Suite of LWD Services Enables Full Characterization of Reservoir in South China Sea

Imaging while drilling and petrotechnical interpretation help CNOOC maximize oil production from coral reef reservoir

**CHALLENGE**
Place production wells in target layer of highly heterogeneous coral reef reservoir and acquire reservoir characterization data needed to optimize overall development plan and maximize oil production.

**SOLUTION**
Use a robust suite of LWD services for formation evaluation and imaging while drilling to provide real-time data for geosteering and evaluation by Schlumberger petrotechnical experts.

**RESULTS**
- Acquired measurements needed to place wells within target reservoir layer, optimize overall development plan, and maximize oil production.
- Enabled Schlumberger petrotechnical experts to identify all fractures and fully characterize heterogeneity of reservoir.

"We obtained in-depth understanding of fracture distribution and secondary porosity distribution. More importantly, the result helped clarify the controlling factors on productivity, which is very significant to future dynamic reservoir management."

Luo Donghong
CNOOC

**Acquire data for well placement and reservoir characterization**
The China National Offshore Oil Corporation (CNOOC) planned to drill two pilot wells and eight horizontal production wells targeting the second of four oil layers in a coral reef reservoir in the LHX-1 oil field, located in the central uplift of the Pearl River Mouth basin in the South China Sea. Placement of the horizontal wells near the top of the target layer would be challenging because appraisal data from two exploration wells that had been drilled in the highly heterogeneous carbonate reservoir was limited and did not resolve uncertainty about lateral and vertical thickness variation.

It would be a challenge to get the reservoir characterization data CNOOC needed to optimize its overall development plan and maximize oil production. Adequate geological and petrophysical data had to be obtained before the borehole deteriorated and high-quality log data had to be acquired before any alteration occurred around the borehole in the wells’ reservoir sections.

Fracture classification was based on resistivity images from geoVISION service, which were also used to evaluate secondary porosity, both qualitatively and quantitatively.
Use advanced LWD technology to achieve objectives
Advanced Schlumberger LWD technology and a multidisciplinary team of petrotechnical experts helped CNOOC achieve both its well placement and reservoir characterization objectives. The suite of technology used included geoVISION* imaging-while-drilling and adnVISION* azimuthal density neutron services, and in one of the horizontal wells, arcVISION* array resistivity compensated service.

This suite of LWD services acquired lateral resistivity images, azimuthal density data, and neutron-porosity logs while drilling—before the borehole could deteriorate. They also enabled real-time geosteering to place the wells near the top of the targeted reservoir layer, despite limited offset well information.

Schlumberger petrotechnical experts identified all fractures from resistivity image logs and integrated the LWD data with core analysis data and fracture-characterization information to provide a structural map of the field. In addition, multidisciplinary teams of experts built a planar fracture-distribution map for further qualitative study and analysis of secondary porosity spectra, dynamic resistivity images, and core data. Fracture quantity was found to have a linear relationship with productivity, and secondary porosity was also found to be a key factor controlling productivity.

Maximize oil production by placing wells within target reservoir
The advanced logging BHA provided the accurate measurements CNOOC needed to place the wells within the target reservoir layer, optimize its overall development plan, and maximize oil production. Resistivity images from geoVISION service enabled Schlumberger petrotechnical experts to identify all fractures and fully characterize the heterogeneity of the coral reef reservoir in terms of fracture evaluation, secondary porosity characterization, and analysis of factors controlling productivity. Based on the success of this operation, CNOOC decided to use geoVISION and adnVISION services in drilling two adjustment horizontal wells in a similar coral reef reservoir in the South China Sea.

Contact your local Schlumberger representative to learn more.

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