# Real-Time Mineral X-Ray Analysis for Efficient and Sustainable Mining

## Project summary

The X-Mine project is an about 12 M€ research project coordinated by VTT Technical Research Centre of Finland and funded by the European commission Horizon 2020 programme. The X-MINE project studies and develops X-ray and 3D vision based sensing technologies and 3D ore deposit modelling. The sensing technologies have been integrated in two types of large-scale prototypes: drill core analysers and mineral sorting prototypes, which are being demonstrated in the four mining sites of the project in Sweden, Greece, Bulgaria and Cyprus. The sites have been chosen to illustrate different sizes (from small-scale to large-scale) and different target minerals (zinc-lead-silver-gold, copper-gold, gold). The targeted impacts of the X-Mine project include a 20 % reduction in transportation costs through more efficient ore and waste separation, a 7 % reduction in waste rock, and a 10 - 30 % reduction in energy consumption and $CO_2$ emissions. Current results show that these numbers could be achieved, and the project is continuing research to quantify the impacts more precisely.

In the longer term, the new analysis methods developed in X-Mine could lead to a revolution in the exploration and characterisation of existing and new mineral deposits, enabling entire value chain of mining operations to be optimized based on improved insights into mineral grain size, distribution and other structural, geological, geochemical and mineralogical information. This would not only make mining more efficient but would reduce its environmental impact in various ways, for example by minimizing waste through the more accurate selection of blasting and excavation sites, which in turn would lower energy use, transport costs and $CO_2$ emissions.
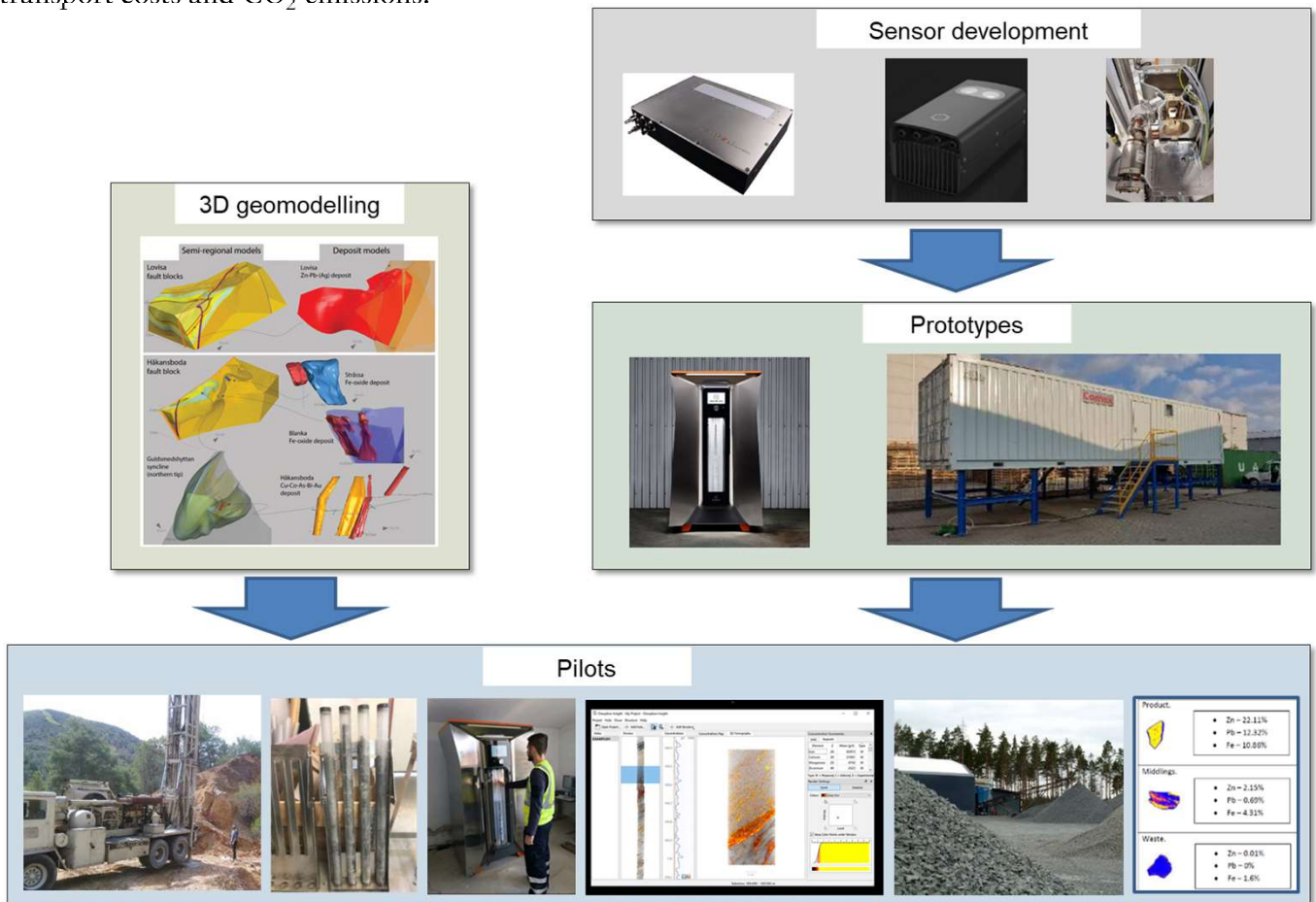


**Figure 1.** The X-Mine project research and development has four main streams: 1) New sensor developent (X-ray sensors and 3D cameras), 2) integration of new sensor technology into drill core analyzer and mineral sorting prototypes, 3) 3D geomodelling of mineral deposits and 4) pilots: large-scale demonstrations of the prototypes and 3D modelling at the participating mines.

**Figure 2.** The X-Mine project pilots at the four participating mines: Lovisagruvan in Sweden, Hellas Gold in Greece, Assarel Medet in Bulgaria and Hellenic Copper Mines in Cyprus. An important part of the demonstration activities is the drilling of oriented boreholes. The orientation of the drill core is maintained from drilling to logging, and to the scanning with the drill core scanner. This way, the 3D structural geology information in the drill cores can be fully exploited in the 3D modelling software packages.

The container-based pilot sorting prototype is used as a pre-concentration method after ore crushing. The first results show that several tens of per cent reduction in transported waste rock and $CO_2$ emissions could be achievable. There is also some potential of converting existing waste piles into feasible ore or ore resource.

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