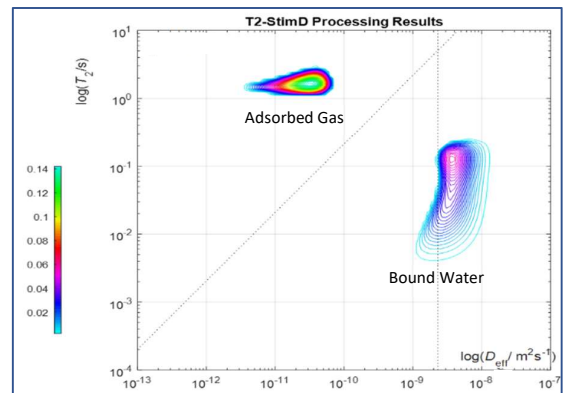
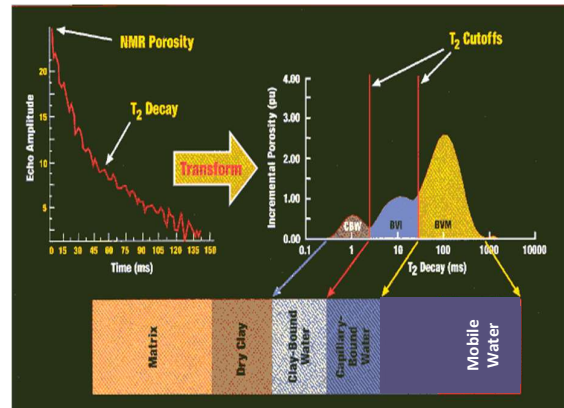


## Description

Borehole Magnetic Resonance (BMR) logging makes use of strong permanent magnets and a weak oscillating magnetic field from precisely timed bursts of electromagnetic (EM) energy at specific radio frequencies (RF). Between these pulses an antenna is used to detect decaying spin-echo signals from hydrogen nuclei in resonance with the permanent magnetic field.

These signals are processed to characterize the pore structure of rocks in much the same way as Magnetic Resonance Imaging (MRI) is used to interrogate the interior structure of the human body. Borehole NMR is specifically tuned to sense pore network fluids only, enabling precise determination of rock total porosity (moisture content), mobile fluid content (specific yield), bound fluid content (specific retention) and permeability (hydraulic conductivity). NMR can also distinguish fluid types, with advanced analysis techniques developed to quantify both adsorbed gas content and free gas content of coals.

This unique interrogation technique eliminates the need for radioactive sources and is independent of lithology, thereby eliminating need for tool calibrations also.



## Applications

- Mapping moisture content, specific yield and dry weight density in iron ore deposits to determine blend for feed stock to the crusher, quantify resource and pick open/closed fractures (in combination with ATV/OTV).
- Developing dewatering strategies in and around underground coal mines and open pit ore mines.
- Mapping aquifer hydrogeology to guide development of comprehensive groundwater management strategies.
- Mapping brine hydrogeology to determine the economic viability and shaping development strategy of brine mining operations.
- Map coal seam gas content and permeability distribution to plan coal mine layout, size mine ventilation systems and determine need for gas pre-drainage ahead of longwall mining operations.

## BMR Features & Benefits

While NMR has been used routinely in the oil and gas logging industry for decades, uptake by other industries has been hindered by NMR tool size and cost of the logging service. NMRSA have addressed this capability gap through development of an advanced miniaturised, slim borehole Magnetic Resonance (BMR) logging tool.

- Advanced NMR pulse sequences and signal processing techniques enable aquifer pore structure and mobile water content to be determined with a high degree of precision and accuracy.
- An appropriate theoretical model is used to also estimate intrinsic permeability.
- Raw data transmission, complemented by a powerful analysis software, enables a detailed log of these geophysical parameters to be generated real-time.
- Despite miniaturisation, the BMR logging tool has impressive signal-to-noise (SNR) characteristics, resulting in a large depth of investigation.
- High SNR, coupled with rapid data acquisition and processing, enables variation in geophysical parameters through the aquifer to be mapped while continuously logging at 1 m/min (~200ft/hr).
- The BMR logging tool can be run centered in open-hole, fiberglass or PVC lined boreholes.

## BMR Tool Specifications

To fit inside the typically small diameter boreholes drilled to explore and delineate coal seams, aquifers and ore deposits, development of the BMR logging tool necessitated a high degree of hardware miniaturization and implementation of new NMR excitation and NMR relaxation measurement techniques. These challenges were successfully overcome through pioneering applied research, innovative design and a number of inventive steps. As a consequence of these breakthrough achievements, BMR is able to deliver high quality, high resolution data, on a wide range of geophysical pore-related parameters.

Specification	Value
<b>Physical Dimensions</b>	
Tool Diameter	60 mm
Tool Length	2.01 m
Operating Pressure	200 bar (Tool Top Adapter)*
Operating Temperature	100 °C
Vertical Resolution	8 cm
<b>NMR Field</b>	
Diameter of Investigation	Configurable 16-30 cm
Echo Spacing (TE)	Configurable 280 μs+
Wait Time (TW)	Dual
T2 Distribution	0.5xTE – 5 seconds
Porosity Range	0 – 100 pu
Total Porosity Precision	2 pu – 5 level averaging
<b>Well Parameters</b>	
Hole Sizes	75 – 160 cm
Hole Condition	Open hole or PVC casing

\* BMR Logging Tool rated to 300 bar

