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From Interpretation to Modeling: The application of Sequence Stratigraphy and Genetic Inversion in the Columbus Basin

Gabriella Kokaram[1], Arnulfo Briceno[2], Luis Roncero[1], and Jean Gérard[3]

[1]*Respsol, TTBU*
[2]*Repsol, Houston*
[3]*Repsol Geological Specialist Group*

Abstract

A combination and integration of techniques is needed to reduce the level of uncertainty when building a 3D geological model as geoscientists are required to predict detailed reservoir characteristics below the resolution of exploration tools and often with limited data to constrain the model. The field of interest is located in the Columbus Basin. Reservoir sands were identified within multiple stacked Lower Pleistocene shelf-edge delta and slope reservoirs. Despite the limited data (only two wells drilled and a PSTM seismic volume acquired in 1995), an integrated approach provided a better understanding of reservoir variability and prediction in both the hanging wall and footwall blocks.

Sequence stratigraphy at the interpretation stage was used to predict reservoir distribution and the behaviour of the field, which lies along the shelf to slope transition. Firstly, flooding surfaces, sequence boundaries, progradational and retrogradational sequences were identified in the wells. Secondly, surfaces and sequences were tied and compared to seismic data; this provided a direct calibration of the clinoforms away from the wells along the shelf margin. Finally, special seismic attribute processing (genetic inversion) was used at the modeling stage to predict porosity and the volume of clay (VCL). The genetic inversion technique in Petrel uses multi-layer neural networks combined with a genetic algorithm to produce geologically sound seismic inversion. This technique relies on well logs and seismic amplitude as training data, while constraining the convergence closer to a global minimum error. This is a major breakthrough in comparison to traditional techniques. Results from this method fit well with the geological model, outcrop studies and gross depositional environment maps. The combination of both traditional and new techniques has supported the building of static and dynamic models and the elaborating of the field development plan for this field.