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Upper crustal conductivity models in 2D and 3D of the Kristineberg area, Skellefte District, Northern Sweden

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We present results from a magnetotelluric (MT) case study in Kristineberg, a well investigated mining area in the Skellefte Ore District, Northern Sweden. The study area is known for the presence of VHMS (volcanic hosted massive sulfide) deposits and has been studied intensively using geological observations and different geophysical methods (reflection seismics, potential field methods). This study is embedded in the framework of building a crustal scale 3D geological model.
During the past three years several MT measurements along three N-S running profile lines were conducted. The 2D model from the pilot study collected 2007 on the profile furthest to the West associated the main electrical features to the Revsund granites in the south, the Skellefte volcanic and metasedimentary rocks in the center of the profile and a possible sedimentary basement at 3 km depth. The model was derived from 2D determinant inversion with an assumed electrical strike direction of 75 °. The results were in good agreement with former interpretations made from reflection seismic studies. Nevertheless the complexity of the structures increases the urge to test the 2D approximation of the model with a complete 3D inversion of the impedance tensor in an array of measurement points. In 2008 and 2009 additional MT measurements in the East closer to the mine were collected. The new data shows that the 2D assumption is not consistent overall. Indicated also by the tipper the most dominant feature in the second profile is a very strong and shallow conductor. It has been associated with the contact between metasediments and volcanics and seems to be very localized to the west of profile, but is not seen in the easternmost profile. Also the presence and extension of a very strong conductor at depth, which was discovered as a major crustal anomaly already in the eighties and was recently interpreted as the reflective north dipping Bothnian basement, is further studied with the new data. To perform a 3D inversion the data coverage was improved with additional measurement points between the profiles. A 3D inversion model of the central part of the study area was derived to identify and position the off profile features. Both 2D and 3D models help to reveal the complicated geology of the area and estimate the dimensions of the lithological units at depth. They offer a vital component in the interpretation of geological observations and the seismic reflection data to improve the 3D model of the subsurface.