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Mountain building processes in the Scandinavian Caledonides studied by COSC scientific drilling

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The Collisional Orogeny in the Scandinavian Caledonides (COSC) scientific drilling project, located in the Caledonian foreland of Sweden, attempts to sample a continuous section from the allochthons through the basal décollement into the Baltican basement. The primary target of the project is to improve our understanding of mountain building during major continent-continent collision.

COSC is located on the Central Caledonian Transect (CCT) in Jämtland, Sweden, a classical locality in the Caledonian mountain belt where nappe emplacement was proposed already 130 years ago. During this long time of research, a wealth of geological and geophysical survey data at different resolution have been acquired. Thus, the CCT is optimal for the integration of scientific work at different scales, from micro-scale investigation on high-resolution borehole sections to orogen-scale geodynamic models.

With COSC-1, a first 2.5 km deep fully cored borehole was drilled during 2014 to study in detail a section from a hot allochthon into the underlying thrust zone. Located on the slopes of mountain Åreskutan, the drilled profile through the lower part of Seve Nappe Complex can be extended upwards with good field exposure to the top of Åreskutan, where micro-diamond bearing gneisses were discovered recently. This combined profile was accomplished last year and, at present, the pressure-temperature conditions along it are being established. First results are presented by Holmberg et al. (this session). Comprehensive borehole surveys and geophysical experiments facilitate the integration of borehole data with the regional data sets and provide a better physical characterisation the encountered rock bodies. Of particular interest is here a major shear zone in the lower c. 800 m of the borehole, whose base was not penetrated. It is clearly different and lower grade than the penetrative deformation in the surrounding gneisses and, thus, expected to be younger and, potentially, cutting across tectonostratigraphic boundaries. Microstructural investigations and age dating are ongoing. Results of the latter are presented by Glodny et al. (this session).

Although COSC-1 research will continue for several years, planning of COSC-2 is already very advanced and the borehole will be drilled as soon as funding is secured. First, the continuously cored hole will sample the Lower Paleozoic sedimentary succession preserved in the Lower Allochthon. This will provide a unique distal section through the Baltica Shelf palaeoenvironment, which elsewhere is only known from proximal areas with high bioproductivity as they are exposed in the Baltic Sea region. The borehole will then sample a laterally extensive imbricate section of Cambrian and, most likely, Ordovician strata that developed above the main Caledonian décollement, i.e. the detachment horizon below the Caledonian allochthons that is hosted in the very organic-rich Alum shale. Finally, it will penetrate 1-1.5 km into the Baltican basement and sample the sources for several seismic basement reflections. Thus, COSC-2 will provide a unique opportunity to study in detail the deformation on and above the décollement and how the basement of the during collision underriding plate was affected by deformation.

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