Petrophysics

CHAPTER 1:
INTRODUCTION

What is Petroleum?

- Petroleum is a naturally occurring hydrocarbon that can exist as solid, liquid or gaseous states. The physical state of the hydrocarbon is a function of the pressure (P) and temperature (T) to which it is exposed as well as its structure (chain length/molecular weight).

- Hydrocarbons: Chemical compounds composed of hydrogen (H) and carbon (C) atoms.

The Origin of Petroleum

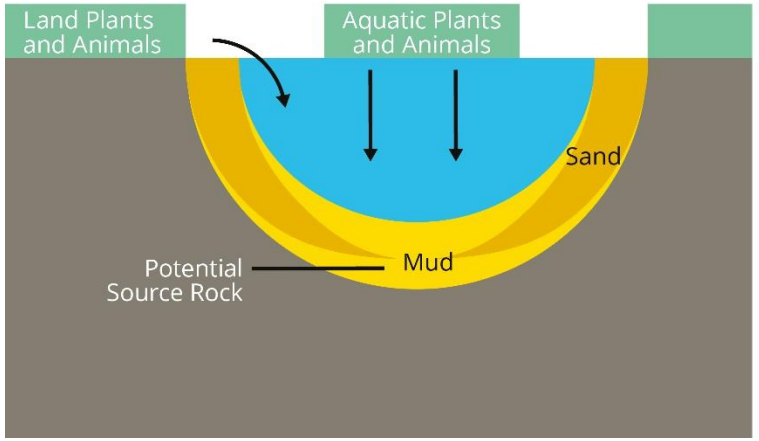
There are two different opinions about the origin of petroleum:

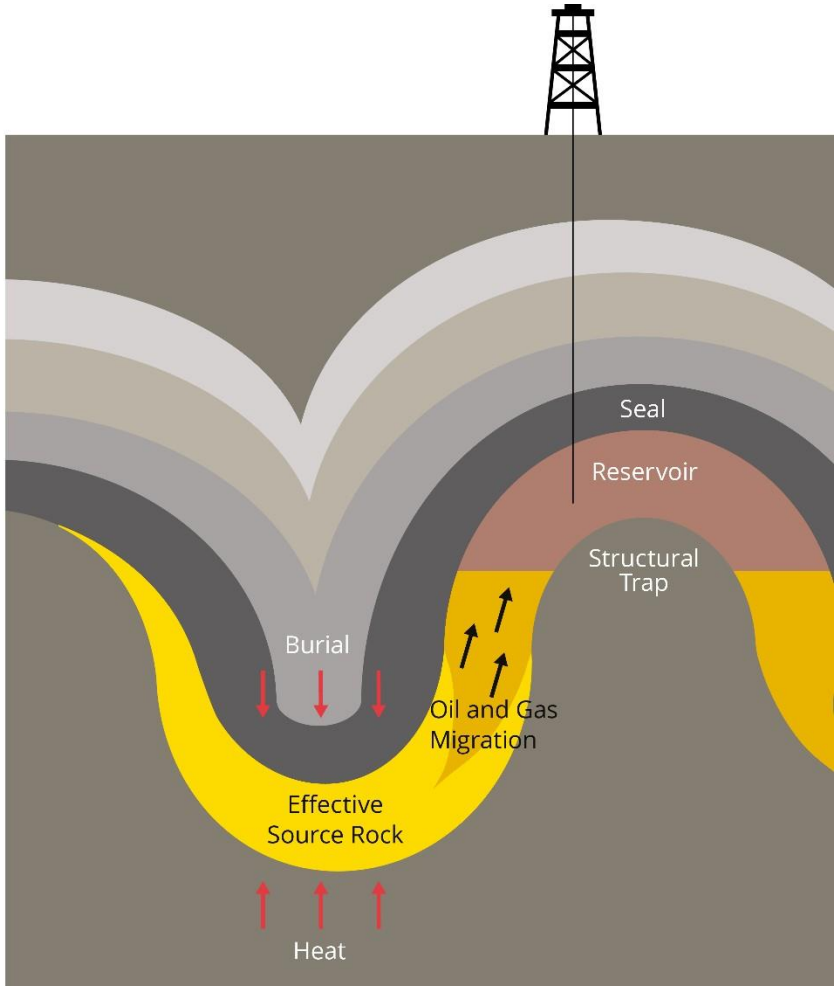
1. Organic Theory (the most accepted)
   - States that petroleum evolved from the decomposition of animals and plants that lived during previous geological times.

2. Inorganic Theory
   - States that petroleum was formed through chemical reactions between water, carbon dioxide, and several inorganic substances such as carbonates in the earth.

Petroleum System

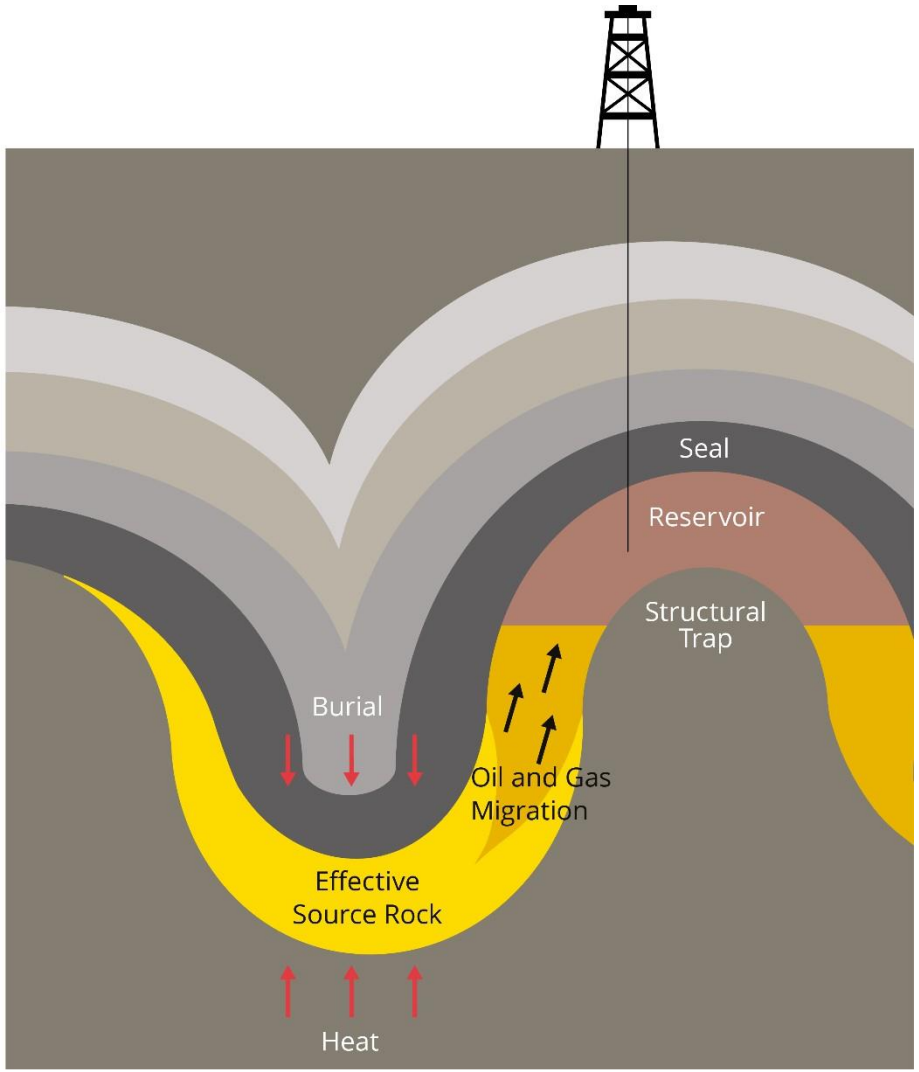
- Consists of:
  - Source rock
  - Migration paths
  - Reservoir rock
  - Seal
  - Trap





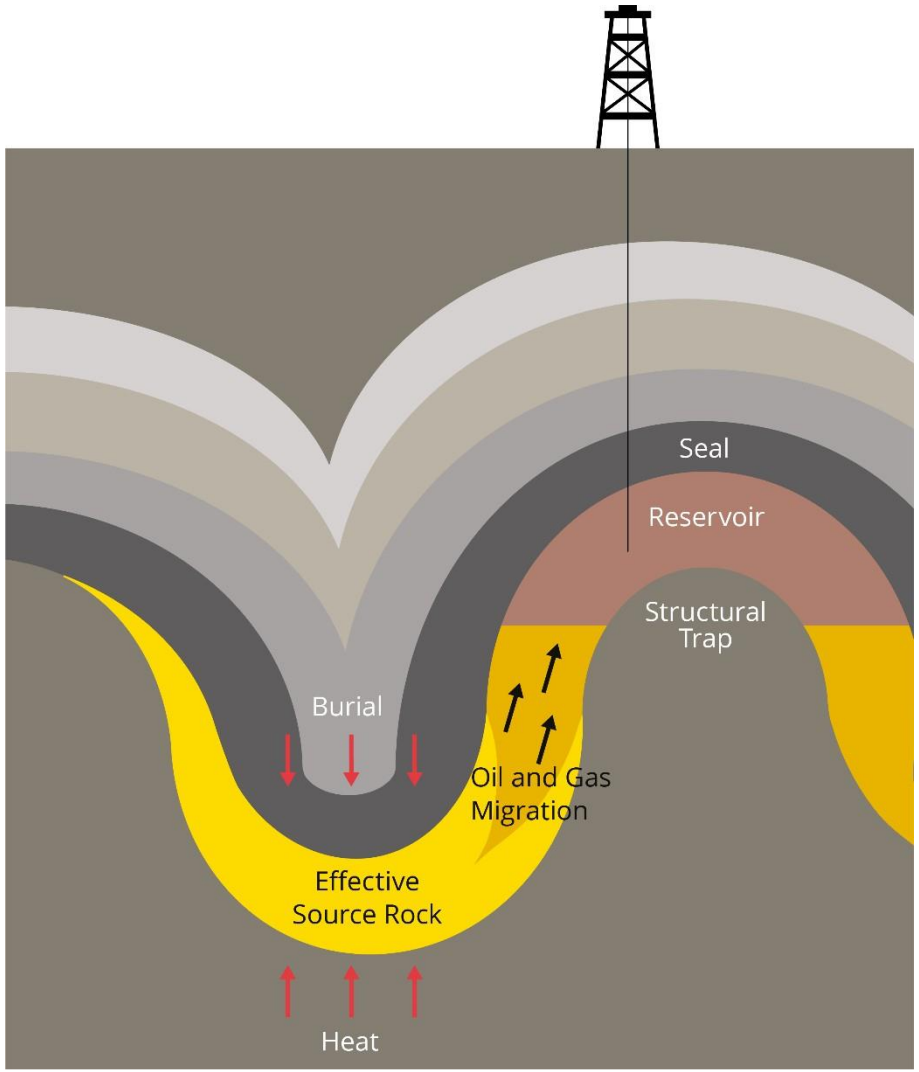
Petroleum System

- Hydrocarbons (HC) are formed in the source rock under sufficient T and P.
- The HC travel upward because they have low density compared to water.
- HC are stored in the pores of rocks (these are called reservoir rocks).
- The HC reach an impermeable layer known as the seal where it will be trapped.
- The HC can also be trapped based on the configuration of the system.

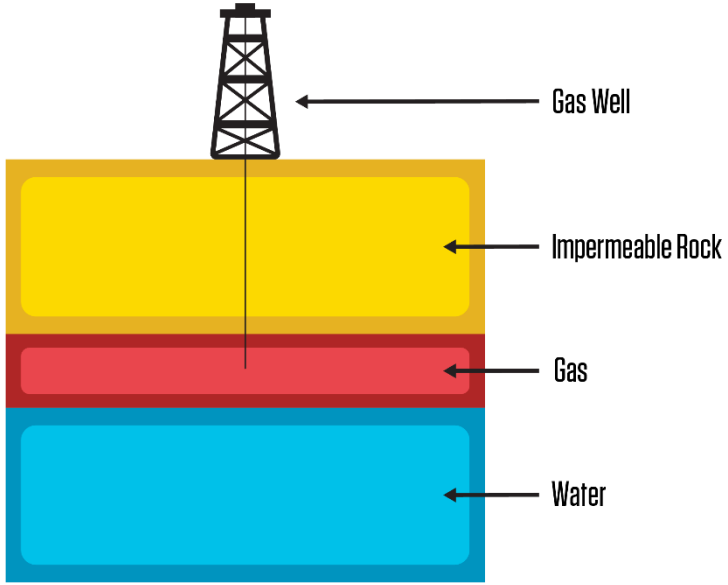


What is a Reservoir?

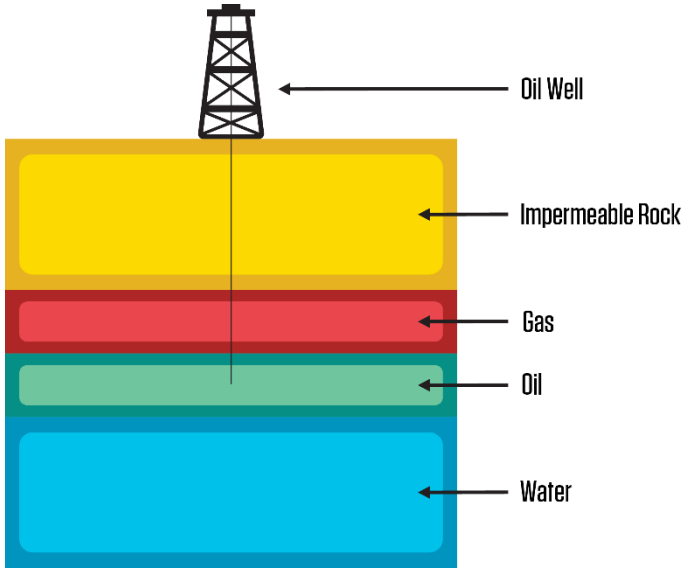
- A reservoir is a place where the hydrocarbons are stored.
- There are three types of hydrocarbon reservoirs:
  1. Gas reservoir
  2. Oil reservoir
  3. Oil and gas reservoir
- Lithology of petroleum reservoirs
  - Sandstones
  - Carbonates



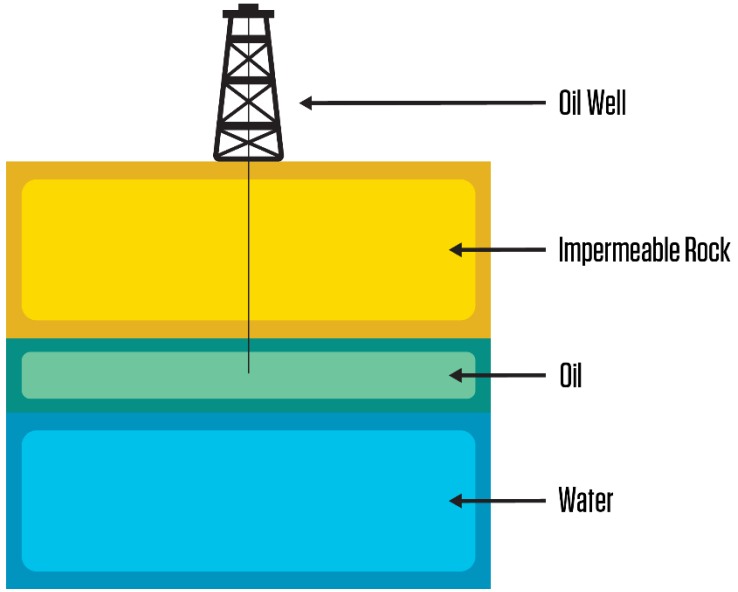
Reservoir Types in PETE



Gas reservoir



Oil and gas reservoir



Oil reservoir

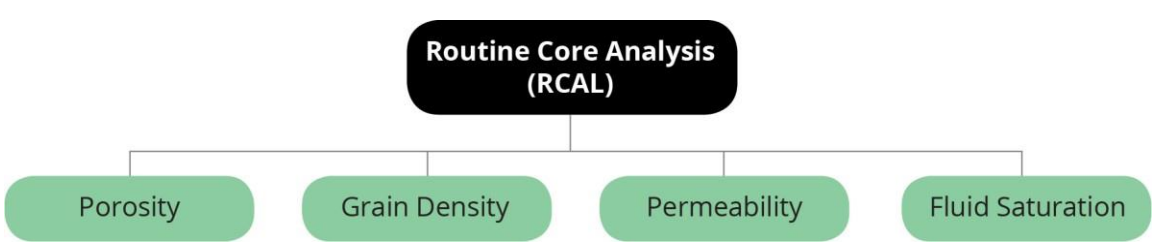
What is Petrophysics?

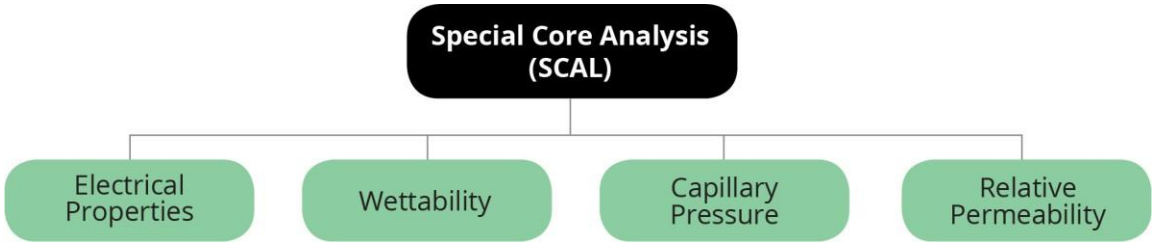
It is the study of rock properties and rock-fluid properties.

- Rock properties include:
  - Porosity
  - Rock compressibility
  - Absolute Permeability (single-phase)
  - Fluid saturation
  - Electrical properties of reservoir rocks
  - Wettability
  - Capillary pressure
  - Relative permeability
- Petrophysics can be divided into core (cm scale) and wireline (m- km scale) petrophysics.

Core Petrophysics

- It requires conduction of lab experiments on core samples (extracted from reservoirs in the subsurface through coring).
- Core samples can be subjected to two categories of lab experiments:





Why do we need to understand Petrophysics?

- To:
  1. Quantify the amount of HC in the reservoirs (e.g. porosity and fluid saturation)
  2. To understand how the HC will flow from the reservoir to the well during the production stage (e.g. permeability, wettability and relative permeability)

Fluid Properties

- There are different fluid properties that need to be studied in this course.
- For example: density, viscosity and pressure.