Storth Geotrail Guide

September 2013

This 5 kilometre (3.2 miles) route with 18 waypoints explores the landforms and geology around Storth and Sandside in the Arnside & Silverdale Area of Outstanding Natural Beauty (AONB). Full exploration will take about 3 hours. There is a shorter 1 hour option along Sandside Cutting or a longer 8 kilometre (5 miles) route extending south to Arnside Moss and Hazelslack. At the end of this guide there is advice about safety, local services and geological information sources.

Start
The trail begins at the Ship Inn (SD478807) close to Sandside Cutting where there is an information board. The route is best done anticlockwise starting with a walk along the Cutting.

Seasons
This is a lovely walk at any time of year but winter offers the best geoviews with less vegetation.

Storth Geotrail Route

Landscape Trust, Arnside & Silverdale Area of Outstanding Natural Beauty
Transport

The 552 Kendal to Arnside bus stops outside the Ship Inn

From Arnside Rail Station follow the embankment north for 700m to join the trail at Stop 5.

Part of the trail can be cycled from Sandside Quarry (Stop 17) to Throughs Lane (Stop 9).

Disabled access to the best part of Sandside Cutting is possible from the Friar Cote gate.

Park by the estuary 300m south of the Ship Inn - Patrons of the pub may use their car park.

Stop 1 - The Ship Inn (SD 478 807)

The Ship Inn dates back to the 17th century when Sandside was a thriving port for Milnthorpe and Kendal. Its location offers wonderful views across the Kent Estuary. The River Kent rises on the volcanic rocks of High Street, 20 miles away and flows south to an extremely dynamic estuary. Morecambe Bay has a macrotidal range of 9-10m, the second highest in Britain’s after the Bristol Channel. Spring tides with storm surges can inundate the Ship Inn car park – look at the spectacular photograph inside the pub.

Across the estuary from the car park, three geological zones can be seen. The upstanding peaks of central Lakeland like the Langdale Pikes are composed of tough Borrowdale Volcanic Group (BVG) rocks whilst the middle distance features the rounded profiles of the more easily weathered Silurian rocks. In the foreground, Whitbarrow includes the three limestone units seen around Storth; Dalton Limestone, Park Limestone and Urswick Limestone, referred to later by their abbreviated titles of Dalton, Park and Urswick. These local names come from across the bay in Furness, two from villages and Park from Park Sop mine.
These limestones were deposited between 345 and 336 million years ago in the Carboniferous Period from the remains of tropical sea creatures when ‘Britain’ lay just south of the equator. Dalton is the oldest formation and Urswick the youngest. The beds were originally horizontal but many have been faulted and folded by tectonic stresses and at Whitbarrow they slope down or ‘dip’ to the east.

This concept of rock structure changing through geological time is important because you are about to enter a world where the limestone beds have ended up in some strange positions. Another key concept is that of weathering and erosion which has removed much original rock cover. A powerful source of mechanical erosion has been the repeated flow of glacial ice and you will see evidence of the most recent (Devensian) ice age which left this area about 19,000 years ago. But even more erosion has occurred when the land has been ice free or subaerial and this erosion is still going on today as limestones are weakened by many factors such as freeze thaw, biological growth, water flow, gravitational collapse and chemical solution.

Walk a few metres north from the Ship Inn Car park to enter the footpath leading to the information boards about the Geotrail and the history of Sandside Cutting.

Sandside Cutting (SD 4751 8046) follows the line of the former Kendal to Arnside railway which opened in 1876 and closed in the early 1970s. It is owned by Beetham Parish Council and the public trail through it was developed in 1995/6. The cutting walls offer views of this area’s complex structural geology, not all of which has been fully explored.

The Silverdale Disturbance is a major monocline, where the beds have been folded from horizontal to vertical and back to horizontal again. The monocline is best seen later at Throughs Lane but the tectonic upheavals of the Disturbance also dominate Sandside Cutting where the beds have been compressed and turned to near vertical. West of Throughs Lane, the surface extent of the three limestone units reflects the thickness of the beds of each unit (see section below). The rocks of the upper part of the monocline have eroded away.

Section from St John’s Cross to Throughs Lane showing the likely configuration of beds below ground level
**STOP 2 – SLICKENSIDE (SD 4751 8046)**

The first rocks exposed along the cutting are **Park Limestone**. This was laid down in shallow tropical seas and is rather weakly bedded making it more prone to erosion than its tougher neighbours, the older Dalton and younger Urswick.

As the cutting becomes deeper around the first bridge at Storth Road, the Dalton beds crop out but a better place to inspect them is half way between the two bridges at Stop 2 where there is an example of a **slickenside**. This smooth polished surface was caused by friction of two beds as one moved sideways during folding and faulting.

**STOP 3 - CORAL BEDS (SD 4741 8038)**

Past the second bridge at Green Lane another longer slickensided slab appears on the right side (west) with fossil corals. The bottom left hand corner (yellow circle) is the best place to start looking but once you get your eye in you will find them all over the slab. They stand out because their crystalline composition has withstood erosion better than the surrounding limestone matrix.
Stop 4 – Folded Vertical Beds

Just past the coral beds on the other side of the cutting there are some interesting folded vertical beds. The figure in the picture is looking at the hinge of this fold which is the underside of a bed. Imagine that the cutting has sliced through an upended Swiss roll. The inner rings (folded younger beds) are exposed in front of the figure whilst the outer layers (folded older beds) are on the opposite side of the cutting and not visible in the photo.

It is difficult to be certain how this folding formed but it is likely to be related to forces producing curvature of the overall outcrop of the Silverdale Disturbance.

Walk on to the Friar Cote picnic table (SD 4736 8038) where the low lying field was once part of the estuary coastline and called Bomersha Bay. At the height of the last (Devensian) ice age, about 27 thousand years ago locally, sea levels were 120m lower with land bridges to the continent and Ireland. When the ice melted, levels rose to about 6m higher than today and seawater would have been lapping around Bomersha Bay. Once the earth’s crust was relieved from the pressure of around 700m of ice, it gently rebounded so that sea levels fell, stabilising about 6000 years ago. This isostatic rebound of the ground is still happening very slightly in Northern England and Storth is going up in the world. However because climate change is melting global ice, overall sea levels are likely to rise along the Kent Estuary.

Turn right at the gate and carefully backtrack northwards along the busy road to St John’s Cross at the bottom of Green Lane.

Stop 5 – St John’s Cross

St John’s was an estuary crossing point and hostelry when Sandside was a thriving port for Milnthorpe and Kendal. The ridge behind St John’s Cross is formed of Dalton Limestone but the impressive gateposts on the left are Urswick Limestone and quarried from limestone pavement, a common practice in South Cumbria until it was banned in 1981. Looking west there is a small salt marsh, used for summer sheep grazing, and meandering tidal channels with a backdrop of Lake District splendour.

As you enter Green Lane look right, at the steep cliff in the back garden at St John’s and then about 30m further on look left at a similar cliff in the garden of Dolfriog House. These two cliffs represent the same bed of Dalton Limestone that has been parted by the Bouskill Fault, a strike slip fault which has caused the rocks on the left to move 30m eastwards. You will meet the Bouskill Fault again at Stop 10.
When the last shop owner was unable to find a buyer, the villagers of Storth reopened the business in 2004 as a community shop run by volunteers.

The shop has funded the geotrail information boards so please call in and buy something to support our village.

Opposite the shop the patch of roadside rock is Dalton Limestone.

The older houses in Storth are built from local limestones and Urswick was popular for door and window lintels.

**Stop 6 – Storth Village Shop**

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**Stop 7 – Playing Field, the Park Corridor**

*Walk along Yans Lane* to the Playing Field where you leave the Dalton ridge and meet a corridor of gentle topography over Park Limestone.

During the last ice age, glaciers flowed south from the Lake District and passed through Storth, accentuating the erosion of the softer Park Limestone to form this corridor which is also visible in the field on the north side of Yans Lane. Sub-aerial erosion has also contributed to the formation of this corridor.

*Cross the playing field to Shaw Lane, follow this to Storth Road, turn left and head south to the cross roads.*

The houses of Greenbank Avenue and Langdale Crest are built on a ridge of Dalton Limestone which extends northwards down to Rose Hill Grove and Storth Village Hall. The Dalton/Park boundary runs through the garden of the large house at Four Lane Ends.

*Turn left into Cockshot Lane* passing the Park corridor again at Paddock Way and Burntbarrow. The little hill between Burntbarrow and Throughs Lane (Throughs Ridge) is formed from Urswick Limestone, a tough rock that has withstood erosion better than the Park.

Before entering Throughs Lane, peer over the wall opposite into a ravine heading south towards Hazelslack. This ravine and Throughs Lane follow the line of a soft bed of rock called Woodbine Shale, which has been partly eroded by ice or glacial meltwater. Geology often influences the courses of roads and footpaths.
**Stop 8 - Throughs Orchard (SD 4778 7991)**

We are now at an important part of the **Silverdale Disturbance**. The terraced cliffs above the abandoned damson orchard are near vertical beds of Lower Urswick and the cliff on the right (eastern) side are younger Urswick beds. In the trail description and diagrams, for clarity, these beds above the Woodbine Shale are labelled Upper Urswick. Some authorities prefer to divide the Urswick more precisely by micro-fossil assemblage into Upper and Lower Urswick at a point about 5m above the Woodbine Shale. However this division is difficult to identify in the field and the 5m of beds in question may in any case have been partly eroded away at Throughs Lane.

This monocline was formed during the Hercynian or Variscan **orogeny** (mountain building period) which began in the late **Devonian** 367 million years ago and continued until the early **Permian**. East of the road, the beds of the monocline return to near horizontal within 120m.

**Stop 9 – Walking along Throughs Lane (SD 4777 8009)**

On the right, the underside of younger Urswick Limestone beds incline at 76° down to the east and probably mark the upper boundary of the Woodbine Shale. You would have to dig up the road to find the shale now!

Further along there is a marvellous view of the Lower (older) Urswick Limestone on the left. The exposed bedding plane forms a long backdrop to the sloping driveway of The Croft seen in the picture on the right. Near the end of Throughs Lane on the right in the woods, behind the old well, the bed alignment changes from vertical back towards the horizontal.

*Turn right into the final part of Yans Lane and after 50m at the brow of a small rise just before a garage, turn right at a footpath sign at SD47838026 to follow a path between a wall and the meadow opposite Bouskill.*
**Stop 10 – Limestone Depression at Bouskill (SD 4788 8023)**

This field lies in a shallow topographic depression, related to underlying geological structure and was probably deepened by the chemical erosion of limestone and glacial erosion. The beds dipping 17° SE at Fell End are Lower Urswick and abut the Park Corridor. But the beds at Throughs Lane Well which seem to be heading for Fell End are Upper Urswick. The reason for this mismatch or discontinuity is the **Bouskill Fault**, previously met at Stop 5 at St John’s Cross and Green Lane. At Bouskill this strike slip fault has moved the Lower Urswick outcrop at Fell End about 250m eastwards to the right so it is called a dextral fault.

*Continue into woodland and climb gently with cliffs and fallen boulders on the right. A little further on a wall appears above the cliff. Keep this in sight until it turns away.*

**Stop 11 – Enclosure Wall (SD 4808 8016)**

This wall was constructed in 1821 as part of the Beetham Parliamentary Enclosure Act. It is historically interesting but serves little purpose today. The boulders here are one of many local examples of the weathering of small Urswick cliff scars. Several mechanisms contribute to this. Blocks can be plucked by glacial quarrying or fall after weakening by repeated freeze thaw. Differential erosion of shale bands at cliff bases can also be important. At this particular location, the Bouskill Fault has also weakened the rock structure making it more likely to break up.

*Ascend gently for 200m to a couple of little bends and Stop 12 which is just past a yellow path marker pole.*

**Stop 12 – Borrowdale Volcanic Group (BVG) Erratic (SD 4818 8009)**

On a shelf 5m right of the path there is a rounded boulder whose surface is very different from the surrounding limestones. This rock does not belong here and probably came from the upper regions of Kentmere or Longsleddale. It would have become stranded during melting of the Devensian ice about 19,000 years ago and is a fine example of an **erratic**, a rock carried to a new location by glacial action. BVGs only account for about 5% of the AONB’s erratics. The much commoner **Silurian** erratics are found everywhere - in paths, walls, fields and as isolated erratic boulders.
At a T junction (SD 4837 8000) follow the footpath (along the line of the Bouskill Fault) through mossy limestone pavements until a fork right and yellow markers guide you to Cockshot Lane. Turn left along the road for 200m and after emerging from woodland, turn left again along a bridle path. Stop after 50m when you have an unobstructed eastern view.

**STOP 13 – VIEWS OF FARLETON KNOTT (SD 4860 7996)**

The undulating gentle foreground terrain is formed from fluvialglacial deposits overlying Park Limestone. Above the prominent skyline notch on Farleton Knott, Urswick beds dip towards the spectacular limestone pavements of Holme Park. The lower slopes of Farleton Knott are covered with periglacial screes of the more friable Park. In the foreground there is another topographic depression, quite a common feature in the AONB karst landscapes. It probably represents the combined effects of limestone dissolution and glacial erosion with some marginal till deposition accentuating earlier topography.

At a Y fork of paths (SD48518013) turn left into woodland after the cottage and barn (signed Cockshot Lane and Milnthorpe); cross the stile, pausing to inspect a fine, one metre thick, medieval wall with enormous blocks at its base. The path soon forks right climbing gently along Urswick Limestone with the Urswick/Park junction just over the fence on the right. Pass through the gate into open fields and down to a wall gateway.

**STOP 14 – FIVE STAR VIEWS AND A GEOLOGICAL BOUNDARY (SD 4854 8065)**

Milnthorpe is in the foreground and just to its left St Anthony’s Tower is built on a drumlin. Beyond and to the right near Crooklands is one of the finest drumlin swarms in England, with the rounded shapes of the Silurian Howgill Hills on the skyline. Left of Milnthorpe is the confluence of the rivers Bela and Kent. The low lying flat land here was inundated at the peak of the Devensian ice melt and the mosses you see now have resulted from isostatic rebound plus some land reclamation with drainage dykes.
The junction between the Park and Lower Urswick Limestones on Haverbrack Fell is in the fields sloping up towards the quarry edge.

*Follow the path down past small surface quarry pits to a bend in the wall by a small hawthorn tree. Stop 5m past this in a little depression by the wall.*

**STOP 15 - WALL ERRATICS (SD 48498 80750)**

This wall is constructed mainly of Park Limestone which came from the little surface quarries nearby. Being poorly bedded and rather friable, the Park is easier to excavate than the much tougher Urswick. But the wall also contains many Silurian erratic greywackes and one BVG erratic.

Many rocks develop a coating of algae, lichens, mosses and weathering features so that the surface appearance is not necessarily the same as the rock interior. At this stop some of the Silurian greywackes have been cut so you can admire their grey blue colour.

**Silurian Greywackes** were formed by turbidity flows (submarine landslips) around 430 million years ago. Notice how different lichens favour different rocks. The white one here, *Porpidia tuberculosa*, prefers the more acidic Silurian rocks.

![Porpidia tuberculosa on greywackes](image1.png)

![BVG greywacke](image2.png)
Continue downhill admiring the views and before leaving the field look back up at the bench marking the boundary between the Urswick and Park Limestone above a line of small Park Limestone quarries.

STOP 16 - SHAP GRANITE ERRATIC (SD 4837 8113)

Cross Lovers Lane by the seat and follow the path down and left past fields and through woodland until 40m beyond a stile there is large erratic of Shap Granite. This rock only appears on the surface in a small area of 6km² just south of Shap Village. Because granite erodes very slowly and the large pink crystals are so distinctive, erratics of Shap Granite are excellent for tracing the lines of former glaciers. Apart from flowing south to the AONB, ice and erratics from Shap moved east through the Stainmore Gap to the Yorkshire coast. The boulders just beyond the Shap erratic are Silurian greywackes.

By the Shoreline Business Park walk along Quarry Lane and after 200m turn left towards the quarry entrance.

STOP 17 - SANDSIDE QUARRY ENTRANCE (SD 4816 8102)

Quarrying operations at Sandside began in the 1880s and are now managed by Lafarge Tarmac (formerly Tarmac Northern). A new entrance cutting has exposed some interesting geology but the faces are unstable so heed the warning signs and observe from a distance!

When the Devensian ice melted it left a patchy covering of rock and soil (till) over the poorly bedded Park Limestone. A prominent thin mudstone layer can also be seen whilst the large blocks by the roadside are Urswick Limestone.

Return to Quarry Lane, turn left (SW) and follow the road for 400m.
STOP 18 – LIME KILNS (SD 4801 8090)

There is a Landscape Trust information board about this kiln and the history of lime burning in the area.

Just beyond is a restored shipping warehouse from the days when Sandside was a thriving port for Milnthorpe and Kendal. Siltation, changing channels and construction of the Arnside Viaduct in 1857 rendered the upper Kent Estuary unnavigable.

Continue along Quarry Lane to a signed footpath 200m past the builder’s yard on the right to return to the start of the trail for a well-deserved drink at the Ship Inn!

BONUS FEATURES - Storth Geotrail

SUMMERHOUSE POINT AND RIVER BELA – A SHORT EXTENSION FROM QUARRY LANE

After Stop 16 when Quarry Lane is reached turn right and carefully cross the B5282 road to follow the signed public footpath for 500m first along the railway embankment and then around open coast to reach Summerhouse Point, a magical spot on a sunny day with the tide coming up the Kent into the River Bela. There are wonderful views.

We are back to Dalton Limestone but unlike Sandside Cutting the beds here are not vertical – they dip down 20° towards the estuary. There are some pavement features with small grikes and runnels and just inland from the red lifebelt there is an old river terrace marking an earlier course of the Bela.

Return the same way to Quarry Lane.
THE ‘FULL STORTH’ – A LONGER ROUTE OF 5.5 MILES

From Friar Cote picnic table (SD 4735 8037) turn right at the gate and carefully backtrack northwards 50m along the busy road and cross to a concessionary coastal path opened by Dallam Tower Estate. There is a coastguard warning sign by the gate so take care at high tide before crossing a stile to regain the former railway embankment.

Dalton Limestone is exposed at the start of the path. There are more Lake District views, some salt marsh (used for summer sheep grazing) and meandering tidal channels.

Follow the delightful embankment for 1km to the second gate exit on the left by a bench. Cross the road to another path signed for Arnside Moss.

STOP A - ARNSIDE MOSS (SD 4697 7908)

This level area is only 5m above sea level and was formed during marine inundation at the height of the Devensian glacial melt when sea levels were around 6m higher than today.

Following the removal of around 700m thickness of ice, the land gradually rebounded and sea levels receded to their present limits.

The path offers views of Arnside Knott and then Middlebarrow Quarry. After 800m, cross the stile at a footpath signed Hazelslack. Continue ENE across little ridges of Dalton Limestone, cross the road, more fields and a small limestone 'obelisk' and head for Hazelslack Tower.

STOP B - HAZELSLACK TOWER (SD 4743 7866)

This fortified, late 14th century farmhouse with a Pele Tower is built on a well-cemented bed in the upper part of the Park Limestone. A high curtain wall can be seen on the west side of the field you are crossing.

Follow the path through fields to the west of the Tower, cross the road and enter more fields at a footpath signed Cockshot Lane.
**STOP C – URSWICK RIDGE (SD 4780 7904)**

After about 50m, the rocky exposure is Urswick Limestone, the rock on which the AONB’s **limestone pavements** are formed. This band of rock shows some pavement like features such as runnels, flutings and kamenitzas. But the prominent linear edge does not mark a long grass-filled grike; it is actually a bedding plane or junction between two beds and it has been turned to near vertical by the Silverdale Disturbance.

*Follow the footpath through fields to a wooden stile and gate and continue to Cockshot Lane to Stop 8.*

**THREE OTHER VARIATIONS**

Arnside Moss becomes rather boggy after persistent rain but there are other interesting alternatives on good paths.

**V1** - From Friar Cote 200m of exposed road walking southwards reaches a public footpath starting at Rock Cottage. The route climbs up towards Storth Road through ground underlain by beds of steeply inclined Dalton Limestone.

**V2** – (Guard Hill) Continue along the road 300m past Rock Cottage and turn into Guard Hill Lane which also climbs through similar Dalton Limestone terrain to the Village Shop. Check the AONB website for information on a Landscape Trust reserve at Guard Hill.

**V3** – Follow the ‘Full Storth’ along the embankment and to the exit gate, cross the road and head north for 250m to Keasdale Road. Just past the Carr Bank Garden Centre follow the footpath sign to pick up another delightful path climbing through Dalton Limestone to Four Lane Ends.

**STORTH GEOTRAIL**

This trail has been planned and described by Peter Standing with artwork by Janet Brady. Valuable suggestions were added from Mike Dewey, Audrey Brown, Melville Thomson and Mike Balderstone. The display boards were designed by H&H Reeds Printers of Milnthorpe. The Storth Geotrail is supported by

- The Arnside and Silverdale Area of Outstanding Natural Beauty (AONB)
- The Landscape Trust
- Storth Community Shop
- Beetham Parish Council
- Cumbria GeoConservation (formerly Cumbria RIGS) and the Westmorland Geological Society

We are also grateful for help from Dallam Tower Estate and Sandside Quarry (Lafarge Tarmac).

**If you have any feedback or suggestions for improving the trail we would love to hear from you please email** landscapetrust@arnsidesilverdaleaonb.org.uk **or telephone 01524 761034.**
Safety

+ Although the Geotrail is a reasonably safe excursion it is sensible to observe health and safety basics and to remember that Beetham Parish Council, the AONB, Landscape Trust, their partners, officers and the geotrail planners cannot accept any responsibility for any loss, injury or inconvenience you might suffer.
+ Limestone can be slippery especially when wet.
+ For all AONB walks there is a chance of picking up ticks with a small risk of Lyme Disease. A free leaflet is available online and from the AONB Office at Arnside Station advising on how to minimise exposure to ticks and safely remove them. In summer, when walking through woodland, keep arms and legs covered to reduce the chances of bites.
+ During very high tides the permissive coastal path across the road from Friar Cote may be submerged. Tide times are available on the internet and in the Westmorland Gazette.
+ Take special care walking on the road near Friar Cote. Most drivers are sensible but occasional maniacs think this is Silverstone.
+ Near Sandside Quarry stay safely on the pavement as heavy vehicles use this road. Also follow warning signs to avoid rock faces.

Conservation

Do not collect rock samples or fossils.

Please look after this precious landscape. Leave no litter, keep to paths, close gates, and keep dogs on leads in fields with livestock.

You can support the work of the AONB by joining the Landscape Trust or volunteering for conservation tasks.

Refreshments - Please support our local services

Storth Community Shop and Post Office sells food, newspapers and many other things.

The Ship Inn stocks excellent ales and serves meals. The Kingfisher Restaurant is also close to the trail.

Other Geological Sites in the AONB

If you have enjoyed exploring the Storth Geotrail there are many other interesting AONB geological sites. There are guides to the following three walks and others are planned.

1. **Trowbarrow Quarry** – more spectacular evidence of the Silverdale Disturbance
2. **Gait Barrows NNR** – Britain’s finest lowland limestone pavement
3. **Arnside Coastal Trail** – all three limestone beds, synclines and splendid Lower Carboniferous fossils
4. **AONB Geotrails** – Check [www.arnsidesilverdaleaonb.org.uk](http://www.arnsidesilverdaleaonb.org.uk) for news of other geology trails.
Learning more about Geology

The AONB Office at the old Arnside Station is a treasure trove of information and holds leaflets on Trowbarrow Quarry, Warton Crag and Limestone Pavements. Walk PDFs - www.arnsidesilverdaleaonb.org.uk

The Landscape Trust, a charity of 900 members who support the AONB, runs guided landscape walks on geology, ecology and local history. Check the AONB website www.arnsidesilverdaleaonb.org.uk for details.

Cumbria GeoConservation (formerly Cumbria RIGS) has registered the sites at Sandside Cutting and Throughs Lane as regionally important sites of geological and geomorphological importance. See www.cumbriarigs.co.uk for information on Cumbrian geology, free downloads and leaflets.

The British Geological Survey (BGS) has a superb website including a free app on UK geology www.bgs.ac.uk

The Westmorland Geological Society holds winter lectures and summer field trips and always welcomes visitors and new members. Details from www.westmorlandgeolsoc.co.uk

Storth’s Three Limestones in Summary

<table>
<thead>
<tr>
<th>Limestone</th>
<th>Age Million years (Ma)</th>
<th>Sub Divisions</th>
<th>Thickness in metres</th>
<th>Colour</th>
<th>Character</th>
<th>Depositional Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>URSWICK</td>
<td>339-336 Ma</td>
<td>Upper Urswick</td>
<td>120 to 160m</td>
<td>pale grey</td>
<td>Thickly bedded, forms scars and pavements</td>
<td>Shallow seas. Beds formed during 30-40 cycles each corresponding to glacial events with sea levels rising as ice melted. Cycles continued for at least 3.5 Ma and each cycle probably lasted about 100,000 years.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Woodbine Shale</td>
<td></td>
<td>dark brown to black</td>
<td>Very friable Easily eroded</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lower Urswick</td>
<td></td>
<td>pale grey</td>
<td>Thickly bedded, forms scars and pavements</td>
<td></td>
</tr>
<tr>
<td>PARK</td>
<td>343-339 Ma</td>
<td></td>
<td>120 to 130m</td>
<td>pale grey or cream</td>
<td>Weak bedding, erosion prone</td>
<td>Shallow seas at depths of around 10-30m.</td>
</tr>
<tr>
<td>DALTON</td>
<td>345-343 Ma</td>
<td></td>
<td>110 to 255m</td>
<td>dark grey</td>
<td>Usually well bedded - can form cliffs. Thin shale partings in Middle Dalton.</td>
<td>Gently sloping ramp below a storm wave base &lt;100m. Deposition related to sea level change from tectonics rather than glaciation.</td>
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