



— University of Mosul —
College of Petroleum & Mining Engineering



Lecture-2

Petroleum System

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Petroleum system is group of elements and processes combined together to formed oil and gas . If absence anyone of these elements or processes, the petroleum system will be not active .

Elements :

- 1-Source Rock
- 2-Reservoir Rock
- 3- Migration Rout
- 4- Seal Rock
- 5-Traps



processes

1-Generation

2-Migration

3-Acumelation

4-Pressivition

5-Timing

1-Source Rock

The term "Source Rock " is meant to be any rock that has the capability to generate and expel enough hydrocarbons to form an accumulation of oil and gas.

Type of source rock

1-Effective source rock : any sedimentary rock that has already generated and expelled hydrocarbons .

2-Possible source rock : any sedimentary rock whose source potential has not yet been evaluated , but which may have generated and expelled hydrocarbons .

3-Potential source rock : any immature sedimentary rock known to be capable of generated and expelled hydrocarbons if its level of thermal maturity were

petrophysical properties

petrophysical properties of source rock are :

1-Low density.

2-High sonic.

3-High neutron porosity.

4 –Very high gamma ray.

Organic matter in source rock

Source rocks are sediment contain sufficient organic matter which is basically derived from marine or lacustrine algae and land plants .

This organic matter contains chemical compounds which are preserved within sediments during deposition in reducing environment .

Factors influencing organic richness

1-Productivity : (many factors influencing productivity would include light intensity ,temperature ,carbonate supply ,and general water chemistry).

2-Preservation :(Three factors affect the Preservation of organic matter , the concentration and nature of oxidizing agents ,the type of organic matter deposited ,and the sediments –accumulation rate).

Kerogen

Kerogen is normally defined as that portion of the organic matter present in sedimentary rock that is insoluble in ordinary organic solvents. The soluble portion, called bitumen.

Kerogen Types

Kerogen (solid organic matter) has been classified to four kerogen types:

- 1-Kerogen Type I
- 2-Kerogen Type II
- 3-Kerogen Type III
- 4-Kerogen Type IV

2- Reservoir Rock

Reservoir rock is a body of porous and permeable rock containing oil and gas through which fluid may move towards recovery opening under the pressure existing or that may be applied.

A petroleum reservoir consists of three essential elements.

- 1- The reservoir rock .
- 2- The pore space or void space .
- 3- The trap .

1-Reservoir rock

- The composition and texture of reservoir rock.
- The edges of the reservoir rock may coincide with the edges of the petroleum pool .

The reservoir rock ,through extending through a large region ,my become a petroleum reservoir only at locally favorable areas.

2-The pore space or void space sometime called reservoir space Is expressed as a fraction or percentage of total volume of the rock (for example 23%) And is called porosity.

3-Migration Route

Migration Route is a particular ways or direction between grains where petroleum took place and migrate through pores from place near source rock to trap.

4-Seal rock

A reservoir needs a cap rock which is impermeable cap rock where keeps the fluids trapped in the reservoir .

Some examples are (shale ,salt, anhydrite and zero-porosity carbonates).

5-The traps

Traps are formed by a wide variety of combination of stratigraphic and structural features of the rocks.

Classification of traps

The classification divides the traps broadly into four basic traps.

1-Structural traps.

2-Stratigraphic traps.

3-Combination traps.

4-Hydrodynamic traps.

1-Structural traps

Traps that are formed mainly as a result of deformation, such as faulting and folding or both.

-It is the most apparent from mapping, and most readily located underground .

-So they are given the most help to the discovery of oil and gas.

2-Stratigraphic traps

Is a general term for stratigraphic traps that are result of lateral variation in lithology of the reservoir rock , or a break in its continuity .

- A permeable reservoir rock changes to an impermeable rock
- It is truncated by unconformity .
- Overlapped .
- changes along its bedding .

Stratigraphic traps may be divided into two general classes.

1-Primary stratigraphic traps.

2- Secondary stratigraphic traps.

1-Primary stratigraphic traps.

- Formed during the deposition of the rock.
- Include lenses, facies changes(pinch-out) , channel fillings, reefs.

2-Secondary stratigraphic traps.

They are associated with unconformity.

- It might called unconformity traps.

- Have resulted from later causes.

Such as solution and cementation.

3-Combination traps.

The trap is formed partly by structural and partly by stratigraphic effects ,but not completely due to one of them.

- The stratigraphic element may have formed early ,during the deposition of the reservoir rock ,or later ,by subsequent local cementation, or by uplift , and unconformable overlap.

- The structure elements may be any kind of folding or faulting or both.

- One of most kind combination traps is salt domes traps.

4- Hydrodynamic trap.

These traps is due to water flowing through the reservoir and holding the oil in places where it would not otherwise be trapped .

Petroleum system processes

1-Generation :Burial of source rock to temperature and pressure regime sufficient to convert organic matter into hydrocarbon .

2-Migration :Movement of hydrocarbon out of the source rock toward a reservoir rock.

Type of migration :

A-Primary migration: From the source rock to a porous rock ,this is a complex process and not fully understood.

It is limited to a few hundred meters.

B-Secondary migration : It is migrate the hydrocarbon along the porous rock to the trap.

- This occurs by buoyancy ,capillary pressure and hydrodynamics through continuous water-filled pore system.

- It can take place over large distances.



3-Accumulation :A volume of hydrocarbon migration into a trap faster than the trap leaks resulting in an accumulation .

4-Preservation : Hydrocarbon remains in reservoir and not altered by biodegradation or water-washing.

5-Timing : Trap forms before and during hydrocarbon migration.