



Online drilling mud gas monitoring and sampling during drilling the Scandinavian Caledonides (COSC)

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The COSC project (Collisional Orogeny in the Scandinavian Caledonides) drilled a 2496 m deep hole in Åre (Sweden) to deliver insights into mid-Palaeozoic mountain building processes from continent-continent collision, to improve our understanding of the hydrogeological-hydrochemical state and geothermal gradient of the mountain belt and to study the deep biosphere in the metamorphic rocks and crystalline basement.

COSC was the first slimhole drilling project where online gasmonitoring of drilling mud was conducted during continuous wireline coring. Gas was continuously extracted at the surface from the circulating drilling mud with a gas-water separator, pumped in a nearby laboratory container and analysed in real-time with a quadrupole mass spectrometer for argon, methane, helium, carbon dioxide, nitrogen, oxygen, hydrogen, and krypton. Gas samples were taken from the gas line for laboratory studies on chemical composition of hydrocarbons, noble gas isotopes and stable isotopes.

Every drill core created a gas peak identified in the drilling mud ~20-30 min after core arrival at the surface. With known core depth and surface arrival time, these gas peaks could be attributed to depth. As a result, nearly complete gas depth profiles at three meter intervals were obtained from 662 m (installation of the gas-water separator) to 2490 m depth.

Maximum concentrations of non-atmospheric gasses in drilling mud were ~200 ppmv helium, ~300 ppmv methane and ~2 vol-% hydrogen. Helium peaks between ~900 m and 1000 m and correlates with enhanced concentrations of methane. Methane and hydrogen exhibit maximum concentrations below 1630 m depth where helium concentrations remain low. Integration of the drilling mud gas monitoring dataset with data from geophysical downhole logging and core analysis is ongoing to help clarifying provenances and origin of gasses.