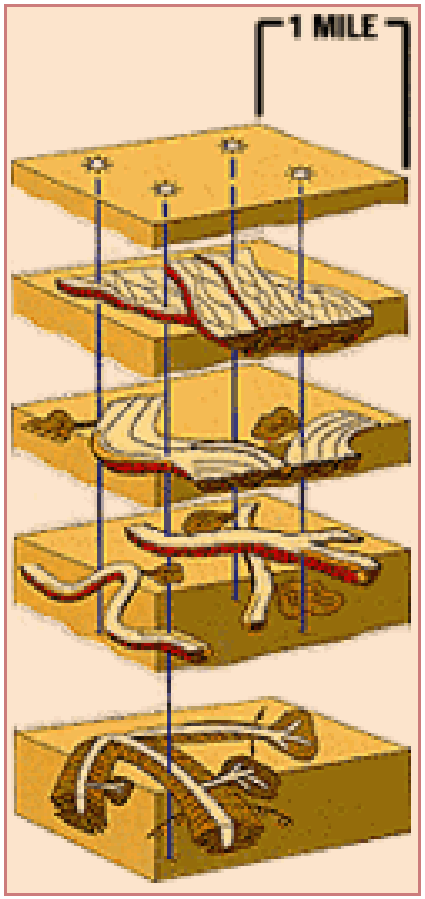
Reservoir characteristics



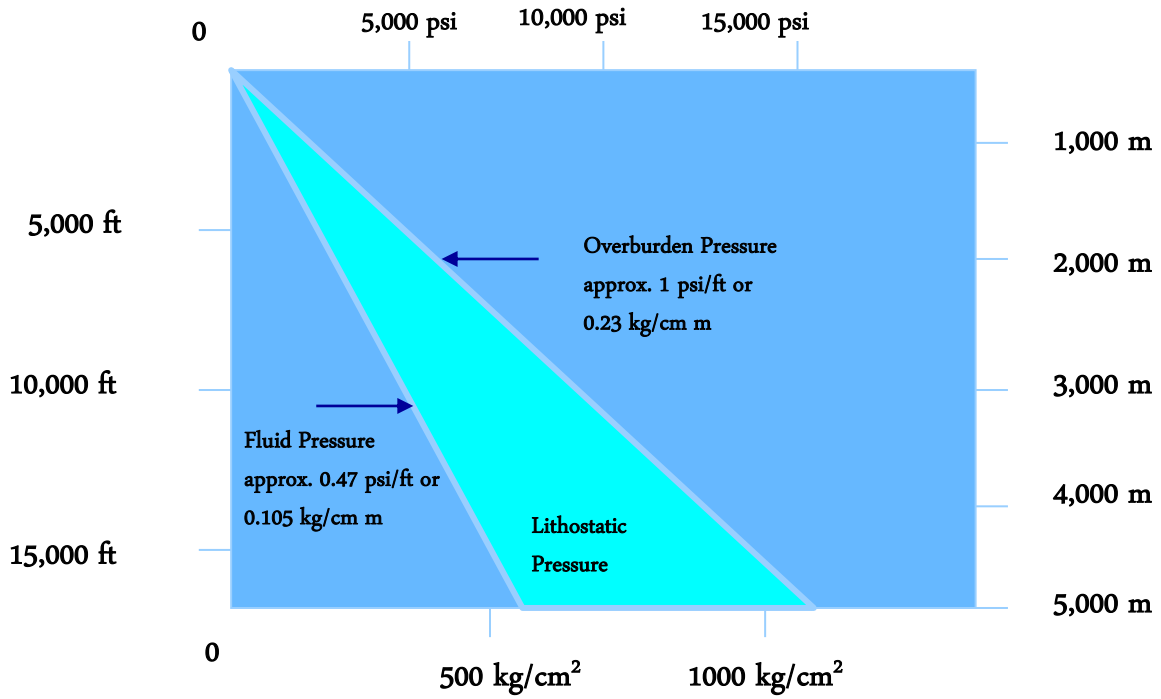
The geological subsurface structure of a reservoir is very complicated and not one reservoir is alike another one.

The shape of the formation is the result of millions of years of erosion, sedimentation, glaciers, animal life and tectonic movements.

Any oil and gas reservoir must meet a series of physical, historical and structural conditions to be commercially usable. If only one point is missing, all is lost as far as exploitation is concerned.

Subsurface Pressure

Overburden Pressure = Lithostatic Pressure + Fluid Pressure



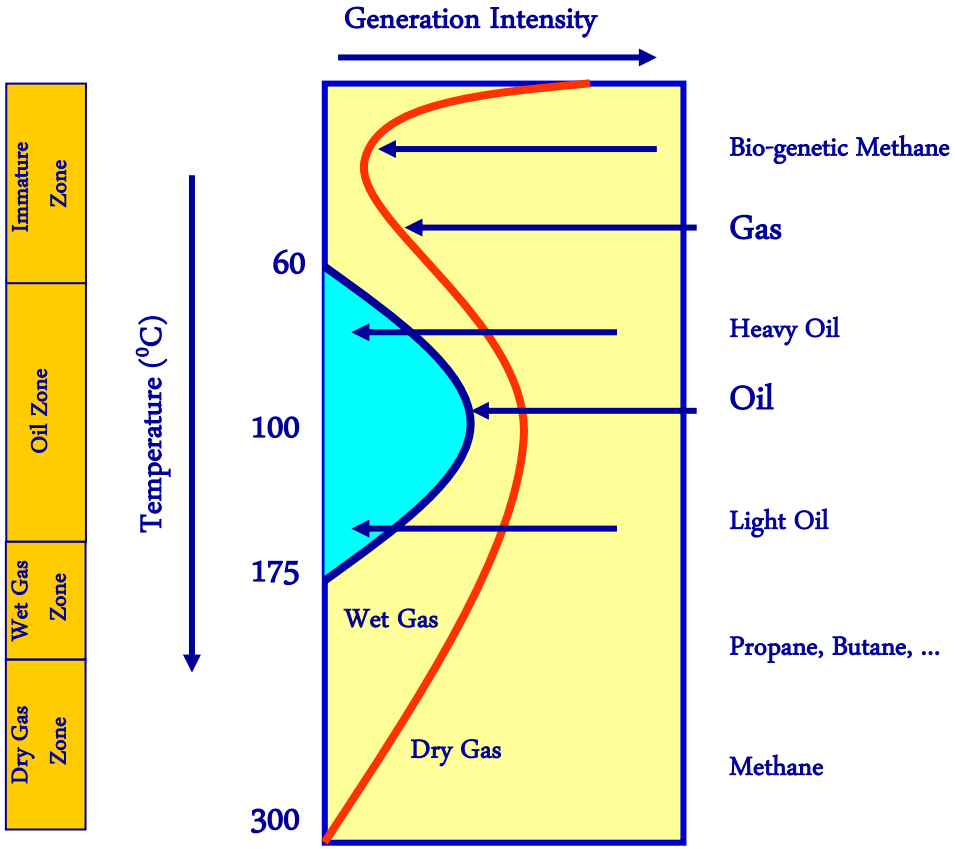
Subsurface structures are exposed to enormous pressures. Due to its mineral content subsurface water has an average density of 1.05 g/cc. The average rock density is 2.3 g/cc. Both together create pressures of e.g. 230 bar at 1,000 m or 1,150 bar at 5,000 m below surface.

Generation of petroleum v. temperature

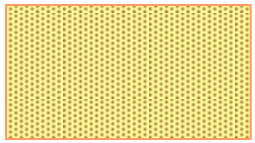
The global average temperature rise is 26°C/km. However, it can be as high as 55°C/km or as low as 18°C/km.

At temperatures of 60 to 120°C oil was created. When this oil was exposed to temp. over 150°C the long chained HC molecules were "cracked" into Methane, Propane, Butane ... called "wet gas", ~ 90% Methane.

Dry gas, 99% Methane, was directly produced by bacteria and does not require heat.

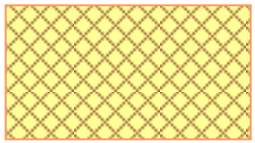


Reservoir rock



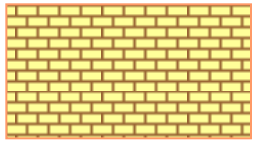
60%

Sandstone



1%

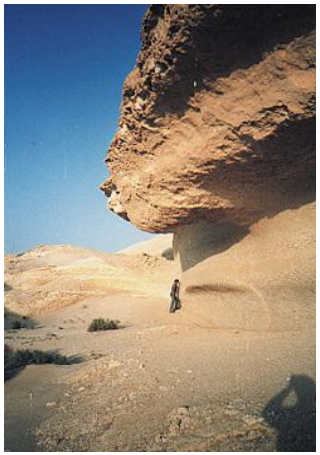
Fractured rocks of other types



39%

Carbonate Limestone & Dolomite

Sand dunes



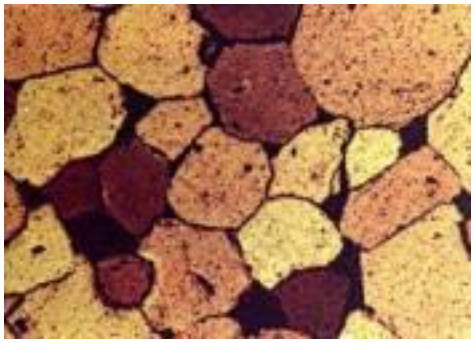
Coral reef

The majority of reservoirs consist of sandstone and limestone.

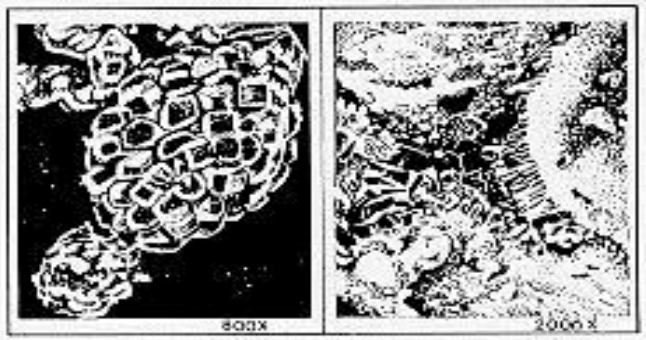
Sandstone is sedimented and cemented erosion material. Limestone a product of corals.

Characteristics of reservoir rocks; Porosity

Nothing looks more solid than a rock. Yet, a piece of sandstone or limestone shows under a microscope many tiny openings. Geologists call these tiny rock openings pores.



Sedimentary rock



Pyrite in coal
x 800

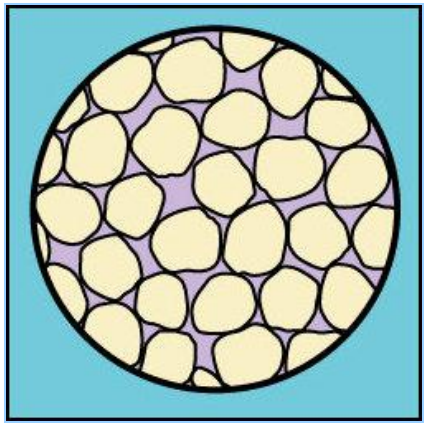
Oil formation porosity
x 2000

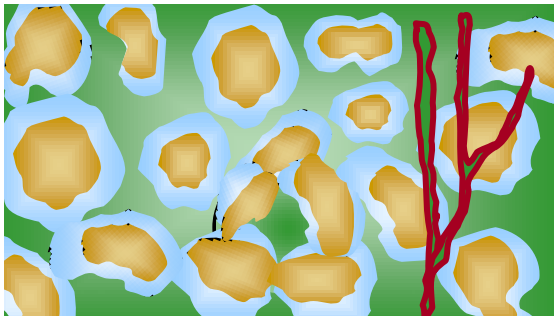
A rock with pores is referred to as porous. This means it has tiny holes through which oil may flow. Reservoir rocks must be porous, because hydrocarbons can occur only in pores.

Porosity is measured in % and ranges from 10 - 25% up to 45%

Characteristics of reservoir rocks; Permeability

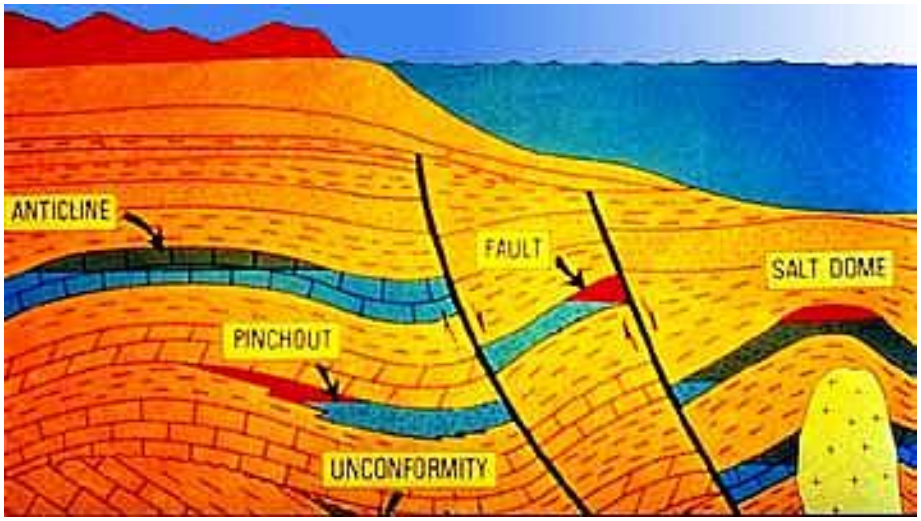
A reservoir rock is also permeable. That means its pores are connected. If hydrocarbons are in the pores of a rock, they must be able to move out of them. Unless hydrocarbons can move from pore to pore, they remain locked in place, unable to flow into a well. A suitable reservoir rock must therefore be porous, permeable, and contain enough hydrocarbons to make it economically feasible for the operating company to drill for and produce them.





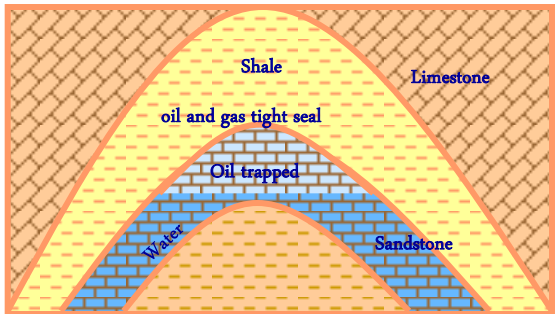
Permeability is measured in Darcies. A reservoir typically has 5 - 500 mD (millidarcy), up to 5 Darcies

Oil and gas traps



Anticlines, make up to 75% of all reservoirs

1%	Faults
2%	Salt domes
3%	Unconformity
3%	Reef
7%	Other stratigraphics
9%	Combination



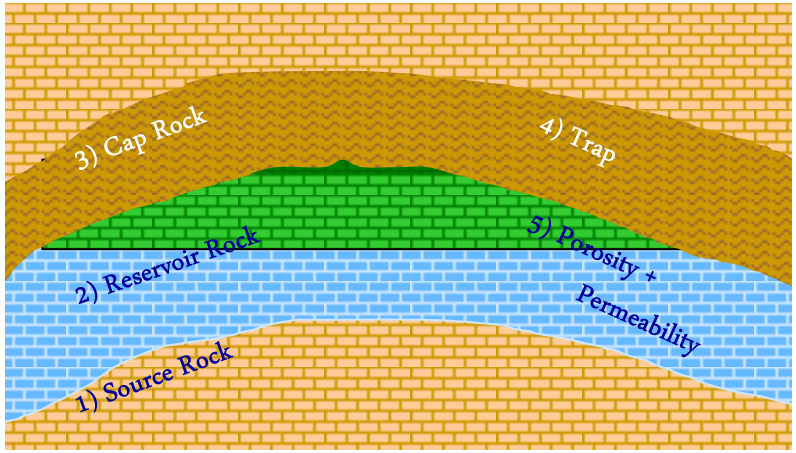
Anticline, trapped oil

For a reservoir rock to hold the infiltrated oil and gas it needs a sealing cap above, called cap rock. Without it all light HCs evaporate into the atmosphere, the heavy HCs remain at surface, known as tar sands, found e.g. in Canada and Venezuela.

5 requirements

To make up an exploitable reservoir five criteria need to meet.

Is only one missing - there will be no reservoir!



1- A source rock, transforming organic matter into petroleum

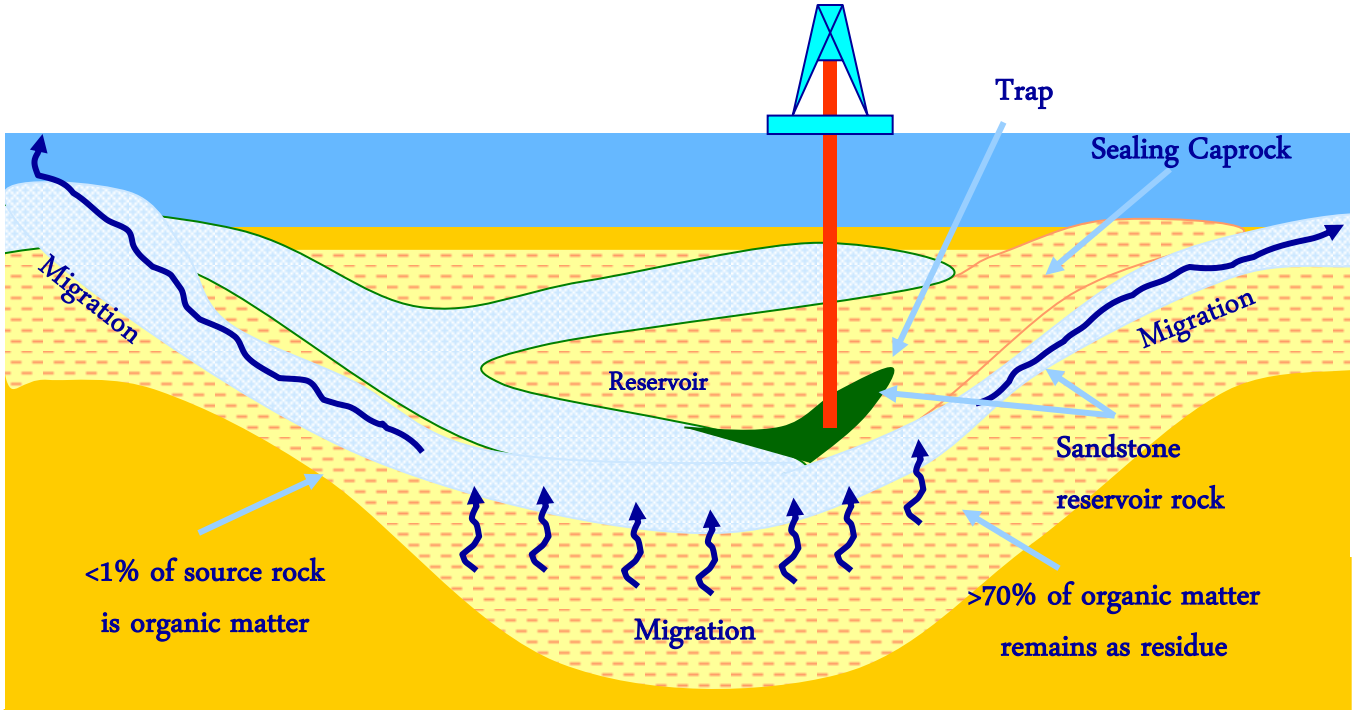
2- A reservoir rock, accumulating petroleum

3- A cap rock, sealing off the reservoir

4- A trap, the right shape of the cap to hold petroleum in place

5- Porosity and permeability to allow petroleum to flow in quantities into the oil well

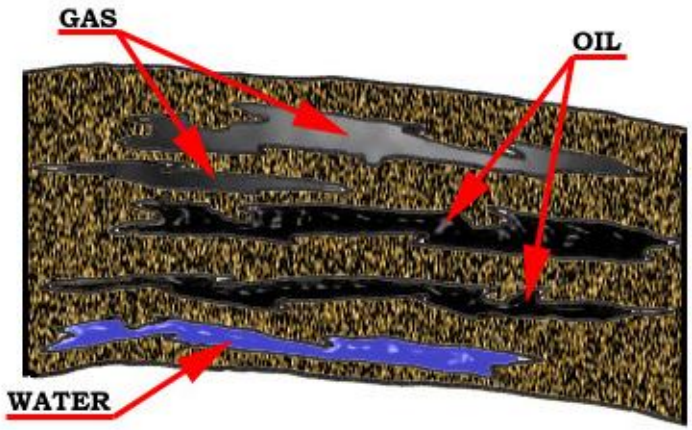
Chances of petroleum accumulation



Less than 1% of a source rock is of organic matter. Of this less than 30% is converted into petroleum. Less than 30% of this migrates as HC into a reservoir. Of all of this more than 99% is lost to the atmosphere and only less than 1% is trapped.

Summery

Oil reservoirs can be complicated



STRATIGRAPHIC TRAP

Petroleum is found in only one of 10 exploration wells.

The saying;

“drill and hope” can easily translate

“drill and get broke.”

Summery, oil's origin

Crude oil – properly called petroleum – includes natural gas, a flammable fluid usually found with oil. Petroleum is the remains of organic material that was deposited, usually in marine environments, millions of years ago. Most commercial petroleum was generated from rocks which are between 65 million and 213 million years old.

Plants use photosynthesis to fix carbon dioxide from the atmosphere into organic forms of carbon – carbon bonded with hydrogen and other elements. This carbon becomes the basis for our biosphere – everything living. The details are not all worked out,

Marine organisms died and drop to the ocean floor. If not eaten, they may start to rot. Bacteria decomposes them, and they became mere organic gunk on the ocean floor. But before bacteria has completely devoured them, the mass of sediment piling on top established a sealed off area.

Bacteria needs oxygen, sulphur or certain other chemicals to do their eating, and the rain of organic matter – or other forces like thermal or chemical stratification – eventually cuts off the supply of these elements, halting the bacteria in mid-rot. By now, chemical reactions have trimmed off most elements except for carbon and hydrogen – the major components of petroleum. Finally, a small percentage of the former maritime organism became crude oil. Oil being lighter than water, it floated from the "source rock" into porous "reservoir rock." It may have reached the surface and became one of the oil seeps ancient people used to caulk their boats and preserve their dead with. But sometimes it was jammed by an impermeable "cap rock." The cap restrained the oil and formed a reservoir.

Click here to proceed to Index