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WATS Survey Optimization in Angola for Subsalt Appraisal and Development Planning

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SUMMARY

Block 31 is located in water depths ranging from 1200-2500 meters, approximately 150 km offshore Angola. BP is operator on behalf of the Block 31 license group. Reservoirs comprise Miocene and Oligocene sediments, deposited in erosional channel complexes. Typical traps are associated with uplifted channels on the crests and flanks of salt-cored ridges. The structural evolution is driven by salt-induced tectonics with approximately 60% of the block covered by allochthonous salt.

Exploration efforts have resulted in 18 discoveries in Block 31 (including 5 subsalt discoveries) with success driven by conventional deep-tow, narrow-azimuth seismic acquisition methods using the latest migration algorithms. Limitations are clearly apparent and these datasets are considered insufficient for appraisal and development.

Deepwater Angola has historically been associated with some of the highest quality seismic imaging in the industry. Post-exploration projects have benefited from the use of shallow-tow, narrow-azimuth acquisition methods. These high resolution datasets have become the standard acquisition approach for field development in primarily extra-salt environments. Although appropriate for some of the discoveries in the open basins of Block 31, offshore Angola, narrow-azimuth methods are not adequate for developing the subsalt discoveries in the western area of the block.

In 2005 BP conducted a successful field trial using a wide-azimuth, towed-streamer (WATS) acquisition geometry in the Gulf of Mexico. The survey design was developed using 3D acoustic finite-difference modeling. Extensive modeling, later confirmed by field trial results, indicated that imaging from a WATS survey acquisition would be significantly better than that from conventional narrow-azimuth acquisition.

Key areas in Block 31 were modeled using the same 3D acoustic finite-difference methods to assess the benefits and optimal design of a WATS survey aimed at improving subsalt imaging in deepwater Angola. Modeling was designed to address both the different salt geometries and reservoir architectures in Block 31 compared to the Gulf of Mexico. Modeling results predict that WATS acquisition will result in significant subsalt imaging improvements of a level similar to that seen in the Gulf of Mexico. Modeling also tested key WATS acquisition parameters to optimize both the quality of the data and the associated costs.

We will discuss and illustrate in this paper how 3D acoustic finite-difference modeling was vital in establishing technical support, business justification and acquisition parameter optimization for WATS data in Block 31. We will also discuss optimization of the WATS fast-track velocity model and show early products from the actual dataset acquired in 2009 which is the first WATS survey outside of the Gulf of Mexico and the first in Angola.