

Exploration



Exploration is the first stage in the Petroleum process in which oil and gas is sought by geologists and geophysicists. The process begins with trying to understand the geology of the area by conducting geophysical surveys.

Exploration is a very expensive process. Highly trained professionals including Petroleum Geologists, Geophysicists and Geochemists are employed to assist companies in reducing the risk and cost of petroleum exploration. Together these experts aim to pinpoint the five elements needed to make oil or gas deposits: a source; a reservoir; the migration path; a trap; and a seal.

Petroleum exploration begins in sedimentary basins - areas where sediments (e.g. sand, clay, reefs) have accumulated through time. This is because sedimentary rocks have two important characteristics: they are porous (have spaces between the grains) and may have organic material (plant and animal matter) from which to produce hydrocarbons.



Source

Petroleum is naturally generated in the earth as decaying plant and animal matter is buried (where extreme temperatures and pressures develop). Rocks rich in plant and animal matter are commonly referred to a 'source rocks', and may have originally been ancient lakes and swamps or offshore reefs and shales.

The first kind of petroleum generated is asphalt, which is nearly solid at room temperature. As the source rocks are buried deeper, the petroleum generated becomes lighter and liquid (crude oil) and eventually gas (natural gas) is produced.

Migration

The pore spaces in sedimentary rocks allow fluids (usually water) to move through the rock. Petroleum is more buoyant than water, and will float upwards from the source rocks towards the surface of the earth. This process is referred to as the 'migration' of petroleum.

Reservoir

The rock within a trap that has suitable porosity (voids between sand grains) and permeability (connected porosity that allows fluids to flow) is referred to as a reservoir. Petroleum filled high quality reservoirs are the target of petroleum exploration and production.

Reservoir rocks are commonly sandstone (beach/dune/river deposits) or carbonates (reefs).

Seal

Rocks impermeable to the migration of petroleum are referred to as 'seals'. The presence of a seal is critical to stop the migration of petroleum and allow the build up of a oil or gas column.

Seal (or cap) rocks need to be strong enough to hold an economically significant volume of petroleum. Shales are the most common sealing rock with other types being salt, carbonate and volcanics.

Trap

With the Earth's total surface being 512 million km², which consists of 362 million km² Ocean and 150 million km² land, random exploration for petroleum is about a one in 500 chance of a discovery.

With statistics such as these it easy to see why oil and gas companies invest so heavily in exploration and the technologies employed!

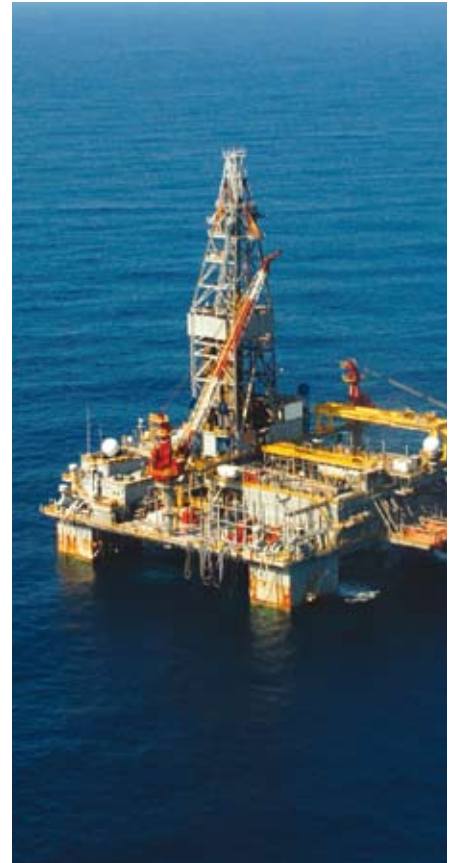
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Exploration Technology

Exploration wells are very expensive to drill. In order to reduce the number of exploratory wells drilled and manage costs, scientific methods are used to pick the most prospective locations. These include:

- › Field Geology - maps surface geology and the relationship of various rock units.
- › Geophysics - uses geophysical surveys to identify contrasts or anomalies in relation to a region's surroundings.
- › The main geophysical tool in the petroleum industry is the seismic survey. A seismic survey sends sound waves into the ground and records reflections coming back from changes in rock character (for example, when shale overlies sand). These surveys are conducted over vast areas (100's km²) and produce 2D and 3D images of the earth.
- › Gravity surveys - detects large-scale subsurface structures by means of the disturbance they produce in the earth's gravitational field at ground level.
- › Magnetic surveys - measures variations in the magnetic field of an area.
- › Geochemical surveys - undertaken with other survey techniques and characterises oil and gas samples taken from wells.
- › Satellite imagery - obtains accurate pictures of topography.
- › Radiometric surveys - detects radiation from uranium and thorium which may be associated with hydrocarbons.
- › Controlled electro-magnetic (EM) surveys - sends low frequency EM signals to receivers in the sea bed that measure the electro-magnetics of the sea floor.



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