
N771: Geochemistry and Petroleum System Modeling

Instructor(s): Leon Dzou

Format and Duration

Classroom - 2 Days

Virtual - 4 Sessions

Summary

This course teaches participants how to utilize geochemistry and petroleum systems modelling in the evaluation of conventional and unconventional resource plays. It covers the range of depositional settings for organic-rich source rocks, as well as generation, expulsion, migration, and accumulation processes. Integrating the geological framework with petroleum systems modelling is key to assessing petroleum composition and reservoir pressure and, ultimately, identifying sweet spots in shale play fairways. The course also addresses tight oil and gas petroleum systems, which contain all the elements of a conventional petroleum system and therefore follow the same physical principles.

Business Impact: Successful exploration depends on the accurate evaluation of sweet spots, which represent the commercial targets. This course will equip geoscientists with the capabilities needed to identify sweet spots in unconventional resource play fairways.

Learning Outcomes

Participants will learn to:

1. Employ bulk properties, gas chromatographic fingerprints, biological markers (GCMS), and carbon isotope data to correlate oil to oil and oil to source rock, and to infer the depositional environment of source rocks.
2. Interpret source-rock depositional systems.
3. Analyze source rocks and their petroleum-generating potential using total organic carbon, vitrinite reflectance, Rock-Eval pyrolysis, pyrolysis gas chromatography, and kinetics data.
4. Determine the limitations and uncertainties inherent in thermal models.
5. Use petroleum systems modelling as a holistic approach to evaluate tight oil and gas plays.
6. Define shale oil and gas plays, including the key productivity drivers and methods for identifying sweet spots.
7. Appreciate a wide range of case histories from basins worldwide and apply relevant lessons to their own prospects to help reduce risk.

Training Method

This course can be delivered as either four online webinar sessions (four half-day sessions) or a two-day classroom, hands-on course. It includes a range of informative exercises designed to reinforce the key principles, supported by a series of short lectures. A rich set of global examples and case histories is included throughout.

Who Should Attend

This course is relevant to exploration and development/production geoscientists of any experience level who come into contact with geochemistry or basin modelling in their work. Reservoir engineers seeking

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to broaden their understanding of the origin and properties of fluids could also benefit from attending this course.

Course Content

The key elements to be discussed will be:

- Organofacies, source rock properties, source potential and distribution
- Thermal modeling principles and practices
- Petroleum generation – maturation processes
- Pressure, fluid flow and migration processes
- Oil and gas geochemistry
- Correlation of oils
- Tight oil and gas petroleum systems
- Shale oil and gas sweet spot evaluation

The following shows the anticipated schedule of content, which may vary according to the pace of your course and focus of the participants, as well as if any new case studies arise.

Topic 1 - Practical Petroleum Geochemistry

- Course overview
- Introduction to gas geochemistry
- Introduction to petroleum geochemistry
 - Exercise: Williston basin
- Molecular geochemistry
 - Case history North Slope, Alaska
- Oil–oil and oil–source rock correlation
 - Case history SCOOP and STACK, Oklahoma
 - Exercise: Geochemistry of crude oils from Eastern Indonesia

Topic 2 - Source Rock Evaluation & Thermal Modeling & Petroleum Generation – Maturation Processes

- Source rock properties and potential evaluation (total organic carbon, vitrinite reflectance, Rock-Eval pyrolysis, pyrolysis gas chromatography, and kinetics)
- Thermal modeling principles & practices
 - Input data, workflows, and common software tools
 - 1D, 2D and 3D thermal modeling
- Petroleum generation - maturation processes and kinetics
- Case history Western Canada basin
 - Exercise: Thermal stress maps
- Case history Eagle Ford basin modeling



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Topic 3 - Pressure, Fluid Flow and Migration Processes

- Pressure and fluid flow fundamentals
 - Exercise: Water flow – can you predict it on paper?
- Petroleum expulsion – primary migration processes
- An overview of petroleum secondary migration guiding principles
 - Exercise LW3-I gas field
- Formation, preservation, and release of overpressure in shale gas reservoirs
 - Case history Anadarko Woodford, Arkoma Woodford, Eagle Ford, Sichuan Basin Wufeng–Longmaxi shales to illustrate the importance of post-burial uplift in shale plays

Topic 4 - Unconventional Petroleum Systems

- Unconventional plays
- Finding sweet spots in a shale play fairway
- Basin-centered tight gas accumulations
- Bakken tight oil petroleum system
- Mississippian Barnett shale oil/gas petroleum system
- Early Permian Wolfcamp tight oil petroleum system
- Late Jurassic Haysville shale gas petroleum system

Concluding remarks and summary of best practice