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Collisional Orogeny in the Scandinavian Caledonides (COSC): Scientific objectives for the planned 2.5 km deep COSC-2 borehole

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The Collisional Orogeny in the Scandinavian Caledonides (COSC) scientific drilling project employs two fully cored boreholes for investigating mountain building processes at mid-crustal levels in a deeply eroded Paleozoic collisional orogen of Alpine-Himalayan size. The two COSC boreholes will provide a unique c. 5 km deep composite section from a hot allochthon through the underlying 'colder' nappes, the main décollement and into the basement of the collisional underriding plate. COSC's unprecedented wealth of geophysical field and borehole data combined with the petrology, geochronology and rock physics information obtained from the drill cores will develop into an integrated model for a major collisional mountain belt. This can be utilized as an analogue to better understand similar modern tectonic settings (Himalaya, Izu-Bonin-Mariana, amongst others) and, thus, advance our understanding of such complex systems and how they affect the (human) environment.

COSC investigations and drilling activities are focused in the Åre-Mörsil area (Sweden) of central Scandinavia. The first drill hole, COSC-1, was completed in late August 2014 with near 100% core recovery down to 2.5 km. It targeted the high-grade metamorphic Seve Nappe Complex (SNC) and its contact with the underlying allochthon, investigating how this metasedimentary unit, that was initially deeply subducted during orogeny, was exhumed and then, still hot, emplaced as an allochthon onto the foreland of the underriding plate.

COSC-2 will investigate the main Caledonian décollement, which is the major detachment that separates the Caledonian allochthons from the autochthonous basement of the Fennoscandian Shield, and the character of the deformation in the basement. Combined seismic, magnetotelluric (MT) and magnetic data provide control on the basement structure and the depth to the main décollement, believed to be hosted in the carbon-rich highly conductive Alum Shale. Key targets are to understand the geometry, stress distribution and rheology of the main décollement and associated fault systems in the foreland of one of the Earth's largest orogens, and to determine the relationship between the basement deformation and the thrust tectonics in the nappes above. COSC-2 will provide insights into the evolution of Baltica near the Ordovician-Silurian boundary by providing a new, distal section from the Early Paleozoic sedimentary basin. High-quality, high-resolution temperature profiles will allow the reconstruction of the ground surface temperature history and its variations for up to 100000 years and gather new knowledge about the Weichselian glaciation and climate evolution in northern Europe during the Holocene, including industrial age trends. Furthermore, research will address the hydrogeological and geothermic characteristics of the mountain belt and investigate the geological energy sources utilized by the deep biosphere.

The drilling program and on-site science will build on the experience from drilling COSC-1. Applications for drilling related costs have been made to ICDP and the Swedish Research Council and if funded, drilling can be performed in 2017 at the earliest. Researchers interested in any aspect of the COSC project are invited to join and provide parallel funding for drilling, on-site science, and studies on core and downhole geophysics.