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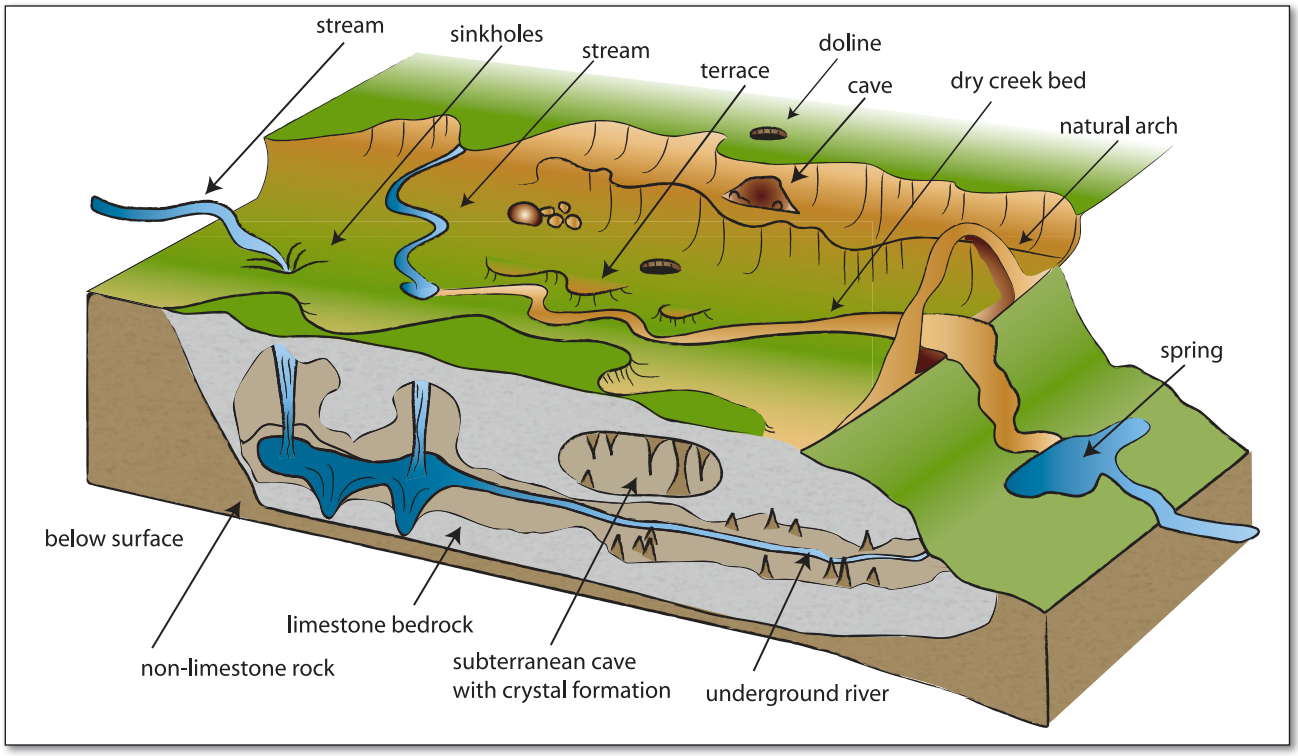
Karst forming and development processes

Foundations in limestone

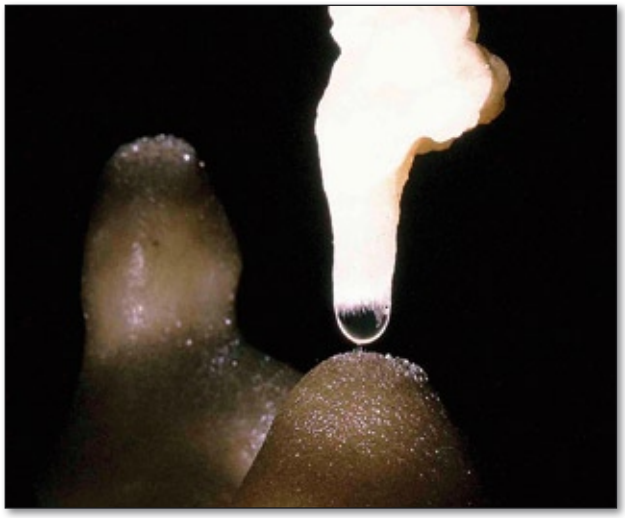
The first curio of karst environments is not their variety of magnificent and unusual features such as stone outcrops, arches, gorges and caves, but the presence of carbonate rock such as limestone, dolomite and marble on the Earth's surface. This type of rock did not exist early in the Earth's history and first appeared some 1000 million years ago, when photosynthesis lowered the acidity of oceans allowing calcium carbonate to form.

In New South Wales (NSW) the majority of karst environments are formed from limestone, a sedimentary rock consisting of the cemented remains of marine organisms such as corals, brachiopods, stromatoporoids and crinoids, and/or fine grained calcite (lime mud), which are all made from calcium carbonate ($CaCO_3$).

This sedimentary material was deposited in the ocean millions of years ago where it was converted to limestone and buried under layers of rock. The lifting and faulting of the Earth's surface exposed the limestone to the atmosphere, where physical and chemical weathering resulted in the development of caves and other karst landforms.



Karst formation and development process. ©M.Inwood



Speleothem formation. ©S.Babka

It depends on water

Limestone caves form in two main ways: from surface streams finding their way through cracks in the ground and forming underground rivers, and by groundwater rising up through cracks in rocks under the influence of heat and pressure, dissolving out mazes and rounded chambers. Caves in NSW have formed from both of these processes.

Water, and the materials it dissolves and carries, drive the development of karst environments.

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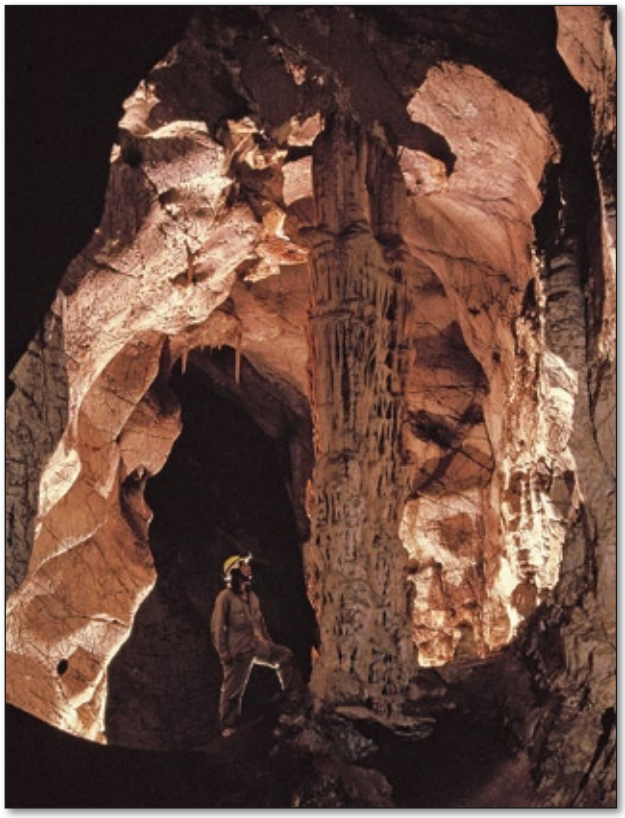

Pillar – the joining of stalagmite and stalactite. ©S.Babka

Rainwater is responsible for the natural sculpturing of limestone and many other features of caves such as stalactites. This intricate process begins when rain falls through the atmosphere and in doing so, picks up small amounts of carbon dioxide, which dissolve in the water droplets forming a weak solution of carbonic acid. As the rain water continues its journey it makes contact with the ground, where it travels through the soil profile picking up further amounts of carbon dioxide and other organic acids, increasing its level of acidity and therefore the ability to dissolve carbonate rock. This acidic water dissolves outcropping stone resulting in rich patterns and displays, before it finds its way underground through weaknesses in the limestone.

On making its way below the surface, the water percolates through the various cracks and fissures, expanding them and creating holes, which over time, evolve into the great subterranean voids that are the trademark of karst environments.

Roof of Orient Cave, Jenolan. ©J.Lim

Water is also responsible for the array of minerals and other features found in caves. Chemically saturated water degasses as it drips, pools, flows and percolates in the below ground karst environment, releasing calcium carbonate (that it dissolved during its travels), which over time, forms into towering stalagmites, hanging stalactites, straws, columns and cave pearls to name a few. These formations (or speleothems) may also be formed from sediments comprised of dust, either washed or blown into caves, guano (bat dung) and various minerals.

Water is the engine of the karst system. It drives the various chemical and physical processes that create the karst landscape and provides the medium for complex biological processes and interactions to occur.

Cathedral structure. ©S.Babka

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