THE IMPORTANCE OF EVALUATING INITIAL KEROGEN POTENTIAL AND RESTORING KINETIC SCHEMES FROM MATURE SAMPLES, A CASE STUDY FROM KUWAIT

S.AlAli¹, A.AlKhamiss¹, S.AlEnezi¹, M.Dubille², G. Maury²

¹ Kuwait Oil company, Kuwait, ² Beicip-Franlab, France

Evaluation of initial source rock potential is usually challenging for lack of suitable samples: source rocks may be mature everywhere and/or organo-facies changes complicate extrapolations at basin scale. Consequently, although it is critical to obtain a good estimation of generated HC quantities, explorationists often use analogs and neglect this task.

We here propose good practices for kinetic schemes restorations, combining geological elements and basin modeling, thermal calibration data and pyrolysis data. A case study from Kuwait (Jurassic kerogens) is used to illustrate the methodology which consists in several steps:

1/ Detailed analysis and filtering of pyrolysis data along with SARA. Identification of different maturity trends on HI vs. Depth and HI vs. Tmax plots (preliminary evaluation of HI₀). Estimation of a "minimum TR" through amounts of free hydrocarbons.

2/ Estimation of S₂₀, HI₀, TOC₀ and checking geological and geochemical consistency of proposed HI₀, hydrocarbon mass balance, correlation with Tmax and VRo data. At this step basin modeling helps to assess absolute maturity levels.

3/ Available kinetic schemes restoration. “Missing” and “partially consumed” activation energies can be identified. Rebuilding of the full spectrum is constrained by assumptions made on HI₀ and by calculated TR. Hypotheses are validated if TR vs. VRo and HI vs. VRo trends obtained with restored kinetic schemes are consistent with observed data. Computed Tmax are also calibrated (HI vs. Tmax, TR vs. Tmax, and VRo vs. Tmax trends).

4/ Finally hypothesis on HI₀, TR, and “missing” activation energies are adjusted to a compromise explaining all observed features. The calibration is confirmed through basin modeling.

This workflow reduces uncertainties on source rocks behavior in basin models, better constraining maturity timings and volumes of generated hydrocarbons, which is invaluable for exploration of both conventional and unconventional petroleum systems. In this particular example from Kuwait, careful integration of all available data allowed a more consistent assessment of initial kerogen states (S₂₀, TOC₀, HI₀) and transformation ratios (TR). Finally the study demonstrated that the source rock potential was significantly underestimated: what was believed to be an early mature type II-III source rock was in fact a mature type II-IIS, much more prolific, which led to the reevaluation of the yet-to-find in the basin.