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Geological Process Modeling Software for Improved Reservoir Prediction

Software provides deterministic modeling of complex heterogeneous geological settings.

CONTRIBUTED BY SCHLUMBERGER

The oil and gas industry is continuously pushing for advancements in subsurface modeling and analysis tools to be able to make better predictions of where to drill. There is also a drive to improve conceptual geological models that lead to the enhanced reservoir simulation models.

To this end, Schlumberger developed the geological process modeling software, a simulator for stratigraphic forward modeling that reconstructs the processes of erosion, transport and deposition of clastic sediments as well as carbonate growth and redistribution. The models show the geometry and composition of the stratigraphic sequences attributable to the interaction of sea level change, paleogeography, paleoclimate, tectonics and variation in sediment supply.

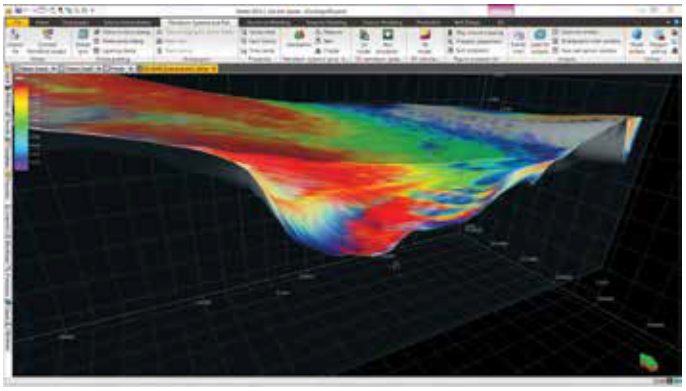
Based on a geological process-oriented methodology, the new modeling software provides deterministic modeling of complex heterogeneous geological settings such as the resulting bedding structure from multiple sediment sources and the dual porosities stemming from multiple diagenetic processes over geological time in carbonates. Geological process modeling creates realistic models with geological elements correctly positioned with respect to other elements in the deterministic model. The models can capture details such as shale baffles that conventional models cannot.

The new software can be used with other Schlumberger tools such as the PetroMod petroleum system modeling software for basin-scale studies to provide details for particular layers or sequences. Tight integration of this software with the Petrel E&P software platform also enables true cross-domain collaboration and workflow standardization.

Application offshore Australia

For example, the software was applied to a shoreline dataset from the Gippsland Basin offshore Australia. The interval of interest corresponds to the top of the Eocene Cobia Subgroup in the Latrobe Group and is composed of fluvial to shallow marine deposits arranged in cycles within a transgressive stacking pattern.

Published well data correlations suggest that high-frequency, relatively low-amplitude sea level changes occurred during the deposition of this sequence. The combination of these high-frequency sea level fluctuations and the lower frequency transgression controlled the erosion and the deposition further downslope of the coarse shore sands that constitute the best reservoir potential in the overall sequence. The complex interactions between subsidence, eustatic cycles and sediment supply determine whether a transgressional shoreface will be physically present to form a successful reservoir.



The model produced by the geological process modeling software highlights the noncontinuity of the prograding upper shoreface sands. (Image courtesy of Schlumberger)

The software enabled the quantification of the sedimentary processes, thereby providing a deeper understanding of the reservoir architecture. Specifically, the software identified the locations of high erosion, indicating places where no reservoir could be present as well as where a reservoir could be found further down the slope. The resulting model agreed with the evidence obtained from well correlations and facies interpretation.

The best case model was selected and then translated into sediment proportion maps that were subsequently used to guide and constrain the geostatistical facies model directly within the Petrel E&P software platform. By guiding the geostatistical facies modeling, the geostatistical numerical algorithms were tied to a true physical and numerical model honoring physical principles. The reservoir model consequently honors geological trends from sedimentary processes, with added confidence based on the understanding of the conceptual geology and how it is being used numerically in the model building.

Finally, the software enabled the conceptual geological model to be the base of the reservoir model in a digital format directly inside the Petrel project, thereby ensuring both workflow continuity and confidence in the results.

The software is available from June 2017 along with the Petrel E&P software platform from the Petrel 2017.1 release. For more information about the new software, visit Schlumberger booth 930. ■