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Hydrogeologic Testing During Drilling of COSC-1 Borehole: Application of FFEC Logging Method

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Drilling of a deep borehole does not normally allow for hydrogeologic testing during the drilling period. The only time hydraulic testing is done during the drilling operations is when drilling experiences a large loss (or high return) of drilling fluid representing encountering of a large-transmissivity zone. Then, either the zone is cemented for drilling to continue or drilling is stopped for conducting, for example, a drill-stem test (DST), which involves installation of a packer above the drilling depth and performing a pressure or flow transient test. The first alternative means loss of critical information on in-situ hydraulic transmissivities and the second option enables the study of only the one high-transmissivity zone, with a significant delay of the drilling schedule. The drilling of the COSC-1 borehole at Åre, Northern Sweden, presented an opportunity of conducting a particular hydraulic testing with negligible impact on drilling schedule, yet providing important and accurate information on in-situ hydraulic conductivities on both high- and low-transmissivity zones, already during the drilling period. This information can be used to guide downhole fluid sampling programs and future detailed borehole testing. The particular testing method used is the Flowing Fluid Electric Conductivity (FFEC) Logging Method, which has the capability of identifying large and small hydraulically active zones and providing data for estimating their transmissivity values and local formation water salinity. In this paper, the method will be described and its application to the drilling of COSC-1 borehole presented. Results show that from 300 m to the borehole bottom at 2500 m, there are eight hydraulic active zones in COSC-1, with very low transmissivity values which range over one order of magnitude.