



Basic Information about Oil and Gas

Outline

- **What is Petroleum?**
- **How is oil formed?**
- **What is Oil used for?**
- **Oil Composition**
- **Oil Properties**

What is Petroleum?

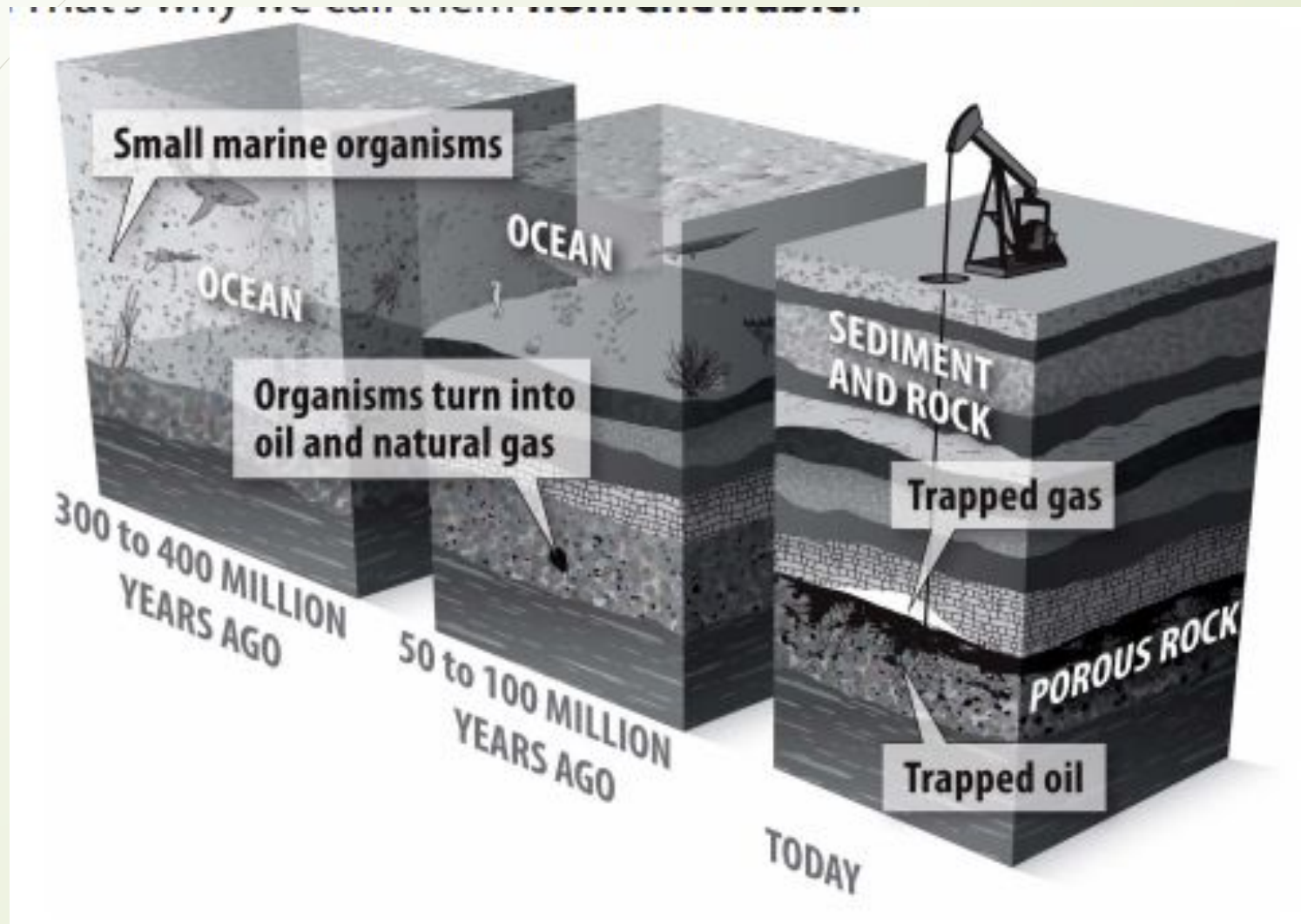
- ❑ **Petroleum: a complex mixture of naturally occurring hydrocarbon compounds found in rock.**
- ❑ **Petroleum Latin word (“Petra” means rocks, “oleum” means oil)**
- ❑ **Solid, gas or liquid**
- ❑ **Petroleum generally refers to liquid crude oil**
- ❑ **Crude Oil: A general term for unrefined petroleum or liquid petroleum.**



How is Oil formed?

- ❑ Oil was formed from the remains of animals and plants that lived millions of years ago in a marine (water) environment.
- ❑ Over the years, the remains were covered by layers of mud.
- ❑ Heat and pressure from these layers helped the remains turn into what we today call crude oil.

How is Oil formed?



What is Oil used for?

- **90% of all transportation fuels**
- **Lipstick**
- **Aspirin**
- **Artificial Heart**
- **Shampoo**

virtually everything in the modern world is either made from oil derivatives, or uses oil-based energy to produce and transport it



Oil Composition

- **Hydrocarbons – 98%**
 - **Alkanes**
 - **Cycloalkanes**
 - **Aromatic HCs**
- **Non-hydrocarbon components < 1%**
 - **sulphur, nitrogen, oxygen and heavy metals (Vanadium, Nickel, Copper, Zinc and Iron)**
 - **but their influence on the product quality can be considerable**

Hydrocarbon Chemistry

Classification:

- Arrangement of the carbon molecules
 - Open Chain
 - Cyclic
- Number of Bonds between carbon molecules:
 - Saturated (Alkanes)
 - Unsaturated (Alkenes, Alkynes)

Alkanes

Under Standard Conditions (Temperature 298K and Pressure 1 atm)

- C1 – C4 are gases
- C5 – C17 are liquids
- >C17 are solids

Alkanes

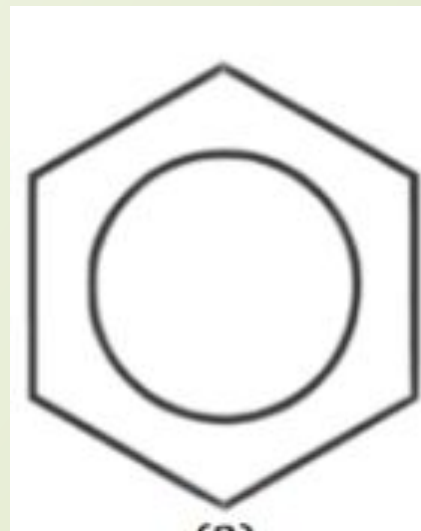
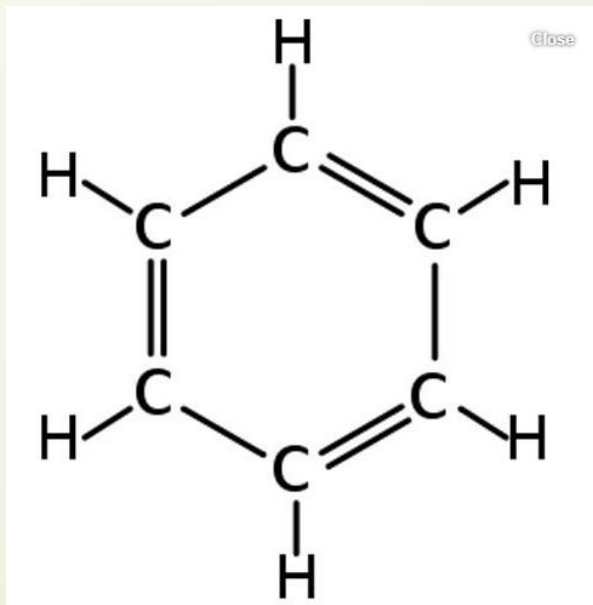
- ▣ CH_4 to $C_{40}H_{82}$ in crude oil
- 20 % of oil by volume
- Inert
- Alkenes and alkynes are Reactive
(uncommon in crude oil)

Alkanes

- At reservoir - Long chain of HCs may exist in solution
- At tubing and surface facilities - Long chain of HCs may solidify
- The detailed laboratory analysis of the crude oil composition is required
- Cyclic HCs are common in crude oil

Aromatic Hydrocarbons (Arenes)

- Carbon atoms are connected by alternating double and single bonds
- Benzene



Non-Hydrocarbon Components of Petroleum Fluids

- Typically < 1%
- Significant Impact on Product Quality and Processing Requirement

Non-Hydrocarbon Components of Petroleum Fluids

- ❑ Sulphur - 0,2 % to 6% (average 0,65 %)
- ❑ Highly Corrosive and Toxic
- ❑ Corrosive: Free Sulphur, Hydrogen Sulphide (H₂S), and other carbon compounds with Sulphur.
- ❑ Natural Gases – H₂S

Non-Hydrocarbon Components of Petroleum Fluids

- ❑ Nitrogen <0,2%, high as 2%
- ❑ Reduces Caloric Value
- ❑ Oxygen can produce corrosive compounds
- ❑ Carbon Dioxide + Water = Carbonic Acid
- ❑ Metals: Vanadium, Nickel, Copper, Zinc and Iron.

Oil Properties

- Crude oil properties can vary widely depending on where the oil is found and under what conditions it was formed
- The properties of oil include its density, called the API gravity (named after the American Petroleum Institute)

Specific Gravity of a Liquid

- The specific gravity of a liquid is the ratio of its density to that of water

$$\gamma_o = \frac{\rho_o}{\rho_w}$$

API gravity

$$^{\circ}\text{API} = \frac{141.5}{\gamma_o} - 131.5$$

- the lower its density, the higher its API gravity

Light and Heavy Oil

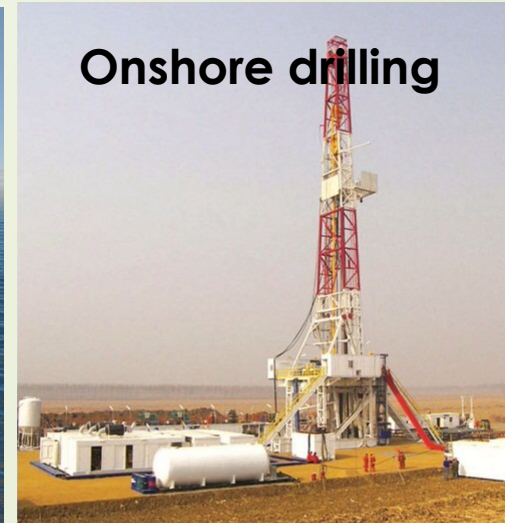
- ❑ Crude oil can be classified as either light or heavy depending on its API gravity (or density).
- ❑ Heavy: 10–20° API gravity- quality of oil less
- ❑ Light: above 25° API gravity- quality higher

Sour and Sweet Oil

- ❑ Crude oil can also be classified as either sour or sweet, depending on the amount of sulphur it contains.
- ❑ Oil with a high sulphur content (0.5% and above, by weight) is considered sour.
- ❑ Sweet crude oil, on the other hand, has low amounts of these sulphur compounds.

Onshore and Offshore field

- Onshore field: fields on dry land (Tengiz Oil Field)
- Offshore field: fields in the middle of sea (Kashagan Field)



Oil and Gas Field Phases

- The life of an oil or gas field can sub-divided into the following phases:
 1. Exploration
 2. Appraisal
 3. Development
 4. Production
 5. Abandonment

Exploration

- ❑ Exploration is a process of finding regions which there might be oil by analyzing available information.
- ❑ Exploration is almost like a detective work which requires looking for clues, careful observation, taking notes of different information and evaluation of survey data.
- ❑ This is the job of petroleum geoscientists who are experts on rocks.
- ❑ Petroleum geoscientists begin looking for places where there might be oil.
- ❑ They look for signs that might indicate the presence of oil.

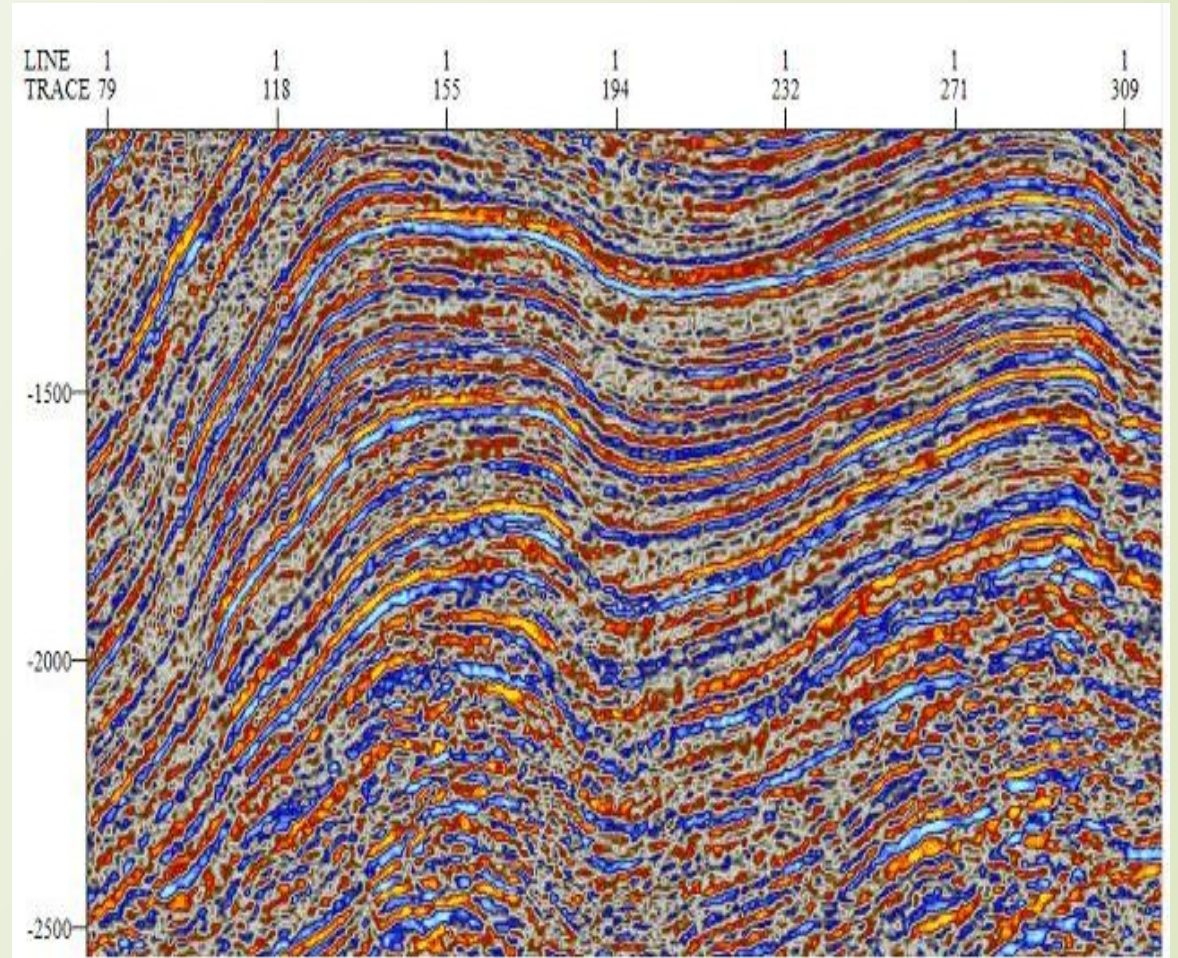
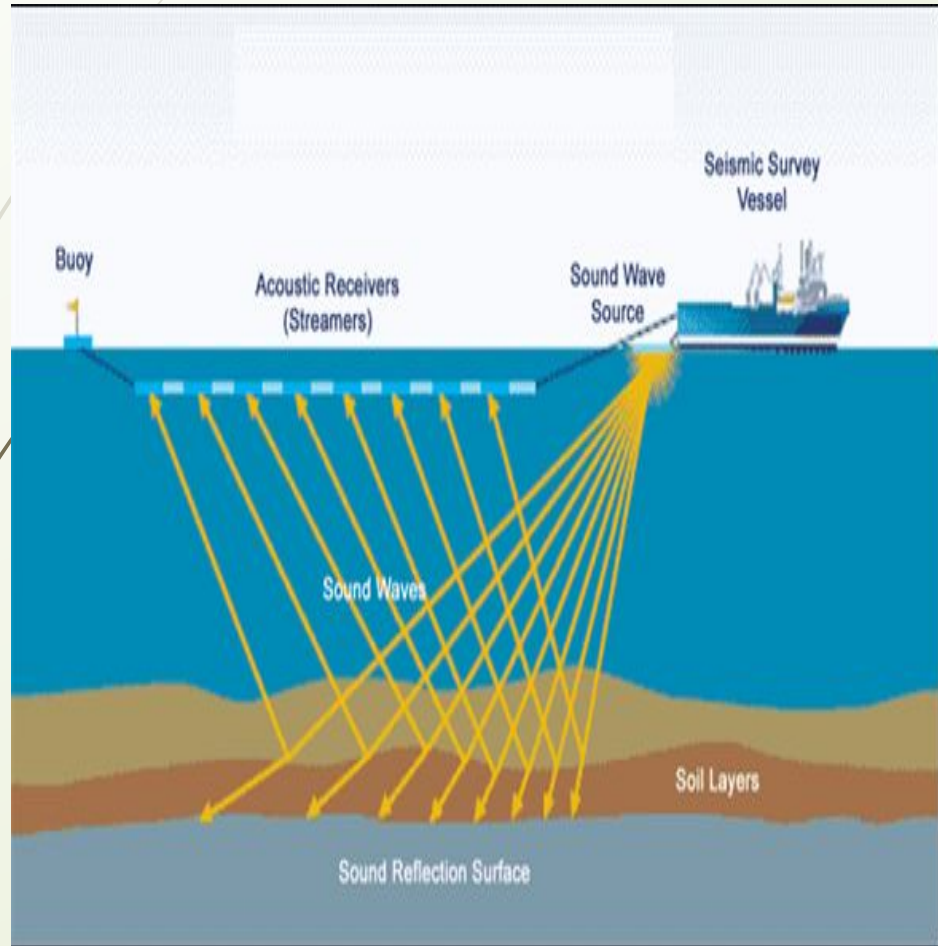
Exploration

- **Geoscientists should create the picture of underground, and figure out how everything is organized underground.**
- **They use special tools in order to see the rocks underground.**
- **Most commonly they use seismic technology**

Seismic Technology

- ❑ The working principle of seismic is based on shock waves created by an explosion or sound generator.
- ❑ These waves travel beneath the surface of the Earth and reflected back by the various rock layers.
- ❑ The reflections travel at different speed depending upon on the type of rock layers through which they pass.
- ❑ So geophysicists interpret the readings for signs of rocks which might contain oil or gas.

Seismic Technology



Exploration Well

- The only way to be absolute sure that there is oil in the underground is simply to drill a well.
- Drilling is expensive, the cost of drilling one well can be anything from 1 million to 35 million
- the cost depends on several factors:
 - location of the field (onshore or offshore)
 - the size of the field, the amount of information which is available
 - the type of rocks underground
- So if hydrocarbons are not found there is no return on the investment.
- Therefore there is a large risk involved

Appraisal Phase

- If the results of exploration look promising, then the company enters the Appraisal phase of the life of the field.
- During this phase, more seismic waves may be shot and more wells will be drilled to obtain precise picture of the size, shape and producibility of the accumulation.

Field Development Plan

- **If the prospect considered to be economically attractive a Field Development Plan will be prepared and submitted for approval to the government.**

Development

- **When the approval for development is received then the company will commence drilling Development wells and building production facilities according to the Development Plan.**

Production

- The production phase commences with the first commercial quantities of hydrocarbons ("first oil") flowing through the wellhead.
- This marks the turning point from a *cash flow* point of view, since from now on cash is generated and can be used to pay back the prior investments, or may be made available for new projects.

Abandonment

- **At some point in the life of the field the costs of production will exceed the revenue from the field and the field will be abandoned.**
- **All of the wells will be plugged and all surface facilities will be removed in a safe and environmentally acceptable fashion.**