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"Caribbean Exploration – Planning for the Future"

ABSTRACT

TUTORIAL: IMAGING THROUGH SHALLOW GAS, DIVING WAVE REFRACTION TOMOGRAPHY FOR OFFSHORE TRINIDAD

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The effects of shallow gas, multiple reflections, and severe velocity variations on the seismic signal pose a difficult challenge for the geophysicist working the oil and gas fields surrounding Trinidad. In 2004, BP and WesternGeco formed a joint technical project team and selected a 3-D survey in the Columbus basin as a pilot project to evaluate new technology to improve the seismic image quality of streamer data.

Our project team found that poor quality imaging over this area is substantially improved (Figure 1) by an integrated workflow including: multiple removal, Diving Wave Refraction Tomography (DWT), and reflection tomography (Tanis et al., 2006). A key component of this work is the use of DWT with first arrival times rather than reflection tomography to build the shallow velocity model for depth migration.

Refraction tomographic inversion of first arrival times is an iterative process. It includes initial velocity model building, travel time calculation, and minimization of the difference between calculated and observed travel time by updating the velocity model (Bishop et al., 1985). It is important to have automatic and reliable picks to run the inversion. Our automatic picking is based on onset of energy to avoid unwarranted phase-related changes in pick times over a large offset range. We used several attribute displays, overlays of first arrival time picks on seismic shot and common-offset gathers, and maps of sail-line pick times and total-survey common-offset pick times to assure the quality of pick times.

Pre-stack depth migration highlighted the benefits of using the DWT velocity model. This work shows that DWT is a robust technique that produces beneficial near-surface models in the presence of gas and in areas with low signal-to-noise ratio reflection data. Fundamentally, because DWT resolves rapidly varying velocities and velocity anomalies in

the shallow section better than reflection tomography, it provides a good starting model for reflection tomography.

References

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Tanis, M.C., Askim, O.J., Lancaster, S., Ward, G., Gainski, M., Nagassar, V., Shih, C.C., Canales, L., 2006, An integrated workflow for imaging below shallow gas: A Trinidad case study, 76th Ann. Internat. Mtg., Soc. of Expl. Geophys., Expanded Abstracts, 3051-3055.

PSTM vs PrSDM with Diving-wave model

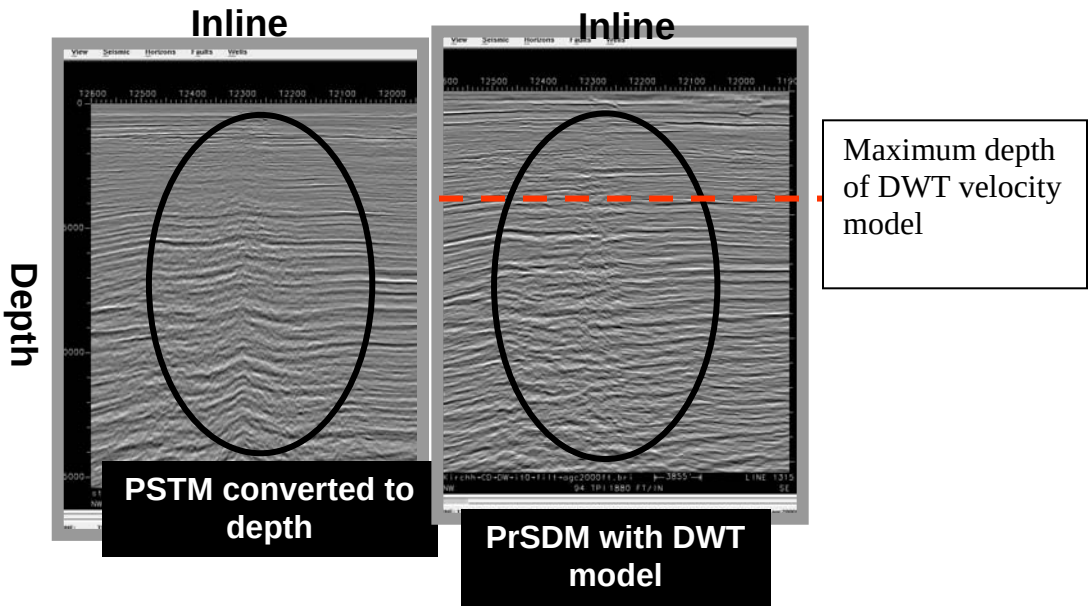

Figure1: Significantly improved image and event continuity (courtesy of BP)

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