Investigations of the Wyanbene Caves area

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Abstract

The Wyanbene Caves are located about 50 km south of Braidwood, NSW and about half way between Canberra and the coast. The main Wyanbene Cave is 580 m long with 1830 m of passage. It is presently used for recreation under a permit system which is managed by the National Parks and Wildlife Service of NSW from their Narooma office. The cave contains extensive speleothem deposits, a perennial stream and has a locked gate about a quarter of the way in. This paper discusses some preliminary findings by the author concerning the structure of this and other caves in the area.

Introduction

I first became interested in Wyanbene after visits to the caves in 1979, 1986 and 1990. Figure 1 shows the location of Wyanbene Caves in NSW. Figure 2 shows a general plan of the area. The caves are part of the Deua National Park. To the east of the main cave (WY-1) there are some abandoned mine addits. Further to the east lies the Minuma Range which divides the Shoalhaven drainage from the Deua drainage. To the south of WY-1 lies Wyanbene Caves Mountain.

The SUSS library has a copy of the excellent maps of WY-1 (by Brush et al. of NUCC), drawn in the 70's. After studying the maps, I realised that not only were there several interesting structural features of the cave, but the area hydrology was also unknown. This raises some interesting questions:

- Where does the cave get its water from? Is it the Shoalhaven side north of Wyanbene caves mountain, the Shoalhaven side south of Wyanbene caves mountain, or the Deua side?
- Where is the cave with respect to the topographic map?
- What are the soft, vertically bedded dyke-like structures found throughout the cave?
- Why do many of the cave cross-sections display a tilt toward the west?
- Is there a relationship between the avens of the cave and geological structures on the hillside?

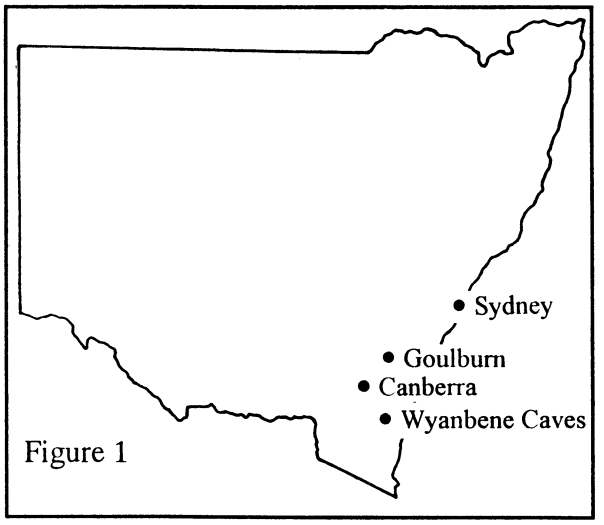

Figure 1: Location of Wyanbene Caves in NSW

This year (1994), Mike Lake and I surveyed from the car-park near the cave entrance to the trig station on top of Wyanbene Caves Mountain. We used both forward and backward bearings at each survey station to help reduce errors because of the known magnetic ore deposits in the vicinity. Figure 2 shows how this survey positioned the cave on the topographic map, together with approximate positions of the other caves, mines and other features in the area. Note how the cave runs fairly straight in a north to south direction.

Figure 3 is an elevation of the cave, looking to the west. This drawing has a vertical exaggeration of 2 times in order to show vertical features. Errors in the positioning of the cave features and/or the topographic map have resulted in the top of one of the avens (the Gunbarrel - GB) being drawn about 5 metres above the surface of the mountain! The cave ends in a sump called Frustration Lake, marked FL in figures 2 and 3.

Avens

There are several avens of interest. The Gunbarrel is by far the most spectacular and well known, rising some 110 m to what is either a boulder choke or part of the conglomerate and sandstone cap of the mountain. The evidence for this includes a large non-limestone boulder in the base of the Gunbarrel, together with many smaller pieces of sandstone and conglomerate. Figure 4 is a cross section through the Gunbarrel looking north. Note that the Gunbarrel is actually a double-barrelled aven. The height of the larger aven of the Gunbarrel was measured by members of NUCC in the early 1970's using helium filled balloons. It has been climbed to about 80 metres by Alan Warild, who reported that above this point "it narrows, then widens," and "the limestone was becoming poor and crumbly". The smaller aven is coated with a reddish mud.

Figure 4 also shows an aven in upper Rockfall Chamber. Rockfall Chamber is, strictly speaking, part of Caesar's Hall (CH on figures 2 and 3) which itself contains two avens, one at each end. Note also that the lower access to the Gunbarrel is virtually at creek level; this would help to explain why there is usually a puddle in this chamber. It would appear from figure 3 that the steeper parts of the hillside are directly above the avens in the cave. Aitcheson's Avens are marked AA in figures 2 and 3.

Evidence For North-South Jointing

The cross sections of figure 5 are all looking north. They were taken from the NUCC map. Note the passage shapes; they seem to follow a joint of some sort which is dipping steeply to the east. It is unlikely that the passage follows the bedding, as this was measured by the author to have a dip of 20° in the direction 268° (ie. approximately west) in Goat Cave (WY-5), high on the Deua saddle. This was measured along a contiguous band of fossil shells on the roof and both sides of the passage.

During a recent SUSS trip (3rd July 1994), Armstrong Osborne measured the bedding at the WY-2 entrance of the main cave and found it to be much the same. On that trip, we were able to follow a huge joint structure on the surface, over the cave and up the hillside until it disappeared under loose conglomerate rubble. Additionally there are some north-south trending grikes (3°) on the main hillside (that is, the most obvious bare limestone hillside which you see as you drive to the area). These could be solutionally enlarged north-south joints.

Other Caves

Near the lower (north) end of the most pronounced grike is WY-6, an insignificant cave, and a couple of tufa terraces which form a feeble efflux of sorts during wet weather. Near the top (south) end is WY-9, a tight vertical shaft some 23 m deep as estimated by rope length. Continuing in a southerly direction to the Deua side we find Goat Cave (WY-5), then what looks like an oxide band, then Ridge Mine Pot (see figure 2).

Goat Cave is a small two-chambered cave with an earth floor. It is an important roost for Horseshoe bats and faces the Deua side. Ridge Mine Pot is a 60 m deep vertical cave, choked with calcite and generally similar to WY-9. Jennings (ref 2) wondered about the relative altitudes of the WY-1 creek and the bottom of Ridge Mine Pot. From his article and from field observations by Norton (ref 3), I have estimated its bottom level to be about 100 m above the WY-1 creek and maybe 60 m above the WY-6 efflux. Is it possible that at some earlier time, Ridge Mine Pot was part of a cave system which took water from what is now the Deua side to the Shoalhaven side of the Minuma Range?

Clarke's Cave (WY-7), also known as Bushranger Cave, is a rock shelter which lies on the unconformity between the limestone and the conglomerate. It also appears to contains a large joint or dyke filled with reddish material. The limestone at the conglomerate interface is not flat; rather, it has conglomerate-filled solution-like features which suggest it has been subject to weathering prior to deposition of the conglomerate.

According to the NSW Geological Survey (ref 4), the ages of the Wyanbene limestone and conglomerate are late Silurian and late Devonian respectively. This leaves about 50 million years in between, during which time the limestone may have been exposed to weathering. There is a doline about 100 m to the north, below Clarke's Cave, on the scree-covered slope. One wonders whether the two features are hydrologically connected.

Conglomerate and Sandstone Cap of Wyanbene Caves Mountain

At the top of Wyanbene Caves Mountain is a sandstone cap. This is broken up into pillow-sized boulders and rocks with lenses of a soft reddish material. These rocks have rounded, almost solution-like features. Below this lies a maroon conglomerate layer, which overlies the limestone. The conglomerate is made of angular volcanoclastic material which is cemented together. To the northwest and downslope of the trig, the conglomerate is more intact but terraced. There are steep to overhanging structures resembling faults about 2 m high. They also occur near the saddle to the east of the trig, where they are oriented in the direction 338°.

The boundary between the conglomerate and the limestone is usually hard to find because of scree. The conglomerate also occurs in the WY-1 cave all along the streamway as loose pebbles which have been washed in somehow. The conglomerate cap corresponds approximately to the end of Far Caesar's Hall, where the nature of the cave changes from an open hall to a narrow, vertical rift system. The conglomerate may be impervious to water, except at the "fault" structures. If so, surface water may be able to reach the limestone under the conglomerate via these structures.

East-West Banding

The limestone has almost vertical bands of reddish material running approximately east-west. This material does not follow a straight line, but tends to wander a bit both in dip and strike. In WY-1, these structures show up as walls through which the streamway has eventually made its way. One of the most pronounced is right near the WY-1 entrance, about 25 m in along the streamway. Inside the cave, this material is soft, brown and chemically altered, but on the surface it shows up as reddish bands in the limestone. Some of these surface bands are lined with quartz. The limestone nearby appears to be dolomitised. A particularly spectacular band winds its way across the lower terraces of the main hillside. This band contains sparkly material described as Maghemite by Cooper (ref 7) and is still being investigated. The "oxide band" near Goat Cave appears to be a similar structure.

I would propose that the "West Passage" of Ridge Mine Pot is developed along one of these structures, whereas the "North Passage" may be developed along a joint (ref 2). The NSWGS report describes similar structures (as found near the mines) as hydrothermally deposited base metal ore bodies (ref 4). It would seem (from looking in the field) that the north-south jointing postdates the east-west banding.

Breccias

On the surface, at the saddle between Clarke's Cave and the steep eastern side of the Minuma Range, the rocks are a breccia of limestone fragments surrounded by dark reddish material. In WY-1, a similar material forms the floor of the area known as the Chamber Pot near Anderson's Wall (AW in figures 2 and 3). Some of this material can be magnetised (see below).

Magnetics

I was concerned that the original survey may have been affected by remnant magnetism of the "oxide material", as some key stations were located on "oxide bands" so Mike and I tested some of the surface material. The brecciated material affects a compass only very slightly, around 1° when the compass rests on the material. After it is placed in a strong magnetic field the material becomes permanently magnetic! (ferromagnetic). This means that the survey is probably accurate to ASF survey grade 5. One should be careful when using a compass in this area.

Mineralogy

Aragonite is found in WY-1 in the form of "flos ferri" (literally "flowers of iron") associated with bands of "oxide material" in the north-south trending joints. "Flos ferri" are tangled helictites of aragonite. Aragonite is also found in Caesar's Hall and near Frustration Lake in the form of radiating masses. It is possible that calcium carbonate has precipitated into the aragonite crystal form as a result of the presence of magnesium in dolomitised limestone near the joints.

Gypsum is present in the floor of Helictite chamber (marked HC in figures 2 and 3). It is possibly the result of oxidation of iron pyrites in the ore bodies reacting with the limestone. Note that both pyrite and goethite is mentioned as occurring in the mines area (ref 4). Some of the chemical reactions are as follows:

1. Iron pyrites is oxidised in the presence of water and air forming hydrated iron oxide (goethite) and sulphuric acid (there are a few other possible reactions forming different iron oxides).

$$4\,FeS_{2(s)} + 14\,H_2O_{(l)} + 15\,O_{2(aq)} \Rightarrow 4\,Fe(OH)_{3(s)} + 16\,H^+_{(aq)} + 8\,SO_4^{2-}{}_{(aq)}$$

2. Sulphuric acid in water reacts with calcite in limestone to form gypsum and carbon dioxide (and holes in the limestone). Note that gypsum has a higher solubility in water than has calcite.

$$2\,H^+_{(aq)} + SO_4^{2-}{}_{(aq)} + CaCO_{3(s)} + H_2O \Rightarrow CaSO_4 \bullet 2\,H_20 + CO_{2(g)}$$

Calcite in the form of extensive flowstone is found in the cave before the water crawl. Some of the flowstone is cracked. It is possible that it has been affected by gypsum crystals wedging from underneath the flowstone. Note that the presence of gypsum in solution will cause calcite to precipitate from solution (the common ion effect). Is this the reason for the extensive flowstone in this section?

Other minerals in the cave especially in Caesar's Hall and Rockfall Chamber have not yet been identified, however they could be an unusual form of calcite.

Of interest is the list of elements from the nearby mine addits and dumps described by the NSW Geological Survey: gold and silver (minute quantities), copper, lead, zinc, iron, arsenic, tin, tungsten, molybdenum, nickel, cobalt, bismuth and cadmium. This list would give one second thoughts about drinking the cave water, especially as the "ironstones" described were rather high in some of these elements.

Conclusions

Wyanbene is a most fascinating area. There is still much more work to be done: nomenclature of surface features, tagging, surface surveying, mineralogy, speleogenesis, geomorphology and hydrology.

Acknowledgements and References

1. "Wyanbene Cave", Map by J. Brush, J. Furlonger, K Palmer, D. Hughes, M. Ellis, E. Collins, M. Coggan, C. Keppie, A. Harding, W. Allen and C. Collins, National University Caving Club 1972-3.

2. "Ridge Mine Pot, Wyanbene, New South Wales" by J. N. Jennings, M.A., "Helictite" January 1963.

3. Chris Norton, Sydney University Speleological Society: Personal comments regarding tag numbers and SUSS trip to Ridge Mine Pot on 3rd July 1994.

4. "A Rock Chip Geochemical Survey of the Wyanbene Base Metal Prospect, near Braidwood" by S.J. Richardson, J. Byrnes and P. Degeling, Metallic Minerals Section, Geological Survey of New South Wales Department of Mineral Resources (GS1981/430, M79/2979).

5. Andy Spate, NSW National Parks & Wildlife Service - personal comments and assistance.

6. John Brush, Canberra Speleological Society - personal comments regarding survey of WY1.

7. Ian Cooper, Sydney University Speleological Society: personal comments regarding ore bodies at Wyanbene during SUSS trip 31st October 1993.

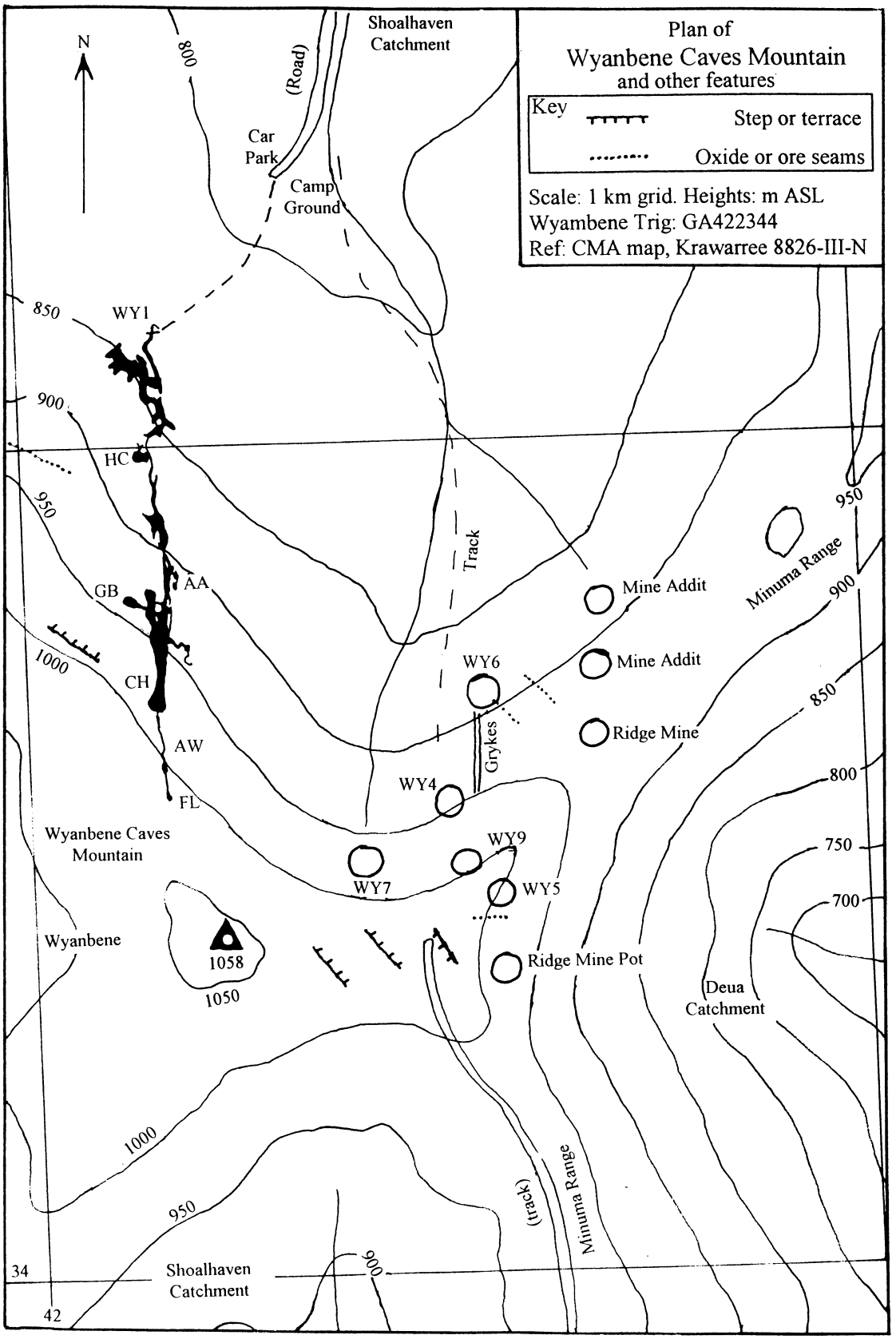

Figure 2: Plan of Wyanbene Caves Mountain and other features

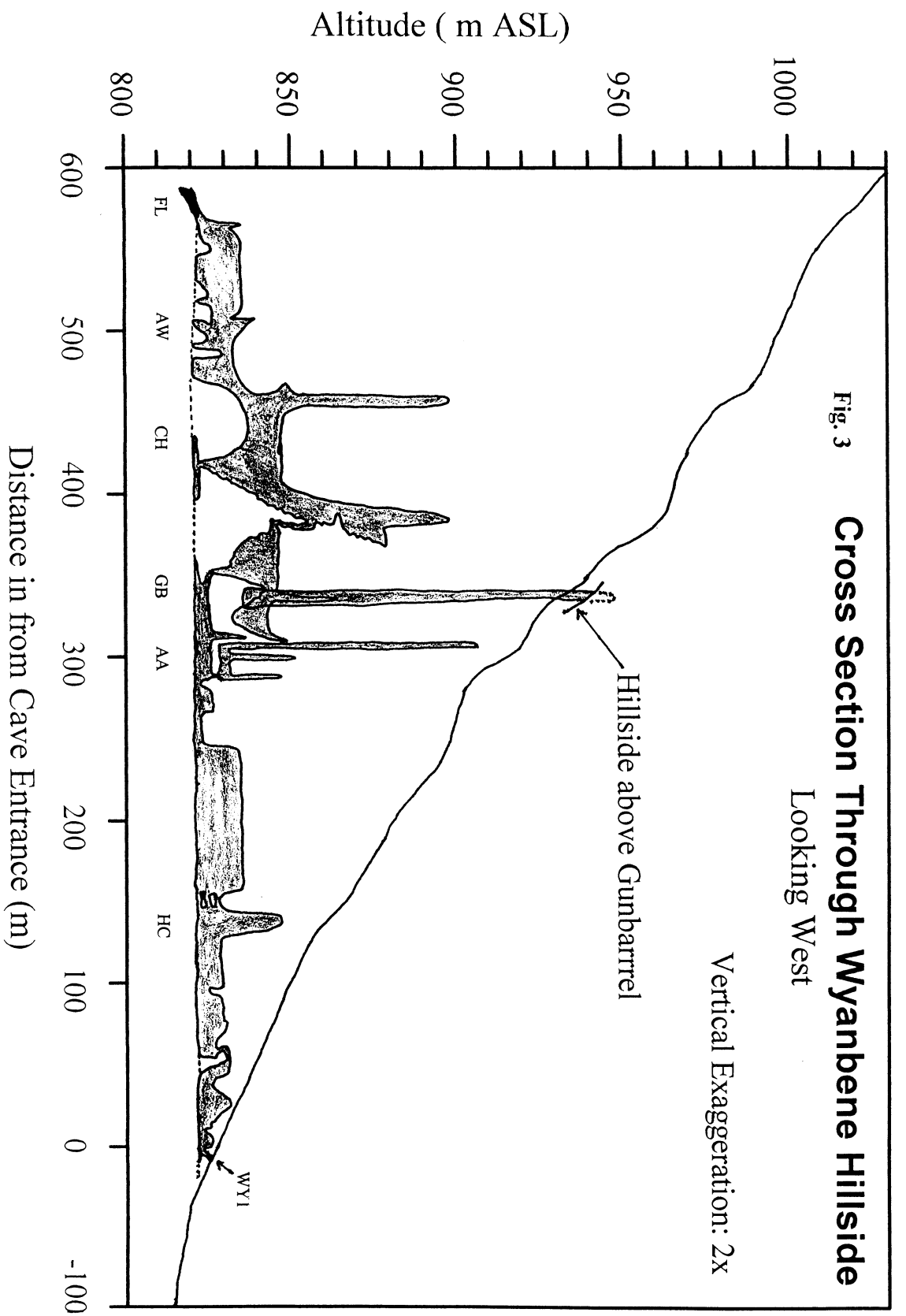

Figure 3: Cross Section Through Wyanbene Hillside

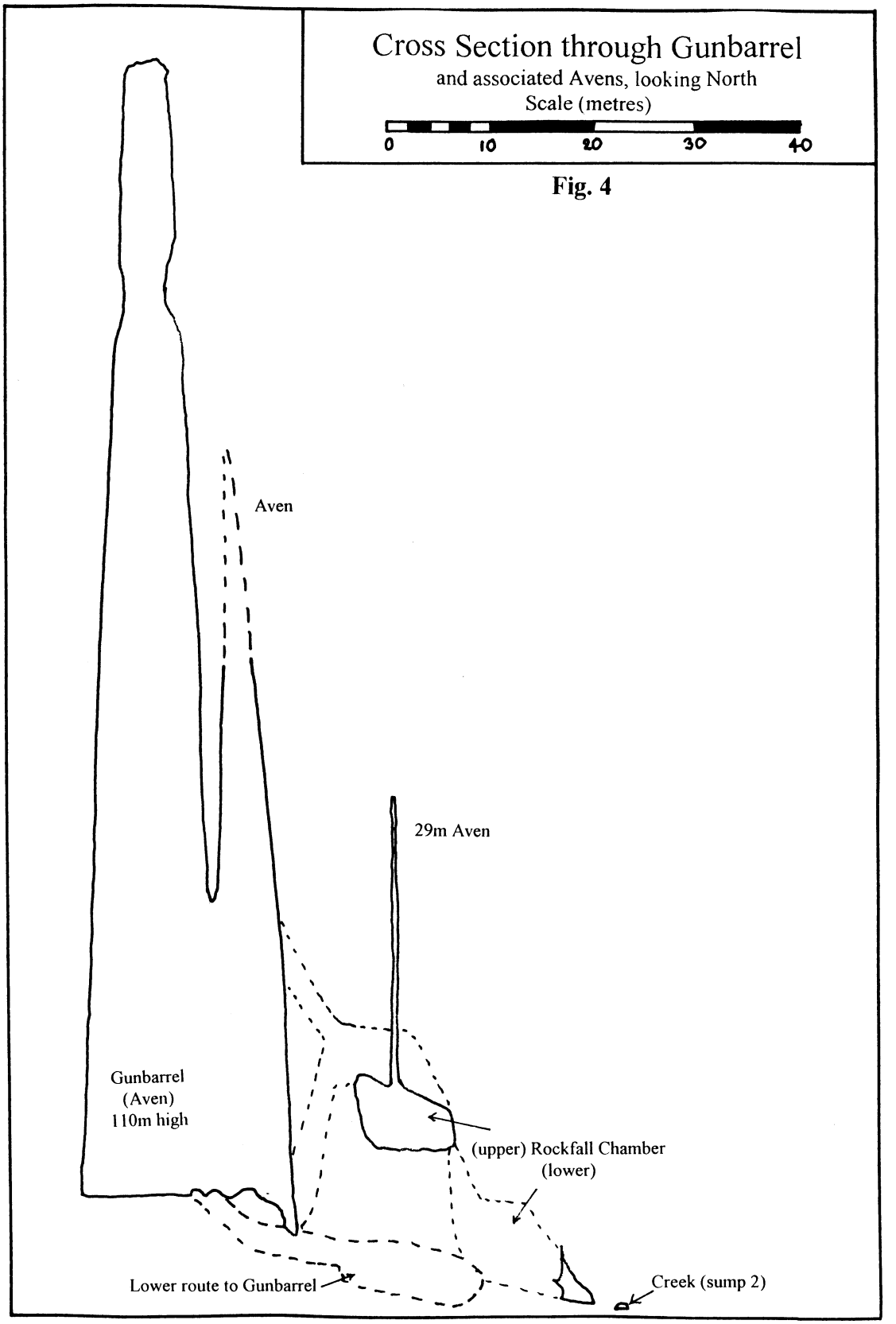

Figure 4: Cross Section through Gunbarrel

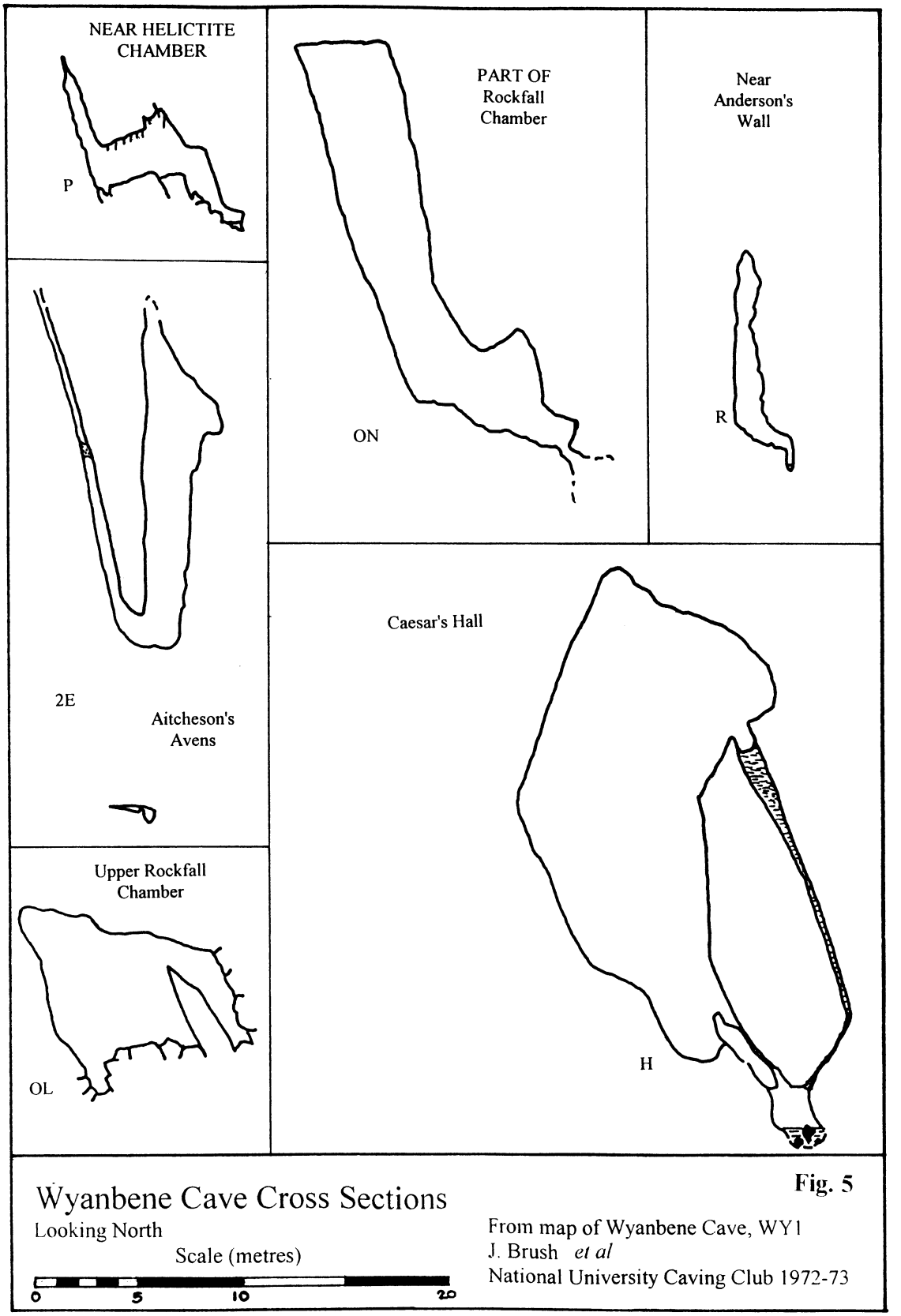

Figure 5: Wyanbene Cave Cross Sections