

Seismic images of the upper crust in Northern Finland

S. Buske¹, S. Heinonen², F. Hlousek¹, T. Jusri¹, E. Kozlovskaya³

¹ TU Bergakademie Freiberg, Institute of Geophysics and Geoinformatics, Freiberg, Germany

² Geological Survey of Finland, Espoo, Finland

³ Oulu Mining School, Faculty of Technology, University of Oulu, Finland

Seismic data were acquired in the Sodankylä area (Northern Finland) within the project XSoDEx (eXperiment of SOdankylä Deep Exploration) with the main objectives to achieve a better understanding of the mineral system at depth and to show a possible linkage of the two major mineral deposits in the area, the Kittilä orogenic gold deposit in the West and the Kevitsa Ni-Cu PGE deposit in the East.

A combined seismic reflection and refraction survey was performed during July and August 2017 resulting in four profiles with a total length of approximately 80 km. The seismic reflection data were recorded in a roll-along scheme by a 3.6 km long spread with 10 m geophone spacing and 20-40 m source point spacing. The seismic refraction data were simultaneously recorded by ~60 vertical- and ~40 three-component receivers along an extended line around the reflection spread with maximum offsets of around 10 km. The 32 ton Vibroseis truck of TU Bergakademie Freiberg was used as a source for both parts of the acquired data sets.

In a first step, a velocity model was obtained along the profile lines by first-arrival traveltimes tomography from the reflection and refraction data down to depths of about 1 km. The resulting models are characterized by relatively high velocities near the surface with only small vertical velocity gradients but partly strong lateral variability. Both can be well explained by the geological and lithological situation in the area and suggest a strongly varying lithology in horizontal direction with subvertical structures and contacts in the shallow upper part of the crust.

In a second step, the reflection data were processed including the application of focusing pre-stack depth imaging approaches. A large amount of well pronounced and clearly imaged reflectors is visible in the resulting seismic sections, partly down to depths of 8-9 km.

The obtained results provide a high-resolution seismic image of the upper crust in Northern Finland that enable a detailed geological interpretation of the subsurface features and provide a good basis for a 3D geological model including the major mineral systems in the Sodankylä area.