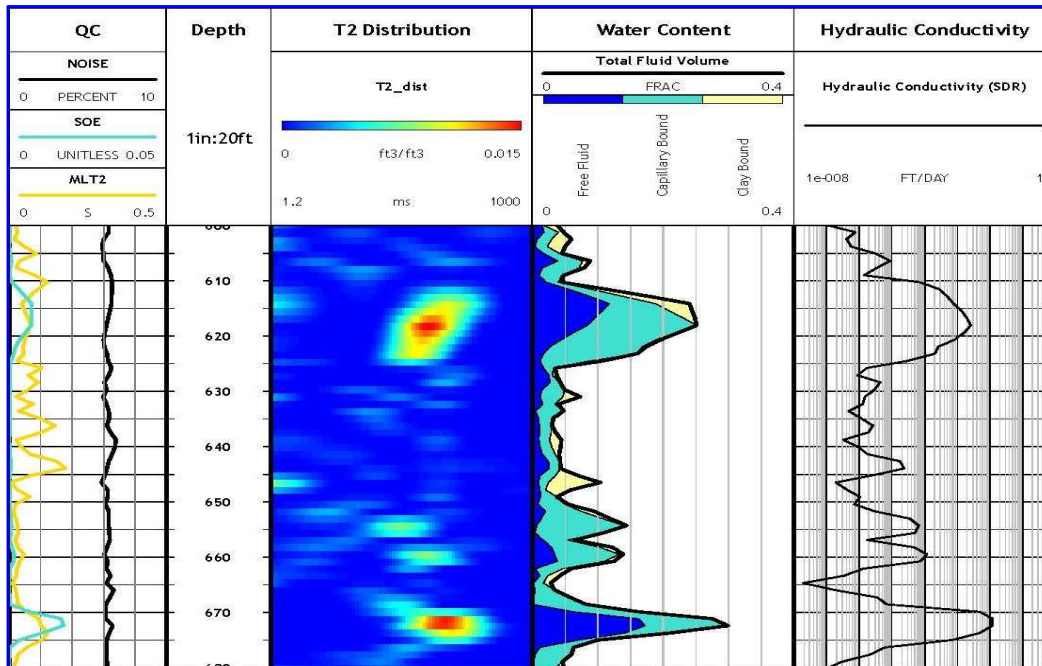




BOREHOLE NUCLEAR MAGNETIC RESONANCE (NMR)

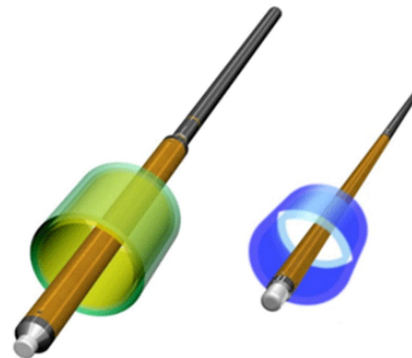


Borehole Nuclear Magnetic Resonance (NMR) logging measures lithology-independent true porosity, free porosity, and clay-bound porosity components. These measurements can be used to calculate pore size distribution and continuous hydraulic conductivity logs. The hydraulic conductivity curves can help understand water mobility and provide a high resolution log of flow properties that are otherwise often interrogated as bulk measurements (as with packers or radioactive source logging). NMR pore size distribution can also give additional correlation and nuanced understanding of rock mechanics.

NMR is extremely useful in filling in the gaps between other geophysical logs, cuttings and core samples, and hydrogeological testing. By running in-situ, either in open hole or behind PVC, NMR can provide information about broad scale matrix porosity in a fraction of the time and cost compared to other tests. No radioactive source is required for operating the tool.

APPLICATIONS:

- + Hydrogeology
- + Dewatering Studies
- + In-Situ and Brine Mining
- + Sand and Shale Lithography
- + Rock Mechanics
- + Identification of Potential Contamination Pathways



COLOG Regional Offices

corporate office
833 Hog Back Drive
Golden, Colorado 80403
303-279-0171

southeast region
Ocean Springs, MS
256-424-5780

western region
Elko, NV
775-777-3433

southwest region
Eloy, AZ
480-236-6815

northeast region
Hartford, CT
203-666-1234

www.colog.com



BOREHOLE NUCLEAR MAGNETIC RESONANCE

COLOG offers borehole Nuclear Magnetic Resonance logging through multi-frequency probes with multiple depths of investigation, allowing better signal to noise ratios and characterization of borehole conditions. Each probe uses static and oscillating magnetic fields to polarize hydrogen nuclei in the formation. The strength of magnetization and rate of de-polarization of the hydrogen nuclei characterize the formation pore volume, structure, and fluid type.

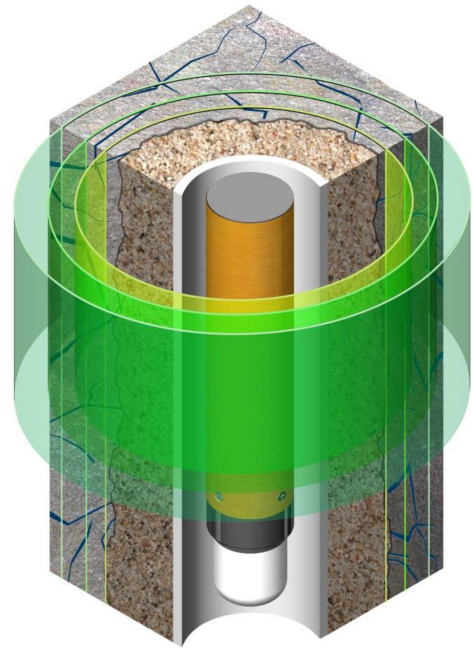
COLOG's multiple NMR probe sizes enable measurements in holes from as small as 2 inches to as large as 18 inches in diameter. The NMR probe is also able to collect data through nonmetallic casing, such as PVC, to directly measure the formation.

Processing and interpretation of NMR data can be completed in-house, by COLOG. Final log results are available at the logging site to enable quick decision-making, based on the data. NMR data can be further processed with other hydrogeology and geophysical data to provide a robust interpretation of site hydrology.

PROBE SPECIFICATIONS:

Diameter:	1.75" / 2.38" / 3.50" / 5.25"
Length:	13.7' / 11.3' / 10.8' / 10.8'
Max Temperature Rating:	80 °C (176 °F)
Max Pressure Rating:	1700 psi (JPZ175E: 710 psi)
Hole Diameter Range:	2.0 – 18.0 inches
Logging Speed*:	100 – 500 ft/hr
Vertical Resolution*:	19.0" / 19.0" / 19.0" / 21.0"
Open Hole Logging:	Yes
Casing Conditions:	Yes, non-metallic casing

**Vertical resolution dependent on logging speed – faster speeds lead to lower resolution.*



Multiple Frequencies = Multiple Depths of Investigation

Probe Type		JPZ175E	JPY238	JPY350	JPX525
Probe Diameter		1.75"	2.38"	3.5"	5.25"
Depth of Investigation (Frequency)	F1	9"	9"	12"	16"
	F2	10"	11"	13.5"	18"
	F3	---	---	15"	21"

Advantages of Multiple Depths of Investigation:

- Higher Signal to Noise Ratio (SNR) as data from multiple frequencies can be combined to optimize SNR.
- Reduces the effect of noise: if one frequency shows RF interference, use frequencies unaffected by noise to obtain quality data set.
- Different depths of investigations can identify if drilling disturbances or washouts are present.

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