



## X-MINE project (H2020): testing the capabilities of X-ray techniques in drill core scanning and ore sorting

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The X-MINE project (Real-Time Mineral X-Ray Analysis for Efficient and Sustainable Mining), under the Horizon 2020 program (grant agreement no. 730270), combines high-energy XRF sensors, multi-energy XRT sensors and optical sensors to be able to support both drill core analysis and mineral sorting applications, including high speed processing of low-grade ores.

The aims of the project are: (1) smart exploration, (2) selective (more efficient) drilling and (3) optimal extraction in existing mine operations. The expected effects of project outputs include: reduced quantity of mining waste by a better selection of the ore; reduced consumption of energy, explosives and other chemicals thus less CO<sub>2</sub> and NO<sub>2</sub> emissions; further critical raw materials acquisition for the EU; better planning of mining operations; increased resource efficiency.

On the purpose of smart exploration, multi-parameter 3D near-mine ore deposit models were built, under SGU coordination, for 4 mining areas: Lovisagruvan(Sweden), Assarel(Bulgaria), Skouriotissa-Apliki(Cyprus) and Mavres Petres-Piavitsa(Greece).

The project improves and combines various online sensing technologies, integrates the multi-sensor solution in an online analysis platform and demonstrates the solution in real mining operations. Two prototypes are being developed and demonstrated in the X-MINE project.

(1) A sensitive transportable X-ray Analyser based on undertaken drill core scanning (GeoCore X10, delivered by Oreplore and further developed within X-Mine project). This performs penetrative combined and integrated XRF-XRT scanning, providing assaying of exploration drill cores and 3D tomographic imaging, that also allows linear and structural annotations and measures bulk density.

(2) A complex analyser, developed by X-Mine consortium, integrated in a sorting line by Comex. The multisensory analyser unit uses XRT-XRF based scanners and 3D cameras, platforms, algorithms and software developed by Oreplore, VTT, Advacam, and Antmicro.

The X-Mine project has reached the phase of pilot demonstration. The prototypes are being tested on various types of mineralisations and rocks from the four operating mines mentioned above. The tests done so far showed that the drill core scanner allows the tomographic observation and structural study of the cores, which could be ore-genetically evaluated and interpreted. Elemental composition is analysed and bulk density is measured for 1 m of core and calculated for segments as short as 8 mm based on estimated mineralogy. The scanning can be done at a speed of 3-4 meters of NQ-size drill core per hour with results available immediately and therefore useful while the drill rig is still on site.

The development of the new X-MINE sorting application started with laboratory and full-scale tests, and base line studies of previously available dual-energy X-ray technology. A first full-scale initial test at Lovisagruvan indicated that 75% of available size fractions are amenable for sorting, although alternative crushing/size screening may increase sortable fractions. Laboratory and base line studies performed so far, at a speed of 17-20 tons / hour, indicate that waste rock may be reduced by as much as 22 % for some materials.

The testing of the prototypes continues, with special focus on the calibration for different matrix/grade combinations and optimization of hardware, software, algorithms and productivity.