

Cave diving fatality at Cenote Odyssey, Sistema Ox Bel Ha, on April 23, 2022

by Gustavo Buenrostro and Martin Gaspar Ramirez

A fatal accident took place at Cenote Odyssey, part of Sistema Ox Bel Ha, on Saturday, April 23, 2022.

Location:

Cenote Odyssey is part of the Ox Bel Ha cave system, south of Tulum, Quintana Roo, Mexico, and toward the sea. The cave's average depth is 12 meters/40 ft, with the downstream flow toward the ocean.

The victim:

The deceased diver was a 32-year old Russian male who was an experienced cave diver. His certifications included full cave, stage cave, and diver propulsion vehicle (DPV) cave. He had been very active in the area, training, diving, and surveying caves. He was a passionate diver who pursued exploration while working remotely as a programmer. He had been actively diving in the area over the last two years, staying for six months in 2021 and for all of 2022. He knew the cave area well and had done many dives in this cave as part of an ongoing survey project. We estimate that he had around 300-400 cave dives.

The accident:

The victim had dived frequently at Cenote Odyssey. He had become known to the neighbors, who are building a house on the property next to the cenote.

According to the neighbors, the diver arrived at around 10 am on Saturday morning, started his dive, and never came back. They became increasingly worried during the afternoon and evening. The neighbors contacted another local

diver, and the alarm was raised in the community. A first search team was assembled with divers arriving from Playa del Carmen, Puerto Aventuras, and Tulum.

The search:

A team of three divers, Lanny Vogel, Kim Davidsson, and Peter Broger, conducted the first search at 02:57 on Sunday morning (Saturday night). Robbie Schmittner, Alessandra Figari, and Hitoshi Miho provided surface support. Due to the system's complexity and amount of lines, the plan was to try to retrace the missing diver's steps. The team had no information about the missing diver's dive plan.

Each recovery diver used sidemount configuration, an extra stage tank, and a DPV. We found the deceased diver after first searching some other areas of the cave. He had done three jumps (navigational decisions) from the entrance and was using REMs (line markers). He had conducted his navigation properly and consistent with safe cave diving practices and protocol.

The diver's body was located at approximately 700 ft of penetration (seven minutes' trigger time using DPVs) from the Cenote Odyssey entrance. The team photographed and documented the site and left the body and gear intact. The team exited to notify the surface support personnel and the authorities. Because the search took place in the middle of the night, the team planned to regroup the next morning (Sunday, April 24) to complete the recovery.

The deceased diver's equipment consisted of four aluminum 80 ft³ tanks filled with 32% nitrox as marked on the cylinders and a Blacktip brand DPV. He was diving in sidemount gear configuration and with two stages.



Figure 1. Stick map of the cave area. The entrance at Cenote Odyssey is marked by the star.

The diver's route:

Figure 2 (page 4) shows the victim's route. The yellow lines represent the existing lines in the cave, with the star denoting the cenote and starting point. The red lines show where the diver traveled (based on his dive computer profile and the survey data recovered from his Mnemo survey device). The green lines show the jumps that he had placed to ensure his continuous guideline to the surface. The blue circle indicates where he was found with his tanks and DPV.

The recovery:

After the call went out into the community, there was a great response among local instructors to help out and assist.

A team was selected according to readiness, experience level, and availability. The team met

up at a local dive center, discussed the plan, and coordinated with the authorities. The whole operation went very smoothly. The diver and all of the equipment was recovered and brought to the surface by around 13:30 on Sunday, April 24. Local authorities then took over in combination with funeral services.

Recovery team members:

- Alex Álvarez (surface support and point of contact with the authorities)
- Arthur Nguyen-Kim (search and recovery)
- Gustavo Buenrostro (search and recovery)
- Marissa Eckert (search and recovery)
- Martin Gaspar Ramirez (search and recovery)
- Kim Davidsson (search and recovery)

Two recovery teams were formed after planning the operation. Team 1 (Martin and Kim) entered the water at 12:30 and exited at 12:53. They each used sidemount cylinders and a DPV to scooter to the victim and to recover his four tanks and DPV.

Back at the surface they informed Team 2 (Arthur, Gustavo, and Marissa), who did a swimming dive with sidemount gear configuration and an extra stage tank. Marissa and Gustavo recovered the diver while Arthur recovered the jumps installed for navigation. Recovery Team 2 surfaced successfully at around 13:30.

What happened to the victim?

We found the diver's body within an arm's length of where he had "dropped"/attached his stage tanks to the line. Both sidemount tanks were attached to his body. Both of these tank valves were fully open, and both tanks were empty. He was positioned horizontally and face down. His helmet was in place, and his mask was on his face (no blood was in the mask). There were no apparent signs of struggle.

The stage tank valves' positions raise additional questions as to what may have occurred. Both tanks were attached/clipped off to the guideline per standard protocol with hoses and regulators stowed properly. One stage tank was found empty with the valve inexplicably fully open. The second stage tank's valve was closed, and the tank was pressurized with 170 bar/2500 psi of remaining gas. The DPV was clipped to the line at the same location and was functioning.

The diver had a survey slate in his pouch and a wrist slate with many sheets of information. He had most likely been working and re-surveying the lines near where he "dropped" the stages and DPV. But we have no information about his dive plan.

Equipment was functioning properly.

The recovery team checked the diver's equipment with the police investigators as witnesses. Three of the tanks were completely empty as

described, and one still contained 170bar/2500 psi of gas. Analysis confirmed that the remaining gas was 32% nitrox as marked on the tank. The team checked for malfunction by connecting all of the regulators to a full tank. There were no signs of malfunction of any of the regulators, hoses, or o-rings. They were all of a high-quality brand and looked very new and well maintained.

Reconstructing the dive

Martin and Gustavo conducted two additional dives to gather more information about the diver's route and navigation. Their second dive followed the deceased's route based on the information retrieved from his dive computer profile. They were able to find the missing last piece of equipment, an Mnemo (mapping and survey device) that the diver had used. During their dives, they were able to recreate his dive profile, which matched the time, distance, and depth retrieved from his dive computer.

We believe that the diver had set up a "base camp" from which he would be exploring and mapping the lines in that section of the cave. He would have scooted in using a stage tank and may have clipped this tank off before starting a swimming dive using the other stage bottle. He would have left his DPV on site, returning to "base camp" after mapping the adjacent lines.

During one of those consecutive not-so short dives, he returned to "base camp" to leave the second stage tank. We hypothesize that he recalculated his remaining gas at this point. He continued to survey, probably because he was familiar with his surroundings. At some point, he placed the third jump (navigational decision) and proceeded to explore that section of the cave using his sidemount tanks with the goal of completing the mapping of that section of the cave.

The dive profile indicates that he had followed this jump line for about 10 minutes, during which time he found a promising crack leading to a deep unexplored section of the cave. He decided to continue to what was the end of the existing line (confirmed by the recon dives that were

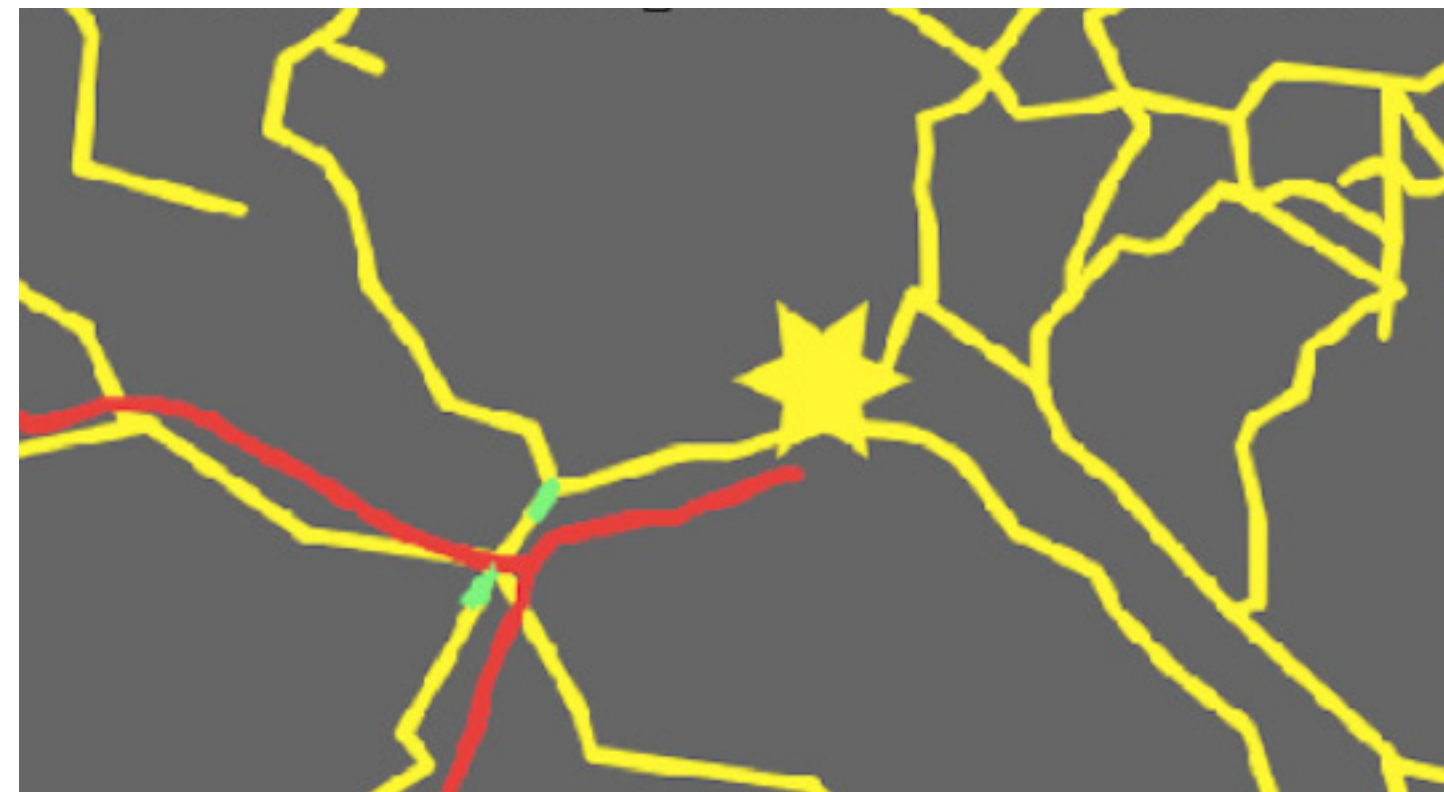


Figure 2. Stick map of Cenote Odyssey and the diver's route.

made). Then—using only his two sidemount tanks—he proceeded back toward the "base camp" using the Mnemo to complete the cave line map. His sidemount tanks by this time would have been at his turnaround reserved pressure.

On the return trip, he decided to take a look into the crack. In this unexplored section, he found himself in a very narrow vertical restriction (a confined space that allows room for only one diver). Contact with the cave caused a silt out and zero-visibility situation (confirmed by Gustavo and Martin on a recon dive). These stressful events would have caused him to increase his gas consumption.

Due to this unexpected situation, and in combination with the depth, the diver most likely drained one of his sidemount tanks. He managed to find his way out of the crack, rushing back toward his stage tanks and DPV. On the way he dropped his Mnemo, which was later found just a few meters from him. He drowned only one foot/30 cm from his partially full stage tank and DPV, which would have gotten him out of the cave.

Hypotheses and Analysis

We hypothesize that the victim may have recalculated his available gas from the "base camp," raising the question of aggressive gas management as a contributing factor. This is a not-uncommon practice to maximize bottom time for work. But recalculation requires caution and attention to managing the risk: For every recalculation and restart, the "on board" reserve gets smaller and smaller.

Why was a stage tank fully drained with the valve open but properly stowed? We knew this diver to be conscientious. He would not have drained a tank dry and risked damage to the cylinder and regulator. Possibly he used most of the gas while surveying and forgot to close the valve. Or the attached regulator may have free flowed and drained the tank. This remains one of the accident's unanswered questions.

A few words to fellow cave divers

We don't really know the events that led to this diver's situation. But what we shouldn't forget is

that every time we decide to enter an underwater cave, we are accepting the risk of what cave diving implies. We are diving in a flooded overhead environment in which our lives depend on our training, gear, and our own decisions. This environment has proven many times to be ruthless and unforgiving.

One can become very comfortable and complacent in an uncomfortable and potentially dangerous environment. Just because one is comfortable doesn't mean that there is no risk.

We must always be aware of our limits and guard against overconfidence and our own egos. Saying "that will never happen to me" can lead to blind spots and distraction. Accidents happen when least expected. We kindly call upon all our fellow cave divers to review all of the cave protocols and safety rules. Dive as if your life depends on it, because it does.

There is no shortage of exploration leads. Some of the important questions to ask ourselves are:

- Are they safe?
- Do I have enough gas?
- Do I have a support team to help me?

And there are many more.

Remember that there is always a next day to go back. It is always better to call a dive before starting to bend the rules. Caves have been there for millions of years and will be there for us tomorrow. It is well said: ***There is nothing in any cave worth dying for.***

Report made on June 14, 2022