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Developing a new system for temperature measurement in boreholes – Methodical advances and field experiences within the MOREXPERT project, Kitzsteinhorn (3.203 m), Austria

Ingo Hartmeyer (1), Markus Keuschnig (1), and Lothar Schrott (2)
(1) alpS - Centre for Climate Change Adaptation Technologies, Austria, (2) University of Salzburg, Austria

Analysis of borehole temperature data plays a major role in a large number of polar and alpine permafrost investigations. Despite its fundamental importance relatively few scientific contributions address the technical details and challenges that are associated to the instrumentation of boreholes in permafrost-affected rock. Frequently information is provided only on utilized temperature sensors and sensor spacing whereas information on installation works, casing properties etc. is usually not discussed in great detail. Within the research project MOREXPERT ('Monitoring Expert System for Hazardous Rock Walls') a number of essential methodical questions have been tackled during the development of a new system for temperature measurement in boreholes.
Within the project five boreholes (20-30m deep) have been drilled into permafrost-affected bedrock (calcareous-micaschist). For temperature measurement Pt100 thermistors with an accuracy of less than $\pm 0.1^{\circ}$C are used. The depths of the temperature sensors were selected in accordance with the PACE borehole strategy. Temperatures are recorded in hourly intervals to resolve near-surface thermal variations.
All boreholes, drilled by 90 mm diameter air flush rotary drilling, were equipped with a new system for borehole temperature measurement which has been designed and manufactured by the Austrian company GEODATA. The measurement system consists of an impermeable polyethylene casing that prevents water and air entry into the borehole – an essential prerequisite considering the heavily fractured surrounding rock. The polyethylene casing is interrupted by brass rings which are located in the designated depths of the temperature sensors. Brass was chosen as the preferred material since it is non-corrosive and displays a very high thermal conductivity. The temperature sensors which are subsequently inserted into the casing establish mechanical contact to the brass rings. The annulus (i.e. the space between casing and bedrock) is then filled up with concrete from bottom to top. As opposed to numerous other techniques the newly introduced system therefore enables a significantly improved thermal coupling between the temperature sensors and the surrounding rock and is able to deliver highly representative temperature data.