# Advanced 2D and 3D seismic imaging techniques for the characterization and deep-targeting of mineral deposits – a case study from Blötberget (Sweden)

Lena Bräunig[1], Stefan Buske[1], Felix Hlousek[1], Helge Simon[1], Magdalena Markovic[2], Alireza Malehmir[2], Emma Bäckström[3], Paul Marsden[3], Lukasz Sito[4]

[1]TU Bergakademie Freiberg, Freiberg, Germany, [2]Uppsala University, Uppsala, Sweden, [3]Nordic Iron Ore AB, Danderyd, Sweden, [4]Geopartner Ltd., Krakow, Poland

The Smart Exploration project comprises the development of cost-effective and environmentally friendly methods and solutions for geophysical mineral exploration in order to make critical mineral resources available to the European Union. Different methods and prototypes are developed and tested at several exploration sites to improve the characterization, spatial resolution and delineation of mineral deposits and their host rock. Towards these goals, we set up and tested an advanced seismic depth imaging workflow for an iron-oxide deposit in Blötberget mining area of Ludvika in central Sweden to unravel its features within a complex hard-rock geological setting.

In the first stage, we used a 2D data set acquired in two campaigns in 2015 and 2016, using a drophammer as source, and derived a high-resolution seismic image from these datasets using focusing seismic imaging techniques. Additionally, frequency dependent images of the subsurface were obtained using the Reflection Image Spectroscopy (RIS) approach, which provided additional information about the mineralization and its internal structures at different spatial scales.

In the second stage, a 3D seismic survey was acquired in April-May 2019. The 32-ton Vibroseis truck of TU Bergakademie Freiberg was used as the seismic source and the data were recorded by a combination of different seismic receivers, comprising a cabled receiver system used to quality control the data, a network of wireless nodes with real-time QC capability as well as autonomously recording stand-alone receivers. In total about 1300 receivers recorded over 3000 sweeps generated at about 1000 different source points. We present the first data processing results of the 3D survey, including a shallow P-wave velocity model derived from first arrival seismic tomography as well as 3D pre-stack depth migrated images. Since the 3D survey includes the same source and receiver locations as the 2D survey acquired in 2015/2016, a direct comparison of both datasets is possible and allows conclusions about the advantages of 3D vs 2D seismic data acquisition and imaging for a reliable characterization of mineral deposits at depth.

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