



# Ingleton Waterfalls Trail



# Geology and Ecology Guide



# Trial Guide Map

- MAIN ROUTE
- ALTERNATIVE PATH

**FALLS PARK HOLIDAY PARK**

- SNACKS & DRINKS
- TOILETS
- LITTER
- MOTORHOME PITCHES
- CAMPING
- HOLIDAY LODGES

**BROADWOOD CAR PARK**

- PARKING
- TOILETS
- SNACKS & DRINKS
- TICKET OFFICE
- LITTER

- 1 PECCA FALLS
- 2 HOLLYBUSH SPOUT
- 3 THORNTON FORCE
- 4 BEEZLEY FALLS
- 5 BAXENGYLL GORGE
- 6 SNOW FALLS

## Information point

Note the place marks and the trail locations are only approximate.



# Introduction

**Welcome to the famous Ingleton Waterfall Trail – 4½ miles of spectacular scenery which has attracted visitors since 1885!**

In recognition of its rare and interesting plants and animals, and also for its geological features, much of the walk has been designated by English Nature as the Thornton and Twistleton Glens Site of Special Scientific Interest (SSSI).

This guide will point out some notable ecological and geological features around the walk.

# Faults and Earthquakes

These are evidenced by the Craven Fault system, parts of which (the South and North Craven Faults) are crossed in this walk just as you leave the car park and head up (north), they run northeast-southwest and are responsible for the features such as Malham Cove and Giggleswick Scar.

These faults are just part of the constantly evolving surface of the planet earth.

This area must have had many major earthquakes in ancient geological time but now they are extremely rare and generally are so slight that only very sensitive instruments called seismometers can detect them.

A photograph of the fault is shown on the next page, with a diagram of the different types of fault as well as geological maps for the area shown on the following pages. The Craven faults are what are known as Normal faults, where one side is downthrown relative to the other side along an inclined fault plane. This is why there are younger coalfields south of Ingleton and older basement rocks to the north.



# Faults and Earthquakes

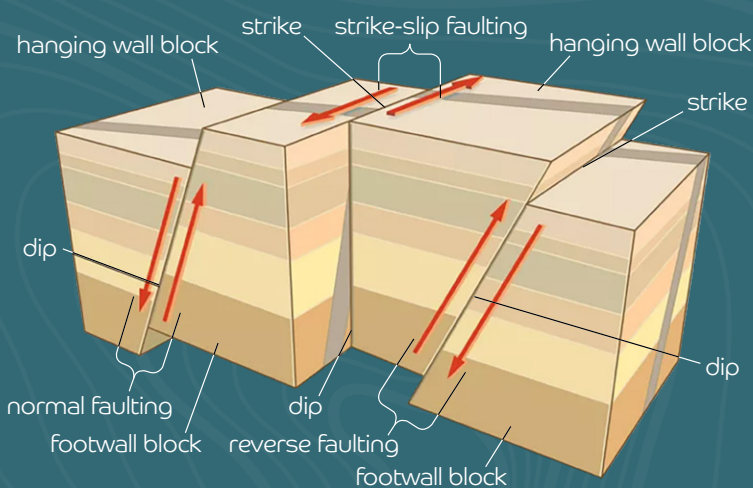
## 2



As you cross the South Craven Fault, the Limestone beds can be seen dipping towards the fault line.

# Faults and Earthquakes

The major faults in this region are the Craven Faults which are normal faults running northeast-southwest.

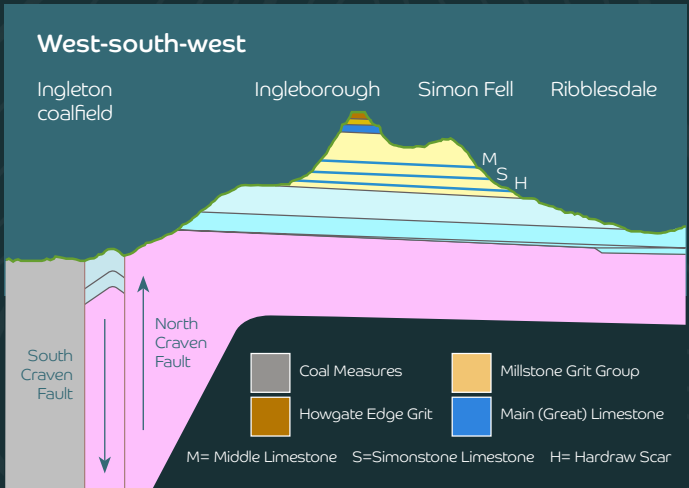
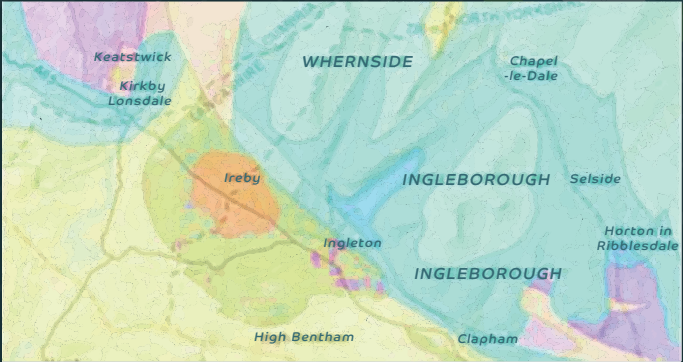


The diagram above shows the different types of faults. A normal fault is shown on the left of the diagram.

02

# Faults and Earthquakes

Geological map and section of the area.



# Thornton Glen

**Thornton Glen is an excellent example of a gorge woodland. The gorge is cut into Carboniferous Limestone.**

Woodland on the limestone is principally of ash with an understorey of hazel. Wych Elm is frequent by the riverside and yew grows on the cliffs and scars.

The ground flora is dominated by either dog's mercury, ramsons or tufted hair grass and is locally rich in woodland herbs, including sanicle and sweet woodruff.

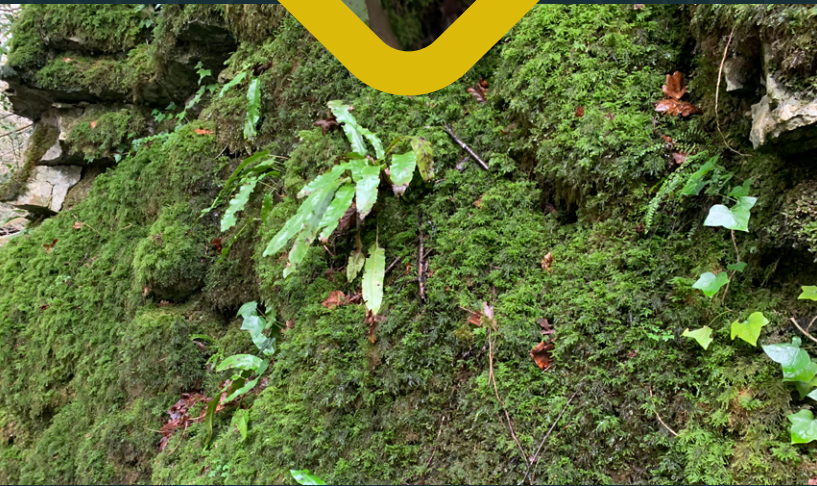


# Ecology

This rockface is shaded and damp. It is covered by mosses and harts tongue fern. The hart's-tongue fern is a medium-sized fern that can be found growing in damp, shady gorges and banks in woodlands, as well as on rocks, walls and mossy branches.

The hart's-tongue fern gets its name because it is thought to look like the tongue of a deer. The leaves are, indeed, tongue-shaped, with pointy, curly tips.







# Ecology

The exposed rocks in the river are used by dipper, which is a short-tailed bird with a plump body shape.

They are unmistakable, with a white throat and breast, whilst the rest of their body is a brown-black colour. They can be found in many different habitats, including; rivers and streams, estuaries, lakes, and the coast.

Dippers feed on aquatic invertebrates, including mayfly nymphs and caddisfly larvae, and small fish such as minnows.

While the majority of small food items are swallowed under the water, dippers bring larger food items to the surface to eat, and any undigested material is regurgitated as pellets. To hold their position and move around in fast flowing streams dippers use their wings.



Dippers are also known to feed on land along stream banks, turning over stones, leaves and debris.

Foraging is a time consuming activity, taking up to 66% of their day.

# Ecology

The money trees were approximately 130 years old when they fell.

They would have been seedlings during the final years of the reign of queen Victoria.







# Ecology

The woodland here includes hazel. You can identify it by the multiple stems growing from its base.

Hazel is traditionally used for making walking sticks.

This shrub can live to about 70 or 80 years of age – coppicing, however, can dramatically increase its lifespan.

Coppicing allows the shrub to constantly renew itself. The 'stool' (the base of the plant that remains uncut) is the only part of the plant that reaches any great age.

Coppicing is very good for wildlife, as it opens the woodland floor to more light and lets the amazing variety of spring flowers bloom, like lesser celandine, wood anemones, bluebells, wood sorrels and dog violets.

Dog violet is an important food plant for caterpillars of fritillary butterflies.





# Ecology

The cavities in the stone gabion baskets to the side of the bridge are used by nesting grey wagtail.

This bird is typically found around streams and rivers.

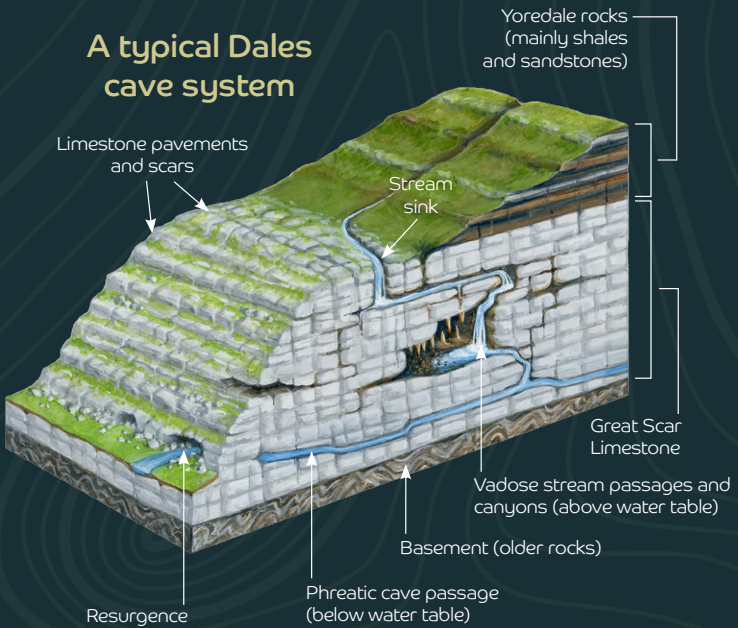


# Cave Formation in Limestone

Limestone, despite being a hard rock and forming features such as Malham Cove and Gordale Scar, has a major weakness and that is that even slightly acidic water can dissolve its way through the solid rock. Water dissolving the rock is how caves are formed in the limestone.

Water becomes acidic by picking up carbon dioxide from the air when it is falling as rain.

## A typical Dales cave system



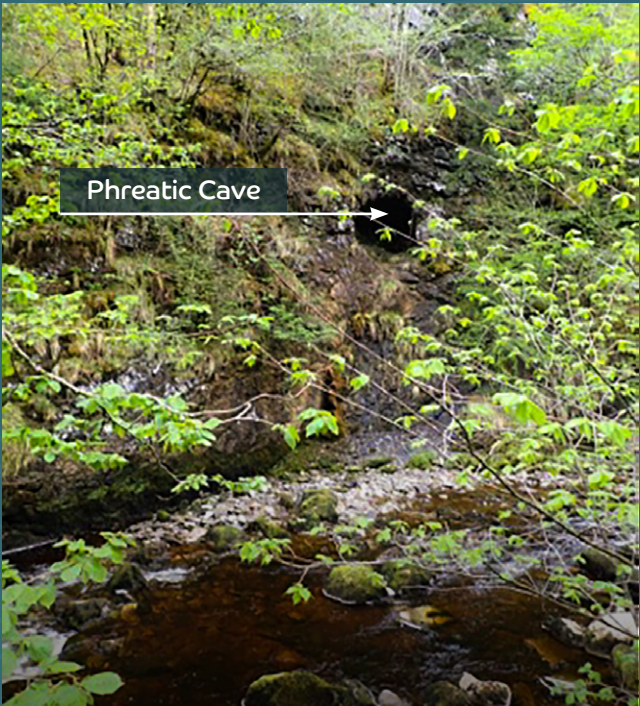


# Limestone Formula



where:

- $\text{CaCO}_3$  is a solid - calcite
- $\text{H}_2\text{CO}_3$  is carbonic acid - a relatively weak naturally occurring acid that forms by the reaction between water and carbon dioxide:
- $\text{H}_2\text{O}$  (rainwater) +  $\text{CO}_2$  (0.04% in the atmosphere)  
=  $\text{H}_2\text{CO}_3$  (carbonic acid)



# Ecology

Fern can be seen growing on the branches of trees in this area. The woodland in this valley is designated as a Site of Special Scientific Interest.

One of the reasons for this designation is that there are several species of moss and fern which occur at the limits of their British distribution. The damp, wet valley and large trees are ideal for these species.

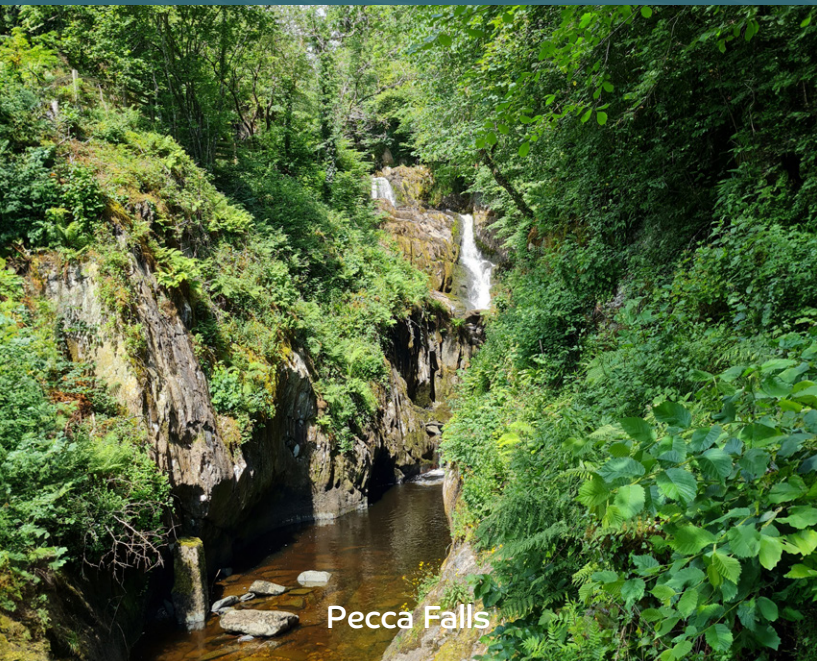




# Ecology

Pecca falls is the furthest upstream point which salmon and sea trout can reach for spawning.

Spawning usually occurs from November to December. After spawning many fish will die of exhaustion and their bodies can sometimes be seen to the sides of the pool below the falls.



Pecca Falls

# Hidden Landscapes

**The oldest rocks in this region were deposited in deep oceans around 500 Million years ago and subjected to periodic underwater landslides.**

The rocks were created from sediment being eroded off the landmasses into the deep sea. At this time, the British Isles did not even exist as an identifiable area. A world map showing the position of the UK at the time the rocks were created is shown on the following page.

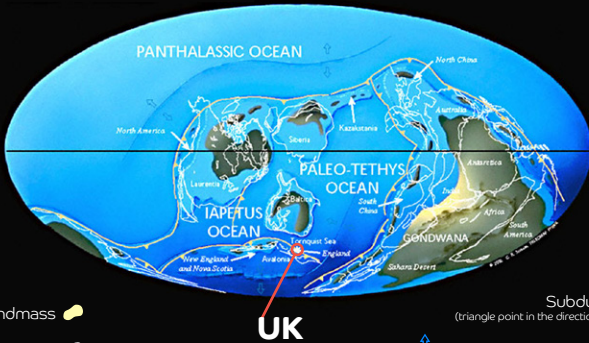
These Ingletonian rock are from the time period known as the Ordovician and have no easily identifiable fossils in them.


The rocks are known as 'basement' in the area as they underlie most of the Yorkshire Dales. They have been subjected to great pressures and some heat at depth and this made them form very hard slates and coarse sandstones (greywacke) seen in the falls. They are impervious to water and don't allow it to flow through.


# Hidden Landscapes

The Ingletonian (Ordovician)


Middle Ordovician 458 million years ago



Ancient landmass 

Modern landmass 

Subduction Zone  
(triangle point in the direction of subduction)

 Sea Floor Spreading Ridge



Slate/flag quarry



# Pecca falls

At Pecca Falls, the 'slatey cleavage' of the Ingletonian Basement can be seen. The Ingletonian Basement does not have parallel beds and instead they show a high angle cleaving of the slates.

The Ingletonian basement is exposed and quarried at Ingleton Quarry, which can be seen later in the walk.



High angle cleaving resulting in near vertical beds rather than horizontal beds.



# Thornton Force

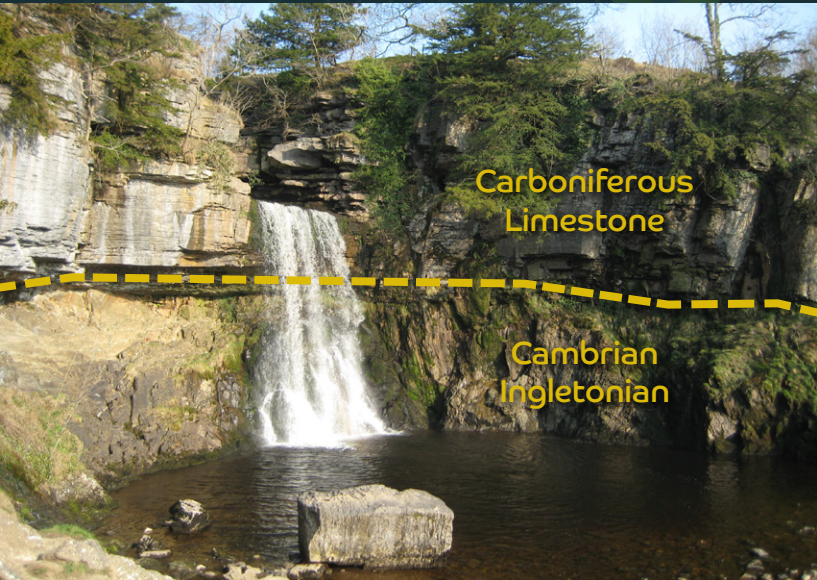
At Thornton Force, the junction of the Carboniferous Limestone, which rests upon the Ingletonian, is a classic example of an unconformity, where two groups of rock rest discordantly against each other.

The gap in age between the two rock layers is approximately 90 Million years!

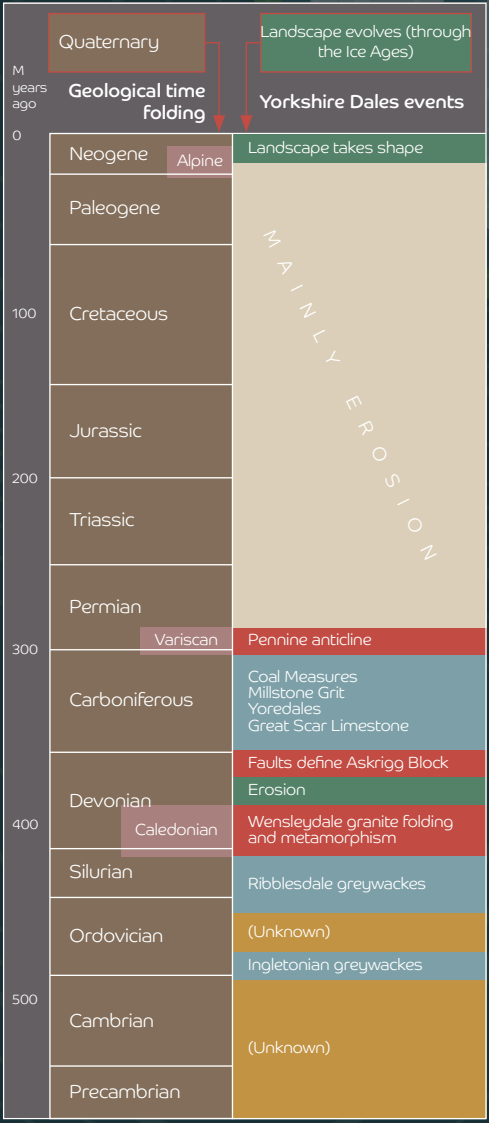
The unconformity provides evidence of severe earth movement and subsequent erosion which took place after the deposition of the Cambrian Ingletonian, but before the Carboniferous Limestone was deposited.

On the following pages, a labelled photograph is shown highlighting the line of the unconformity, and a table provides details on geological time.

# Thornton Force



The table on the next page provides details on geological time.



# Formation of Carboniferous Limestone

In the time that followed, the Ingletonian landscape was slowly covered by a tropical sea that was rich in life. This is known as the beginning of the Carboniferous.

The seas consisted of limestone mud full of corals, crinoids (fossil sea lilies), brachiopods and gastropods (marine snails). The rocks are so old that even dinosaurs did not exist when they were formed.

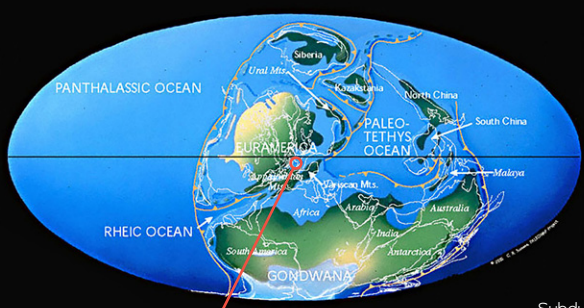
A world map showing the UK at the time the rocks were created, along with diagrams showing limestone formation, are shown on the following pages.



# Tropical Seas

## Carboniferous Limestone





Early Carboniferous 356 million years ago

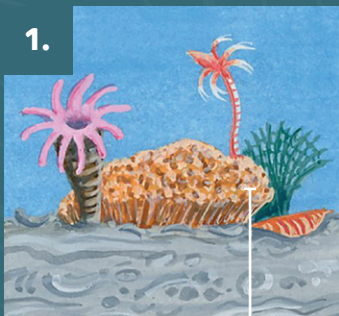


Ancient landmass   
Modern landmass 

UK

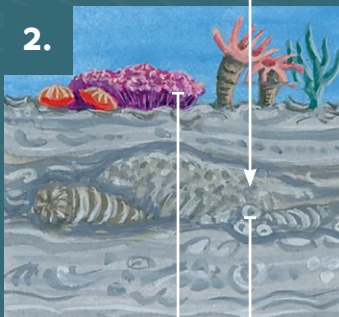
 Subduction Zone  
(triangle point in the direction of subduction)  
 Sea Floor Spreading Ridge

1.



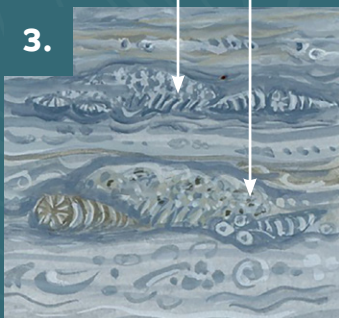
Sea creatures such as corals, crinoids and shellfish lived on the limy floor of a tropical sea.

2.



When they died their hard parts were buried under more shelly fragments and limy mud.

3.



More mud and shelly debris built up, eventually hardening into layers of fossil-rich limestone.



# Living in the Ice Age and Kingsdale

- Above Thorntons Force we can clearly see the 'U' shaped valley of Kingsdale which was cut by a glacier which also created a moraine, or dam, just above the falls, until the water was able to cut through it and create the series of falls we see today.
- The valley and moraine were not created by one single event but rather multiple advances and 'retreats' of the ice (so cold and 'warm' periods) over the course of 2.6 million years.
- This is probably the process that has had the greatest influence on the formation of the landscape, waterfalls and caves of the Yorkshire Dales.
- The current 'warm' period in which we live started about 11,500 years ago.
- We are still living in the ice ages!



# Living in the Ice Age and Kingsdale



Valley side

Moraine

River cut through

Valley side

Moraine

River cut through

# Ingleborough View Point



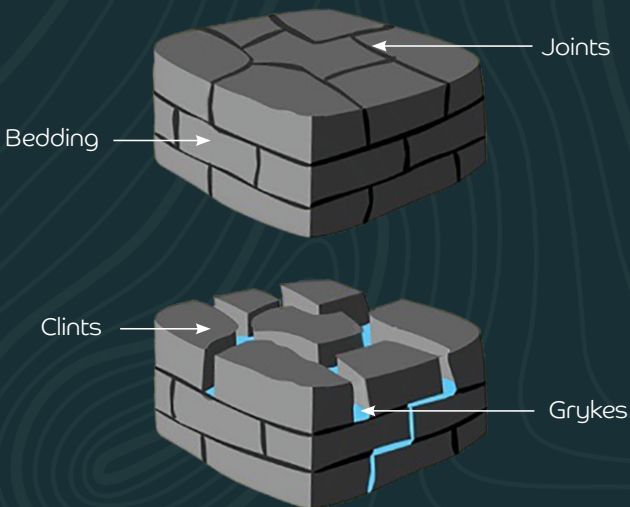
View of Chapel-le-dale

# Joint and Bedding

Joints are vertical features in the limestone that formed as the lime muds were drying and the water within them was being forced out under pressure.

Bedding planes are the horizontal features in limestone that separate units with different characteristics and often lithologies.

On the surface these joints become 'clints and grykes' of the limestone pavement scenery.





# Twisleton Glen

You are now entering Twisleton Glen, which is another example of a gorge woodland. Instead of Limestone, this woodland is instead above Silurian Slate, which has led to a different plant community to that found in Thornton Glen.

On the more acidic soils overlying the slate, the woodland instead consists mainly of oak with some birch. The ground flora includes great wood-rush, bilberry and wavy hair-grass.

# Ecology

The woodland here is typical of that which formed after the last ice age.

The remote nature of the valley meant that timber was not felled and the trees and associated plants to the forest floor have remained in their natural state. In spring, Bluebells carpet the forest floor. Wild garlic may be smelt and the woodland canopy is alive with birds which forage on the caterpillars associated with the ancient oak trees.



# Ecology

Mushrooms have been carved out of the stumps of oak trees in acknowledgement of the woodlands value for mushroom and toadstools.

The terms "mushroom" and "toadstool" go back centuries.

The term "mushroom" and its variations may have been derived from the French word mousseron in reference to moss. Delineation between edible and poisonous fungi is not clear-cut, so a "mushroom" may be edible, poisonous, or unpalatable.

The word toadstool appeared first in 14th century England as a reference for a "stool" for toads.

**Please don't pick or eat any mushrooms you see in the woodland.**



# Rocks from Water

When an underground stream reaches the surface it is known as a spring or resurgence and can form 'petrifying wells', such as this.

Tufa, travertines often occur where water has travelled underground for a long time before surfacing.

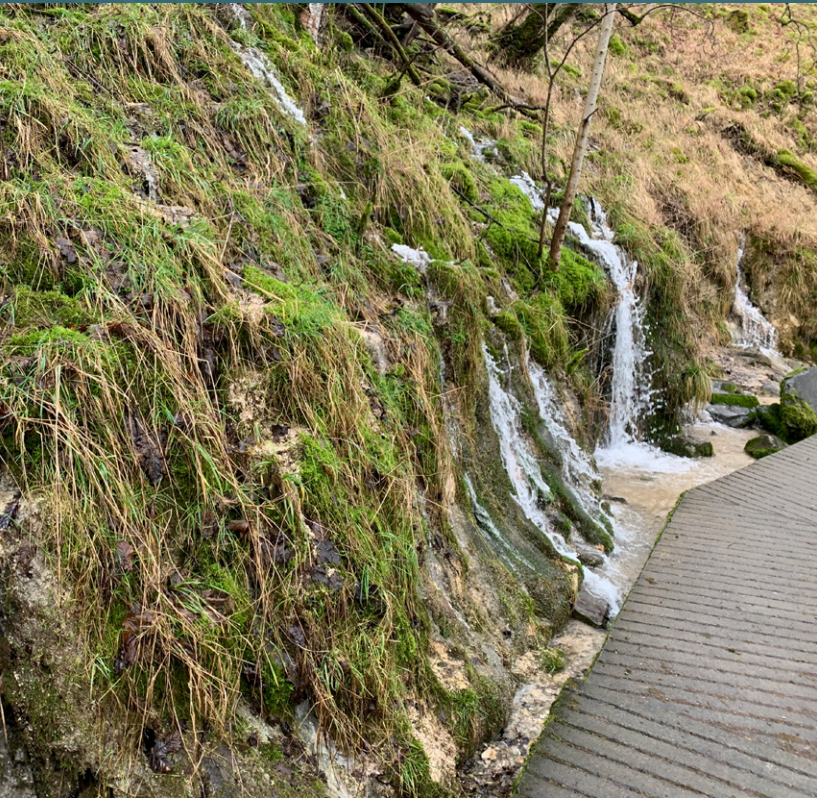
Tufa, travertines are formed in the same way that stalagmites and stalactites are formed. Calcium Carbonate dissolved in the water is deposited onto the ground and builds up until the surface is covered in rock.





# Ecology

The petrifying well allows the growth of a diverse range of plants not found elsewhere in the valley.



# Acknowledgements

Information on the geological features was provided by John A Helm.

The information on ecology was provided by Envirotech NW Ltd.

Further details were taken from the Natural England document on Thornton and Twisleton Glens SSSI; and the article titled 'A sleeping monster: The South Craven Fault;' which can be found on the Yorkshire Dales National Park website.

# Index

<b>MAP</b> .....	2
<b>1. Introduction</b> .....	3
Welcome to the famous Ingleton Waterfall Trail.	
<b>2. Faults and earthquakes</b> .....	4
Craven faults/Geological map and section of the area.	
<b>3. Thornton Glen</b> .....	8
Gorge woodland. The gorge is cut into Carboniferous Limestone.	
<b>3. Ecology</b> .....	9
Harts tongue fern.	
<b>4. Ecology</b> .....	11
Dipper which is a short-tailed bird.	
<b>5. Ecology</b> .....	12
Money trees.	
<b>6. Ecology</b> .....	14
Hazel woodland.	
<b>7. Ecology</b> .....	15
Nesting grey wagtail.	
<b>8. Cave Formation in Limestone</b> .....	16
Where it is possible to see the phreatic cave in the opposite bank.	
<b>8. Ecology</b> .....	18
Site of special scientific interest.	
<b>9. Ecology</b> .....	19
Spawning salmon and sea trout.	
<b>9. Hidden landscapes</b> .....	20
The oldest rocks in this region.	
<b>10. Pecca Falls</b> .....	22
'Slaty cleavage' of the Ingletonian basement.	
<b>11. Thornton Force</b> .....	23
The junction of the Carboniferous Limestone/ Rock Formation Table.	
<b>11. Formation of Carboniferous Limestone</b> .....	26
The beginning of the Carboniferous.	
<b>11. Tropical Seas</b> .....	27
Early Carboniferous 356 million years ago.	
<b>12. Living in the Ice Age and Kingsdale</b> .....	29
Kingsdale U-shapes valley.	
<b>13. Ingleborough View Point</b> .....	31
View of Chapel-le-dale.	
<b>13. Joints and bedding</b> .....	32
Joints and bedding diagrams.	
<b>14. Twisleton Glen</b> .....	33
A different plant community to that found in Thornton Glen.	
<b>14. Ecology</b> .....	34
Woodland formed after the last ice age.	
<b>15. Ecology</b> .....	35
Mushrooms and Toadstools.	
<b>16. Rocks from water</b> .....	36
By the tuffa bank	
<b>16. Ecology</b> .....	37
Plant life - Diverse range of plants.	



# Ingleton Waterfalls Trail

## Opening Times

### March

1st - March 31st: 9am - 4pm

### April

1st - August 31st: 9am - 7pm

### September

1st - October 31st: 9am - 4pm

### November

1st - February 28th/29th: 9am - 2.30pm

Ingleton Waterfalls Trail is located on the edge of the village of Ingleton, about 25 miles away from both Skipton and Kendal. It's well sign-posted from the main A65 Skipton to Kendal road and is also easily accessible from Leeds and the M6.

**Find us at - Ingleton Waterfalls Trail, Broadwood  
Entrance, Ingleton, Carnforth LA6 3ET**