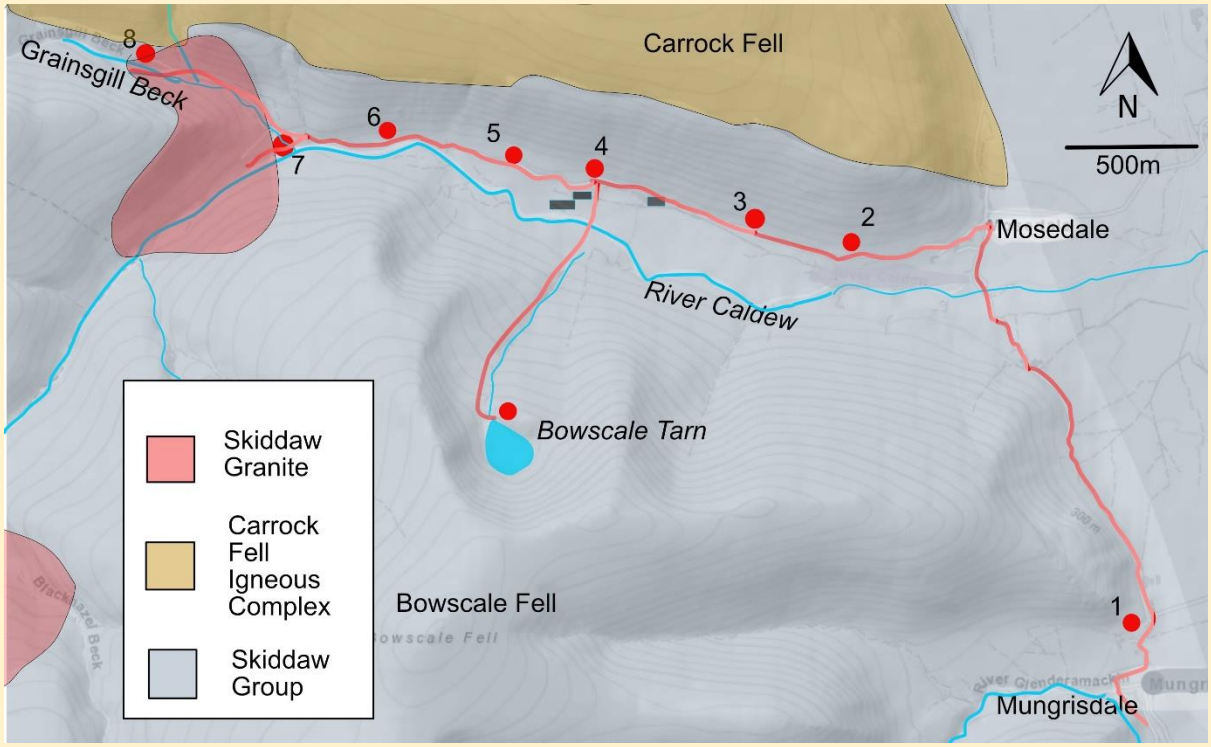
Mosedale and Bowscale Tarn

Purpose: To examine complex folding in Skiddaw Group rocks close to the junction with the Skiddaw granite, visit the site of a famous mine, and explore the Lake District's most northerly mountain tarn.

Practical details: A good way to conduct this excursion is by bike. Start at Mungrisdale village hall (Satnav CA11 0XR) and cycle to Mosedale via Locality 1. If you prefer to use a car, then remember that the narrow road up Mosedale can be very busy in summer, and that there is limited parking at the head of Mosedale valley. If you prefer to walk, then miss out the first location (Schoolhouse Quarry at Mungrisdale) and instead park at Mosedale village and walk up Mosedale valley from there. The spectacular folding in rocks along the bed of the river Caldew are best seen in summer, when river levels are low. Map: OS Explorer OL5.

Geological background:

Some 400 million years ago, towards the end of the Acadian Orogeny, hot magma ascended from deep within the crust into rocks of the Skiddaw Group. Here, around 7–10km beneath the Devonian land surface, it slowly cooled and crystallized to produce the Skiddaw granite. The granite is exposed at the surface where Skiddaw Group rocks that overly it have been eroded away – such as here in bed of the river Caldew. The Skiddaw Group rocks had already been strongly folded during earlier phases of the orogeny, and examples of these folds are beautifully exposed in the bed of the Caldew. Many of the landscape features seen in the excursion (such as Bowscale Tarn) are a product of much more recent processes – occurring during and immediately after the last glacial period, which ended some 11,500 years ago.



Mosedale and Bowscale Tarn Excursion map

Excursion details:

The road north from Mungrisdale passes St Kentigern's Church on the right, then 100m later there is a junction with a minor road leading off to the right. Opposite this (ie on the left-hand side of the road) at NY 36317 30638 is the disused School House Quarry, **Location 1.** Here you will see a good exposure of dark Skiddaw Group slates, with well-defined vertically, or near-vertically inclined bedding. On weathered exposures of the bedrock on the quarry floor you will see the bedding is composed of mm-scale alternating mudstone (dark grey)-siltstone (light grey) laminations.

Millimetre-scale bedding seen on a weathered rock surface at the base of School House Quarry (Location 1).

Imposed on the generally vertical inclination of the beds are gentle folds which give the main quarry face a wavy profile when viewed from the east. Skiddaw Group mudstones may show well-developed cleavage at some localities in the northern Lake District, but here the cleavage is almost absent (or is oriented parallel to the bedding), and the slates are splitting cleanly along planes of bedding.

The main quarry face at School House Quarry. The Skiddaw Group beds have been tilted by earth movements into a near vertical attitude. The wavy appearance of the bedding indicates a separate phase of gentle folding of the already vertical beds.

If you examine the quarry floor at its eastern end (nearest the road) you may be able to make out a 50 cm-thick band of rock in which laminations are absent. This is a small igneous intrusion known as a sill – a body of molten rock (magma) which forced its way between beds of sediment, probably during the period when the Borrowdale Volcanic rocks were erupting. A small fault can be seen cutting through the sill and the sediments on either side. Note how the movement along the fault has caused the sill to fracture cleanly, indicating the magma must have already cooled and become brittle when the faulting occurred. By contrast, the same fault has caused the mudstone beds to buckle and deform, suggesting they had retained a degree of ductility. This sill, and another one parallel to it, can be traced westwards into the main quarry face.

The pen rests on the base of a small igneous intrusion known as a sill – a body of molten rock (magma) which forced its way between beds of sediment, probably during the period when the Borrowdale Volcanic rocks were erupting (top and bottom of sill marked in pink). A small fault (marked in yellow) can be seen cutting through and displacing the sill and the sediments on either side. Note how the movement along the fault has caused the sill to fracture cleanly, indicating the magma must have already cooled and become brittle when the faulting occurred. By contrast the sediment layers have bene deformed by the displacement suggesting they had retained a degree of ductility.

With care you can ascend the steep slope above the quarry and examine weathered Skiddaw Group exposures on Raven Crags - the fellside above Undercrag Farm. These show well-defined alternations of light-coloured siltstone or fine sandstone and darker mudstone beds, all inclined steeply. In some places you may be able to spot evidence that the sandstone beds were deposited by turbidity currents - look for the sharp erosive bases of these beds passing upwards into laminated mudstones. These beds, and those of Schoolhouse Quarry, are placed in a part of the Skiddaw Group succession known as the Loweswater Flags.

The tip of the pen points to the sharp erosion surface which marks the base of the this turbidite sandstone bed, the upper surface shows a transition from sandstone to laminated mudstone.

Careful geological mapping has revealed the rocks to be strongly folded here, and analysis of the pattern of folding has been important in unravelling the tectonic history of the Skiddaw Group.

Return to the road and follow it northwards towards Mosedale village. Note the well-defined bedding in exposures of Skiddaw Group rocks on the fellside above the road.

If you are driving, a small carpark at NY 35719 31954 is a good place to stop and admire the view of Carrock Fell rising steeply above Mosedale village. Extensive patches of scree and blockfield mantle the sides of Carrock – in contrast to the generally grassy slopes of Bowscale Fell on south side of the side of valley. From Mosedale village take the minor road (signed to Swineside) which leads into the Mosedale valley.

Carrock Fell, on the north side of the valley is underlain by a variety of igneous rocks which together form what is known as the 'Carrock Fell Igneous Complex'. The rocks here vary from silica-rich granites to much darker silica-poor gabbros, and are thought to have been intruded into the crust around the same time as the volcanoes of the Borrowdale Volcanic Group were active. The boundary between the igneous intrusions that form the complex, and the surrounding Skiddaw Group runs approximately half-way up the side of Carrock Fell and parallel to the road. Interesting as these rocks are, they are not however the object of the current excursion.

200 m after the last house the road ascends a small hill, **Location 2** (NY 3520 3212). This is a good point to stop and admire the perfect flatness of pastureland on the valley floor. The hill has been interpreted as being the remains of a glacial moraine which once extended right across the valley, and perhaps dammed a post-glacial lake extending up-valley as far as Swinside Farm.

The flat valley bottom of Mosedale may indicate that the valley was occupied by a moraine-dammed lake after the retreat of the glaciers.

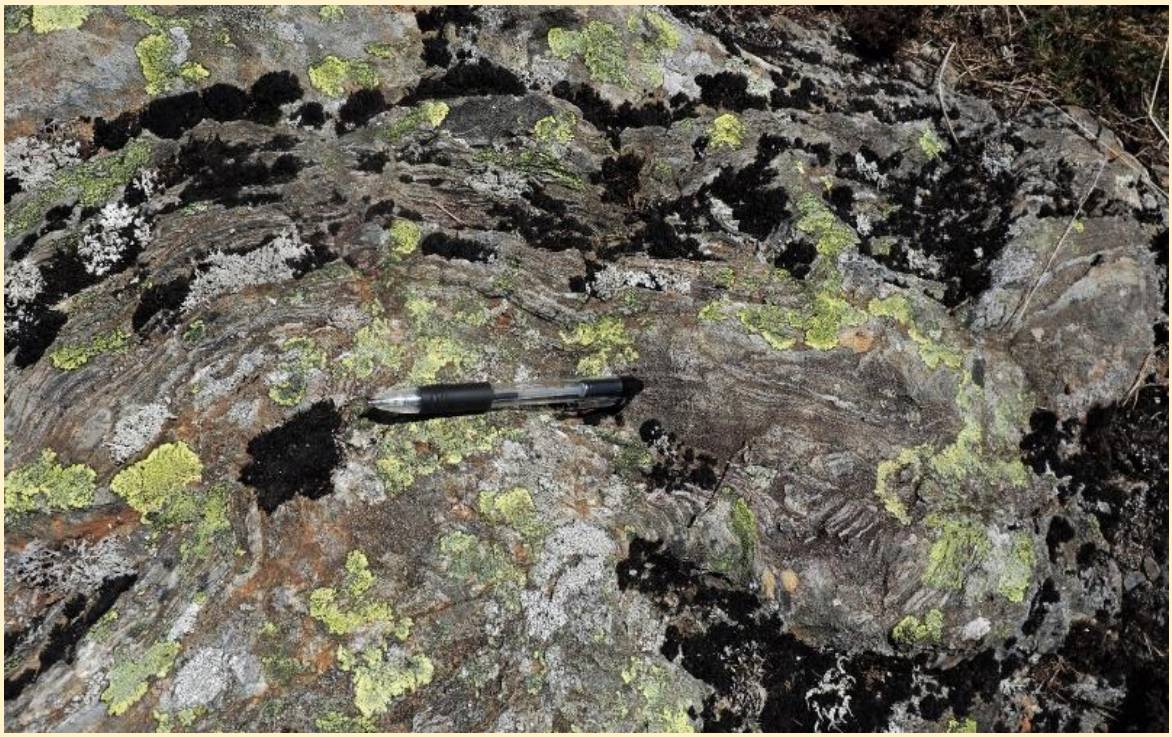
After another half-kilometer or so, you will see a small roadside quarry **Location 3** (NY 34595 32292), where the substantial thickness (5 – 7 m) of the talus apron at the foot of Carrock Fell can be appreciated. This material is probably a combination of glacial till left by the glacier as it retreated up-valley at the end of the Younger Dryas, and talus produced by post-glacial weathering erosion of the bedrock.

The disused roadside quarry at Location 3

At **Location 4** (NY 34023 32454) just past the junction with the track to Roundhouse Farm, the road has been cut through a roche moutonnee. This is Skiddaw Group rock, but heat from the nearby Skiddaw Granite (which will see further up the valley) caused minerals in the sediments to break down and recrystallize. The result is a very hard rock (compared with the slates we saw in School House Quarry) known as a hornfels.

At location 4 the road cuts through a roche mountonnee composed of hornfelsed Skiddaw Group slate.

If you examine the top surface of the larger outcrop (north of the road) you will see that weathering has revealed a confused patterns of folding, distortion and fragmentation of the original sedimentary layers. This type of deformation indicates severe disruption of the sediments whilst they were still relatively soft (perhaps as a result of earthquake activity affecting the Iapetus Ocean floor). Structural geologist are able to distinguish these soft-sediment folds (known as slump-folds) from later episodes of deformation that took place during the main Acadian Orogeny when the sediments had become more brittle. The hardening of the sediments to hornfels in proximity to the granite here took place at the very end of the orogeny, many millions of years after the sediments were first deposited.



Chaotic deformation in Skiddaw Group rocks at Location 4

Location 5 is another roche mountonnee at NY 33793 32472, on the left-hand side of the road, towards the west end of the plantation. As at the previous location, there good exposures of slump-folds, picked out by differential weathering of silty and muddy bedding laminae.

Slump fold at Location 5

Good as these exposures are, it is the folding exposed in the bed of the Caldew higher in the valley which is really special. About 1km from Roundhouse, the road runs very close to the river and here, at NY 33041 32618 there are several parking places on the left **(Location 6**). Follow the bank of the Caldew (as close to the river as is safe) upstream from here, and over the next 400 metres or so you will see a series of superb exposures of water-smoothed Skiddaw Group rocks, pale in colour, and hardened by the Skiddaw Granite into hornfels. Millimeter-scale laminations in the rock (the original bedding surfaces) pick out the shape of the folds in exquisite detail. The geometry of the folds is highly complex, but it is thought to be slump-folding which took place in Ordovician times, probably before the eruptions that produced the Borrowdale volcanics. These very early slump folds seem to have been refolded by later tectonic events in the Acadian Orogeny, which partly accounts for the great complexity of the folding here. It is striking that there is no sign of cleavage in these rocks – in contrast with the hornfels seen in Sinen Gill (Excursion 2 in the book). This is perhaps because the Skiddaw Group sediments here had by Acadian times already been hardened by thermal metamorphism associated with the intrusion of the Carrock Fell igneous complex in Ordovician times.

Folding in Skiddaw Group rocks exposed in the bed of the Caldew upstream of Location 6.

After the junction with the Grainsgill Beck, the Caldew bends round to flow from a south-westerly direction. There are several popular bathing spots here, the main one a large pool below a rib of Skiddaw Group hornfels which runs almost right across the bed of the river, disfigured by several geological sample-holes **Location 7** (NY 32707 32592**)**.

A rib of hornfels runs across the bed of the Caldew at Location 7

Though we can't see it, the actual contact with Skiddaw Granite must be very close to this point - 100 m upstream you will see a pale buff exposure of rock in the centre of the stream bed, cut by a series of regular joints intersecting at right-angles – this is granite. The granite appears in the river bed at several other points upstream from here for the next 250 m (at the confluence of Blackhazel Beck), where is disappears again under the Skiddaw Group. Refer to the accompanying map to understand the shape of the granite outcrop here.

The first appearance of the Skiddaw granite in the bed of the Caldew 100m upstream from Location 7.

Return down the Caldew to the confluence of the Grainsgill and follow the beck upstream to the little bridge. The rocks downstream of the bridge are Skiddaw Group, just before you reach the bridge you are on Skiddaw Granite again. Rejoin the main track at the bridge and walk back eastwards to join the track that leads up to Carrock mine, **Location 8.**

The veins that were exploited at Carrock formed from hot fluids generated by the Skiddaw granite magma as it rose into the crust some 400 million years ago. The two principal veins (known as the Emerson and Harding veins) are rich in rare metallic elements such tungsten, molybdenum, and bismuth - run north-south through the western edge of the granite outcrop near where Brandy Gill flows into the Grainsgill. To the north the veins pass into rocks of the Carrock Fell Igneous complex, and to the south into the Skiddaw Group on Coomb Height. If you climb a little way up the side of Brandy Gill you will get a good view south to Coombe Height where the Harding vein can be clearly picked out as a line of open-cut workings on the fellside.

Carrock mine as see from Brandy Gill. Open workings on the Harding vein run up the side of Coombe Height

Little now remains of what were once extensive spoil heaps and mine buildings, but an interpretation panel has been erected on a levelled area at the end of the mine track. The history of the mine is a fascinating one, but beyond the scope of these brief excursion notes. Interested readers are referred instead to the links at the end of this document.

The next stage of the excursion involves a moderately steep (but not rocky) fellside ascent of around 250m. If you are not feeling keen on this, return to Mungrisdale. Otherwise, go back down Mosedale only as far as Roundhouse (**Location 4**), then follow the track down to the farm, which leads to a wooden footbridge over the Caldew. Beyond the bridge, the track leads directly up the grassy slope of Bowscale Fell towards the imposing cirque. As you ascend, there are superb views across to Carrock Fell, and down the Mosedale valley westwards towards the Carboniferous lowlands of east Cumbria, with the Pennines beyond.

The view down Mosedale towards the distant Pennines from the path leading to Bowscale Tarn

The cirque (**Location 9**) itself is probably the best example of this type of glacial feature in northern Lakeland. It is very symmetrical, with an imposing rocky backwall, a tarn (16m at its deepest), and a large moraine at its threshold. Excavation of the cirque by glacial erosion probably took place over

many thousands of years during the last glacial period, but the moraine itself is likely to have been formed during the relatively short interval of the Younger Dryas (13,000 to 11,500 years ago), when a glacier last occupied the cirque. The moraine is about 400 m in length, and as much as 20m above tarn level. It does not extend right across the lip of the cirque, either because of breaching and erosion by Bowscale Beck, or because for whatever reason the glacial debris failed to accumulate across the entire width of the cirque edge.

Panoramic aerial view from above Carrock Fell looking over the Mosedale valley to Bowscale Tarn and its well-defined threshold moraine.

Bowscale Fell is within the metamorphic aureole of the Skiddaw granite, and the growth of cordierite crystals caused by thermal metamorphism is widespread in the Skiddaw Group here. Look out for pieces of slate with the characteristic pock-marked surface, caused by weathering of crowded cordierite crystals.

Weathered cordierite slate on Bowscale Fell.

If you are returning to Mungrisdale, you can either go back along the route just taken, or more directly *via* the track which leads westwards from Bowscale Tarn to the hamlet of Bowscale, only a short walk (or cycle) north of Mungrisdale.

Carrock Mine links

https://www.aditnow.co.uk/Mines/Carrock-Wolframite-Mine_3009/

and

https://historicengland.org.uk/listing/the-list/list-entry/1019958