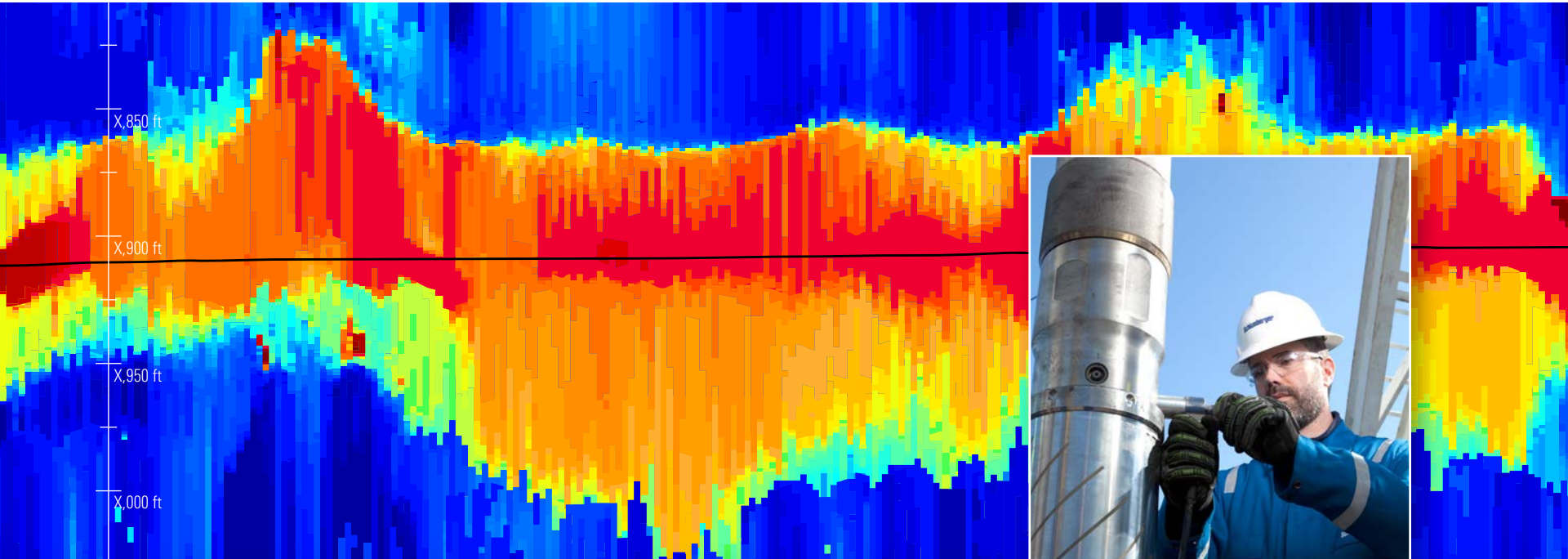


Schlumberger



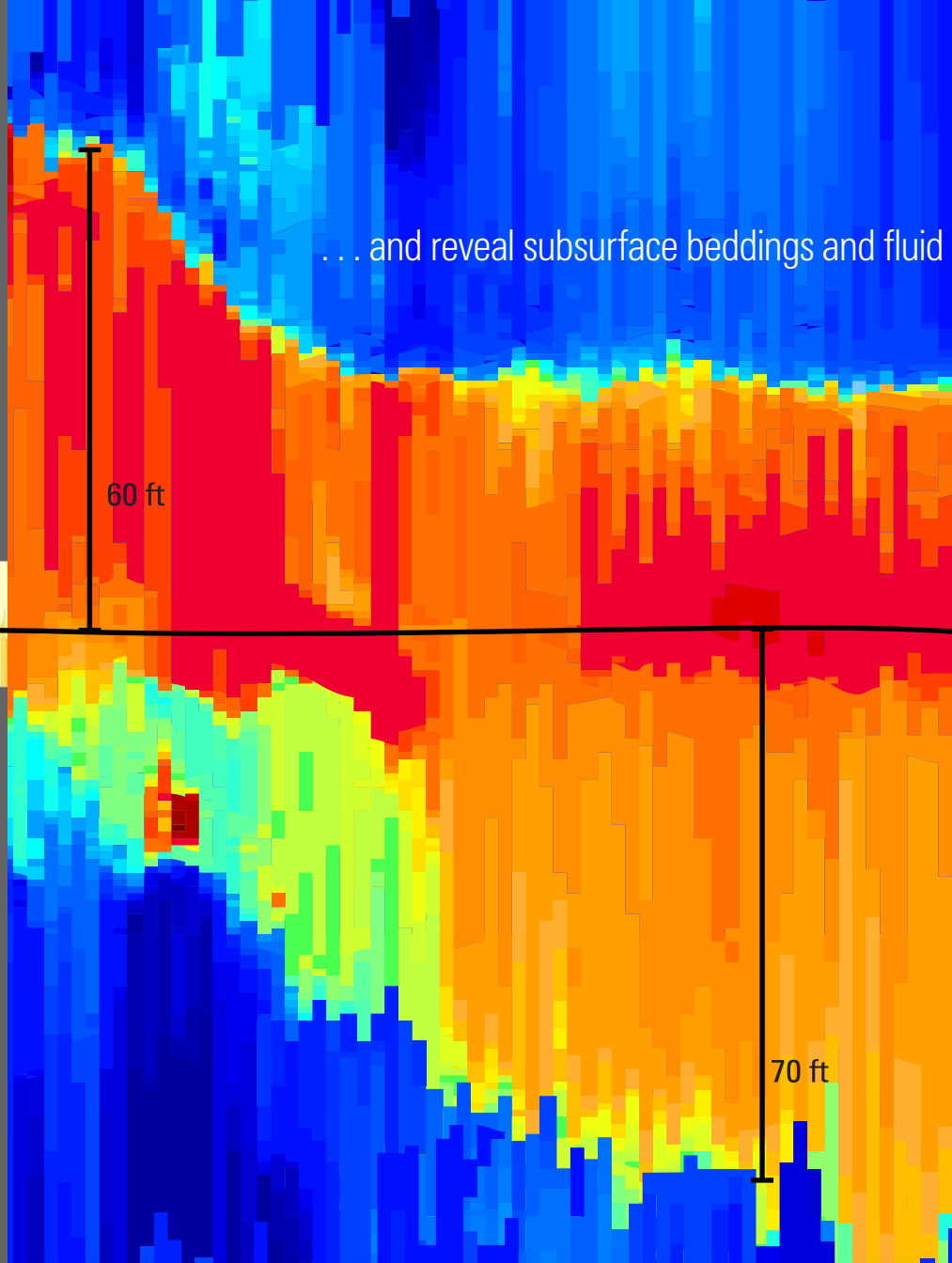
GeoSphere

Reservoir Mapping-While-Drilling Service

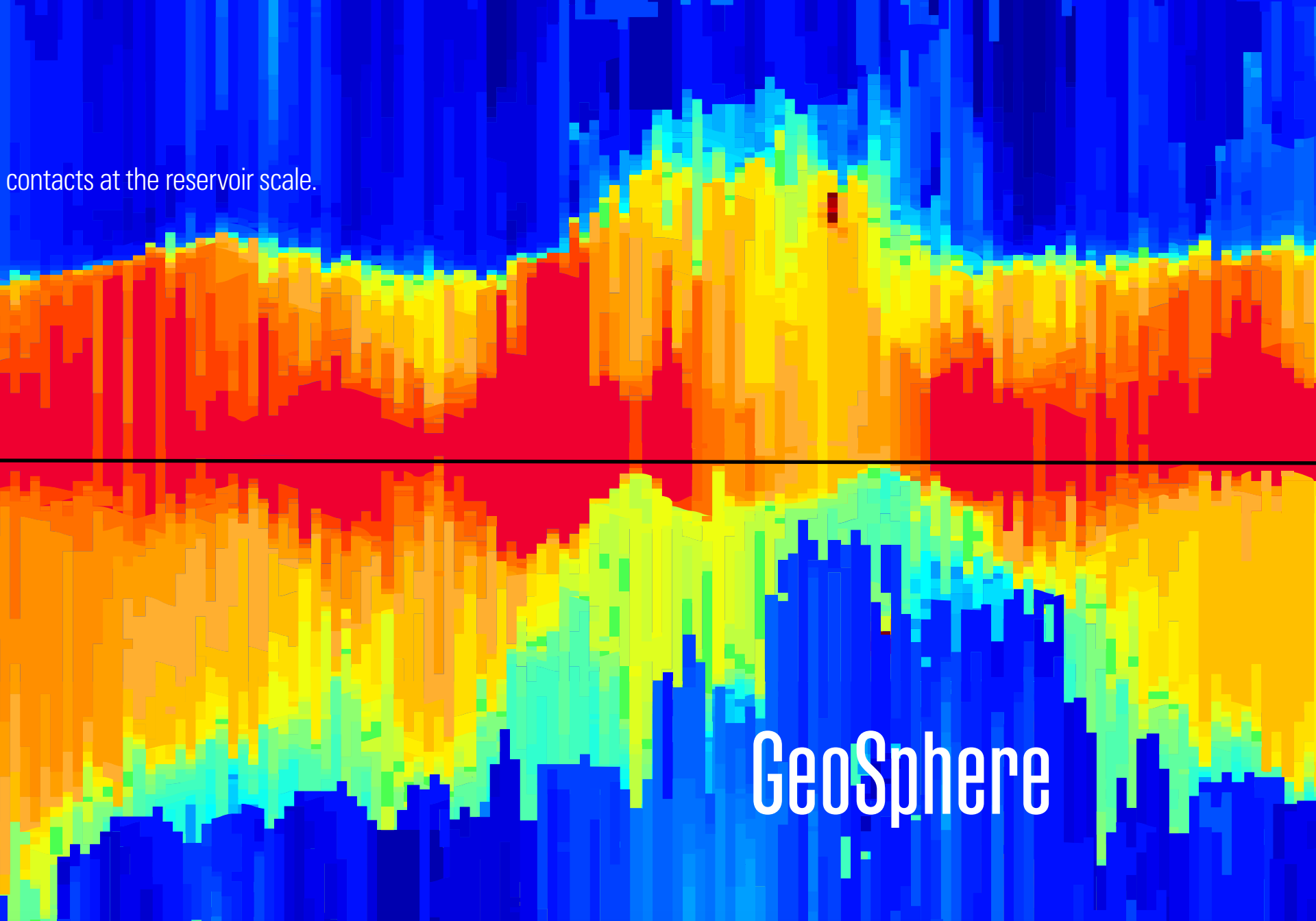


Discover reservoir mapping-while-drilling . . .

. . . and reveal subsurface beddings and fluid



contacts at the reservoir scale.



GeoSphere

GeoSphere

Reservoir Mapping-While-Drilling Service



Receiver

Receiver

Transmitter



Using deep, directional electromagnetic measurements, the GeoSphere* reservoir mapping-while-drilling service reveals subsurface-bedding and fluid-contact details more than 150 ft [45.72 m] from the wellbore. This reservoir-scale view provides an unprecedented depth of investigation, enabling operators to optimize landing, reduce drilling risk, and maximize reservoir exposure. By integrating real-time reservoir maps with seismic surveys, interpretation of reservoir structure and geometry can be refined, revolutionizing field development strategy.

Applications

- Mapping and interpretation of multiple stratigraphic surfaces, reservoir thicknesses, and formation dips
- Accurate landing of wells
- Reservoir exposure maximization
- Water zone detection and avoidance
- Drilling risk reduction
- Multilayer formation modeling
- Near-wellbore 3D structural modeling

Features

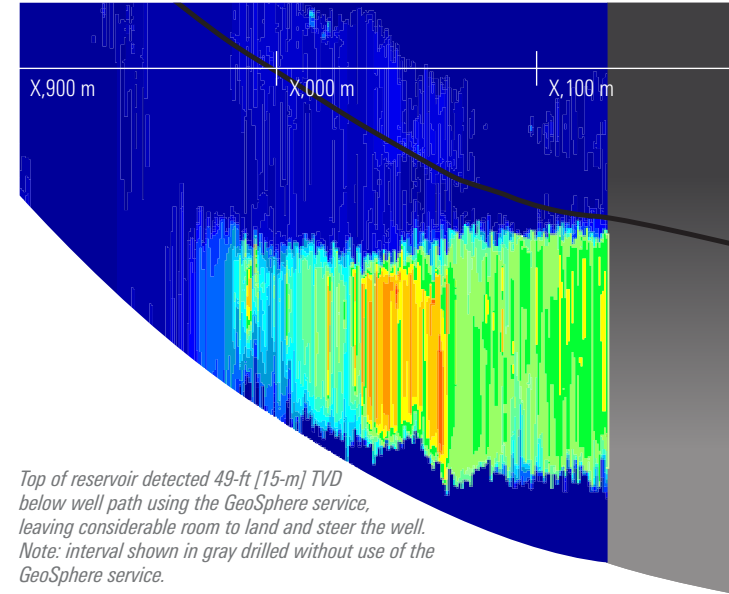
- Depth of investigation in excess of 150 ft [45.72 m]
- Deep, directional electromagnetic measurements with 3D sensitivity
- Multifrequency measurements to accommodate a wide variety of formation resistivity
- Real-time, automated stochastic inversions
- Modular system design tailored for multiple applications

Benefits

- Increase potential production and recovery rates
- Unlock access to new or marginal reserves
- Minimize water production
- Avoid drilling hazards
- Estimate reserves with greater accuracy
- Reduce number of pilot holes
- Eliminate geological sidetracks
- Refine seismic interpretation

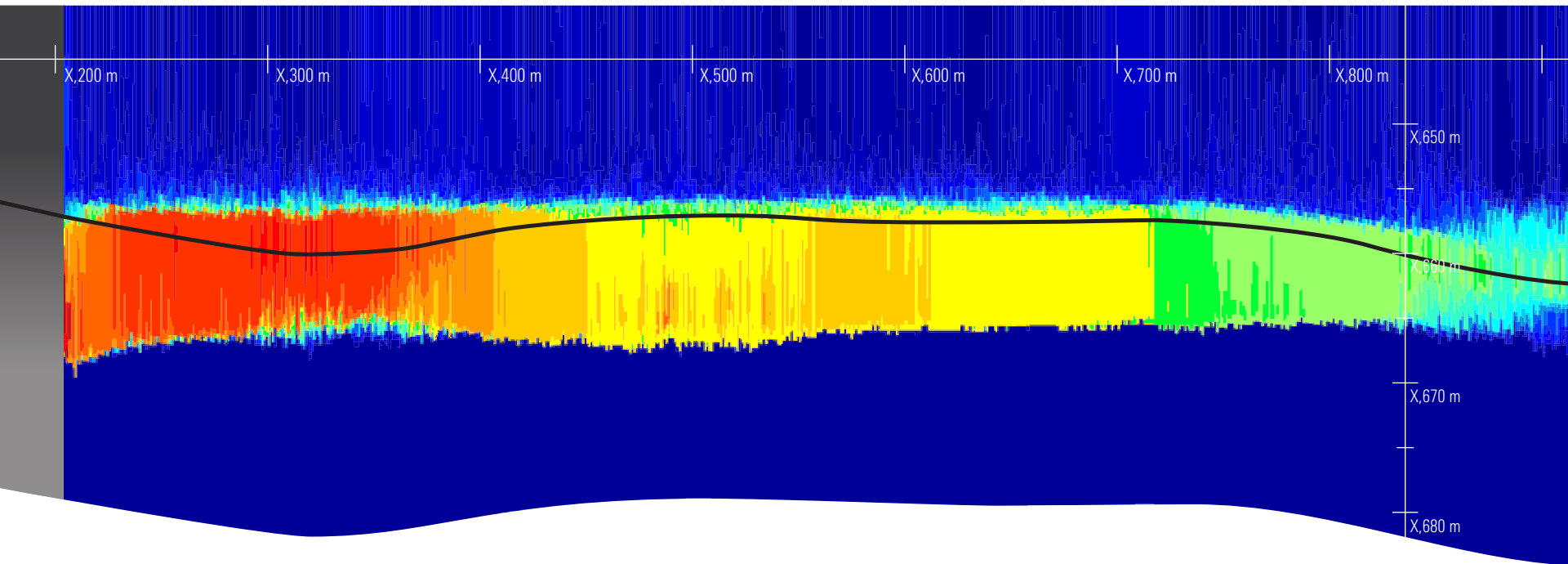
Landing

The GeoSphere service mitigates the risk of shallow or deep landings with a depth of investigation exceeding 150 ft [45.72 m] from the wellbore in real time. This service provides the measurements needed to complement well-to-well correlation and reduce pilot holes in unpredictable geological environments.



*Top of reservoir detected 49-ft [15-m] TVD below well path using the GeoSphere service, leaving considerable room to land and steer the well.
Note: interval shown in gray drilled without use of the GeoSphere service.*





Determine reservoir top TVD to land without pilot holes

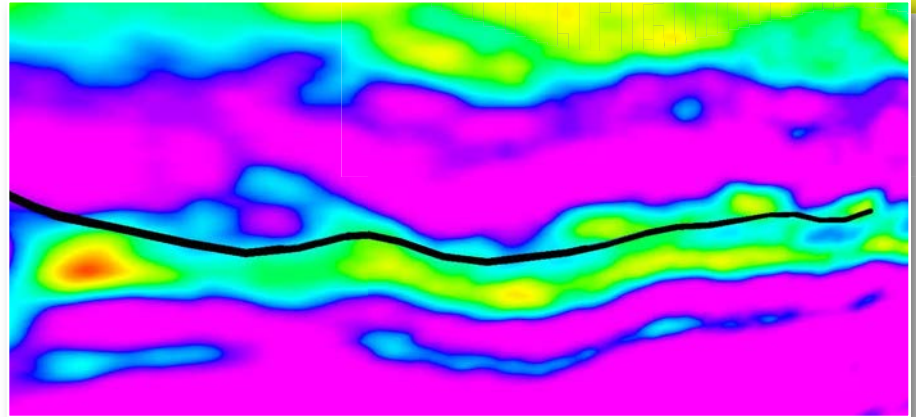
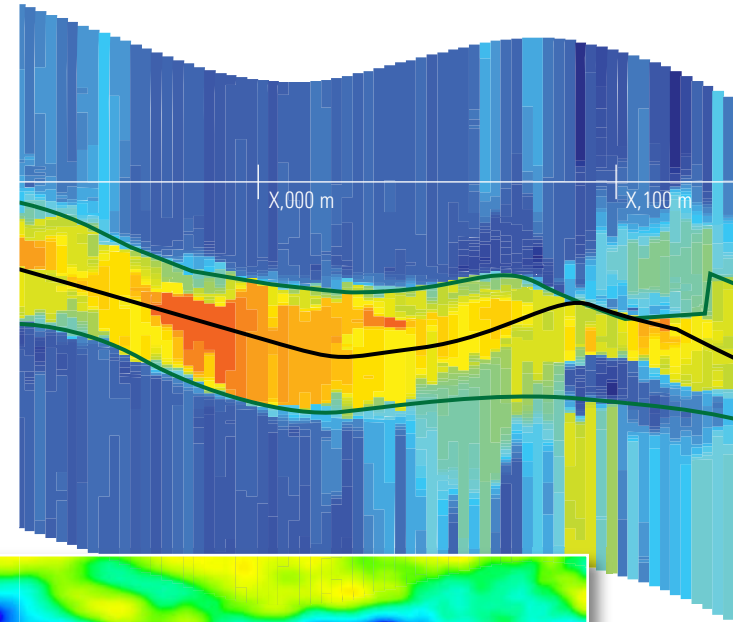
The GeoSphere service maps structural shifts on a reservoir scale, providing a precise TVD of the top of the reservoir and eliminating the cost and risk of drilling a pilot hole. Although pilot holes provide good local information about the geology of a reservoir, they are ineffective for predicting lateral geological variability across the reservoir. Similarly, well-to-well correlation alone cannot accommodate various structural shifts inherent to many downhole environments.

Maximize reservoir exposure with optimized landing

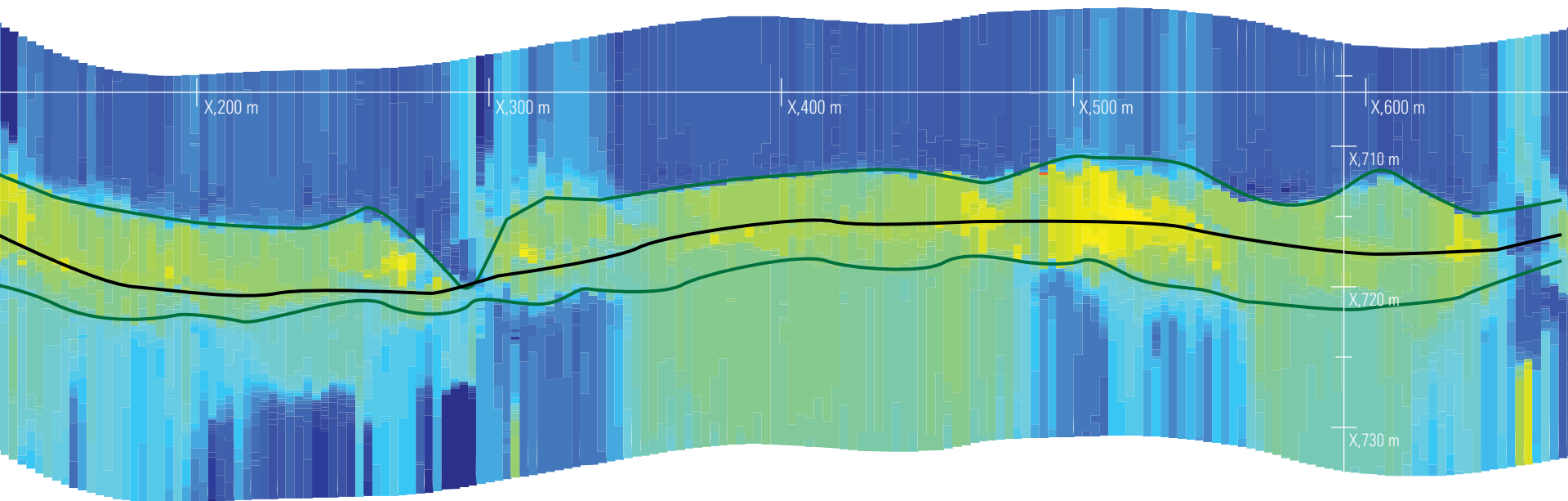
Using deep, directional electromagnetic measurements, the GeoSphere service effectively reduces the risk of shallow or deep landings. With a clear, real-time view of formation boundaries and fluid contacts, the service avoids losing lateral exposure and creating sumps. By exposing more of the lateral section to the reservoir, the GeoSphere service improves production potential and helps operators maintain wellbore integrity.

Steering

The GeoSphere service images reservoir geometry for a more strategic approach to steering the wellbore. By revealing details of structural dips and fluid boundaries, the real-time mapping data provides operators with information critical to avoiding undesired exits into nonproductive layers.



Data from the GeoSphere service (top image) and seismic acoustic impedance data (bottom image) led to reservoir exposure of 2,674-ft [815-m] MD, representing a net-to-gross ratio of 0.98.



Precisely position wells in sweet spot to extend laterals

The GeoSphere service detects individual layers in horizontal sections radially more than 150 ft [45.72 m] from the wellbore, exceeding the formation coverage of conventional logging-while-drilling technologies. Combined with surface seismic data, this amount of zonal coverage gives geoscientists and drilling engineers the capability to extend laterals—even in complex geological settings—within the sweet spot.

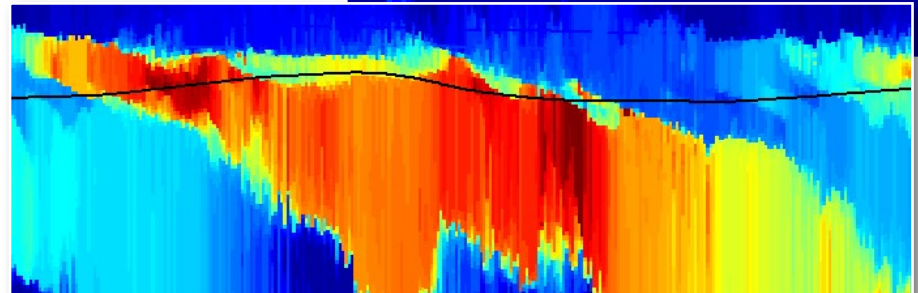
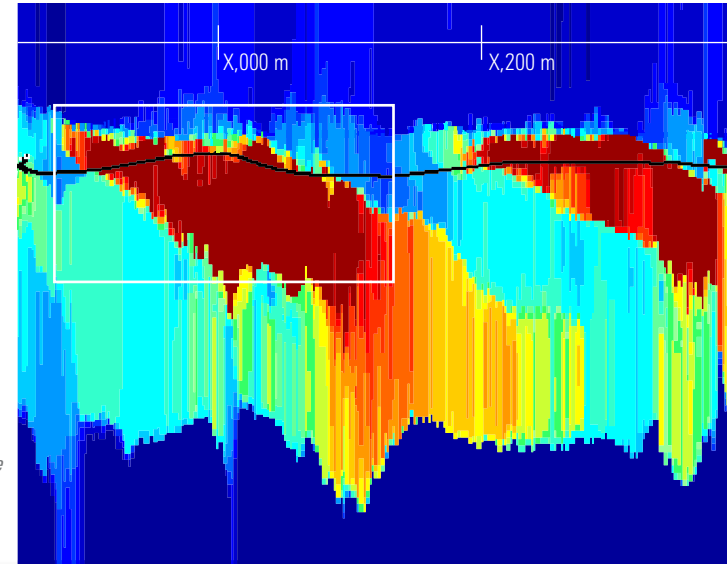
Avoid geological sidetracks, hazards in complex formations

In challenging downhole environments, such as disconnected sand bodies, the GeoSphere service estimates structural dips and enables operators to avoid unplanned reservoir exits. With this information, operators can adjust drilling trajectories in anticipation of geological variations to avoid water zones and unwanted geological sidetracks. This produces smoother wellbores, making the well easier to complete and produce.

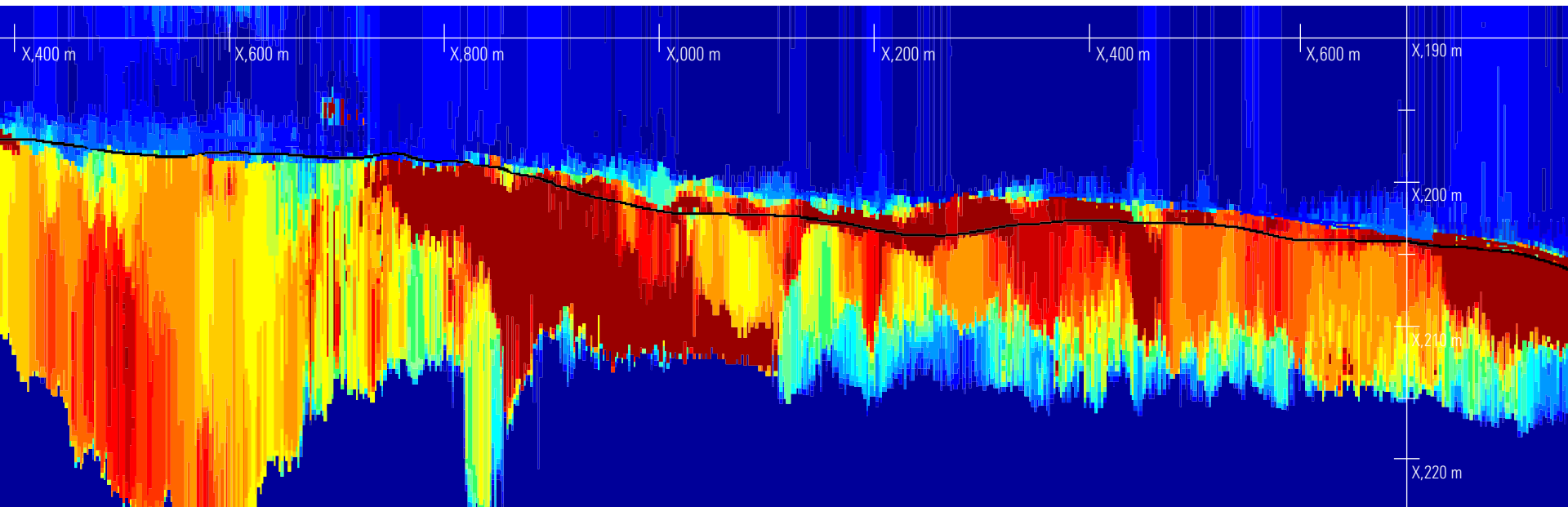
Mapping

By delineating subsurface beddings and fluid contacts at the reservoir scale, the GeoSphere service enables operators to optimize field development strategy. Real-time mapping data can be combined with surface seismic data to refine structural and geological models, resulting in enhanced production and recovery.

The GeoSphere service was used to evaluate an oil column and delineate layering within the reservoir, which had a structural dip of 3–5°.



This image highlights on-target drilling of the well, as shown in the white box in the top image.



Map subsurface layers to characterize reservoir

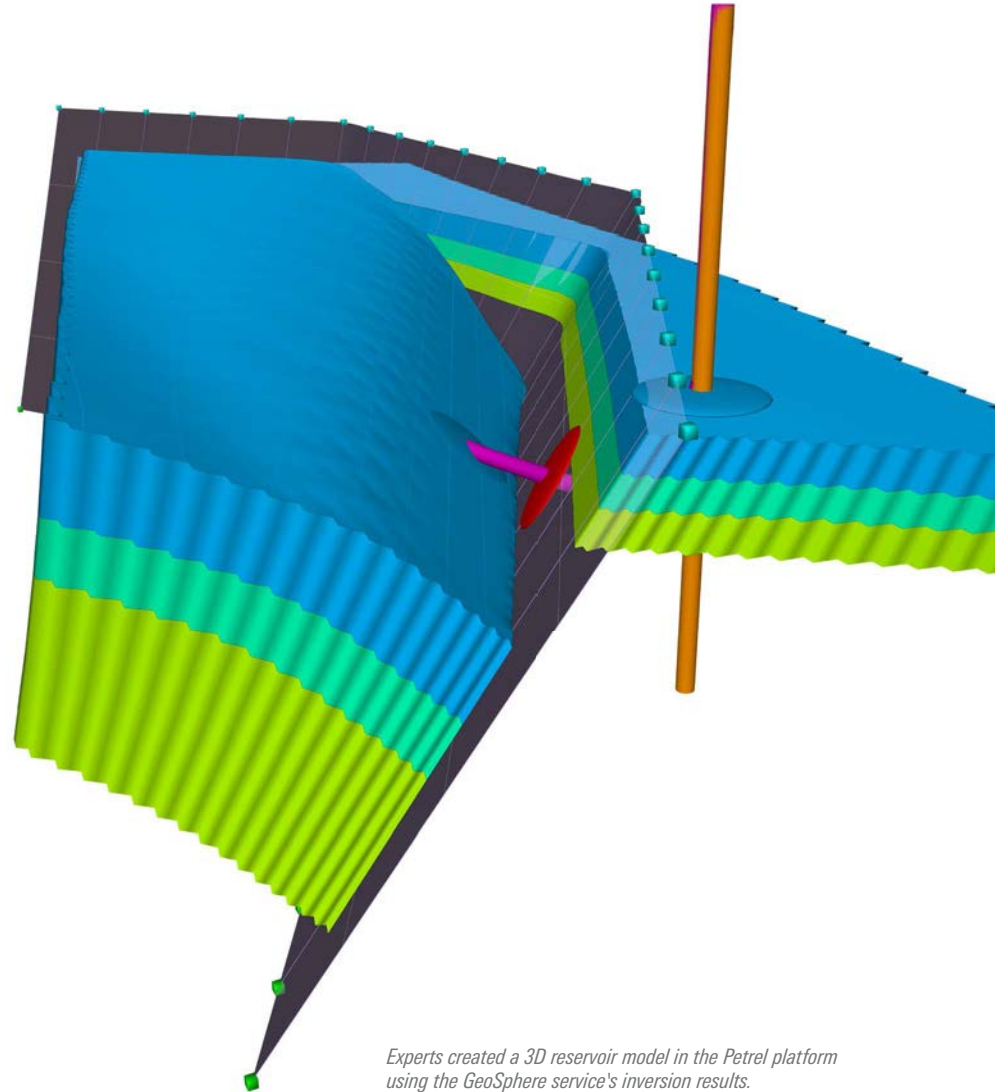
With a depth of investigation exceeding 150 ft [45.72 m], the GeoSphere service reveals subsurface beddings and fluid boundaries at the reservoir scale. The deep, directional electromagnetic measurements of this service complement surface seismic data and can be combined to refine reservoir models to gain a better understanding of sweep efficiencies in horizontal wells.

Investigate deeper for more complete development plans

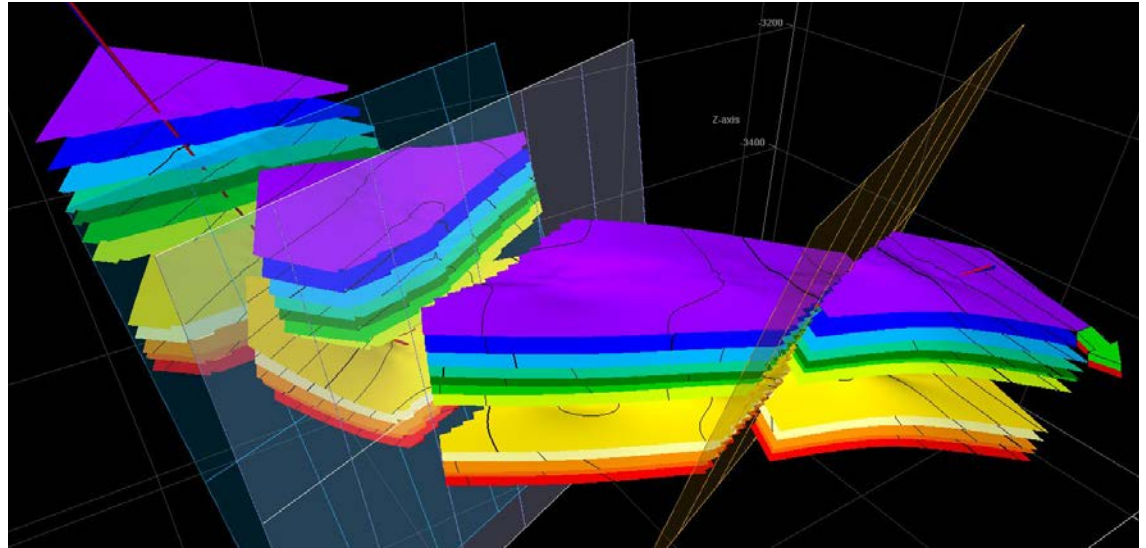
The GeoSphere service maps the reservoir top and base, providing data on the presence of lateral heterogeneities, subsurface unconformities, and reservoir geometry. Asset teams can then integrate all data from the service to optimize production and reservoir management. With complete well development plans, operators have a greater likelihood of successfully enhancing recovery techniques and exceeding expectations for the reservoir.

Advanced Applications

Mapping data from the GeoSphere service can be integrated into 3D reservoir models to optimize drilling operations and completion designs, leading to production improvement and better field development strategies.



Experts created a 3D reservoir model in the Petrel platform using the GeoSphere service's inversion results.



Using a reservoir map from the GeoSphere service and the Petrel platform, experts created an advanced 3D visualization that highlighted faults and complex structures.

Use 3D visualization to fully understand reservoir complexities

Reservoir maps from the GeoSphere service can be seamlessly exported into Petrel* E&P software platform. Experts can create 3D displays with formation evaluation data attributes to enhance the evaluation of layered formations. This aids seismic correlations and reservoir model updates.

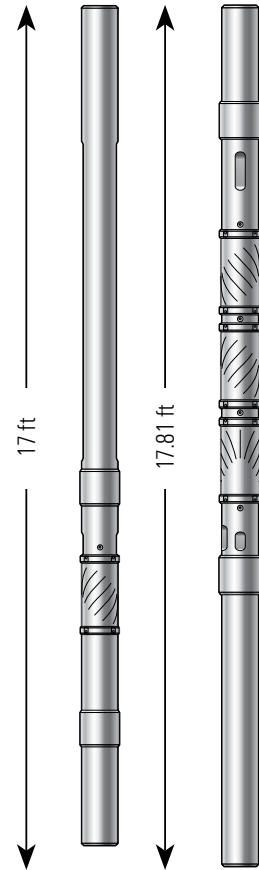
Optimize completion design to enhance potential production

Using mapping data from the GeoSphere service, operators can refine completion design, regulate flow control management, and enhance depletion profiles before completions are run. In addition, indications of fluid contacts allow for injector and production well optimization by influencing infill drilling decisions to eliminate bypassed pay zones.

Identify fluid boundaries to evaluate sweep efficiency

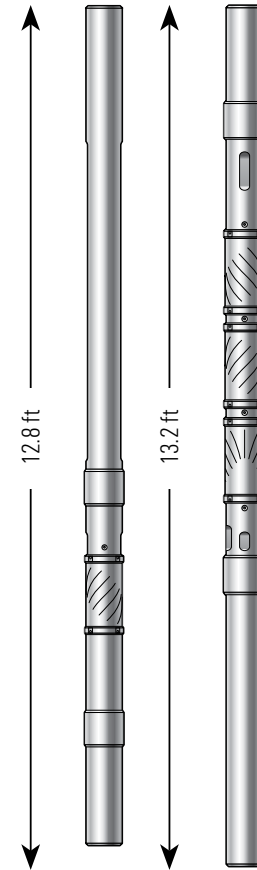
By delineating multiple subsurface layers in the reservoir using the GeoSphere service, operators can evaluate sweep efficiency between existing formation layers, map the top and bottom of the reservoir, and determine distinguishable barriers and patterns. This enables gains in vertical distance above the OWC.

Specifications



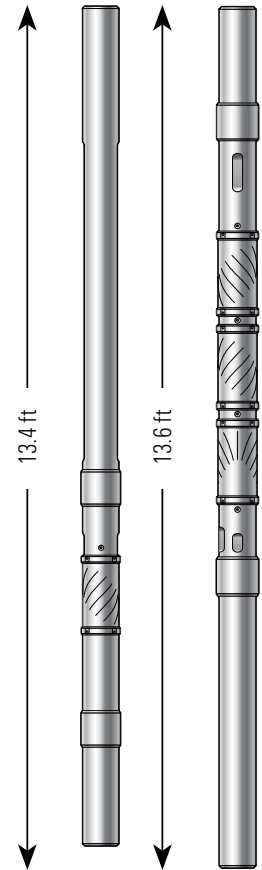
Transmitter Receiver

475



Transmitter Receiver

675



Transmitter Receiver

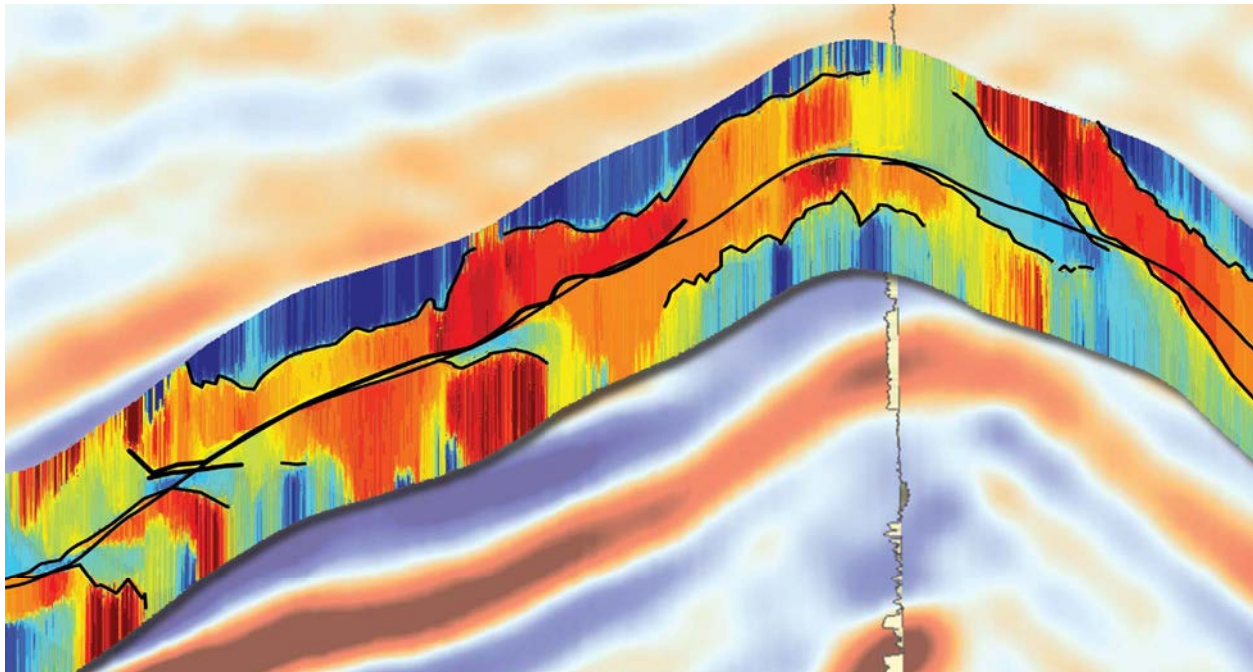
825

GeoSphere Service [†]				
Number of transmitters in BHA		1		
Number of receivers in BHA		up to 2		
Measurement Specifications				
Azimuthal coverage		360°		
Azimuthal resolution		2°		
Detection range		150 ft for 1–50 ohm.m boundary		
Recorded Data				
Recording time while pumping		15 d [360 h]		
Power and Combinability				
Power supply		MWD turbine (no battery)		
Combinability		Combinable with all Schlumberger technologies [§]		
Mechanical Specifications		475	675	825
Hole size		5½ in–6¾ in	8½ in–9⅞ in	10½ in–14¾ in
Drill collar nominal OD		4.81 API	6.75 API	8.25 API
Max. collar OD		5.4 in [137.2 mm]	7.5 in [190.5 mm]	9.1 in [231.1 mm]
Collar length	Transmitter	17 ft [5.18 m]	12.8 ft [3.91 m]	13.4 ft [4.09 m]
	Receiver	17.81 ft [5.43 m]	13.2 ft [4.02 m]	13.6 ft [4.14 m]
Top thread connection		NC 38 (3½ IF) Box	5½ FH box	6½ FH box
Bottom thread connection		NC 35 Box	NC-50 (4½ IF) box	5½ IF box
Operating Specifications				
Mud		WBM/OBM/SOBM	WBM/OBM/SOBM	WBM/OBM/SOBM
Max. operating temperature		302 degF [150 degC]	300 degF [150 degC]	300 degF [150 degC]
Max. tool curvature	Rotating	15°/100 ft	8°/100 ft	7°/100 ft
	Sliding	30°/100 ft	16°/100 ft	14°/100 ft
Max. flow rate		400 rpm [1,514 L/min]	800 rpm [3,028 L/min]	1,200 rpm [4,542 L/min]
Max. operating pressure		25,000 psi [172 MPa]	25,000 psi [172 MPa]	25,000 psi [172 MPa]
Rotation speed range		20–200 rpm	20–300 rpm	20–300 rpm

[†] The GeoSphere service requires standard resistivity measurements from EcoScope[®]††, PeriScope[®], or arcVISION[®] services.

[§] Note: The transmitter must be placed at least 35 ft [10.7 m] from proVISION[®] service.

Refer to the Schlumberger shock and vibration references for details regarding axial, lateral, and torsional limits of the tool.



The GeoSphere reservoir mapping-while-drilling service provides a radial view in excess of 150 ft from the wellbore, enhancing field development strategy and production potential.

*Mark of Schlumberger.

[†]Japan Oil, Gas and Metals National Corporation (JOGMEC), formerly Japan National Oil Corporation (JNOC), and Schlumberger collaborated on a research project to develop LWD technology that reduces the need for traditional chemical sources. Designed around the pulsed neutron generator (PNG), EcoScope service uses technology that resulted from this collaboration. The PNG and the comprehensive suite of measurements in a single collar are key components of the EcoScope service that deliver game-changing LWD technology.

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