Forward Stratigraphic Modeling applied to Brazilian East Margin Reservoir Characterization

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ABSTRACT: Heterogeneity pattern identification is a crucial phase for reservoir characterization workflows, as it has significant impact on hydrocarbon volume calculation and hydrodynamic behavior understanding, and therefore on field development planning. As the industry faces new challenges related to reservoir characterization, it is clear the necessity to invest on new technologies with empowered prediction capabilities. The classical geostatistical methods have demonstrated to be very robust, however given the industry trend to more complex or detailed scenarios these methods may not be enough.
In this sense, the idea of using geological process modeling methods, built around a series of physical equations is presented as an alternative or, even better, an add-on to the classical geostatistical methods.
These methods, commonly known as Forward Stratigraphic Modeling, can represent a great step for the oil industry, not only for reservoir modeling, but also as a support tool for exploration plans by predicting sediment accumulation beyond reservoir scale.
Forward Stratigraphic Modeling is based on the principles of mass and energy conservation in order to simulate physical and chemical processes responsible for the filling of sedimentary basins (for example deposition, transport, erosion, carbonate factory). The result is determined by combination of different processes such as diffusion, flow-based sediment movement (episodic or constant) and carbonate growth, all of which are influenced by relative base-level changes, wave energy, and more. The output of this workflow is a 3D model, where its several layers represent pre-determined iso-chronostratigraphic events.
Additionally and playing through the evolution of the model it is also possible to check global and specific sediment/facies proportions, quantify reworked sediments such as microbialite grainstones, unconformities, depositional window depth and sediment residence time in each diagenetic zone.
All these results can be used as inputs or drivers for classic geostatistical models targeting reservoir characterization and numerical simulations, including but not limited to: probabilistic analysis, training images for multipoint statistics methodologies and conversion to seismic cubes for analysis of possible seismic flexions.
One of the greatest advantages of using this methodology is the preservation of stratigraphic and sedimentological relationships. Being able to reproduce physically feasible sedimentary body geometries and internal architectures.
Also to understand facies distribution on carbonate platforms, carbonate growth rate and other valuable characteristics for a better understanding of the reservoir behavior.
The present work shows the application of Forward Stratigraphic Modeling methodology on a Brazilian East margin carbonate reservoir and the results of the combination with classical geostatistical methods, lesson learned, and actions for further development and understanding of the technology involved.

KEY-WORDS: FORWARD STRATIGRAPHIC MODELING, GEOLOGICAL PROCESS MODELING, RESERVOIR CHARACTERIZATION.