

DRILLING SERVICES

HEATWAVE™ EXTREME LOGGING-WHILE-DRILLING SERVICE

Delivering high-resolution triple-combo
LWD logs in ultrahigh-temperature wells



Weatherford®

QUALITY AT ANY TEMPERATURE

Acquire high-resolution gamma ray, neutron density, bore and annular pressure, and resistivity logs while drilling in the world's hottest wells

As offshore drilling moves into deeper and hotter environments, even high-temperature logging-while-drilling (LWD) systems can't handle the heat. Operators often settle for extensive temperature-mitigation measures, additional operating time and expense, or the prospect of receiving no data at all.

The HeatWave™ Extreme service brings reliable LWD measurements to the most challenging drilling environments on Earth. Jointly designed and field-proven with a major E&P company, the service acquires high-quality LWD data in temperatures up to 392°F (200°C) and pressures up to 30,000 psi (206.8 MPa).

Each HeatWave Extreme service component—from electronics to elastomers—was completely redesigned for optimal reliability and robust resistance to ultra-high temperatures, high pressures, and vibration. The result is the first LWD service to reliably acquire gamma ray, resistivity, neutron porosity, bore and annular pressure, and density data at high temperatures without wireline runs, extra trips, or temperature mitigation.

HEATWAVE EXTREME SERVICE COMPLETES OFFSHORE HPHT CAMPAIGN, SAVES \$6.9 MILLION IN RIG TIME

Tasked to help with drilling a development field in the Gulf of Thailand, Weatherford jointly developed and deployed the HeatWave Extreme service. The drilling team reached total depth in each well without temperature mitigation efforts or other nonproductive time despite temperatures up to 392°F (200°C). The technology provided real-time and recorded triple-combo data and reduced drilling time by 20 hours per well, which amounted to US \$150,000 per well and US \$6.9 million during the campaign.

HEATWAVE EXTREME SERVICE APPLICATIONS

GAMMA RAY SERVICE

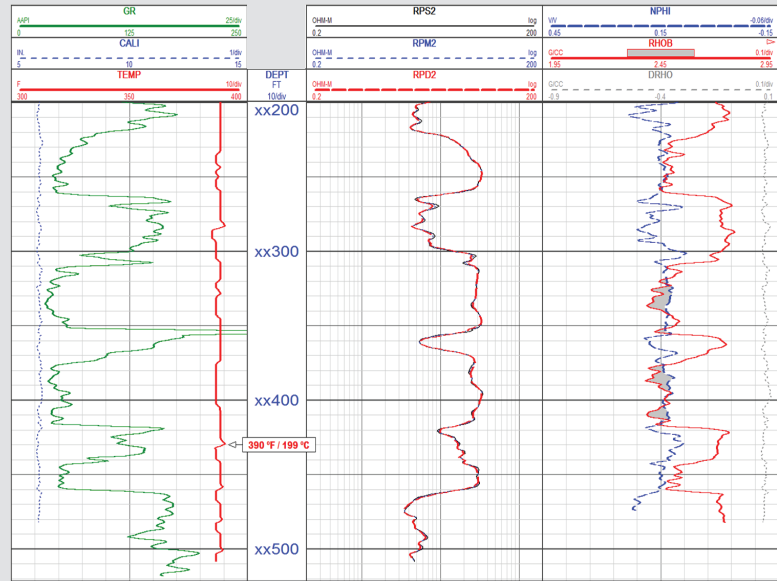
- Correlate reservoir models
- Measure shale volumes
- Determine well placement

NEUTRON-DENSITY SERVICE

- Determine water saturation, lithology, and porosity

RESISTIVITY SERVICE

- Determine hydrocarbons in place
- Calculate water saturation
- Evaluate pore pressure



Radially mounted Geiger Mueller tubes obtain real-time and recorded gamma ray data.

Quartz transducers provide bore and annular-pressure measurements and data for determining equivalent circulating density.

Directional measurement sensor uses orthogonally mounted, triaxial accelerometers and magnetometers to provide rotating inclination and azimuth.

HeatWave Extreme MWD Sensor



Two centrally mounted receiver antennas are part of the fully-compensated, dual-frequency resistivity system. The antennas capture measurements from three transmitters spaced 20, 30, and 46 in. away. Operating at 2 MHz and 400 KHZ, the tool provides a range of curves with differing depths of investigation and vertical resolution.

HeatWave Extreme MFR™ Multifrequency Resistivity Sensor



He₃ tubes measure the reaction between matrix and pore fluids and Am₂₄₁Be neutrons to determine formation porosity.

Scintillation detectors measure gamma ray scatter from a chemical source mounted in the collar.

HeatWave Extreme Density and TNP™ Thermal Neutron Porosity Sensor



ACQUIRE GAMMA RAY, NEUTRON DENSITY, BORE AND ANNULAR PRESSURE, AND RESISTIVITY LOGS IN ULTRAHIGH-TEMPERATURE WELLS

The Weatherford HeatWave Extreme service delivers high-resolution triple-combo LWD logs in ultrahigh-temperature wells. To learn how our services and technologies can work for you, contact your authorized Weatherford representative or visit our website.

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