



# HOW THE LAND WAS FORMED

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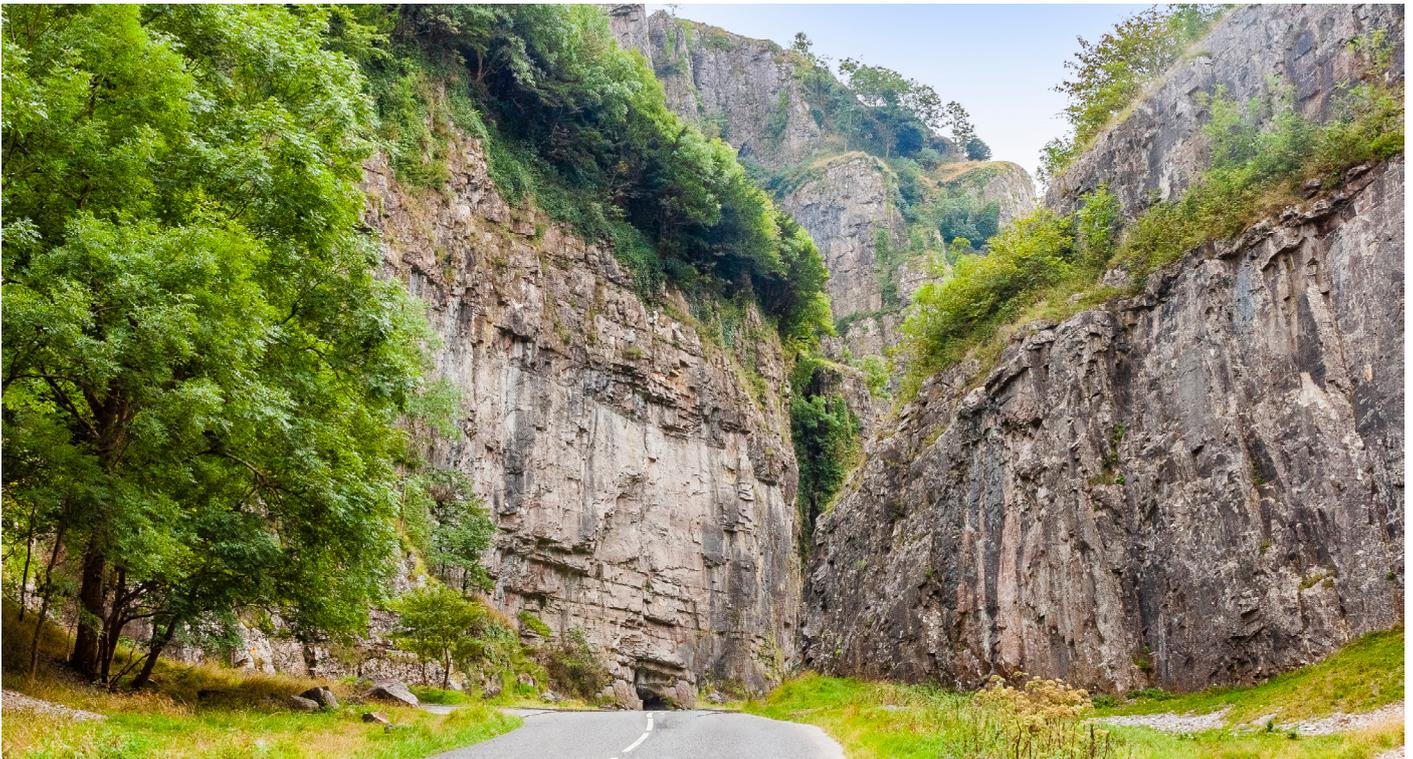
**FACT SHEET**

# INTRODUCTION

All the landscape you see around Cheddar has been created by water, during hundreds of millions of years. It is still being formed, and you can watch the processes which are building and changing it.

This fact sheet has information on the making of the:

- Hills
- Gorge
- Caves
- Calcite
- Levels



Cheddar Gorge from the road

# MAKING THE HILLS

## CARBONIFEROUS LIMESTONE

During the Carboniferous Period (360-300 million years ago) this area was covered by a shallow, warm sea, similar to the Great Barrier Reef or the Caribbean of today. The bed of this sea was the much older red sandstone laid down in the Devonian Period. When plants and creatures living in the sea died, their shells and skeletal remains (containing calcium carbonate) sank to the bottom, eventually forming a layer of carboniferous limestone hundreds of metres thick. (Fig. 1)

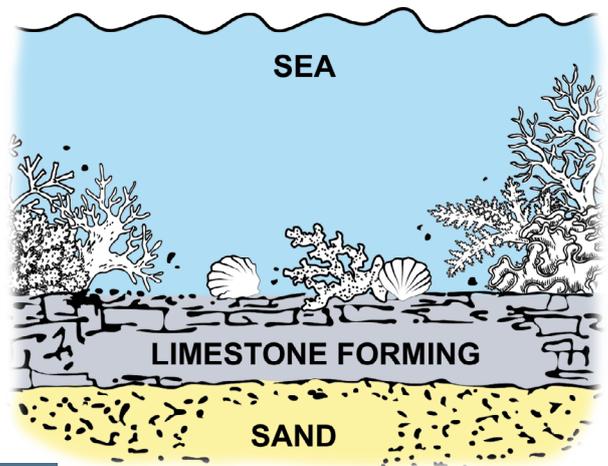
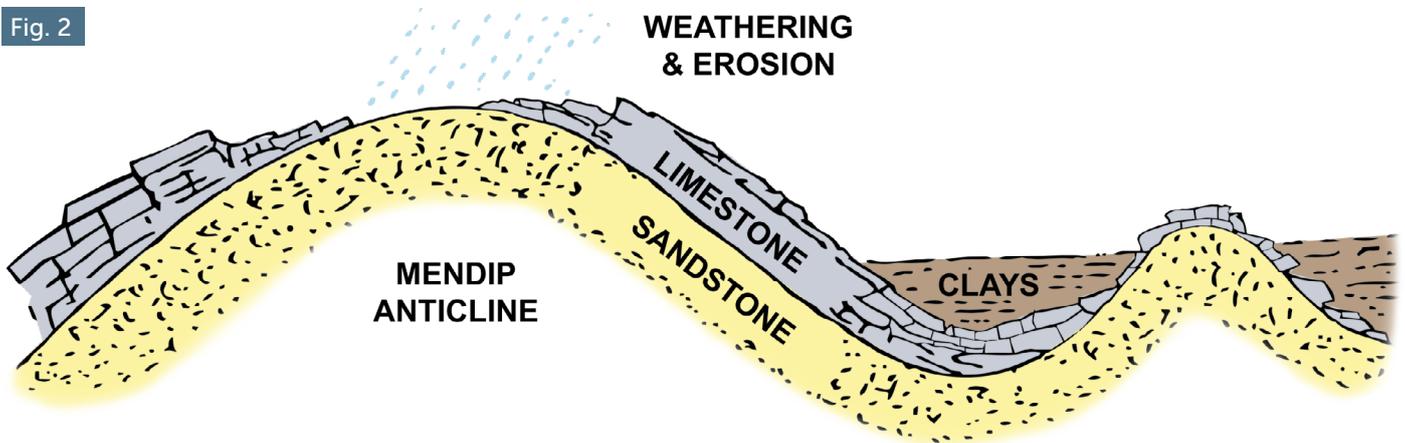


Fig. 1

## MENDIP HILLS

Tremendous earth movements then forced up ridges of rock (periclinal), four of which became the Mendip Hills. The rock became eroded by wind, water and frost. Limestone was worn away from the domes of the pericline, leaving old red sandstone exposed. An anticline, running east to west to the South of the Mendips, was also worn away, so that only small knolls remained. (Fig. 2)

Fig. 2



## DOLOMITIC CONGLOMERATE

During the Triassic Period (250 - 200 million years ago) many of the valleys on the flanks of the hills became filled with eroded sandstone, limestone rocks and gravel. These rocks became cemented with water containing calcium and magnesium salts to form dolomitic conglomerate. The rock deposits become jumbled and confused during this process. The Mendip Hills levelled into a plateau.

# MAKING THE HILLS

## JURASSIC PERIOD

In the Jurassic Period (200 - 145 million years ago) the sea covered the area once more, depositing younger rocks over the limestone and dolomitic conglomerate, which in turn were then worn away once the sea had receded.

## ICE AGES AND MELTWATER

During the last one million years (the Pleistocene Epoch), Ice Ages gripped most of Britain. During the glacial phases, sheets of ice reached as far south as the Mendips, which still show some evidence of glaciation. During interstadials (warmer periods) torrents of meltwater were released, escaping to the south along existing river valleys. In the last major stadial (or glacial period), the ice did not reach the Mendips but stopped approximately where the M4 is today, however the hills were under periglacial conditions, with the ground frozen and ice caps on the hills. At this time the caves were blocked with ice and frozen mud.



Cheddar Gorge looking towards the Cheddar Reservoir

# MAKING THE GORGE

## THE CHEDDAR RIVER

After each warm period, a new torrent of meltwater was released, sweeping boulders and gravel along with it. This process enlarged and scoured out the riverbed. The Cheddar River eventually cuts itself a gorge 400 feet deep and three miles long, the biggest in Britain. You can see from the ledges which remain on the sides of Cheddar Gorge that the riverbed used to be much higher. The river has cut a deeper 'gorge within a gorge' several times, possibly as sea level has fallen, and the ledges are what remain. (Fig. 3)

Today the only river in Cheddar Gorge is the Cheddar Yeo, which rises in Gough's Cave, and joins the River Axe to reach the sea at Uphill.

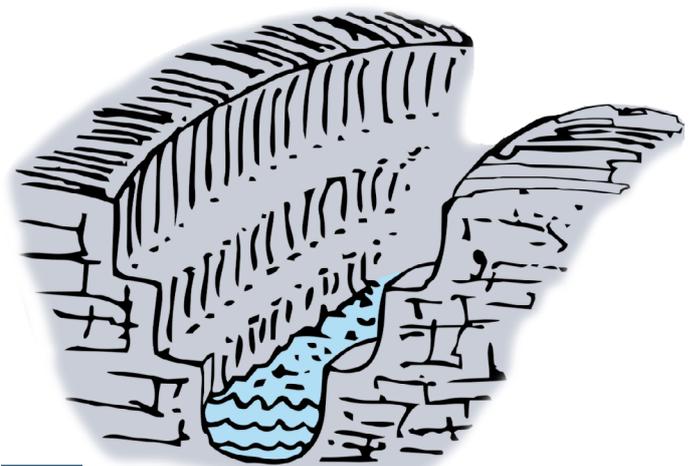
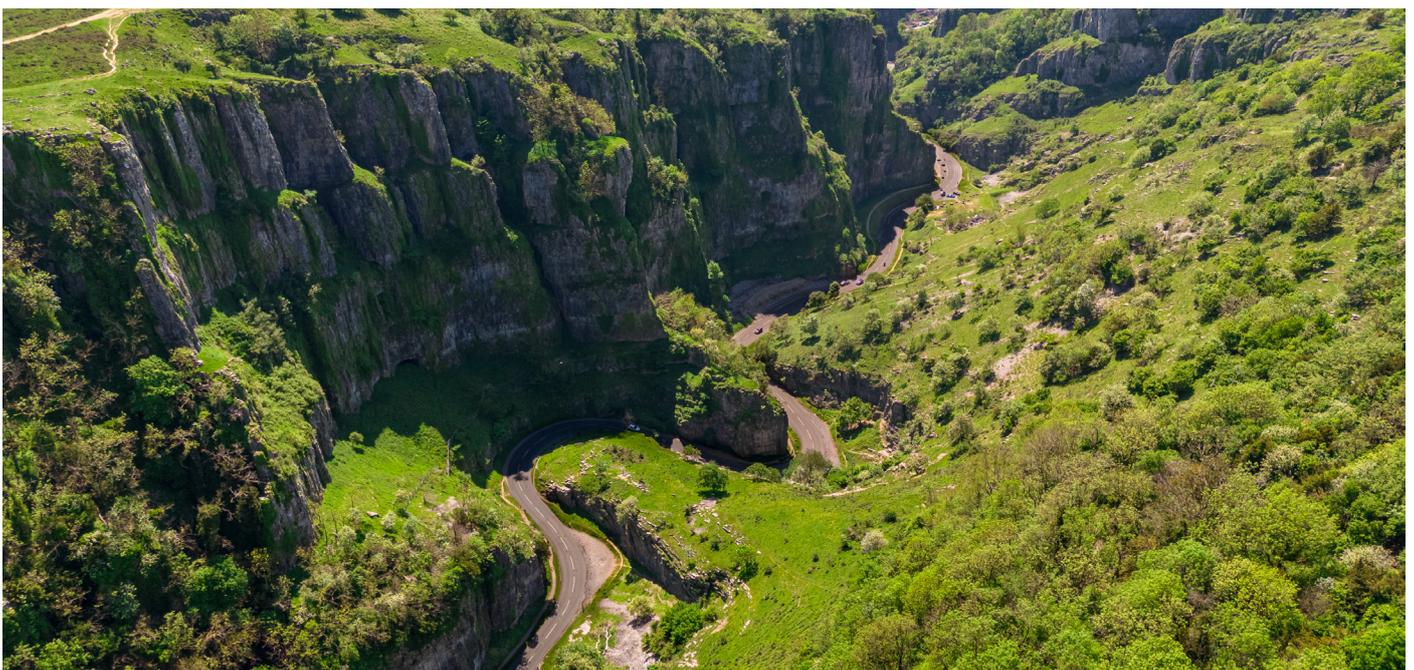


Fig. 3

## JOINTS

Earth movements caused the limestone to crack vertically creating 'joints'. Subsequently erosion, weathering and frost, shattered the limestone of the Mendips, which was full of cracks on the surface. The line of Cheddar Gorge shows where an existing deep joint has become widened and deepened by water, which exploits every weakness in the rock. Some of these weaknesses also enabled water to disappear underground and form caves.



Cheddar Gorge looking down into the valley

# MAKING THE CAVES

## ACIDIC WATER

After younger rock deposits were eroded, the limestone was exposed to water and when the ground was not frozen, floodwater was able to fill up cracks on the Mendip limestone plateau. Rainwater and river water (H<sub>2</sub>O) can absorb carbon dioxide (CO<sub>2</sub>) from air and soil, turning the water into carbonic acid (H<sub>2</sub>CO<sub>3</sub>). It is then able to dissolve calcium carbonate within the limestone (CaCO<sub>3</sub>), carrying it along in the water as calcium bicarbonate (Ca(HCO<sub>3</sub>)<sub>2</sub>). This acidic water ate away the rock below ground.



Water and carbon dioxide form carbonic acid



Carbonic acid and calcium carbonate form calcium bicarbonate

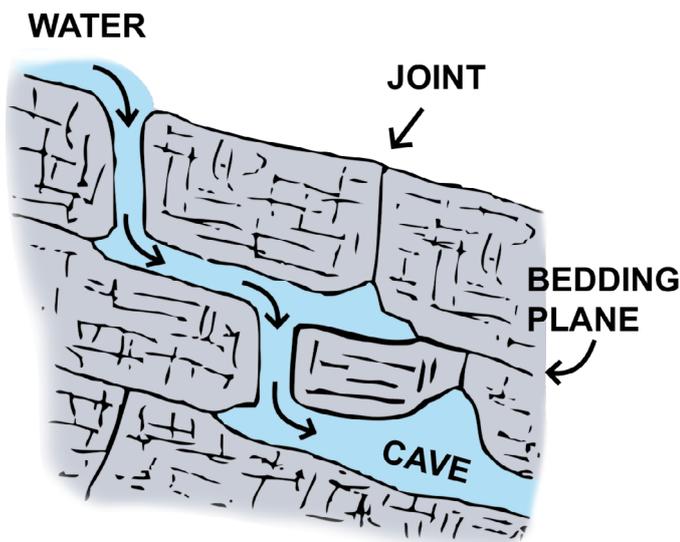


Fig. 4

## LIMESTONE CAVES

Limestone is full of weaker areas between different sections of the stone: vertical 'joints' and horizontal 'bedding planes'. This makes it permeable. The floodwater set out to find an underground route down to the sea, seeping through tiny gaps in the limestone, enlarging them as it went.

All limestone caves are formed by water. They are either underground riverbeds, or carved out by wave action on the seashore. River caves are either 'swallets' (where a surface river disappears underground) or 'resurgences' (where an underground river re-appears again). Whilst you can find both on the Mendips, the Cheddar Caves are resurgences. There is always a geological reason for the position and shape of any cave. Gough's Cave, for example, runs along one slope of an anticline at right angles to the dip ('strike') (Fig. 4).



Rock pool and calcite formations in Gough's Cave

# MAKING THE CAVES

## THE WATER TABLE

Below the limestone is a layer of old red sandstone, which was laid down earlier and is impervious to water. When saturated, water collects above this, flooding the cracks in the lower part of the limestone. Limestone is pervious as water travels through weaker areas such as joints and bedding planes. The surface of the flooded area is the 'water table' and caves which form at or below the water table are filled with water while they were being formed, like a water main. These caves are called 'phreatic'.

The smooth, polished roof and rounded shape, the domes and the 'scalloping' within Gough's Cave shows that it is phreatic. Caves can form above the water-table, carved by active streams which lower the floor of the cave to form a trench-shape cross section. These caves are called 'vadose'.



Scalloping effect within Gough's Cave

## RABBIT-WARREN PASSAGES

A complicated underground 'rabbit-warren' of passages and chambers (large spaces where the roof of a passage has collapsed) was formed around Cheddar Gorge. As the water table falls, the water will form a series of deeper passages, almost independent of the higher ones. These passages loop up and down, because of the head of pressure within the enclosed system, finding the route of least resistance. This is quite different to a surface stream, as this means the water can flow uphill.

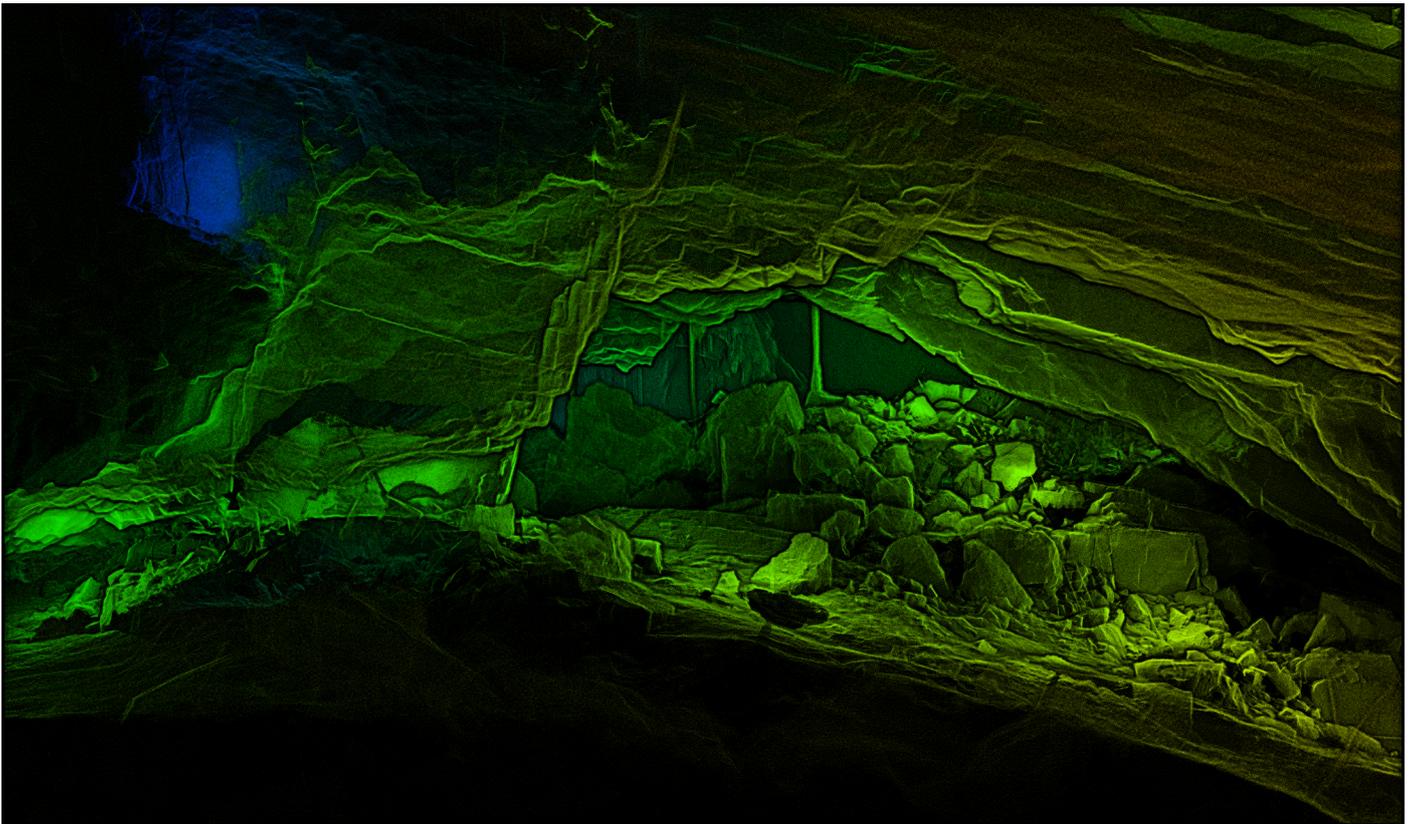


Members of the public going through Cox's Cave

# MAKING THE CAVES

## THE FROZEN DEEP

Below the Showcave is an active river cave, Gough's River Cave, still being carved out by the Cheddar Yeo. Divers have explored this cave, hoping to trace it back to its headwaters. The underground river originates at swallets at Charterhouse and Chewton Mendip, so has some way to go. Several miles have been explored and a cave higher up the Gorge contains the largest cave chamber in Britain, known as the Frozen Deep.



LiDAR imaging of The Frozen Deep, taken January 2026

# MAKING THE CALCITE

## FLOODING

No sooner had water succeeded in hollowing out a cave then it set about filling it up again. Boulders and sand were washed through the cave by floods, helping to scour it out, but leaving behind plugs of mud and boulders in the narrow chokes. But the most interesting form of 'cave-filling' is calcite.

## RAINWATER

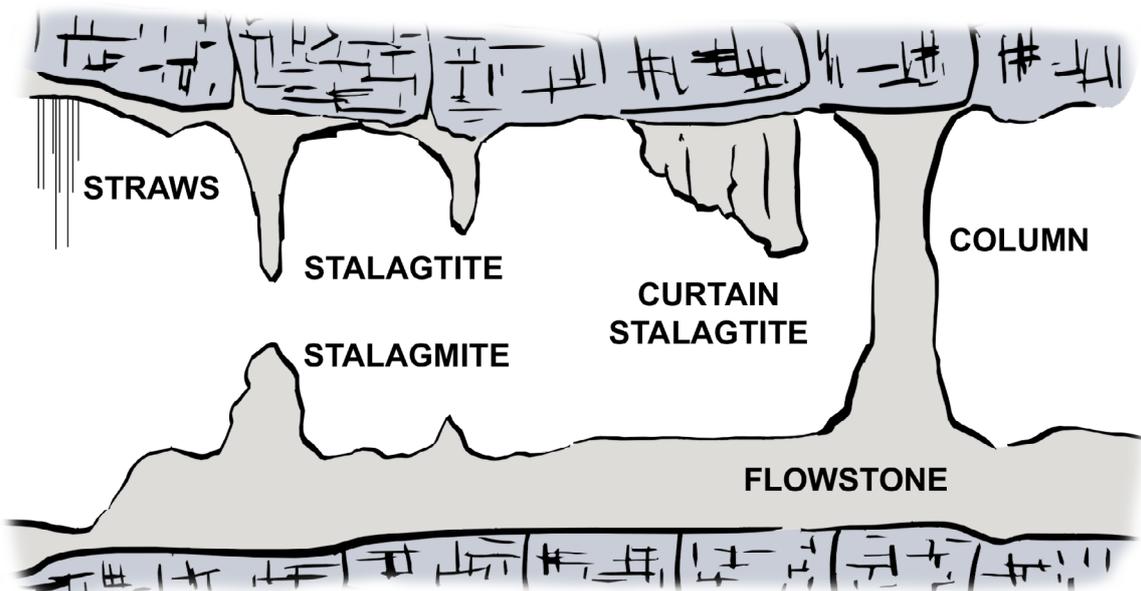
When rainwater leaks through into a cave, or a river trickles gently through it, the water loses some of its carbon dioxide to the air in the cave. This means that it cannot carry as much calcium bicarbonate and must leave some behind as calcium carbonate on the roof or floor of the cave. This produces sparkling white calcite. This is similar to the process that happens when 'hard' water is evaporated in a boiling kettle, leaving limescale.



## FLOWSTONE, STALACTITES AND STALAGMITES

Calcite can take the form of flowstone, a covering of the floor and walls of the cave, or stalactites, where water dripping through a crack in the roof has caused a cone-shaped 'icicle' of calcite to build up. Sometimes water runs along the roof to create a long, thin 'curtain' stalactite. Water which drips off a stalactite builds up a stalagmite below it. If the two ever meet in the middle, the result is a continuous column. (Fig.5)

Fig. 5



# MAKING THE CALCITE

## CHEDDAR'S CALCITE

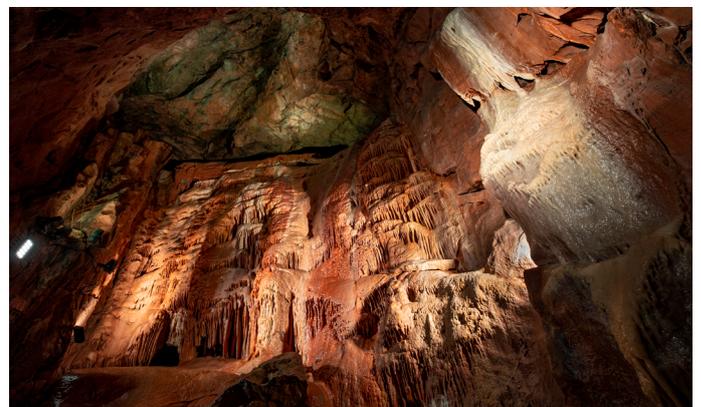
Stalactites and flowstone were formed in the Cheddar Caves during interstadials and are still being formed today. Calcite forms very slowly, often only a few cubic centimetres every thousand years, and our formations are anything up to 260,000 years old. Those in the higher – and drier – chambers are the oldest.



Column in the Diamond Chamber, Gough's Cave

## COLOURFUL CAVES

Just as water can 'decorate' the cave it has formed, it can also choose its own colour scheme. Water passing through limestone dissolves trace elements of many minerals, and these colour the calcite when it is re-deposited. A red, brown or yellow colouring in calcite indicates the presence of iron oxide. Lead and manganese stain calcite grey and black, whilst zinc minerals cause a pink colouration. Copper contributes blue and green but is rare on the Mendips.



St Paul's Cathedral in Gough's Cave

# MAKING THE LEVELS

## SOMERSET LEVELS

All the water in the Gorge and caves ended up in the Somerset Levels, which have been covered by the sea at various stages of their history. They were variously desert, sea, swamp and until only 1,500 years ago, marshland, when efforts to drain and reclaim them began. What is left is a bed of silt, filling up the 'syncline' or hollow between the Mendips and the Polden Hills.



View across the Somerset Levels

Rotting swamp vegetation has composted into a layer of peat between Bridgwater and Glastonbury, and a ridge of clay has built up along the present-day coastline, making drainage difficult. The isolated hills which interrupt the Levels were islands in historic times and are all that remain of other periclines less fortunate than the Mendips.



View across the Somerset Levels to Glastonbury Tor and St Michaels Tower

# GLOSSARY OF GEOLOGICAL TERMS

## **Anticline**

A ridge of stratified rock raised by folding.

## **Bedding planes**

Natural boundaries between beds of rock laid down as a discrete layer.

## **Calcite**

A form of calcium carbonate that forms the basis of rock features within caves.

## **Carboniferous Period\***

A geological period 360-300 million years ago, when coal measures and carboniferous limestone was laid down.

## **Column**

Over time a stalagmite and stalactite may lengthen and join to form a column or pillar.

## **Devonian Period\***

A geological period 420-360 million years ago when old red sandstone was laid down at the bottom of lakes and coastal inlets.

## **Dolomitic conglomerate**

Pebbles cemented together to form solid rock, formed during the Triassic period.

## **Faults**

Vertical cracks through stratified rock where adjacent blocks are displaced by earth movements.

## **Flowstone**

Calcite deposited on walls or floor of caves.

## **Glaciation**

The process of glaciers carving out the landscape as they move.

## **Interstadial**

A warm period during an ice age when ice melts and sea levels rise. The current interstadial began around 10,000 years ago.

## **Jurassic Period\***

A geological period 200-145 million years ago. The rocks are mainly marine.

## **Joints**

Vertical cracks through stratified rock, with no displacement of the adjacent blocks.

## **Knoll**

An isolated hill.

## **Pericline**

A dome-shaped formation of stratified rock.

## **Phreatic**

Cave development which occurs under the water table, in the absence of air. Typical cave passages are rounded or elliptical in section.

## **Resurgences**

Springs or risings at the foot of the hill where subterranean water finds its way to the surface.

## **Scalloping**

Turbulent water in phreatic conditions can form spoon shaped depressions in the rock. The depressions may be only a few centimetres or as large as a metre across. The steepest part of the scallop occurs at the upstream end of the flow.

## **Stadial**

A cold period during an ice age, when the land is covered with ice sheets and permafrost.

## **Stalactite**

A tapering rod of calcite suspended from a cave roof.

## **Stalagmite**

A squat cone of calcite formed on the cave floor.

## **Sumps**

Sections of a cave passage that dip under water level. They may be of any length. The longer ones can only be passed by divers.

## **Swallets**

Places of engulfment at the boundary of the impervious sandstone and limestone where surface streams sink underground.

## **Syncline**

A downward fold of stratified rock.

## **Triassic Period\***

A geological period 250-200 million years ago. The climate was very hot and arid.

## **Vadose**

Cave development where the passage contains air. Further expansion of the cave mainly occurs under the water surface, leading to high, narrow passages.

## **References**

<https://www.bgs.ac.uk/discovering-geology/fossils-and-geological-time/geological-timechart/>

*\*All geological time periods are quoted from Geological Timechart produced by British Geological Survey 2012 to nearest 5 million years.*



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