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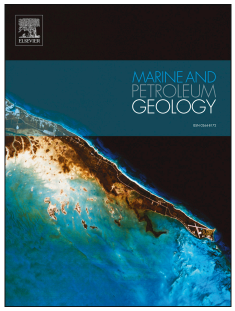

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Fused spectral-decomposition seismic attributes and forward seismic modelling to predict sand bodies in meandering fluvial reservoirs

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Abstract

Understanding the hierarchical architectural elements of fluvial sand bodies is important for planning their development strategy and to enhance oil recovery. Red-Green-Blue (RGB) blending of multiple seismic attributes and forwarding seismic modelling are commonly used in the analysis of compound sand bodies. However, RGB blending of multiple seismic attributes can only qualitatively describe the boundaries and thickness of sand bodies. The forward seismic modelling techniques previously documented in the literature are not effective when depicting the geometry of, and stacking relationships between, sand bodies (i.e., reservoir compartmentalisation). Hence, we propose in this work a new workflow that combines fused spectral-decomposition seismic attributes (SDSAs) and forwarding seismic modelling to quantitatively predict sand thickness, and to characterise stacking relationships between sand bodies. First, we employ a Support Vector Machine (SVM) algorithm to fuse high, middle, and low frequency components (attributes) of seismic data so as to quantitatively predict the thickness of sand bodies. Second, we define the seismic waveform response patterns corresponding to the typical conceptual stacked sand bodies. With the constraints of waveform patterns and predicted sand thickness (fused SDSAs), the geometry and stacking relationships of the sand bodies are characterised by forward seismic modelling. To illustrate the effectiveness of our proposed workflow, we apply it to the Neogene Minghuazhen Formation (Nm) of the QHD 32-6 oil field, Bohai Bay Basin, China. We define five architectural elements of a meandering fluvial reservoir by analysing the hierarchy of sand bodies using our workflow. The predicted sand bodies in this workflow were further proven by horizontal drilling and production data.

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