GEOTECHNICAL EVALUATION WITHIN HAZARDOUS GROUND

SUMMARY

Acquiring televiewer image data from underground-collared boreholes within hazardous ground presents significant operational risk. Digital Surveying's hazardous hole deployment system successfully mitigates associated risks while ensuring the capture of high resolution and fully orientated images.

PROBLEM

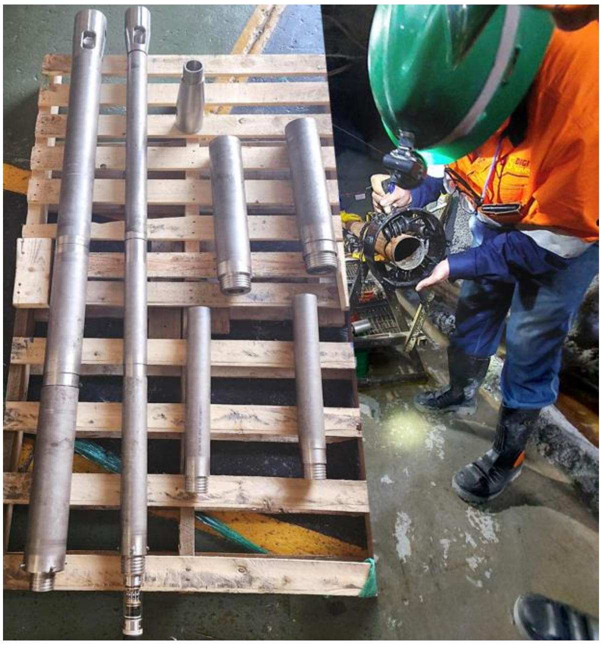
Televiewers, both acoustic (ATV) and optical (OTV), have become a staple of any geotechnical evaluation in both surface and underground drilling programs. In a growing number of instances formation stability concerns have precluded the acquiring of ATV/OTV image data, as the holes have been deemed too dangerous to enter, with the risk of equipment loss in hole being beyond acceptable limits. Although not specifically limited to underground boreholes, this concern has seen quite a few underground logging programs limited to only "safe" boreholes or being terminated, with the subsequent loss of valuable litho-structural data and any downstream interpretations based on them.

SOLUTION

A robust, risk management solution is required that, if not eliminating the risk completely, should at least limit it to acceptable levels.

Digital Surveying developed a hazardous hole deployment system for televiewers that significantly reduces the risk of tool damage or loss in boreholes. Deploying an armored carrier to house the televiewer on the end of the drill string has a significant risk reduction potential over standard cable or push rod deployment methods.

The televiewer is well protected in the carrier from both borehole collapse and any existing in-hole obstructions. Maintaining a high-strength, rigid connection with the probe while in hole, makes successful retrieval of the instrument in the event of hole collapse even more likely, thereby mitigating the otherwise significant risk of tool damage or loss associated with televiewer data acquisition.



Left: Hazardous hole deployment system components for NQ and HQ hole diameters. The OTV, in this image, is housed in an NQ carrier but still requires the imaging head protection cage to be fitted prior to deployment in hole. Right: preparation of the drill rod prior to deployment underground.

The imaging head protection cage has been specifically engineered to offer maximum possible protection to the televiewer tool while limiting the introduction of image artefacts as far as possible.

Safety | Range of Services | Depth of Service | Training | Experience & Knowledge

Example OTV image section acquired using the hazardous hole deployment system in a 200m dry up-hole. Longitudinal artifacts are from the carrier arms which extend past the imaging head.

As the accurate interpretation of any ATV/OTV image features requires borehole diameter information, the system is adaptable so that it can be used to house a 3-arm caliper tool. This does however require a second run in the borehole.

Both the ATV and OTV tools make use of an onboard flux gate navigation system for image orientation. It is therefore advisable that a gyroscopic deviation survey is also completed in the hole. This will allow the correction of the image orientation for any magnetically introduced orientation artefacts introduced by the drill string or the formation within any non-vertical borehole sections.

IMPACT

The use of this system greatly reduces the risks associated with ATV/OTV image data acquisition in underground boreholes with formation stability issues. This risk reduction redefines the possibilities open to numerous underground drilling/logging programs previously labeled as hazardous. Making more data available in the downstream decision-making process enables safer operations due to improved design of interventions reducing the likelihood of fall-of-ground and rock burst events.

Although this system was primarily designed for risk reduction in unstable holes, its deployment on the end of the drill string has some other added benefits. ATV/OTV data capture in long shallow dipping, horizontal and up-hole boreholes has now become even easier and safer.

TECHNOLOGY

Acoustic Televiewer: (ATV) generates images of the borehole wall by transmitting ultrasonic pulses from a fixed transducer, with a rotating acoustic mirror, and recording the amplitude and travel time of the signals reflected at the interface between the borehole fluid and the formation (borehole wall). The reflection amplitude is predominantly controlled by the acoustic impedance of the formation. Variations in the acoustic impedance both vertically and radially are mapped in the generated image. Changes in borehole diameter result in variations in acoustic travel-time which are used to generate a second image.

Optical Televiewer: (OTV) uses high-resolution optical imaging of the borehole wall, measuring the intensity and visible colour of the reflected light. OTV results are presented as a continuous and oriented true-colour image of the borehole wall enabling mapping of litho-structural features. OTV requires optically transparent fluid inside the borehole (air or clear fluid) with the quality of the image reduced by tool decentralization, muddy water or dust on the borehole wall. The OTV log can be used as a replacement for litho-structural core logging and can provide superior results within zones of core loss or significant breakage.