

Borehole logging provides in situ measurements of the physical properties of the subsurface layers. The Mount Sopris MGX II borehole logging system is a portable system controlled by a notebook computer that allows for the acquisition of up to 9 logs simultaneously, using Polyprobe technology. The motorised winch, efficiency of data acquisition, and the amount of information available from one logging run make this a very economical survey tool. The system logs include natural gamma, self potential, single point resistance, normal resistivity (using 8, 16, 32 and 64 inch arrays), a lateral log, induced polarisation, magnetic susceptibility, acoustic velocity, temperature, fluid resistivity, electromagnetic induction, flow meter, caliper, and borehole deviation.

The acquisition software allows the operator to log in real time and inspect the logs to direct further surveying and/or drilling. Final log analysis and full colour presentation is completed using the Geological Survey of Canada's LogView software.

In environmental and groundwater investigations, locations of greatest groundwater flow are determined using temperature and/or self potential logs, flow meters and caliper logs. Natural gamma, electrical, and magnetic logs characterise the lithology in terms of grain size and clay volume.

Fluid and formation resistivity logs are used to delineate areas of groundwater contamination. An acoustic velocity log provides information on porosity and well completion to help minimise cross-contamination in remediation programs. The determination of exact depths and the physical characteristics of each layer decrease the uncertainties in groundwater modeling and allow for the accurate placement of well screens for sampling, or groundwater extraction.

In geotechnical investigations, borehole logs provide a direct measure of the physical properties of the subsurface with accurate delineation of each horizon. The full waveform sonic log provides compressional wave velocities, and the sonic porosity of each layer. Companion surveys provide shear wave velocities for dynamic moduli determinations.

In mining applications, a variety of tools are used to determine petrophysical properties and physical boundaries not visible in the

drill core. The sonic log is used in conjunction with seismic reflection surveys to provide accurate interval velocities of subsurface layers for interpretation.

The natural gamma log is a standard parameter used in coal evaluation, and uranium exploration, as well as in geological mapping of igneous and metamorphic environments. This log shows variations in natural radioactivity which are correlated with changes in lithology.

The resistivity logs including 4 normal configurations, a lateral log, and single point resistivity that measure the changes in the resistivity of rocks due to the presence or absence of minerals such as clay minerals, sulphides, oxides and graphite. When these conductive minerals are not present, the resistivity of the rock is governed by the porosity of the rock and the amount of water filling these voids. Therefore resistivity logs can be used to indicate conductive minerals and fracture zones. The self potential log is used to map areas with graphite or high concentrations of sulphides as these areas often have large potentials related to electrochemical processes.

Additionally, a magnetic susceptibility log provides an in situ measure of the amount of ferromagnetic minerals (magnetite, ilmenite, and pyrrhotite), within a rock unit. This log is then used to determine lithologies, and locate alteration zones. Borehole deviation and caliper probes are also available for determining borehole orientation.

Applications

- *Groundwater/Environmental* stratigraphy, flow zones, porosity & permeability, moisture content, contaminated intervals (mapping & monitoring), grain size, clay volume, bedrock characteristics.
- *Geotechnical* overburden stratigraphy, bedrock depth and physical properties, fracture zones, permafrost conditions, cavities, groundwater conditions, dynamic moduli.
- *Mining* lithologies, mineralised zones, alteration and fracture zones, petrophysical properties, physical properties not visible in drill cores.

