- Oil -

Where does it come from?

Topics:

- Natural Resources
- Energy Resources
- What is petroleum?
- Origin of petroleum
- How is it found?
- Where is it found?

- Reading: Chapter 21
Everything around us was either:

- Grown (renewable)
- Mined (non-renewable)

World economy is based on exploitation of natural resources

Earth at Night
Global energy Use

Composite satellite image - NASA
**U.S. Energy Use**

- Oil 39%
- Gas 24%
- Coal 23%
- Nuclear 8%

Renewable 6%

Fossil Fuels 86%

Non-renewable

**Renewable Energy Resources**

- Biomass 50%
- Hydroelectric 42%
- Geothermal 6%
- Solar 1%
- Wind 1%

Total = 96.935 quadrillion btu
Petroleum was known since Biblical times

- Genesis 6: 13-14
- “And God said onto Noah . . . make yourself and arc of gopher wood; make rooms in the arc and cover it inside and out with pitch.”
- Pitch = tar = petroleum
**History**

- Modern petroleum industry started in the 1860’s in Pennsylvania and West Virginia
- At first main product was kerosene for lighting
- Gasoline was useless until the invention of the internal combustion engine

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**Oil & Natural Gas = hydrocarbons**

- *Petroleum*
  - Crude oil
  - Natural gas
- *Molecules of carbon and hydrogen atoms*
- *Usually in chains or rings of carbon atoms*
- *Crude oil is a mix hydrocarbons*
Hydrocarbons

- Short chains (C1 to C10)
  - gases and light liquids
  - Natural gas to gasoline
- Medium length chains (C11-C18)
  - Thicker liquids
  - Kerosene
  - Diesel
- Long chains (C19- >40)
  - Very viscous to solid
  - Motor oil
  - Tar
Cracking of Hydrocarbon Chains

Ten Carbon Chain

Origin of Petroleum

- Inorganic or Organic?
- Debated for many years
- Now most scientist agree on ORGANIC origin
- Oil forms from the decay and transformation of dead organisms buried in sedimentary rocks
Factors required to make an Oil deposit

- Source rock - rich in organic matter
- Burial heating -> maturation
- Reservoir rock - porous and permeable
- Trap-
  - structural trap
  - stratigraphic trap
**Source Rocks**

- Black organic-rich marine shales
- Organic matter is preserved low-oxygen water
- Restricted marine basins and zones were water rises from the deep

**Maturation of Organic Matter**

- Organic matter in sediments is solid (kerogen)
- At about 60°C transformation begins
  - Liquid hydrocarbons begin to form
- At 120°C gas begins to form
- At 140°C organic matter is exhausted
- Only gas forms at higher T
**Migration of oil**

- Oil is less dense than water
- Oil will move up by buoyancy
- Oil needs a permeable bed to move
- It will stop when it reaches an impermeable bed

*Figure 1. Definitions of primary and secondary migration. (After Tissot and Welte, 1984.)*
Oil traps
- Permeable reservoir bed
- Impermeable seal
- A trap

Porosity

Hydrocarbon Trap Types
- Anticline
- Fault
- Pinchout
- Salt Dome
- Unconformity

American Petroleum Institute, 1950
3D Geological Model

Drilling Rig
Drill Rig

Off shore drilling (Brazil)
Offshore Platform

Roncador Platform (Brazil)