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Integrated Multifont Geophysics for Risk Reduction in Reverse Circulation Drilling

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Introduction

Geological drilling campaigns demand high investments, especially in remote areas or those with complex geology. Reverse circulation (RC) drilling stands out for its efficiency and lower cost compared to diamond drilling, as well as providing representative samples more quickly. However, its performance can be compromised by the presence of groundwater, which hinders sample recovery and can cause clogging or jamming of the borehole.

Method and/or Theory

The geophysical methods that comprise this work are frequency domain electromagnetometry (RESOLVE) and magnetometric gradiometry (GRADMag). The RESOLVE FDEM system is a technology developed by CGG, which uses a set of six discrete acquisition frequencies, arranged in horizontal/coplanar and vertical/coaxial configurations, ranging from 400 Hz to 140 kHz. This system is towed by helicopter in a frame with an average altitude varying from 30 to 50 meters. This system also includes magnetometry sensors to collect GRADMag data, from which magnetic lineament information can be correlated with geological structures and, therefore, provide information on regions where water flows may occur.

Results and Conclusions

The data interpretation premises are that the reference value for saturated areas is up to 450 ohm.m (aprho); and that the representative frequencies for depths are established at 140k Hz (up to 25m depth), 40k Hz (between 25 and 50m depth), and 400 Hz (above 50m depth – limited to 100m depth). Structural interpretation through GRADMag data, which indicates regions most prone to water flow, associated with RESOLVE products, delineates potential portions for water interception by reverse circulation drilling. The methodology is corroborated by already executed RC drilling, Water Level Indicators, and Piezometric Wells.