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## 6 Dinantian and Namurian rocks of Bolton Abbey and Trollers Gill

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### Purpose

This excursion displays Dinantian and early Namurian sedimentary rocks from the northeastern part of the Craven Basin. It begins on the southern flank of the Skipton Anticline and passes northwards through the Barden Syncline and Skyreholme Anticline before ending at the North Craven Fault. There is abundant evidence of mineralization in Trollers Gill.

### Logistics

Conveniently split into two half days, each of which may be covered separately. For the Bolton Abbey section, begin at the Abbey car park [SE 071 538], and have transport waiting at the Strid car park [SE 058 563] parking charges operate; walking distance about 4 km. The terrain is easy for much of the distance, but care will be required on the narrow footpath on the wooded east bank of the Wharfe.

The Trollers Gill section begins at the old school house between Appletreewick and Skyreholme [SE 063 601] and ends at the top of the mine track at [SE 065 623], where there is roadside parking. The walking distance for this section is also about 4 km with easy tracks for the whole distance and only one steep section.

There should be *no hammering of any exposures*.

### Maps

O.S. 1:25 000 Outdoor Leisure 10, Yorkshire Dales, Southern Area; 1:50 000 Sheets 99 Northallerton & Ripon and 104 Leeds, Bradford & Harrogate; B.G.S. 1:63 360 New Series Sheet 61, Pateley Bridge.

### Geological background

The Carboniferous sequence of the Craven Basin is conspicuously thicker than that to the north of the North Craven Fault, and its base is not seen. In contrast to equivalent rocks to the north, these rocks were folded and faulted during Variscan times into a series of anticlines and synclines which strike and plunge towards the northeast. Bolton Abbey lies on the southeastern flank of a large, plunging anticline, the Skipton Anticline (Figure 6.1), which is broader and structurally more complex to the west. The first half of the route crosses this anticline and ends on the axis of the adjacent Barden Syncline, covering rocks ranging in age from mid-Dinantian (Skibeden Shale) to early Namurian (Skipton Moor Grit = Grassington Grit). The second half of the excursion crosses the Skyreholme Anticline and is primarily within late Dinantian limestones.

Folding occurred on two scales. The major anticlines and syncline are generally too large to be seen at individual locations, but small-scale disharmonic folds, within the Bowland Shales, can be examined in both horizontal and vertical section. Faulting is simple and also strikes to the northeast. Those faults within the limestones of the Skyreholme Anticline tend to be mineralized.

### Excursion details

#### The Bolton Abbey Section

Take the gateway into the Bolton Abbey grounds at the 'hole-in-the-wall' and follow the footpath towards the footbridge.

### **Locality 1 [SE 075 541]**

Downstream from the footbridge, across the river, is the best exposure of Upper Bowland Shale (early Namurian, Pendleian Stage) in the district. This large cliff, approximately 20 m high, is maintained by erosion at its base by the meandering River Wharfe. Surface weathering obscures details of the structures present but careful observation of the orientation of thin ribs of muddy limestone indicates that several folds are present. Note the bluish-grey colour typical of slightly calcareous shale, and the orange iron oxide (limonite) stain which results from modern weathering.

To the right (downstream), the shale is replaced by massive, well-jointed Skipton Moor Grit (Namurian). The contact is clearly a fault, which from this viewpoint appears to be reversed, with the younger grit being thrust beneath the shale. This impression is false; viewed from the footbridge along the strike, the fault is seen to be almost vertical.

The erosion of the shale at the foot of the cliff is so rapid, compared with that of the grit, that the river is in the process of cutting its way behind the gritstone, which will be eventually left as a small island.

### **Locality 2 [SE 076 542]**

Take the footbridge across the river, and look right to confirm the orientation of the fault. About 50 m upstream from the bridge, close to the river, there is a good exposure of well-jointed, friable Middle Bowland Shale (basal Pendleian) which dips downstream (southeast) at about 40°. This shale contains a poor fauna of immature fragmentary goniatites. Note the excellent concretion horizons, formed at an early diagenetic, pre-compaction stage.

### **Locality 3 [SE 075 543]**

Walk 100 m upstream to a point across the river from a small anticline (Figure 6.2). Folds on this scale are common within the Bowland Shale, having been formed during the folding of the main Skipton anticline, when bedding-plane slip concentrated movement within the soft and easily deformed shale, which lies between more competent limestone below and gritstone above. This fold is obvious because of the many thin limey bands. Note that the latter are strongly fractured but remain constant in thickness, whilst the intervening shales have been squeezed into the fold axis. This fold strikes northeastwards across the river and flood plain, cropping out for a second time on the opposite side of the meander.

### **Locality 4 [SE 076 544]**

Cross the meander along the strike of the fold to the river once again. Here the alternating shales and thin limestones of the Middle Bowland Shale crop out along the near-side of the river. Note that the fold is here observed in horizontal section. Most of the outcrop consists of southeasterly dipping beds, but the angle of dip increases downstream to a point where almost vertical shales are seen to be dipping to the northwest. The vertical shale marks the position of the fold axis. Once again, poorly preserved goniatite fragments may be found. The general absence of benthonic remains, combined with this distinctive lithology, are indicative of anoxic conditions on the sea bed at the time of accumulation.

The view up the Wharfe valley affords an excellent demonstration of river terraces, the most important of which occur at approximately 1.0, 2.5 and 5.0 m above river level.

### **Locality 5 [SE 078 455]**

Walk upstream for 300 m to a point where the path descends once again to river level. Middle Bowland Shale can be seen cropping out on the opposite side of the river, below the terraces, whilst on the left bank there is a high gritstone cliff. This cliff represents a fault plane, with a spring-line at its base where permeable grit is thrown against impermeable shale. Here the downthrow side of the fault is the side with the high relief. This is most likely part of the same fault system which was observed at Locality 1, where the downthrow was in the opposite direction.

### **Locality 6 [SE 078 554]**

Follow the path upstream through woodland for 700 m to the Storiths road and the ford across Pickles Beck. Cross the ford and continue along the road to a point 40 m beyond the crossroads at the river bridge. Here there is an old,

overgrown quarry set in lateral moraine left by the Wharfedale glacier. This material is typical of glacially derived deposits in being unsorted and unbedded and includes only locally derived Carboniferous clasts.

#### **Locality 7 [SE 076 553]**

Return to and cross the river bridge before turning right (upstream) and entering Strid Woods. About 100 m into Strid Woods take a small path down towards the river on the right to Sulphur Well. This well is situated approximately on the axis of the Skipton Anticline where sulphate-bearing groundwater (from pyrite in the shale) reaches the surface, the hydrogen sulphide being produced by the activity of sulphate-reducing bacteria. The white filamentous strands in the water of the spring are probably the bacterial colonies. The thick Skibeden Shale from which the water is emanating is very poorly exposed in this region and can only be seen in small exposures along the riverside between this locality and the next.

#### **Locality 8 [SE 075 555]**

Walk 150 m upstream, passing, on the opposite side of the river, well-exposed Draughton Limestone (Late Dinantian, Asbian Stage), to where thinly bedded limestones and shales of the Middle Bowland Shale are folded into plunging anticlines and synclines. One syncline in particular produces the characteristic V-shaped outcrop pattern in the river-bed, the V being directed towards the observer, in the opposite direction to that of the northeasterly plunge. Dips on the limbs of this syncline vary from 60° to 70°. When the water level is high these folds may not be visible.

#### **Locality 9 [SE 073 558]**

Return to the main path and continue upstream for 350 m to an outcrop of gritstone. This marks the position of a small fault striking northeast–southwest, which downthrows gritstone to the northwest. From this point to the Strid the route is over gritstone, the change from variably resistant Bowland Shale to uniformly resistant gritstone being recorded by a marked change in the characteristics of the river.

#### **Locality 10, The Strid [SE 064 565]**

Follow the path upstream to the Strid, a distance of approximately 1 km. At this famous locality, except in times of extreme flood, the entire River Wharfe descends through a series of large pot-holes which originally developed along a joint in the river bed and which have now merged to form a narrow, deep (c. 10 m) channel through which the river flows. Evidence of pot-holing abounds, including some large dry pot-holes on the abandoned margins of the river.

This is also an excellent locality at which to study the composition and sedimentary structure of the grit, but there should most definitely be *no hammering*.

Follow the track up to the Strid car park, a distance of about 1 km, and then drive to the old school-house at Skyreholme. Note that the shortest route, via Barden bridge, is not suitable for large vehicles. The alternative route, via Burnsall, also includes a very narrow road between Burnsall and Appletreewick.

### **The Trollers Gill Section**

Parking is not available at the start of this section so vehicles should be left at the end of the route [SE 065 623]. From Appletreewick take the road to Skyreholme and Parcevall Hall.

#### **Locality 11, Skyreholme Valley [SE 065 602]**

From this viewpoint there is abundant evidence of glacial deposition by a branch of the main Wharfe glacier. Downstream, the valley is blocked by moraine at its junction with Wharfedale. Look upstream to see the valley partially filled with drift, the depth of filling being indicated by the change in slope, vegetation and land use on the valley side to the right. Geophysical evidence suggests that the modern stream (Fir Beck) is not directly above its pre-glacial position.

Walk up the valley and turn left at the T-junction (signed to Parcevall Hall). Immediately before the road crosses Skyreholme Beck take the footpath on the left signed to Gill Heads and New Road. Follow the track as far as the old Skyreholme dam.

#### **Locality 12, Trollers Gill or Ghyll [SE 067 614]**

From Skyreholme Dam, the late Dinantian (Asbian) limestones can be seen dipping downstream (southeast), beneath the topography which consists of Bowland Shale in the foreground and Namurian gritstone in the distance (Simon's Seat).

The view upstream demonstrates clearly the curved southeastern limb of the Skyreholme anticline in the limestone outcrops of the valley side. This area has all the features of limestone country. This limestone is the lateral equivalent of the Draughton Limestone of the Skipton Anticline, but here it is much more massive and has more in common with the Great Scar Limestone of the Askrigg Block to the north. The local water-table is represented by the water surface of Skyreholme Beck; upstream the gradient of the valley floor is steeper than that of the water-table and therefore that part of the valley is dry. This was the worst possible position to have built a dam, since the reservoir would have been impounded entirely upon permeable Asbian limestone.

#### **Locality 13 [SE 067 615]**

Take the track upstream for 150 m and examine the view across the valley. Smooth, curved, overhanging outcrops of limestone mark the points where supra or sub-glacial streams impinged on the valley wall when this valley contained ice. The position of normal faults is marked by vertical discontinuities in the outcrop pattern on the valley walls.

#### **Locality 14 [SE 068 616]**

Take the track upstream to just beyond the stile, where a worked mineral vein may be examined on the left, about 20 m above the track. This inclined mineralized fault, close to the axis of the Skyreholme Anticline, was like many others in the region worked for galena.

Walk down to the valley floor. Here the valley forks; take the right fork (with Skyreholme Beck), and walk upstream as far as the first of two (sometimes three) springs.

#### **Locality 15 [SE 068 617]**

From this point upstream the gradient of the valley is steeper than that of the water-table and the valley remains dry. The gradient of the water-table is shown by the difference in elevation of the adjacent springs. The screes offer an opportunity to examine the limestone, the dip of which is now gently towards the northwest, i.e. in the reverse direction from that at the dam.

#### **Locality 16 [SE 069 618]**

Walk upstream as far as the boundary wall and look into Jackdaw Nick. This upper part of Trollers Gill is clearly a collapsed cavern, which under normal circumstances is dry.

#### **Locality 17 [SE 066 619]**

Return downstream and take the steep slope up into the hanging valley on the right. Walk up to the spoil tip on the left which marks the position of an old level, where working has taken place for galena. This is another mineralized fault and the irregular nature of the vein can be seen in the roof of the level.

#### **Locality 18 [SE 066 621]**

Walk up the valley, cross the stile and then examine the old workings at a disused mine on the left (Gill's Head Mine or Gill Heads Mine). This mine was the largest in the vicinity and was worked sporadically until recently. The width of the

fault zone represents a major fracture and the presence of horizontal slickensides indicates that the most recent movement has been in a horizontal direction. *This area is extremely dangerous and the old workings must on no account be entered.* This major fracture does not appear on the opposite side of the valley, indicating that it must be displaced by a second fault, which runs up the valley floor. The dip of the limestone is to the northwest, i.e. we are here on the northwestern limb of the Skyreholme Anticline.

#### **Locality 19 [SE 068 621]**

Continue up the track until it passes through a small cutting. Here the track follows the line of a small fault through the limestone escarpment, and affords an excellent opportunity to examine two different facies of Asbian limestone. On the right (east side) the limestones contain colonial corals, whilst on the left (west side) there are abundant productid brachiopods.

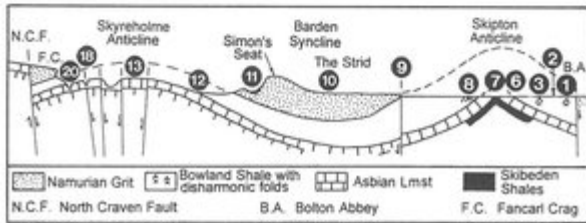
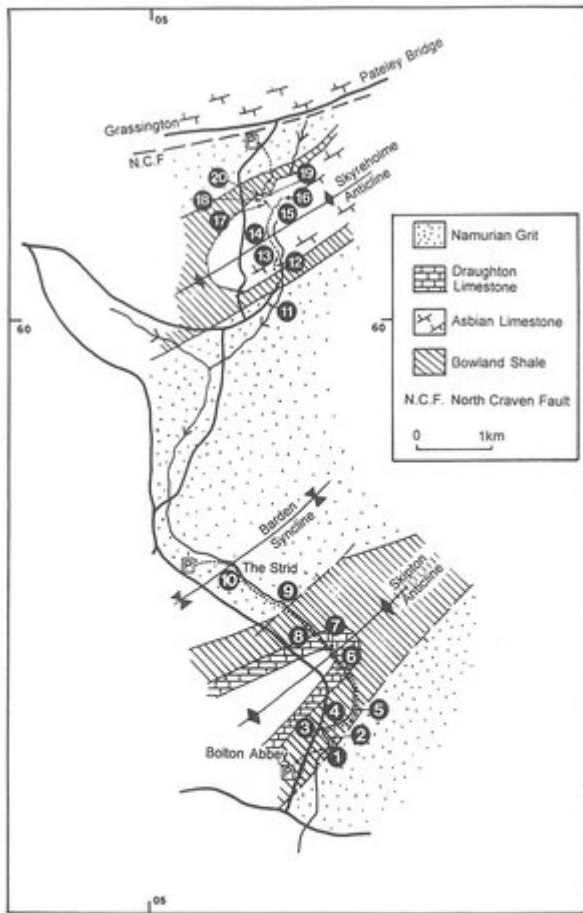
#### **Locality 20, Hell Hole [SE 066 622]**

This large swallow hole is just one of a series which mark the junction between the top of the limestone and the base of the overlying Bowland Shale. Since the Bowland Shale is impermeable, run-off is concentrated at this boundary. The important marker horizon, the *Girvanella* Band, may be examined on the flat limestone slabs in the entrance to the hole. This algal band marks the junction between the Asbian and the overlying Brigantian and is very widespread throughout northern England.

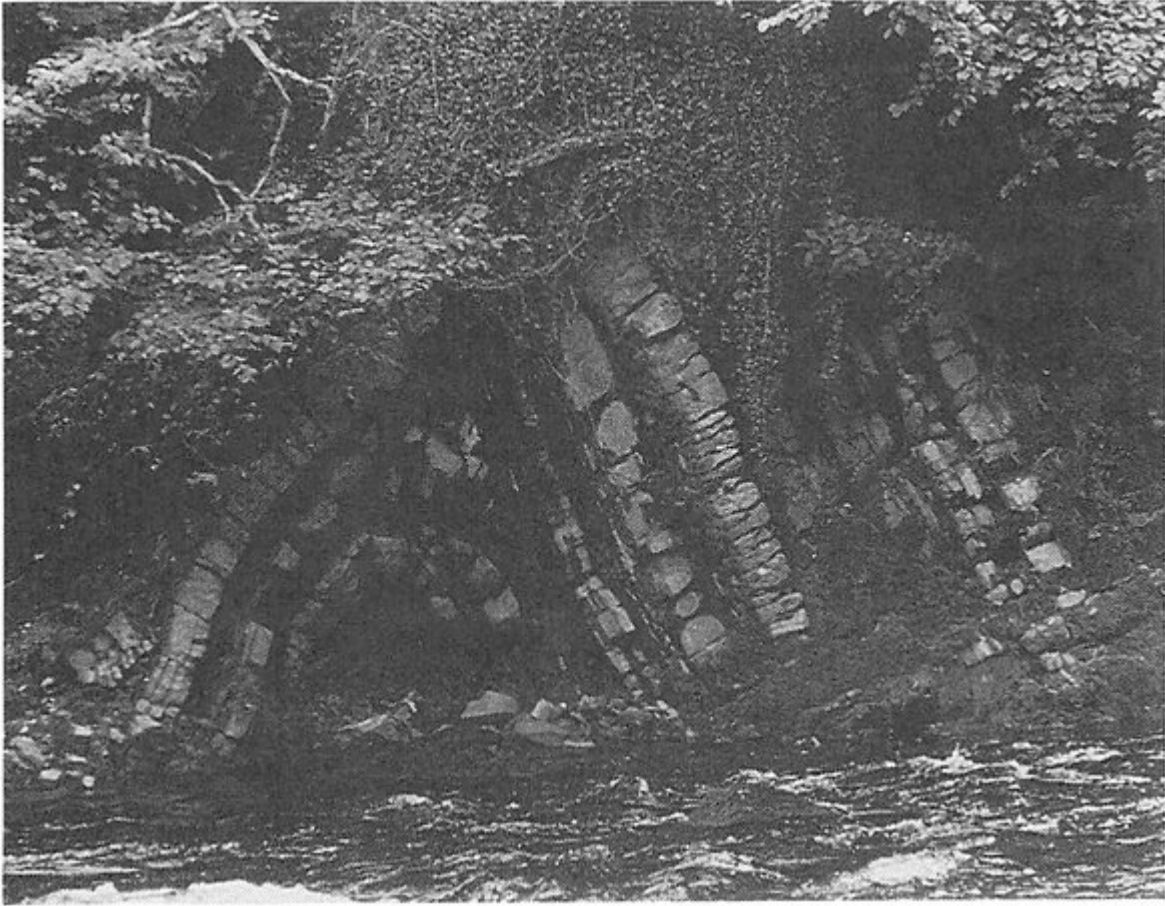
Return to the track and walk to the parking place. Note the feature of Fancarl Crag to the northwest, formed of Grassington Grit which lies upon the Bowland Shale. The scale of the Skyreholme Anticline can be judged by now looking towards Simon's Seat to the southeast. Fancarl Crag and Simon's Seat both consist of Namurian grit (although not at precisely the same horizon), on opposite sides of the Skyreholme Anticline. The limestone of Trollers Gill is at the anticline's core. The parking place is on Bowland Shale, which is clearly considerably thinner here than in the Skipton Anticline. This shale also contains two prominent limestone bands, each of which produces a marked change in gradient on the road.

Finally, while driving the short distance northwards to the Grassington/Pateley Bridge road, note that beyond the gritstone of Fancarl Crag there are once again the distinctive features of a limestone landscape. This sudden change from grit to limestone marks the southern boundary of the Askrigg Block, at the position of the North Craven Fault, which here has a throw to the south of several hundred metres and runs approximately along the line of the Pateley Bridge/Grassington road.

#### **[Bibliography](#)**



(Figure 6.1) (a) Geological map of the area between Bolton Abbey and the North Craven Fault. (b) Geological section of the area between Bolton Abbey and the North Craven Fault.



*(Figure 6.2) Disharmonic folding in Middle Bowland Shale at Bolton Abbey. Photo: J. Varker.*