AAPG International Conference: October 24-27, 2004; Cancun, Mexico

Using Petroleum Type Organofacies for Prediction of Hydrocarbon Phase Behaviour

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The possibility to model petroleum composition during hydrocarbon generation as well as the phase behaviour of the fluids during migration is now available in modern basin modelling software. Being able to define the bulk composition of first-formed petroleums is prerequisite, and we do this in two stages. First, we have extended the organic facies concept from one of relating kerogen abundance and composition to depositional settings to now be based on major petroleum types. This step is of paramount importance because petroleum composition directly controls the physical response of the fluid to changing pressure and temperature conditions during secondary migration. Then, model input definition is performed using a combination of laboratory pyrolysis and, where possible, tuning using natural fluid compositions. While pyrolysis methods accurately reconstruct hydrocarbon GORs they are incapable of correctly reproducing the gas composition of natural fluids. As the gas composition dominantly controls the phase behaviour of hydrocarbon liquids multi-compound compositional kinetic predictions based on pyrolysis results alone are inappropriate for the prediction of phase behaviour. We have combined open and closed system pyrolysis techniques to characterise the compositional evolution of the fluids generated as a function of increasing thermal stress. Gas compositions determined analytically are iteratively tuned to natural fluid phase behaviour and the ensuing “corrected” gas compositions used for the definition of multi-compound kinetic models. Selected studies in the Norwegian North Sea demonstrate the quality of the tuned compositional predictions for different organic facies types, with error in black oil property predictions being close to 10%(e.g. GOR or saturation pressure).