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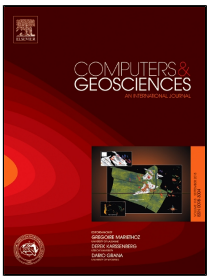

Geochemical property modelling of a potential shale reservoir in the Canning Basin (Western Australia), using Artificial Neural Networks and Geostatistical tools

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Geochemical property modelling of a potential shale reservoir in the Canning Basin (Western Australia), using Artificial Neural Networks and Geostatistical tools

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Abstract

In underexplored sedimentary basins, understanding of the geochemical property distribution is paramount to a successful exploration campaign. This is traditionally obtained through the routine laboratory pyrolysis experiments. Compared to Machine Learning approaches, bulk geochemical analysis is relatively more time consuming, more expensive and generally provides property distribution in a lower resolution. This study has used the Artificial Neural Networks approach to predict continuous geochemical logs in wells with no or limited geochemical information. The neural network was trained with the Levenberg-Marquardt training algorithm, based on the established relationships between the typical well logs with laboratory measured geochemical data. A total of 96 data points from the Goldwyer shale of the Canning Basin, WA were used to train the network, with an accuracy of greater than 75% R^2 values for the training, test and validation data in all models. The predicted, continuous geochemical logs have a good agreement with the laboratory measured geochemical data, particularly the TOC and S2 logs. Subsequently, these optimized geochemical logs are used as the input into a petrophysical property model to predict the organic matter distribution across the Broome Platform of the Canning Basin. This revealed the potential geochemical sweet spots, with higher free oil yield (S1), source rock potential (S2) and organic content (TOC) towards the north-western part of the sub-basin. The kerogen type distribution, on the other hand shows that in the south-eastern part of the sub basin, the shales yield Type II to Type III kerogen type, while they are predominantly Type III in the north-western part of the study area.

Keywords

Canning Basin; petrophysical well logs; artificial neural networks; 3D geochemical property modelling.

Lukman Johnson: Study conception, design, data analysis and interpretation, manuscript writing.

Reza Rezaee: Provided significant advice in the study, contributed to the manuscript writing and editing and revision.

Ali Kadkhodaie: Provided advise on data analysis and clean up, study conception and valuable experience in using both computer software (for the neural networks and 3D models).

Gregory Smith: Provided advise on data analysis, and valuable experience in the 3D models and interpretation.

Hongyan Yu: Provided general advice on data analysis and clean up, manuscript design and critical revision.