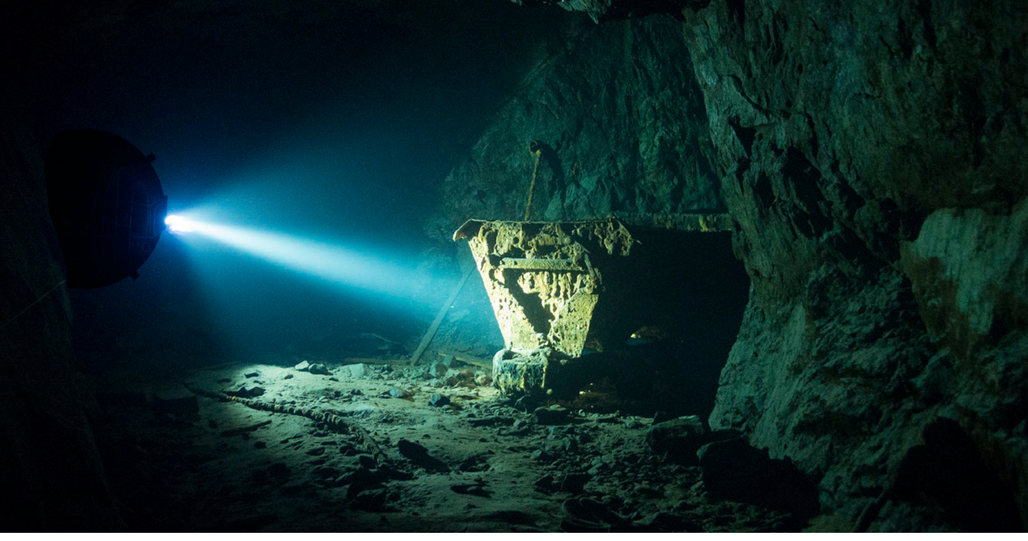
UNEXMIN

UNDERWATER EXPLORER FOR FLOODED MINES



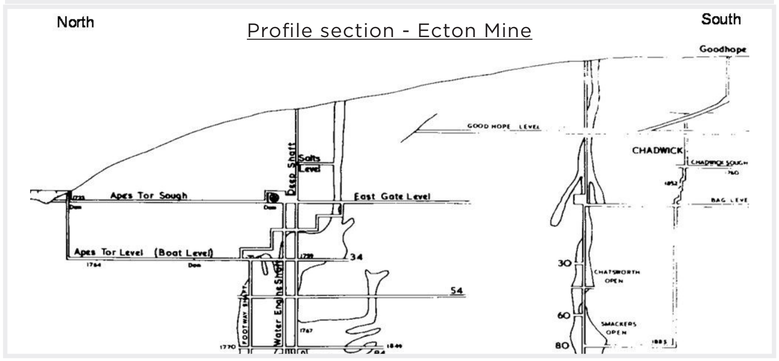
A NOVEL ROBOTIC MINE SURVEYING SYSTEM TO BE USED FOR THE AUTONOMOUS EXPLORATION AND MAPPING OF FLOODED UNDERGROUND MINES

Many of Europe's closed underground mines are now flooded and the last piece of information on their status is decades or over a hundred years old. The complex underground mine layout and the complex topology and geometry of these mines makes any kind of surveying impossible using conventional tethered or remotely controlled equipment. For safety reasons, it is almost always impractical to carry out such work using human divers.

UNEXMIN's pioneering solution will generate valuable information on underground mine geometry as well as geological data. The multi-robot platform will link several surveyors together into a distributed payload system, where each of the vehicles can carry a different set of sensors, reducing the size, weight and power demands of the individual robots. This approach will provide security of operations for the submersibles that will be able to share data in real time, and will also provide scalability for future operations, where larger mines could be re-explored by a swarm of collaborative robots.

OBJECTIVES

- Design and build a Robotic Explorer (UX-1) for autonomous 3D mapping of flooded mines;
- Develop and calibrate scientific instruments for collecting mineralogical information;
- Develop a multi-robot platform that allows the collaboration and task distribution between several UX-1 robots;
- Demonstrate the operation of the prototype at representative pilot sites.

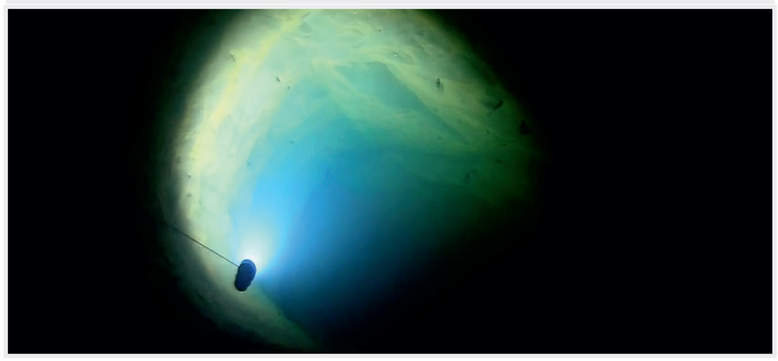


CHALLENGES

- Localization, Navigation and 3D Mapping: autonomous operation in difficult heterogeneous three dimensional tunnel structures;
- Scientific instrument design and adaptation: optimising miniaturisation in terms of price, weight and power consumption, whilst providing valuable geological data;
- Explorer structural design: physical robustness, resilience and self-diagnosis capabilities.

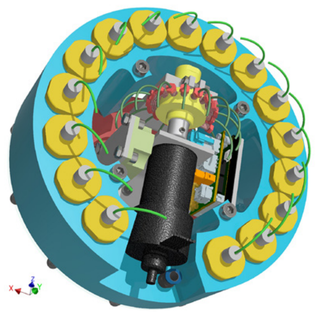
IMPACT

- Pushing the EU to the forefront in sustainable minerals surveying and exploration technologies;
- Increasing Europe's capacity to re-evaluate its abandoned mines for their mineral potential, with reduced exploration costs and increased investment security for any future mining operations;
- Help to document and safeguard Europe's unique mining heritage.



UX-1 CHARACTERISTICS

- Maximum operation depth of approximately 500m
- Spherical shape
- Diameter of approximately 0.6m
- Expected weight of 112Kg
- Power consumption between 150-300W
- Maximum speed between 1-2Km/h
- Autonomy up to 5 hours
- Thrusters power between 2-5Kgf
- Neutral buoyancy

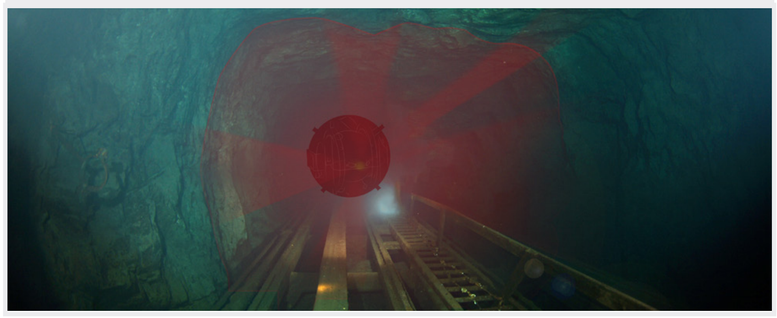


INSTRUMENTATION

- Water sampler
- Conductivity and pH measuring units
- Sub-bottom profiler
- Magnetic field measuring unit
- UV and SLS imaging units
- Multispectral camera
- Acoustic cameras
- Laser scanners
- Thrusters
- SONARs
- Pendulum and buoyancy control system
- Rechargeable batteries
- Protective pressure hull

APPLICABILITY

- Providing information about mineral deposits and opening new exploration scenarios for raw materials;
- Drafting more informed and successful drilling plans for exploration;
- Underwater exploration in highly hazardous or dangerous areas
- Offering supporting data for areas such as archaeology, energy efficiency or resource management;
- Monitoring the integrity of civil engineering structures
- Environmental monitoring



Extensive pilots and demonstrations will confirm the capabilities of the Platform. During the pilots, UX-1 will be iteratively improved after each trial session, which will be increasingly demanding in mission objectives. This iterative piloting activity will last for approximately 16 months, after which the final, most ambitious demonstration takes place in the UK with the resurveying of the submerged parts of Ecton mine that nobody has seen for over 150 years. This final mission will be the most challenging and complex endeavour. At this pilot site the entire mine will be resurveyed, using multiple robots, and all available scientific instruments in order to demonstrate the Platform's ability to adapt to the size and complexity of different flooded underground environments.

The UNEXMIN consortium:

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