Geophysical Research Abstracts
Vol. 14, EGU2012-10643, 2012
EGU General Assembly 2012
© Author(s) 2012

Seismic reflection profiling employed in the 3D-modeling of mineralized regions: A case study from Pyhäsalmi VHMS-deposit, Finland

S. Heinonen (1), D.B. Snyder (2), P.J. Heikkinen (1), and I.T. Kukkonen (3)

(1) Institute of seismology, University of Helsinki, Finland (suvi.heinonen@helsinki.fi), (2) Geological Survey of Canada, Ottawa, Canada, (3) Geological Survey of Finland, Espoo, Finland

Structures of the upper crust can be best understood by using 3D visualization and modeling techniques. Often most of the geological data available for such studies are from the surface and geophysical methods are needed to follow the features mapped from the surface to the depth. The seismic reflection profiling, or 3D-seismic studies, provide an important tool for geophysical-geological modeling. We present the results of the on-going 3D-modeling from Pyhäsalmi, Finland.

In this study, six seismic profiles acquired in the area during project HIRE (High Resolution Reflection Seismics for Ore Exploration, 2007-2010) are used to develop and constrain the geological 3D-modeling.The Pyhäsalmi volcanic hosted massive sulfide (VHMS) deposit (>50 Mt) is located in a Proterozoic volcanic belt in central Finland. Currently mine is $\sim$1.5km deep. The existing infrastructure with depth enables the economic exploitation of new deep ore reserves giving motivation for the geological modeling.

Drill hole logging indicates that the seismic imaging of contacts between mafic and felsic volcanic rocks is plausible. Furthermore, acoustic impedance of Pyhäsalmi ore (32 x 106 kg/m2s) is distinct from the host rocks (16–19 x 106 kg/m2s) enabling its detection with seismic reflection methods. Six seismic profiles show discontinuous reflectors and complicated reflectivity patterns due to the complex geology. We used the texture and intensity of reflectivity together with individual reflectors and drill hole data to model the geological structures of the area. Near the surface (>500m) the structures are known to be sub-vertical. Seismic profiles show that generally they turn to almost subhorizontal orientation with depth. Steep folding with approximately north-south oriented fold axis can explain the large-scale reflectivity patterns of the area. In this interpretation, the steep fold limbs are not imaged directly with seismic technique but fold hinges, where orientation is locally subhorizontal, cause clear reflection.

Contact zone between mafic and felsic volcanic stratigraphies has potential to host mineralizations. When the orientation of this contact zone is not too steep, it can be directly detected with reflection seismic data. This enables the mapping of the key horizon for mineral exploration over a wide area. Thus seismic data enables extrapolation of the geological model to where no drill hole data exists. These results from Pyhäsalmi demonstrate how seismic reflection profiling is an important method for constraining structural modeling even in geologically complicated areas.

Acknowledgements: Pyhäsalmi Mine Oy