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Layer-based inter-bed multiple prediction: less interpretation, more geophysics

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ABSTRACT

Seismic interpretation for pre-rift and syn-rift sequences (Miocene and pre-Miocene) in the Gulf of Suez is affected by prominent inter-bed multiples generated at the thick Miocene evaporite and shale sequences. These multiples often have minimal velocity differentiation from primaries, and conventional de-multiple methods have limited success.

Extended interbed multiple prediction algorithm is an extension of surface multiple prediction that is data-driven with minimum a-priori information. It is able to handle any acquisition geometry and can predict multiples at true azimuth. The multiples once modelled can be removed using adaptive subtraction, similar to ones used for surface multiple prediction. When used in combination with other surface multiple prediction processes, it can result in better representation of primary energy (Wu et al, 2011) In previously described methods (El-Emam, et al, 2011), multiple generating horizons interpreted on pre-stack migrated stack data have been used to predict corresponding models. These models are sensitive to the quality of interpretation. In this presentation we discuss the use of layer-based interbed multiple prediction, which does not require picking of horizons. Instead, it requires definition of multiple generator zones. Well data is analyzed to estimate major multiple generators using ray-tracing. This approach reduces dependency on errors from interpretation on pre- migration stack data. Attenuation of multiples is by adaptive subtraction of models, separately or simultaneously, and well ties provide means to evaluate the results.

The results presented show samples from a marine 3D streamer survey in Gulf of Suez. The zone based interbed multiple prediction performs well, internal multiples in target sections have been attenuated based on well ties on pre- stack time migrated data. Any bias from interpretation affecting multiple modeling is reduced. As the zones of multiple generators can be confirmed by ray-tracing experiment, it can be used with confidence over survey area with existing well data.
The interbed multiple prediction is computationally intensive, but the cleaner image after multiple attenuation provides substantially better data to drive the tomographic velocity modeling loop for subsequent pre-stack depth imaging. The resulting improved image of the complex sub-salt targets should in turn improve the interpretability and reduce the risks associated with target identification and drilling.