Sequence Stratigraphic Analysis Driven by the Relative Geological Time Modelling Method: An Innovative Application to a Siliciclastic Analogue Model Compared with Real Seismic Datasets

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Abstract

The characterization of a sedimentary basin requires to build a correlation framework. Acquiring seismic data thus aims at imaging the depositional trends of the basin, and interpreting the data means building a sequence stratigraphic framework to understand the structures and facies distribution. The author shows the results and perspectives of an automation-assisted and amplitude-driven approach for global seismic interpretation. The output Relative Geological Time 'RGT' model (Pauget et al, 2009) is used to emphasize regional to reservoir scale stratigraphic features, and can be ultimately converted into 'simulation ready' models.

The presented workflow is here applied to synthetic 3D seismic datasets generated from the 'XES02' analogue model ('eXperimental Earthscape Basin' facility, National Center for Earth-Surface Dynamics at the University of Minnesota). Experiments conducted in this large-scale sand-box express the effects of user-designed scenarios for sea-level changes, subsidence, and sediment supply on depositional systems architectures. High-resolution photographs of dip-direction cross-sections are upscaled to real-world dimensions, converted into elastic properties, combined into 3D elastic models, then used to generate the synthetic 3D seismic datasets at various resolution scales (datasets courtesy of SeisMomentum Limited). The author performs the global RGT modelling approach to investigate the impact of seismic resolution on sequence stratigraphic analysis by combining RGT- derived attributes (stratigraphic and structural gradients), real time 3D Wheeler transformed seismic sections, sub-sample stratal slicing, seismic expression emphasis methods such as spectral decomposition, and seismic facies discrimination through waveform classification. Results are compared to real seismic datasets from Taranaki Basin (rifting basin, offshore New-Zealand, datasets courtesy of New Zealand Government) and Neuquén Basin (back-arc basin, onshore Argentina, dataset courtesy of YPF), both featuring a progradational sequence with a deepwater depositional system, but with significantly different sedimentation rate and dimension.

A final phase of voxel-based stratigraphic model conversion into a vector space stratigraphic grid connects the input seismic samples with the output static models in real time, and offers new perspectives in the integration of analogue models and real world basin seismic data for subsurface modelling and georesource potential evaluation.

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