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Improved Imaging of a Fold and Thrust Belt Regime, Onshore Trinidad, by Means of the Common Reflection Surface (CRS) Method

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Abstract

Petrotrin's North West District, onshore southwest Trinidad, is characterised by a Miocene fold and thrust belt regime. This was later overprinted by Plio/Pleistocene strike slip faulting to form a complex structure that complicates the seismic imaging. Additionally, the surface of this survey is predominantly covered by a deep weathered layer, swamps and vegetation. Due to these settings, strong ground roll and abnormal amplitudes exist. Weak primary reflections are mostly masked by strong noisy events, making it very difficult to enhance the S/N ratio using conventional methods. Additionally, the complicated near surface conditions lead to serious static problems. All these problems make it very difficult to pick accurately the correct stacking and migration velocities. Several reprocessing attempts have been carried out by other contractors without providing satisfying results in the geologically complex areas. This paper describes the application of a CRS workflow to enhance the overall image in such an area.

A first step was the refinement of the existing refraction statics solution. It was found that the existing first breaks could be improved using an iterative approach between model calculation and application. A minimization of the error led to an improvement of the refraction static solution. Another key step was the CRS stacking velocity analysis to create an improved and reliable stacking velocity field. For that purpose, preliminary CRS gathers were calculated and inputted into another iteration of stacking velocity analysis. Thus, the velocity analysis could benefit from the improved S/N ratio of the CRS gathers leading to a much more reliable stacking velocity field. This model was then used as input for another iteration of residual statics calculation which improved the image even further. With these improved stacking velocities and statics solutions a standard CRS processing was carried out providing CRS gathers with significantly improved S/N ratio. Additionally, the bin size was reduced from 25x25 m to 12.5x12.5 m to further increase the spatial resolution and which also led to better imaging of the steeply dipping events near the surface.

The final CRS gathers were used as input to a Kirchhoff PreSTM and the improved S/N ratio was transferred into the prestack migrated domain. Again, the migration velocity analysis benefited from the improved S/N ratio of the CRS gathers leading to a more reliable velocity volume. The final PSTM showed a general improvement of the data quality both for the shallower sediments and the complex subsurface structure in the centre of the survey. The structural image could be highly improved and the continuity of reflectors could be increased. The bin size reduction led to a higher resolution of present fault systems and steeply dipping layers.