The Essentials of
CAVE DIVING

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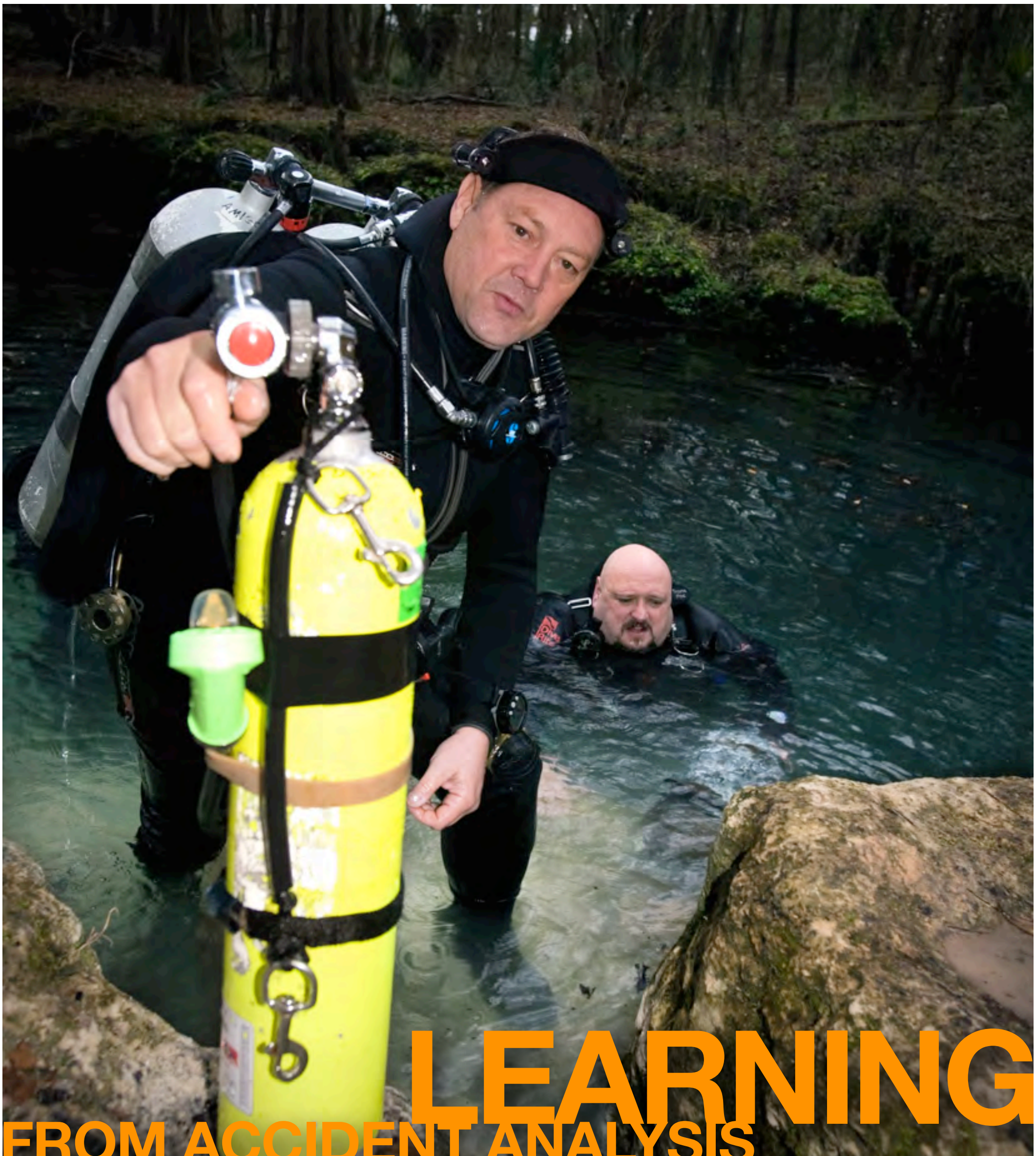


LEARNING FROM ACCIDENT ANALYSIS

CHAPTER 4

Chapter Four

Learning from Accident Analysis

In 1973, a pioneering cave diver named Sheck Exley, became alarmed by the number of fatalities that were occurring in caves. A math teacher by trade, Exley had a fascination, and some would say, obsession, with statistics. He carefully tracked records, logs and the minutia of exploration throughout his career. Exley's greatest gift to the dive community was his careful assessment of accidents and incidents, which he organized into a series of direct causes. In his first review, he determined the most likely causes of death for divers with no experience or training in caves. He summarized these as follows:

Training

The greatest common denominator between accidents was the lack of training. In fact, many of the deceased were highly experienced open water divers, even instructors, who simply had no idea what they were getting themselves into. Caves were rumored to be dark, frightening places where silt would engulf a diver in an inescapable claustrophobic nightmare. Experienced divers visiting the pure and alluring Florida springs did not perceive these stunning places as dangerous. They were tempted by the false comfort of crystal, clear springwater welling up in the entrances. But without training, it was easy to become lost or disoriented in the maze of passages, kick up silt, or simply fail to reserve enough gas to get out.

Guideline

The second direct cause of fatalities was a failure to run a guideline to the open water. Again, the lure of the cave, tempted divers further into the cave than they could safely navigate. Without a tactile reference for return, the divers were simply lost.

Air

The third direct cause of death was a failure to reserve enough gas for exit. Equipment was much less reliable in the early days of cave diving and gear failures were common. Open water divers, accustomed to the habit of turning around with slightly more than half their pressure, did not retain enough to deal with a buddy emergency or increased respiration due to stress. Many fatalities occurred close to the entrance as divers were scrambling to get out, sharing air and stretching dwindling supplies beyond their limits.

Depth

Many fatalities occurred at depths exceeding 150 feet. Air dives with air decompression were the norm. Narcosis contributed to some of these fatalities and lack of time to deal with these crises made deep diving a high risk activity.

Lights

The final issue cited by Exley, was the failure to carry at least three lights. Cave diving lights were rare, negatively buoyant and expensive. Recreational divers were not likely to own proper lighting, and in several cases, a team of divers shared one or two lights. Equipment failures likely left these divers lost in the darkness of the cave.

Fatalities of Trained Cave Divers

A new training regimen emerged that was based on correcting the faults identified in Exley's accident analysis. Yet, experienced divers were still dying in unacceptable numbers, so Exley further examined their deaths in order to form a new list of causes.

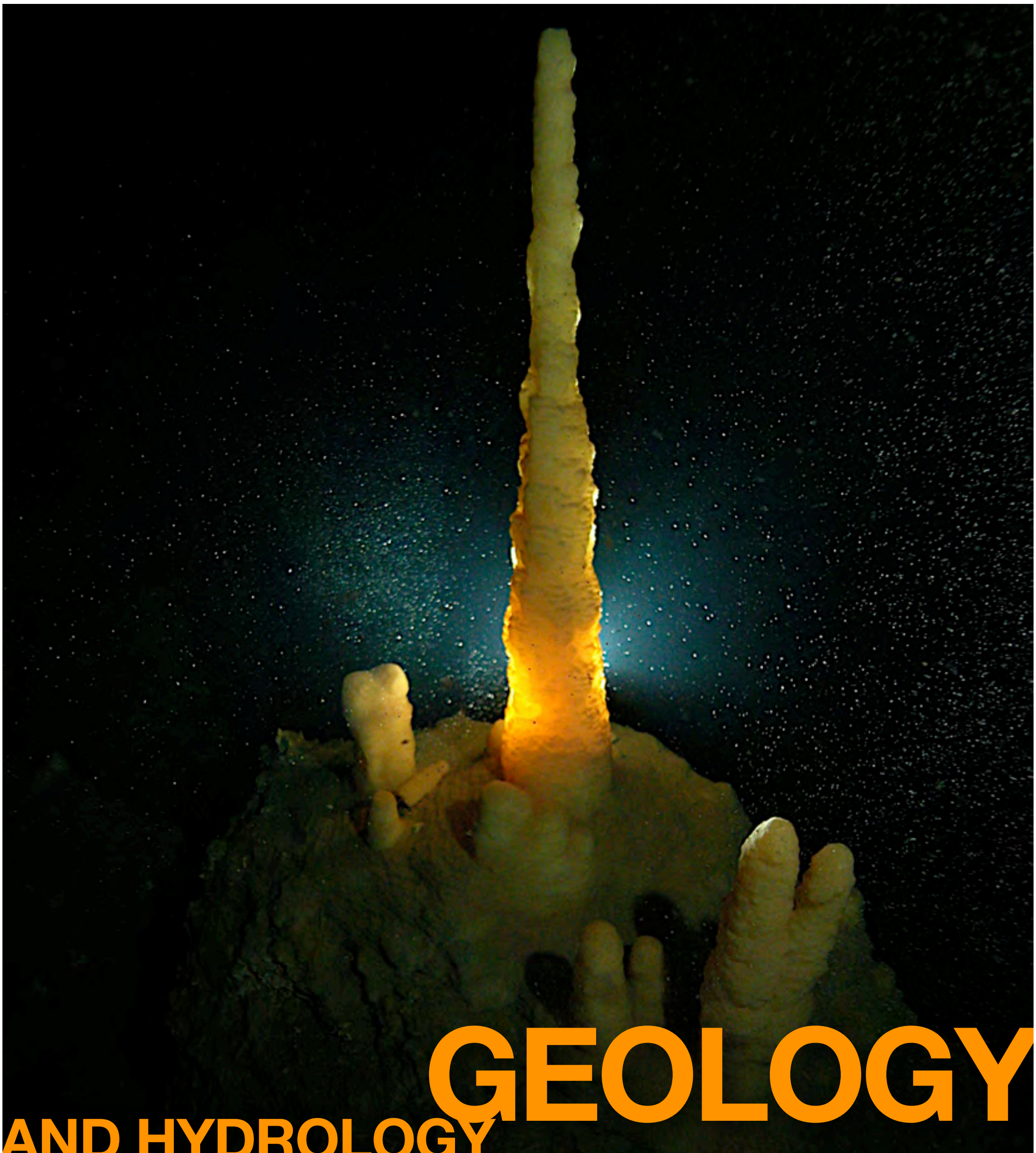
For trained cave divers, exceeding experience and training levels, along with complacency, appears to be much more of an issue. Roughly 80 percent of fatalities occur at depths greater than 150 feet. In our early history, many of these were associated with narcosis and deep air diving. These days, some are attributed to improper gas choice, but the time pressure of dealing with emergencies in deep water is also a factor. There is very little time to make good decisions and retreat from gas supply emergencies. Extensive training and experience is needed for cave dives below 130 feet.

The "no lights rule" adopted by many dive sites protects untrained divers. The darkness repels their intrusion into areas where they do not belong.

The second leading cause of fatalities is associated with guideline issues and the failure to run a continuous guideline to open water. These preventable situations often arise from complacency. Some divers fail to properly mark Ts, gaps and jumps. Other divers conduct "visual gaps," somehow reasoning that familiarity with an area negates the need for standard safety protocols. Still more divers simply skip running a reel to connect with the main line. There is no excuse for laziness, when running a reel could save the life of a diver trying to exit in decreased visibility. When an emergency causes perceptual narrowing, a reel can make the difference between confusion and survival.

THE VALUE OF PRACTICE: After the completion of cave training, it is prudent to continue regular rehearsal of critical skills. You and your buddy should practice drills such as air sharing and no-vis exits so that you remain current and precise.

The third killer of trained cave divers is failure to



GEOLOGY
AND HYDROLOGY

CHAPTER 5

Chapter Five

Geology and Hydrogeology

A rudimentary understanding of geology and cave formation provides a cave diver an enhanced awareness of their environment. Basic knowledge will assist the diver in making good risk assessment choices, aid in navigation and add to the enjoyment of diving. With an apology to scientists everywhere, I present this chapter as general knowledge, with the understanding that cave divers have created their own vocabulary that may differ from scientific terminology. Geology is a highly specialized discipline and well beyond the scope of most cave diving classes.

Cave Diving Regions of the World

Submerged caves are found throughout the world, but infrastructure and access are often the limiting factors for cave divers. As passion for the sport expands, new regions of exploration are constantly opening. At the time of this writing some of the most active regions for cave divers include: Florida, Missouri, Mexico, Bahamas, Belize, Brazil, France, UK, Spain, Czech Republic, Australia, Hungary and Russia with burgeoning areas in China, Thailand, Papua New Guinea, Scandinavia, and the Ukraine. Most caves are found in areas rich in limestone, but other types of caves are worthy of exploration.

Types of Underwater Caves

CORAL CAVES

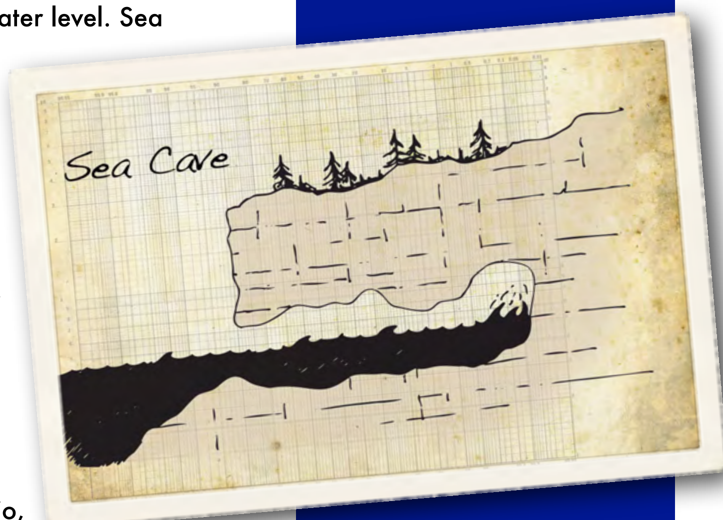
Many divers have their first experience in the overhead environment in coral caves. These formations are typically found beneath living coral structures, when arching branches of Elkhorn coral or large sheets of plate corals enclose a corridor of sea floor. Some offshore reefs are known as spur and groove formations. Often running perpendicular to shore, these ridges of coral are interspersed with sand hallways. As the reef matures, the ridges create a canopy, much like arching trees over a country road. Daylight usually dapples through the canopy and lengthy passages are rare.

Two Nautilus rebreather divers emerge from a coral cavern in Cabo San Lucas, Mexico.

Although getting lost is not likely, there are other specific hazards to this environment. With passages running perpendicular to shore, they can be subject to dramatic surge, which can push the diver against delicate corals and hydroids, damaging them and injuring the diver. Marine life may seek refuge in these caverns, and as such, care should be taken when entering. Many years ago, I came face to face with a weary Bull Shark when I turned the corner in a coral cavern at a site called Snapper Hole on the east side of Grand Cayman. I'm not sure which of us was more surprised, but the large shark was able to turn on a dime and exit. My only thought at that moment was that I was glad it wasn't a dead end tunnel!

SEA CAVES

Sea caves are a bit of a misnomer since sea caves do not necessarily occur in the ocean. These caves are formed when wave action cuts a notch into a rocky escarpment at water level. Sea caves may become further submerged during different water stands and as a result, it is possible to find remnant sea caves at great depths on walls, such as the "Tongue of the Ocean" in the Bahamas. Sea caves may also be found in lakes. The North American Great Lakes have very aggressive waves action that cuts into locations such as the Niagara Escarpment near Tobermory, Ontario, Canada. Sea caves may also be present in icebergs and are formed in a much shorter period.

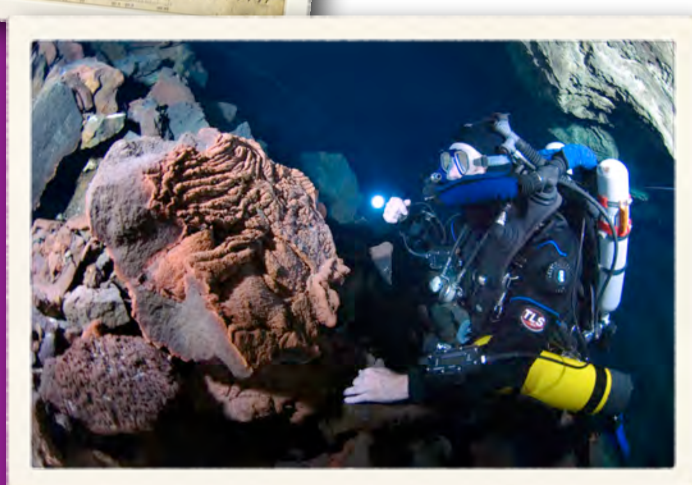


A sea cave formed at the water line, may remain dry at low tide and fill to other levels during higher tides.

When entering active sea caves, divers should be wary of surge as well as tides. Anchoring a boat in the entrance of a sea cave may also be risky. While exploring in Antarctica, my team entered a iceberg sea cave on a reasonably calm day to take water chemistry data. Motoring slowly into the entrance, a large rogue wave surged into the doorway almost pinning the crew and their Zodiac to the ceiling. Ironically, underwater, I felt considerably safer than the boaters.

LAVA TUBES

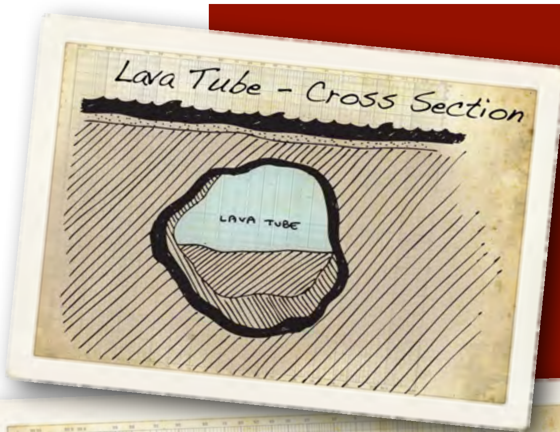
Caves may be formed by volcanic activities. The most common type of volcanic cave is called a lava tube. When lava spills down the flank of an active volcano, the exterior of the flow cools before the interior of the tube. Like a literal fire hose, hot lava rushes through the hose, sometimes leaving a void after the flow has subsided. When lava reaches the ocean, it hits the water causing a massive gas explosion, sometimes vaporizing parts of the sea

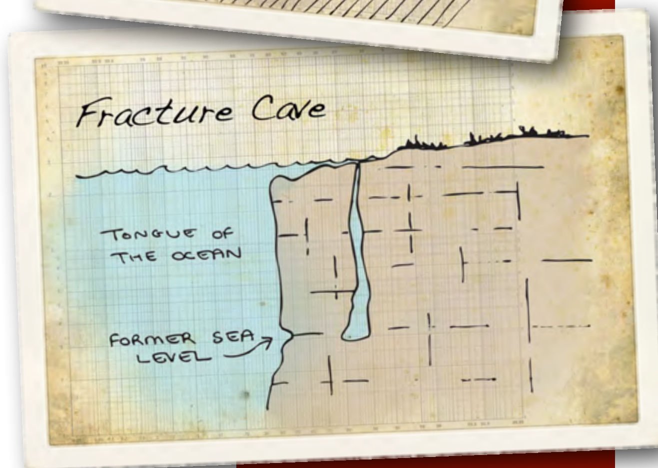


Dr. Tom Iliffe examines a volcanic lava flow inside Atlantida Tunnel on the island of Lanzarote.

in its wake. If the flow continues below the surface of the water, the skin cools first and tunnels are left where the lava has continued moving down the slope.

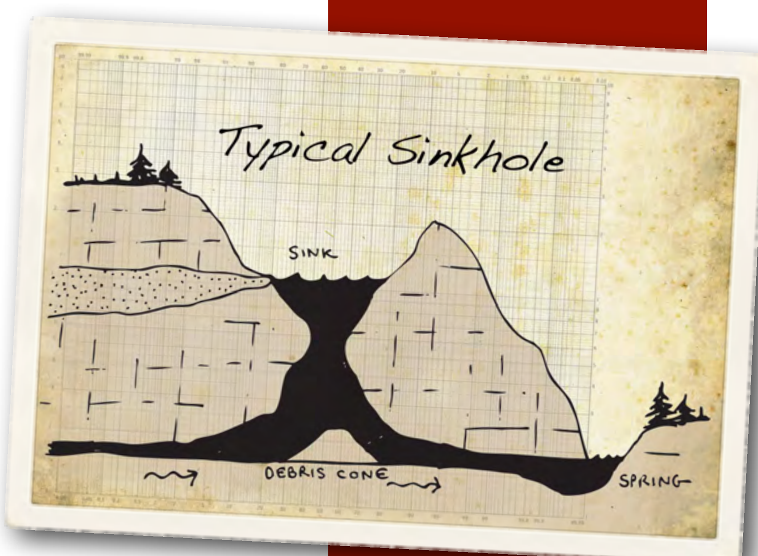
The longest known, submerged lava tube cave in the world is called Atlantida Tunnel, on the island of Lanzarote, off the western coast of Africa. The lava tube is over 7 km long with parts submerged in sumps and a lengthy portion running out below the sea floor.





FRACTURE CAVES

Some caves are found in fault lines and fractures. Andros Island and Iceland are common destinations for this type of diving. In Andros, fractures or fault lines often intersect other types of caves. In Silfra Crack at Iceland's Thingvellir Lake National Park, one may dive in the rift between the North America and Eurasia continental plates. At this World Heritage Site, the plates move apart approximately two centimeters per day. The majority of dives here occur within the view of daylight from above, but in places, a true cave scenario has been created where large boulders have fallen into the crack, creating elaborate swim throughs.



MINES

Flooded mines are technical sites that require the use of cave diving techniques. Popular in Scandinavia and other parts of the world, mines demand the same respect for safety and contain many of the same hazards as