Resources

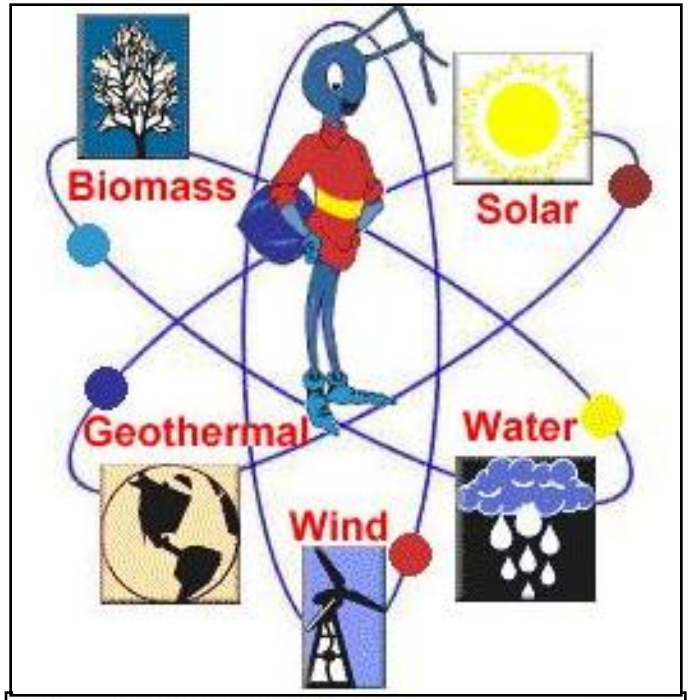
Resources are commonly divided into two categories:

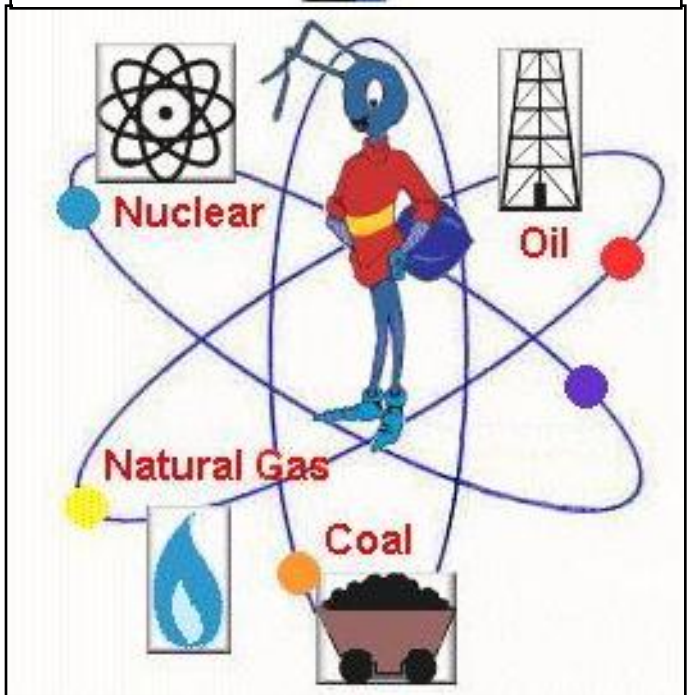
1. Renewable resource: Can be replenished over relatively short time spans such as months, years or decades.

   Example: Materials derived from animals, plant; energy derived from water, wind, sun.

2. Non-renewable resource: Processes responsible for producing these resources are extremely slow. So the deposits take millions of years to accumulate.

   Example: Mineral resources like iron, copper, gold; energy resources like coal, oil, natural gas.



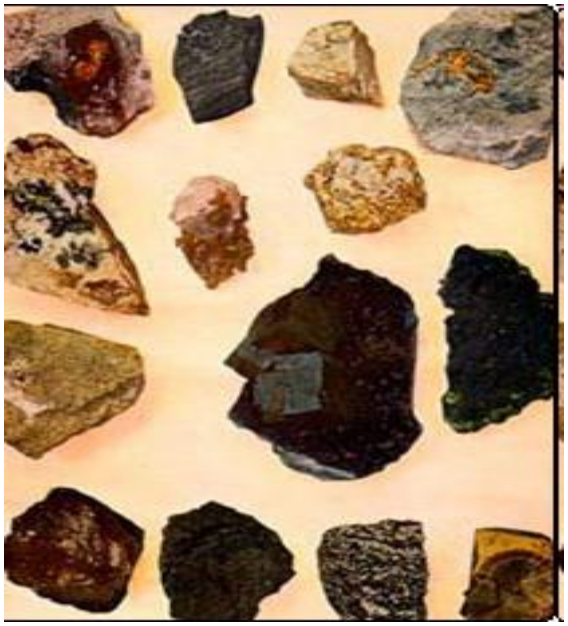


Mineral resources

-Mineral deposits from which minerals could be extracted profitably is called a reserve.

- Ore is a special rock from which one or more metals can be extracted profitably

- Generally ores are extracted from mines through mining.



Three main types of activity could result in formation of a reserve.

1. Igneous processes
2. Metamorphic processes
3. Sedimentary processes

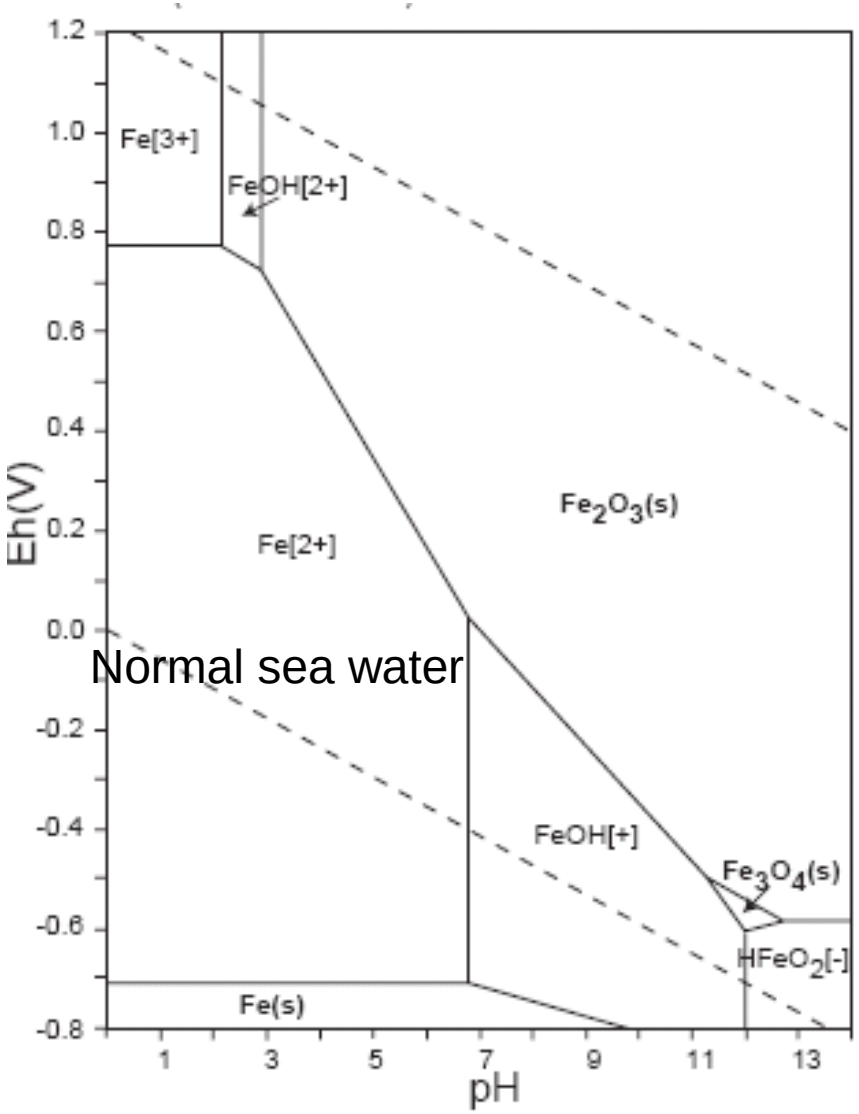
Banded Iron Formation

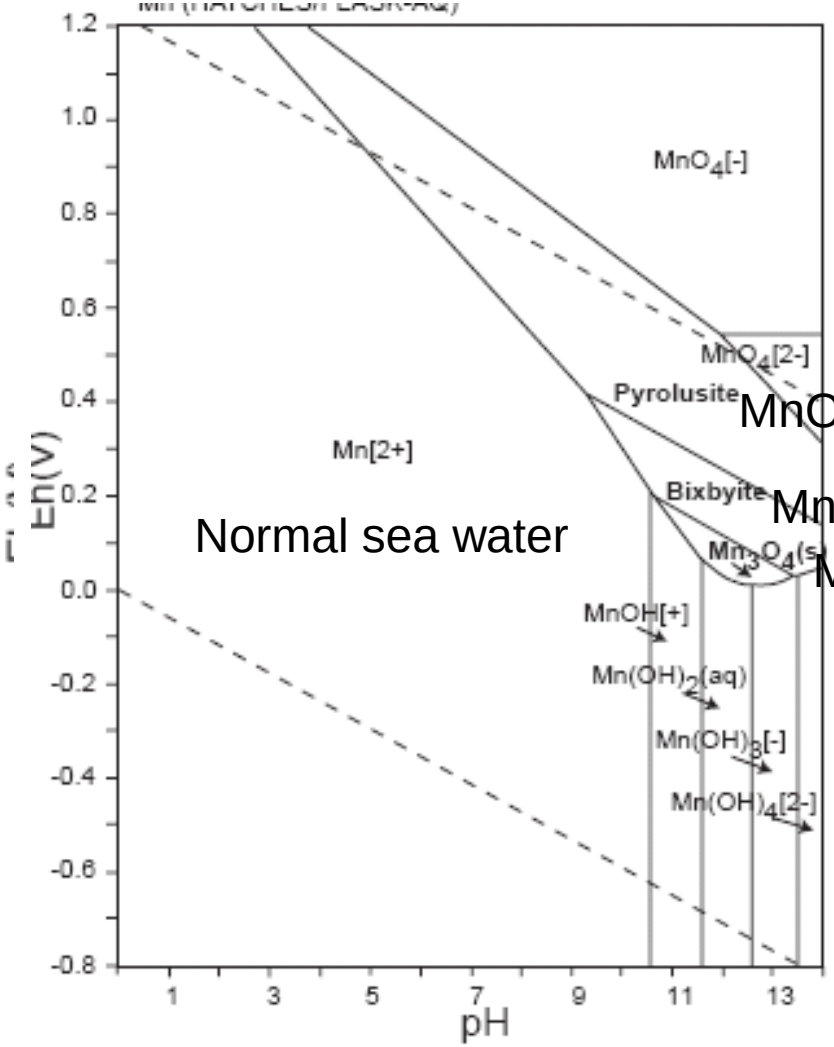
Red layers: Fe-bearing silica (chert)
Black layers: Hematite Fe_2O_3

First occurrence: 2400 Million Years ago

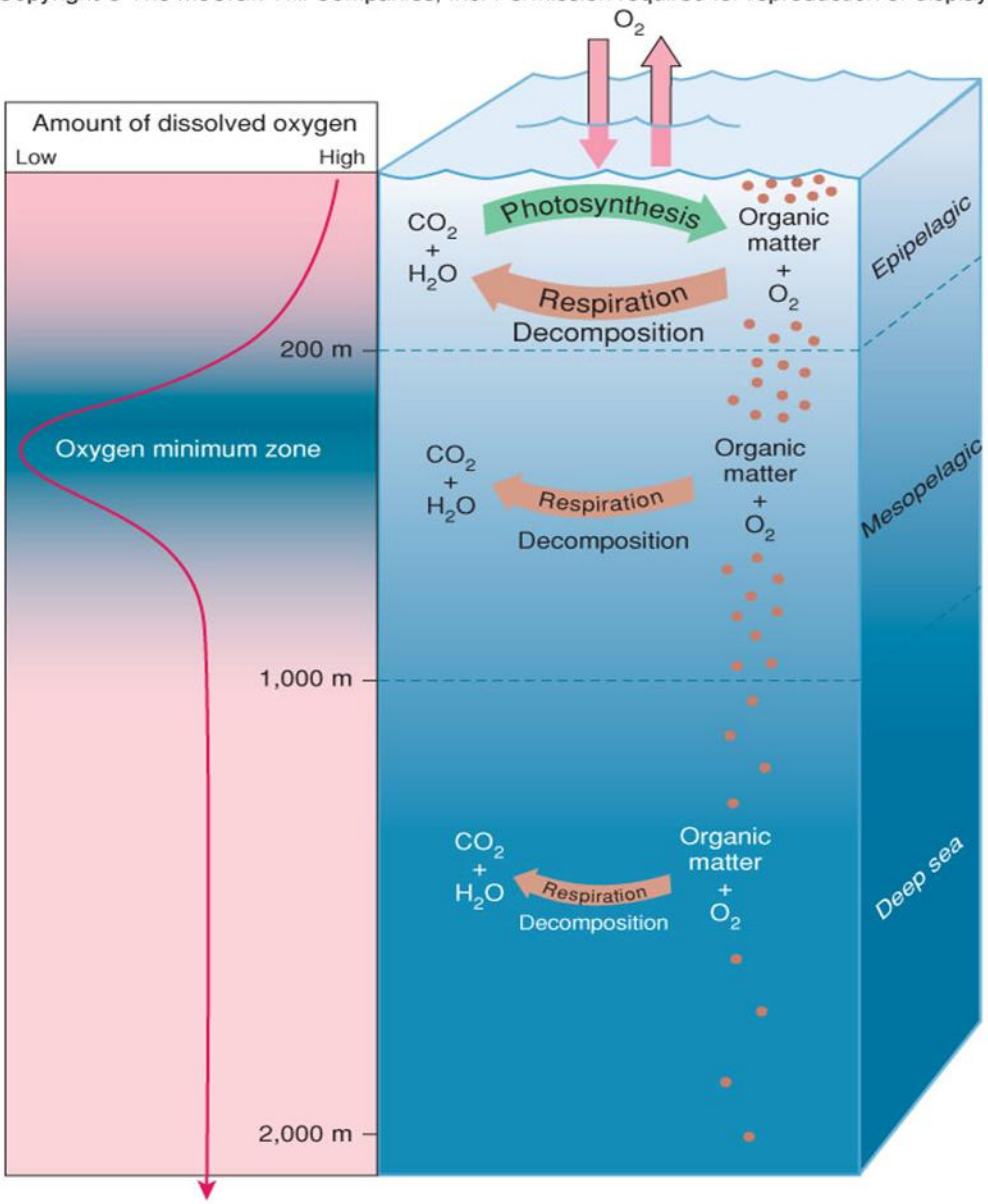
What does this signify?

Great Oxidation Event at 2200 Million Years


Fe[3+]
FeOH[2+]
Fe[2+]
$Fe_2O_3(s)$
FeOH[+]
$Fe_3O_4(s)$
$HFeO_2[-]$
Fe(s)
Eh(V)
pH
Normal sea water


$MnO_4[-]$
$MnO_4[2-]$
Pyrolusite
MnO2
Mn[2+]
Bixbyite
Mn2O3
$Mn_3O_4(s)$
Mn3O4
MnOH[+]
$Mn(OH)_2(aq)$
$Mn(OH)_3[-]$
$Mn(OH)_4[2-]$
Eh(V)
pH
Normal sea water

Do you know that modern ocean is oxygen stratified ?



Present day oceans: **Antarctic Bottom Current** makes the bottom layer oxygenated

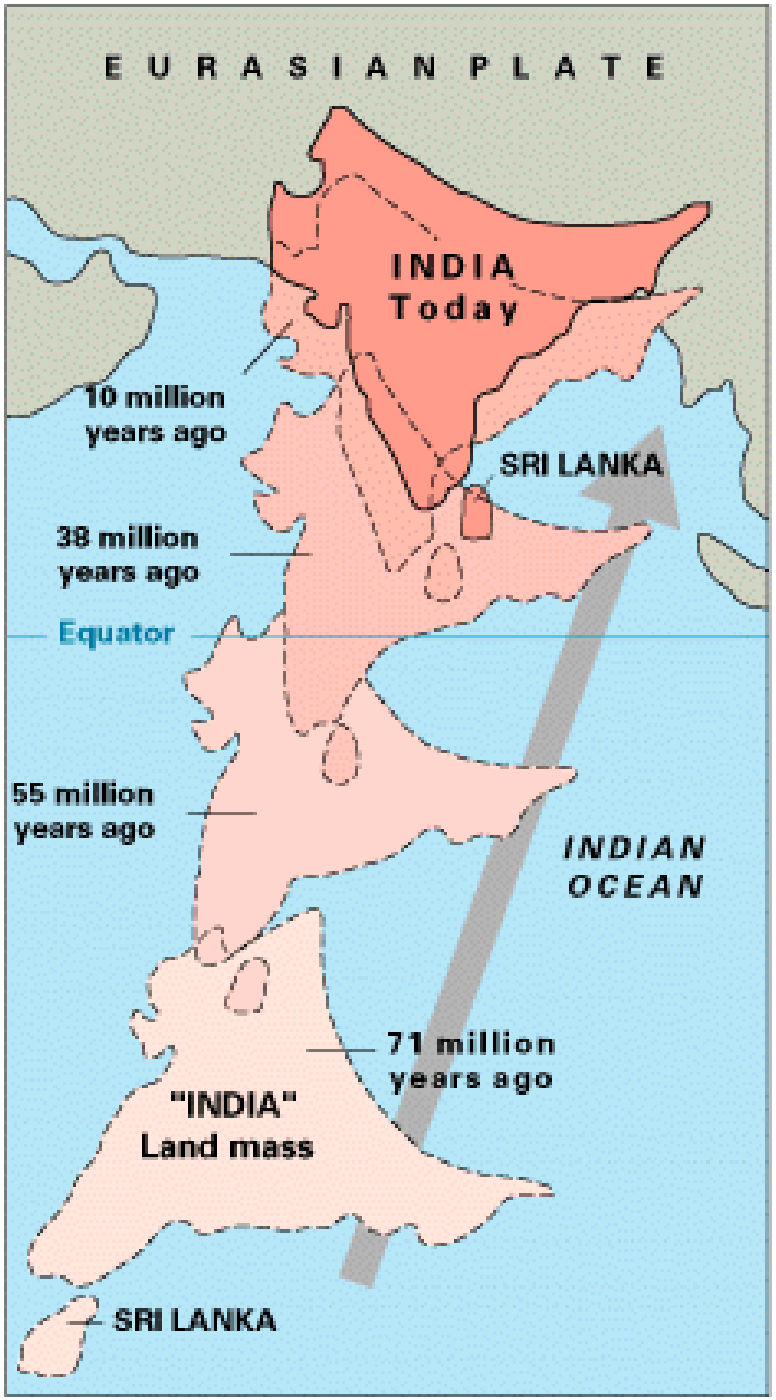
Antarctic Bottom Current originated in last 50 m.y. WHY?

Before 50 m.y. ocean water was anoxic from 200 meter depth to the bottom

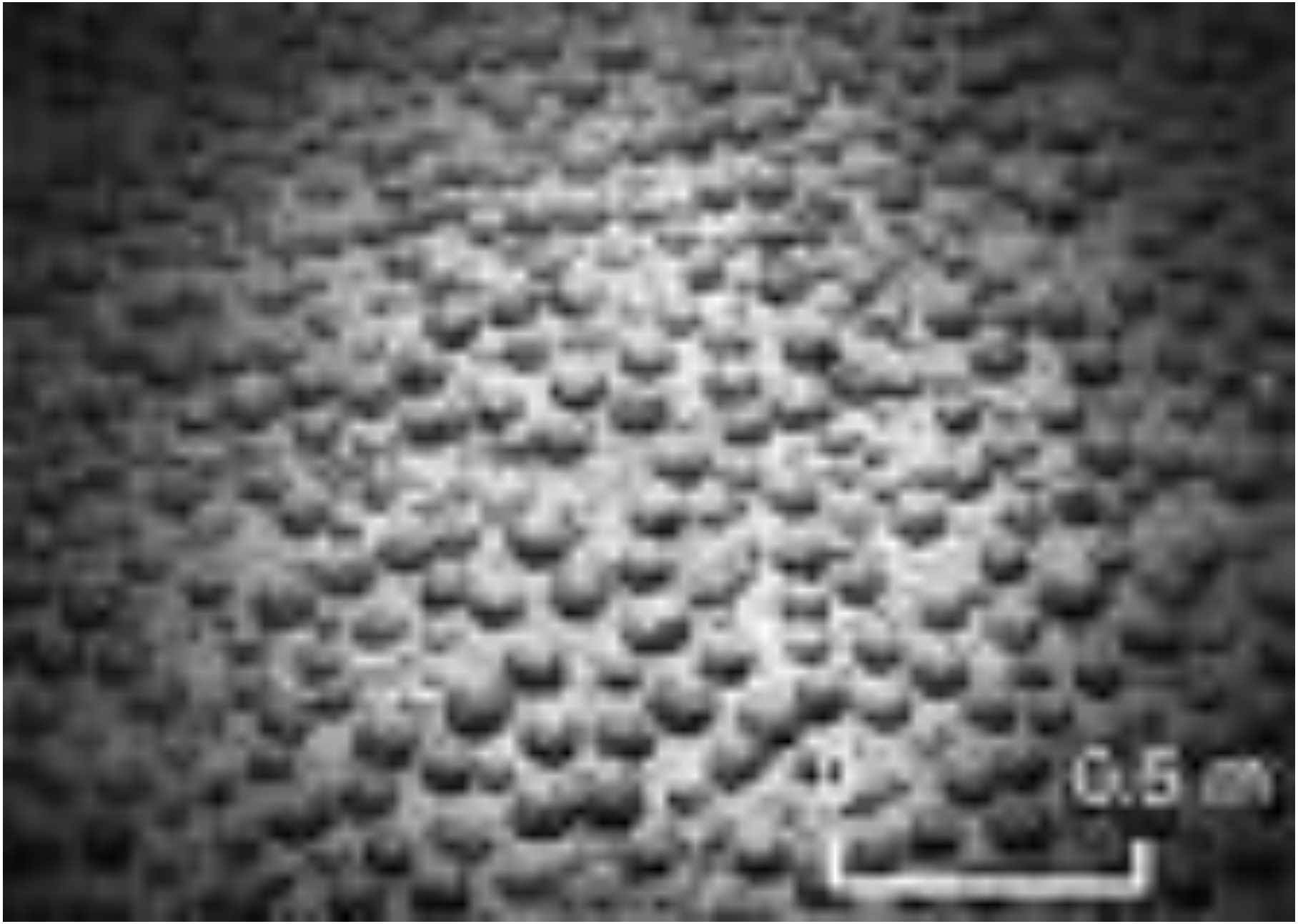
Older Fe-Mn deposits can only form at shallow water depth

Present day deposition of Mn-Fe is possible at great depth due to ABW

Pangaea approximately 200 million years ago

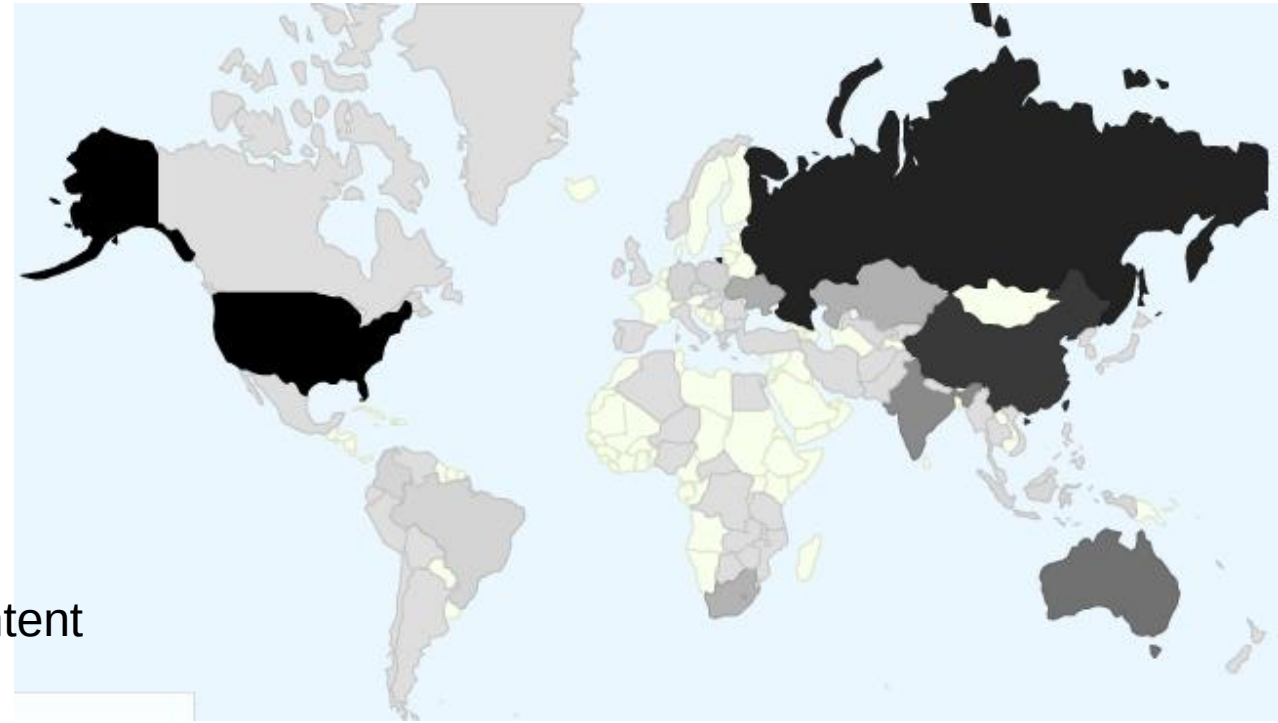


Movement of India after detachment from Antarctica


0.5 μm

Energy resources: Coal

-Non-renewable
- Forms from buried plant material
- Takes over millions years to form.
- Formation of coal



With increasing carbon content

Peat
Lignite
Bituminous coal
Anthracite

Fossil fuel: It is a fuel that contains organic remains of millions of years ago. We are burning a “fossil”.

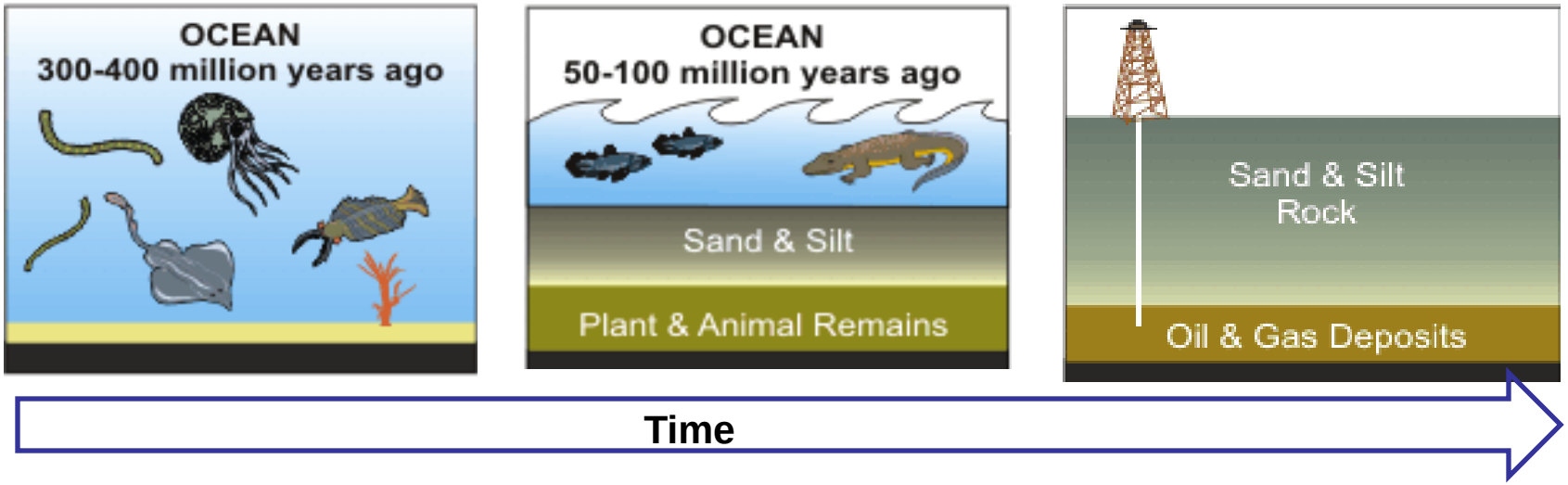
Energy resources: Oil & natural gas

-Come from the organic debris of former life: plants and microorganisms (such as bacteria and algae) that have been buried, transformed, and preserved in sediments.

-Formation:

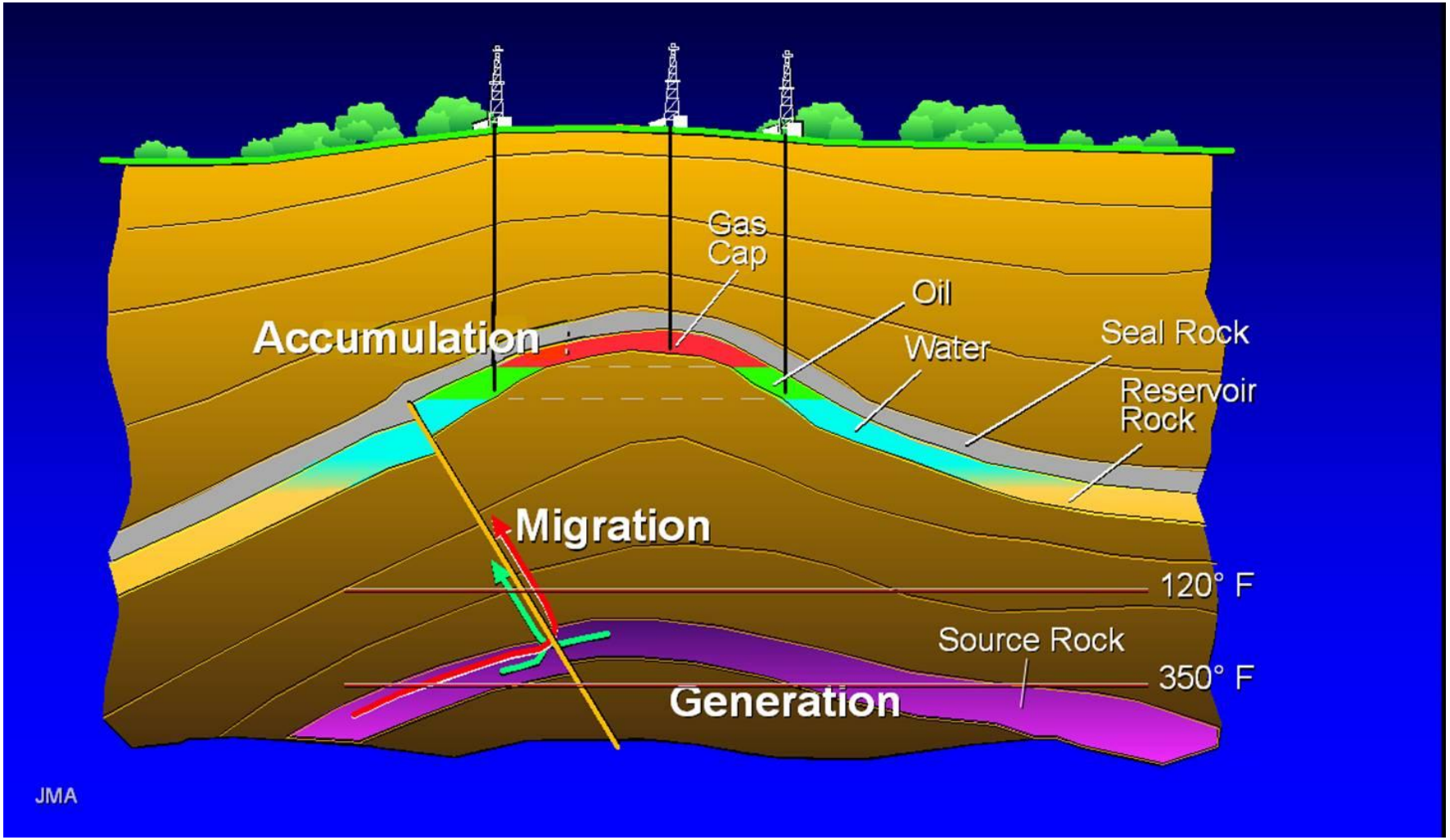
1. Oil and gas begin to form in areas with high organic matter low supply of oxygen (inadequate to decompose all the organic matter).

2. Under deep burial with elevated temp. & pressure, chemical reaction converts organic rich sediments to oil and natural gas.



Large accumulation of oil and natural gas can only occur where combinations of geologic factors create an impermeable barrier to upward migration—an oil trap.

The petroleum system



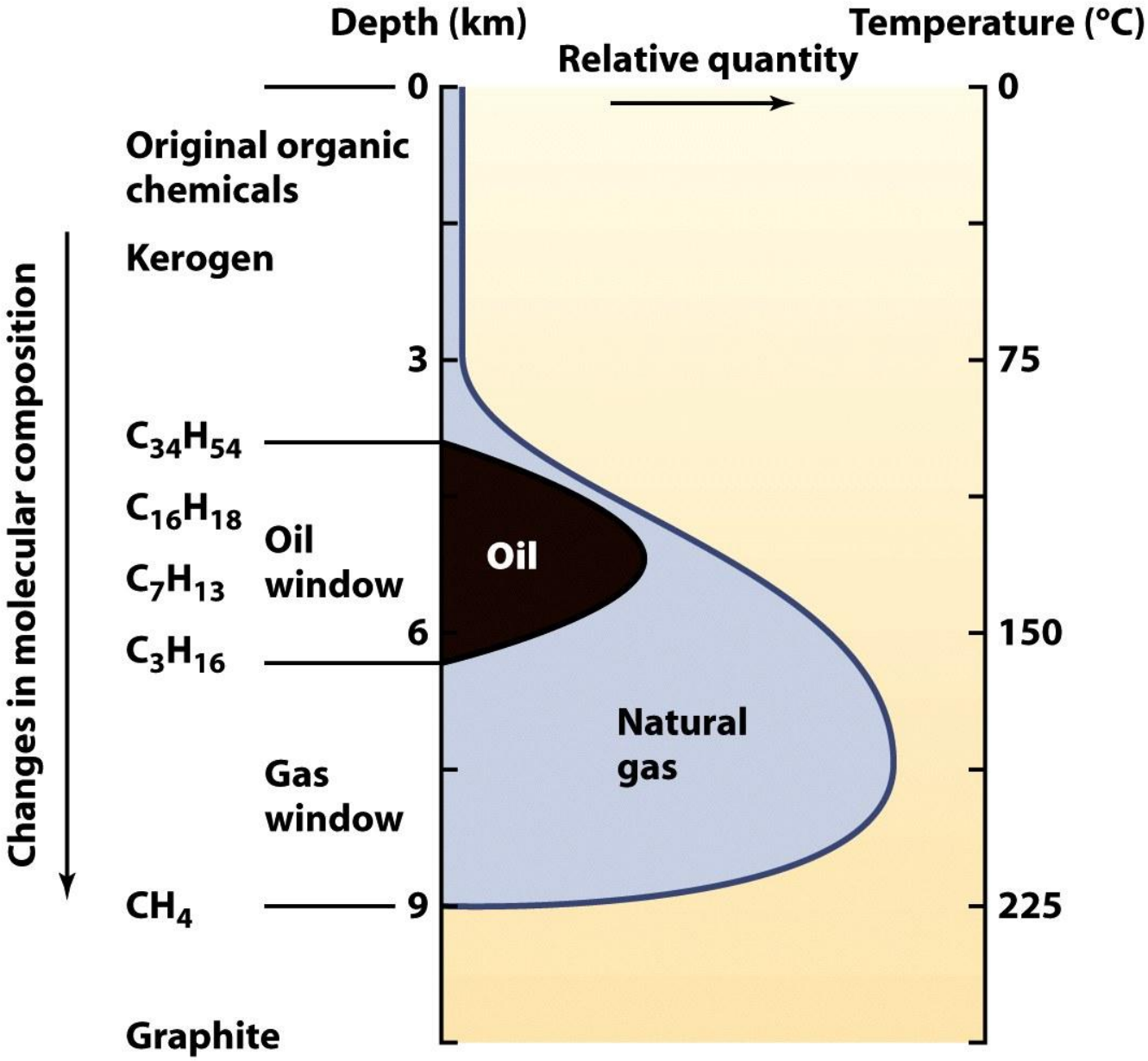


Figure 14-5 Earth: Portrait of a Planet 3/e
Adapted from Tissot et al., 1974

Carbon cycle

The carbon cycle describes the movement of carbon among its principal geochemical reservoirs: the atmosphere, the lithosphere, the hydrosphere, and the biosphere.