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GEOLOGICAL SETTING OF FISHMONGERS SWALLET

by

MARK TRINGHAM

ABSTRACT

A geological interpretation of Fishmongers Swallet is presented and places the cave within the context of previously published geological data from the area North of Bristol. Geological observations were made and hand specimen rock samples collected. The cave is located close to the outcrop boundary between the Penarth Group shales and the Clifton Down Limestone on the West flank of the Coalpit Heath Syncline and close to the Ridgeway Fault. The host limestone has a sparry and micritic composition and also contains two thin white claystone seams, likely formed from degraded tuffs. The limestone strata dip moderately to the East-South-East and are cut by numerous wrench faults. Near the bottom of the cave a North-East plunging anticlinal axis is seen and the oldest strata exposed in the cave are ascribed to the topmost beds of the Lower Cromhall Sandstone. Rocks within the cave are commonly altered and cut by calcite veins and minor fractures and these likely formed the focus for a mixed speleogenesis history with both upwelling phreatic waters and later vadose solution..

STRATIGRAPHY

Published surface geological maps for the area of Fishmongers Swallet include the Geological Survey, 1:50,000 scale Chepstow Sheet 250 (1981). This reveals that the cave has formed in the Clifton Down Limestone (CDL), which is of early Carboniferous Visean age (Figure 1). The swallet is located close to the unconformable boundary between the CDL and the Penarth Group shales and mudstone which are of Late Triassic Rhaetian age. Surface rock outcrops are limited to the CDL exposed in the entrance doline and immediately adjacent feeder stream gully. The combined stratigraphical thickness of CDL seen in the gully, doline and cave is approximately 50 m, with the cave passing downwards stratigraphically through the CDL. At the deepest point in the cave an approximately 0.6 m thickness of sandstone is seen and this likely corresponds to the topmost part of the Lower Cromhall Sandstone (LCS) which is also of Visean age.

LITHOLOGY

Seventeen hand samples were collected from both the doline and underground for lithology identification, most of which required thorough cleaning to remove surface mud and drying before much could be determined. After examination under a hand lens and 10% HCl acid application it was determined that these nearly all comprise a mixture of light to medium grey and brownish sparry and micritic limestones with pelmicrites, biosparites and oosparites the most common (Folk classification). Many of the samples contain calcite veins, likely resulting from intense tectonic deformation here. The author obtained advice and assistance from South Gloucestershire quarry geologist Mark Mitchelmore (*pers. comm*. Jan. 2022) to corroborate and improve the lithology descriptions and compare to better and larger outcrops at Tytherington and other nearby quarries. The advice received from him also suggested that some of the altered nature of the rocks within the cave, such as dolomitisation and limonitisation might have

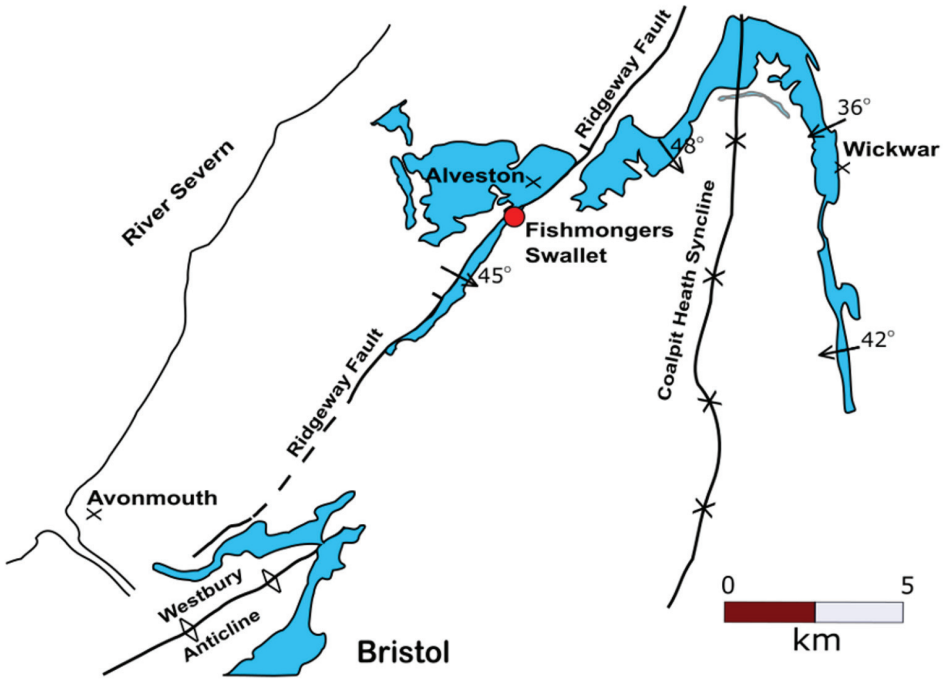

Figure 1. *Fishmonger's Swallet in relation to the north Bristol Carboniferous Limestone outcrops and structure.*

been caused by early cave formation during the Triassic followed by metasomatic chemical alteration from saline hydrothermal fluids.

Interbedded with the limestones are two thin seams of white claystone, each about 4 cm thick. These are about 9 m apart stratigraphically, with the upper one exposed right across the roof of Hardwick Hall and the other lower one seen at the bottom of The Mudlands Chamber. The abrupt lithogy change could be explained perhaps by potassium rich volcanic tuff deposition that was later degraded to kaolinite and other light coloured minerals. The lower white claystone seam sits at or close to the contact between the CDL and LCS formations and it is affected by a soft-sediment water escape structure, with the claystone seam protruding downwards between two sandstone balls typical of 'ball and flame structure'.

The thin interval of sandstone ascribed to the LCS formation right at the bottom of the cave is of particular interest in that it is seen to act nowadays as a rising water source and could perhaps have also formed an ancient input point for hydrothermal fluids. The sandstone is quartzose, red-brown in colour, very fine grained and mostly has a calcareous cement, however some parts are calcite-free. It is finely laminated with the layering strongly contorted by the ball and flame structure mentioned above.

TECTONIC STRUCTURE

The Carboniferous rocks in the region of Fishmongers Swallet are dominated by the large North-South trending Coalpit Heath Syncline with the cave located on the West side where dips are at 30° to 45° to the south-east (Figure 2). However only about 150 m from the cave the north-east – south-west trending Ridgeway Fault is also present and this down-throws the Carboniferous Limestone several hundred metres to the north-west. Movement on this fault is complex and it likely involved wrench-related transpression where previously existing underlying basement faults were oblique to the main Hercynian South to North compression. Triassic strata also are down-thrown north-west on the Ridgeway fault, but with a lesser throw. The cave entrance doline shows limestone beds dipping at around 40° to the south-east as expected from regional considerations but the bedding appears to level off to approximately horizontal above the entrance itself (Figure 3). In addition at least five sub-vertical fractures are visible cross-cutting the doline, trending north-north-west – south-south-east with one other trending perpendicular to these. At least one of these fractures is seen below in the roof of the cave at Bone Idle Chamber.

Figure 2. *Fishmonger's Swallet: entrance doline geology.*

Within the cave bedding dips are initially again to the south-east at around 40°, but these gradually decrease along Hardwick Hall to about 30° and at Mudlands Chamber the bedding flips over within a short distance and the arched cave roof is formed at a very clear anticlinal axis, the crest of which plunges north-east down to the lowest point in the cave (Figure 3).

Several of the rock hand samples collected are veined by calcite and iron minerals, another likely product of the local deformation processes. The intense fracturing and folding observed likely forms part of a major wrench-related compressive deformation zone along the Ridgway Fault.

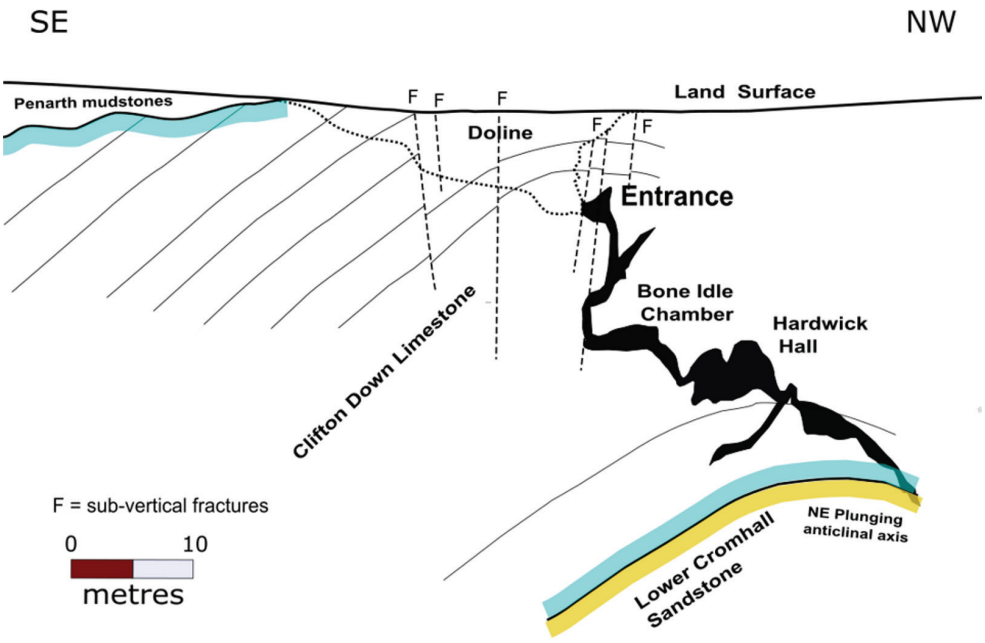

Figure 3. *Interpretative geological cross-section through Fishmonger's Swallet.*

CONCLUSIONS

In conclusion it can be stated that the cave has likely formed preferentially where intense fractures and folding have weakened the limestone and permeability has been enhanced to either upwelling phreatic hydrothermal or down-going vadose waters. The altered nature of some rocks within the cave point to the presence of an early formed cavity similar in age to infilled Triassic paleo-karst features seen not far away at Tytherington (Whiteside and Marshall, 1981). But Fishmongers Swallet has in large part likely formed by more recent development involving both phreatic and vadose solution related to the present surface terrain and sub-surface drainage.

ACKNOWLEDGEMENT

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REFERENCE

Whiteside D. and J.E.A. Marshall. 1981. The age, fauna and palaeoenvironment of the Late Triassic fissure deposits of Tytherington, South Gloucestershire, UK. *Geological Magazine*. **145.** 1. 105–147.

Mark Tringham
mtringham@btinternet.com