Introduction

- **Petroleum** is a naturally occurring, flammable liquid found in rock formations in the Earth consisting of a complex mixture of hydrocarbons of various molecular weights, plus other organic compounds.
  - Petra = Rock
  - Oleum = oil
  - L. *petroleum*. *"rock oil"* was first used in the treatise *De re metallica* published in 1556 by the German mineralogist Georg Bauer.

Petroleum

- World's foremost source of energy
- Oil accounts for 38% of all energy use worldwide
- Petroleum has high energy density which allows it to be used for heating homes, generating electricity, fueling transportation, etc.

History

- Initially, hydrocarbons collected from oil seeps- "springs" discharging liquid hydrocarbons.
- Usage of the hydrocarbon included warfare, medication (externally on wounds and rheumatism, internally as laxative), waterproofing.

History

- In 1847- James Young began retorting (a method of distillation by heat) oil from oil shale's in Scotland.
- Products and their uses included paraffin, used for candles, and kerosene (coal oil), used for lamps.

History

- Kerosene became cheaper than whale oil (which previously had been used in lamps)- this greatly expanded the demand for oil products- **The first oil boom**.

History

- In 1859, "Colonel" Drake drilled a well to 59 feet and produced oil at Oil Creek PA. This well marked the beginning of the modern oil "bidness" where large volumes of hydrocarbons were extracted from the subsurface.
- As a result of this discovery, so much oil was discovered and produced that the price of kerosene dropped to nearly nothing. **The first oil bust**

History

- The oil bust continued until the mass production of the internal combustion engine, and the development of mass produced automobiles. The auto created another large demand for hydrocarbon products, and caused a **second oil boom**

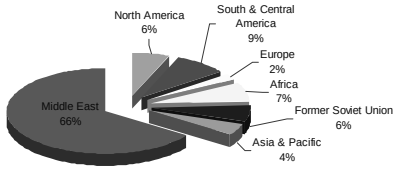
History

- With the second oil boom, and first world war, large multinational oil companies developed. The seven Sisters: BP, Shell, Exxon, Gulf, Texaco, Mobil, Socal, among other "minor" companies, and thousands of "independent" oil companies.
- The major and some of the minor oil companies are vertically integrated- that is they explore, produce, refine, and market the products. Thus when crude oil prices are low, they make money in the refining business, when crude oil prices are high, they make money in the exploration/production business.

History

- In 1960, Organization of Petroleum Exporting Countries (OPEC) was founded. Consist of countries whose economy is based on oil exports. Countries include Iraq, Iran, Kuwait, Saudi Arabia, Venezuela, Algeria, Dubai, Ecuador, Gabon, Indonesia, Libya, Nigeria, Qatar, and United Arab Emirates.
- By the 1970's, OPEC countries produced 2/3 of the worlds oil. Thus controlled the price of crude oil. By limiting production, the price increased rapidly through the 1970's

World Crude Reserves



as percent of 1296 thousand million barrel total

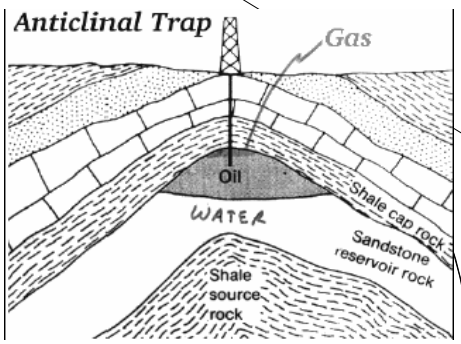
History

- The result was conservation, a world wide recession, and drop in consumption of oil.
- About the same time, major oil deposits were discovered in the North Sea. The combined drop in consumption and the increase in production from the North Sea (largely from Norway), caused a major slump in oil prices in the early 1980's. **Another Bust**
- Since that time, prices of gasoline have remained more or less constant, and as a result consumption has risen again.

Occurrence

- Occurs mainly under the rocky strata of the earth's crust.
  - Often floating over salt water or brine.
- Together with the oil, a certain amount of gas is usually associated in the form of a **gas cap**
- This gas cap is known as **natural gas**

Occurrence



Composition

- **Crude oil** is the term for "unprocessed" oil petroleum
- Crude oil is a **fossil fuel**
- **Crude oils vary in color**, from clear to tar-black, **and in viscosity**, from water to almost solid.
- Crude oils are comprised of **hydrocarbons** molecules that contain hydrogen and carbon and come in various lengths and structures, from straight chains to branching chains to rings.

Composition

- Crude Oil is extracted from the earth and can be refined into various forms:
  - Natural gas
  - Gasoline
  - Kerosene
  - Fuel and lubricating oils
  - Asphalt

Composition

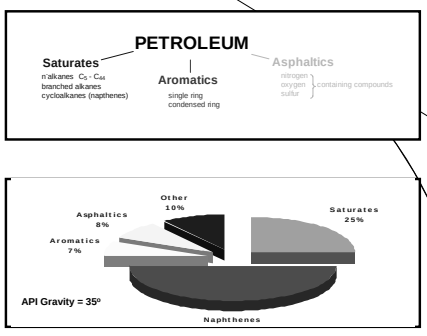
Crude Oil Products

- **Petroleum gas** - used for heating, cooking, making plastics
- **Naphtha** or **Ligroin** - intermediate that will be further processed to make gasoline
- **Gasoline** - motor fuel
- **Kerosene** - fuel for jet engines and tractors; starting material for making other products
- **Gas oil** or **Diesel distillate** - used for diesel fuel and heating oil; starting material for making other products
- **Lubricating oil** - used for motor oil, grease, other lubricants
- **Heavy gas** or **Fuel oil** - used for industrial fuel; starting material for making other products
- **Residuals** - coke, asphalt, tar, waxes; starting material for making other products for making other products

Composition

- Petroleum is a mixture of a very large number of different hydrocarbons; the most commonly found molecules are
  - Alkanes (linear or branched),
  - Cycloalkanes,
  - Aromatic hydrocarbons
  - Hetero aromatic hydrocarbons
  - more complicated chemicals like asphaltenes.
- Each petroleum variety has a unique mix of molecules, which define its physical and chemical properties, like color and viscosity

Composition



Composition

- The proportion of hydrocarbons in the mixture is highly variable and ranges from as much as 97% by weight in the lighter oils to as little as 50% in the heavier oils and bitumens.

Composition

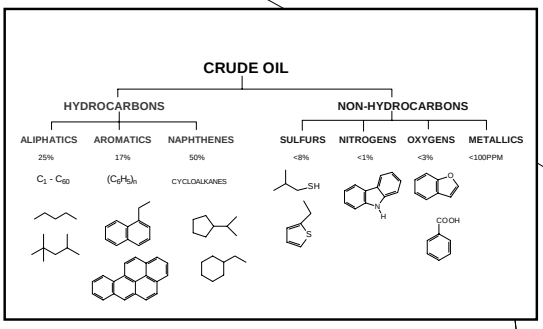
Carbon	83-87%
Hydrogen	10-14%
Nitrogen	0.1-2%
Oxygen	0.1-1.5%
Sulfur	0.5-6%
Metals	<1000 ppm

Composition

Hetero Aromatic Hydrocarbons

- They main "other" elements in crude oil include Oxygen, Nitrogen, and sulfur.
  - Oxygen can range between 0.06 and 0.4 wt. %
  - Nitrogen between 0.01 and 0.9 wt %
  - sulfur between 0.1 and 7 wt%
- These elements are not other compounds (e.g. H2S or free N) or contaminants
- There are also some metals, but only Nickel and Vanadium have been shown to be part of the compounds and not contaminants.

Composition



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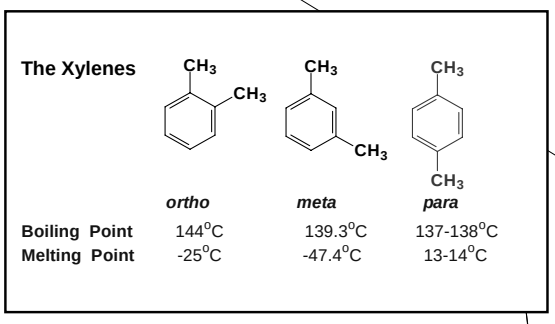

Composition

- Alkanes with < 5 carbons are gas
- Alkanes with 5 to 15 carbon atoms are liquids
- Alkanes with > 15 carbon atoms are viscous liquids and solids.
  - Largest molecule recorded from crude oil contains 78 carbons.