Seismic imaging technologies for mineral exploration. The SIT4ME project

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Our society is greatly dependent on raw materials and their ever-increasing demand puts their supply under strong pressure. The European Institute of Innovation and Technology (EIT) with its KIC-RawMaterials Programme promotes research and innovation solutions for sustainable mineral exploration (www.rawmaterials.eu). Within this framework, the SIT4ME project, supported by the EIT, aims to develop and assess seismic imaging approaches for mineral exploration within crystalline (hard-rock) Precambrian age basement and Carboniferous age volcano-sedimentary environment. The SIT4ME project seeks to test the efficiency of different seismic approaches for subsurface imaging including: control and natural source seismic data-sets. Two world-class case studies are being developed in active mine sites (in Sweden and Spain).

In the Iberian site, located at the southeastern of the Iberian Pyrite Belt (SW Spain), a multi-method seismic dataset (i.e. 3D-3C controlled source and natural source) was acquired. The target of this experiment is a pyrite-rich massive sulfide orebody interbedded with felsic volcanic rocks and shales, located at 300 – 500 m depth. The acquisition comprised 653 seismic receivers, distributed in a 3D mesh and six 2D-crooked lines, that registered 875 vibration points in an area of approximately 6 km^2. The processing workflow involves standard commercial processes such as static corrections, surface-consistent deconvolution, amplitude equalization, frequency filtering and velocity analysis. Here, we present the results of this processing flow in a few 2D-seismic sections crossing the study area in the north-south and east-west directions. The seismic images present coherent reflectivity down to ~2000 ms two-way traveltime (TWT). The North-South line shows a ~400m long highly reflective zone of in the center at 130 ms, characterized by high amplitude, north-dipping reflections. The east-west transects show a soft folded structure (antiform and synform) which can be observed down to ~235ms TWT. Towards the north, these structures are difficult to identify as the transects become parallel to the subsurface structures. These lines will become the framework for the processing and interpretation of a dense 3D grid acquired at the location of the target orebody. Future processing will involve pre-stack depth migration and P-wave travel-time tomography.