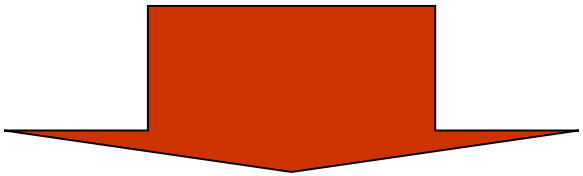
A brief overview of petroleum geology

The philosophy of exploration

Velledits Felicitász

What is the goal of the petroleum exploration?

- 1. to find oil/or gas in commercial quantities,
- 2. to produce it in such a way as to give maximum return on the invested money.



- To achieve our goal we use developed science and modern technology

The aspects of exploration

- 1. To understand the formation, the occurrence and the nature of petroleum.

- If we want to capture an animal (lion, or tiger), we have to know: 1) how it looks like, 2) where it lives, 3) what its habits are.
- If we want to find CH, we have to know 1) where (in which environment) it occurs, 2) under which conditions it was formed, 3) what its habits are.

- 2) We can never be sure

  - about the presence of CH until we drilled a well,

  - about the quantity of the CH until we have produced all the quantity.

3. Modern technique and developed science help us to collect information, to process it, and to apply it during finding and producing HC.

4. We have to evaluate the quantity of discovered and undiscovered reserves. (we are not interested in finding quantities too small to cover only our invested money)

Exploration Geology

Dammholm Energy

- Basin Study
  - Structural Evaluation
    - structural style (from surface geology, basin type)
    - oil/gas seeps
  - Reservoir Evaluation
    - Facies and diagenesis maps (outcrops etc.)
  - Geochemical Methods
    - gas measurements, bitumen analysis, hydrochemical analysis
  - Exploration Drilling (Wildcats)

Petroleum

- Petroleum consists of variable mixtures of the chemical substances known as HYDROCARBONS.
- The molecules are made up predominantly of carbon (C) and hydrogen (H) atoms,

  but other elements: - Oxygen

  - Nitrogen

  - Sulphur

  - Metals: (Vanadium, Copper, Nickel) are also present.

Origin of the oil and gas

- Oil and gas are formed from the soft parts of microscopic organisms preserved in sediments.
- Mainly remains of marine plankton is converted to oil and gas.
- Land-derived plant material (including coal) generate pure natural gas (methane).

Source rocks

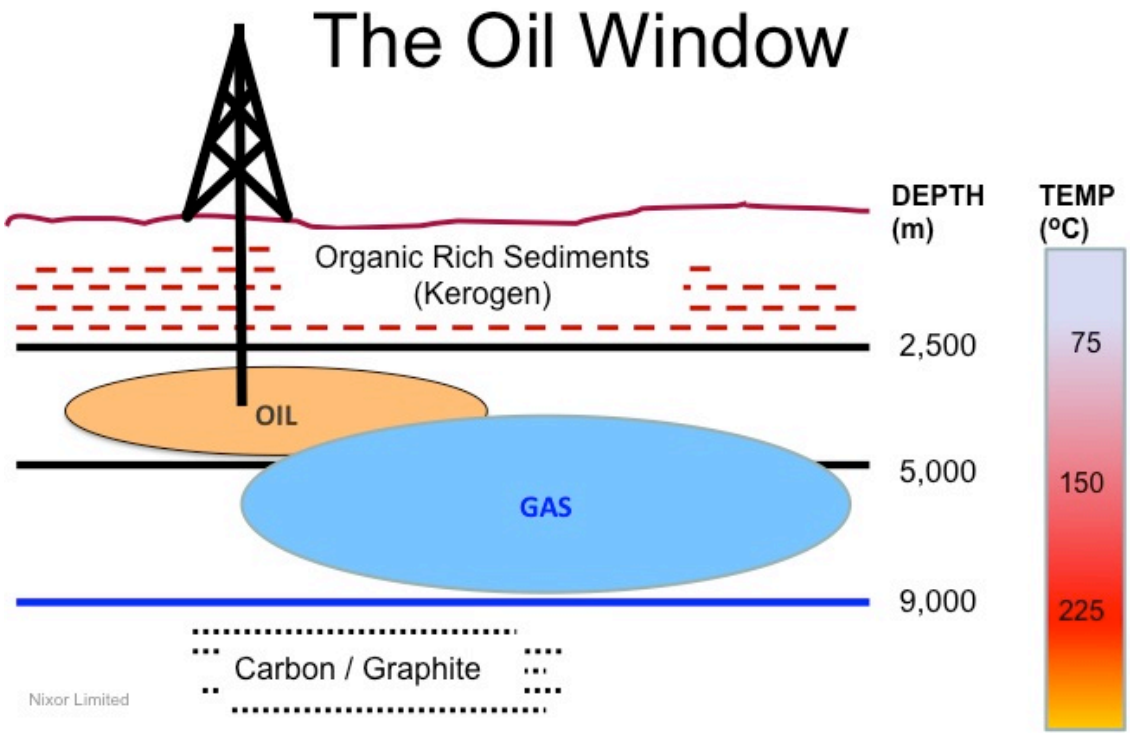
- To preserve this organic matter from early destruction we need an oxygen-free environment.



- Clay and mudstones (carbonate) are the most common source rocks.

The source rock must be gradually and gently cooked (matured)

- The heat is obtained from the Earth by burial/subsidence of the source rock.

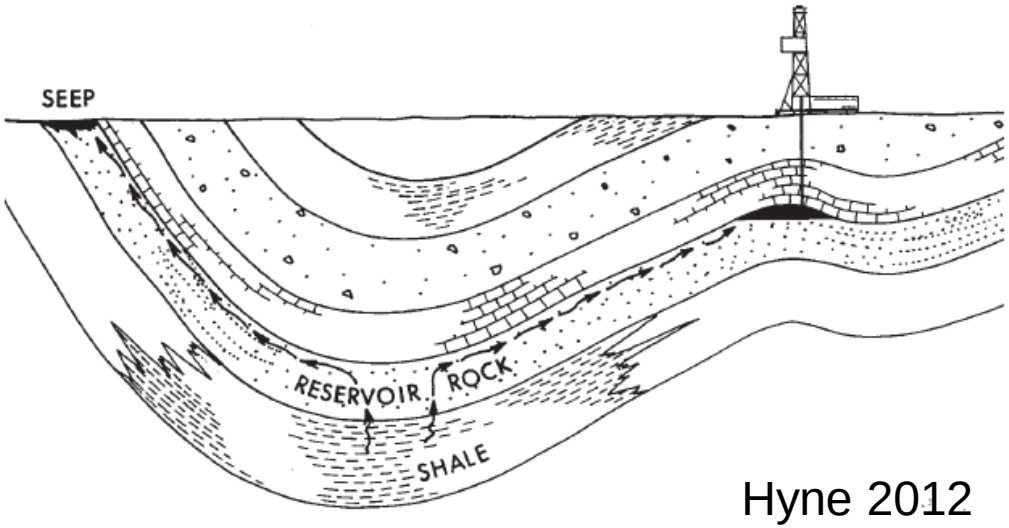


Primary migration

- At considerable depths oil and gas are formed and then slowly squeezed out of the source rock.

- 1. If they can, they will escape up to the surface of the Earth

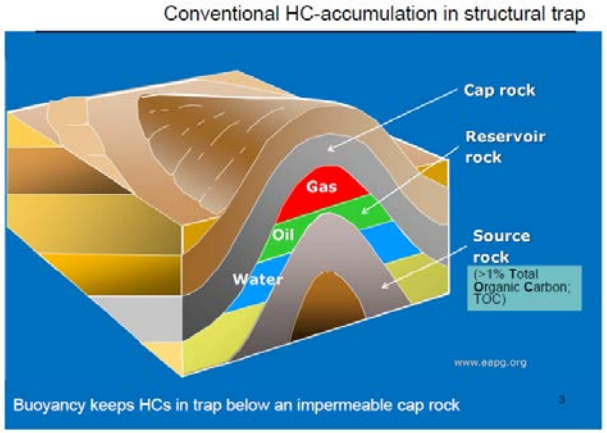
- where they are lost for ever.



Hyne 2012

- 2. The petroleum migrates until the upwards percolation (migration) is blocked (**trap**).
- The petroleum start to accumulate in the fine pores of the reservoir rocks (sandstones and carbonates).

Such a trap could be formed for example at the crest of an anticline.



Exploration Methods, Seeps

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Offshore Hydrocarbon Detection (Seeps)

- Seeps are direct evidence of hydrocarbon occurrences, and are associated with many major discoveries.
- Seeps provide significant targets for more intensive exploration efforts

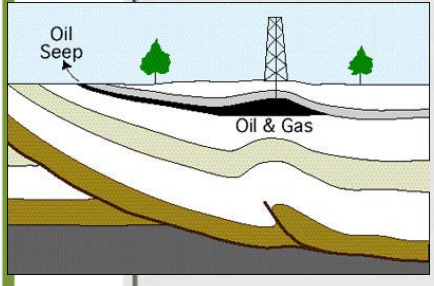
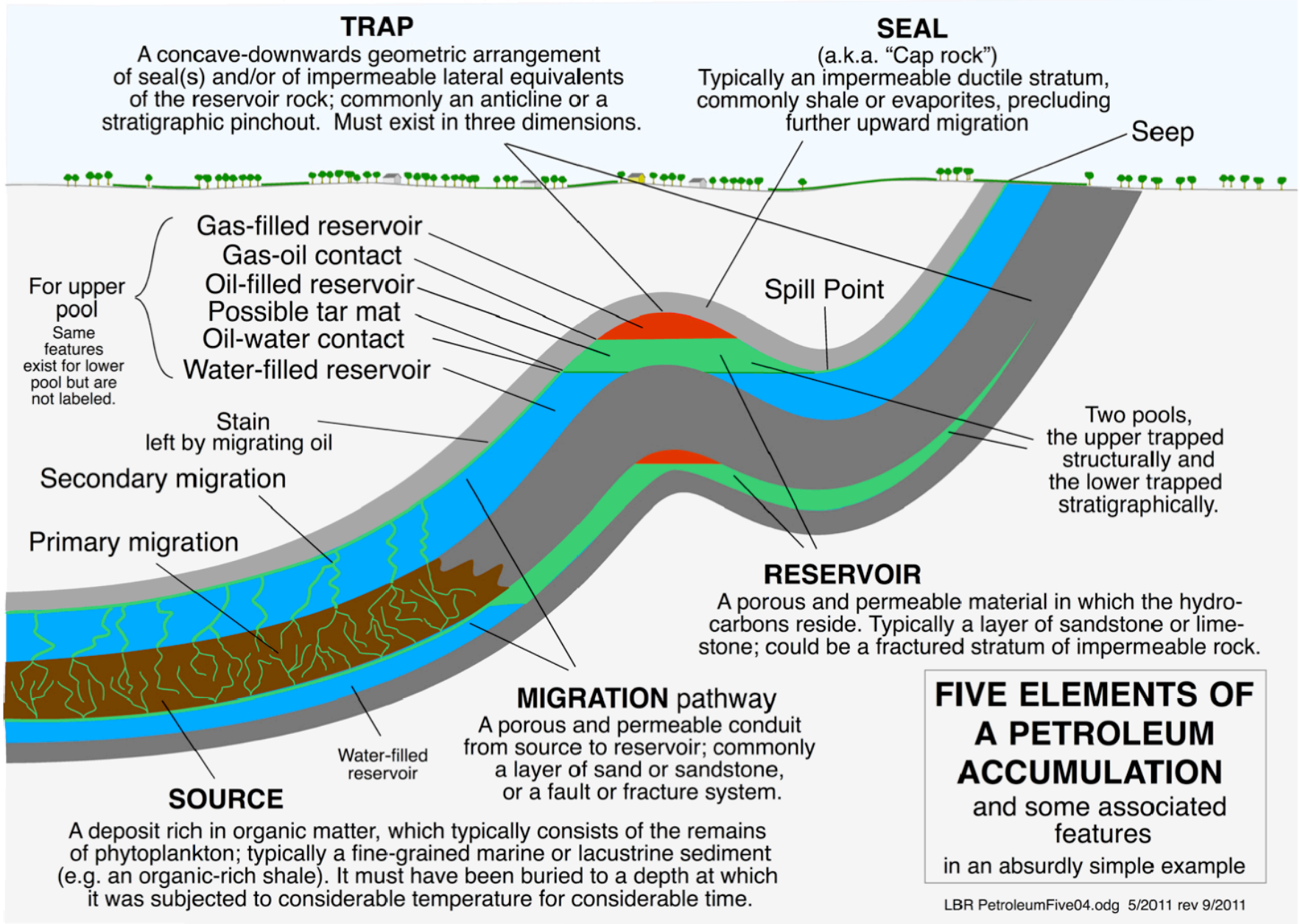


Abb. 2 Lokationen von Erdölaustritten an der Erdoberfläche [2, 3]

„Magic fives”

- Five requirements that lead to accumulation of oil and gas.

- Successful exploration: all five factors have to come together and in the correct sequence. If one fails, than we cannot expect there to be any oil or gas.


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

- **1. Source rock**
- Shale (black shale) or very fine grained limestone, with a minimum of 0,5 % of organic matter.
- **2. Heat**:
- Obtained from the Earth by burial of the source rock.
- **Oil window**: oil generation: between 60 - 120 °C
- **Gas window**: 120 - 225 ° C.
- Above 225 ° C, the kerogen is inert, having expelled all hydrocarbons; only carbon remains as graphite.

- **3. Reservoir**

A layer or formation of rock that is both porous and permeable, usually sandstone of limestone.

4. Cap rock or seal

An impermeable layer above the reservoir to retain the petroleum within it: in most cases shale or evaporite.

5. Trap

- A subsurface environment, formed by structural or stratifraphic control, where the petroleum is barred from migration.

- The trap must have been there before the oil/gas migration starts.
- The petroleum must be preserved in the trap. Later tilting or faulting could allow it to escape.
- Further deep burial can lead to petroleum destruction.