Geophysical Research Abstracts
Vol. 19, EGU2017-2594, 2017
EGU General Assembly 2017


# A Hydraulic Stress Measurement System for Deep Borehole Investigations

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Luleå University of Technology (LTU) is developing and building a wire-line system for hydraulic rock stress measurements, with funding from the Swedish Research Council and Luleå University of Technology. In this project, LTU is collaborating with University of Strasbourg and Geosigma AB.

The stress state influences drilling and drillability, as well as rock mass stability and permeability. Therefore, knowledge about the state of in-situ stress (stress magnitudes, and orientations) and its spatial variation with depth is essential for many underground rock engineering projects, for example for underground storage of hazardous material (e.g. nuclear waste, carbon dioxide), deep geothermal exploration, and underground infrastructure (e.g. tunneling, hydropower dams).

The system is designed to conduct hydraulic stress testing in slim boreholes. There are three types of test methods: (1) hydraulic fracturing, (2) sleeve fracturing and (3) hydraulic testing of pre-existing fractures. These are robust methods for determining in situ stresses from boreholes. Integration of the three methods allows determination of the three-dimensional stress tensor and its spatial variation with depth in a scientific unambiguously way.

The stress system is composed of a downhole and a surface unit. The downhole unit consists of hydraulic fracturing equipment (straddle packers and downhole imaging tool) and their associated data acquisition systems. The testing system is state of the art in several aspects including: (1) Large depth range (3 km), (2) Ability to test three borehole dimensions (N=76 mm, H=96 mm, and P=122 mm), (3) Resistivity imager maps the orientation of tested fracture; (4) Highly stiff and resistive to corrosion downhole testing equipment; and (5) Very detailed control on the injection flow rate and cumulative volume is obtained by a hydraulic injection pump with variable piston rate, and a highly sensitive flow-meter.

At EGU General Assembly 2017, we would like to present this new and unique stress measurement system and some initial test results from a 1200 m long borehole in crystalline rock.