



N373: Petroleum Geology for Non-Geologists

Instructor(s): Jon Noad

Format and Duration

Classroom - 2 Days

Virtual - 4 Sessions

Summary

Petroleum geology is the study of origin, occurrence, movement, accumulation, and exploration of hydrocarbons. This course will introduce the participants to the concepts essential to understanding petroleum geology, including basic geological principles; depositional systems; the play elements required for the development of an oil or gas field; the oil field life cycle; characterizing the reservoir and estimating hydrocarbon volumes.

Learning Outcomes

Participants will learn to:

1. Recognize that Geology is a science that is based upon careful observation and interpretation.
2. Describe the basic composition and structure of the Earth, how it has evolved through plate tectonics, and how these aspects continue to affect the Earth today.
3. Identify the main types of sedimentary rocks, the depositional environments in which they form, and how this impacts reservoir properties and geometries.
4. Use aspects such as grain size, sedimentary structures, and fossils to determine the environment of deposition.
5. List the play elements required to generate, migrate and trap hydrocarbons.
6. Discuss how to characterize your reservoir in the subsurface, and what techniques can be applied to facilitate this process.
7. Understand how hydrocarbons are generated, explored for, and produced, and how geology shapes reservoir performance.
8. Review the technical specialists needed to work in an integrated oil and gas team.

Training Method

This is a classroom or virtual classroom course comprising a mixture of lectures, videos and live examinations of rocks and fossils, discussion, and practical exercises.

Who Should Attend

Anyone who works in the petroleum industry and has little or no prior knowledge of geology. The course will also provide a useful overview and refresher for those working in technical, non-geology related disciplines.

Course Content

Section 1: Basic Geology and the Oil Cycle

- Structure of the Earth
 - Core, Mantle, and Crust

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- Plate tectonics
 - Continental Drift; Major plates and plate boundaries
 - Earthquakes and volcanoes
 - Evolution of the Earth
- Igneous, Metamorphic, and Sedimentary rocks; The Rock Cycle; Minerals
- Sedimentary rocks
 - Clastic versus Carbonate reservoirs
 - Characteristics of Clastic sedimentary rocks
 - Depositional settings
 - Types of clastic rocks and grain sizes
 - Sedimentary structures
 - Grain size, sorting, shapes
 - Colour, texture, and mineralogy
 - Types of carbonate rocks
 - Depositional settings
 - Carbonate grains
 - Diagenesis
 - Sequence stratigraphy; the impact of changes in relative sea level through time
- Structural Geology
 - Folds; Basins; Faults and fractures
 - Geological time
- Fossils
 - Body fossils; microfossils; trace fossils

Section 2: The Five Play Elements; Reservoir geology

- Play elements
- Introduction to the five play elements; Reservoir, Source Rocks, Seal, Trap, Timing; Definitions
- Reservoir
 - Volumetrics: the STOIP equation and what information is required
 - Assessment of Porosity and Permeability
 - Net:gross
 - Oil shrinkage factor
 - Recovery Factor
 - Brittleness and rheology: fractures
 - Conventional versus Unconventional Reservoirs
- Source rocks
 - Types of hydrocarbons and geochemistry
 - Kerogen; Evaluation;
 - Source rock maturity and Vitrinite reflectance;
 - Formation of oil and gas; Biomarkers
- Seals



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- Geology and lithologies
- Effectiveness and why seals may be breached; Overpressure
- Spill points
- Traps
 - Structural: Faults and fractures; anticlines
 - Stratigraphic: Depositional; Salt domes; Diagenetic traps and karst
 - Idealized workflow to assess structure;
- Migration pathways and barriers; Timing

Section 3: Evaluating Subsurface Sediments

- Their importance in Exploration and Production
- Remote sensing
 - Satellite imagery
 - Gravity and Magnetic data
 - Seismic data collection and interpretation; Fluid contacts
 - Seep data
- Petrophysical well logs: Main types of logs and what they signify
 - Gamma ray
 - Resistivity
 - Spontaneous potential
 - Neutron density
 - FMI
- Uses of well logs: correlation
- Drill stem tests
- Core, Chip samples, Cuttings
- Volumetrics:
 - Critical economic questions
 - Mapping prospects
 - Dry well analysis
 - Volumetrics and risk
 - Field size distributions
- Reservoir Geology
 - Building a picture of the reservoir; Archie equation; Reservoir drives

Section 4: Applying Petroleum Geological Concepts

- The Oil Cycle
 - Exploration, Appraisal; Production; Abandonment
 - Technical Roles and Responsibilities
 - Geologist
 - Geophysicist
 - Reservoir Engineer



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- Petrophysicist
 - Production Engineer
- Exploration geology
 - Exploring for hydrocarbons
 - Overview of methodology; regional analysis; old datasets; remote sensing data; seismic stratigraphy; gross depositional environment maps; structure maps
 - Basin characterization
 - Tectono-stratigraphic framework
 - Play based exploration
 - Risk and Uncertainty; what we know and what we don't
 - Examples of Standard plays; Extraordinary plays
- Production geology
 - Mapping
 - Reservoir Evaluation and Reserves
 - Types of reserves; break even prices
 - Methods to estimate reserves: Material Balance; Decline curves; Reservoir simulation
 - Use of Well data
 - Enhanced oil recovery
 - 4D seismic
- Final review: what have we learned?
 - Course summary
 - Further information sources