NATURAL MATERIALS IN PRODUCTION OF CHEMICAL PRODUCTS. BASICS OF CARBON MATERIAL CLASSIFICATION AND EXPLORATION

Discipline: *Chemical Technology of Fuel and Carbon Materials*
Department: *Department of Fuel Engineering and Chemical Cybernetics*
Lecturer: *Elena Khlebnikova*

COVERED TOPICS

1. CLASSIFICATION SYSTEMS

1.1. CLASSIFICATION AS A HYDROCARBON RESOURCE

1.2. CLASSIFICATION BY CHEMICAL COMPOSITION

2. ORIGIN AND OCCURRENCE

2.1 ABIOGENIC ORIGIN

2.1 BIOGENIC ORIGIN

3. EXPLORATION

3.1 GRAVITY METHODS

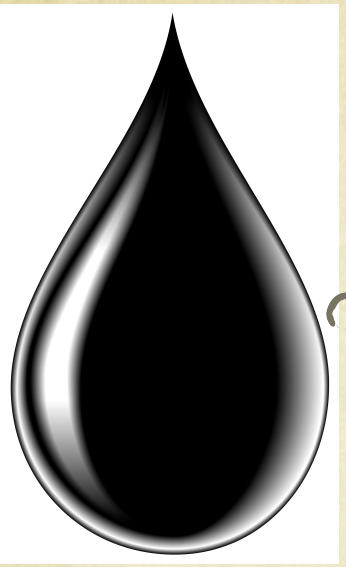
3.2 MAGNETIC METHODS

3.3 SEISMIC METHODS

3.4 ELECTRICAL METHODS

3.5 ELECTROMAGNETIC METHODS

3.6 RADIOACTIVE METHODS



By definition *petroleum* is a mixture of gaseous, liquid, and solid hydrocarbon compounds. It occurs in sedimentary rock deposits throughout the world and also contains small quantities of nitrogen-, oxygen-, and sulfur-containing compounds as well as trace amounts of metallic constituents.

- Any naturally occurring hydrocarbon, whether in a liquid, gaseous, or solid state

- Any naturally occurring mixture of hydrocarbons, whether in a liquid, gaseous or solid state

- Any naturally occurring mixture of one or more hydrocarbons, whether in a liquid, gaseous, or solid state and one or more of the following, that is to say, hydrogen sulfide, helium, and carbon dioxide

1. CLASSIFICATION SYSTEMS

1.1. CLASSIFICATION AS A HYDROCARBON RESOURCE

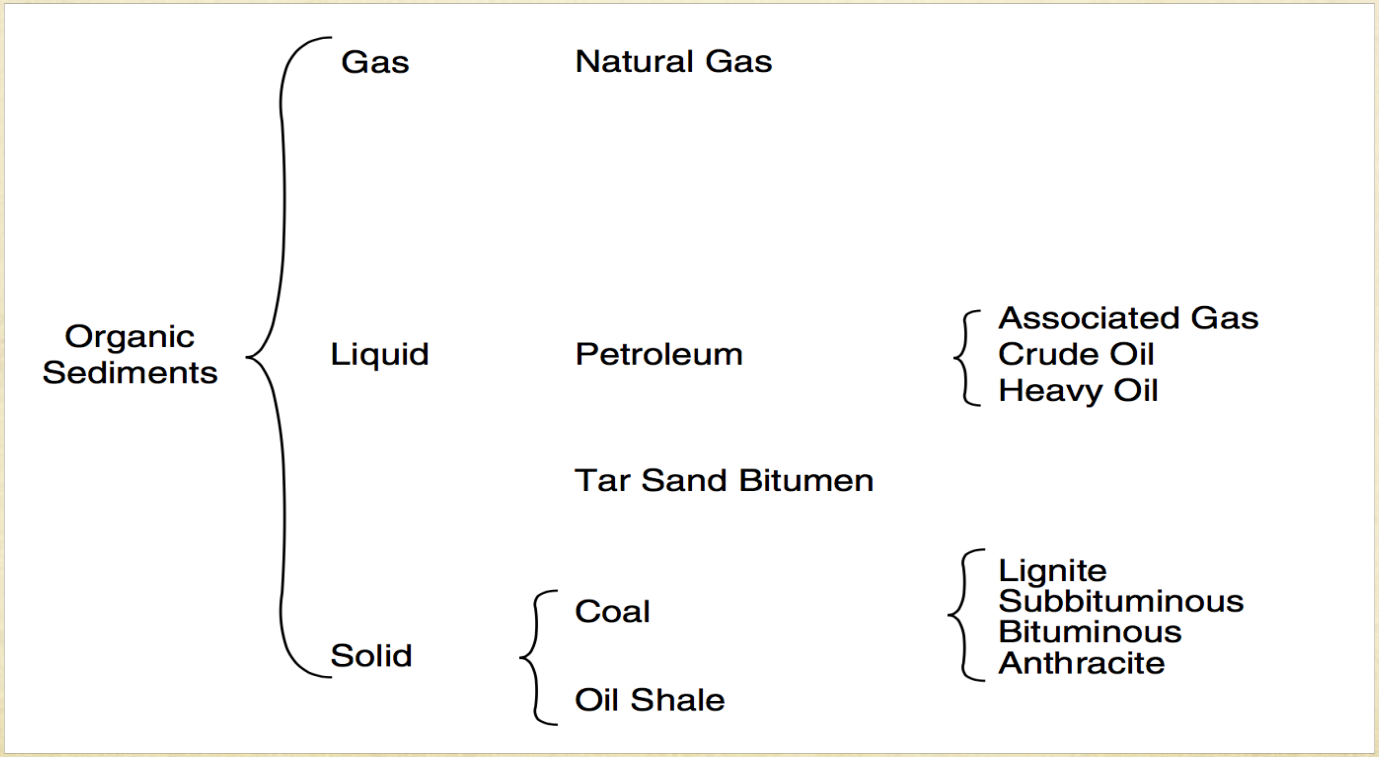


FIGURE 1 - Subdivision of the earth's organic sediments

- ✓ The inclusion of coal and oil shale kerogen in the category hydrocarbon resources is due to the fact that these two natural resources (coal and oil shale kerogen) will produce hydrocarbons on high-temperature processing.

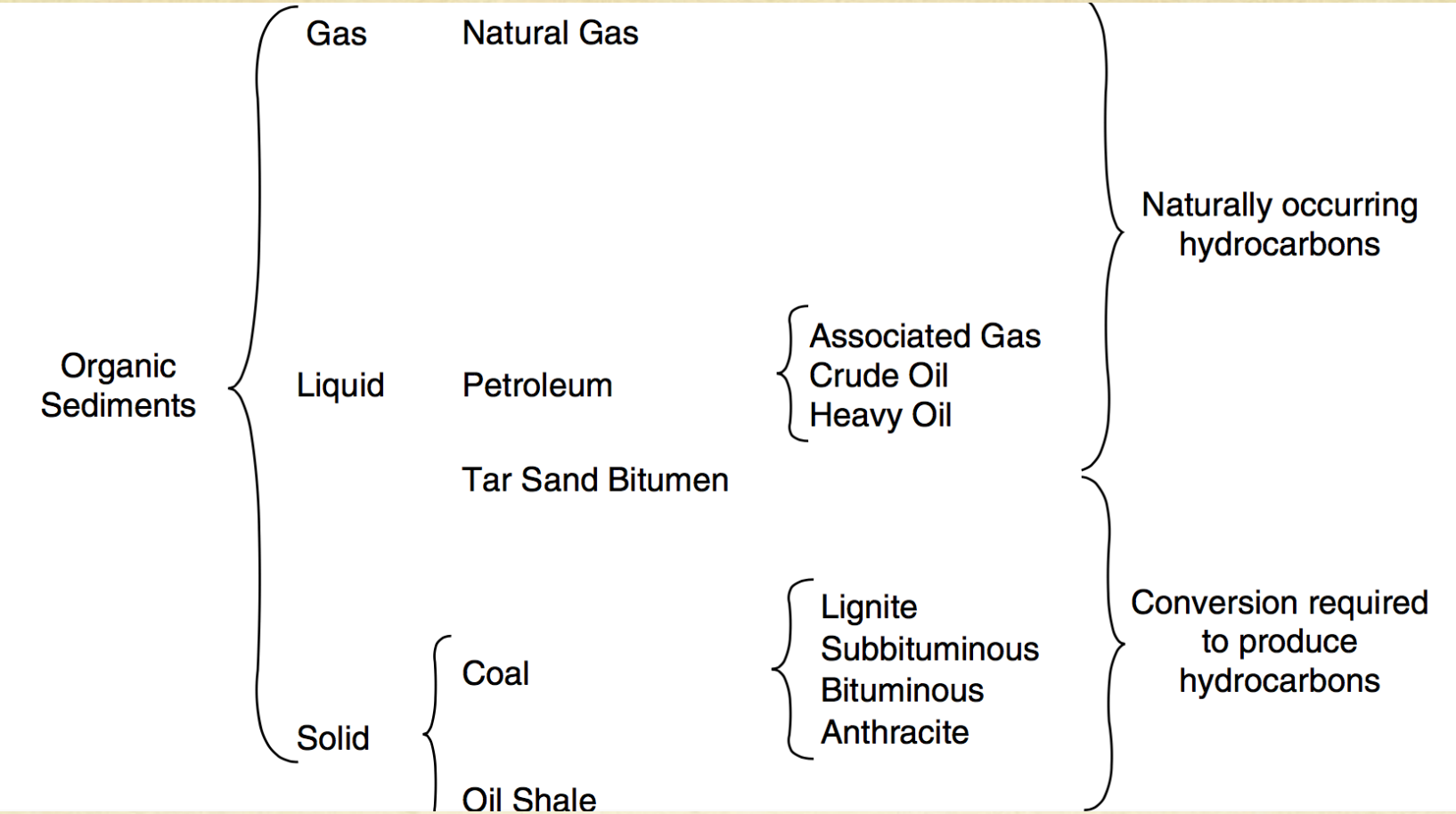


FIGURE 2 Classification of the earth's organic sediments according to hydrocarbon occurrence and production.

The classification of petroleum and natural gas as naturally occurring mixtures of hydrocarbons occurs by virtue of the fact that they can be separated into their original hydrocarbon constituents that have not been altered by any applied process.

1.2. CLASSIFICATION BY CHEMICAL COMPOSITION

Composition refers to the specific mixture of chemical compounds that constitute petroleum. The composition of these materials is related to the nature and mix of the organic material that generated the hydrocarbons.

The hydrocarbons found in petroleum are classified into the following types:

- *Paraffins*, i.e., saturated hydrocarbons with straight or branched chains, but without any ring structure
- *Cycloparaffins* (naphthenes), i.e., saturated hydrocarbons containing one or more rings, each of which may have one or more paraffin side-chains
- *Aromatics*, i.e., hydrocarbons containing one or more aromatic nuclei such as benzene, naphthalene, and phenanthrene ring systems that may be linked up with (substituted) naphthalene rings or paraffin side-chains

2. ORIGIN AND OCCURRENCE

- In recent years, the average quality of crude oil has worsened. However, it is now believed that there has been a recent tendency for the quality of crude oil feedstock to stabilize. Be that as it may, the nature of crude oil refining has changed considerably.

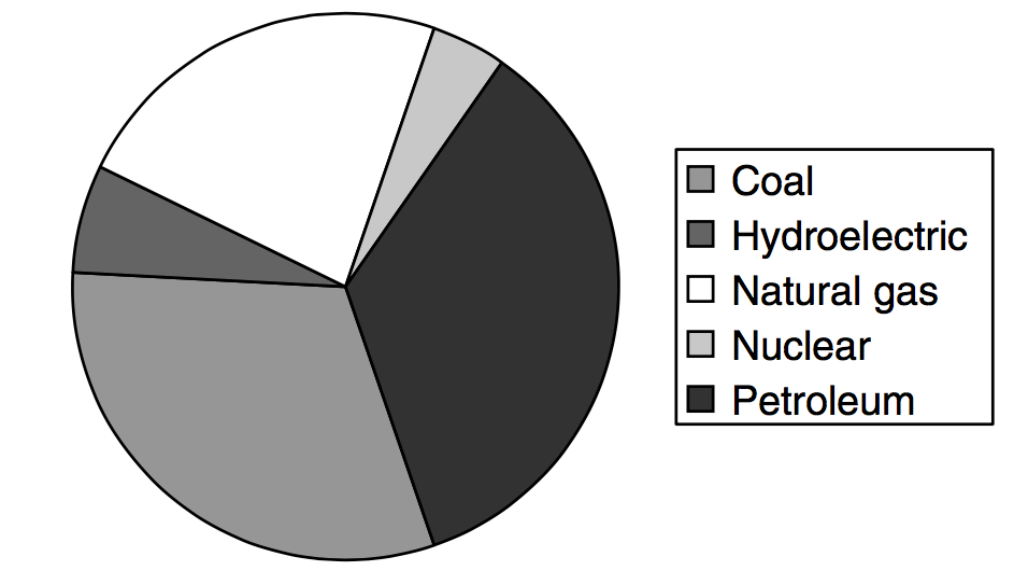
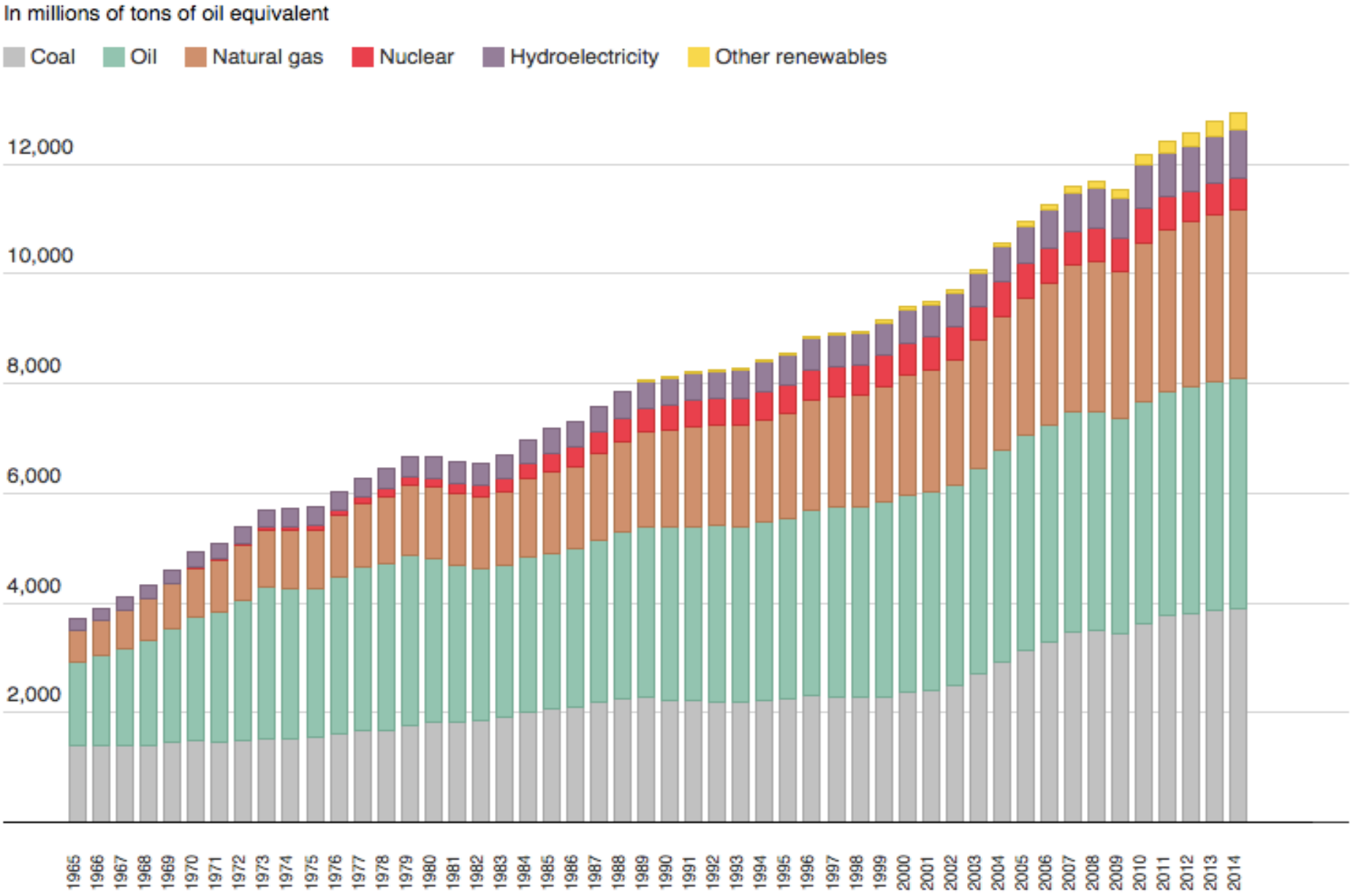


FIGURE 3 Distribution of world energy resources

Global energy use by source



Source: BP Statistical Review of Energy 2015

2.1 ABIOGENIC ORIGIN

In 1866 it was considered acetylene the basic material and crude oil constituents were produced from the acetylene. Initially, inorganic carbides were formed by the action of alkali metals on carbonates after which acetylene was produced by the reaction of the carbides with water.

$CaCO_3$ + alkali metal → CaC_2 (calcium carbide)

$CaC_2 + H_2O$ → HCCH (acetylene) → petroleum

- According to another theory in which acetylene is considered to be the basic material:

$Fe_3C + H_2O + H^+$ → hydrocarbons → petroleum

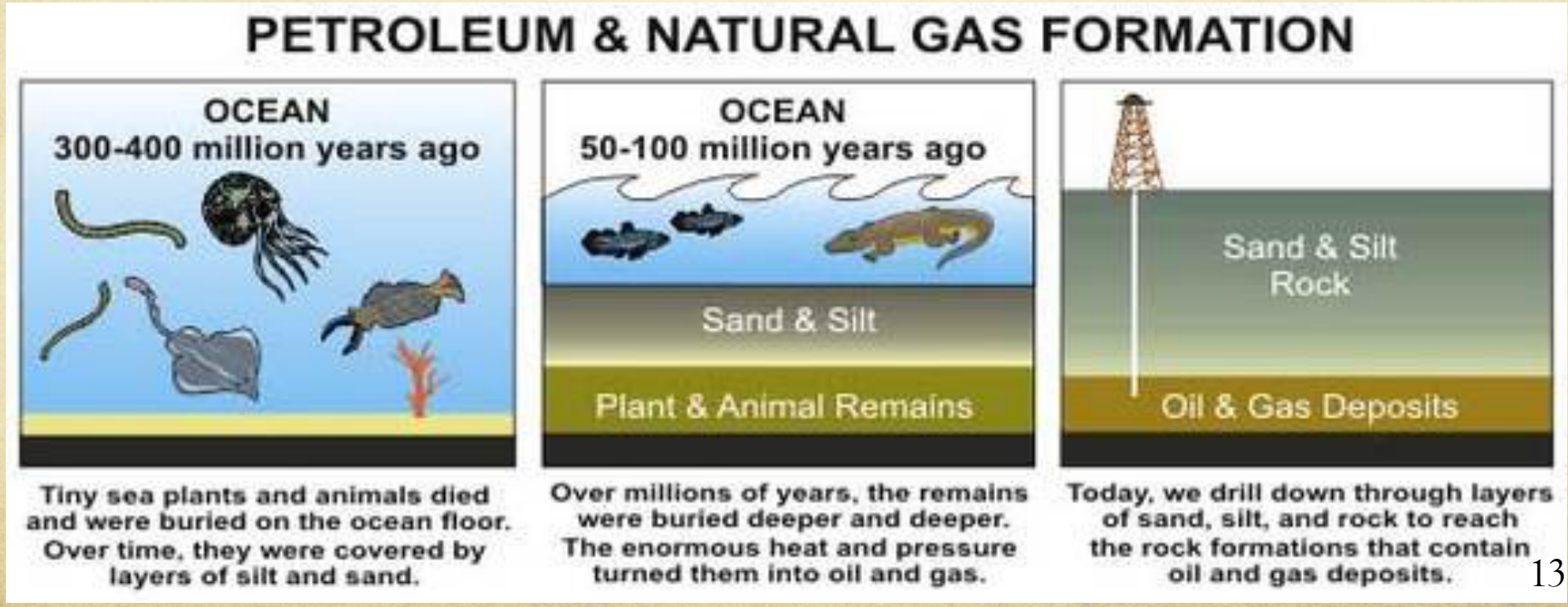
$Mn_3C + H_2O + H^+$ → hydrocarbons → petroleum

2.1.2 BIOGENIC ORIGIN

Petroleum is a naturally occurring hydrocarbon mixture but hydrocarbons that are synthesized by living organisms usually account for less than 20% of the petroleum.

The remainder of the hydrocarbons in petroleum is produced by a variety of processes that convert other organic material to hydrocarbons as part of the maturation processes generally referred to as **diagenesis**, **catagenesis**, and **metagenesis**.

During the past 600 million years, incompletely decayed plant and animal remains have become buried under thick layers of rock. It is believed that petroleum consists of the remains of these organisms but it is the small microscopic plankton organism remains that are largely responsible for the relatively high organic carbon content of fine-grained sediments like shale that are believed to be the principle source rocks for petroleum.



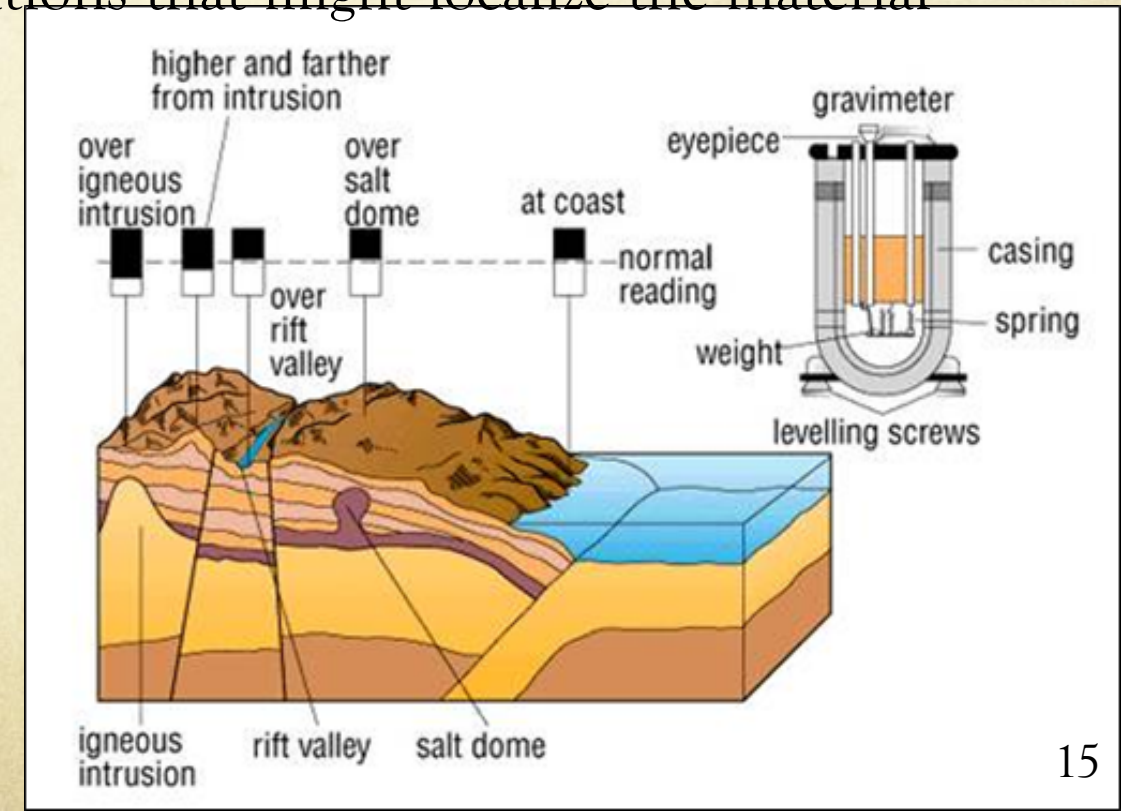
3. EXPLORATION

- Exploration for petroleum originated in the latter part of the nineteenth century when geologists began to map land features to search out favorable places to drill for oil .

- The principles used are basically **magnetism** (magnetometer), **gravity** (gravimeter), and **sound waves** (seismograph). These techniques are based on the physical properties of materials that can be utilized for measurements and include those that are responsive to the methods of applied geophysics.

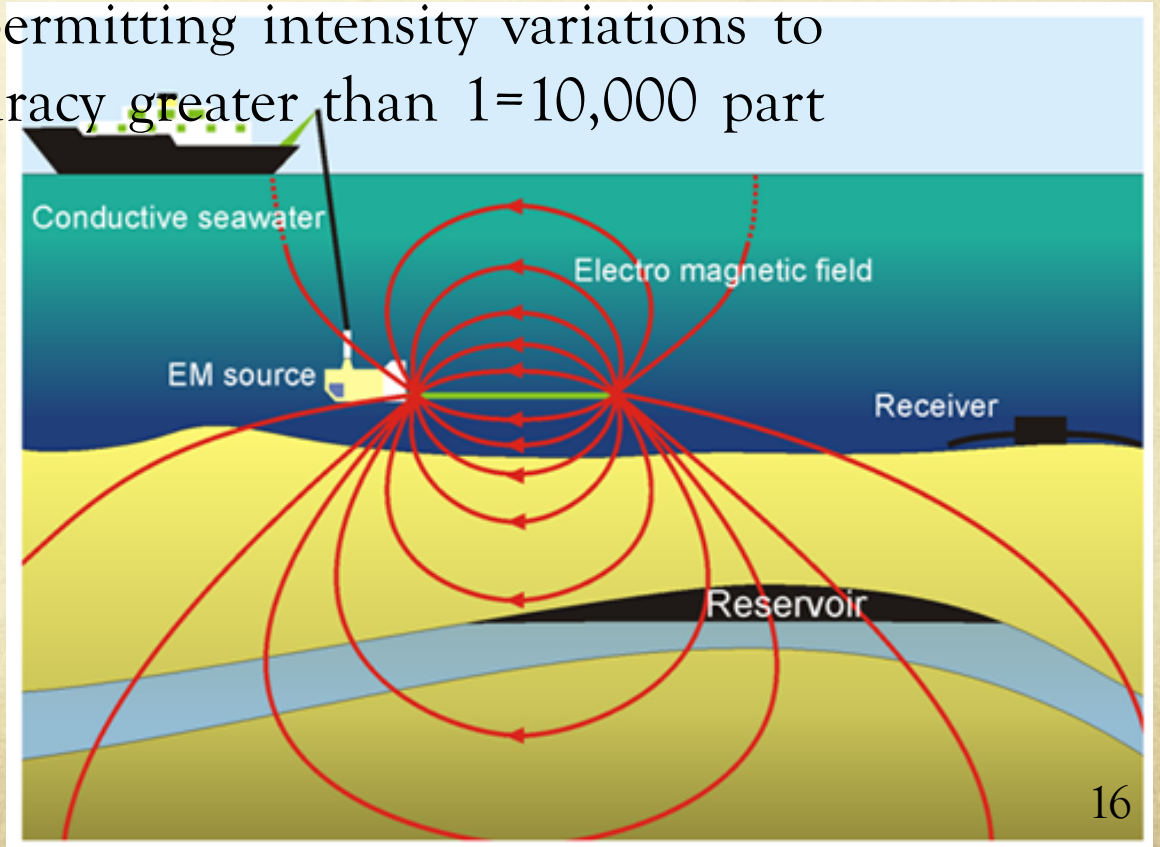
1. GRAVITY METHODS

Gravity methods are based on the measurement of physical quantities related to the gravitational field, which in turn are affected by differences in the density and the disposition of underlying geological bodies. In oil and gas exploration, in which no direct density control is associated with the material being sought, exploration is based on the mapping of geo- logical structures to determine situations that might localize the material being sought.



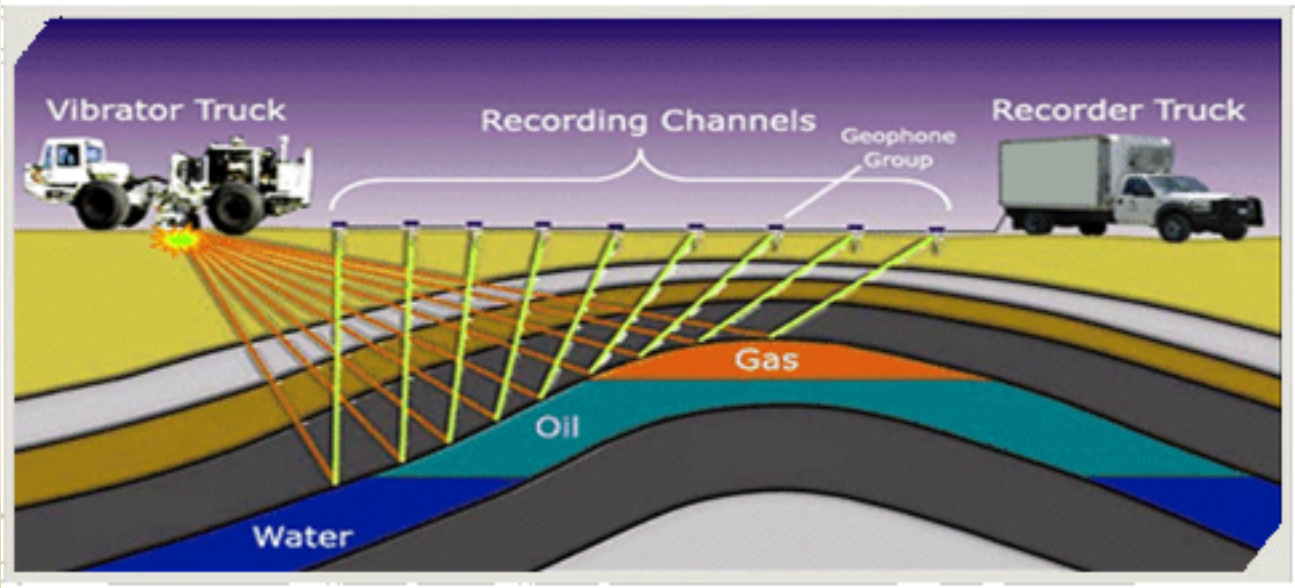
2. MAGNETIC METHODS

Magnetic methods are based upon measuring the magnetic effects produced by varying concentrations of ferromagnetic minerals, such as magnetite. Instruments used for magnetic prospecting vary from the simple mining compass used in the seventeenth century to sensitive airborne magnetic units permitting intensity variations to be measured with an accuracy greater than 1=10,000 part of the earth's field.



3. SEISMIC METHODS

Seismic methods are based on determinations of the time interval that elapses between the initiation of a sound wave from detonation of a dynamite charge or other artificial shock and the arrival of the vibration impulses at a series of seismic detectors (geophones). The arrivals are amplified and recorded along with time marks (0.01 sec intervals) to give the seismogram.



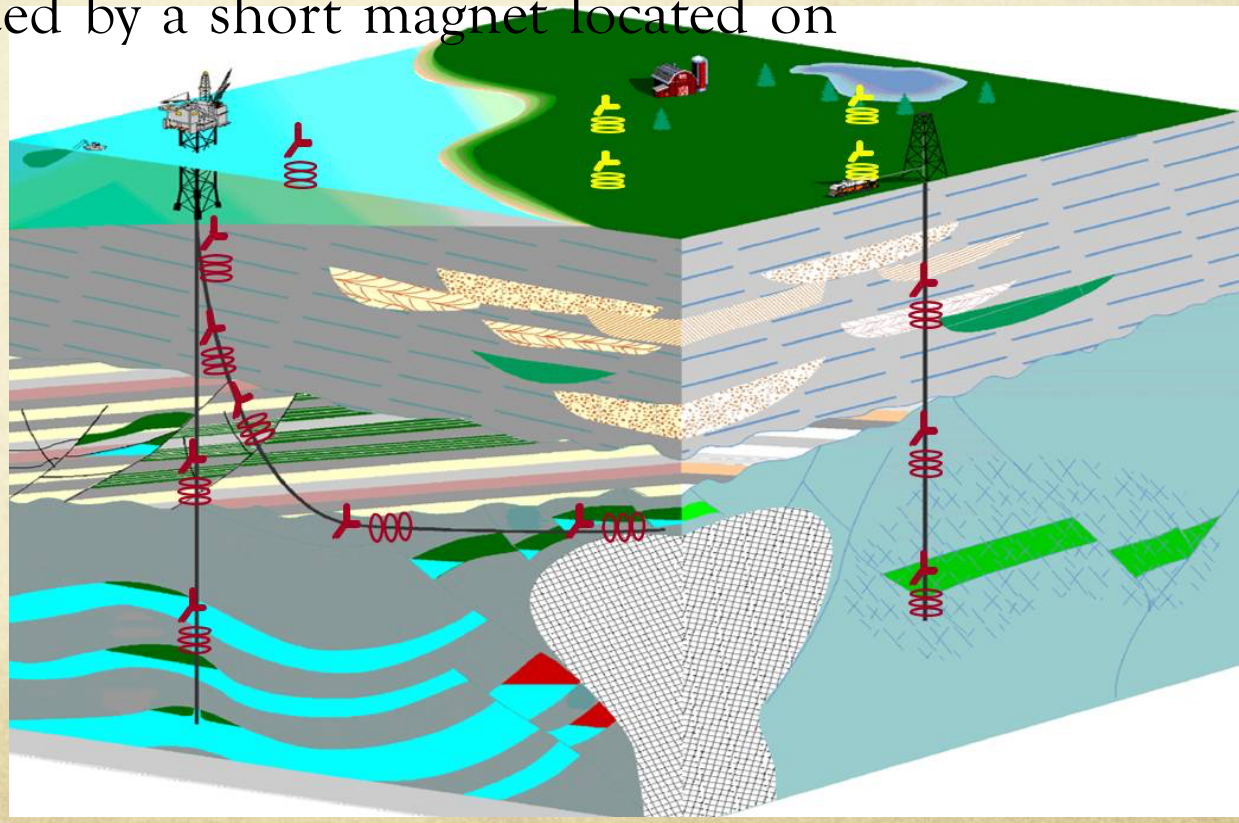
4. ELECTRICAL METHODS

Electrical prospecting methods depend upon differences in electrical conductivity between the geological bodies under study and the surrounding rocks.

The resistivity of the last depends largely on the amount and electrolytic nature (salinity) of the included water.

5. ELECTROMAGNETIC METHODS

Electromagnetic methods are based upon the concept that an alternating magnetic field causes an electrical current to flow in conducting material. Measurements are carried out by connecting a source of alternating current to a coil of wire, which acts as a source for a magnetic field similar to that which will be produced by a short magnet located on the axis of the coil.



6. RADIOACTIVE METHODS

In the disintegration of radioactive minerals three spontaneous emissions take place, the election of an electron (b-ray), a helium nucleus (a-ray), and short-wavelength electromagnetic radiation (g-rays).

Different sedimentary rocks are naturally characterized by different concentrations of radioactive materials. Shale and volcanic ash give the highest g-ray count and limestone, the lowest g-ray count.