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Imaging the western Skellefte Ore District with MT and reflection seismics

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Our area of study is the Skellefte Ore District, a very rich mining area in northern Sweden. The main deposits consist of volcanic-hosted massive sulphides (VHMS) rich in zinc, copper, lead, gold and silver. The most relevant geological units are the ore bearing volcanic rocks of the Skellefte Group, early granitoid intrusions coeval with the previous, sedimentary rocks of the Vargfors Group, and late post-orogenic granitoid intrusions (e.g. the Revsund granites). All these units are metamorphosed to greenschist and lower amphibolite facies. Within the district, the structural relationships and contacts between the geological units are obscured by the great areal extension of the Revsund granites, and a minimal number of outcrops, leaving the general knowledge of the geological setting rather limited. Aiming at a better understanding of the district and a successful future exploration, new geological and geophysical data have been collected in key areas within the framework of the "VINNOVA 4D modelling" project. In this contribution we will focus on the outcomes from magnetotelluri (MT) and seismic reflection data.

The MT data were acquired with broadband stations yielding transfer functions between 700 Hz and 200 s. The achieved penetration depth was around 10 km, depending on the conductivity of the ground. The seismic reflection surveys were about 20 km long, with a crooked line geometry, and shot and receiver spacing of 25 m. The resulting seismic sections show distinctive reflections between 600 m and 7 km depth, and by applying pseudo-3D processing routines it was possible to obtain more information about their real 3D geometry. Using the 3D geometries of the reflectors as a priori information in the inversion of the MT data produced resistivity models with more defined features than if no a priori information was used.

The combination of both, seismics and MT, turned out to be a very valuable tool to determine the extension and depth of the main geological units in the area, constrain hypotheses about the basement, and raise new questions regarding the geological evolution of the district. Subsequently, these results provide important information that help to disentangle the complex geology of the Skellefte Ore District.