

## **CHAPTER-5**

### **RESERVOIR DRIVE MECHANISMS**

Producing oil and gas needs energy. Usually some of this required energy is supplied by nature. The hydrocarbon fluids are under pressure because of their depth. The gas and water in petroleum reservoirs under pressure are the two main sources that help move the oil to the well bore and sometimes up to the surface. Depending on the original characteristics of hydrocarbon reservoirs, the type of driving energy is different.

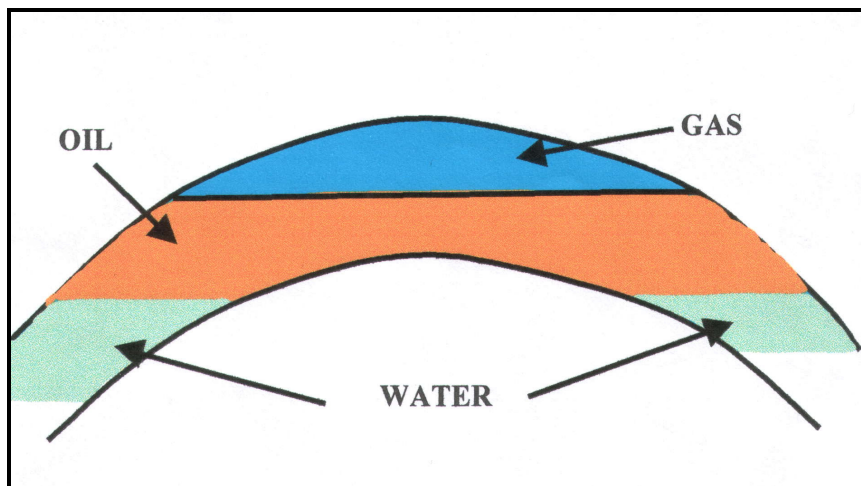
#### **5.1 Solution Gas Drive Reservoirs**

When a newly discovered reservoir is below the bubble point pressure, there will be free gas as bubbles within the oil phase in reservoir. The reservoir pressure decreases as production goes on and this causes emerging and expansion of gas bubbles creating extra energy in the reservoir. These kinds of reservoirs are called as solution gas drive reservoirs. Crude oil under high pressure may contain large amounts of dissolved gas. When the reservoir pressure is reduced as fluids are withdrawn, gas comes out of the solution and displaces oil from the reservoir to the producing wells. The efficiency of solution gas drive depends on the amount of gas in solution, the rock and fluid properties and the geological structure of the reservoir. Recoveries are low, on the order of 10-15 % of the original oil in place (OOIP). Recovery is low, because the gas phase is more mobile than the oil phase in the reservoir. Solution gas drive reservoirs are usually good candidates for water-flooding

#### **5.2 Gas Cap Drive Reservoirs**

Sometimes, the pressure in the reservoir is below the bubble point initially, so there is more gas in the reservoir than the oil can retain in solution. This extra gas, because of density difference, accumulates at the top of the reservoir and forms a cap. These kinds of reservoirs are called a gas cap drive reservoir. In gas cap drive reservoirs, wells are drilled into the crude oil producing layer of the formation. As oil production causes a reduction in pressure, the gas

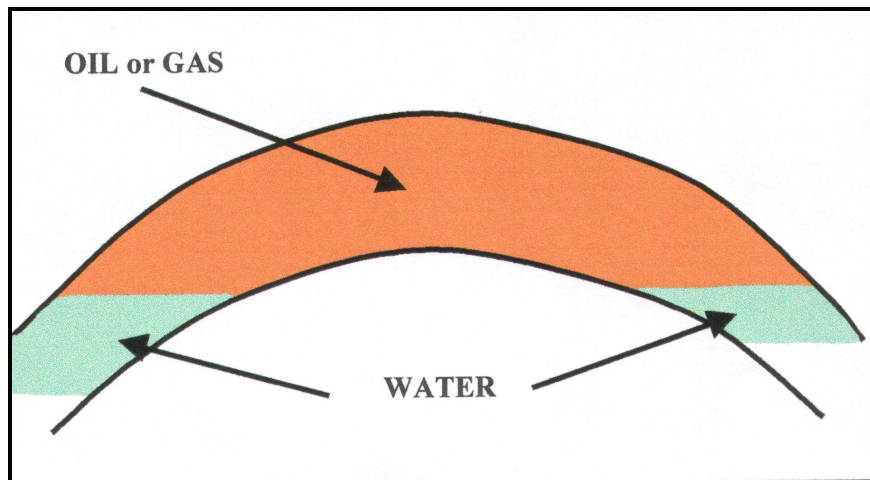
in gas cap expands and pushes oil into the well bores. Expansion the gas cap is limited by the desired pressure level in the reservoir and by gas production after gas comes into production wells.



**Figure 5-1** Schematic of a Typical Gas Cap Reservoir

### **5.3 Water Drive Reservoirs**

Most oil or gas reservoirs have water aquifers. When this water aquifer is an active one, continuously fed by incoming water, then this bottom water will expand as pressure of the oil/gas zone is reduced because of production causing an extra driving energy. This kind of reservoir is called water drive reservoirs. The expanding water also moves and displaces oil or gas in an upward direction from lower parts of the reservoir, so the pore spaces vacated by oil or gas produced are filled by water. The oil and gas are progressively pushed towards the well bore. Recovery efficiencies of 70 to 80 % of the original oil in place (OOIP) are possible in some water drive reservoirs.



**Figure 5-2** Schematic of a Typical Water Drive Reservoir

#### **5.4 Gravity Drainage Reservoirs**

Gravity drainage may be a primary producing mechanism in thick reservoirs that have a good vertical communication or in steeply dipping reservoirs. Gravity drainage is a slow process because gas must migrate up structure or to the top of the formation to fill the space formerly occupied by oil. Gas migration is fast relative to oil drainage so those oil rates are controlled by the rate of oil drainage.

#### **5.5 Under-saturated Reservoirs**

A crude oil is under-saturated when it contains less gas than is required to saturate the oil at the pressure and temperature of the reservoir. When the oil is highly under-saturated much of the reservoir energy is stored in the form of fluid and rock compressibility. Pressure declines rapidly as fluids are withdrawn from the under-saturated reservoir until the bubble point is reached. Then, solution gas drive becomes the source of energy for fluid displacement. Reservoir fluid analysis, PVT behavior and the pressure data will identify an under-saturated reservoir. Those reservoirs are good candidates for water injection to maintain a high pressure to increase oil recovery.