An Integrated Reservoir Modeling Workflow for Proglacial Outwash Channels

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Abstract

Objectives/Scope: Pro-glacial outwash fans exhibit a distinct morphology and sequence amongst channelized systems, where the extended narrow channels erode the underlying shale interval depositing in the open ocean. The proposed workflow introduces a combined deterministic and stochastic approach to build the stratigraphic and structural framework using geometrical and facies modeling techniques in accordance to the data availability and quality.

Methods, Procedures, Process: The modeling method integrates the seismic interpretations of the top and base horizons of the channel facies with digitized discrete facies logs interpreted from core data to construct the stratigraphic and structural framework. Next, the regional channel polygons of the area of interest can be utilized to produce a first geometric model to separate the channels from the background shale facies. A second geometric model can be introduced by segmenting the channel facies into its respective members (ie. Tight, Moderately Porous, Porous, etc...) through isochore modeling. Finally, by combining both geometric models, a full horizon model that honors the channel facies, its corresponding members and the eroded shale is constructed.

Results, Observations, Conclusions: After following the outlined workflow, the facies logs were added to the geometric model to run Indicator Simulation, producing a facies model. The facies were propagated in accordance to the penetrated channel width, and honored at the available data sets including well locations, pay polygons, and channel boundaries. This was achieved after the identification of the distinctive channel facies from core data and seismic horizon calibration with the model. Some discrepancies were observed in the thinner facies within the unpenetrated channel locations. This observation was accounted for through variogram analyses and 3D seismic maps as trend surfaces.

Novel/Additive Information: The workflow provided a practical and time-efficient approach to produce a data-driven, complex conventional-unconventional proglacial reservoir model. By the integration of core and seismic facies, log analyses, and production data coupled with the applied methodology, robust models of channelized environments can be delivered. Combining the deterministic geometrical models with the stochastic influence of variograms and 3D seismic trend maps, a full horizon model was built. With sufficient production data, this horizon model can develop into a full-field 3D geomodel of a channelized conventional or unconventional reservoir.