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Fluvio-deltaic facies interpretation using 3D-seismic attributes analysis and unsupervised machine-learning algorithm: strategy to reduce geothermal exploration risk in the North German Basin

L. Bello[1], H. von Hartmann[2], M. Franz[1], I. Moeck[1,2]

[1]University of Göttingen, Geoscience Center - GZG, Göttingen, Germany, [2]Leibniz Institute for Applied Geophysics, Hannover, Germany

The application of machine learning algorithms for reservoir characterization and prospect identification in seismic data is becoming standard practice in the exploration industry. This technique has proven useful in identifying patterns in the data that might be overlooked by the interpreter. In addition, it improves reservoir predictions and characterization at a lower computational cost.

In this study, we evaluate the fluvio-deltaic facies of the Upper Triassic Exter formation in the North German Basin. We apply a workflow consisting of three main stages: 3D-Seismic Interpretation; seismic attributes analysis for the identification and delineation of the fluvio-deltaic system; and clustering of the fluvio-deltaic facies.

For seismic facies clustering we apply an unsupervised machine learning algorithm based on waveform segmentation of seismic amplitude data. Furthermore, to evaluate the evolution of deltaic complexes, we implemented the stratal slicing technique through the resulting waveform segmentation and the generated attributes volumes.

Results allow understanding and delineation of a number of fluvial architectural elements in the study area, i.e. lateral shifting of individual channels contributing to the formation of channel belt reservoirs within the Rhaetian Deltaic System.

These results contribute significantly to reducing the risk of geothermal exploration in the North German Basin by proposing for the first time a way to improve the prediction of Rhaetian reservoirs on a local scale based on seismic methods.