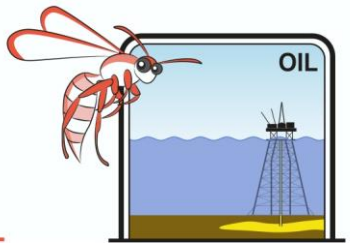


Structural Seal – Teacher Notes

The timely migration of oil and gas into porous reservoir rocks where it may be trapped and stored is the final requirement for an oil reservoir. Traps must be established before the oil and gas start to migrate. Some traps in the North Sea Oilfields were established 100 million years before the beginning of the generation of oil.

Seal ***an impermeable layer***
Trap ***a seal formed into a geometric shape*** (containing shape)

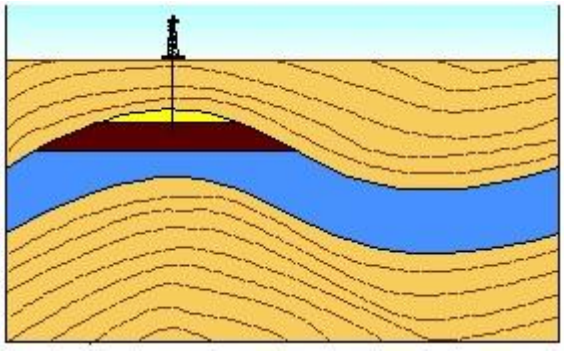
Usually hydrocarbons created elsewhere migrate into younger rocks in geographically different parts of the basin where they became trapped and in time built up to become a reservoir. Where hydrocarbon seeps approach the surface, bacteria prefer the lighter portions leaving thick tarry deposits such as the Athabasca tar sands and the oil seeps in the Middle East.

Interesting fact ***Over 90% of all hydrocarbons created escape to be digested by soil and marine bacteria.***

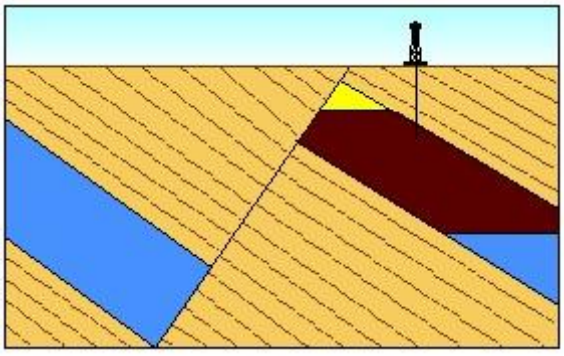
There are two types of seals for hydrocarbon reservoirs:

A. A structural seal

Structural seals are the result of tectonics (Earth movements) that fold rocks into suitable shapes and bring different rock types together. The Barrow island anticline in our North West was one of Western Australia's earliest recognised oilfield reservoirs. More recent discoveries have been traps sealed by closed faults



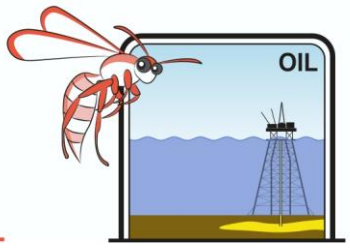
anticline



fault

B. A stratigraphic seal

Many reservoirs are created in sands deposited by ancient river systems that emptied into sedimentary basins and in porous limestone that formed offshore. These often form stratigraphic seals. For example, an overlying bed of impermeable rock such as clay stopping the upward migration of hydrocarbons. When a river's flow slows down, the heavier sands are dropped out leaving a capping of fine impermeable clays at the top of the bed. This is called graded bedding. When a deposition basin finally fills, lower lying sediments may be capped by fine silt and mudstone that provide an impermeable barrier to the migration of water, of oil and of gas.



Structural Seal – Teacher Notes

Materials:

- Test tube or narrow clear plastic cylinder
- Shallow bowl or tray at least 5 cm deep
- Sand, enough to fill the bottom 2-3 cm of the tray
- Water, enough to fill the top 3-4 cm of the tray
- Pasteur pipette/transfer pipette.
- A little cooking oil

Steps:

1. Fill bottom of the tray with sand, and then gently add water until water is about 3 cm above the surface of the sand.
2. Fill the test tube completely with water, and place thumb over the opening to seal in the water.
3. Invert the test tube and place it on the surface of the sand, under the surface of the water.
4. Hold the test tube with the other hand, and carefully remove thumb, so no air gets into the test tube. The test tube should be able to mostly stand on its own.
5. Fill the pipette with 5ml of oil.
6. Place pipette nozzle into the sand below the test tube and squeeze out the oil. Take care to make sure the pipette tip is underneath the test tube; it is easy to accidentally miss to either side.
7. Remove the pipette and allow it to fill with air. Replace pipette under test tube and squeeze out the air into the sand below the test tube.

The oil and gas will rise upwards because they have lower densities than the sand and water. Gas will rise above the oil, even though it was added after the oil, as it does in hydrocarbon traps.

Demonstration set up

Gas rises above oil in a trap.

Option Gas rises faster than oil. This can be tested with a measuring cylinder, filled by the water above the tray then turned through 90^0. Two pipettes, one with oil and the other with air are placed below and both squeezed at the same time.