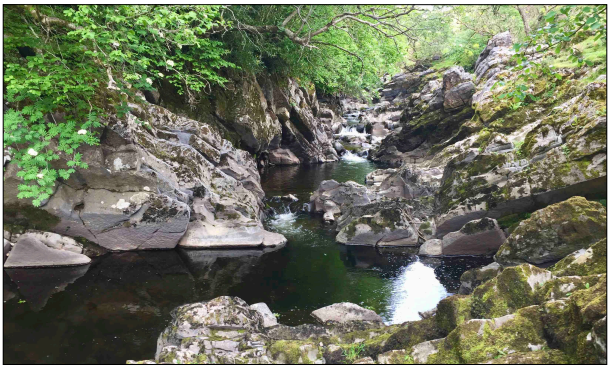
Cumbria GeoConservation

Geotrail Guide

The Sedgwick Trail

A Geological excursion across the Dent Fault, Garsdale

The Sedgwick Trail celebrates the life of local geologist Adam Sedgwick by exploring the geology around the Dent Fault in Garsdale. The fault is a major fracture in the Earth's crust in northern England. It divides the Silurian bedrock of the Howgills to the west from the younger Carboniferous limestones of the Yorkshire Dales to the east. Adam Sedgwick, a founding father of the modern science of geology, was the first to identify the fault, known as "The Dent Fault".



River Clough, Garsdale.

This trail was opened in 1985 to commemorate the bicentenary of Adam Sedgwick. Following severe river bank erosion in 2024, parts of the trail route has had to be altered. A revised fully illustrated trail leaflet is currently in production and will replace this interim guide.

We recommend downloading this geo-guide before arriving at the start point because there is limited mobile phone reception in the valley.

The Route

Walking length / time: 1.5 Km / 1.5 hours.

Start Location: Danny Bridge SD 6981 9127.

Car park: on the A684 at SD 694 912. Follow the signpost to the start of the trail at Danny Bridge.

Practical Details

The Common is private farmland. Please keep to the marked route. No dogs on the trail please.

Use of the trail is at your own risk. Good walking boots are essential as the terrain is steep and slippery when wet. Extra care is needed when walking on bare rocks. We recommend not to walk the trail in wet weather as the water level in the river can rise significantly.

OS Map: OL 19 (1:25,000)

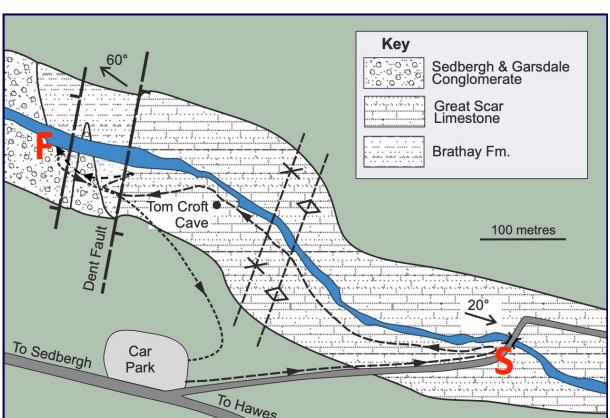
British Geological Survey map: Sheet No. 40 Kirkby Stephen (1:50,000)

Geological Overview

This steep wooded valley of the River Clough exposes a small section of the Dent Fault. Over a distance of just 600m, you'll be able to:

- locate the Dent Fault,
- observe how the Carboniferous rocks have been impacted by the Dent Fault,
- see a variety of rock types and fossils which helps us to understand the ancient environments that once existed over the area.

All these features provide a great introduction to geological processes and aspects of the regional geology. The following sections describe 12 stops along the trail which can be identified in the field by numbered posts.



Geological overview and route of the trail.
The start of the trail is at "S" and the finish point is at "F".

Viewpoint at the Car Park

Look west and you are looking across the Dent Fault towards the Howgill Fells, which geologically speaking belongs to the Lake District.

Now turn to face east and you are looking into the heart of Dales fell country, which noticeably has a more subdued upland landscape.

An explanation for these contrasting landscapes lies in their very different bedrock geology. The Howgills are formed of highly folded Ordovician and Silurian slates and sandstones. In contrast, the level-topped terraced fells of the Dales are formed of younger Carboniferous rocks.

Valley of the River Clough looking west towards the Howgills which rise in the distance.

Stop 1 Danny Bridge

The rock exposed in the river bed is Great Scar Limestone. It was formed from lime mud, calcite shells and skeletons of marine animals around 340 million years ago during Lower Carboniferous times.

Like most sedimentary rocks, the limestone was deposited in layers called *beds* and you can clearly see the beds in the opposite bank.

The beds are inclined, or *dip,* about 60º upstream. Throughout the Dales, the Great Scar Limestone are mostly horizontally bedded, but here they have been tilted, all because of disturbance related to the Dent Fault.

Stop 1 Next to Danny Bridge

Stop 2

In the bedrock below you are several fossils in the limestone. The fossils can be seen as white semi-circular forms which are the cross sections of shellfish known as brachiopods. This particular species is called *Gigantoproductus* and, as its name suggests, they are quite big. Indeed, they were the largest species of brachiopods in the Carboniferous. They lived at the bottom of the sea and used a muscular foot to cling to the sea bed.

Brachiopod Gigantoproductus in the limestone bedrock.

Stops 3 and 4

Interbedded in the limestones are other rock types. At Stop 3, the presence of gullies suggest a different rock type, one that is softer than the limestone and more easily eroded by the river. These are beds of black mudstone and their

presence indicates that the Carboniferous sea received incursions of muddy water from time to time.

At Stop 4, there are several thin layers and nodules of black chert. Chert is similar to flint in that it is composed of the mineral silica. The origin of chert is not fully understood but it possibly formed from the solution of silicious skeletons of marine creatures like sponges.

Stop 5

The steeply dipping limestone beds have now been replaced by an arch structure which is visible in the opposite bank. This is a fold in the limestone beds, known as a *anticline*. Just downstream, you can see the downfold, called a *syncline*.

Great Scar Limestone is folded into an anticline and then syncline just downstream of Stop 5.

Stop 6

In the water-smoothed limestone below you are fossils which appear as clusters of small tubes. These fossils are coral colonies called *Siphonodendron* and they provide clues to the type of environment that existed when the limestone was laid down.

Modern corals flourish in the warm, light and well-oxygenated waters of clear, shallow, tropical seas. We can infer therefore that such conditions existed here in Lower Carboniferous times.

Several Siphonodendron rugose coral colonies in the limestone bedrock.

Stop 7 (Tom Croft Cave)

The small cave next to the river was most likely formed by water draining down along the bedding planes of the vertical beds, and then horizontally

along open joints and fractures. As the river cut down the valley it exposed the cave allowing water to flow out and down the river.

In the riverbed are several potholes. These circular holes have been eroded out by the grinding action of small stones swirling within it.

Potholes in the limestone rock near Tom Croft Cave

Stop 8

Notice the change in the profile of the valley just downstream of Stop 8. The narrow steep sided limestone gorge suddenly opens up into a broader river valley. This is where the Dent Fault crosses the river valley just in front of you. Downstream of the fault, the rock is around 90 million years older than the limestone on which you are standing. They are mudstones which are more easily eroded than limestone, hence the broader valley profile.

Sedgwick was the first person to explain how it was possible to have two very different rock types of very different ages lying side by side. He attributed them to an “orogeny” (a mountain building episode) that raised the Lake District hills to the west by as much as 2.5 km relative to the Yorkshire Dales to the east.

Descend the steps and cross over the fence at the stile to reach Stop 9.

From Stop 8 the profile of the valley changes as you cross over the Dent Fault.

Stop 9

We are still on the upstream side of the Dent Fault and here we can see how the limestone has been broken into a mass of irregular fragments called a *breccia*. The breccia formed from extreme frictional forces as older Silurian rocks was forced up against younger Carboniferous rocks.

The movement shattered the rocks on both sides of the fault plane. You may also notice mineral veins in the breccia. These formed from hot fluids circulating at the time of faulting.

Cross back over the stile and continue walking downstream along the top of the river bank.

Stop 10

Along this section of the river bank, marsh grass and heathers grow in abundance. Although there are no exposures of mudstone here, these plants are key indicators of a dramatic change in the underlying geology, from alkaline to more acidic soil conditions and impervious mudstone bedrock.

Note the wide profile of the river valley and change in vegetation reflecting more acidic soil conditions.

Cross over a style and carefully descend the river bank to reach the final stops of the trail.

Stops 11 and 12

The rock exposed in the river bank at Stop 11 is our first opportunity to see the Silurian rock. It's a black laminated mudstone from the Brathay Formation. It was deposited at the bottom of a deep ocean around 430 million years ago.

Close by at Stop 12 is a large exposure of red pebble bed conglomerate. The conglomerate is a land deposit, dating from the late Devonian to early Carboniferous times before the land was submerged beneath the advancing Carboniferous sea. The arrangement of these two rock types so close together represents an unconformity, an ancient erosion surface. It is thought that the pebbles within the conglomerate were transported in a debris flow and came to rest on the Silurian mudstone bedrock, probably at the foot of an ancient mountain in a desert type environment. The unconformity represents a time gap of around 70 million years.

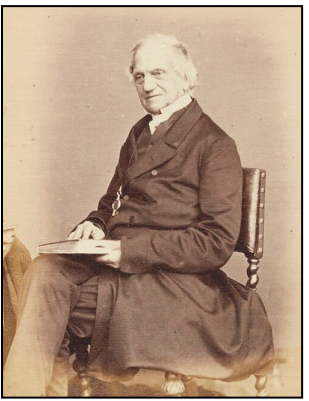
The large exposure of red conglomerate at Stop 12

The trail ends here. Follow the marked route back to the car park.

As you walk back to the car park reflect on what you have seen - three types of rocks laid down in very different environments spanning millions of years, together with evidence of earth movements which buckled and fractured the beds. Today we have the advantage of over a century of geological studies to help us interpret these geological events, but in Adam Sedgwick's day the geology of this area was completely unexplained, and he had to develop his own theories. It is to this man's great credit that his explanation of the geology and structure of the area is still accepted today.

Adam Sedgwick was born in 1785 in Dent. After attending Dent and Sedbergh schools, he went to Cambridge University where he became Professor in Geology in 1818. His researches into the older rock systems of Britain were pioneering and laid the foundation for modern study.

Image source: Wikipedia



This geotrail has been produced by Cumbria GeoConservation. If you've enjoyed this geotrail, visit our website to learn about other special geological sites in the area.

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