

# What is meant by Petroleum?

Non-renewable

1. Coal
2. Oil
3. Natural gas
4. Nuclear

Petroleum and Petrochemicals

Thick, yellow-black liquid, mixtures of solid hydrocarbons, mixtures of liquid and gases, flammable, occurring below the earth's surface called "**CRUDE OIL**"

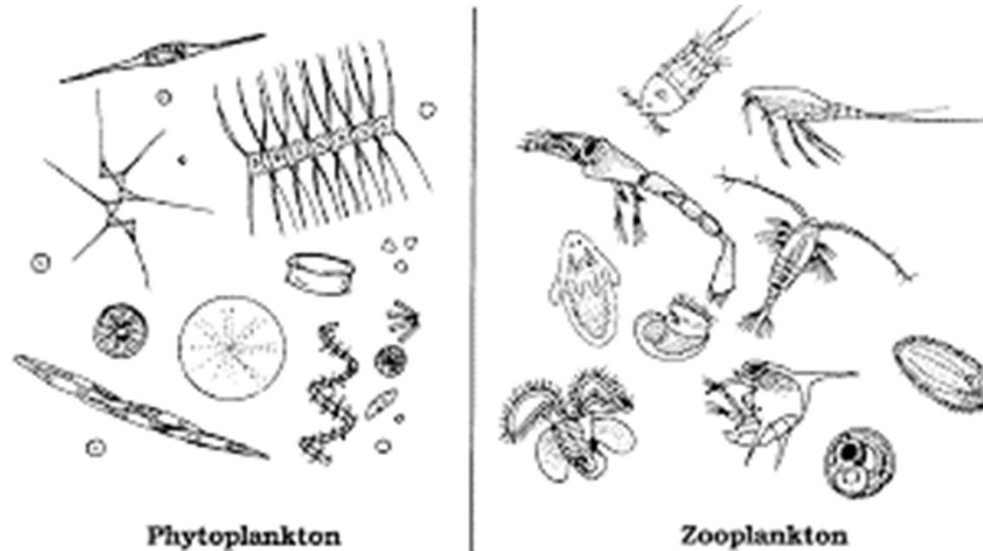
Originated from Latin word: PETRA (ROCK) + OLEUM (OIL) → **PETROLEUM**

**"CRUDE OIL"**: Mixture of various hydrocarbons, Organic & Inorganic substances, Oxygen, Nitrogen & Sulfur compounds, metals such as Iron, Vanadium, Nickel & Chromium.

**CRUDE OIL**: Overall crude oil is a very complex mixture consisting of several lakhs of compounds, whereas only few are being isolated based on differences in their BP's.

# What is the origin of all the Crude Oil?

**Plankton: Microscopic plants & animals living in oceans/water bodies**

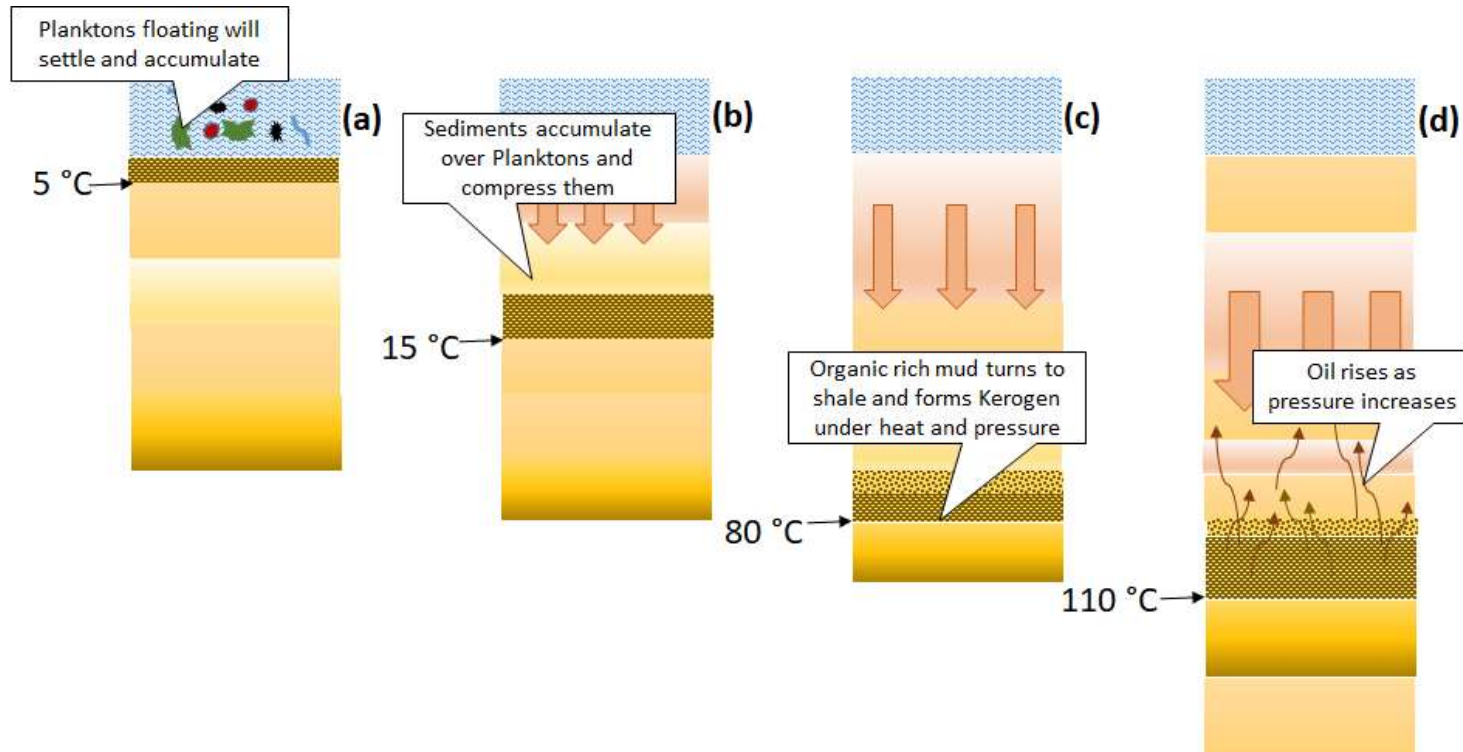


**The two major classifications of plankton are: phytoplankton (plant) and zooplankton (animal).**

**All the petroleum / crude oil is obtained from these microscopic creatures.**

Source: <http://www.forsea.org/wp-content/uploads/2019/08/F5u1a2tgST.pdf>

# Process for the formation of Crude Oil



The process begins when planktons die and the organic debris settles with the sediment.

At the bottom they keep accumulating and start forming layers along with the sediments and start exerting pressure continuously.

## Process for the formation of Kerogen

When this organic matter crosses more than 5%, it forms rocks called Black Shale (shown in all figures as dark brown layer).

More the accumulation, thicker the layer of the Black Shale.

As burial depth increases, the compression increases thereby increasing the heat and pressure

This transforms the sediments into black shale in which organic matter becomes “kerogen” (waxy molecules).

At appropriate temperatures, kerogen becomes oil, which then seeps upward slowly. I have shown here 110 °C.

# Formation of Oil, natural gas and graphite

Shale containing 15% to 30% kerogen is called oil shale.

At temperatures  $>90^{\circ}\text{C}$  kerogen molecules break into smaller oil and natural gas molecules, a process known as hydrocarbon generation.

At temperatures  $>160^{\circ}\text{C}$  , any remaining oil breaks down to form natural gas (not shown in figure)

At temperatures over  $> 225\text{--}250^{\circ}\text{C}$ , organic matter loses all its hydrogen and transforms into graphite (pure carbon).

Thus, oil itself forms only in a relatively narrow range of temperatures, called the oil window. (not shown in figure)