

Trap and Seal Analysis

Consultant / Trainer

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The **Petrogenium** (in collaboration with EPTS) **Trap and Seal Analysis** course will provide participants practical knowledge and skills in trap and seal analysis, which is crucial for evaluating oil and gas exploration prospects and CO2 storage projects. They will learn how to identify valid subsurface traps, understand the causes of trap and seal failure, and assess the risks of leakage, especially in mature basins and areas with limited seismic data quality.



Participants

This **Petrogenium**. course is designed as an advanced module of the Prospect Maturation course by the same instructor, but can also be seen as a stand-alone course; the relevant messages of the Prospect Maturation course will be briefly summarized at the start of the course.



Learning Objectives

At the end of the course the participants will understand the critical elements of hydrocarbon traps and how they affect the trap risk and volume of trapped hydrocarbons. This should result enable participants to focus on realistic traps and in technically sound and realistic pre-drill estimates of prospect volumes. It should also result in a more focused search for alternative trap types (deeper, stratigraphic and unusual) in mature basins.

DAY 1

1. Introduction and the basics

- Summary of the main relevant learnings from the Prospect Maturation course (dependency of trap types on the basin type and deformation history; importance of recognising the spill- and leak-points of traps) followed by a brief introduction of what will be discussed in this course

2. Trap styles and distributions

- Typical basin development and deformation histories will be discussed of different basin types as a basis for understanding what type of traps may occur, and the setting (location within the basin) where these may occur.
- Illustrated with examples of trap densities and field sizes in different basin settings, and of variations of these parameters within basins

3. Control on depth of water contacts in worldwide examples

- Recapitulation of how HC-water contacts are normally controlled by spill- and/or leak-points, followed by 1 or 2 exercises where participants need to propose considered uncertainty distributions for HC column length.

4. Prospect identification from seismic sections and maps (exercises)

- Short presentation followed with exercises on conceptual cross-sections and 'real' maps and seismic lines on identification of potential prospective zones and leads. The data to be used for these exercises comes from different basin types, including deltas, rift basins, passive margins and deep water foldbelts.

DAY 2

Recap of Day 1

1. Sealing lithologies

- Different sealing lithologies and their effectiveness will be discussed, from perfect seals like salt to rather poor silty or marly seals, with examples from different basins. Also unusual seals (e.g. basalt) will be presented. Emphasising the role of sealing on trapped hydrocarbons (oil vs gas, column length).

2. Seal Theory

- The theory of capillary entry pressure; Rate of leakage from theoretical considerations; Tools and methods to determine seal capacity; hydraulic seal failure; column length versus sealing capacity.

DAY 2 continued

3. Faults and fault mapping

- Typical characteristics of faults are presented, which should help their interpretation, especially in areas with limited or poor quality seismic data. The construction of Allen juxtaposition plots will be explained with several exercises

DAY 3

Recap of day 2

1. Fault seals

- Different fault seal mechanisms will be discussed: Juxtaposition, Shale Gouge, Clay smear, Cataclasis and Diagenesis. Industry practices and formulas will be presented and their application and validity will be a topic for discussion. Examples of top and fault seals in different basins, trap types and sealing lithologies: rift basins, deltas, deep water settings, carbonate provinces; Discussion on effects of seal thickness and the role of faults and fractures

2. Differential retention of gas and oil

- The role of seals play on the gas-oil mix in traps will be discussed

3. Geomechanical assessment of CCS containment

- This module will be presented on-line by the industry expert on this topic: Peter van den Bogert. The main leakage mechanisms for CO₂ storage and the Geomechanical metrics used to assess these risks. The Geomechanical differences between CO₂ storage in virgin reservoirs and depleted HC fields. Explanation of the input data for Geomechanical assessments.

DAY 4

Recap of day 3

1. Stratigraphic traps

- Trapping geometries and aspects of sealing for stratigraphic traps; where can stratigraphic traps reasonably be expected to occur, and where are they highly unlikely. Examples will be given from different basin settings and depositional environments

2. Unusual traps

- Basement traps, Volcanics, hydrodynamic traps

DAY 4 continued

3. Traps in Rift basins

- Examples of conventional traps in the syn-rift and post-rift: simple horsts and tilted fault blocks as well as flower structures and anticlinal traps in inversion structures.
- Examples of stratigraphic traps
- Examples where deeper traps have been successfully explored for (deeper syn-rift and pre-rift).

4. Modelling of top and lateral seals

- The Ariane softwarepackage (ÓArianeLogic) will be used to investigate the effect of top seal and side seal strength on trapped HCs. Participants will be given the opportunity to use the software, changing the inputs for charge mix (gas and oil) and seal strengths, and see how this affects the gas-oil mix in traps. This will be followed by a group discussion on observations and learnings. The president of ArianeLogix (Martin Neumaier) will be present online to explain the software and provide assistance

DAY 5

Recap of day 4

1. Traps and seals in different basin settings

- A comprehensive overview of traps and seals in different basin settings will be available in the provided course material. Based on the interest of the participants a few of these settings will be discussed in detail. Several exercises can be chosen from to deepen the understanding of trap types and seal issues in these basins:
- Delta settings: NW Bornea, Nigeria
- Deep-water passive margins: Surinam-Guyana, Ghana, xNamibia
- Deep-water foldbelts: NW Borneo, Nigeria
- Orogenic foldbelts: Andes, Alps, Apennines
- Salt basins: Gulf of Mexico, South Atlantic and Southern Permian Basin
- Carbonate settings: Arabian platform and Central Luconia province

2. Risk & Volume analysis of traps and seals

- Dependencies for prospects with more than 1 reservoir-seal pair; what are the consequences of a proven seal for a deeper reservoir on the chances for the shallower reservoirs.
- Guidelines and examples of prospects with different trap and seal risk profiles; Rules of thumb for trap and seal risking - related to trap type, seal lithology, depth of burial, pressure regime, degree of faulting / fracturing and data availability

DAY 5 continued

- Simple and pragmatic guidelines for deciding pre-drill uncertainty ranges of column-length (and area) and most likely column length.
- For several basin types pragmatic rules of thumb will be presented for how to assess the likelihood of the presence of effective seals and their roles on the distribution of oil and gas

3. Course summary and close-out

Why select Petrogenium.?

The above support will be provided by principal consultants with 30+ years world-class experience in the technology and hands-on know-how from operation of refinery units.

Contact Petrogenium.:

Email: training@petrogenium.com

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Because Experience Matters