Service Images Formations in High Definition in OBM

Photorealistic reservoir geology service operates at frequencies three orders of magnitude higher than conventional imaging technology.

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A ctivity in the complex formations of unconventional plays and deepwater fields requires high-resolution geological data to provide operators with full understanding and confidence in accurately and reliably estimating reserves, optimizing recovery and placing subsequent development wells.

However, today’s E&P challenges are not well met by traditional data-acquisition methods. For example, the gold standard of whole-core retrieval for laboratory characterization when it is most needed, leaving a high degree of uncertainty in reservoir modeling and field development planning.

Borehole imaging provides a high-quality virtual replacement for core. Although continuous high-definition imaging is well established for wells drilled with water-based mud, most deepwater wells and many unconventional wells are drilled with high-performance oil-base mud (OBM). Previous adaptation of microelectrochemical images for nonelectrically conductive OBM environments did not return high-resolution images and at limited borehole coverage.

These limitations were the driver for Schlumberger to reengineer geological imaging technology by employing new measurement physics enabled by a new electronic and mechanical tool design. The result has earned a 2015 Spotlight on New Technology award at OTC. The digital electronics of the company’s Quanta Geo photorealistic reservoir geology service operates at frequencies three orders of magnitude higher than conventional imaging technology to generate core-like representations of reservoir geology and structure.

The innovative sonde design of Quanta Geo service provides nearly total circumferential coverage in 8-in. boreholes and also makes it the industry’s first imaging tool that can acquire borehole images while running into the wellbore. Downlogging capability improves image quality by reducing stick-slip motion, in turn reducing the potential for having to conduct multiple runs and the likelihood of sticking. The combination of eight fully independent arms and swivel-jointed pads maintains good application in changing wellbore profiles to deliver high-resolution geologic images in highly deviated and horizontal wells; rugged boreholes and washouts; shale, carbonate and clastic plays; and HP/HT environments. Even in highly laminated formations with extreme resistivity contrasts and OBM that can be up to 100,000 times more electrically resistive than the formation, Quanta Geo service provides high-resolution images that accurately represent formation geology.

Designed with 192 microelectrodes mounted across eight pads, the advanced digital electronics of Quanta Geo service acquire more than 46,000 signals per second, enabling logging speeds ranging from 549 m/hr to 1,097 m/hr (1,800 ft/hr to 3,600 ft/hr). This broad, high-resolution measurement capability is interfaced with customized workflows and apps in Schlumberger’s Techlog wellbore software platform to power visualization and interpretation ranging from 3-D structural interpretation of the near-wellbore region to characterization of discrete fracture networks and sedimentological description to identify and orient reservoir architectural elements. These geologic answers extracted from the images are ready for direct use in the company’s Petrel E&P software platform, enabling operators to reliably model interwell space within complex reservoirs.

Following a successful field test in August 2013, Quanta Geo photorealistic reservoir geology service was commercialized in January 2014 and officially launched in August 2014 at the annual Offshore Northern Seas Conference in Stavanger. Quanta Geo service has been successfully deployed in more than 100 onshore and offshore wells in the Gulf of Mexico (GoM), West Africa, North Sea, Australia, Southeast Asia and North America. It has generated high-resolution 3-D images in OBM with ratios as low as 60:40 and as high as 90:10 in carbonate, shale and deepwater formations.

Imaging in the deepwater GoM

A GoM operator used Quanta Geo photorealistic reservoir geology service to obtain high-resolution images and structural and sedimentary data for clastic deposits in an OBM-drilled well that accessed a deepwater slope system. The images were used to accurately identify reservoir facies and determine the paleotransport direction of the turbidite reservoir sands. An additional challenge was the use of a 9-in. drillbit, which resulted in a larger hole than the conventional 8-in. size used for imaging. To account for the 80% circumferential coverage in the larger hole size, multipoint statistics processing was applied in the Techlog wellbore software platform to eliminate any gaps between the pads and ensure a realistic, full-borehole image.

Images were obtained in both uplogging and downlogging passes, with better quality for the downlog pass owing to reduced sticking. An initial interpretation significantly reduced uncertainty in identifying the sand body structures and confirmed the operator’s predrill model. Quanta Geo service clearly imaged unconformities and faults as well as natural fractures and multiple drilling-induced fractures on the northeast and southwest sides of the wellbore indicating the maximum horizontal stress orientation. The images accurately identified net reservoir sand and depositional trends. For example, a sequence of thin-bedded sheet sands was imaged in such detail that it was possible to identify and directly measure orientation of imbricated shale clasts and ripples indicative of the paleotransport direction. Also identified were slump sands, which are characterized by abrupt changes in dip and other features that would not have been visible using conventional OBM-adapted imaging technology. Slumped sands must be carefully considered as they might not be laterally continuous with the main sand target. The detailed imaging provided by Quanta Geo service enabled more accurate and confident decision making, reducing cost and risk for the operator.

For more information on Quanta Geo photorealistic reservoir geology service, visit Schlumberger at booth 4541.