

A BRIEF INTRODUCTION TO THE KARST GEOLOGY OF WOMBEYAN CAVES

- Dr. Armstrong Osborne

Wombeyan Caves is one of the most significant karst areas in New South Wales. It is one of the five most cavernous karsts in the state and is the largest and most cavernous karst developed in marble in New South Wales. In 1865 Wombeyan became the first karst area in New South Wales to be dedicated as a Reserve for the Protection of Caves.

Location and Setting

Wombeyan Caves is located 45 km west of Mittagong and 25 km north of Taralga in rugged country just east of the drainage divide between the easterly flowing Wollondilly River, into which the caves drain, and the westerly flowing Abercrombie River.

The karst forms the floor of a topographic basin surrounded by steep hills of volcanic rocks. The basin is drained by Mares Forest Creek, a tributary of the Wollondilly River, which forms a gorge up to 50 m deep through its floor. Wombeyan Creek, which joins Mares Forest Creek, runs underground through the Fig Tree Cave system. Upstream of Fig Tree Cave, Wombeyan Creek forms a blind valley with a flat alluvial floor, while downstream it has a narrow, incised course.

Geology

The karst at Wombeyan Caves is developed in the Wombeyan Limestone, which has undergone contact metamorphism, forming a coarsely crystalline marble in which no distinct fossils have been identified. It is generally assumed that the Wombeyan Limestone is Late Silurian in age (420-410 million years old), similar to other (unmetamorphosed) limestones that occur nearby.

The Wombeyan Limestone has been quarried in the past for use as marble building stone. It is currently quarried as a source of high-purity limestone for use in the glass industry and in the manufacture of household products.

The limestone is white in colour, making it distinctly different in to the grey of most eastern Australian limestones. This is particularly noticeable in the caves, where the walls are distinctly white.

Early in its history the limestone was exposed at the Earth's surface, and then burred by massive ash fall eruptions from the Yerranderie Volcano. These ash falls produced the rocks of the Early Devonian (390 million years ago) Bindook Volcanic Complex.

The Bindook Volcanics form the steep hills that surround Wombeyan Caves. Some of the volcanic rocks are very resistant, forming steep cliffs and rocky outcrops, while others are deeply weathered,

forming deep light-coloured soils. The volcanics are quartz-rich and as they erode they release large quantities of quartz sand and rock cobbles in the streams.

The hot blanket of the volcanics combined with younger intruding granite is probably responsible for metamorphism of the limestone into marble.

There is scant evidence for the more recent geological history of the area. The volcanics were eroded, exposing the marble in the floor of the basin. This may have been assisted by subjacent karst development beneath the volcanic cover,

Remnants of iron-cemented sandstone around the margins of the basin indicate that at some stage it was filled with sand, most of which has since been eroded. The iron cement in the sandstone is related to low grade iron ore deposits that occur at various places within the basin.

Palaeokarst

There is evidence in the caves, and at the surface, of a number of ancient periods of karstification and cave development at Wombeyan.

The earliest period of karstification is represented by grikes filled with volcanic debris and volcanic-filled cavities interested by the caves. These indicate that grikes and caves had developed in the limestone during the Early Devonian, before it was buried by the Bindook Porphyry Complex.

Crystal-lined cavities and breccias that are intersected by many of the caves indicate a more recent period of karst development, possibly a hydrothermal (warm water) event. Crystal breccias are very common in the walls of Creek Cave and Basin Cave.

Dolines filled with sandstone, and sandstone-filled cavities interested by the caves indicate a more recent, but probably also quite ancient, phase of karstification. These sandstones have an iron cement and are similar to those that occur around the western rim of the basin. A sandstone-filled cavity is exposed in the walls of Creek Cave.

Surface Karst

The most outstanding surface karst landforms at Wombeyan are: -

- the blind valley of Wombeyan Creek
- the natural bridge of Victoria Arch
- the collapse at the end of Victoria Arch
- the gorge downstream of Creek Cave
- the limestone gorge of Mares Forest Creek, upstream of Bullio Cave
- Blackberry Hole, a collapse doline or unroofed cave.

The coarse crystalline texture of marble mitigates against the extensive development of small-scale

solution features such as *rillenkarren* at Wombeyan, although some are present. As a consequence of its large crystal size, the marble outcrops have a rounded form similar to that of tors developed in granite. Grikes and limestone pavements are well developed.

One significant feature at Wombeyan is Glass Cave. The exceedingly thin roof of its entrance chamber illustrates the transformation of a normal cave into a "cave without roof".

Cave Morphology and Development

The Fig Tree cave system, consisting of Victoria Arch, Fig Tree Cave, Creek Cave, Chalker's Cave, Grants Cave, Olympian Cave and Junction Cave, completely captures Wombeyan Creek underground.

Creek Cave, the current flood course of Wombeyan Creek, is an outstanding example of a vadose canyon with a meandering course and potholes developed in its bedrock floor. High-level passages in Creek Cave, now followed by the tourist path, have prominent small-scale scallops, indicating that in the past they acted as rapid-flow phreatic conduits.

There is little evidence of rapid water flow in the remainder of Fig Tree Cave. The Opera House has a flat paragenetic ceiling and there is considerable evidence in the form of sediment remnants and wall features developed at the sediment-rock interface (anastomoses) that much of the cave was filled to the roof by a considerable quantity of sediment which has since been removed.

There is considerable sediment and evidence for paragenesis in Wollondilly Cave also. There has been significant breakdown in both Wollondilly Cave and Fig Tree Cave. Much of the breakdown is quite old, predating the major sediment filling and paragenetic events.

Basin Cave has a significantly different morphology to the other caves at Wombeyan. While large remnant deposits of fine sediment and well-developed planes of repose in the walls indicate that the cave has undergone considerable paragenetic modification, the ceiling of the cave consists of a series of inter linked domes (cupolas). These features are not common elsewhere at Wombeyan and suggest that Basin Cave may have a distinctly different origin to many of the other caves there.

The old marble quarries provide excellent cross sections through the marble. They intersect both caves with speleothem and smaller joint-controlled epikarst cavities.

Speleothem

There are some outstanding speleothems at Wombeyan Caves. The high purity of the marble has resulted in an abundance of white to off-white speleothem.

The most decorated of the Show Caves is Koorunga Cave, which contains a wide range of speleothems, mostly white in colour. Outstanding examples of craybacks and other algal-influenced speleothems are found in Victoria Arch. Fig Tree Cave has excellent examples of pendant flowstones and false flowstone floors.

Junction Cave features shawls, of which Chalker's Blanket is the most celebrated, the Chocolate Fringes, speleothems probably coloured brown by organic material from bat guano, and pendulites. Located off the track is an excellent example of a stegamite.

Mulwaree Cave contains a range of white speleothem, much of which is covered by white encrustations. Gypsum anthodites grow from sediments in the Star Chamber of Wollondilly Cave while delicate pool crystals (Pine Forests) grow in the small-scale rim pools of the Fortifications in the lower section of the cave.

Vertebrate Fossils

Wombeyan Caves came to the attention of vertebrate palaeontologists through the work of Robert Broom, physician of Taralga and later South African fossil human researcher, who collected and described fossil marsupial fauna from a breccia deposit at Wombeyan in the 1890s. Broom described fossils of a small possum, *Burramys parvus*, which he believed to be extinct. Live specimens of *Burramys parvus*, now known as the Mountain Pygmy possum, were captured at Mt Hotham in Victoria in 1966. The species, which is an ice age survivor, is now considered to be threatened due to climate change.

Extensive deposits of bone-bearing sediment have been exposed in the working of the Wombeyan Quarry and other deposits are recorded in Palace Cave and Wollondilly Cave. While some study was undertaken in the 1960s and 1970s there has been little recent work published on the vertebrate fossils from Wombeyan.