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DEPTH IMAGING USING FTG GRAVITY AND PRE-STACK SEISMIC DEPTH MIGRATION: CASE STUDIES FROM THE DEEPWATER GULF OF MEXICO

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In the deepwater Gulf of Mexico (DWGOM), allochthonous salt bodies obscure seismic imaging of deeper geologic features. Gravity and full tensor gradient (FTG) data, which respond to the significant density contrasts associated with the salt bodies, are highly useful when integrated into the pre-stack depth migration (PrSDM) imaging workflow for sub-salt targets.

FTG data contribute to a detailed model of the edges, shapes, and approximate depth to dominate mass anomalies shallower than 6000m. We use available well control, 3-D and 2-D seismic derived surfaces, seismic velocities, and regional gravity and magnetic data to construct a complex, constrained, 3-dimensional prospect-oriented geologic model. The model is modified at each stage during PrSDM, providing the seismic interpreter with a more accurate velocity model for the next stage of imaging.

Our successful integration of FTG data into the PrSDM has been a result of the following keys to quality:
1. The regional gravity gradient is model-constrained, rather than mathematically filtered. Aeromagnetics is used as an additional constraint for regional control. 2. Regional 2D gravity data and seismic horizons are used to build and constrain the density model beyond the prospect volume. 3. We invest additional time and expense to build an FTG-constrained, detailed, sediment velocity/density cube only

when earlier models are deemed inadequate, and only after the longer-wavelength anomalies in the 2D gravity data have been honored. 4. Multiple iterations of the 3D prospect density model provide "fit for purpose" models at each stage of the velocity model building process. This enables the FTG data to have a direct impact on the quality and the cycle time of the velocity modeling, thus supporting superior depth imaging.

Our case studies in DWGOM demonstrate significant contributions of FTG data to PrSDM, and it is now routinely used for all PrSDM projects in DWGOM. Examples include identification of recumbent salt overhangs, location of steeply dipping salt/sediment interfaces, definition of lateral contacts between salt and a high velocity shale mass, and improved imaging of top and base salt reflectors. Many of these model improvements would not have been defined without the superior resolution of FTG data.