Applications of 1D Electro-Facies Modeling

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Summary

The McMurray Formation in the Athabasca basin varies from a fluvio-estuarine to a shoreface shelf deposit with areas of marine and tide-dominated influence. Prior to geomodeling, a 1D electrofacies model was developed using core description and co-located well logs, and subsequently applied to all well logs in the field area. The electrofacies represent a link to the depositional description and reservoir quality, and are useful 1D characterizations of heterogeneity for conditioning the geostatistical models.

Detailed core facies descriptions provide the training data for discriminant analysis and are used as an interpretive guide for mode mapping. Initially, a non-supervised method with rules was used to clean core facies inputs, followed by a non-parametric supervised method to probabilistically assign facies to logs such as gamma ray, neutron, density and effective porosity.

Discriminant methods assume input data accuracy, although the data types are imperfect due to facies interpretation, depth shifts, and measurement scale differences between logs and cores. To screen and compare models, direct and cross validations are useful to check the prediction of the input training data. The 1D model results are checked to ensure a consistent reproduction of input facies proportions after assignment to all the logs. Assignment probabilities are initially equi-probable and are adjusted to weigh facies toward high or low proportions. The electrofacies models are non-unique and require visual checking. Critical interpretive assessment of the electrofacies results by the geologist is an important step. The result ensures the electro-facies model supplies a distinctly useful facies heterogeneity and associated petrophysical model.

The subsurface team uses electrofacies for seismic attribute studies, core analysis, 3D geological modeling, and engineering rock types accounting for capillarity and saturation endpoints. An effective 1D facies model can enhance the results of the broad subsurface effort. These classification techniques can be generally applied to many geological settings.

References

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