Maximizing the value of drilling for resource definition using wireline geophysics

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Resource definition is the process of acquiring information about a mineral deposit to improve the understanding of its size and grade as well as its handling and processing characteristics to reduce risk during mining.

Much of the key information that is required for resource definition is collected by drilling and includes;

- Volume of mineralization
- Grade of the ore
- Tonnage of the ore

The volume of the ore deposit is defined primarily from the observed top and base of mineralization intersected in the drillhole. To correctly position the location of these intercepts in the hole a survey log is required. While this information is often collected using a magnetic survey tool the accuracy of these measurements may be compromised by magnetic stratigraphy in which case a gyroscopic survey tool should be used instead.

The geometry of ore zones is often controlled by geologic structure. Optical and acoustic televiewers provide images of the inside of the borehole wall. These images are constantly oriented and do not contain artificial breakages or missing strata from the drilling process, unlike core. As standard practice, structural measurements interpreted from televiewer images are referenced to surface coordinates using a detailed survey log, not an assumed or planned orientation of the hole.

Ore grades reported from laboratory assays are sometimes only collected in suspected zones of mineralization, not continuously throughout the hole. Petrophysics measurements can be used to identify the presence of mineralization as well as being a useful adjunct to predicting lithology variations within the hole, often with greater detail than can be made by geologic logging of core alone.

While there are examples where ore grade has been predicted from the physical properties of the rock, a new generation of wireline tools is being developed to allow the direct measurement of an in-situ ore grade by either the XRF or neutron activation techniques.

Measurements of formation density are required to convert ore shell geometries to a resource tonnage. While a “global” density value is often assumed for these calculations, continuous density logging of both the ore and waste rock made by a gamma-gamma probe allows for a more robust analysis of the variation of density across the resource. New developments in this technology include the introduction of lower activity (micro-density) sources as well as tools designed to measure formation density from inside the drill string, lowering the risk of losing a radiation source in the hole.

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