How do caves form?

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The term "cave" refers to a natural opening, usually in rocks, that is large enough for human entry (Gunn, 2004). There are several different types of caves: volcanic, glacier, crevice, erosion, and solution. Solution caves occur in limestone and gypsum and are the most common type in central Texas. Although dissolution is the dominant process, other processes such as erosion and gravitational breakdown, or collapse, can contribute to cave development (Palmer, 1991).

Minerals vary widely in their chemical response to groundwater. Calcite, for example, is soluble in a weak acid such as H_2CO_3 - carbonic acid. Thus, limestone which consists primarily of calcite ($CaCO_3$) is vulnerable to chemical attack by groundwater. Carbonic acid can form by a reaction between water and carbon dioxide. As rainwater, already slightly acidic (pH~6), passes through the atmosphere and the soil layer, it mixes with carbon dioxide and forms carbonic acid (Fig. 1). The acidic water passes through fractures, crevices, and cavities and dissolves the limestone very slowly, enlarging the network of passageways. Most solutional caves require more than 100,000 years to grow large enough for a human to be able to pass through (Palmer 1991).

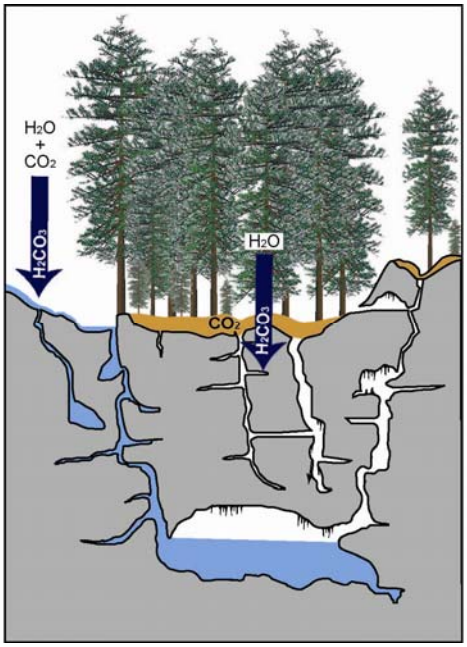

Fig. 1: Rainwater mixes with carbon dioxide in the atmosphere and soils to form carbonic acid (H_2CO_3), which acts to dissolve away limestone.

Most caverns are created at or just below the water table in the zone of saturation in limestone. If the water table is stable, large openings can be created because water would contact all surfaces of the cave, dissolving the limestone at a large scale. If the water table drops, the area of active cave formation will move lower into the bedrock and the upper openings are left in the zone of aeration, only subject to dissolution from running water. Water dripping through these dry passages may deposit $CaCO_3$ in various forms collectively referred to as **speleothems**.

Caves: Windows into the Aquifer

Caves allow humans to access and investigate subterranean processes up close.

Geology and tectonic activity, or folds and faults within the earth's crust, is immediately obvious in caves. Cave walls, ceiling, and floor can show bends, fractures, and folds in rock layers. Cave passages cut through the rock layers and make rock identification easier.

Aquifer Recharge becomes an observable process in caves. An aquifer is a body of rock capable of containing and transmitting large quantities of water (Gunn, 2004); caves are the largest pathway within the aquifer. The water supply within the aquifer is slowly replenished with each water droplet that falls from the cave ceiling to the floor below.

Water flow paths are recorded by the location and patterns of formations throughout the cave passage (Musgrove *et al.*, 2001). Curtains of stalactites, sinuous draperies, or a line of stalagmites can form as water passes through fractures. A tight cluster of soda straws can indicate diffuse flow—water passing through minute void spaces within permeable limestone.

References

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