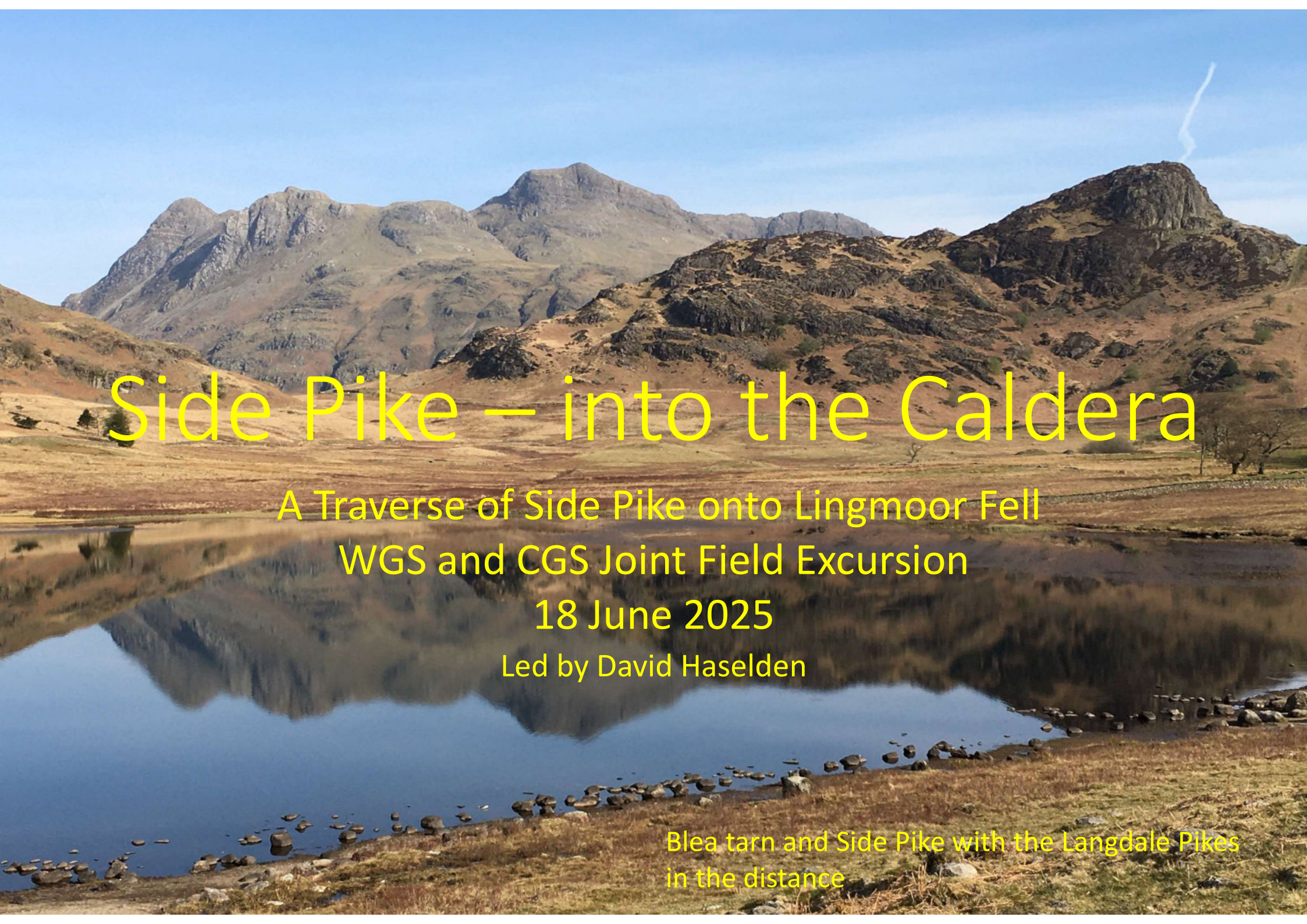


Side Pike – into the Caldera

A Traverse of Side Pike onto Lingmoor Fell

WGS and CGS Joint Field Excursion

18 June 2025

Led by David Haselden

Blea tarn and Side Pike with the Langdale Pikes in the distance

Logistics

Meet at the National Trust Car Park at Blea Tarn (NY 2954 0432) at 10am. Free for NT members.

The excursion will generally follow Itinerary 2.1 ‘The Margin of the Langdale Caldera: volcanic rocks of Side Pike’ by Prof Mike Branney in the new GA Guide No.77 [Branney (2023)].

The day will start by walking round Blea Tarn on a good path to the cattle grid below Side Pike and then traversing Side Pike onto Lingmoor Fell via ‘Fat Mans Agony’ covering around 4 miles (6.5k) and 1200 ft (360 m) of ascent. The route will follow footpaths where possible but even these will involve scrambling up rock steps. The first part of the traverse will involve ascent of some steep exposed ground. Crossing heather and bracken covered tussocky ground will also be required to reach some of the exposures. Although relatively short the excursion is graded medium/hard due to the terrain and good footwear is essential.

The excursion is expected to take around 4-5 hours so please bring adequate food and drink. There are no toilet facilities at the car park or on the excursion.

Introduction

The excursion provides an opportunity to traverse the margin of the Langdale Caldera passing over a series of volcanotectonic faults where iginimbrites and caldera fill deposits can be examined. Today most of the faults downthrow to the west but at the time of the caldera forming eruptions the faults dropped to the east as evidenced by significant thickness changes along the traverse.

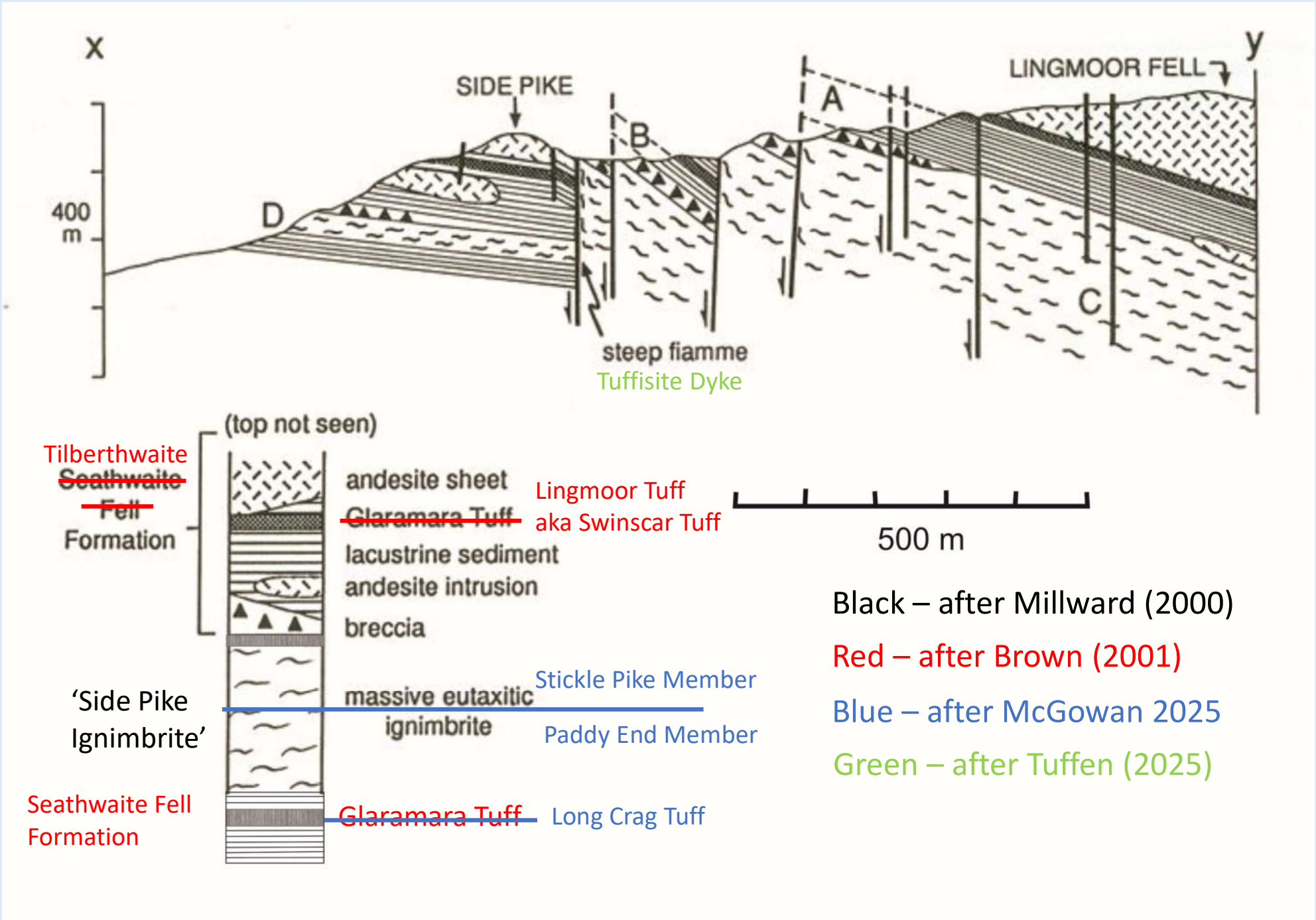
The understanding of the geology of the Side Pike area continues to evolve and new features are regularly being described. During the BGS resurvey in the 1980/90's much of the deposits around Blea Tarn didn't fit the regional stratigraphy and the concept of a mega breccia of 'exotic' blocks known as the Side Pike Complex was introduced [Branney (1988)] with blocks up to a kilometre in size created in a chaotic slide from stratigraphy no longer exposed.

However, when studying for his PhD on the Glaramara Tuff ring, Richie Brown [Brown (2001)] identified the distinctive accretionary lapilli bearing tuff at Long Crag [NY 2799 0400] as belonging to the ring. This provided the first tie into the existing stratigraphy and identified the underlying 70 m or so of turbidite sandstone as belonging to the Seathwaite Fell Formation of the Scafell Caldera. This had major implications for the regional stratigraphy and led to the overlying deposits being recognised as part of a younger Langdale Caldera succession comprising the Side Pike Ignimbrite and the turbidite caldera sediments of the Tilberthwaite Formation.

More recent work by a number of students at Leicester University, in particular Ed McGowan, has modified this interpretation further. His geochemical work has cast doubt on correlation of the tuff at Long Crag with the Glaramara Tuff putting into question the identification of the Langdale Caldera. However, the geochemistry also correlated the Side Pike Ignimbrite with both the Paddy and Stickle Pike Members of the Lickle Formation found south of Coniston, which are demonstrably younger than the Scafell Caldera succession, so confirming the existence of the Langdale Caldera and also indicating the Side Pike Ignimbrite was part of a major pyroclastic flow.

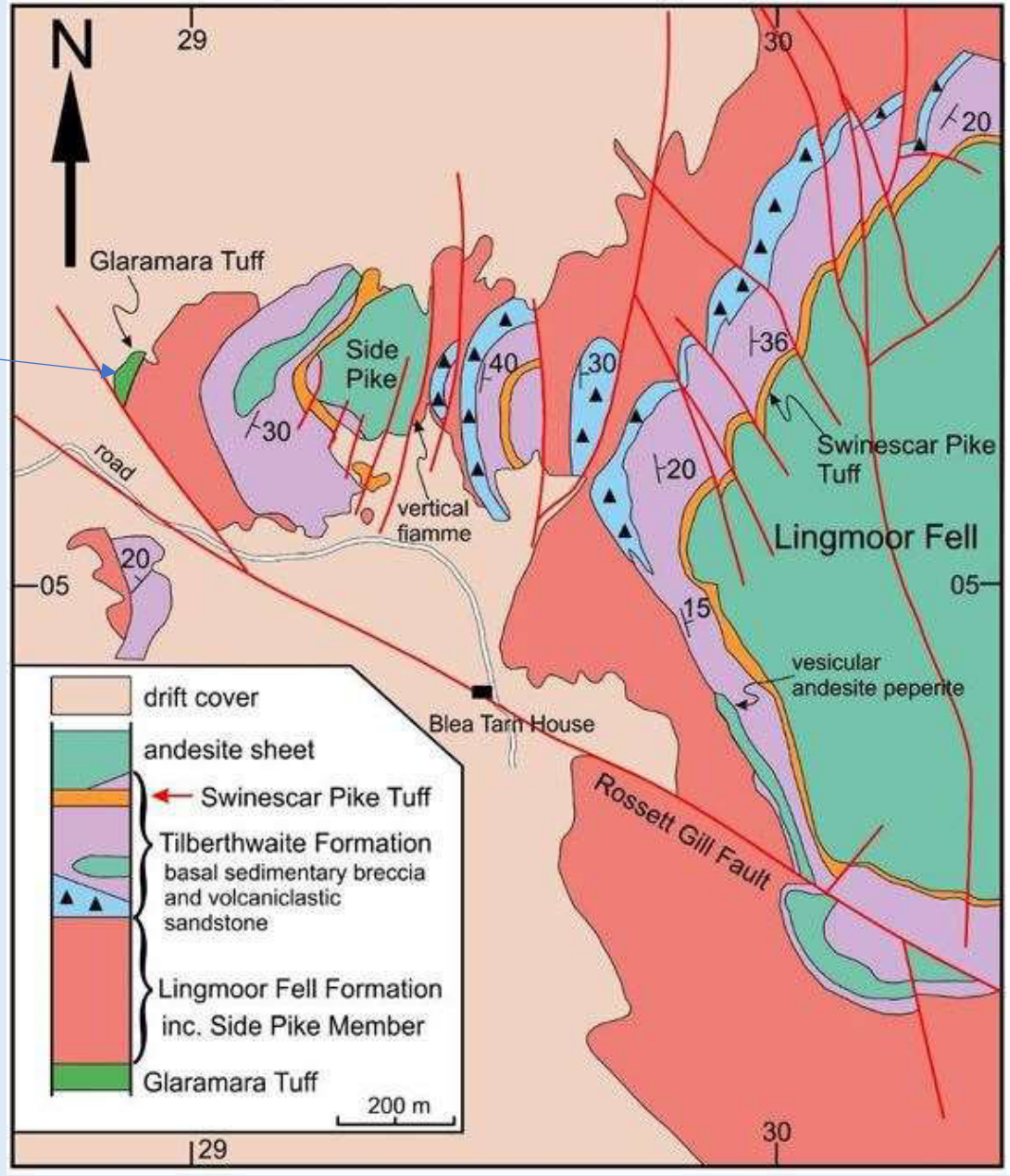
Also more recently, work at Lancaster University under Prof. Hugh Tuffen has identified a possible tuffisite dyke intruding the andesite sill on Side Pike.

Cross-section of Side Pike showing the evolution of understanding

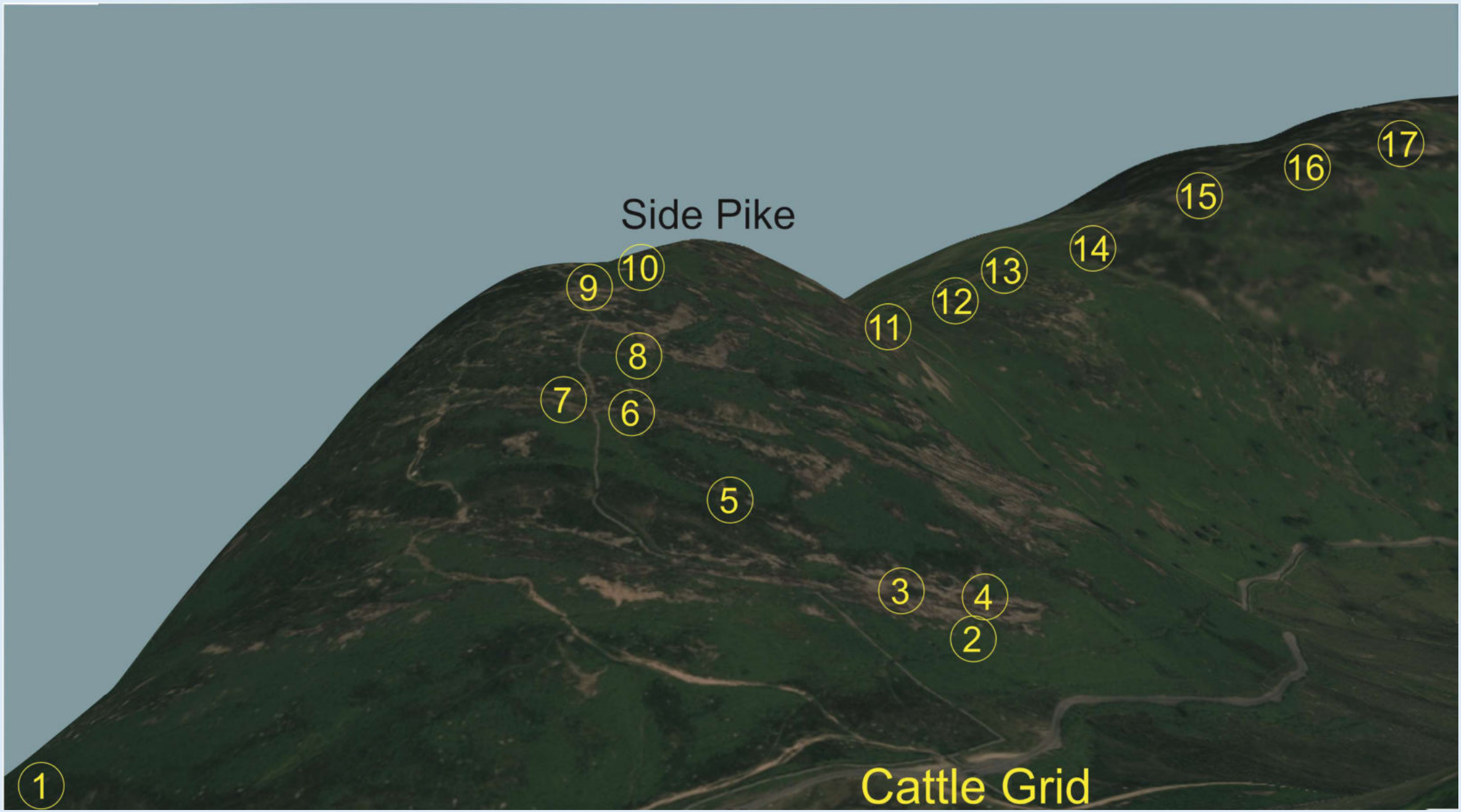


Geological Map of excursion area after Brown (2001)

Now named the Long Crag Tuff



3D View of the localities



Excursion



Locality 1 NY 2888 0535

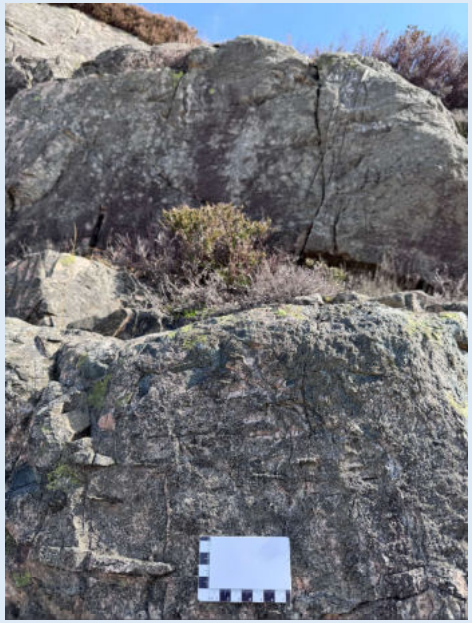
Bedded accretionary lapilli bearing tuff. Th lapilli are poorly sorted and some fragmented indicating deposition from a low concentration pyroclastic density current resulting from a damp “phreato-magmatic” eruption. This is an example of an unwelded ignimbrite. Thought to be part of the Glaramara Tuff ring this is now interpreted as a separate deposit although still belonging to the Scafell Caldera succession. Provisionally called the ‘Long Crag Tuff’.



Locality 2 NY 2900 0515

Coarse low-angle cross-bedded tuff at the base of the Side Pike Ignimbrite is also interpreted as an ignimbrite formed from a low concentration pyroclastic density current and marks the onset of explosive activity in the Langdale Caldera.

Excursion



Locality 3 NY 2900 0518

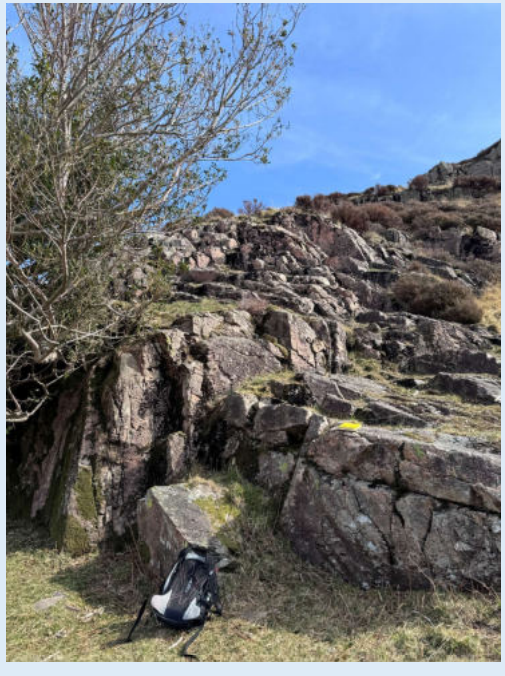
Densely-welded tuff with well developed eutaxitic texture formed from a hot, high concentration, pyroclastic density current. The fiamme protrude from the surrounding ash and comprise collapsed fragments of pumice affected by hydrothermal alteration so they are less easily eroded compared to the surrounding fine ash. This part of the Side Pike Ignimbrite has been geochemically correlated with the Paddy End Member of the Lickle Formation.



Locality 4 NY 2902 0516

Explosion breccia. This deposit maps out as a dyke-like body comprising matrix and clast supported brecciated Side Pike Ignimbrite and is interpreted as a rootless vent formed from a phreatic eruption as the still hot ignimbrite interacted with surface or groundwater similar to the “Valley of 10,000 Smokes”. The breccia appears to be limited to the lower part of the Side Pike Ignimbrite (ie Paddy End Member).

Excursion



Locality 5 NY 2899 0527

Intensely welded Ignimbrite deposited from an extremely hot, high concentration, pyroclastic density current. The fiamme are ‘steaked out’ giving a parataxitic welding fabric. The ignimbrite was hot enough to undergo viscous flow leading to ‘lava-like’ rheomorphic features (see below). This upper part of the Side Pike Ignimbrite has been geochemically correlated to the Stickle Pike Member of the Lickle Formation. The Side Pike Ignimbrite was initially thought to be a single cooling unit but has now been shown to comprise two separate ignimbrite deposits.



Left: Welding fabric deflected around a lithic fragment indicating the deposit was hot and ductile.
Right: A ‘delta’-object indicating top to right shear as the ignimbrite was just able to flow.



Excursion



Locality 6 NY 2902 0526

The top of the Side Pike Ignimbrite comprises a bed of white weathered fine ash which can be picked out by a sudden increase in cleavage intensity. This deposit was formed from the cloud of very fine ash which lofted above the pyroclastic flow as a 'phoenix cloud' before settling as a fine grained airfall deposit. This marks the end of the highly explosive caldera forming eruptions in the Langdale Caldera.



Locality 7 NY 2902 0528

Overlying the Side Pike Ignimbrite is a ~2-5m thick stratified tuff showing classic features of dilute PDC deposits including low angle cross-stratification and antidunes, indicating upper flow regime conditions. By inference from the exposures on Blake Rigg and Bleaberry Knott across the valley, this deposit is the Miller Stands Member [Haselden (2021)] and has been correlated with similar deposits above the Stickle Pike Member in Dunnerdale south of Coniston.

Excursion



Locality 7 cont…

Above the stratified tuff there is a layer of pink breccia consisting of clasts of Side Pike Ignimbrite. Branney speculates whether this was deposited from eruption of the rootless vent at Locality 4. However, there is no evidence for the vent in the upper Side Pike Ignimbrite (Stickle Pike Member) therefore the deposit is more likely to be a debris flow probably from unstable fault scarps formed during caldera collapse. This is supported by examples where blocks of the underlying tuff have also been brecciated. The breccia represents the first part of the sedimentary caldera infill, ie they belong to the Tilberthwaite Formation



Locality 8 NY 2906 0526

Overlying the pink breccia is a unit of stratified volcaniclastic sediments. These are fluvio-lacustrine sediments of the Tilberthwaite Formation. At this locality and along strike to the north there is significant soft-sediment deformation cited by Branney (1998) as evidence for the mega-breccia interpretation of the Side Pike Complex. However, the field relations suggest that the deformation is due to the intrusion of an andesite sill which is exposed above and behind the disturbed sediments.

Excursion



Locality 9 NY 2905 0531

Auto-brecciated andesite sheet with feldspar phenocrysts. On the basis of the deformation of surrounding sediments this is interpreted as a sill intruding the caldera sediments rather than a lava flow.



Locality 10 NY 2919 0536

Beyond the first summit on the ridge is a distinctive pale cream weathered stratified tuff. This is the Lingmoor Tuff of Branney (2023) and the Swinscar Tuff of Brown (2001) and forms a local stratigraphic marker which we will see repeated during the remainder of the excursion. The unit comprises beds of lapilli tuff overlain by fine ash containing abundant ash aggregates and is an ignimbrite deposited from a phreato-magmatic eruption. The tuff is capped by another andesite sheet which forms the summit of Side Pike.

Excursion



Locality 11 NY 2939 0531

Vertical welding fabric in ‘ignimbrite’. This was originally taken as evidence for a volcanotectonic fault where the welding fabric of still ductile ignimbrite was deflected by syn-volcanic faulting. However, work by students at Lancaster University has re-interpreted this exposure as a tuffisite dyke – i.e. a volcanic fissure filled with pyroclastic ash. Close examination shows the contact with the adjacent andesite sheet is too intimate to be faulting and a tuffisite vein can be traced into the andesite demonstrating that the tuffisite intrusion post dates the andesite sheet and therefore the main Langdale Caldera eruptions.



Locality 12 NY 2946 0527

Further exposure of the breccia, repeated by faulting, comprising clast supported blocks of Side Pike Ignimbrite.

Excursion



Locality 12 cont… **(**NY 2947 0528**)**

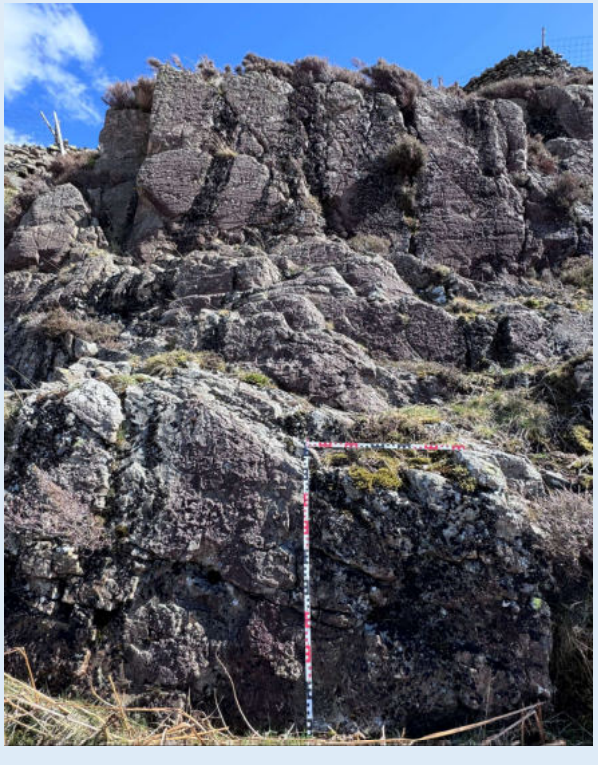
Above the breccia are deposits of fluviatile-lacustrine sandstones as at Locality 8 but here there is no intervening andesite sheet. It can be difficult to distinguish these deposits from ignimbrites deposited from low concentration pyroclastic density currents but here we have clear load and flame structures indicating a water borne deposit.



Locality 13NY 2954 0527

Overlying the sandstones we again find the Lingmoor Tuff. The upper surface of the tuff has been reworked by water and contains pebbles of accretionary lapilli attesting to their strength.

Excursion



Locality 14 NY 2965 0521

Breccia of Side Pike Ignimbrite. The now familiar breccia is repeated several times along the ridge. At this exposure the breccia is again overlain by volcaniclastic sediments which form the dip slope observed over the wall.



Locality 15 NY 2972 0514

Into the caldera. The steep slope ascended to this locality marks the location of the major caldera fault. The Side Pike Ignimbrite descends all the way to the road ~200m below. The geochemistry indicates this thick caldera fill is all Stickle Pike Member and the underlying Paddy End Member is not exposed which means the caldera fill probably extends to a significant depth below the surface. The locality is a spectacular example of the breccia.

Excursion

Locality 16 NY 2981 0506

The route now pass through the Langdale caldera lake deposits. These comprise lacustrine turbidites deposited from high concentration turbidity currents. Within the main caldera the lake sediments have thickened to around 250m and reach over 1km thick towards Tilberthwaite.





Excursion

Locality 17NY 2986 0500

The Lingmoor Tuff capped by an andesite sheet is well exposed in the prominent knoll adjacent to the wall comprising pale cream massive, diffuse bedded and low-angle cross-stratified tuff with beds of accretionary lapilli produced by pyroclastic density currents from an explosive phreato-magmatic eruption. The andesite sheet capping the knoll is the same sheet as forms the top of Side Pike (Locality 10).





Source Material

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