TETRA TECH RPS ENERGY | TRAINING

N471: The Petroleum System in Unconventional Exploration & Production: Geology, Geochemistry and Basin Modeling

Instructor(s): Andy Pepper

Format and Duration

Classroom - 4 Days
Virtual - 8 Sessions

Summary

The course teaches how to use regional geology, geochemistry and petroleum systems modeling in evaluating unconventional/resource play reservoirs.

The processes discussed range from deposition of the organic-rich rock; generation, expulsion, migration and accumulation processes leading to saturation of the reservoir; to the prediction of reservoir and produced fluid properties and values.

Business Impact: This class will arm geologists and engineers with advanced capabilities to: identify, map and evaluate new plays; identify storage and production sweet spots in plays; identify vertical/by-passed storage and production sweet spots to optimize landing zones in new and existing plays.

Learning Outcomes

Participants will learn to:

1. Understand modern approaches to categorizing source rocks: their potential and distribution.
2. Establish the link between organic matter and petroleum: the organofacies scheme and the geochemistry and composition of oil & gas.
3. Identify how the thermics of sedimentary basins and kinetics/organic matter quality control expelled petroleum volumes and compositions.
4. Understand the effects of pressure and capillarity: petroleum migration and accumulation are flip-sides of the same process, controlling reservoir saturation patterns.
5. Differentiate between potentially producible fluid vs. immobile sorbed petroleum in organic-rich reservoirs.
6. Employ sweet-spot mapping of well performance from a pressure and fluid perspective, and fluid prediction using advanced pyrolysis methods in well samples.

Training Method

This is a classroom or virtual classroom course comprising a mixture of lectures, discussion, case studies quizzes, and practical exercises.

Who Should Attend

Exploration and development/production geoscientists and reservoir engineers who need to understand the fundamentals of how the petroleum system works to determine fluid saturation and composition in unconventional/resource plays.

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Course Content

This class uses modern petroleum systems (geochemistry and thermal/fluid flow modeling) approaches, including some all-new modeling of petroleum saturation and composition in unconventional reservoirs. No prior knowledge of geochemistry and basin modeling is required: the class contains all the information needed for a geoscientist to understand the 'unconventional' petroleum system, building upon an understanding of geology and reservoir engineering principles. The class is also suitable for reservoir engineers working unconventional plays, who wish to understand the fundamentals of unconventional reservoir geology.

Topics:

1. Charge | Source Rock Potential - 'The Feedstock'

- Measurements of organic richness and potential
- How organic matter (OM) in source rocks is deposited: variations in distribution, thickness, organic carbon content and organic matter type (organofacies)
- How source rock volumetric potential and system gas/oil potential can be quantified (ultimate expellable potential)

2. Charge | 'Making the Petroleum'

- Modeling generation of petroleum from, and sorption of petroleum in, OM
- Understanding thermal stress levels for oil and gas generation from, and cracking of sorbed oil to gas in, OM
- Prediction of petroleum composition expelled from OM: gas-oil ratio (GOR)

3. Charge | 'Moving the Petroleum'

- Sorbed vs. fluid petroleum phases in OM-rich rocks
- Petroleum fluid phase behavior
- Migration/saturation of the fluid phase within, and adjacent to, the source bed
- Migration into the conventional fluid system - the 'flip side' of unconventional reservoir storage

4. Trap | Seal and Column 'Building the Petroleum Saturation'

- Controls on pressure evolution in sedimentary basins
- Controls on saturation in reservoir rocks: hydrodynamics, buoyancy, capillary entry pressure and interfacial tension
- Recognizing the unconventional reservoir as a petroleum system: source, reservoir and seal

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- Capillary pressure and architecture of saturation patterns in unconventional reservoirs

5. Reservoir | Storage 'Storing the Petroleum'

- 'Unconventional' core measurements of porosity and saturation - effects of Dean-Stark cleaning
- Measuring and modeling sorbed vs. mobile fluid phase saturations
- Profiles of fluid phase saturation in 'classic' unconventional petroleum plays
- Fluid phase properties: predicting GOR and Formation Volume Factor
- Petroleum-In-Place sweet-spot logging and mapping - Permian Basin Wolfcamp example

6. Reservoir | Deliverability 'Producing the Petroleum'

- Pressure - a key limitation on delta-P
- Modeling fluid viscosity in unconventional reservoir fluids
- Petroleum deliverability/rate sweet-spot logging and mapping - Permian Basin Wolfcamp example

7. Product | 'Valuing the Petroleum'

- Properties of the produced liquid stream that affect sales value
- Properties of the produced gas stream that affect sales value

Exercises Included

This course integrates practical exercises to complement theoretical learning. You will complete exercises on:

- Charge Source Potential
- Charge Access Making
- Charge Access Moving
- Trap Container Geometry
- Trap Column Capacity
- Reservoir Storage
- Reservoir Deliverability
- Value Product Quality

These exercises are designed to refine your skills and enhance your ability to tackle complex challenges.