

Krakow, November 5, 2021

REPORT ON A DIVING ACCIDENT

SOBÓTKA - "MARIA CONCORDIA" mine 3 October 2021

The accident happened during a course dive in the "Maria Concordia" mine in Sobótka. The course was at the "cave" level and students with "intro to cave" qualifications participated in the course.

PARTICIPANTS:

1. INSTRUCTOR - diving in SM +1 stage- died;
2. OBSERVER - certified cave diver, member of the Maria Concordia facility team - a diver with a back mount;
3. Student 1 - diving in SM +1 stage - died;;
4. Student 2 - diver with a back mount + 1 stage - died;
5. Student 3 - a diver with a back mount +1 stage.

Dive plan - reconstructed on the descriptions obtained from the mine staff (directly) and diving participants (indirectly) who experienced and survived the unfortunate dive (student 3 and observer).

The plan was for entire team to dive in a vertical shaft to a depth of 15m, swim 30m following the "main line", and then swim into the side passage, which required a "jump" from the main yellow-black line through the so-called "stone dam" to side passage's white permanent line and then swim to the "T" junction, mark it with personal marker and in this area, at the end of the right turn from "T", performing the exercise: finding and then recovering the unconscious diver. During this drills, the divers taking part had to swim through the so-called "Wooden dam", a wooden structure resembling a window frame with a size of 2 m x 2 m. In addition, an exercise for "lost gas" situation was to be performed.

The plan also assumed that every course participant dive with one stage, which they deposited behind a stone dam, on the section before the "T" intersection.

Instructor was the people which pretend to be an unconscious diver, and the course participant Student 1 supposed to extract the unconscious diver, (instructor).

Description of the place where the exercise "search and recover an unconscious diver" was conduct.

A narrow corridor (place so narrow that there is difficult to turn in around and impossible to two divers swim next to each other), without permanent guideline (permanent guideline ended just behind wooden dam attached to ladder like metal structure), with a very unstable (silty, ore more clay like) ground, which when moved by the diver causes a significant drop in visibility. The conditions in the passage were confirmed by our observations during the dive on October 19, 2021. Instructor performed the same exercise two weeks before the accident, with another group, who also confirmed the information about a very quick and significant loss of water clarity in this place. An additional difficulty on this route is a "wooden dam" – obstacle looking like a window frame - it reduces the cross-section of the corridor creating minor restriction.

The course of the dive reconstructed from descriptions of survivors

In the water, the equipment is checked by divers together with the Instructor and the observer. Some of the students do it with the instructor, some with the observer, which means that the course members did not know the details of each other configurations during this dive.

They descend to a depth of 15 m, swim to the jump, put on a jump (made it against the line protocol) from yellow-black main line through stone dam to permanent white guide line behind the dam, after a few meters they reach the place where they deposit the stage, continue to the "T", which they mark with cookie in the way against line protocol, then instructor turns in the right arm of the intersection, through a wooden dam and further into a small corridor to simulate loss of consciousness there. At this moment all students and observer are waiting in the "T" area at that time. At least one student- Student 1 is on the wrong side of the "T" (going further down the tunnel). A few minutes after instructor swim away, Student 2 starts the drills (Student 1 was

supposed to be there but Student 2 moved first). He swims through a wooden dam to perform an exercise "finding and recovering an unconscious diver". About 10 minutes after the start of the exercise, Student 2 himself (without Instructor) returns, and with him a cloud of silty water, which suddenly began to spread over the area where the other members of the team were waiting. Due to the rapidly falling water visibility, two members of the team (Student 2 and Student 3) leave their place at the "T" and begin to retreat towards the exit, moving away from the wall of cloudy water. Observer and Student 1 stayed somewhere near "T". Each of these divers makes decisions individually and there was no teamwork at this stage. Visibility continues to decline. When the Student 2 and Student 3 are already several meters from "T", instructor appears next to them (the visibility drops below a meter) and performs the "lost gas" exercise with the Student 3 (it was planned), then stops the exercise and returns alone to the depths of the tunnels. This is the last time the instructor has been seen by the survivors. Visibility dropped significantly during this time, with participants referring as zero visibility.

The students Student 3 and Student 2 continue retreat to the exit, away from the cloudy water and the "T", where they were supposed to wait. They arrive at the stage tanks which they take, one at a time. Moments later, the Observer appears divers waiting for the return of Instructor and Student 1.

"Later on, the observer on the surface describes that when the water started to get "silty", before retreating from where he was conducting his observation, he checked the line from the "T" direction wooden dam several times, swimming even behind wooden dam. He noticed the loose guideline behind the wooden dam disappearing under the stones, he doesn't mention whether he was trying to stabilize it. He found no one. He also mentioned that the time the visibility starts dropping; he could see a directional marker (arrow), a cookie tag and a flashlight attached in the area of a "T" intersection. After an unsuccessful search behind a wooden dam, he made the decision to retreat towards the stone dam. On the "T", he only noticed (felt) an arrow marker. He also talked about a loose guideline in the area of "T", running towards the exit. During the retreat he lost contact with the guideline for a moment."

Observer, Student 2 and Student 3, still trying to get away from the flowing, cloudy water, swim past the stone dam towards the exit. First, Student 3 with the Observer, and after 10 minutes they are joined by Student 2. After Student 2 arrives, the Observer decides to go back down the corridor towards "T" to search for the instructor and the Student 1, but with no success. He retreats back behind the stone dam. He repeats this action several times. He is also not sure if he reached "T" during this search, he mentions a loose guideline. Eventually he returns to the rest of the group at the stone dam.

All three of them wait by the stone dam from the side of entry shaft for 40-50 minutes, then they deposit one stage on the guideline (Student's 2stage, the one during the subsequent rescue operation we find near the place where the bodies of divers were located) and swim to the surface, making over 20 minutes of deco (it was 119 minutes from the start of the dive).

After 15 minutes on the surface, the Observer enters the water again, but the cloudy water prevents him from swimming beyond the stone dam. What he notices is the lack of a deposit tank he has left on the guideline near the dam. However, he is not 100% sure. Observer returns to the surface.

Then Student 2 was getting ready for search dive. He takes a twin (two-cylinder set) from the Student 3 (his own twin-cylinder setup have little air, about 40 bar) and 4 additional cylinders. He submerges and doesn't come back. Later, we find the body of the Student 2 in the close area as the body of instructor and Student 1. Observer dives two more times, but due to zero visibility, he aborts the dive.

This was what we know from the divers about the situation down there. What happened to the three who died on this dive can only be presumed from the observations made during the search and recovery operation (four dives) and the documentation dive performed on October 19.

HYPOTHESIS

While instructor departed to perform "simulation of an unconscious diver", and Student 2 set out to conduct exercise, the other divers most likely stayed at the main line in a different position relative to the "T". When the visibility start dropping down the students Student 2 and Student 3 decided to withdraw towards the exit, Student 1 probably did not notice it and continued to wait holding to the guideline, or he did it on purpose, because the plan was to wait for the instructor.

Most likely he was holding to the guideline on the wrong side of the "T" intersection as he should have been (such an arrangement was made by the fact that the cookie marker was put on by the second person from the team and not by the first. This is completely inconsistent with the line protocol! Observer does not find Student 1. Maybe he was looking too close to the wooden dam, maybe for a moment, the Student 1 moved away from the guideline, or maybe in this restricted visibility they just passed next to each other without noticing.

On the other hand, instructor, coming out from the passage behind a wooden dam after an unsuccessful exercise with Student 2, could also pass next to Student 1 not noticing him if he was holding the guideline on the wrong side of the "T".

There is also a possibility, however, that the Instructor noticed the Student 1 and told him to stay in a given place in order to be able to do exercises with him (he was supposed to do exercises mainly during this dive). In the meantime, he went to look for the rest of the group, and when he found Student 3 and Student 2, he performed an exercise for sharing gas with Student 3, and then returned to Student 1 to do exercises with him. This version is less likely because it is a very risky action to leave student alone in zero visibility, but taking into account how many irregularities there were at the dive planning stage, such a version cannot be put out of consideration.

One thing is for sure, the Student 1 was still in the "T" area when the rest of the team withdrew to the exit.

From documentation made on October 19, 2021. We observed that some pieces of the equipment which belongs to Instructor and Student 1 (most likely Student's 1 helmet and Instructor's helmet, fin with a rock boot, and cylinder rubbers (which are used to clear the hoses of the breathing regulators) lay less than a meter from the wooden dam. There was also a wooden plank lying directly at the dam, which had fallen down from the top or from the side of the wooden dam frame.

The board fell in such a way that the clearance at the point of guideline crossing was significantly reduced, creating the so-called "line trap" impossible to pass. However there was plenty of room to pass above the board, but in the zero visibility situation it could be difficult to recognize. We are not able to say when the plank dropped. It could have been during the return of Student 2 from an unsuccessful exercise, or later, during Instructor's return, or during a later meeting of instructor with the Student 1, or during a lonely swim of one of them.

Due to the fact that the elements of Instructor and Student 1 equipment lie practically in the same place as the sloped board forming the "line trap", it must be assumed that the "fall of the roof or tunnel collapse" and the creation of the "line trap" had an impact on the course of the accident.

We did find divers bodies 3 meters from wooden dam. Student 1 with unfastened cylinders with his face in close proximity to the water surface - an air pocket in which it was theoretically possible to breathe. Instructor below, with only one cylinder and pieces of cut yellow line on the body. In this tangle of yellow lines entwining instructor, there is also an oxygen cylinder, which was transported by Student 2, during the search operation. Student 1 and Instructor have masks on their necks. Instructor's computer indicates that he was under the ceiling for a long time, probably near the air pocket, before his body sank to the bottom (almost 5 hours from the beginning of the dive).

The location of pieces of equipment at the bottom by the wooden dam may indicate a "fight" that took place there, after which they both took refuge in an air pocket, but without the possibility of leaving the tunnel on their own. We also do not know in what psychophysical and equipment condition they reached the air pocket. After some time, they die there (most likely poisoned with CO₂). From the "screen" of Instructor's computer it was possible to read that in the meantime he was diving for some time, and then returned to the ceiling again (probably to the air pocket). It was around the end of the second hour of diving. We did not have access to Student's 1 computer, so we have no information about his dive.

Student's 2 ACCIDENT

The Student 2 survived the first dive, but he came to the surface with a tangled yellow line on the fin, which meant that some part of the personal guideline somewhere in the tunnels was damaged (the permanent guideline was white). Student 2 enters the dive (rescue attempt) after an unsuccessful attempt to find the Student 1 and instructor made by the observer.

Student 2 enters the water with a borrowed twinset, which was not full (it was Student's 3 twin. After a two-hour dive, with additional air fill up from cylinders) and additional 4 stage cylinders. He was to deliver them to (in his judgment) safe place and deposit there. Student 2 deposits 3 stages at the jump, and with the fourth stage (oxygen cylinder) he swim inside. We find Student's 2 body about 1-2 meters further down the tunnel than the bodies of Student's 1 and Instructor. Twinset was empty and harness was open. Student 2 body was stuck to the ceiling, face up. His mask was 2 meters from the body in direction to the exit, and the helmet was 7 meters in direction to the exit. The stage cylinder with which Student 2 entered was near the bodies of Instructor (tangled with him with a yellow rope) and Student 1, and it was empty (it was an oxygen cylinder).

In addition, during our rescue dives, we notice a few of unusual situations:

1. The guideline was laid by someone from the depths of the passage to a stone dam. This means that someone was repairing the guideline as if they were looking for a way out from depth of the corridor.
2. Instructor's stage disappears from the position where the whole team deposited it (we find it near the victims), the Student 1 stage was left to the end where the Student 1 deposited it on the beginning of the fatal dive. The rest of the dive team also deposited their stages there before.
3. The Student's 2 stage which the Observer was depositing at the stone dam disappears, we find it later near the victims' bodies.
4. Near the victims, we did find 4 fully emptied cylinders with the breathing regulators disassembled.
5. We did find a lot of personal equipment on the bottom of the passage: spools, markers, flashlights.
6. We did find a fallen plank from a wooden dam. The fallen board caused a "line trap" for the guideline with a clearance similar to the major restriction or no mount restriction.
7. During the October 19th dive, we noticed that the air disappeared from the air pocket near which we found the bodies, so we was unable to take gas samples for analysis. This means that this particular air pocket was created temporarily from the exhaled air by divers swimming in that place at any given time.

CONCLUSIONS FROM THESE OBSERVATIONS:

1. Someone was trying to prepare a way for the team evacuation from the air pocket. Theoretically, it could be any of the three divers, although these actions would suit the instructor the most (most experienced diver in this team), but the graph observed on his computer does not confirm this (more detailed analysis of the profile from the computer is needed)
2. The air pocket was most likely being filled and purged with air from a cylinder with unscrewed regulators; as above, we cannot say who was doing it.
3. Masks on the necks of Instructor and Student 1, and the practically no cylinders attached to them, proves that both of them stay in the air pocket for a longer time.
4. The creation of "line trap" could be a big problem for Student 1 in the zero visibility environment and this could increase the stressful situation that had arisen earlier due to the loss of visibility and leaving him alone without supervision. It could also be a serious physical obstacle to overcome.

What we can assume is that during this dive a very stressful situation arises (lost visibility, team separation and damage to the guideline (including the "line trap"), with which Student 1 has to deal alone (at least at the beginning). It should be noted here that it was the first day of the cave course (upgrade from the "intro to cave" part to the full cave course), and the Student 1 performed them in the newly learned "SM Toddy Style" configuration. Earlier "intro to cave" training was performed in twinset. In addition, Student 1 performed this training reconfigured for this specific dive, by introducing a long hose (diving in a new configuration for the first time).

Such a complexity of problems can lead to a situation impossible for the student to overcome and cause irrational actions. We will rather never know what these actions were, but in the end these actions end up with the loss of some of Student 1 and instructor personal equipment and evacuation to the air pocket, resulting consequently in their death as well as Student 2 death during his rescue dive.

DIVE PLAN ANALYSIS:

A very difficult not adequate for this level of training exercise was planned for this dive. Additionally, this exercise has been planned in a very dangerous terrain, in which you can easily lose orientation (due to very silty environment with clay on the bottom) and prevent proper instructor supervision over the entire team. Additionally, the diving is planned with stage cylinders (only two cylinders are used at this level of training). Diving was also planned with too many members of a team. The standards assume a maximum of 3 people (including the observer). There were four people here

ANALYSIS OF THE DIVE COURSE:

The dive was done with many errors. The most serious is the lack of instructor supervision. The instructor, pretending to be an unconscious diver down in the side corridor, is not able to supervise the entire team. Furthermore, during the dive, the rules of the "line protocol" were violated many times, which, combined with the decreased visibility, contributed to team members confusion creating stressful and dangerous situation.

RISK MANAGEMENT

The dive on October 3 was planned with a very high risk factor. Each cave dive, be it course, recreational or exploratory, should not be planned and conducted with more than ONE exercise!!! During this particular dive, the Student 1 had to deal with ten unknowns!!!

Planned unknown:

1. The first cave dive after a long break with high stress in the form of a very difficult exercise,
2. Lack of instructor supervision (the instructor was supposed to hide in a side corridor from where he had no chance to supervise the team),
3. Exercise planning with high probability of zero visibility. Two weeks earlier, instructor Maciek performed such an exercise with another team and the visibility was also lost,
4. New element in the equipment, never used in this configuration before (long hose);
5. Complicating the dive by introducing an additional stage cylinder, inappropriate at this level of training,
6. No leader has been appointed,
7. The dive team was too large,

The unknowns that arose additionally under the water:

8. Frequent violations of the line protocol
9. Damage to the guideline, including the "line trap"
10. Separation of the team members and leaving the Student 1 behind alone

Such a number of unknowns occurring simultaneously can result with a very dangerous and stressful situation in which student/students may not be able to deal with.

SUMMARY

The course was planned very risky (incorrectly) and with many unknowns that the students had to deal with. The conduct of this course was made with many errors and the main practical exercise (retrieval of an unconscious diver) planned in a very dangerous place.

The most serious and dangerous mistake made during this course, as well as during the course conducted two weeks earlier, i.e. on September 19, was LEAVING STUDENTS WITH NO SUPERVISION and choosing the wrong training place, which, due to the dangers known to the instructor, made such supervision impossible!

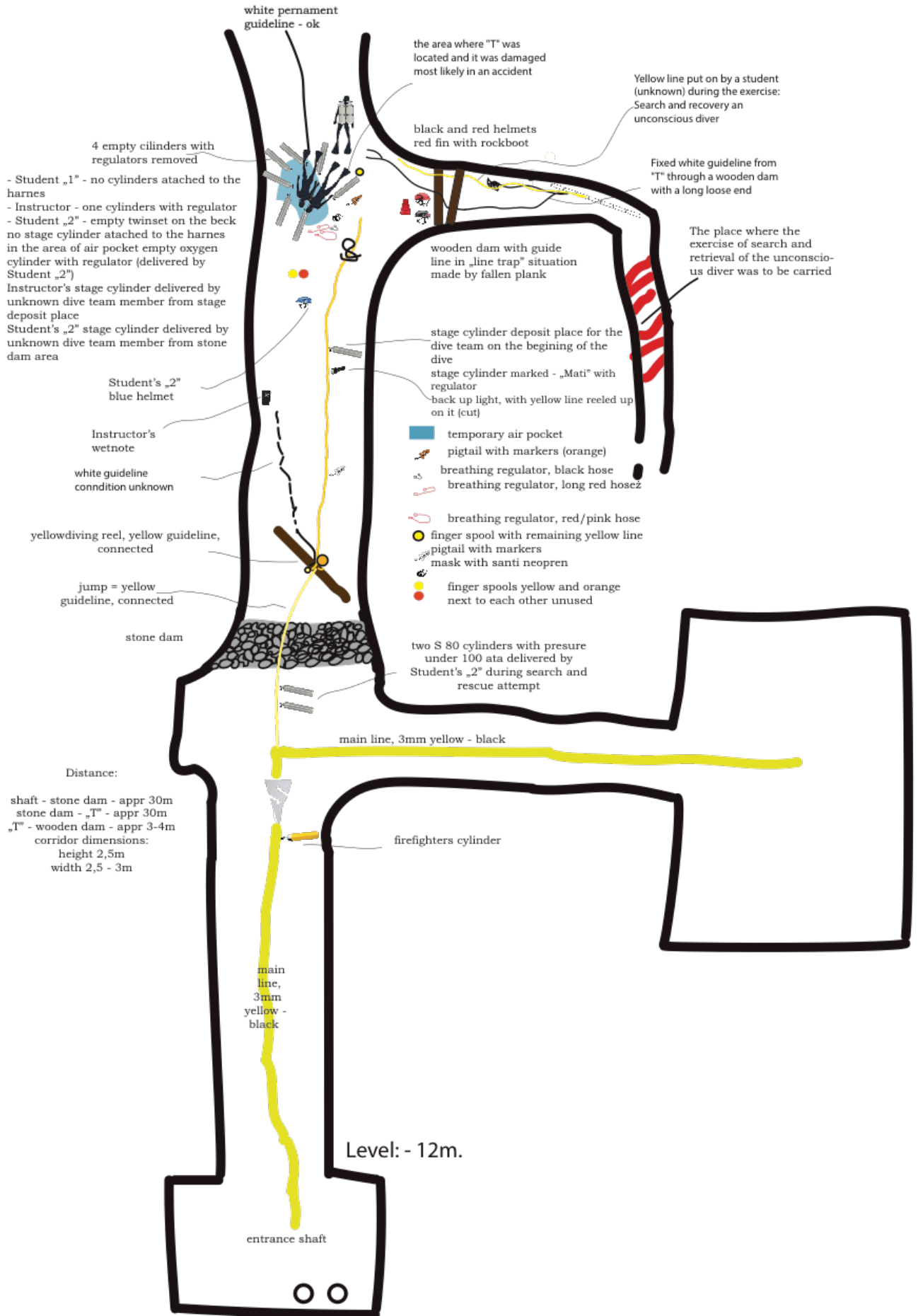
Analyzing all the elements of this diving event, arise a few important questions:

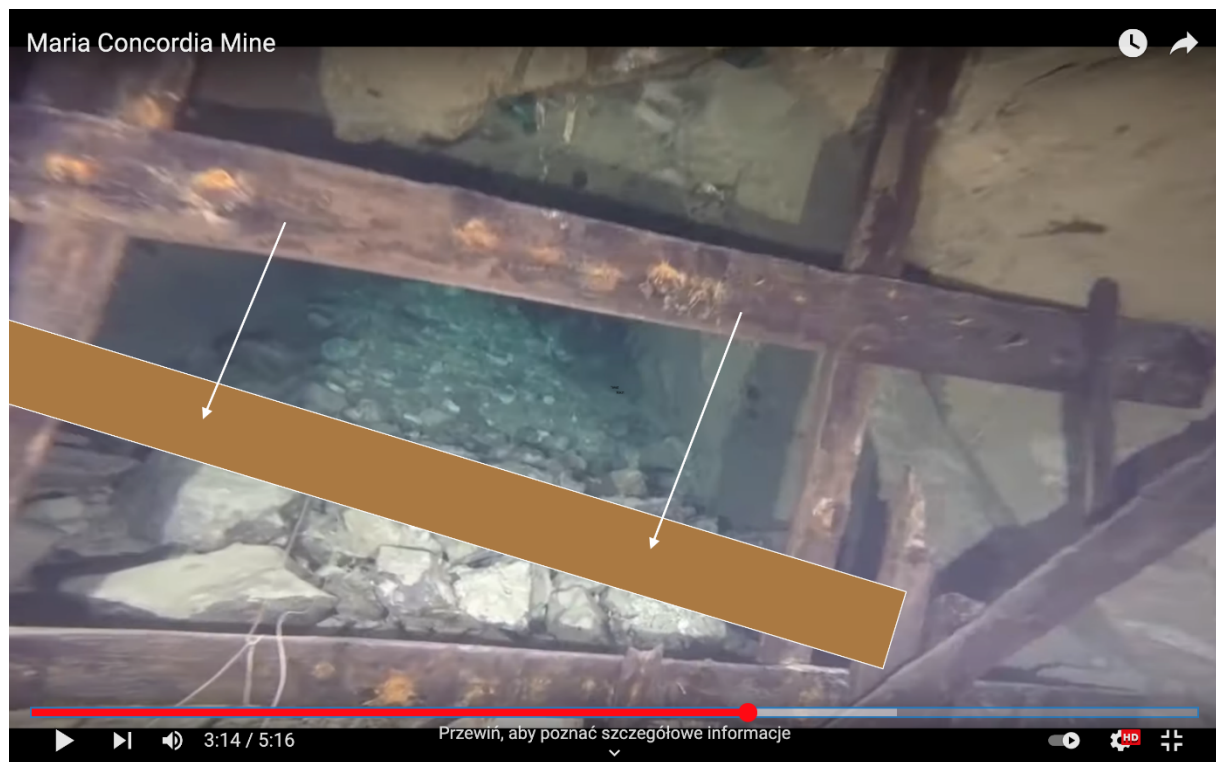
1. What started a diving accident? Was it a continuation of exercises in zero visibility, the student getting lost in zero visibility, damaging the guideline, collapsing plank in a wooden dam, or maybe something else that we do not know?
2. What happened at the wooden dam, near "T", which made Instructor and Student 1 look for help in the air pocket?
3. What prevented the above-mentioned two from being able to evacuate from the air pocket to the exit. The way separating them from the shaft is only a 70m straight (2,5x3 meter)corridor, which, even without a guideline and in zero visibility, should be easy to overcome.
4. Who out of all three carried out the rescue attempts, consisting in delivering the cylinder to the air pocket, flushing it with air from the cylinder and repairing the guideline from the depth of the corridor to the stone dam?
5. And the last, probably most important question. Why did an Instructor with many years of diving experience and the obtained CAVE instructor degree in 2019 (i.e. relatively recently and the knowledge should still be "fresh") planned a dive so risky and with so many errors, the most dangerous of which is LACK OF SUPERVISION and lack of appointment a leader who practically conducts diving and is responsible for emergency proceedings.

We can find answers to questions 1 to 4 by analyzing the computer profiles of all three deceased and survivors. Comparing them on a common timeline may allow us to recreate the course of the event. The computers of Instructor and the students of Student 1 and Student 2 are in the possession of the prosecutor's office and they will be or have already ended up in the hands of an expert.

On the other hand, the fifth question should be answered in the analysis of the federation standards, in which Instructor obtained CAVE Instructor qualifications, and by analyzing his training process at the level of a cave Instructor, as well as the basic cave courses he conducts, after obtaining the instructor's degree in 2019.

Krzysztof Starnawski
Rescue Coordinator





The condition of the wooden dam as we observed during the dive on October 19 (2 weeks after the accident) View from the "T" side. The top plank, which had collapsed, formed a "line trap" for the guideline running through it.