The Jeanne d'Arc Basin Offshore Canada: Testing the Predictive Capacity of PhaseKinetic Models Using 3-D Basin Modeling

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Kinetic models of petroleum generation have become the standard tool for the prediction of hydrocarbon distribution and properties using basin modeling. Such models rely on laboratory analysis of hydrocarbon generation and extrapolation of the reactions characterized to geologic heating rates. Bulk kinetic models describe the primary generation of hydrocarbons using open-system pyrolysis, whereas compositional kinetic models capable of predicting composition, gas vs. oil proportions etc. require either multiple open or closed system pyrolysis experiments.

The compositional kinetic models developed at GFZ, termed PhaseKinetics, are based on a combination of bulk kinetics and closed system pyrolysis experiments to describe the compositional evolution of generated fluids as a function of increasing maturity. Due to the compositional resolution used, which is based on that of PVT data formats, the prediction of petroleum phase properties is possible. Here we demonstrate for the Jeanne dArc Basin offshore eastern Canada that such compositional predictions are accurate.

In the Jeanne dArc Basin offshore Canada the Late Jurassic Ranking Formation is the main source rock and is also characterized by significant facies variability. 5 samples with petroleum type organofacies ranging from paraffinic-napthenic-aromatic sulfur-rich to paraffinic high-wax were studied in detail and compositional kinetic predictions compared to production data from over 100 well tests. In this case 3D basin modeling including the simulation of petroleum generation and migration taking hydrocarbon phase behaviour into account was performed. The basin model predictions correctly reproduced observed distribution, phase state and GORs of the known accumulations in the area and allowed a clear characterization of the principle drainage areas of the known accumulations.

The application of PhaseKinetic models in petroleum exploration via 3D basin modeling provides thus a significant step forward in enhancing our understanding of hydrocarbon generation and migration dynamics as well as reducing exploration risk.