Seismic investigations in the central Swedish Caledonides

P. Hedin[1]*, C. Juhlin[1] and H. Lorenz[1]

[1]*Department of Earth Sciences, Uppsala University, Villavägen 16, 75236 Uppsala, SWEDEN (*correspondence: peter.hedin@geo.uu.se)*

The Collisional Orogeny in the Scandinavian Caledonides (COSC) project aims to provide a deeper understanding of mountain belt dynamics with a focus on the central Scandinavian Caledonides. It involves two 2.5 km deep fully cored scientific boreholes and a wide range of related investigations in the county of Jämtland in western Sweden. Reflection seismic imaging of the sub-surface structure is an important component, both to allow identification of potential drill sites and planning of the drilling, and to provide a link between the detailed studies at the boreholes and the large scale understanding of the tectonic evolution in the region.

A series of reflection seismic profiles have been acquired along a composite c. 55 km long profile to image the upper crust in high resolution. Sub-horizontal reflections in the upper 1-2 km are underlain and interlayered with strong west- to northwest-dipping reflections, suggesting significant east-vergent thrusting of the Caledonian allochthons. Shallow drillholes further to the southeast and previously acquired seismic, magnetotelluric and magnetic data, constrain the basal orogenic detachment to continuous reflections at c. 11.5 km depth. The interpreted underlying basement is characterized by a pattern of strong sub-horizontal to northwest-dipping reflections of unknown origin. These may be related to compressional tectonics during the Caledonian or earlier orogeny, and/or part of an extensional system that was active during passive margin formation.

After the first COSC borehole was drilled in 2014, targeting the subduction-related Seve Nappe Complex, a major seismic survey was conducted in and around the borehole. This included a 3D reflection seismic experiment designed to image the structures around the borehole and allow extrapolation of results from borehole and core into the surrounding rock. The complex geology of the Lower Seve Nappe, with an abundance of mafic lenses within felsic rocks, produces a pattern of west dipping reflections of limited continuity. At c. 1.7 km depth, the COSC-1 core enters a major thrust zone that extends to the bottom of the 2.5 km deep borehole. This thrust zone is imaged as a package of more continuous southeast-dipping reflections with an abrupt decrease in reflectivity at c. 2350 m depth, correlating with a change in lithology that could indicate a transition into underlying allochthons.