

Denée : Carrière de ‘La Bosse

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Ask the average Belgian cavediver if he knows the flooded mine of Denée managed by the UBS and he will answer you affirmatively. Most will know that it is a black marble mine. And yes there is an old plan circulating on the internet to prepare for the dive. But more? And if you show a non-caver a photo of underwater in the mine, he looks up startled and says you must be crazy. Divers from Global Underwater Explorers Belgium (GUE-BE) and the Groupe Spéléo de Charleroi (GSC) are jointly setting up a project to better document the mine and make this piece of Walloon industrial history accessible to the general public.



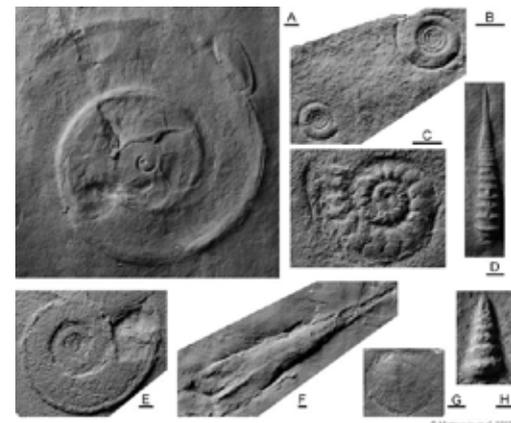
The idea and putting together a team: in tenebris omnia videmus

The idea arose in 2020 at the GUE-BE board to do an underground project. After several successful projects in the Belgian North Sea, in which the wrecks of the SS Kilmore (<https://kilmore.gue-be.be/>) and the Westhinder (<http://westhinder.gue-be.be/>) were documented, members were asked if they wanted to organize a Belgian underground project. We got a resounding yes to this and the cave divers in the club started to get organized. The objectives were set as well as the team members. The aim was to document the ‘La Bosse’ flooded mine in Denée, to check whether the old map was correct, to make a documentary film about it and a website for the general public containing all research, photos, interviews, films, ... and 3D material. The team consisted of 16 members, each with their own specialism and interests. There was a project leader Blas Gallego Ir-

les who would coordinate everything, and then a few people in charge: Olf Smetsers for the catering, Erik De Groef for the video, Laurent Miroult for the photography, Stéphane Riga for local relations and historical information, Johan Wouters for the 3D and Ramon Camp for the website. At that time the corona measures limited the teams to 10 divers, so a team of 10 active project divers was put together. And because some of the GUE-BE members were already members of the GSC, we chose this club to join with the other divers as well. Once registered, the new members would then have to do a dive guided by a godfather to check out their knowledge and skills and also to understand the rules of the UBS. Wearing a helmet, for example, was new and was of course accepted. To promote the team spirit, we had a polo and a hoodie made with the logo of the project ‘Project Denée 2020 - in tenebris omnia videmus’ (literally ‘in the dark we see everything’ or in free translation ‘we reveal what is unknown’). The designer of the logo gave us free reusable mouth masks with an own logo for each specialism.

The project leader

Blas, our project leader, made sure that the dates of the project dives fit everyone. That snacks and drinks were available. That someone provided a first aid kit with oxygen both a large one above and a small one at the bottom next to the water. That there was someone available who didn’t dive down in order to help with the equipment. That the objectives for each team were clear and that the teams respected the order of entry into the water. For example, the 3D team always had to enter the water first, as they preferred to have as clear water as possible. It was also agreed in advance which teams would stay in which parts of



the mine, this also to avoid unwanted encounters, but also to schedule desired meetings for ‘making of’ shots. For example, it was agreed that at a certain moment the film team would meet the 3D team in the central room, where the 3D team would make a turn in front of the camera while the camera rotated (around the axis) making a helicopter turn. These matters were prepared to the smallest detail and repeated during the briefing. And although we were only able to do our first project dive on September 6, 2020, the good preparation ensured that we already had good preliminary results later that year. During the annual conference ‘Tec en wreck night’ in the Netherlands, always with international interest and divers from all over the world present, our project leader was allowed to present the provisional results. This was mainly done by introducing the film (https://youtu.be/q19L6s5_Tjc) that the video team had put together until then.

The video team

The video team was put together based on the coordinated collaboration between





the members. In the past, these people had already made underwater films together in the North Sea and in fresh water. So they were already a bit attuned to each other and that was necessary. The subterranean underwater environment is not an obvious place to deploy a film crew. There is no light and you can't go to the surface to give instructions because then you have to go all the way back to the entrance of the mine. Having an idea of each other's gas consumption can also help to avoid creating unsafe situations, because a videographer sometimes focuses too much on the shot he wants to film and too little attention for his gas consumption and that of his teammates. Planning and preparation were therefore crucial. The members of the film team first made a few scout dives to get to know the mine and to scout the interesting locations. The director determined in advance which shots the videographer had to

take and in which way the lighting had to be done, this was drawn in a storyboard. On this it was precisely marked out what the subject was, where the videographer was and in which direction he was going to film, and whether he would make a film-technical movement (or not), the (two) light divers were also indicated, with the direction in which their video lights had to shine and move or not. The line and the direction of the exit were also always mentioned on the storyboard, safety remains a priority, especially with underground film recordings. A different storyboard was drawn for every other scene. But the number of scenes to be filmed per dive was of course limited. Also because there were other teams working at the same time that couldn't bear to see a film team appearing. The 3D team, for example, wouldn't have liked it if a film team suddenly blocked the corridor and the film crew was stored in the architecture of the mine.

In terms of material, the same very light-sensitive camera was always used (Sony A7Sii), the video lamps were also always the same. The lamps had a wide beam angle but not huge amounts of lumens (rather between 4000lm and 8000lm) so as not to create hot spots or overexposed spots on the walls in the sometimes slightly narrower passages. This benefited the continuity of the images, so that no color adjustments had to be made in post-processing. After each project day, a short film was edited with the collected film material. This encouraged the teams to continue working on the project even though they were only a small part of the whole picture. But only by working together can we bring such projects to a successful conclusion. In the finished movies, it's clear that there are a lot of cogs cooperating. In addition to the 3D views that everyone eagerly and admiringly looks forward to, people are also needed to take measurements, take photos,

provide lighting, ensure security and above all ensure a good atmosphere with good food and drinks.

Food and drinks

After half a day of diving in a cold mine and repeatedly descending and ascending the steep slope with extra and sometimes really heavy equipment, it is good to smell a hamburger (vegetarian or not) in the distance, which Olf offers us in a fresh sandwich with extra onion. Soft drink at will. Only after all dives were completed a local beer was added. During the debriefing in which all experiences and ideas were exchanged, it was degustation time.

3D

Johan was by far the most heavily loaded. To make a 3D plan of a mine, one camera with two video lamps on two arms on an underwater housing - as the videographer - is far from sufficient.

It was the intention that Johan would refine the old topo through a detailed 3D model made with photogrammetry. This is not the traditional survey technique based on azimuth-length-altitude.

Photogrammetry is the art/science of creating 3D models based on 2D images. For this you need many overlapping images of an object. Each image is analyzed for key points. Then the main points of the different images are compared and aligned. With triangulation, it is possible to calculate the location from which each image was taken, as well as the exact X, Y and Z coordinates of each of these key points. This is called a 'point cloud'. The further workflow consists of manually cleaning the point cloud where necessary. Then this thin point cloud is detailed into a denser cloud (with just more points). Any 3 adjacent points are connected by triangles (called

“facet”) to create a “mesh”. The mesh is a colorless model. To give it a more realistic look, the original photos are projected onto these facets. This creates a realistic-looking 3D model.

The concepts of photogrammetry date back to when man discovered perspective. But it was not until 1867 that Albrecht Meydenbauer coined the term photogrammetry. At the time, photogrammetry was a laborious manual process. With the current computing power, it is finally possible to deploy this technology on a large scale. This is exactly what Google does to create the 3D ‘street view’ in Google Maps.

To map caves or mines, where one is in the object to be mapped, we use a setup with multiple GoPros mounted perpendicular to the swimming direction. This allows simultaneous images of the ceiling, side walls and floor to be captured.

For the Project Denée, the raw video footage was captured over 3 days of diving. But the real work starts after the dives. Still images are extracted from the video. These are entered into the photogrammetry software (Agisoft’s Metashape). Due to computational and memory limitations, processing is done in multiple chunks. Then the different chunks are combined into a complete model.

51,000 images were used for the 3D model of Denée. This resulted in a point cloud of 40,000,000 points and a mesh with 12,000,000 faces.

In order to share the model on the web, we had to drastically reduce the size, resulting in less detail. The ceiling was also removed to allow an easy “look inside”. You can take a virtual dive into the flooded quarry on SketchFab (<https://skfb.ly/oqDuJ>).

Once a detailed 3D model is available, it can be used to create derivative products. An example is an ‘orthomosaic’, which is a view where many photos are stitched together to create a very detailed image. By drawing out the contours of this top view and adding depth indications, a topographic map of the mine is created.

Photography

The images or photos from the 3D workflow are only usable for this purpose. Fortunately we had some specialized underwater photographers led by Laurent Miroult who also had an eye for a nice framing. Their wide-angle photos lifted a corner of the veil that was completely removed by the 3D. But the photos are more accessible to the general public without additional software and can appeal to everyone on websites and in articles.

Research

In search of historical and contextual documentation, we first started collecting infor-

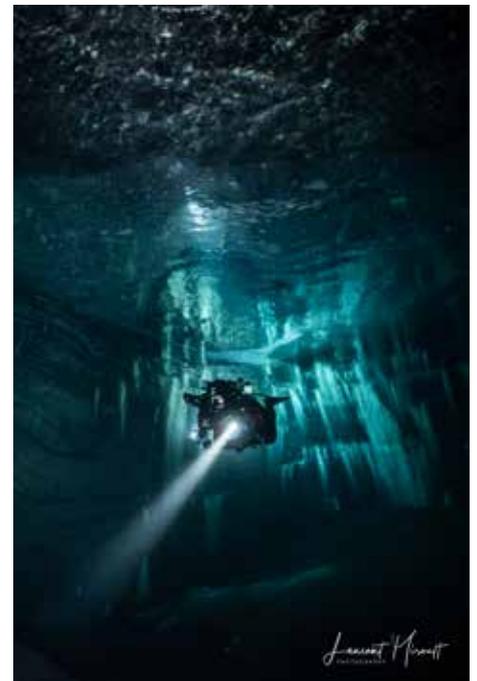
mation on the Internet. Unfortunately, regarding the specific site of the black marble quarry “Falige-Piette” of Denée also known as “La Bosse”, the data is almost non-existent on the web. On the other hand, the internet has provided us with a wealth of scientific documents related to the geology of the village as well as its history. We found that the village was literally cut in half. Indeed, 2 exploitable geological veins rub shoulders in Denée. On the one hand, the famous black marble of Denée and on the other, the small granite (the village has known more than thirty simultaneous exploitations). Thanks in particular to Father Dom Grégoire Fournier (paleontologist) and the relationship he had with the quarry workers, there are impressive collections of fossils embedded in the marble of Denée both in the G. Fournier center of Maredsous Abbey and in the collection of the University of Liège - preserved. It should be noted in passing that in the Middle Ages, much more than stone, it was iron that was extracted from the whole village.

Then we looked at the notarized title deeds of the site. Again, a problem arose: the extent of exploitation of the site reveals identified owners (3 different families), but this is not the case for the site as such. It was therefore very worthwhile to make contact with the owners of the land adjacent to the quarry. Indeed, although the latter themselves had no or very little information about the exploitation period of the quarry, they nevertheless welcomed us very warmly. We were put in touch with two inhabitants of the village who could help us, a third unfortunately died before we could interview him, he was the last worker to participate in the exploitation of quarries in the village.

Many exchanges via e-mail and telephone preceded our interviews with these two special villagers. The first we met was the late Bruno de Wouters de Bouchout, the last of 3 co-authors of a monograph on the history of the village. Unfortunately, Mr. de Wouters also passed away shortly after our first meeting. However, he gave us permission to reproduce the texts and images of his work in our publications.

The third contact person is Éric Cobut. The latter, co-author of a first book on Denée, has started writing a new book devoted to the history of the village, approached from the angle of the meaning and history of the places. It’s still in the works. So we went there with the beautiful pictures of Laurent Miroult from under water as a means of exchange. During our meeting, our host received us in a house built with local stones, where on the facade we can still read the inscription ‘marbrerie’ carved in the stone. We learn on this occasion that Eric’s great-grandfather was a marble worker and master polisher... The link was made: we could not have been better received.

During our various exchanges, Eric Cobut informed us about the origin of the name of the quarry “La Bosse”: the name comes from the slag heap of exploitation waste, which formed a mound in the shape of a



hump. Rich in historical culture and anecdotes about the area, our interlocutor made us discover the village through his stories and explanations, but also through a beautiful walk. This guided walk, along the old exploitation sites of the Noir de Denée and small granite, opens the way to likely new explorations.

Website

Under construction...

<https://denee.gue-be.be>



Laurent Miroult
PHOTOGRAPHY



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