Trap and Seal Workshop (G122)

Tutor

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Overview

This hands-on course enables attendees to enhance their skills and critical evaluation of all aspects related to pressure, trap and seal evaluation workflows. This includes understanding and predicting fluid pressure, retention of hydrocarbon fluids and column heights, and reservoir connectivity and compartmentalization. Fluid pressure is evaluated from first principles, downhole measurements (mudweights, RFT/MDT data) and estimated from porosity-effective stress relationships. We make estimations of mechanical seal capacity ranges using Leak off Test data and fundamental elastic rock properties. Capillary seal attributes are estimated from core measurements and calibrated against buoyancy pressure estimates from the crests of oil and gas fields. The fundamental techniques developed in the first two days of the course are applied across a variety of case studies in various modules, including aspects of oil versus gas prediction techniques in exploration, reservoir connectivity evaluation in a faulted reservoir and seal risking workflows for stratigraphic traps.

Duration and Logistics

Classroom version: This course can be customized for a 3 or 4-day delivery, depending on which of modules 5, 6, 7 and 8 are of most interest. It is also possible to include client data or problems to substitute classroom exercise time with discussion time on actual client datasets and problems. The mix of classroom lectures and discussion (50%), and hands-on exercises with subsurface datasets (50%) allow for an interactive and deeply applied learning experience. The lecture materials will be provided in digital format. Participants can bring a laptop or tablet computer to follow the lectures and exercises using digital provided formats. Exercise manuals will be printed in 11×17 format for each student to enhance learning by interpreting using pencil on paper.

Level and Audience

Fundamental. This course is intended for early to intermediate-experience career geoscientists (0-10 years experience), reservoir engineers and petrophysicists who want to understand the fundamental controls on prospect and field pressure, trap-seal, connectivity and compartmentalization, including seal risking worflows and pre-drill predictions of fluid type, column height and pressure.

Objectives

You will learn to:

1. Describe trap-seal attributes of prospects in a consistent manner (crest, spill points, seal and fault-seal controls).
2. Understand the controls on subsurface fluid pressure and the methods used to describe and predict subsurface fluid pressure.
3. Describe and quantify mechanical seal capacity of various seal types relative to hydrocarbon liquids

and gases using field data, wireline logs and core attributes.

4. Describe and quantify capillary seal capacity of various seal types relative to hydrocarbon liquids and gases using field data, wireline logs and core attributes.

5. Understand various controls on hydrocarbon-water contact distributions, including fault-seal, hydrodynamic tilting, reservoir quality controls on saturation.

6. Make predictions of oil versus gas column heights for multiphase petroleum systems in exploration settings.

7. Make predictions of reservoir connectivity and compartmentalization in faulted reservoirs in appraisal and field development settings.

8. Use seal risking workflows to high-grade portfolios of stratigraphic trap prospects, including both deep-water and shallow-water clastic settings.

Course Content

Topics include:

- Describing trap and seal attributes of prospects and compartments
- Fundamentals of Fluid pressure in the subsurface
- Controls on the distribution of Buoyant immiscible fluids in the subsurface
- Mechanical Seal Evaluation
- Capillary Seal Evaluation
- Quantifying risk and uncertainty related to fluid retention and column heights.
- Sequence Stratigraphic distribution of seals in various tectono-stratigraphic settings applied to stratigraphic trap seal risking.

Session 1: Subsurface pressure and seal

Module 1: Describing trap and seal attributes of prospects (crest, spill points, top, lateral, base seal, fault plane control) and compartments.

Module 2: Understanding aqueous and petroleum fluid pressure fundamentals (overpressure, underpressure, fluid gradients, contacts, centroid concept, dynamic flow).

Session 2: Fundamentals of seal failure

Module 3: Fundamentals of mechanical seal capacity and mechanical seal failure (in-situ stress fundamentals, borehole measurements (mudweights, FIT, (X)LOT), rock elastic properties).

Module 4: Fundamentals of capillary seal capacity (buoyancy pressure, capillary pressure from wells, core calibration using MICP, petrophysical estimation, field column heights).

Session 3: Case studies in capillary controls on oil and gas distribution

Module 5: Advanced topics in hydrocarbon fluid distribution, retention and flow (fundamentals of fault behavior, tilted contacts, saturation variation, oil vs. gas prediction techniques).

Module 6: Predicting oil versus gas presence and column height distribution in exploration& appraisal settings (deep-water Paleogene play).

Session 4: Case studies in reservoir connectivity and stratigraphic trap risking

Module 7: Predicting reservoir connectivity and contact variation in faulted system (development setting in Jurassic/Triassic fluvio-deltaic reservoirs).

Module 8: Seal risking workflows for stratigraphic traps: using central/south Atlantic Cretaceous deep-water stratigraphic trap examples and North Slope Alaska paralic topset play.