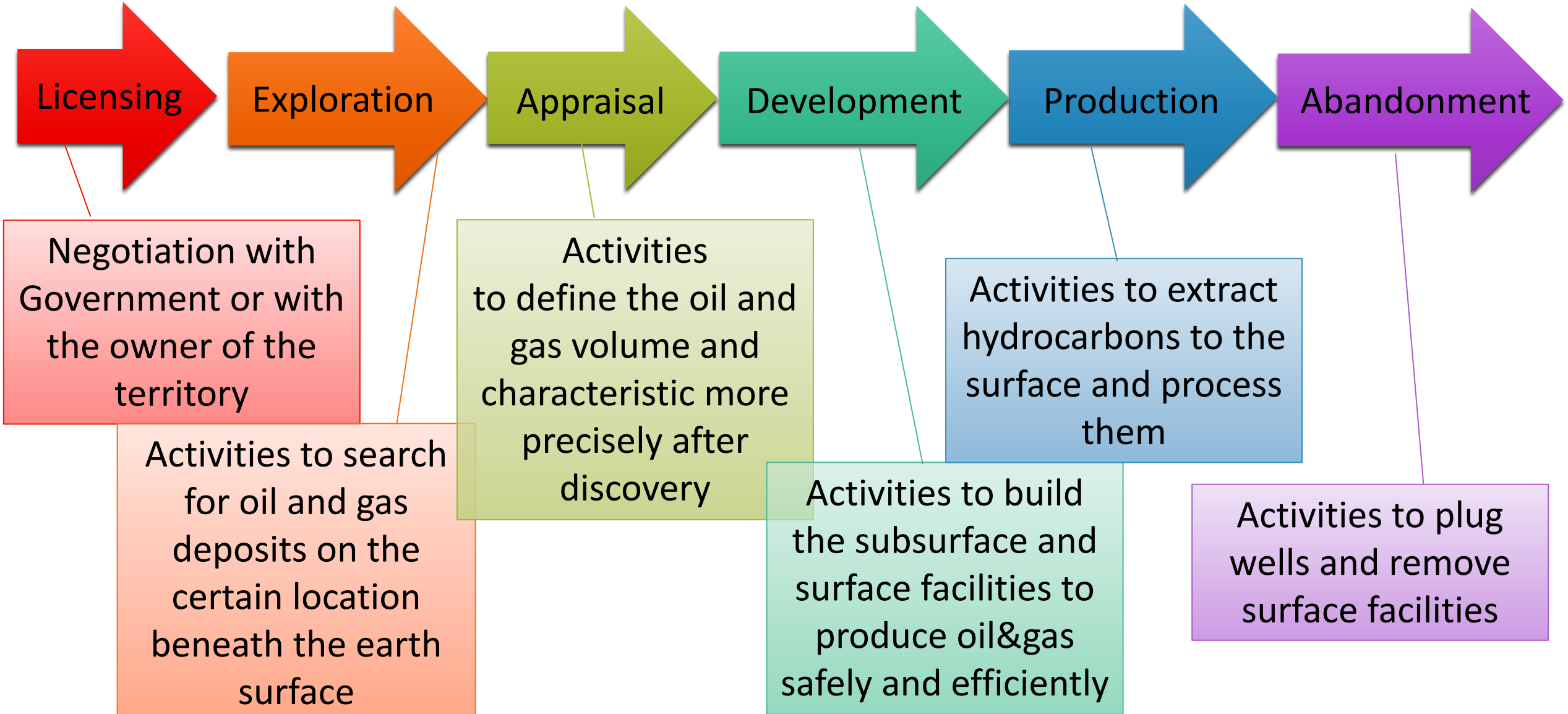
Part 1
Oil and gas industry segments

Upstream, midstream, downstream

Upstream segment of oil and gas is also known as exploration and production (E&P) because it encompasses activities related to searching for, recovering, and producing crude oil and natural gas.

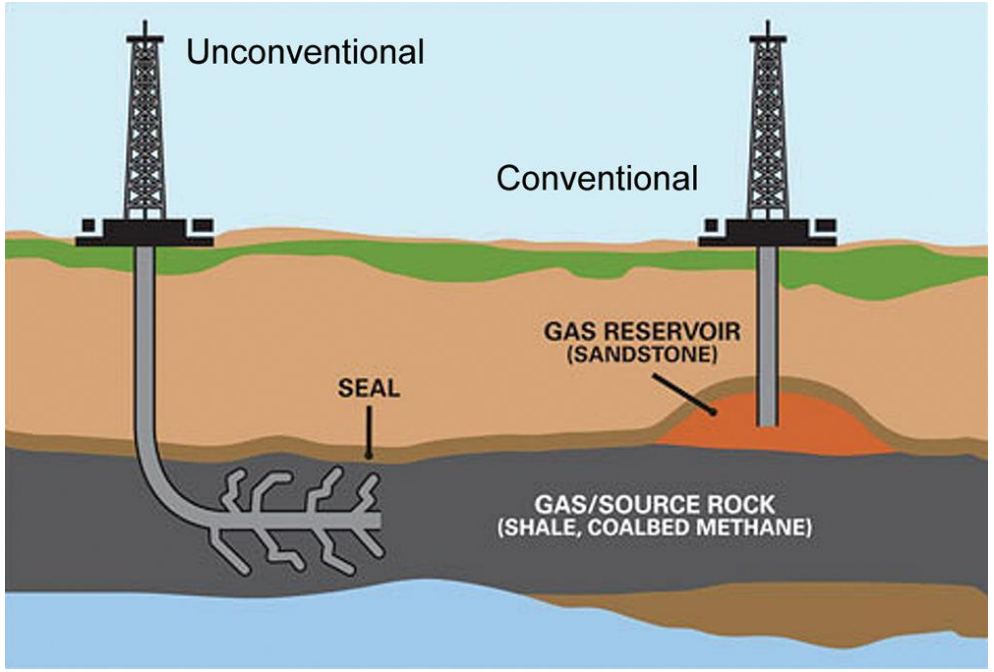


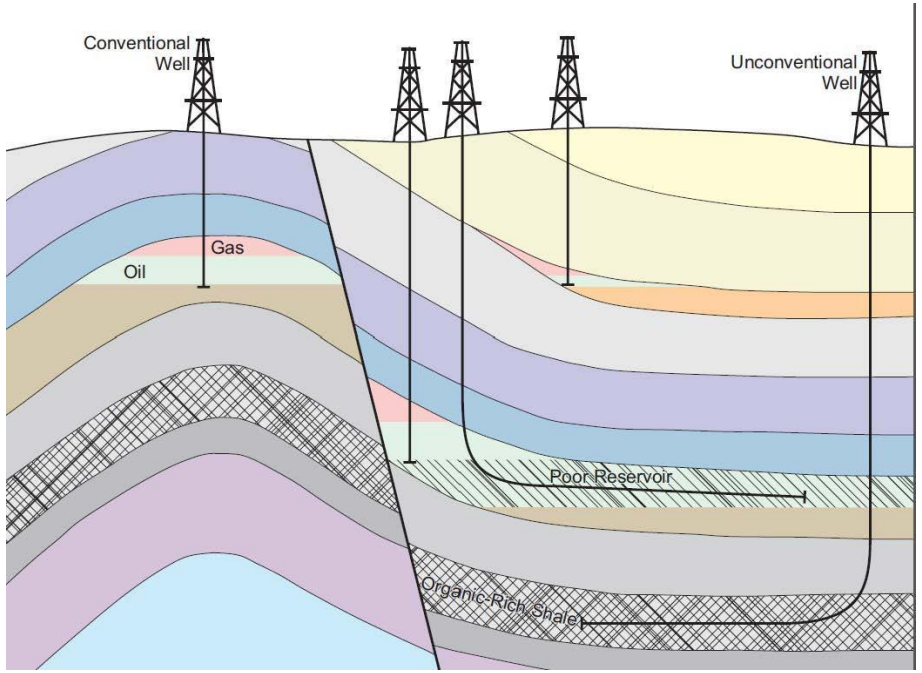
Unconventional methods of oil extraction

- horizontal drilling
- hydraulic fracturing (fracking)
- subsea engineering

Unconventional oil

- oil shale
- oil sands
- tight oil





Midstream primarily involves the storage and transport of oil & gas through a network of pipelines, trucks, rail, ships, tankers and barges to the downstream sector.

Gathering

Field processing

Fractionation

Transportation

- marine vessels
- railroads
- trucks

Storage

- oil is stored in tanks
- gas is stored underground

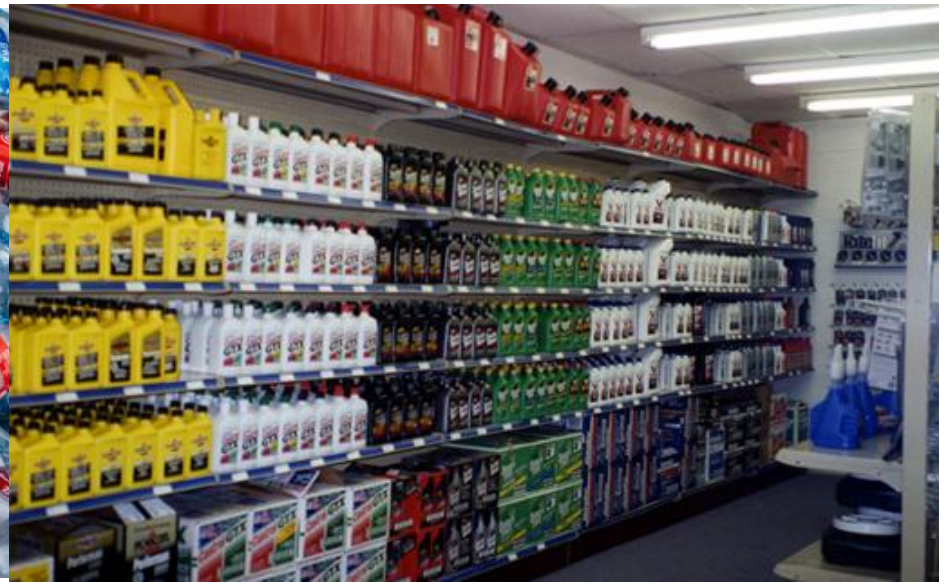
The **downstream** sector focuses on the refining of crude oil and purifying natural gas as well as the marketing and distribution of products derived from them.

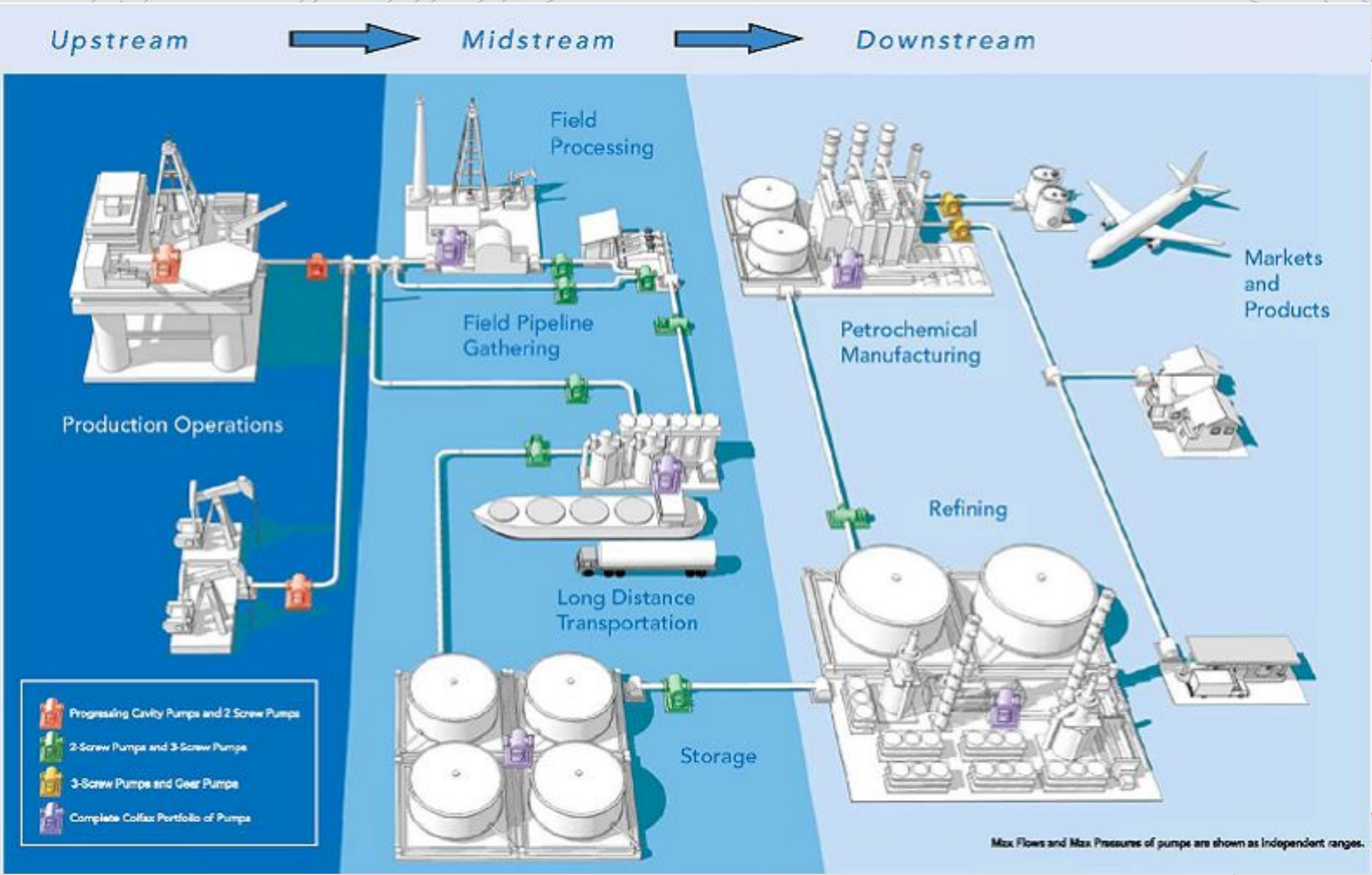
Refining & purifying

- refineries convert crude oil into variety of products (gasoline, diesel, asphalt, jet fuel, plastics, lubricants and etc.)

Retail

- provision thousands of products to the end-user customers around the globe




Upstream
Midstream
Downstream
Field Processing
Field Pipeline Gathering
Production Operations
Petrochemical Manufacturing
Markets and Products
Refining
Long Distance Transportation
Storage
Progressing Cavity Pumps and 2 Screw Pumps
2-Screw Pumps and 3-Screw Pumps
3-Screw Pumps and Gear Pumps
Complete Colfax Portfolio of Pumps
Max Flows and Max Pressures of pumps are shown as independent ranges.

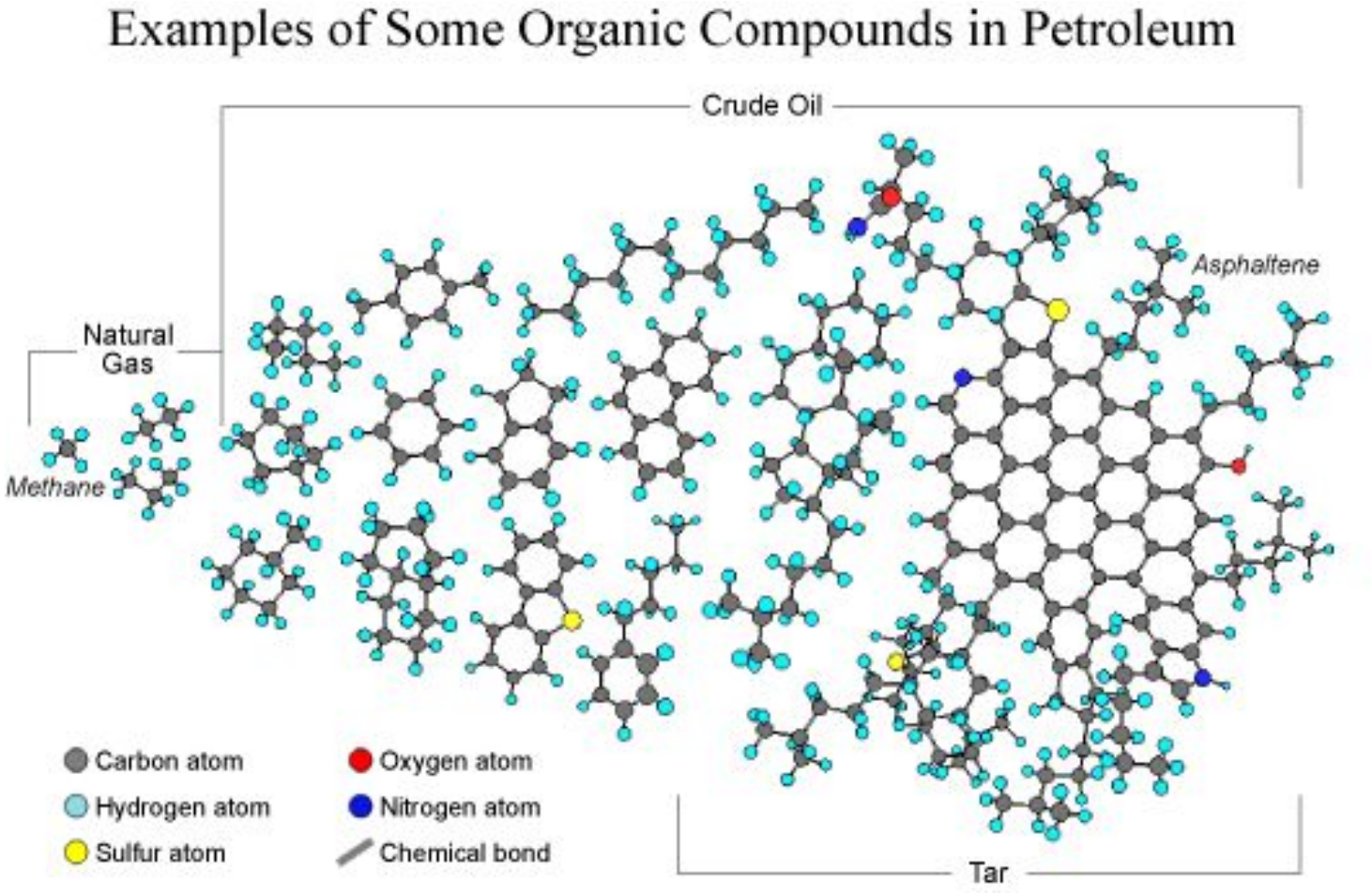
Part 2
Upstream segment: Exploration

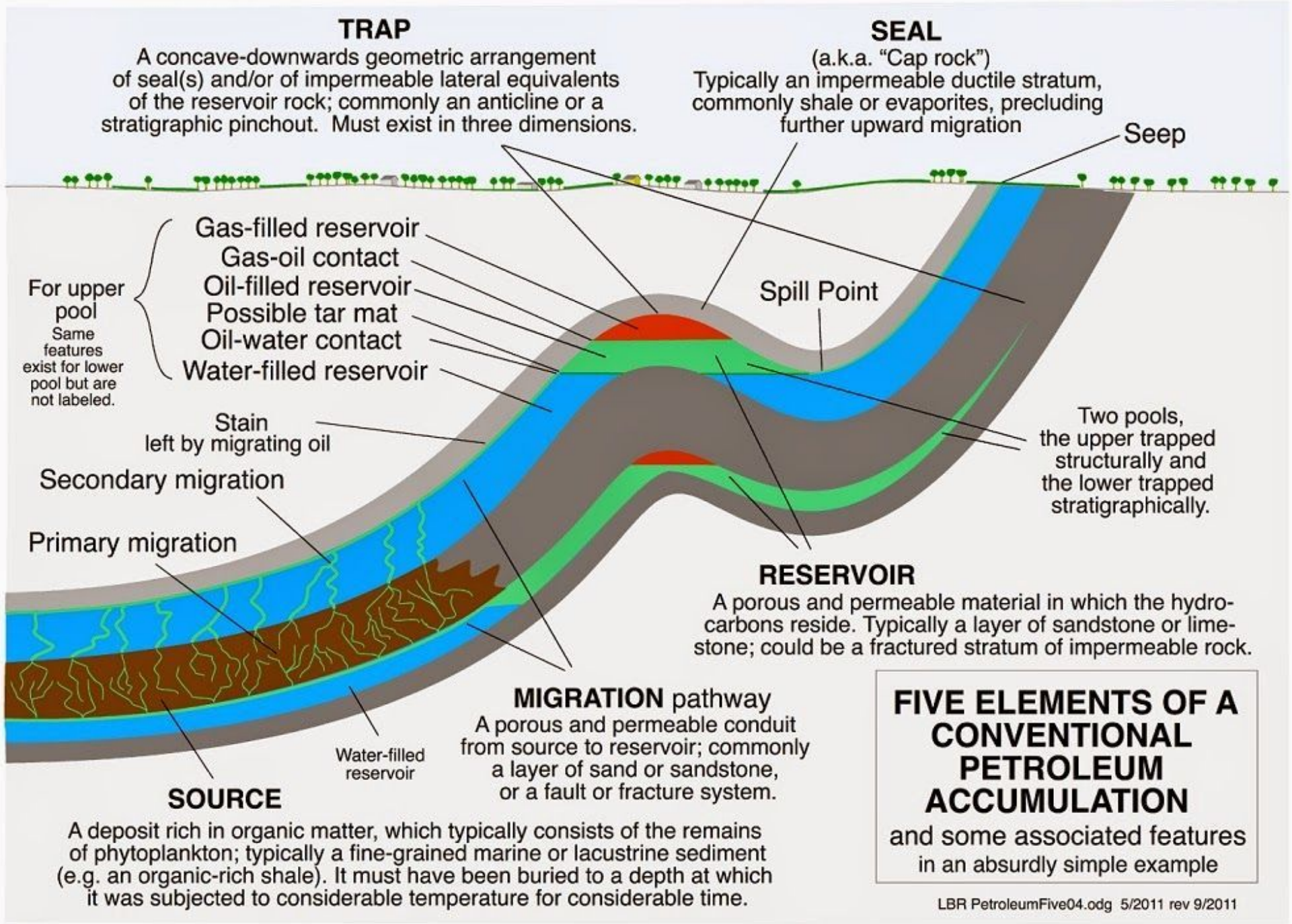
Important terms

Hydrocarbons - organic compounds consisting entirely of hydrogen and carbon.

Crude oil is oil in its natural state before it has been processed or refined.

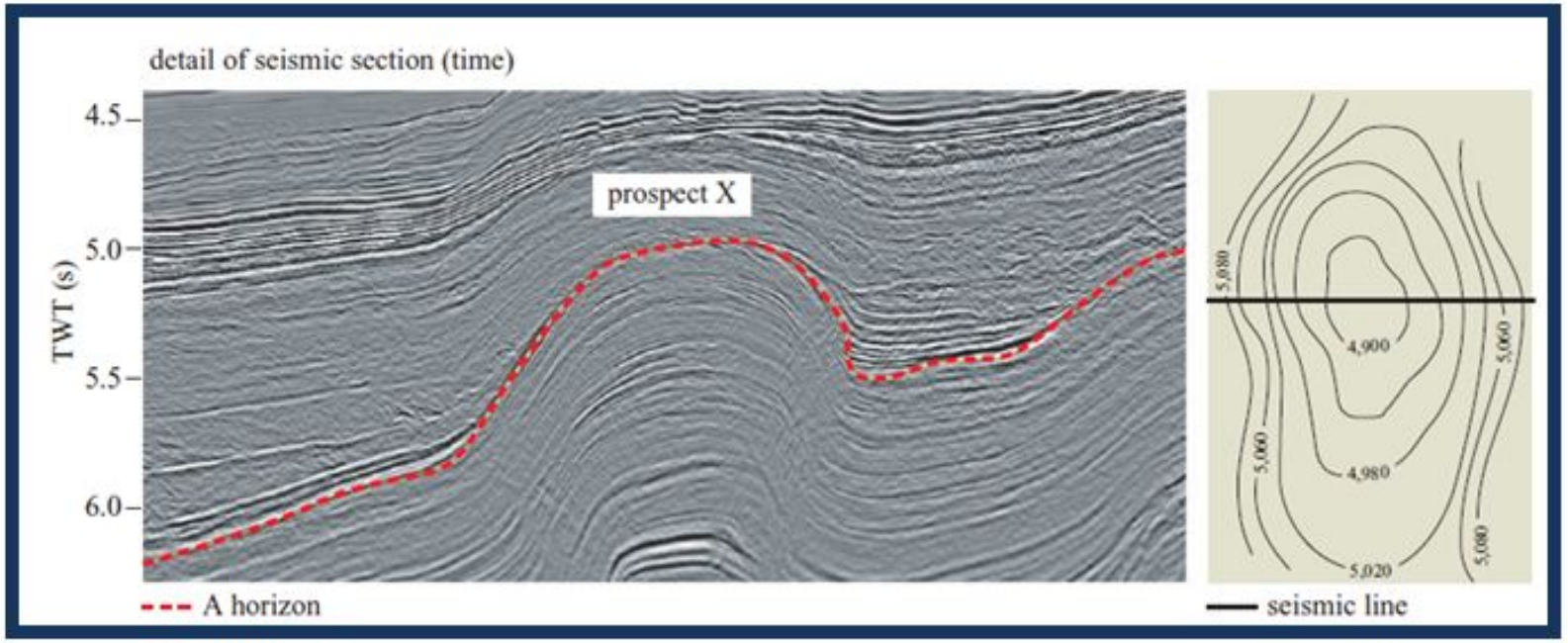
Natural gas (also called fossil gas) is a naturally occurring hydrocarbon gas mixture consisting primarily of methane.




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 CONVENTIONAL PETROLEUM ACCUMULATION
and some associated features
in an absurdly simple example
LBR PetroleumFive04.odg 5/2011 rev 9/2011

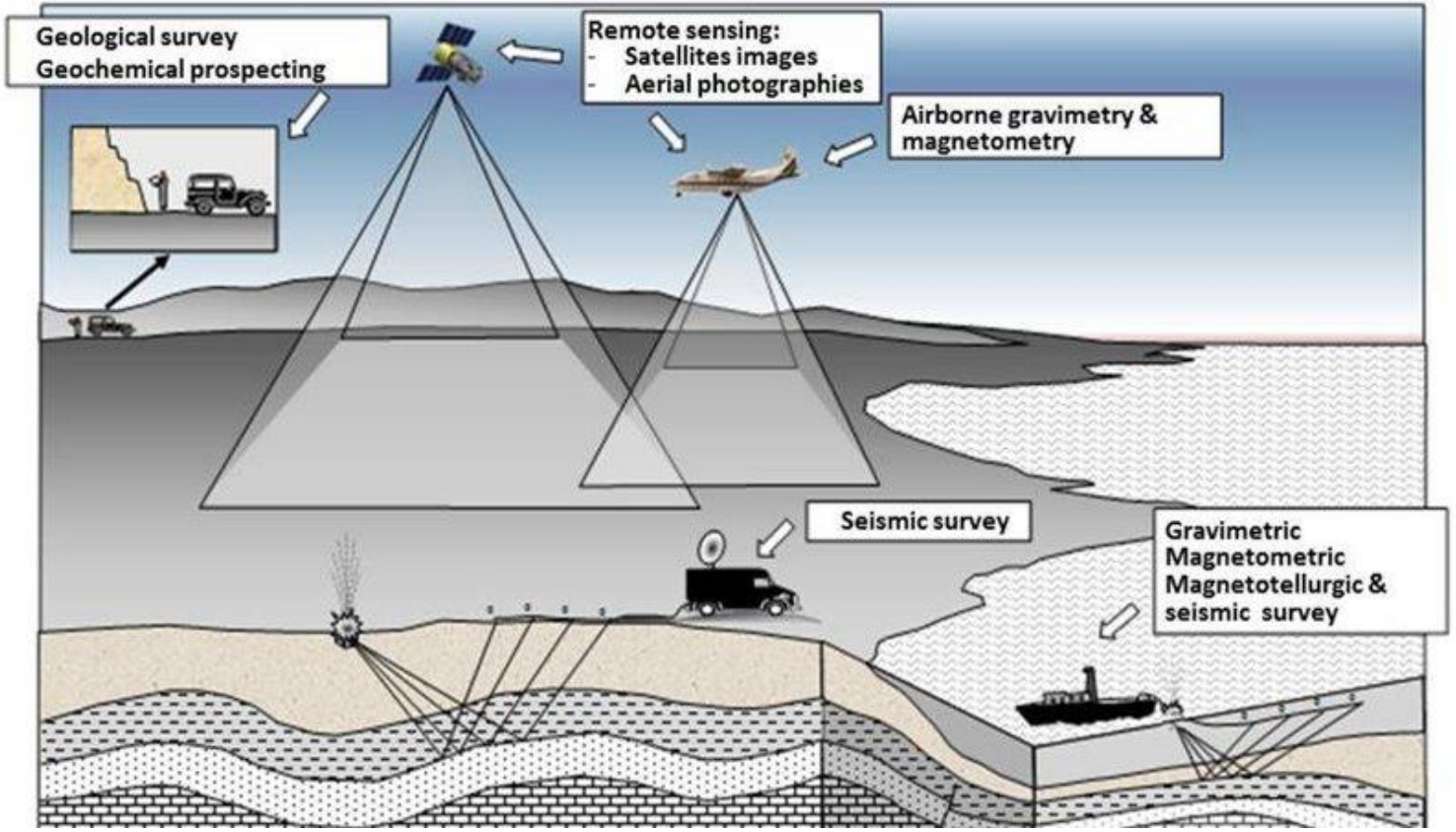
Hydrocarbon exploration (or **oil and gas exploration**) is the search by petroleum geologists and geophysicists for deposits of hydrocarbons, particularly petroleum and natural gas.

- Conduct geological and geophysical surveys on *the features of interest* (known as **leads**)
- Once a lead has been identified, geophysicists will conduct more detailed mapping over it using energy or seismic waves.
- Finally, when **a prospect** (*a lead which has been evaluated and is ready to drill*) has been identified and evaluated an exploration well is drilled in an attempt to conclusively determine the presence or absence of oil and gas.

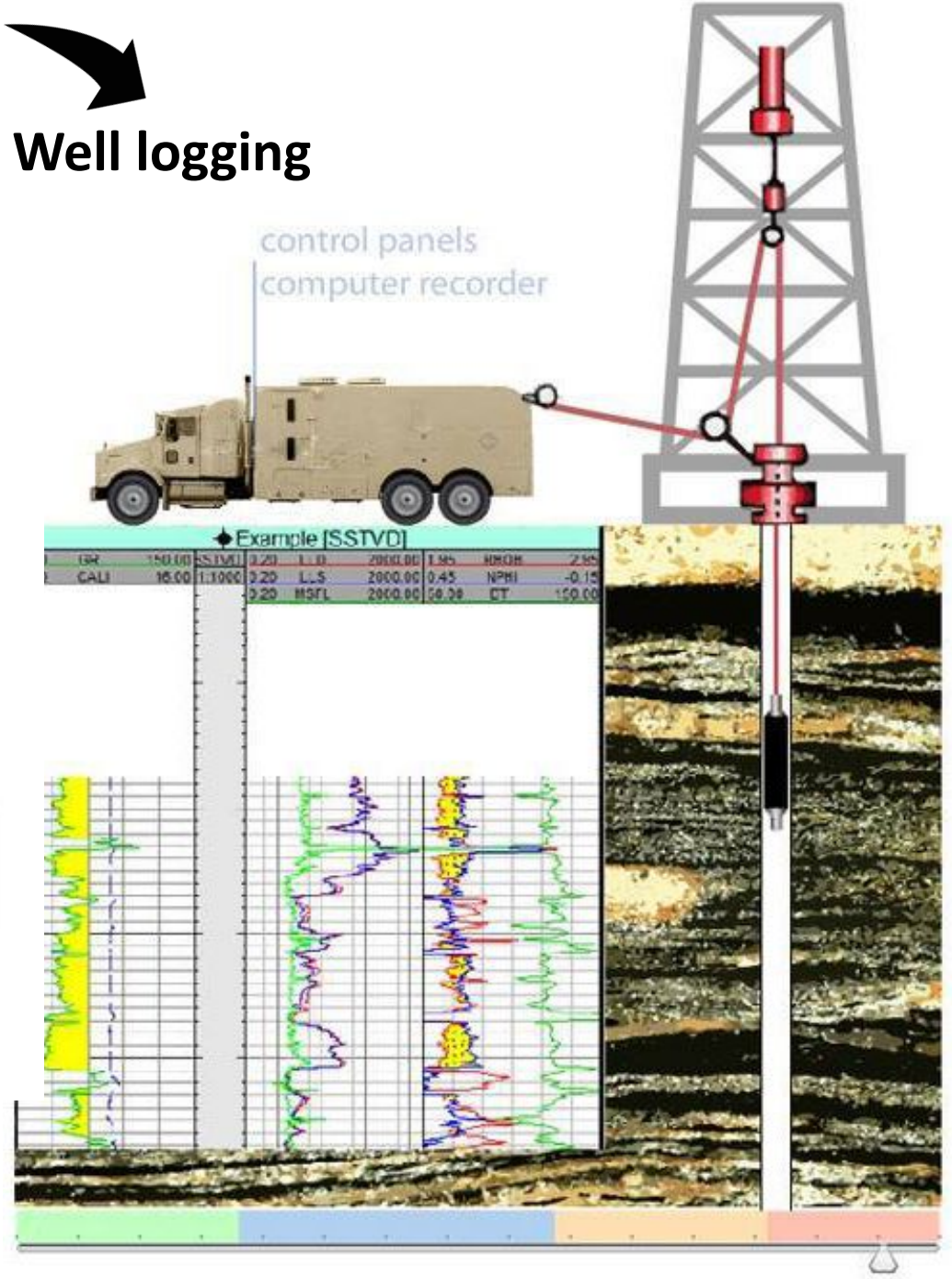


GEOPHYSICS

Geophysical prospecting for oil

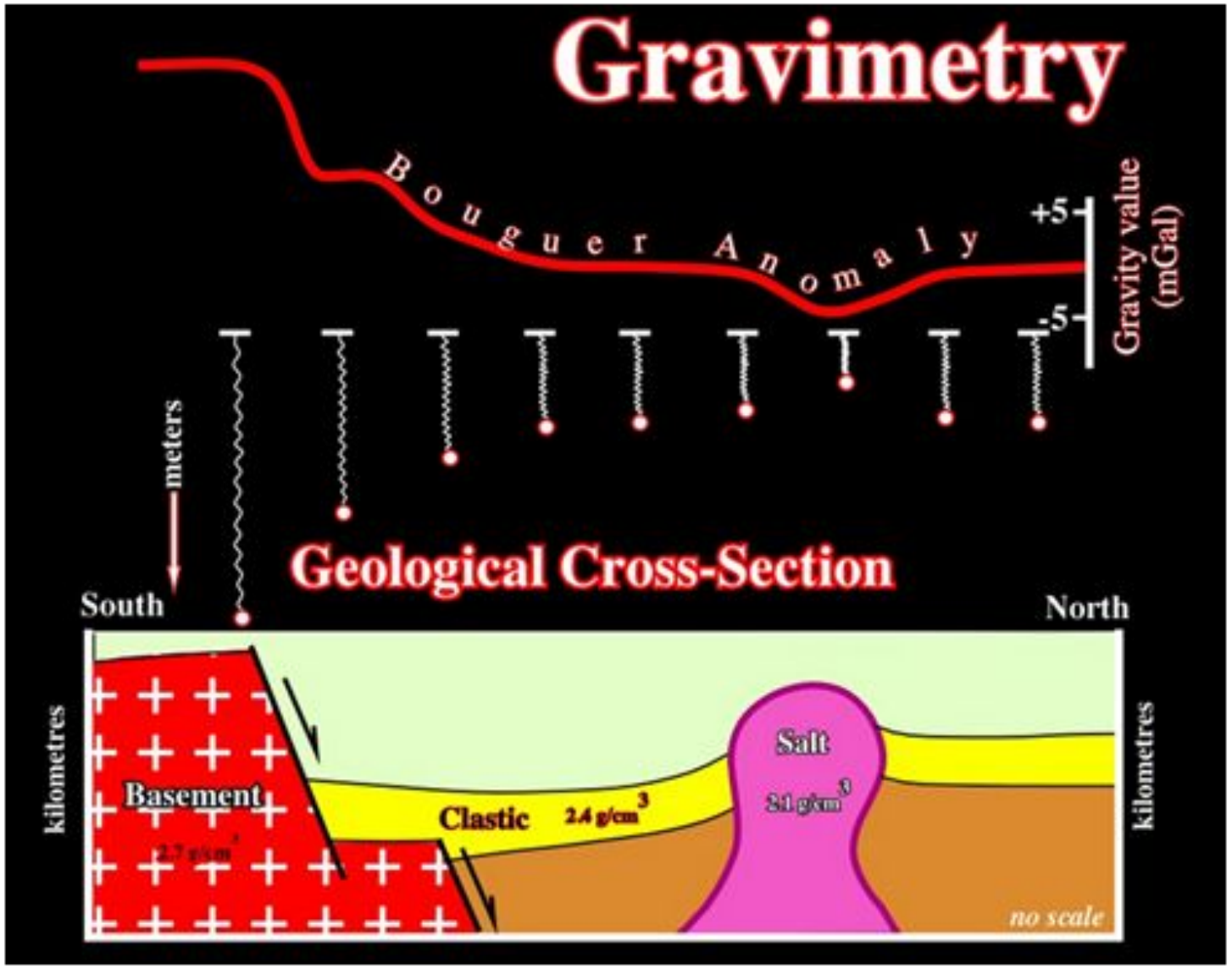


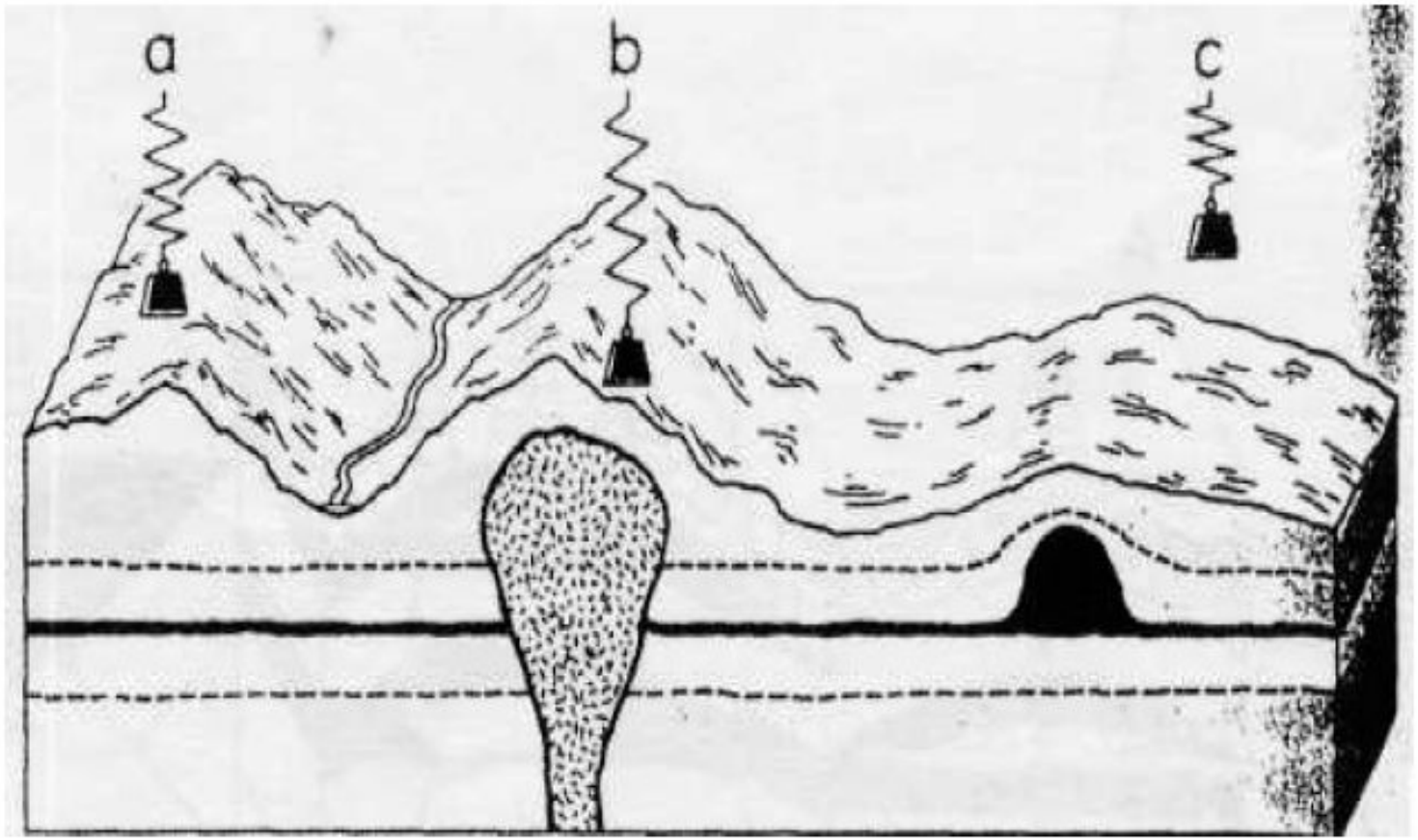
Well logging



Gravity method

The gravity method is based on the measurements of the variations in the pull of gravity from the rocks in the upper layers of the earth`s surface. Denser rocks have greater gravitational attraction than less dense rocks. For example, a structural uplift of denser rocks will appear as an anomaly on the gravity map.
Gravity surveys for hydrocarbons are carried out on land, in the air on helicopters, and at sea on ships.

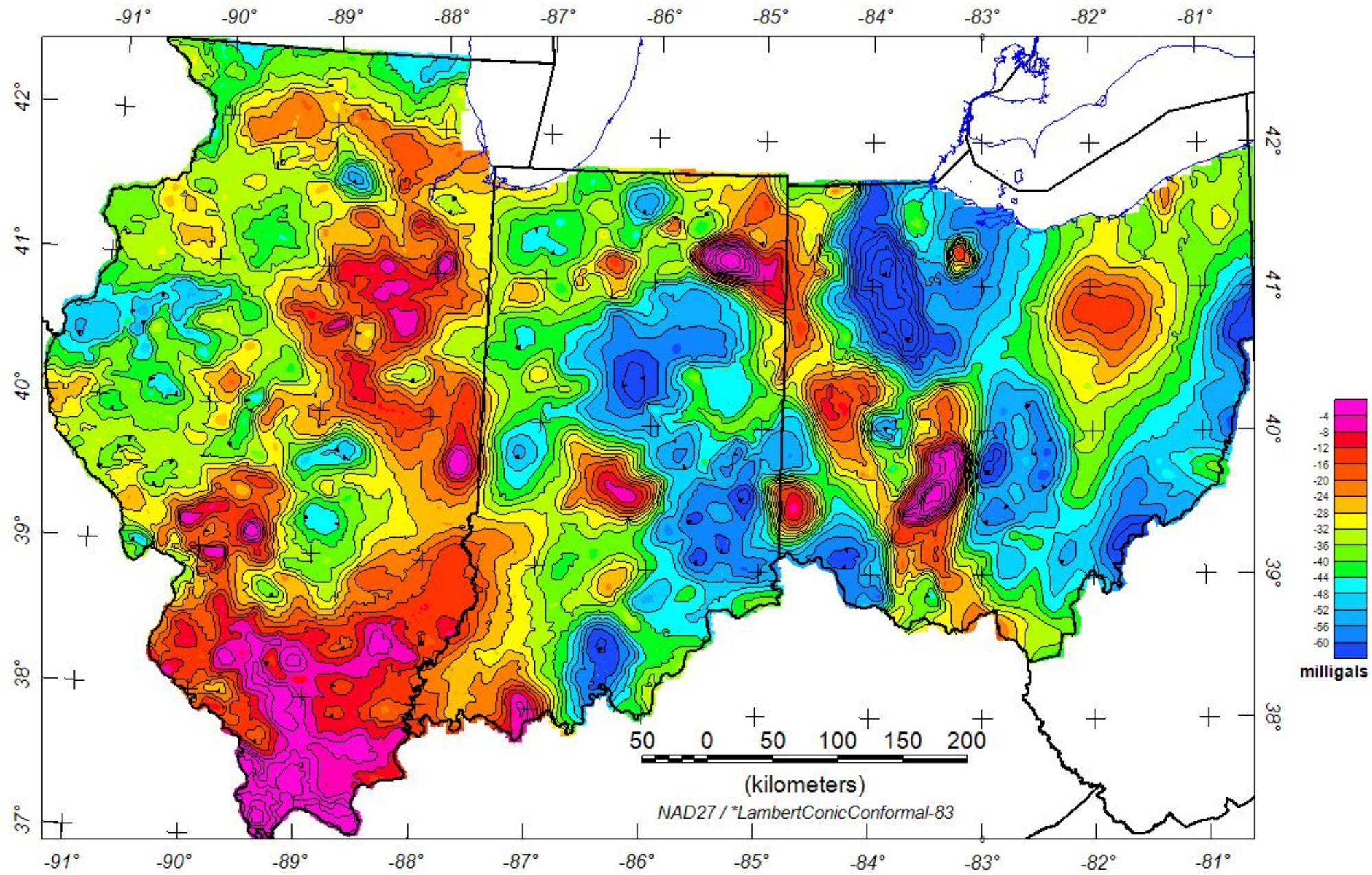




a. Normal gravimetric reading.

b. High gravimetric reading from dense igneous rock near the surface.

c. Low gravimetric reading from low density salt dome.

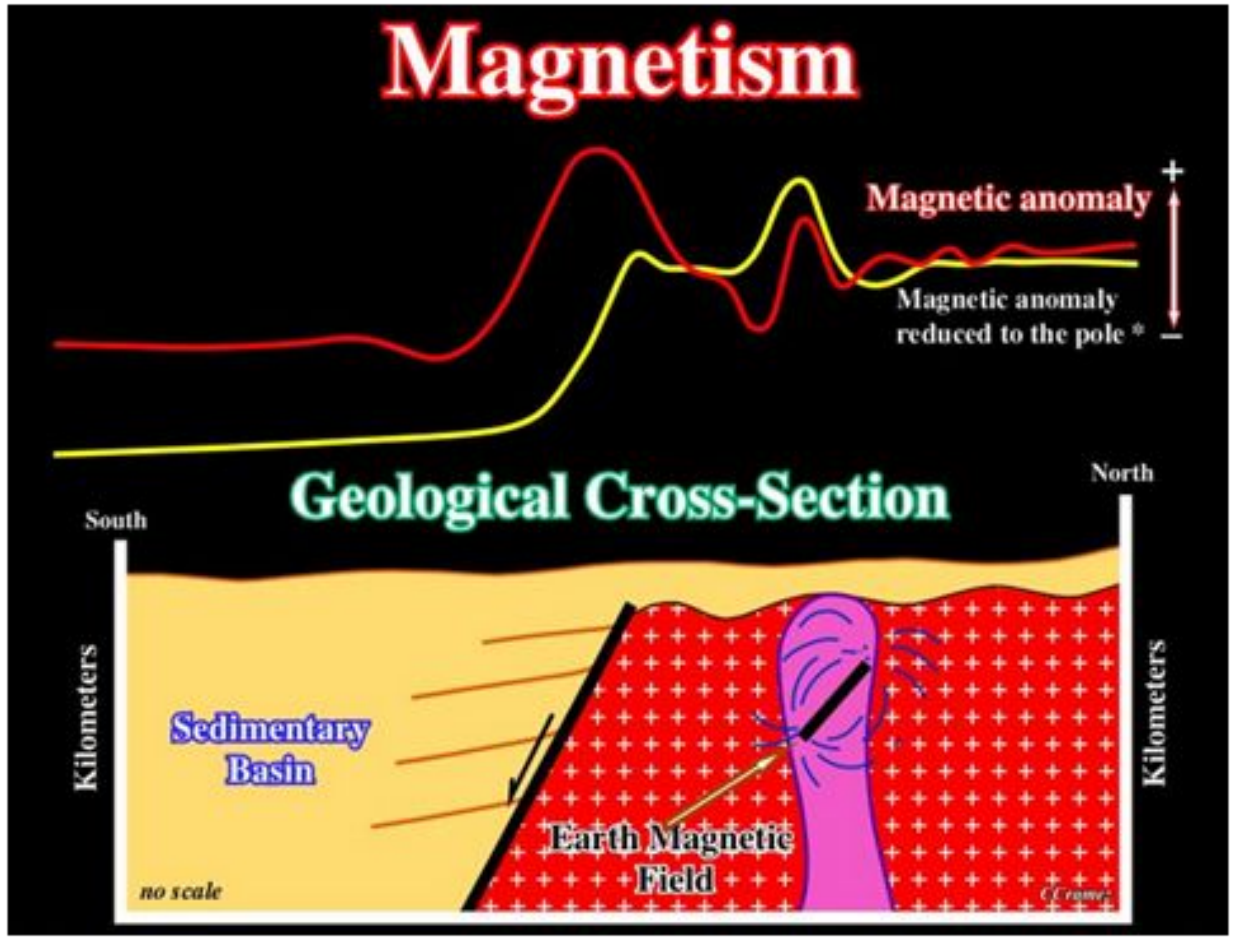

-91°
-90°
-89°
-88°
-87°
-86°
-85°
-84°
-83°
-82°
-81°
42°
41°
40°
39°
38°
37°
-4
-8
-12
-16
-20
-24
-28
-32
-36
-40
-44
-48
-52
-56
-60
milligals
50 0 50 100 150 200
(kilometers)
NAD27 / *LambertConicConformal-83

Magnetic method

The magnetic method is the oldest geophysical method, and is based on the measurement of variations in the magnetic field due to changes of structure or magnetic susceptibility of the rocks.

Today magnetic surveys for hydrocarbon exploration are usually carried out from the air or from a ship.

The gravitational fields of geologic bodies do not depend on the earth`s gravitational field, whereas magnetic bodies frequently owe their magnetization to the magnetic field of the earth. For this reason, magnetic anomalies are often subject to change with latitude.

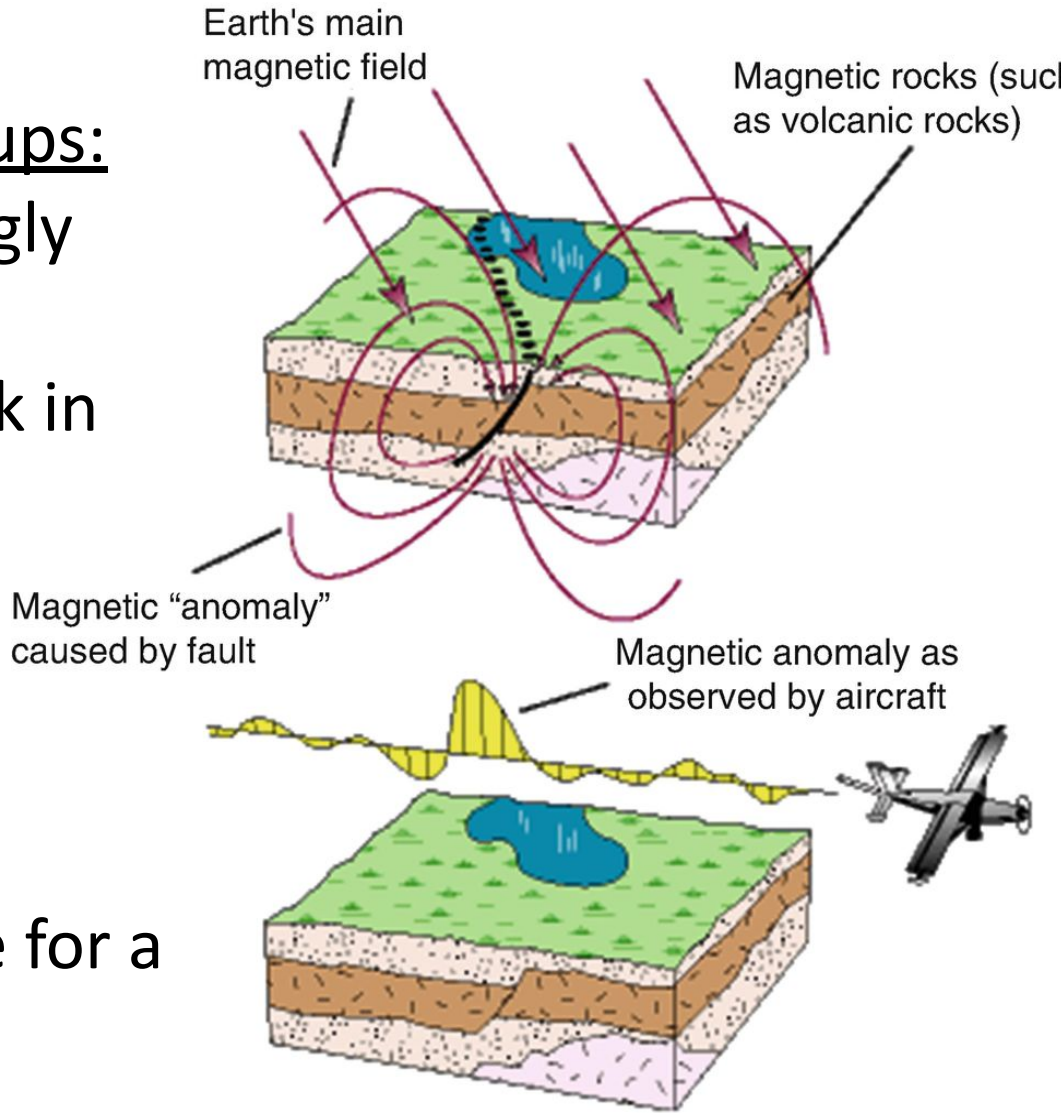


The magnetic anomalies of geologic bodies are dependent on their magnetic "susceptibility" and "remanent magnetism".

<u>Rocks and formations fall into two natural groups:</u>

- Igneous rocks and iron ores which are strongly magnetic
- sedimentary rocks, which are generally weak in magnetization

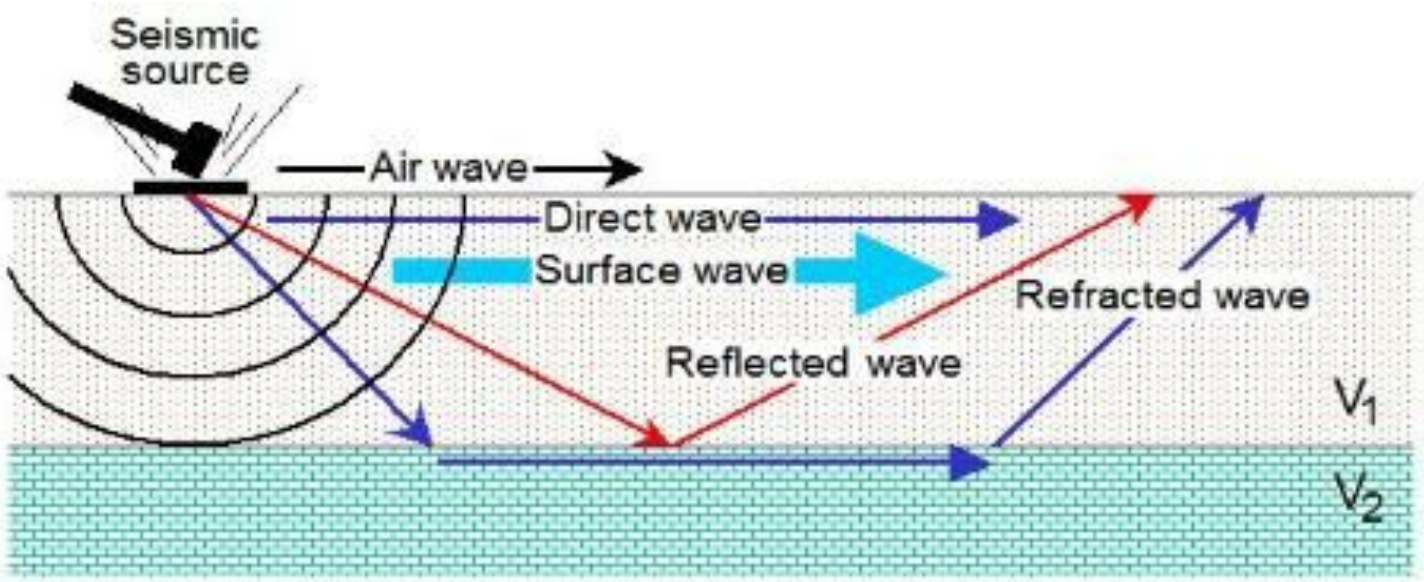
Sedimentary rocks generally have a smaller susceptibility than igneous or metamorphic rocks , so an interpretation of the recorded anomalies can yield the maximum depth value for a sedimentary basin.



Seismic methods

Shock waves (seismic waves) are used to help give a picture of deep rock structures. The idea is to make artificial rock waves and record how they travel through the Earth.

REFLECTION SEISMOLOGY
Reflection – when an incident compressional wave strikes a boundary between two media having different velocities of wave propagation, part of the energy is reflected from the boundary.

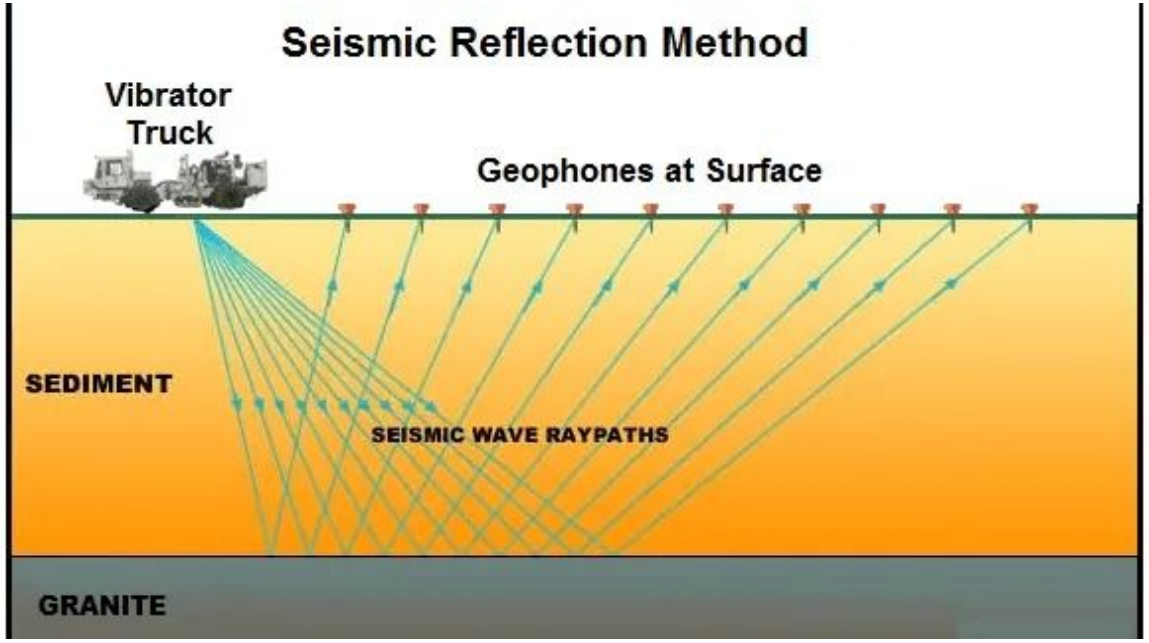


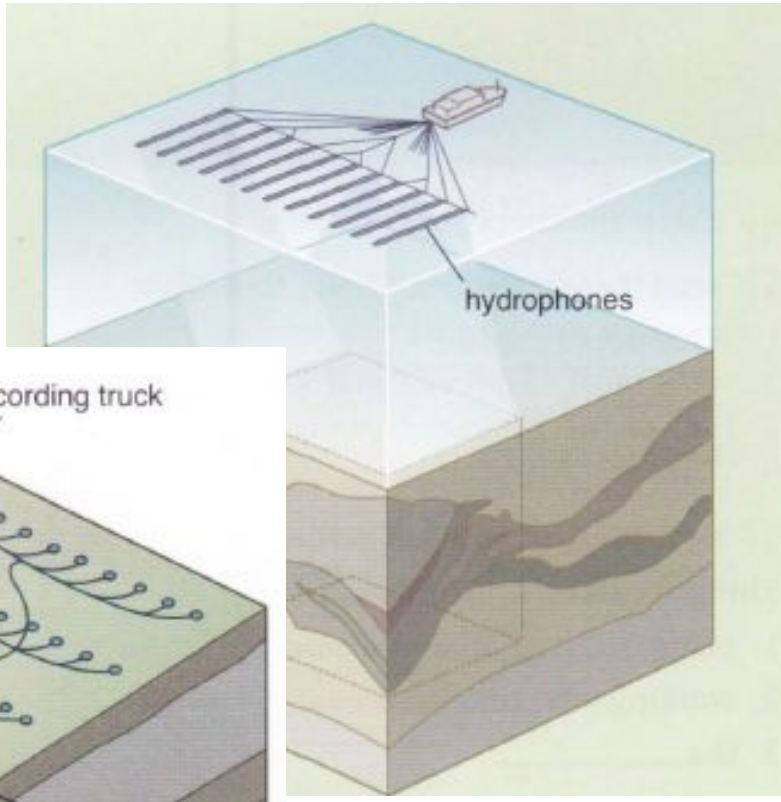
REFRACTION SEISMOLOGY
Refraction – the portion of the incident energy that is not reflected and is transmitted through the boundary and into the second layer.

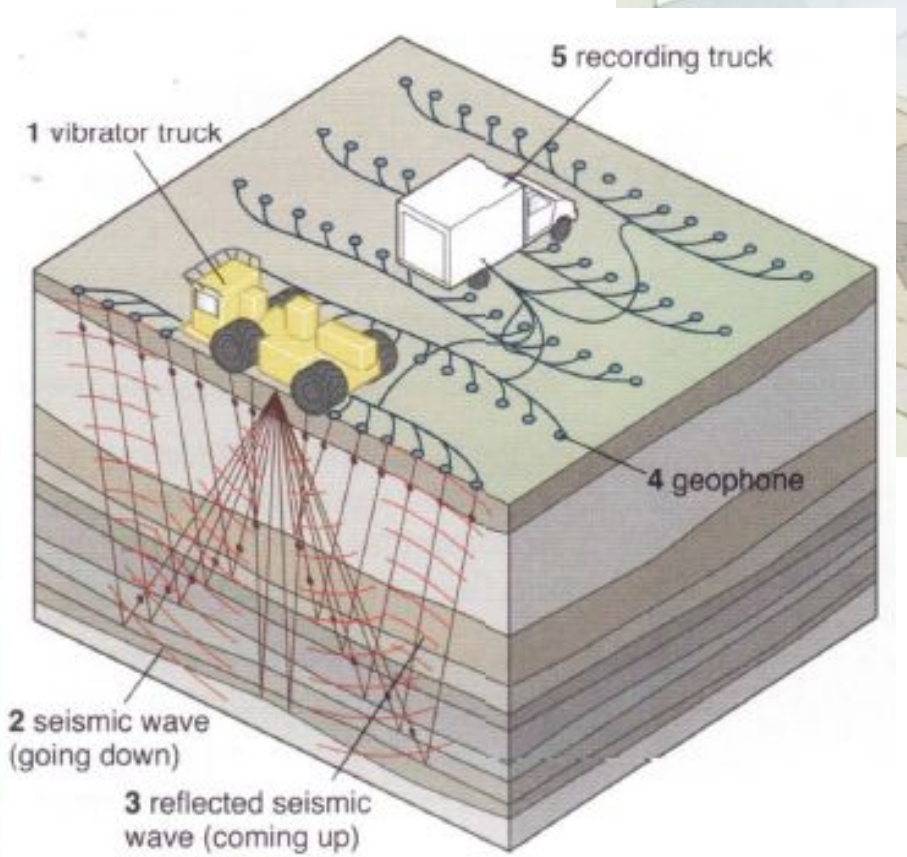
Most petroleum exploration is done by the reflection seismic method.

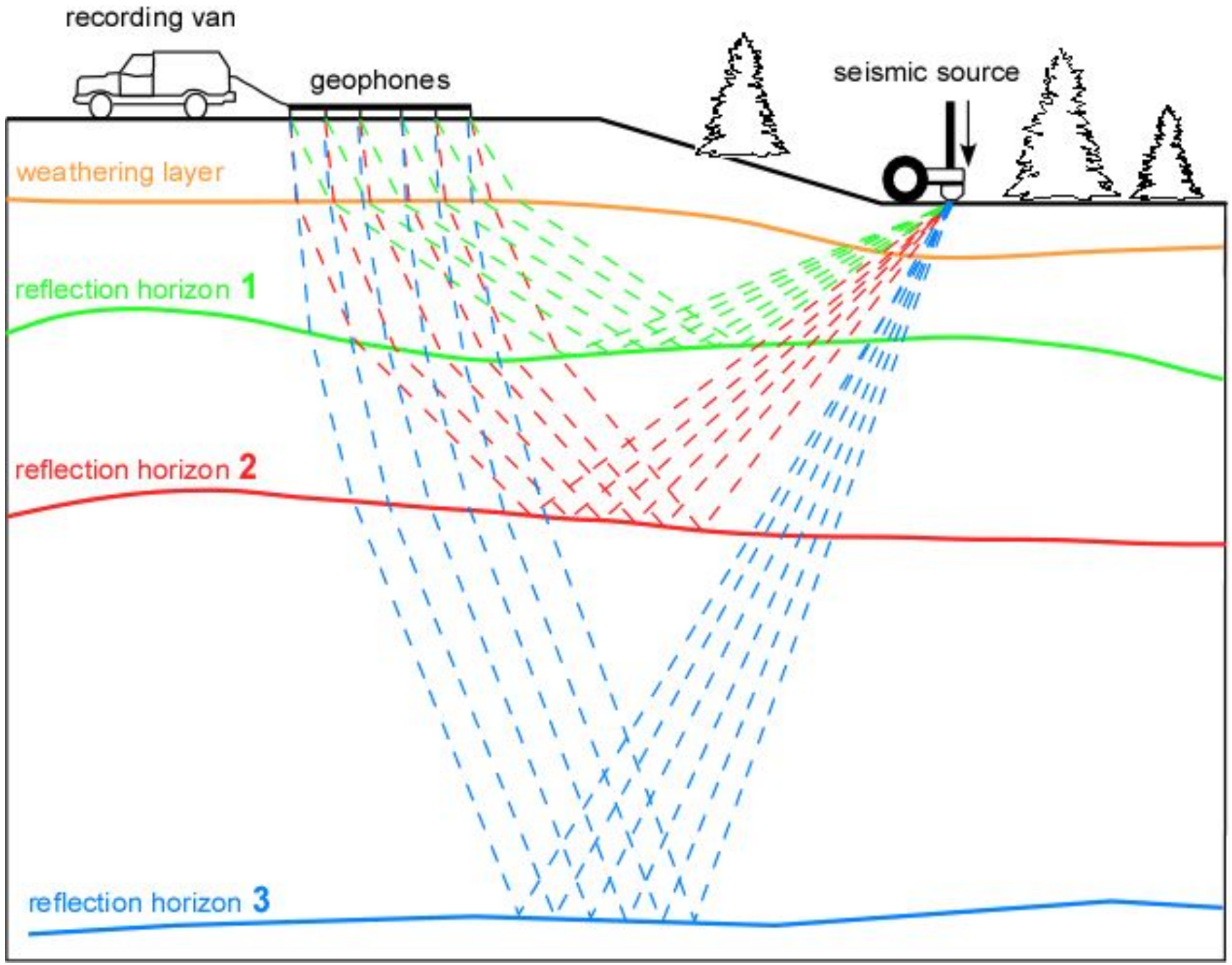
Each rock layer reflects some of the waves.

The reflacted waves travel up to geophones on the surface. Geophones are like microphones: they convert the waves into elecrical signals, then a machine in the recording tuck records the signals.

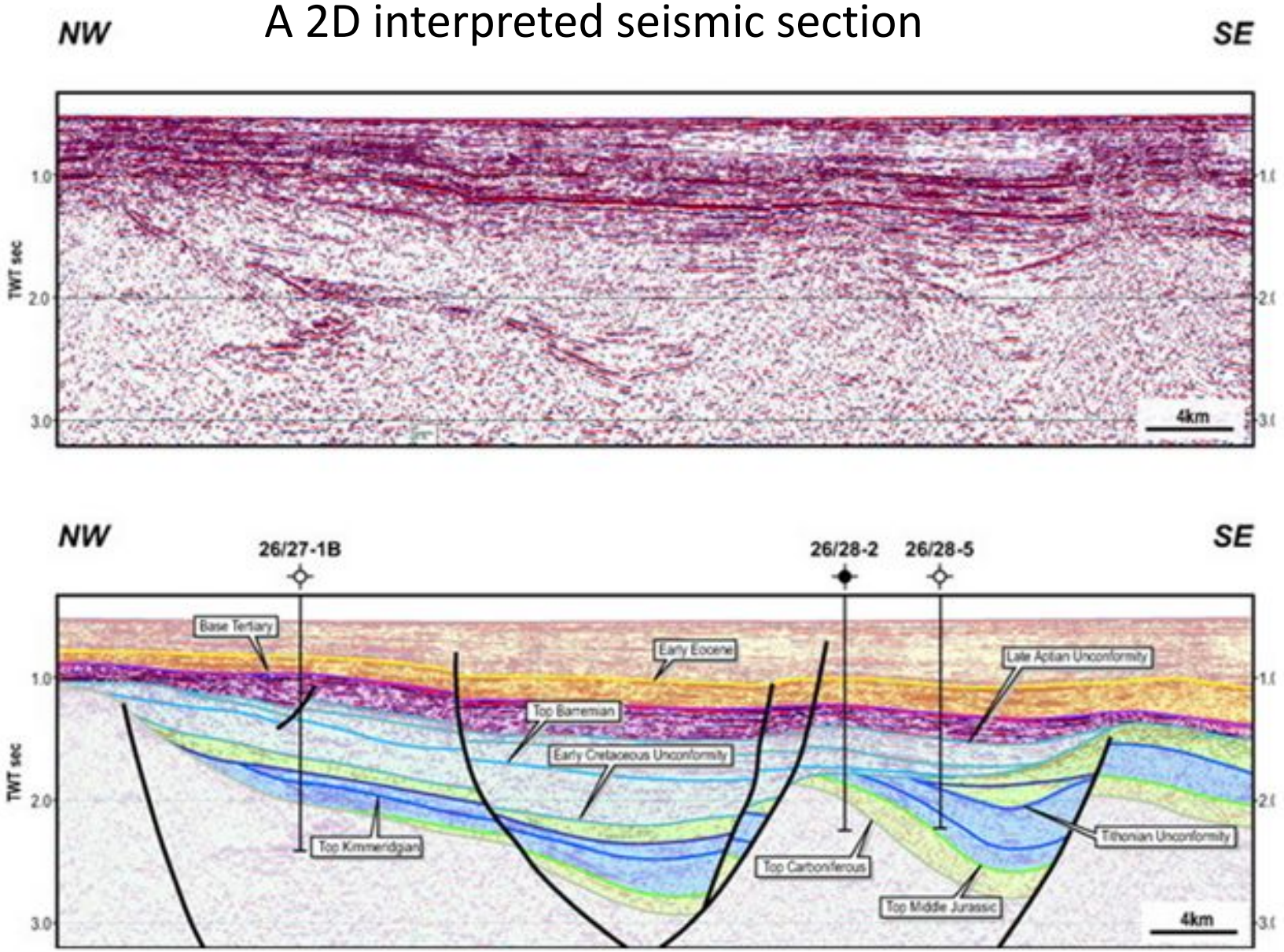


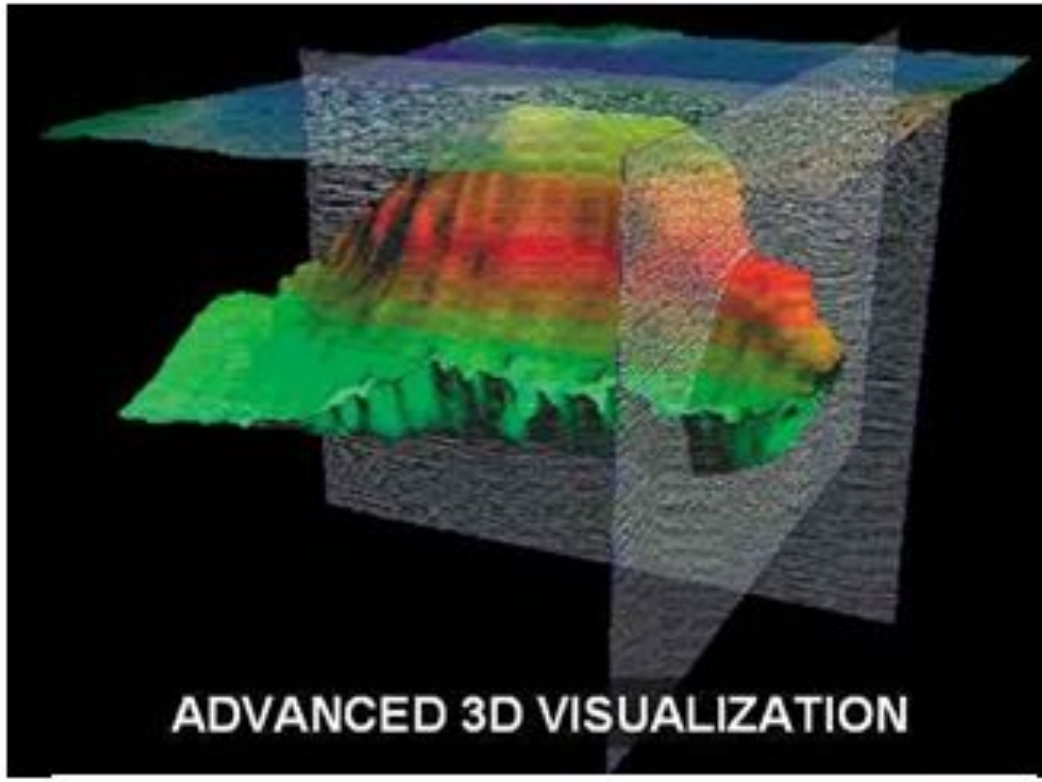





recording van
geophones
seismic source
weathering layer
reflection horizon 1
reflection horizon 2
reflection horizon 3

A 2D interpreted seismic section





3D Seismic Visualization - GEOMORE

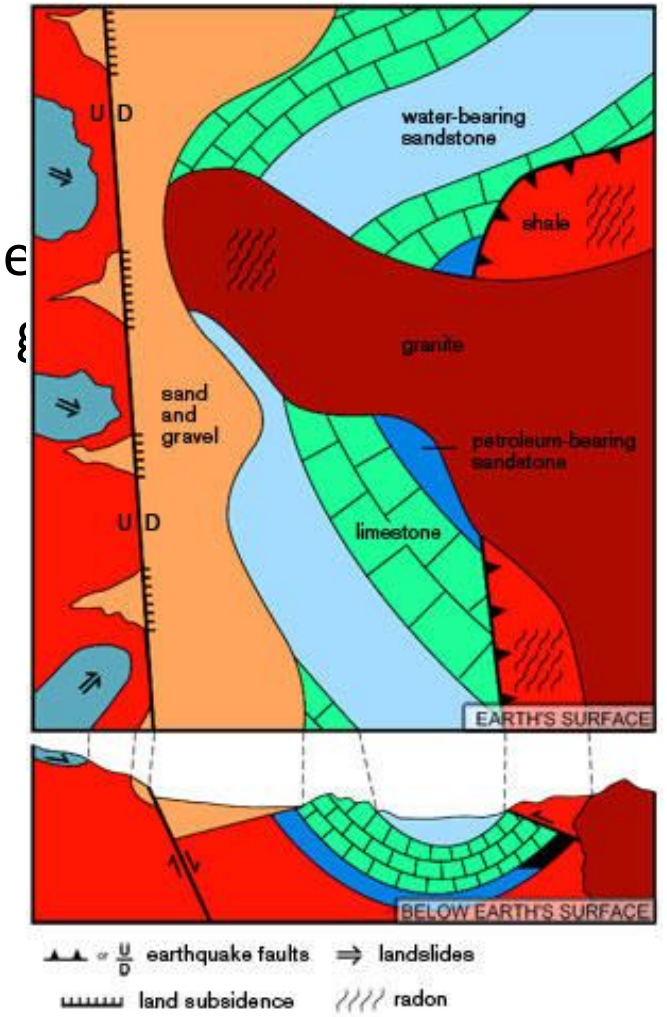
A visualization room

Geological mapping and prospecting

Geologists task is to find the right conditions for an oil trap – the right source rock, reservoir rock and etc.
Geological mapping is basically a technique which allows a graphical presentation of geological observations and interpretations.

Given this collection of information, the geologist can develop a detaile urface feature structure and rock composition, and make an educated g ion of potential oil and gas reservoirs.

In fact, most promising areas are already mapped, but companies are re-mapping. This work is assigned to geologists, whether employed directly by an large companies or under a contract from a private firms.



Geochemical methods

Geochemical methods used in exploring for oil and natural gas are based on the premise that hydrocarbons migrate upward from subsurface petroleum accumulations and produce anomalous patterns near the surface.
Geochemical method is still in an experimental stage and requires extremely precise analysis technique.
Geochemical exploration techniques are both direct or indirect.

- Direct techniques require analysis of microquantities of hydrocarbons that occur in the free state in the soil interstices or that are adsorbed on the fine-grained portions of the soil.
- Indirect geochemical methods are based on the detection, in near-surface soils or in vegetation, of inorganic alteration products that result from upward migration of hydrocarbons.