ENTRANCE TYPES IN QUATERNARY DUNE KARST, BAT RIDGES, VICTORIA

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Abstract

Quaternary dune limestone develops caves with marked similarities in morphology. However there are three distinct entrance types: collapse under cap rock, solution pipe and stream passage, which indicates that variety in morphology is not completely lost in such an area.

Bat Ridges is a small area of Quarternary dune limestone near Portland, Victoria. The area has been worked on by the Victorian Speleological Association since 1973 although it was known to have caves much earlier. The caves appear to have developed concurrently with the lithification of the calcareous dunes.

The area is interesting for a number of reasons.

1. It is an example of syngenetic karst development which has not been thought of in relation to other Victorian karst areas.

2. It is very different from the main caving area at Buchan and so has widened many Victorians' concepts of caves.

3. Despite being a small area (8-10 km^2), it has 40 numbered caves and about 20 unnumbered ones.

4. It shows that even within such a small area with a relatively uniform lithology, big differences in karst forms can occur.

5. In reference to this Conference and W.A. it appears to be similar to caves in the Quarternary limestone of the south-west of W.A.

Some things are constant in terms of the area and its caves. First, all caves in the area are dependent on the formation of cap rock as a primary process. The calcarenite cap rock is formed by solution of calcareous bioclastic sand grains of the dunes and the subsequent redeposition of secondary calcite lower in the profile, cementing the loose sand grains in a calcite matrix. This hard layer has sufficient structural strength to support a cave roof and without it caves do not form in any size. Second, the caves generally can be described as linear and shallow, often with extensive areas of low flat ceilings. Collapse breakdown is an important process. Solution pipes and foibes are common. These features generally fit descriptions of caves in syngenetic karst areas.

However, although the area is small and there are these marked similarities between caves there are quite noticeable variations in land form, for example, cave entrances. In general cave entrances show evidence of cap rock ceilings and show collapse breakdown downslope from the main ridge. Within this generalisation there are a number of variations; cap rock and collapse (by far the most common), solution pipes and stream passages. All of these are closely related to processes of cave formation.

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Cap rock and collapse type. The solution of calcium carbonate in calcareous dunes by percolating water moving down through the rock is an on-going process, but the calcium carbonate is redeposited as a hardened secondary calcite cap rock with sufficient structural strength to support the cave roof and the caves form under this layer. The cap rock is often expressed inside the cave by low uniform, relatively flat ceilings. However this cap rock has finite strength and is subject to collapse. Entrances form where the roof has collapsed. Collapse also results in dome or arch forms due to the tensional and shear components of the compression from collapse. At Bat Ridges, dome forms do occur, but relatively infrequently in comparison to areas such as Kangaroo Island and Naracoorte. Collapse does occur in the main part of the cave, for example, Hut Cave (BR-6), but is often confined to entrance areas, for example, Big Cave (BR-5) and Chimney Cave (BR-1). When a cave is very close to the surface, the roof tends to behave like a beam which sags into the void and eventually collapse occurs resulting in the opening. The dolines tend to be rather small.

Solution pipes. These are present as cylindrical forms of varying size and are generally surrounded by a secondary calcite layer. The pipes narrow downwards and accumulate debris piles beneath them, primarily of soil and surface debris rather than rock collapse debris. An example is the chimney entrance to Chimney Cave. This is 1 m in diameter and drops about 7 m into the cave. Collapse between two adjacent solution pipes, for example, BR-8, can show an interesting "window" form. Some caves, for example, Bat Cave (BR-9), have more than one such entrance.

Two main theories are put forward as to the mechanisms of formation of such pipes. These are not the only theories for the formation of pipes but seem to be the most applicable for consideration in this area. First, the solution of cap rock after its consolidation and second, the development from top to bottom during lithification by a combination of leaching along a descending water thread through the sand and the associated cementation of the pipe surround. Such formation is often associated with plant tap roots either as the tap root follows a pre-existing soil-filled pipe or that the growth of the tap root proceeds with the downward extension of the pipe and the root guides water down the developing pipe. BR-35 shows the close relationship between such pipes and tap roots. This is a small cave, dome-shaped with a large debris pile. However the 3 m deep, 1 m diameter small pipe entrance still had most of the tap root of a now dead tree *in situ* when the cave was first entered. Finally it is important to note that the solution pipes in such limestone are the result of secondary calcite deposition along the walls of leached passageways through the sand, and tree roots although being important, may not be the only agent involved.

Stream entrances. At Bat Ridges these are actually streams formed from the overflow from the Bat Ridges Lake. Water enters the lake from the north during the wetter winter months and during this time River Cave (BR-4) becomes an active inflow cave, whose waters resurge into the southern end of the lake. The inflow entrances show more typical stream inflow characteristics than any other caves of the area.

Many caves are multi-entrance, for example, Chimney Cave, Bat Cave and BR-4, and often show more than one type of entrance, for example, Chimney Cave has three collapse entrances and a solution pipe.

The whole area shows interesting examples of karst features. V.S.A. is currently undertaking an extensive surveying program of the caves with the immediate aim of production of an atlas of the interrelated karst forms of the area.

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