Triple Combination Tool String

Description
The Schlumberger Triple Combination Tool String ("Triple Combo") consists of a series of Schlumberger logging tools combined to provide a broad suite of in situ physical property measurements in an uncased borehole. The term “Triple Combo” is derived from the three principle measurements collected by the tool string: density, porosity and resistivity. Specifically, the Triple Combo is designed to measure formation density, porosity, deep/intermediate/shallow resistivity, natural gamma radiation, hole size, and fluid temperature, all in a single logging pass.

Applications
Hostile Environment Natural Gamma Sonde
- Clay typing
- Mineralogy identification
- Ash layer detection

Accelerator Porosity Sonde
- Formation porosity
- Lithologic determination

Hostile Environment Litho-Density Tool
- Porosity estimation
- Seismic impedance calculation
- Lithology and rock chemistry definition

Dual Induction Tool
- Porosity estimation
- Density and velocity reconstruction
- Lithologic boundary definition and textural changes

Temperature / Pressure / Acceleration Tool
- Geothermics
- Hydrogeology

Deployment Notes
In ODP, the Triple Combo is always the first tool string run into the open borehole to ascertain the condition of the hole. The modular nature of the Triple Combo affords great flexibility with regard to tool substitutions and additions/deletions. For example, third party tools such as the Lamont-Doherty Earth Observatory’s High Resolution Gamma and TAP tools have been run in-line with the Triple Combo.

Tool String Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>28.99 m</td>
</tr>
<tr>
<td>Diameter</td>
<td>3.75 in</td>
</tr>
<tr>
<td>Primary Measurements</td>
<td>Spectral gamma (Uranium, Potassium and Thorium), Formation density, Formation porosity, Resistivity (Shallow, Medium and Deep depths of investigation), Fluid temperature</td>
</tr>
</tbody>
</table>

ODP Logging Services, Lamont-Doherty Earth Observatory, Rt. 9W, Palisades, NY 10964
Triple Combo Tool Specifications

<table>
<thead>
<tr>
<th>Tool</th>
<th>Measurement</th>
<th>Maximum Temperature</th>
<th>Maximum Pressure</th>
<th>Sample Interval</th>
<th>Vertical Resolution</th>
<th>Logging Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>HNGS</td>
<td>Spectral Gamma</td>
<td>260° C</td>
<td>25,000 psi</td>
<td>6 in.</td>
<td>1.66 ft</td>
<td>1600 ft/hr</td>
</tr>
<tr>
<td>APS</td>
<td>Porosity</td>
<td>176° C</td>
<td>20,000 psi</td>
<td>6 in.</td>
<td>12 - 14 in.</td>
<td>1600 ft/hr</td>
</tr>
<tr>
<td>HLDT</td>
<td>Density</td>
<td>260° C</td>
<td>25,000 psi</td>
<td>6 in.</td>
<td>1.25 ft</td>
<td>1600 ft/hr</td>
</tr>
<tr>
<td>DIT</td>
<td>Resistivity</td>
<td>175° C</td>
<td>20,000 psi</td>
<td>6 in.</td>
<td>2.5 - 8 ft</td>
<td>10,000 ft/hr</td>
</tr>
<tr>
<td>TAP</td>
<td>Temperature/Acceleration/Pressure</td>
<td>105° C</td>
<td>10,000 psi</td>
<td>1 sec.</td>
<td>Conditional</td>
<td>Conditional</td>
</tr>
</tbody>
</table>

CALI = Caliper
HSGR = Gamma ray total cts
URAN = Percent uranium
POTA = Percent potassium
THOR = Percent thorium
SFLU = Spherically focused r
IMPH = Deep induction
IDPH = Medium induction
RHOM = Formation density
PEFL = Photoelectric effect
DRH = Bulk density correctic
APLC = Formation porosity
SIGF = Capture cross sector

12/2003