— University of Mosul —
College of Petroleum & Mining Engineering

Petroleum Exploration
Lecture-4

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Geologists and geophysicist work closely together using a variety of methods. All the information is
carefully considered, with the help of computer analysis, before any decisions to drill are made. A
geologist collects small samples of rock. Sometimes the samples of rock are dug out by hand or cylindrical
cores are drilled to give samples, which can be cut and studied under a microscope.

- These help them to find out:

-where the rocks have come from (their origin)
-what they are made of (their composition)
-how the rocks are arranged in strata.

Geologists also find out about the physical and chemical properties of the rocks (mineralogy) and the fossil
record from ancient times (paleontology). All these clues give information to build up a picture of the area
being surveyed.
A geophysicist adds to the information of a geologist by studying the physics of the earth. Surveys are
made of the magnetic field, the gravity and how waves travel through the layers.
Petroleum exploration: a process of determining the location of petroleum reservoir. This process
include three techniques which are:
Direct indications
Geological methods
Geophysical methods

A- Direct indications:

All of the great oil providences of the world exhibit some surface evidence of the presence of

petroleum. Typical of these indications are natural seepages of oil, outcrops of oil bearing rocks, and various forms of gas seepages such as mud volcanoes.

Limitations

- Not that much Effective.
- It Does not necessarily prove that oil exists in commercial quantities. (i.e. Does not tell you about quantity of oil which is present beneath).

B- Geological exploration methods:

- A petroleum geologist's main job is to select the promising sites for the drilling of exploratory wells based on his prediction of an area's subsurface stratigraphy and structure

In order to make predictions about the occurrence of petroleum in a particular area, the geologists prepare maps, both surface and subsurface.

1- Surface Maps :

These maps prepared measuring surface features such as elevations, dips and strikes of the outcrops and lithological changes.

Also, Aerial photographs are sed to locate the most promising of these structures which are then mapped in detailes by field geologists. The value of surface mapping is restricted to shallow areas.

2- Subsurface maps:

Are numerus in variety and type, which include:

a. Structural contour maps:

Composed of lines connecting points of equal elevation above or below a datum (normally
sea level).

a. Used to find out the presence of traps

b. Used to find out the probable location of hydrocarbons.

b. Isopachous maps:

Maps composed of lines connecting points of equal bed thickness.

a. Used to find out the volume of hydrocarbons.

b. Used to find out the drilling depths

c. Cross Section Maps:

A form of subsurface presentation which depicts the position and thickness of various
strata.

Note: subsurface maps are necessary part of any reservoir engineering study, petroleum
engineering and geologist.

The subsurface maps are prepared from subsurface data. The sources of subsurface data are:

1. Well logs: a representation of some rocks properties with depth, example of well
log: Sample log, Drilling time log, Electric log, caliper log, radioactive log, resistivity log.
2. Core drilling: shallow, small hole drilling for information purposes only. The formation encountered are cored , i.e., obtained as a small cylindrical sample (core sample) of formation which are readily and accurately identified.
3. Strata tests: Deep exploratory holes drilled primarily for information (such as build up test, drawdown test).

Note : the construction of subsurface maps required great interpretive skill.

Well Correlation

Consists of establishing correlations by matching strata, rock hardness or softness, and electrical and radioactivity data to determine the origin, composition and distribution of rock strata.

Electrical logs, radioactivity logs, and acoustic logs help geologists predict where oil bearing strata occur.

Sample logs, compiled from well cuttings and cores, are used to identify key beds and lithologic sequences..

Core samples are taken from the top to the bottom of a well and shows rock in sequential order as it appears in the ground. Core samples also provide information on porosity, permeability,
and saturation of rock in the well. Cuttings are not a continuous record like core samples, but provide a means for identifying sections within larger thick layers through fossil and mineral deposits.