CHAT Service Applications Quick Reference

Cased Hole Analysis Tool

Cased Hole Analysis Tool:
The cased hole analysis tool provides formation evaluation for exploration, reservoir monitoring and problem well diagnostics. By providing a through-casing formation density and duel-energy neutron, the CHAT tool allows for identification and quantification of formation fluids after the well has been cased.

Applications Using Cased Hole Analysis Tool:
- Primary Porosity Measurement
- Primary/Secondary Reservoir Evaluation
- Reservoir Monitoring of Depletion
- CBM Evaluation
- Horizontal Formation Evaluation
- Frac Design Analysis
- By Passed Pay & Up Hole Potential
- Surface Casing Vent Flow/Gas Migration Solution
- Problem Well Diagnostics (i.e. Coning)
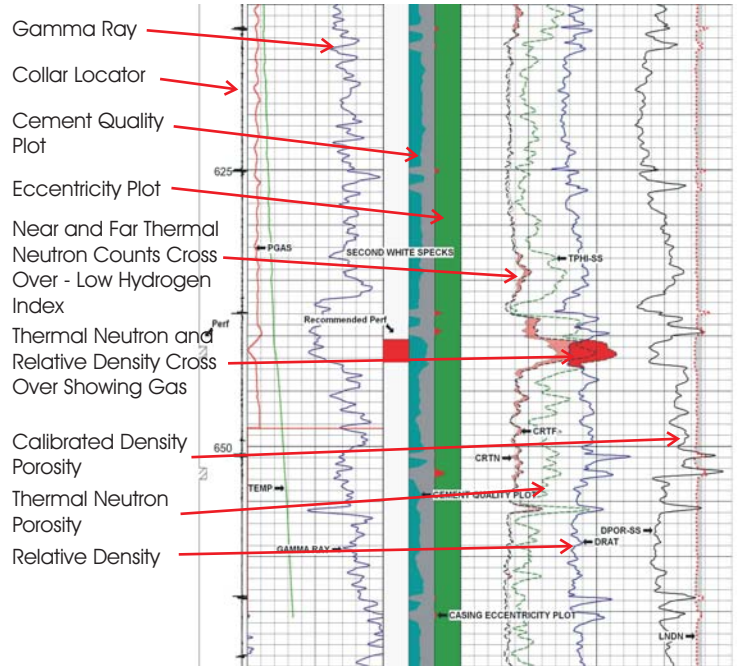- Dry Well Bore Logging
- Full Memory Available for Coil Deployment

Analysis Results:
- Swa (apparent water saturation)
- Gas within Formation
- Oil within Formation
- Annulus Gas Identification (SCVF/GM)
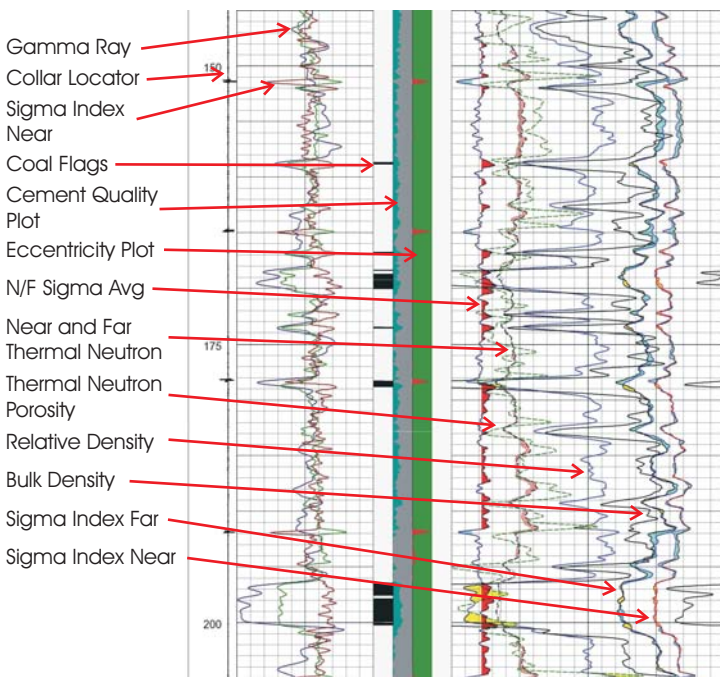- CBM Identification and Evaluation

Measurements:
- GR/CCL, Thermal Neutron, Epithermal Neutron, Formation Density

Shallow Gas - Thermal Neutron-Density

Labels (top to bottom):
- Gamma Ray
- Collar Locator
- Cement Quality Plot
- Eccentricity Plot
- Near and Far Thermal Neutron Counts Cross Over - Low Hydrogen Index
- Thermal Neutron and Relative Density Cross Over Showing Gas
- Calibrated Density Porosity
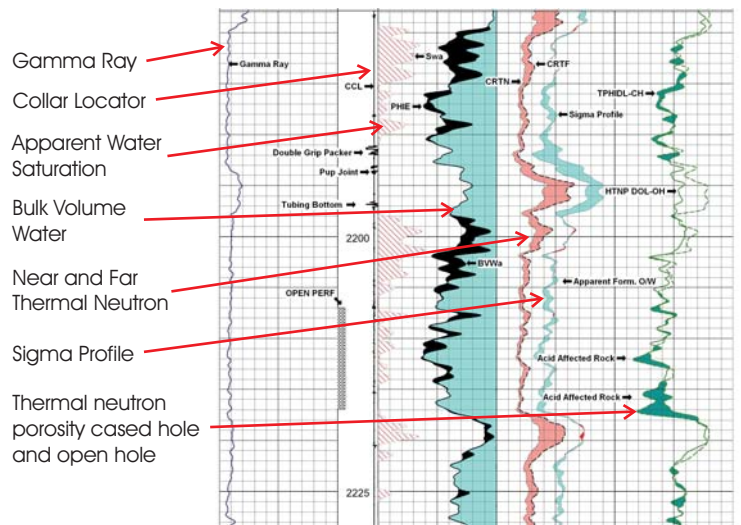- Thermal Neutron Porosity
- Relative Density

Shallow Gas - The cased hole analysis tool shows formation gas as per the thermal neutron density cross over (shaded in red). The near and far thermal neutron counts are also scaled to suggest zones with low hydrogen index (low porosity or gas). The casing cement plot estimates the amount of bulk material just behind casing and the eccentricity plot estimates the casing to formation centralization. Both are used to create a calibrated formation density

Coal Bed Methane

Labels (top to bottom):
- Gamma Ray
- Collar Locator
- Sigma Index Near
- Coal Flags
- Cement Quality Plot
- Eccentricity Plot
- N/F Sigma Avg
- Near and Far Thermal Neutron
- Thermal Neutron Porosity
- Relative Density
- Bulk Density
- Sigma Index Far
- Sigma Index Near

CBM - The processed thermal neutron, epithermal neutron and formation density data from the cased hole analysis tool, identifies coal and grades potential of each using various inputs (i.e. bulk density, gamma ray, neutron and density porosity, etc...). Each coal is analyzed individually with a report summary generated in addition to log type products.

Pembina Water Saturation

Labels (top to bottom):
- Gamma Ray
- Collar Locator
- Apparent Water Saturation
- Bulk Volume Water
- Near and Far Thermal Neutron
- Sigma Profile
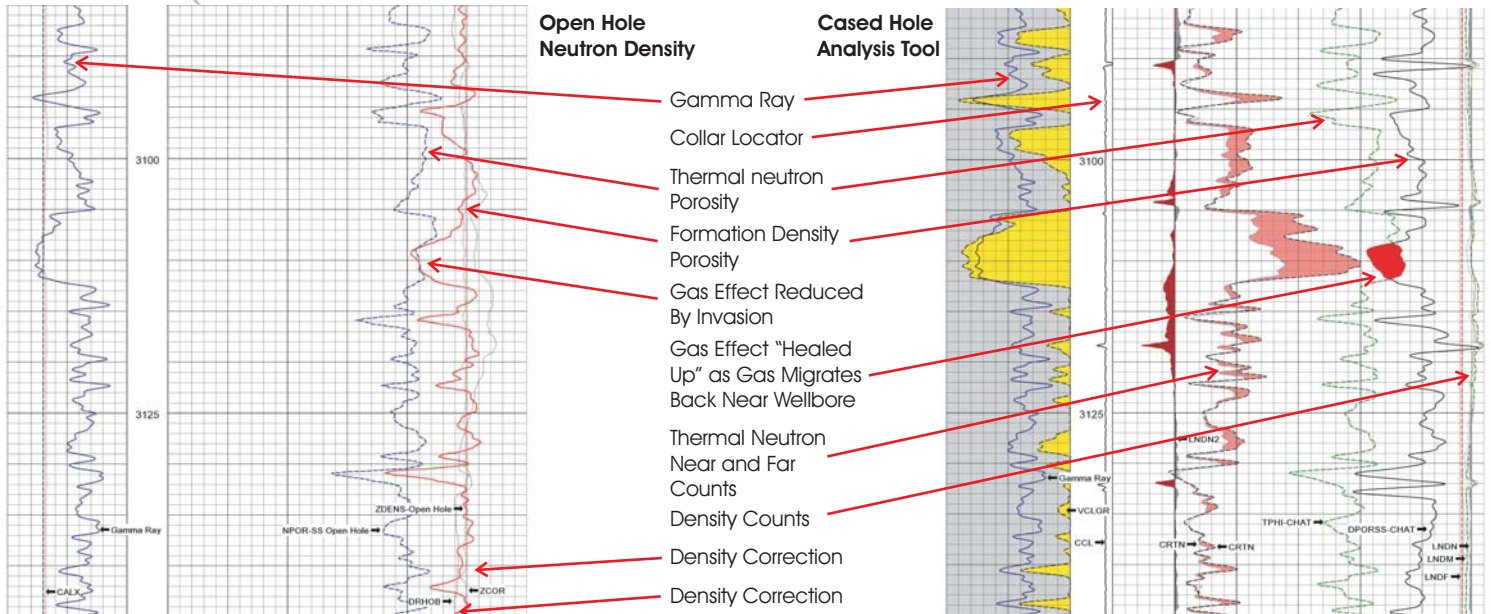- Thermal neutron porosity cased hole and open hole

Water Saturation - Water saturation is calculated from the comparison between thermal and epithermal neutron counts. Thermal counts will be highly affected by the presence of dissolved salts in the formation waters. Epithermal neutrons are not affected to the same extent by formation water salinity. The comparative difference between the two will yield a sigma profile. When this profile is normalized to the effective porosity, a bulk volume and Swa (apparent water saturation) is obtained. The remaining porosity is hydrocarbon. The formation density may also be utilized to gain information related to hydrocarbons present (gas and oil). In this case the cased hole neutron is compared to the open hole neutron to identify porosity changes related to acid introduction.

*** All graphics supplied courtesy of Geolog Solutions

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Missed Pay Due To Invasion - Open Hole & Cased Hole Analysis Tool

Open Hole Neutron Density

Cased Hole Analysis Tool

- Gamma Ray
- Collar Locator
- Thermal neutron Porosity
- Formation Density Porosity
- Gas Effect Reduced By Invasion
- Gas Effect "Healed Up" as Gas Migrates Back Near Wellbore
- Thermal Neutron Near and Far Counts
- Density Counts
- Density Correction
- Density Correction

Missed Pay - During the drilling process, mud filtrate may enter the formation porosity. If the invasion is deeper than the depth of investigation of the open hole neutron density, the gas response may be reduced or eliminated. After the well has been cased and cemented in place, the invaded fluids may dissipate into the formation allowing gas to again occupy space in the near wellbore region. The gas may now be identified by cased hole logs such as the Cased Hole Analysis Tool. The "healing" time is realated to porosity, permeability, pressure, etc but is generally accepted to be at least two weeks.

Reservoir Monitoring

Original completions began to water out. Evaluation of reservoir fluids identified a rise in water contact solved by a re-completion.
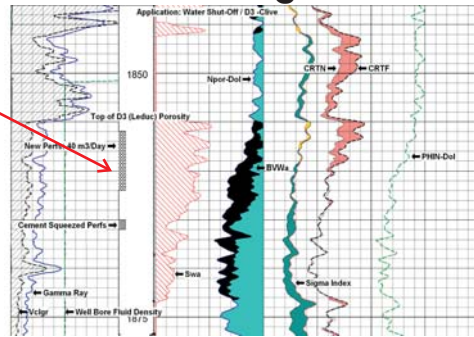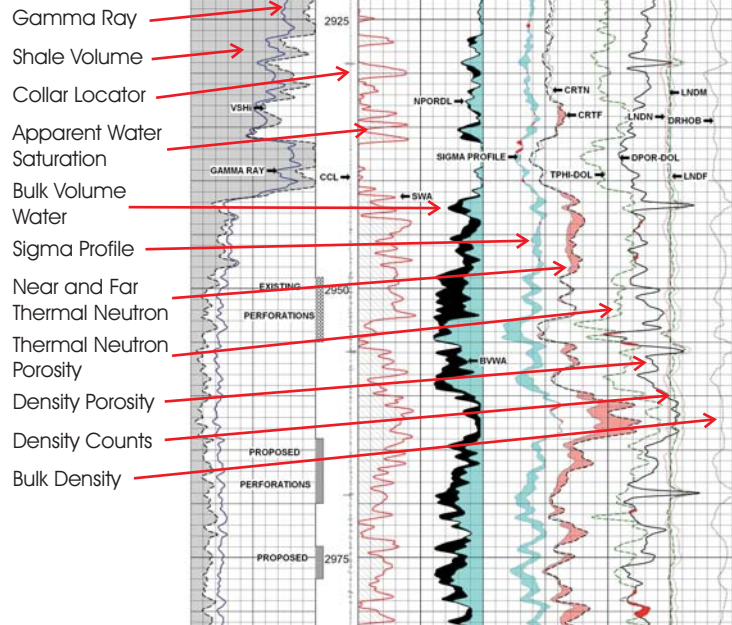

Original completions began to water out. Evaluation of reservoir fluids identified water "fingering in" across upper reservoir
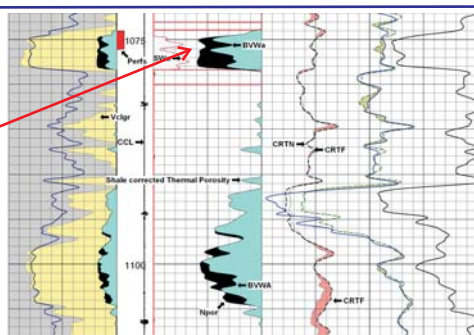
Reservoir Monitoring - As fluids are produced from a well, the reservoir changes. Fluid contacts may rise, different fluids may be pulled in from other parts of the reservoir, etc... The well may start to water out as the reservoir changes. There may still be hydrocarbons to produce, just not in the original completions. Evaluating the current formation fluid status may allow a well to be put back to life with a simple re-complete.

Carbonate

- Gamma Ray
- Shale Volume
- Collar Locator
- Apparent Water Saturation
- Bulk Volume Water
- Sigma Profile
- Near and Far Thermal Neutron
- Thermal Neutron Porosity
- Density Porosity
- Density Counts
- Bulk Density

Carbonate - Carbonates are processed to identify and quantify gas and oil in a similar manor as sandstones. As the thermal and epithermal neutron sigma index is self correcting, there is no need for lithology identifiers such as PE. An effective porosity is calculated from neutron and density (keeping in mind shale) and the sigma profile provides the water content information. The remaining porosity is occupied by hydrocarbon.

***All graphics supplied courtesy of Geolog Solutions

Cased Hole Logging
TCP and Conventional Perforating
Swabbing
Specialty Services

Brooks - 403.501.8474
Red Deer - 888.309.3055
Whitecourt - 780.778.4505
Grande Prairie - 780.538.1108

CHAT Service Applications Quick Reference

Surface Casing Vent Flow

Noise Analysis

Radial Bond Log VDL

Radial Bond Log Radial Mapping Showing Channeling

Near and Far Thermal Neutron

Thermal Neutron Porosity

Relative Formation Density

Neutron-Density gas effect identifies potential gas sources
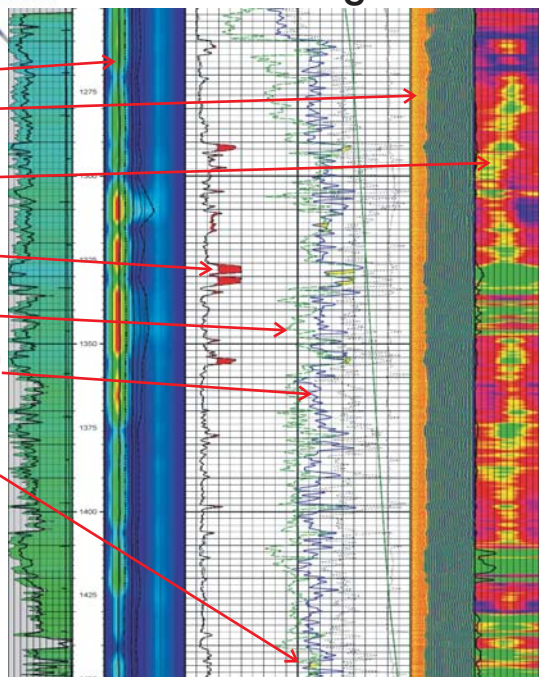
Surface Casing Vent Flow/Gas Migration - Gas flowing outside the pipe may be identified by a Noise Temperature survey. Cement bond quality may be evaluated with the aid of a Radial Bond Log. The Cased Hole Analysis Tool is used with these services to build a "story" of what is actually happening. The Cased Hole Analysis Tool pinpoints the formation gas source causing the problem while identifying annular gas completing the picture.

Cavern Logging

Gamma Ray

Collar Locator

Cavern Top From Date Set

Relative Density

Thermal Neutron Porosity

Near, Medium and Far Density Counts

Change in Cavern Fluids

Sigma Profile Used to identify Brine Interface
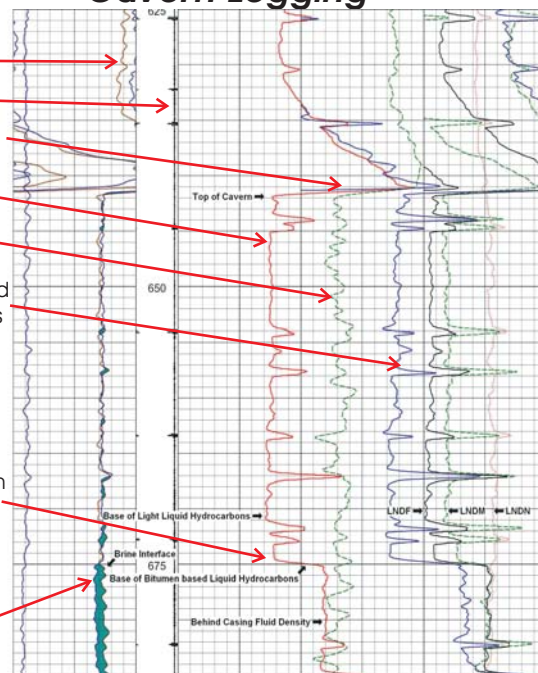
Cavern Logging - Logging of storage caverns identifies fluid levels of various fluids and extent of the cavern itself. Information yielded may be used to evaluate effectiveness of the storage cavern and to aid in planned actions related to these fluids.

N2 Flood - N2 Break Through

Formation arrivals may be weak or not present at all.
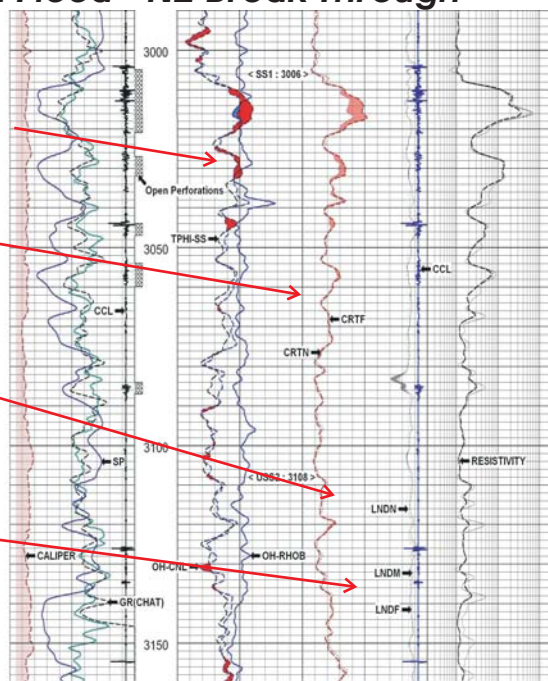
N2 Flood Showing Break Through - In a N2 injection field, intervals of break through were identified by comparing the open hole data to the Cased Hole Analysis tool data set. The data showed an increase in gas (N2) saturation across the upper three intervals

***All graphics supplied courtesy of Geolog Solutions

Problem Well Diagnostics - Water Coning

Gamma Ray From Multiple Passes

Perforation Interval

Epithermal Neutron Under Flowing Conditions

Epithermal Neutron Under Shut-In Conditions

Thermal Neutron Under Flowing Conditions

Thermal Neutron Under Shut-In Conditions

Formation Density
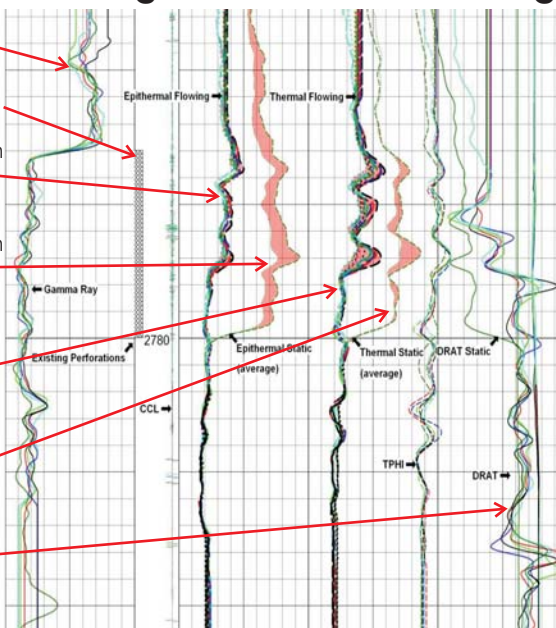
Problem Well Diagnostics (such as Water Coning) - The Cased Hole Analysis Tool had been used to evaluate various problems in al well related to the formation fluids present. In the example above, multiple passes were logged across zone of interest under shut-in and flowing conditions. Water production from the zone was identified to be the result off water coning in the reservoir under flowing conditions. Under static well conditions the water contact was found to be at the base of the perforations. However, under flowing conditions the water level rose two meters up across the perforated interval.

Cased Hole Logging
TCP and Conventional Perforating
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