# Petroleum Migration

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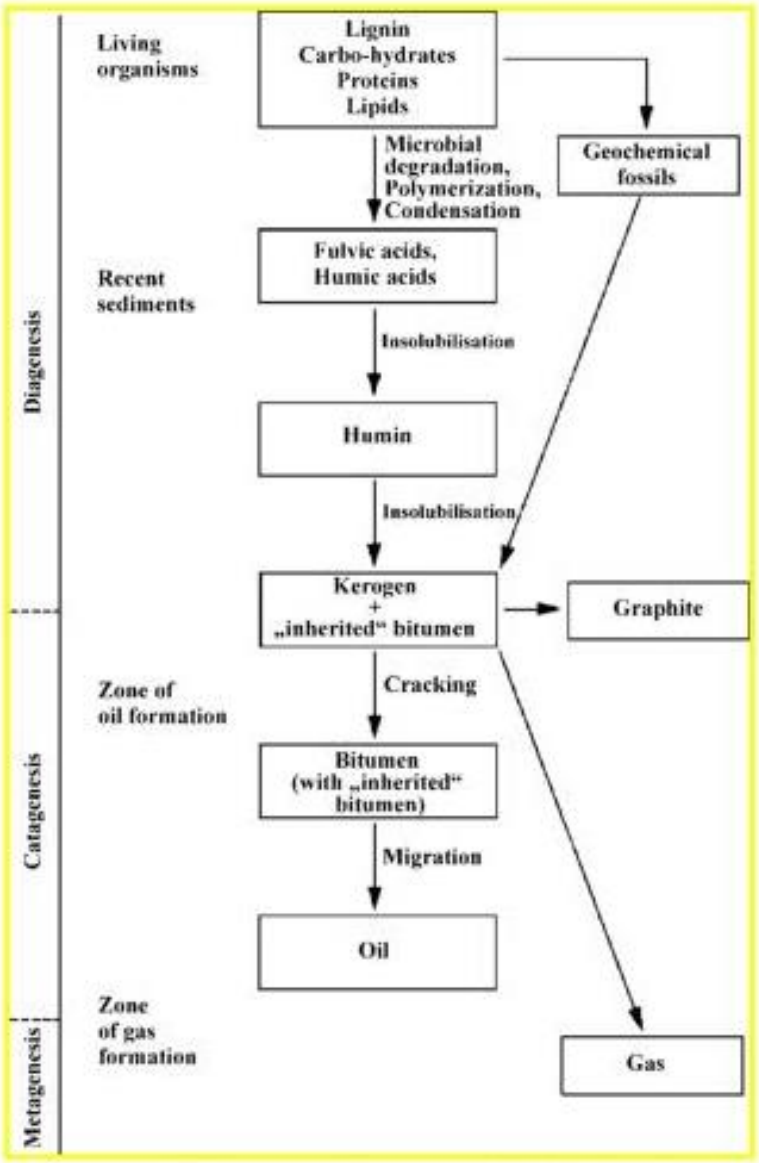
- the fulvic and humic acids,
- humin,
- kerogen
  (in coal, oil shales, source rocks or in sediments),
- **bitumen and inherited bitumen,**
- **oil (petroelum),**
- gas and
- graphite.




All types of organic matter in geosphere are genetically related and are part of the carbon cycle in nature, or carbon cycle in the geosphere. Central place in that part of the cycle belongs to kerogen, because some of these forms are organic substances in geosphere on the way to transform into it while others, however, derive from kerogen.

**A simplified scheme of the transformation of organic matter in the Earth's crust.**

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**The total bitumen of sedimentary rocks actually consists of two forms:**

- "Inherited bitumen "

(is composed of some lipid molecules and it was not incorporated into polymeric materials in type of fulvic and humic acids, kerogen and humin during the diagenesis).

- Bitumen

(that is derived as a product of catagenetic cracking of the kerogen).

These two types of bitumen are combined in the sedimentary rocks during the catagenesis.

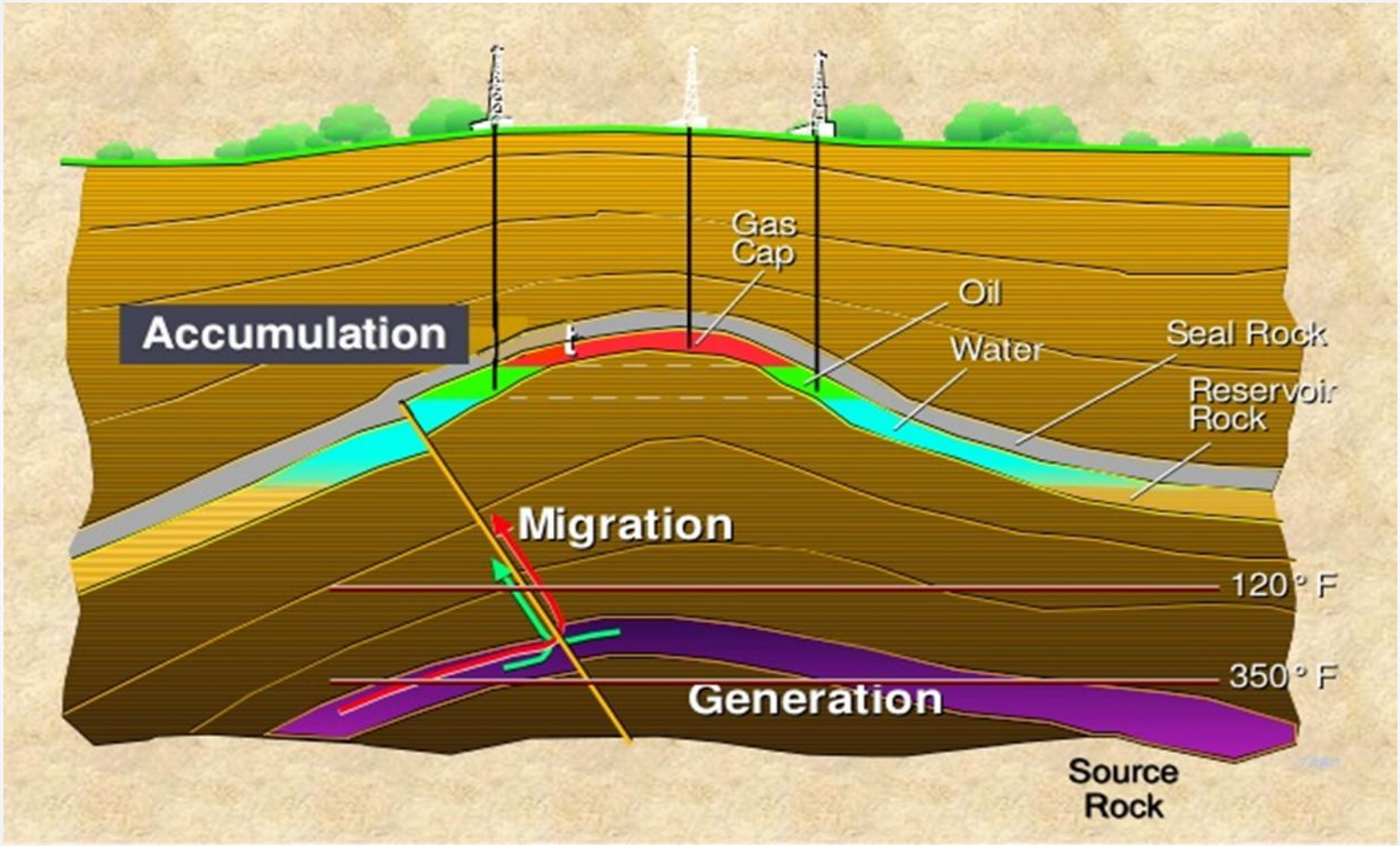
# General Considerations

Oil and gas migration are the least understood processes in the formation of hydrocarbon reservoirs. Much of the current thinking of how it happens is hypothetical and difficult to prove with either experiment or theory.

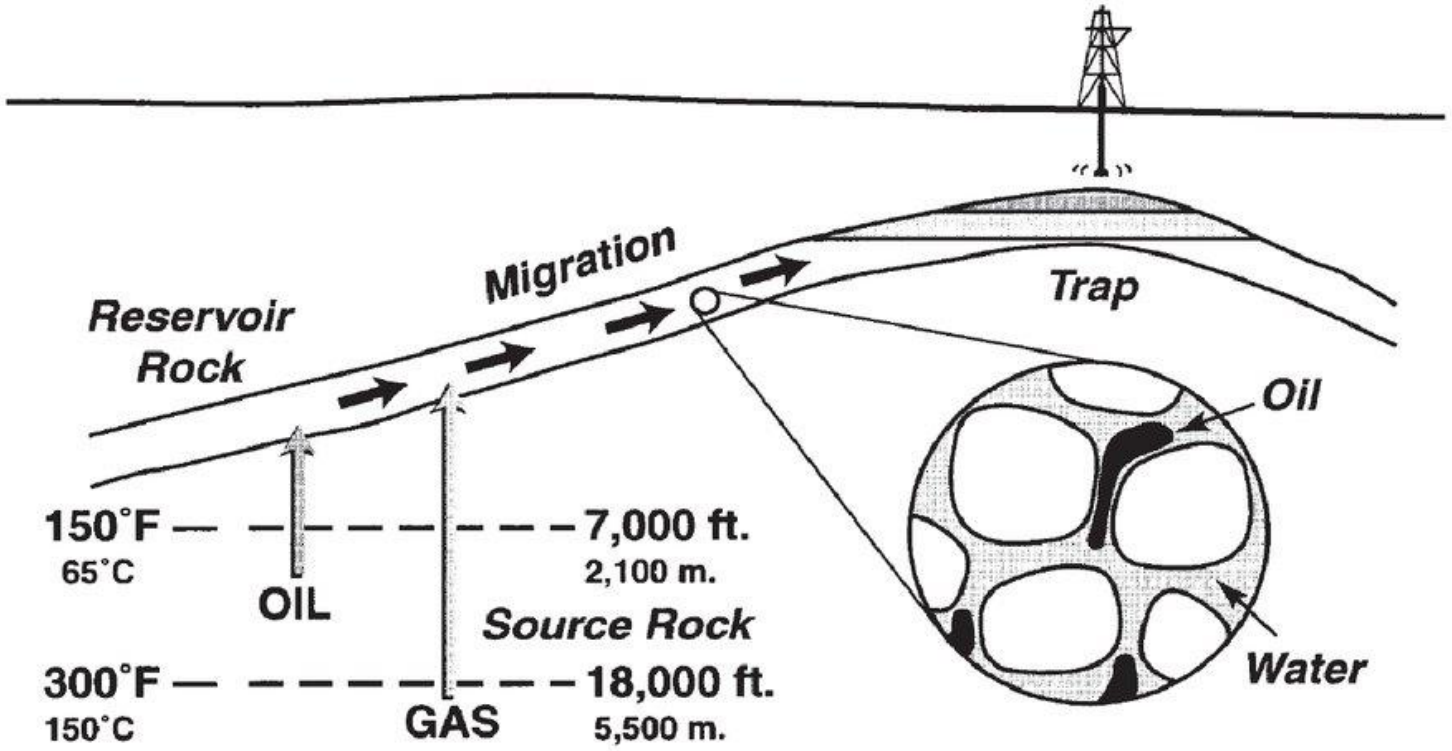
When potential source and reservoir rocks are buried, they contain water in their pore space. The oil or gas, therefore, has to replace this water in the migration process when it reaches the reservoir rock.

We have first a look at the composition of formation water.

# WHAT IS MIGRATION ?



# Migration of oil



# Migration of petroleum

-The hydrocarbons generated from source rocks are expelled within other pore fluids due to continuing effects of compaction, and start moving upwards towards the surface.A process known as Migration.

-Migration is the movement of oil and gas within the subsurface layers

-Migration can be divided according to the distance to Local migration and regional migration

-Migration can be divided into two types or in some refernce three types

A-Primary migration:-is the process by which petroleum moves from source rocks to reservoir rock.

B-Secondary migration:- is the process by which petroleum moves within reservoir after it has accumulated.

C- Tertiary migration (immigration or remigration):- leakage of accumulated hydrocarbons from one from one trap to another or up to the surface.

-According to the direction of migration, it can be classified in to two types:-

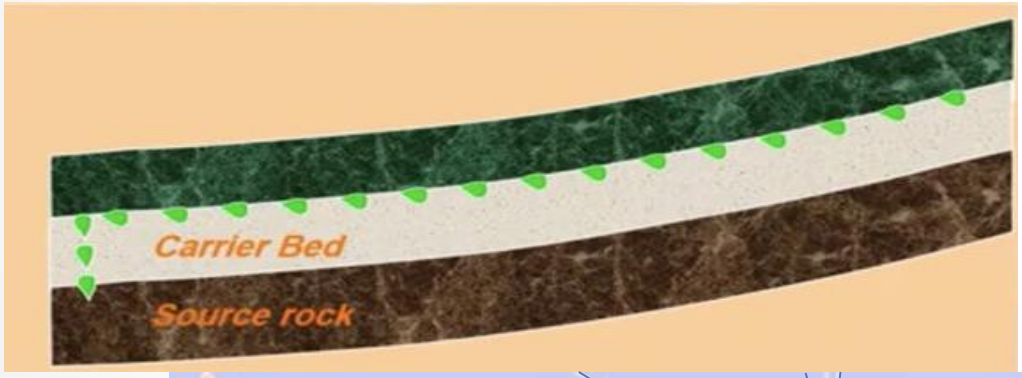
Transverse migration: it is the migration in a transverse (vertical) direction to the stratification.

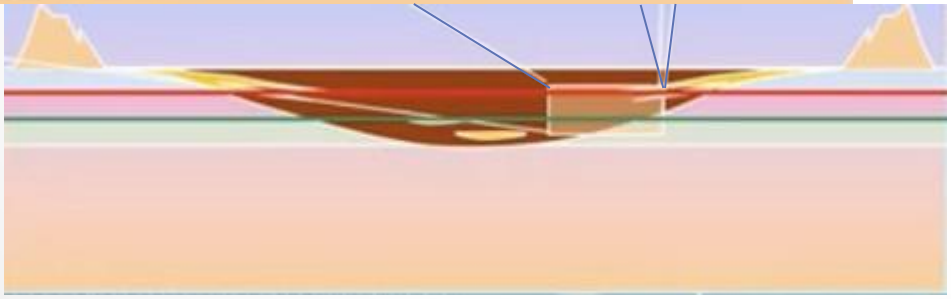
Longitudinal migration: it is the migration in a longitudinal(parallel) direction to the stratification.

Most source rocks are black shales which have very low permeability. How can the hydrocarbons move through these rock?

Answer: there are several force that cause such migration :

1. Compaction of sediments as the depth of burial increases
2. Excess pressure
3. Capillary force
4. Diffusion force
5. Migration along microfractures in the source rock
6. Increase in volume due to maturation
7. Buoyancy force



# TYPE OF PETROLEUM MIGRATION MECHANISMS

There are three types of migration when discussing the movement of petroleum primary, secondary and tertiary

**Primary migration**

Refers to the movement of hydrocarbons from source rock into reservoir rock

**Secondary migration**

Refers to the subsequent movement of the hydrocarbon within reservoir rock,the oil and gas has left the source rock and has entered the reservoir rock.

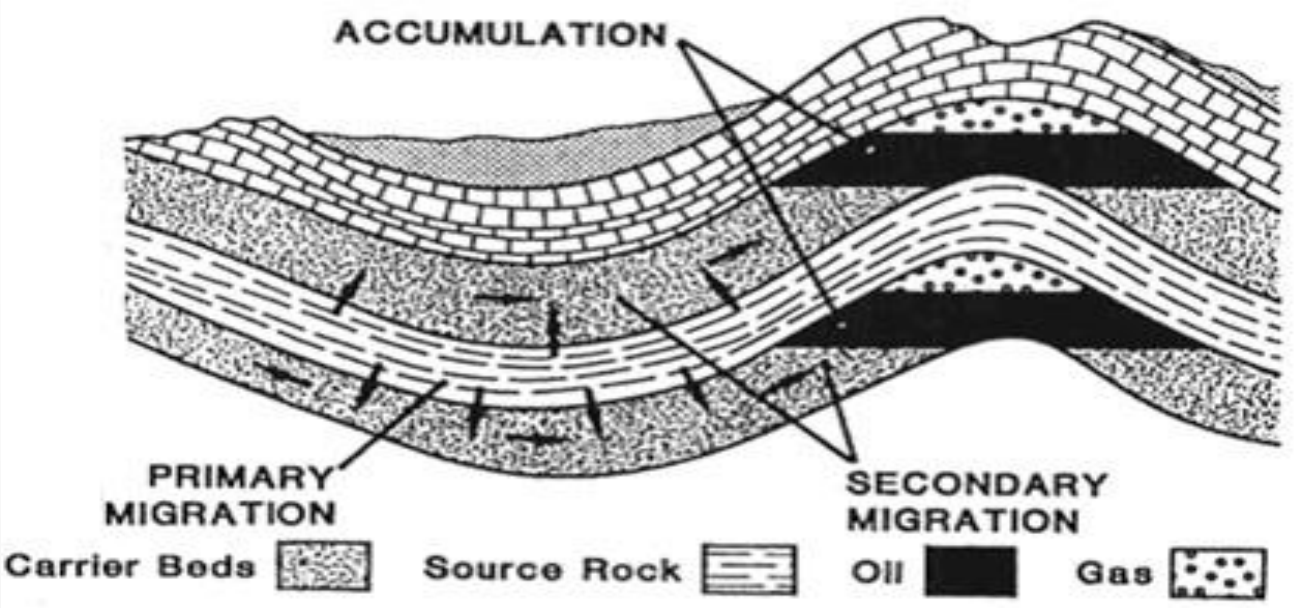
this occurs when petroleum is clearly identifiable as crude oil and gas although the gas may be dissolved in the oil.

**Tertiary migration**

- Tertiary migration refer to the movement of petroleum from trap to surface.
- Tertiary migration includes leakage , seapage , and alteration of petroleum as it reaches the earth's surface.
- The only major difference that can be used to separate teriary migration from secondary migration is the rate of petroleum supply, the rate of supply is much higher when a seal fails compared with escape of petroleum from a source rock.

# Primary migration mechanisms

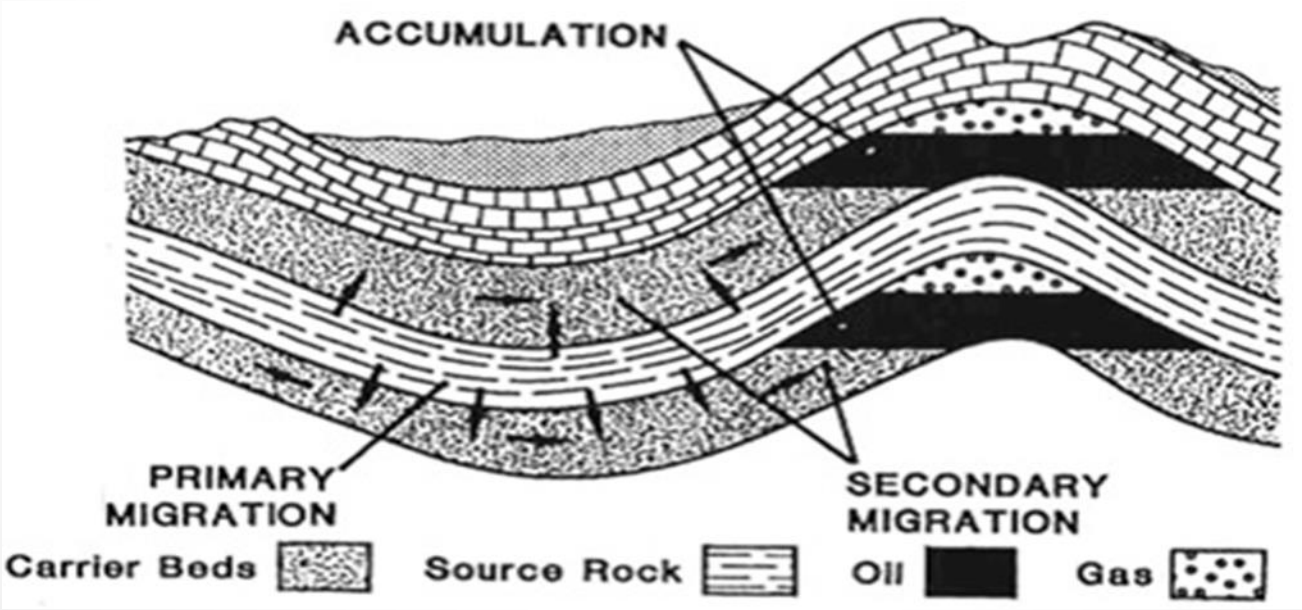
1. Migration by diffusion.
2. Migration by molecular solution in water.
3. Migration along micro fractures in the source rock.
4. Oil phase migration.

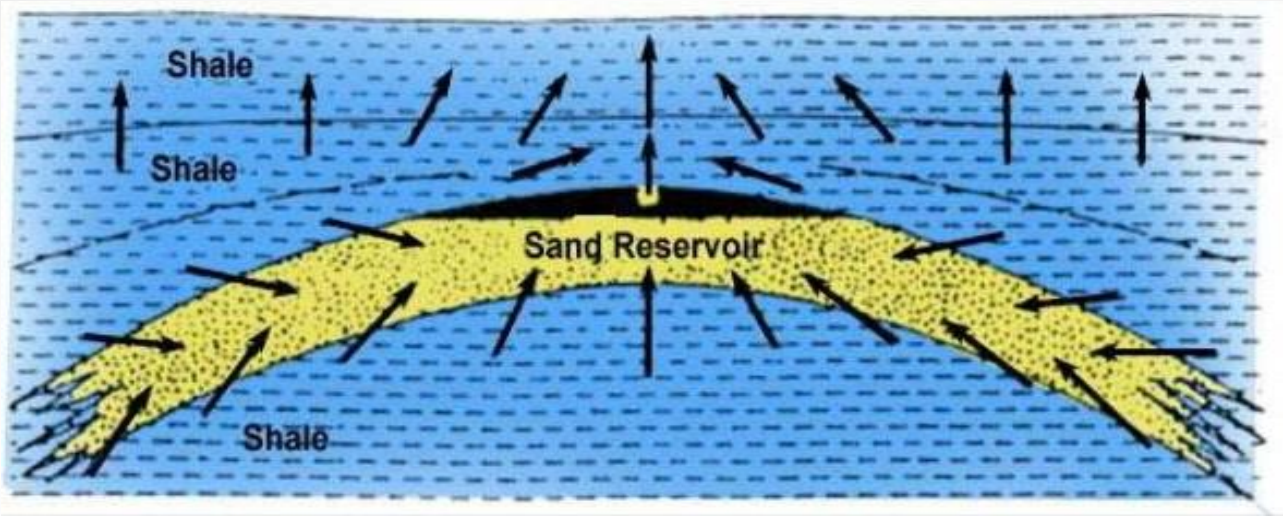


## Secondary migration mechanisms

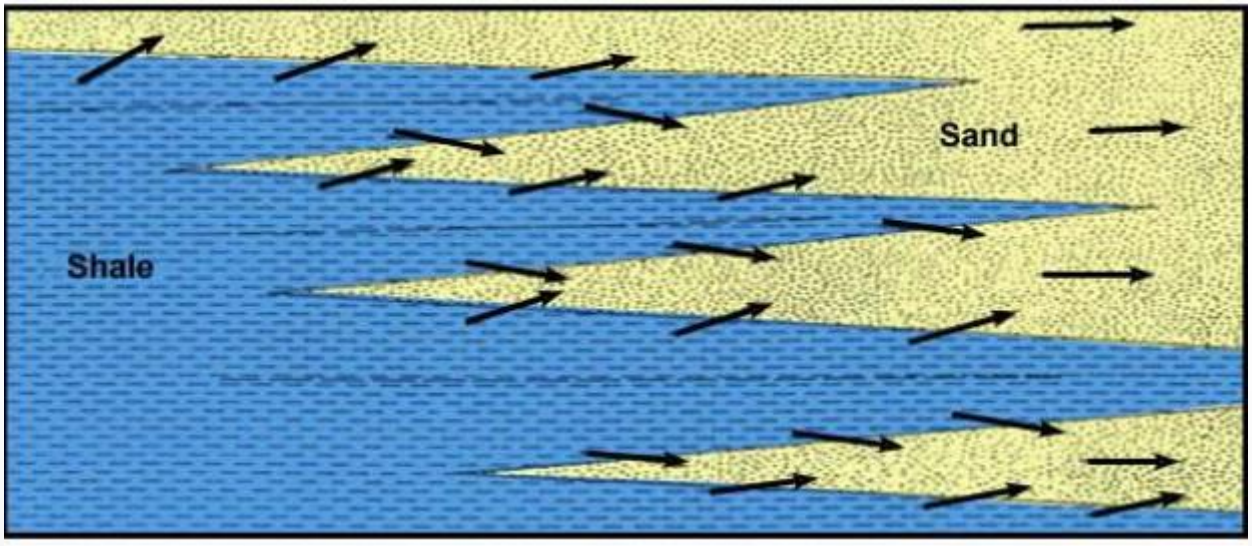
The secondary migration is the movement of petroleum outside of the cared bed and into a reservoir bed.

During secondary migration, the gas and oil separate with the gas traveling ahead of oil. The largest petroleum deposits are the result of lateral migration because this provides a larger drainge volume of source rock than dose vertical migration.

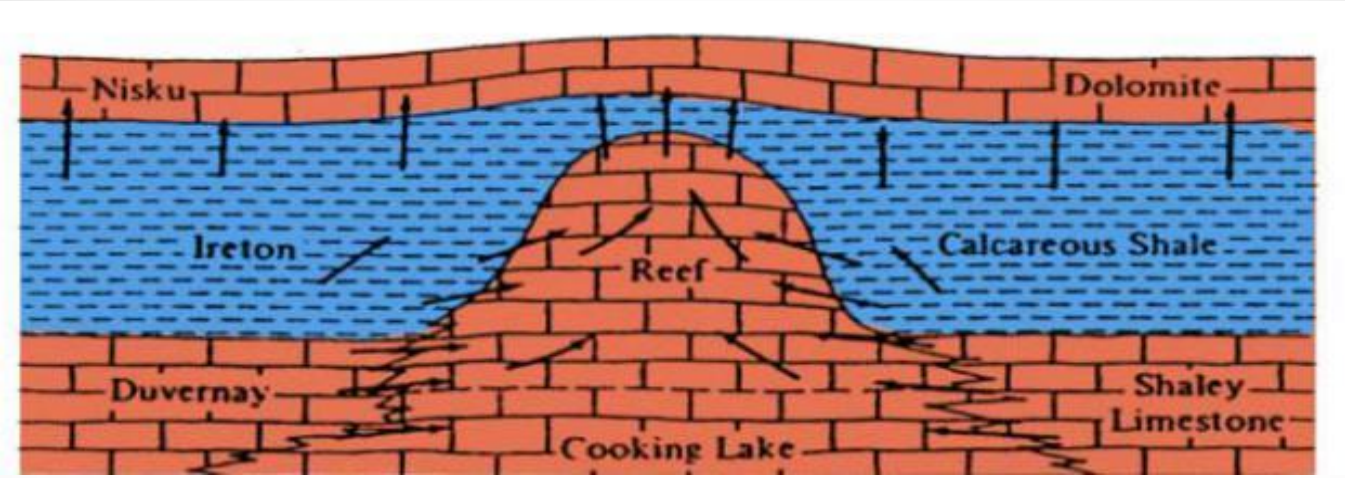




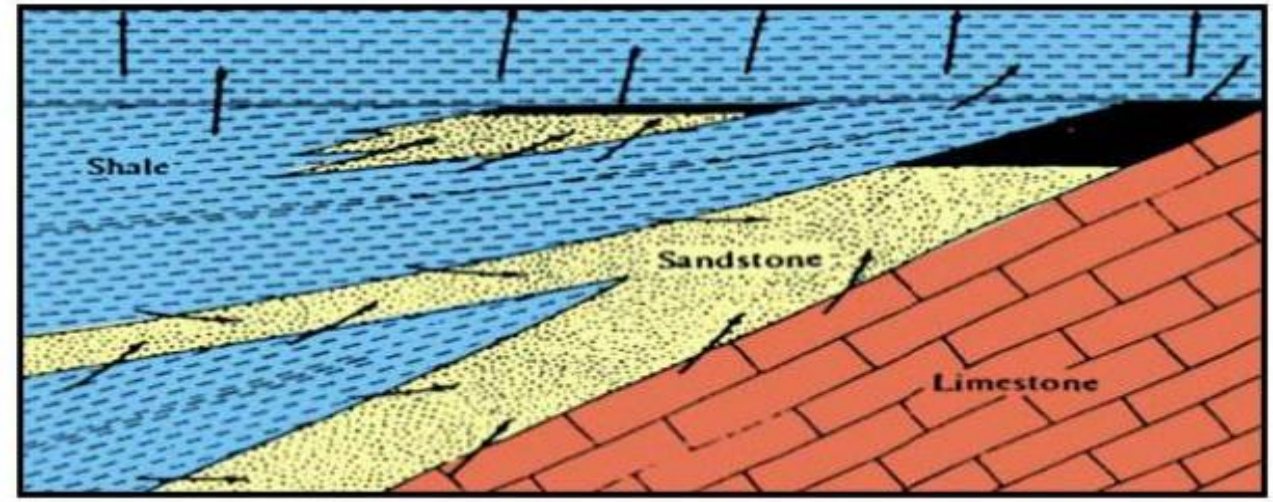

**Migration of fluid into anticline**




**Migration from an interbedded shale-sand**



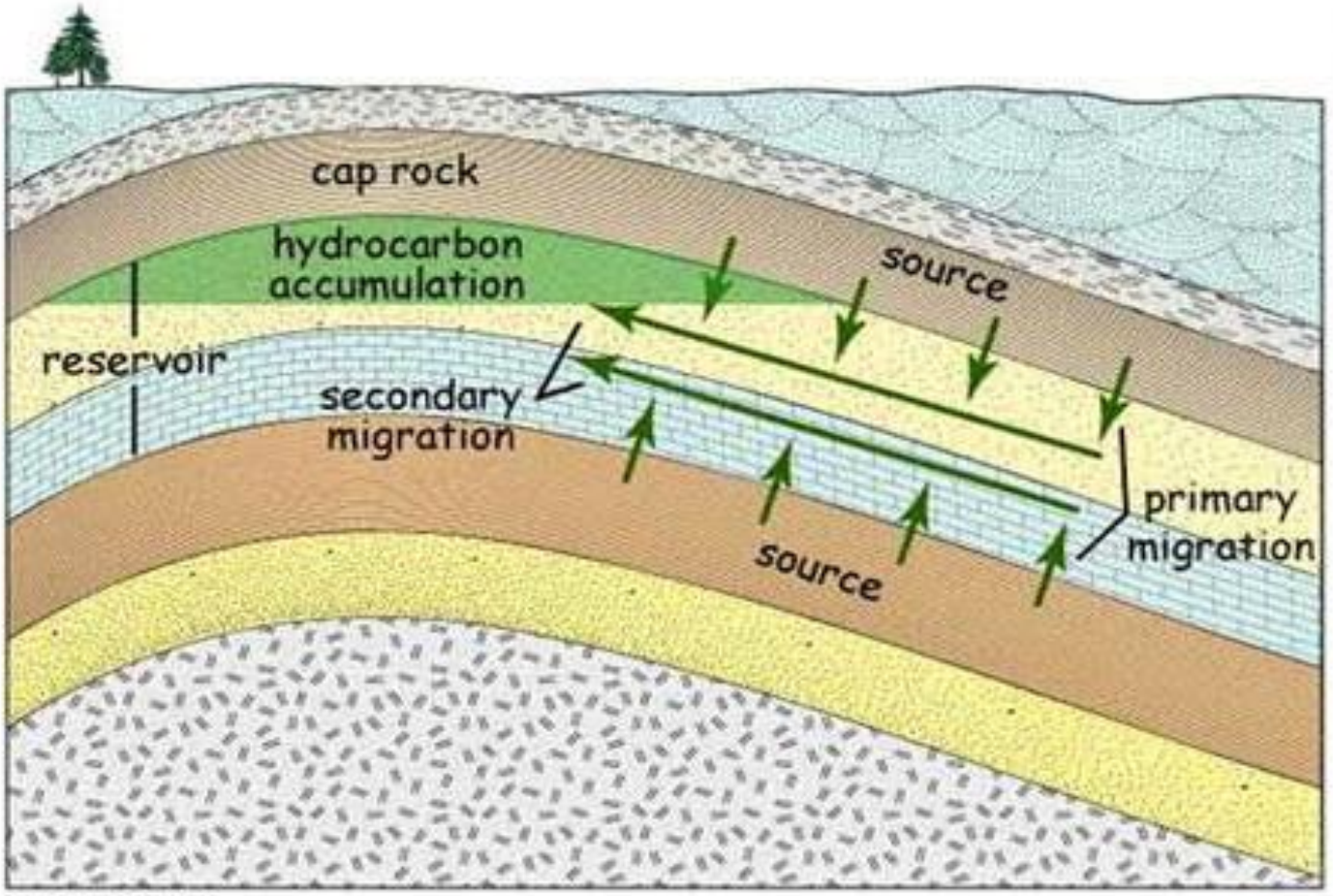

**Migration into a pinnacle**



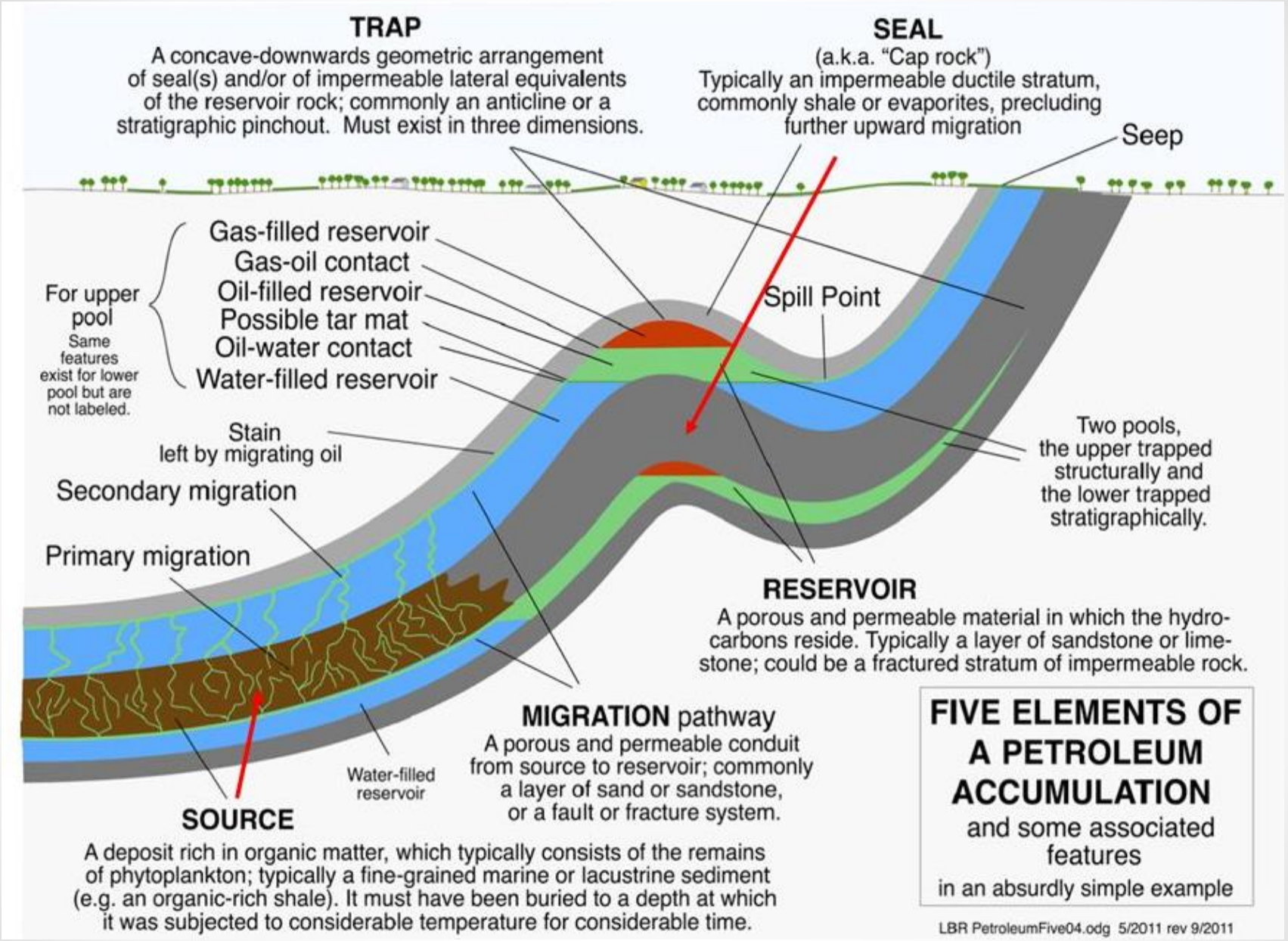

**Migration into stratigraphic traps**

Considerable evidence suggests that petroleum has migrated from its source rock to reservoir formation from which it is ultimately extracted. This migration consists of two components:

- **primary migration:** movement of petroleum through and out of its source rock;
- **secondary migration:** movement of petroleum through high permeability reservoir and/or carrier formations.




cross-section


TRAP
A concave-downwards geometric arrangement of seal(s) and/or of impermeable lateral equivalents of the reservoir rock; commonly an anticline or a stratigraphic pinchout. Must exist in three dimensions.
SEAL
(a.k.a. "Cap rock")
Typically an impermeable ductile stratum, commonly shale or evaporites, precluding further upward migration
Seep
Gas-filled reservoir
Gas-oil contact
Oil-filled reservoir
Possible tar mat
Oil-water contact
Water-filled reservoir
For upper pool
Same features exist for lower pool but are not labeled.
Spill Point
Stain
left by migrating oil
Secondary migration
Primary migration
Two pools, the upper trapped structurally and the lower trapped stratigraphically.
RESERVOIR
A porous and permeable material in which the hydrocarbons reside. Typically a layer of sandstone or limestone; could be a fractured stratum of impermeable rock.
MIGRATION pathway
A porous and permeable conduit from source to reservoir; commonly a layer of sand or sandstone, or a fault or fracture system.
Water-filled reservoir
SOURCE
A deposit rich in organic matter, which typically consists of the remains of phytoplankton; typically a fine-grained marine or lacustrine sediment (e.g. an organic-rich shale). It must have been buried to a depth at which it was subjected to considerable temperature for considerable time.
FIVE ELEMENTS OF A PETROLEUM ACCUMULATION
and some associated features
in an absurdly simple example
LBR PetroleumFive04.odg 5/2011 rev 9/2011