Geophysical Research Abstracts
Vol. 15, EGU2013-4496, 2013
EGU General Assembly 2013

The Skellefte Ore District as seen with magnetotellurics

María de los Ángeles García Juanatey (1), Juliane Hübert (2), Ari Tryggvason (1), Christopher Juhlin (1), Laust B. Pedersen (1), Tobias E. Bauer (3), Mahdieh Dehghannejad (1), and Pär Weihed (3)

(1) Uppsala University, Uppsala, Sweden (maria.garcia@geo.uu.se), (2) University of Alberta, Edmonton, Canada, (3) Luleå University of Technology, Luleå, Sweden

The Skellefte District is one of the richest metallogenic mining areas in Sweden. The main deposits consist of volcanic-hosted massive sulphides (VHMS) rich in zinc, copper, lead, gold and silver, that have been explored and mined for more than a century. Considering that technological advancements allow deeper mining, and that today new discoveries occur less often, new efforts have been directed at locating targets at greater depths. Thus, current exploration strategies need to be adjusted, and a better understanding of regional scale structures is necessary. Following this approach the project "VINNOVA 4D modeling of the Skellefte District" was launched. Its main purpose was to unravel the regional structures and tectonic setting of the Skellefte District and construct a 3D geological model of two key localities within the district. To help accomplish this, magnetotelluric (MT) data were acquired throughout the district together with seismic reflection, geoelectric (ERT and IP) and potential field data.

The MT data set consists of 120 stations that were mainly acquired along existing seismic lines. Time series processing yielded MT transfer functions in the frequency range between 700 Hz and 200 s. These data were inverted into 2D resistivity depth sections and subsequently analyzed to identify robust features. Additionally, 3D inversions were computed and compared with the standard 2D results to assess their reliability and better locate conductive bodies. The resistivity features deemed trustworthy were then interpreted in geological terms. For this task, results from the other geophysical methods were considered. The achieved penetration depth varied between 10 and 20 km.

The main findings include: (1) conductive hydrothermally altered zones are present within the otherwise resistive rocks of the ore-bearing volcanic units, (2) the depth extension of early and post-orogenic intrusions are depicted as high resistivity features, (3) several prominent conductive shear zones in the central part of the district are present, and (4) enhanced conductivity is found associated to the basement of the volcanic rocks at different depths throughout the district.

Although the application of the MT method is challenged by the complex geological setting and extreme resistivity contrasts, a careful processing and analysis of the data made it possible to render robust images of the deep subsurface resistivity. By combining the results from the MT with the findings of other geophysical techniques and geological observations, our understanding of the geological structure and history of the Skellefte District was greatly improved.