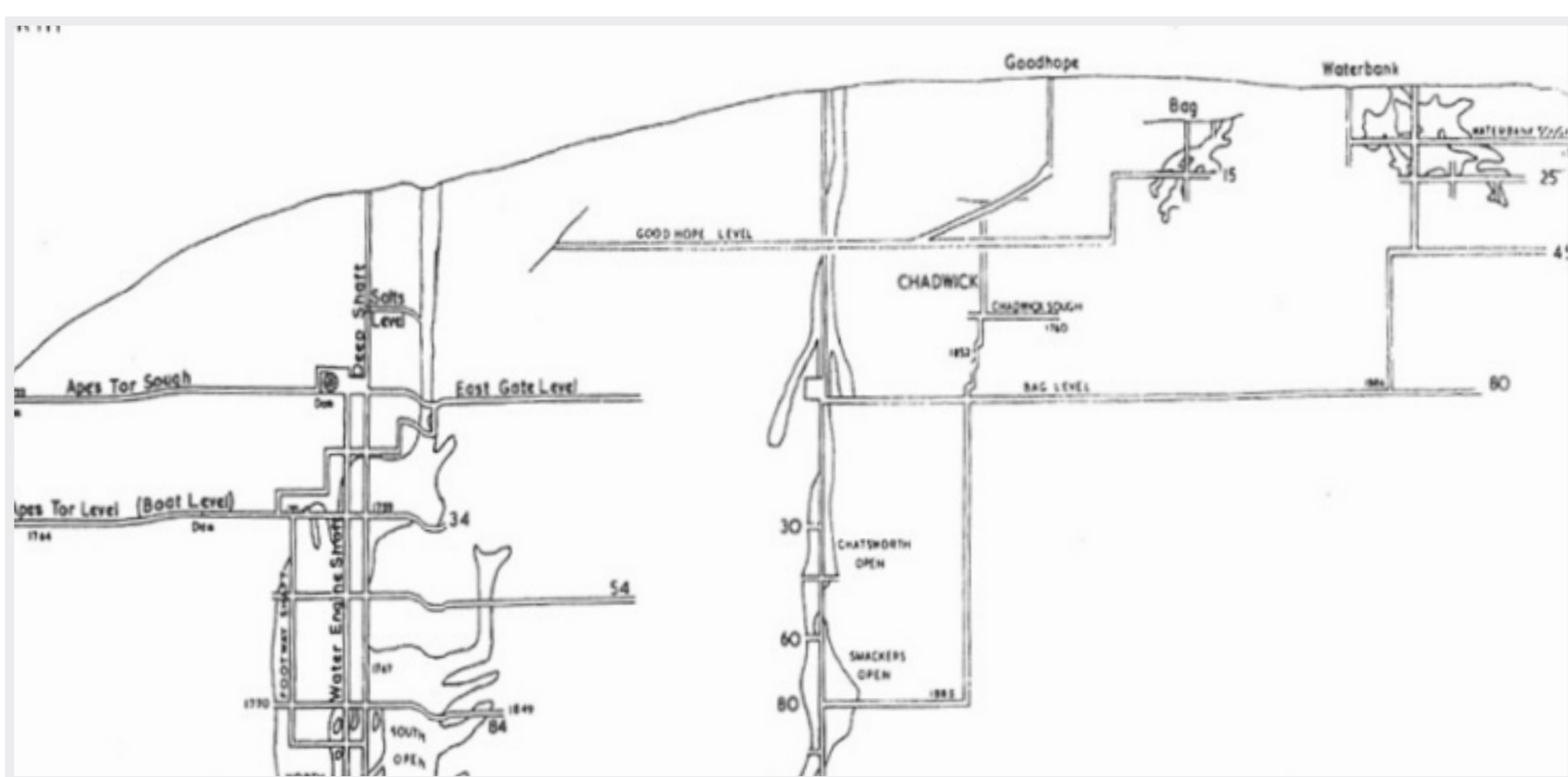


## UNDERWATER EXPLORER FOR FLOODED MINES



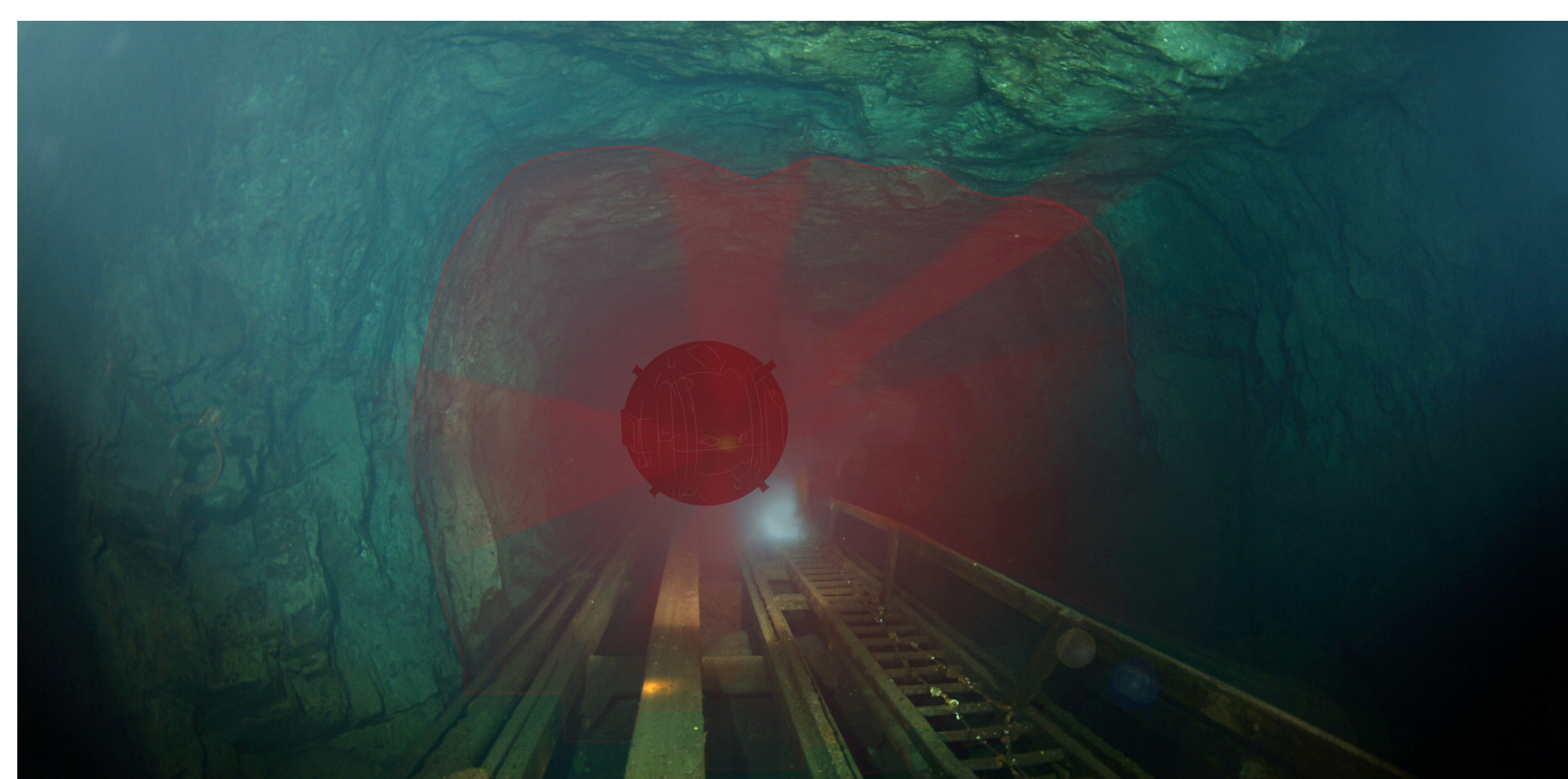
### A novel robotic mine surveying system to be used for the autonomous mapping of flooded underground mines

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 (mineral extraction was often performed on many interconnected levels) 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, as the stability and accessibility of such mine openings cannot be assessed in advance and the water depth in most mines is considerably greater than the safe limit for scuba diving.



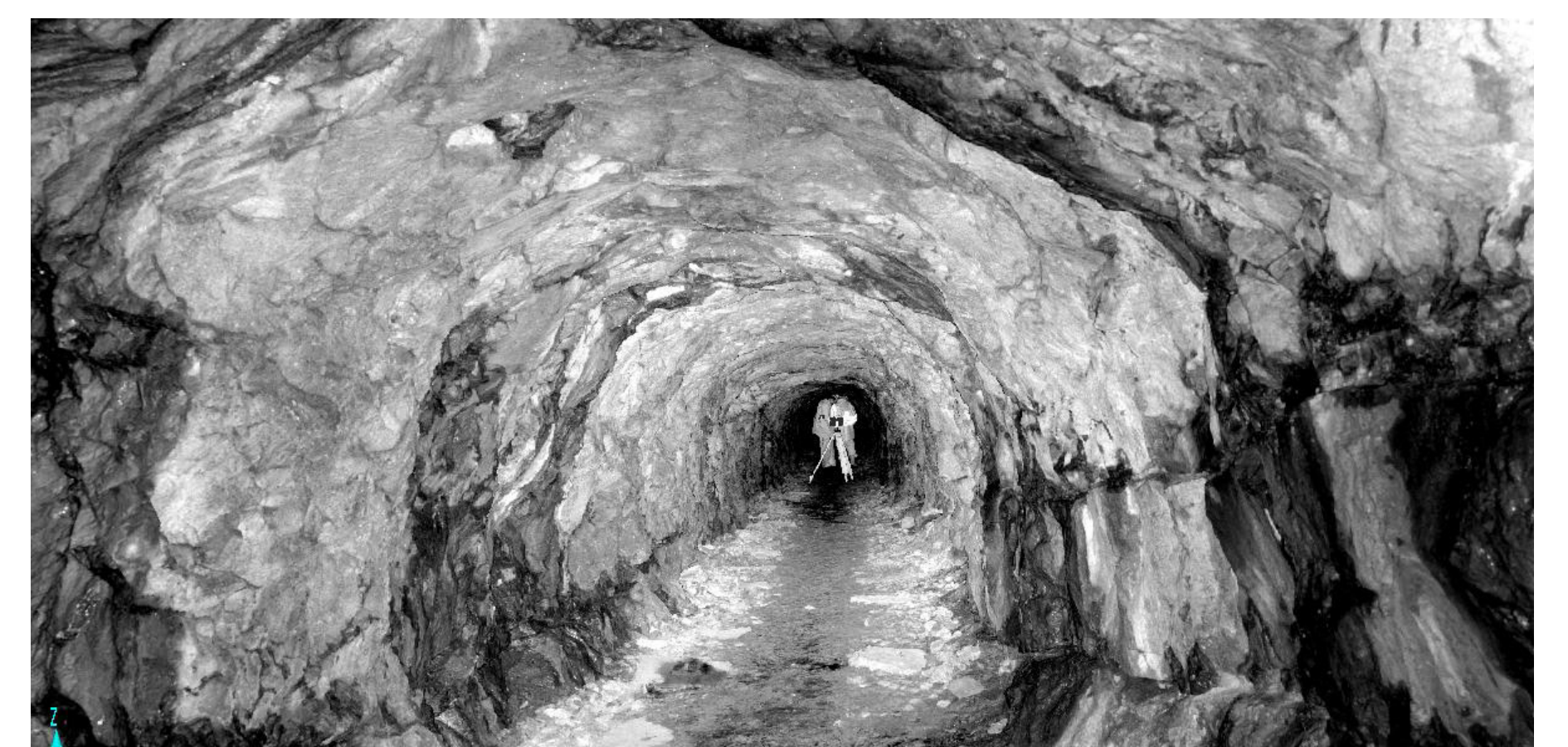
### OBJECTIVES

- 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.

UNEXMIN's pioneering solution will generate valuable information on underground mine geometry as well as geological data for the development or update of 3D regional geological models, replacing much of the need for expensive drilling from surface. 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, the weight and the 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.

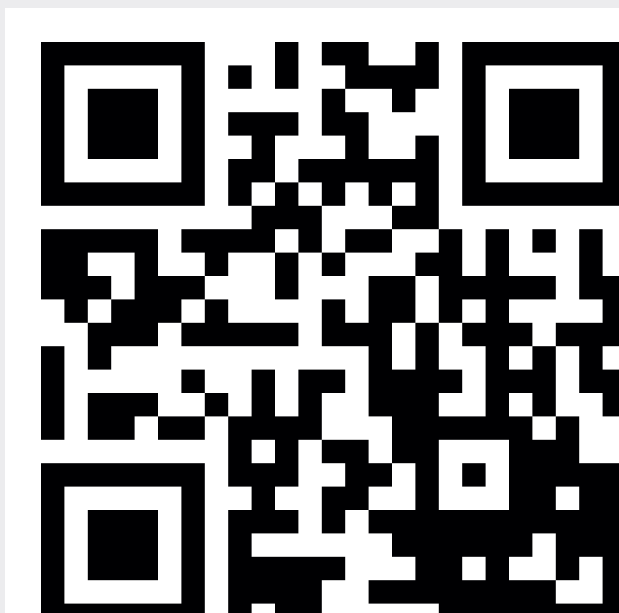
Extensive pilots and demonstration will confirm the capabilities of the Platform. During the pilots UX-1 will be iteratively improved after each trial session, which will be increasingly demanding. This iterative piloting activity will last for approximately 16 months, after which the final, most ambitious 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 most 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 flooded underground environments.

#### The UNEXMIN Consortium:

- University of Miskolc, Hungary
- Geological Survey of Slovenia, Slovenia
- Tampere University of Technology, Department of Mechanical, Engineering and Industrial Systems, Finland
- Universidad Politécnica de Madrid, Centre for Automation and Robotics, Spain
- La Palma Research S.L., Spain
- INESC TEC – Institute for Systems and Computer Engineering, Technology and Science, Portugal
- Resources Computing International Ltd, UK
- Geoplano, Portugal
- Ecton Mine Educational Trust, UK
- European Federation of Geologists, France
- Geo-montan, Hungary
- Empresa de Desenvolvimento Mineiro, Portugal
- Idrija Mercury Heritage Management Centre, Slovenia

#### More information:

**Project starting date:** 1 February 2016  
**Duration:** 45 months  
**Budget:** 4,862,865 EUR



[WWW.UNEXMIN.EU](http://WWW.UNEXMIN.EU)

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