N010: Geochemistry and Petroleum System Modelling

Instructor(s): Chris Clayton

Format and Duration

Classroom - 5 Days

Summary

The key elements to be discussed are the recognition and characterisation of source rocks, 1D and 3D thermal modelling, prediction of petroleum properties, correlation of oils and gases, and genesis of biogenic gas deposits.

Business Impact: Participants will learn how to use the various items in the geochemistry toolbox to evaluate play fairways and individual prospects. Participants will be better prepared to assess charge risk, source rock effectiveness/ultimate generative potential and predict fluid phase in un-drilled prospects. These parameters are crucial to prospect ranking and decision making in exploration.

Learning Outcomes

Participants will learn to:

1. Examine all relevant data required for constructing a 1D or 3D computer-based basin model, including a sound chronostratigraphic framework, thermal profiles, the impact of unconformities and maturity measurements to calibrate the model.
2. Determine the limitations and uncertainties inherent in such models.
3. Analyse source rocks and their petroleum generating potential using the following types of geochemical data: total organic carbon, vitrinite reflectance, Rock-Eval pyrolysis and pyrolysis gas chromatography.
4. Employ carbon isotopic data, gas chromatographic fingerprints and basic biological markers (GCMS) to undertake basic correlation of oil to oil and oil to source rock and to infer depositional environment of source rocks.
5. Distinguish the types and origins of natural gas and be able to determine their origin using carbon isotope signatures.
6. Differentiate the various types of biogenic gas accumulation and be aware of the challenges in modelling their formation.

Training Method

This is a classroom course, comprising a series of lectures interspersed with practical exercises and case studies.

Who Should Attend

Exploration and Development/Production Geoscientists of any experience who come into contact with geochemistry or basin modelling during their work. Reservoir engineers looking to broaden their understanding of the origin and properties of fluids could also benefit from attendance on this course.

Course Content

The key elements to be discussed will be:

- Recognition and evaluation of source rocks
- 1D and 3D modelling principles and practices
- Uncertainties when estimating (1) timing of petroleum generation, (2) expelled products, (3) volumes of oil and gas and (4) prospect charging
- Prediction of petroleum properties
- Correlation of oils and gases
- Genesis of biogenic gas accumulations

1. Introduction

- Principles of geochemical play fairway and prospect evaluation
- Basis of basin modelling and inputs required

2. 1D basin modelling

- Generation and expulsion processes and kinetics
- TOC
- Rock-Eval parameters: S1, S2, HI, Tmax etc.
- Pyrolysis GC
- Reconstructing burial history
- Source rock parameters

3. 3D basin modelling

- Principles of primary and secondary migration
- Integration into basin models
- Phase effects during migration

4. Petroleum properties and correlation

- Oil properties and alteration: controls of GOR, API, S content, viscosity etc.
- Oil correlation: gas chromatography, gas chromatography-mass spectrometry, stable isotopes
- Determining source and maturity of natural gas
- Alteration processes

5. Biogenic gas accumulation

- Methanogenic archaea and how they work
- Primary biogenic gases
- Secondary biogenic gases
- Gas hydrate deposits