Goal & Scientific Objective

COSC is investigating mountain building processes in an old (Paleozoic), deeply eroded collisional mountain belt of Himalayan dimensions. Utilising this orogen, the Caledonides, as an analogue to comparable modern settings, such as the Himalayan mountain belt, will advance our understanding of such orogenic systems and how they affect the stability of the living environment. Key scientific targets are i) to research mountain building processes in the deep interior of an orogen and utilise this new knowledge to better understand how collisional mountain building operates, including the nature and occurrence of natural hazards in modern orogenic environments, ii) to investigate the environmental conditions before, during and after continent-continent collision (c. 440-390 Ma), iii) to study the recent (up to 100 ka) evolution of the surface temperature in northern Europe by borehole temperature inverse modelling, iv) to research the (deep) groundwater and thermal characteristics of old mountain belts and v) the composition of deep microbial communities and their energy sources.

After the drilling of COSC-2, two fully cored boreholes will provide a unique c. 5 km deep composite section through the foreland of a major orogen, in a key-locality for research on mountain building processes that has relevance for the study of past and present mountain belts around the globe.

Data & Sample Access

Technical and scientific data from the operational phase are available at https://doi.org/10.1594/GFZ.SDDB.ICDP.5054.2015. For site survey data and other surveys in the borehole, please contact the PIs.

The COSC-1 drill core is archived at the Core Repository for Scientific Drilling at the Federal Institute for Geosciences and Natural Resources (BGR), Berlin.

Operational Achievements

The borehole COSC-1 was drilled as the first of two c. 2.5 km deep drill holes, cored and open (no casing) from 102.7 m to total depth. Two additional boreholes of 50 and 100 m depth, respectively, were drilled before drilling of the main hole and equipped with seismometers for passive monitoring of the drilling operations.

April to August 2014: drilling operations at the main hole, final depth 2495.8 m.

Downhole logging and borehole vertical seismic profiling (VSP) conducted by OSG, GFZ and Lund University.

Core studies: MSCL (Multi Sensor Core Logging) including density and magnetic susceptibility; DMT core scanner, mud gas analyses (OLGA), geological logging.

A demonstration of the excellent drill core quality in the Seve gneisses.

Web & Media Resources

http://cosc.icdp-online.org/
www.facebook.com/collisionalorogeny/
Timeline

2009 COSC workshop proposal approved
2010 international COSC science workshop
2011 ICDP full proposal for COSC-1 approved
2014 COSC-1 borehole was drilled
2015 international COSC-2 science workshop
2017 ICDP full proposal for COSC-2 approved

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Scientific Findings

During the COSC-1 drilling operations, a nearly complete 2.4 km long drill core was obtained. It sampled a section through the Lower Seve Nappe, which is a during orogeny highly affected and modified rock unit that was emplaced over hundreds of kilometres from the deep internal part to the foreland of the orogen (Lorenz et al. 2015). Since COSC is a two stage project and COSC-2 not yet drilled, the scientific findings are preliminary and restricted to COSC-1 only.

Detailed pressure-temperature studies on drill core samples unexpectedly proved that the Lower Seve Nappe was affected by very high pressure and temperature (up to the amphibolite/eclogite metamorphic facies boundary) in the interior of the mountain belt before it was emplaced onto less affected rocks of the continental margin (Jeanneret et al., in prep.). This on-going study is central for our understanding how mass and heat is transferred within a developing mountain belt.

The rock volume around the drill hole was extensively characterised by geophysical methods. Thus, it was possible to refine the interpretation of regional (>150 km) and COSC (c. 60 km site investigations) multi-disciplinary geophysical data sets and integrate them with the geological findings (Hedin et al. 2016, Wenning et al. 2016, Simon et al. 2017). This work is not finished yet, pending the drilling and investigations of the COSC-2 borehole.

The bedrock drilled in COSC-1 was surprisingly massive and does not provide good conductivity for groundwater. However, seven zones of limited groundwater inflow into the borehole could be detected and characterised (Doughty et al. 2016, Tsang et al. 2016). Such compact bedrock is not very favourable for deep microbial life. However, the limited results and COSC-specific methodological developments in both microbiology and hydrogeology did contribute significantly to applied studies about how to characterise relevant aspects of the subsurface for (mainly) engineering purposes (Eriksson et al. 2016, Dobson et al. 2016).

Key Publications


Key Publications