

How Do We Find Oil & Gas?

The Search for Oil and Gas Deposits

One constant in the search for oil and gas from ancient times to the modern era - *the hunt for as yet undiscovered petroleum deposits never stops*. The ancient Chinese looked for familiar terrain conducive to producing petroleum or natural gas. If a spot looked promising *bamboo poles were fitted with drill bits* and drilling began.

Basic evidence of oil or natural gas deposits even in the modern world include visible surface features like **oil seeps**, **natural gas seeps**, and **pockmarks** (underwater craters caused by escaping natural gas).

Leaping forward in time from Ancient China to today and the most significant change in **exploration geophysics** is the sophistication in technology, and increasingly sensitive instruments. But today's geologist ultimately is searching for the same oil trap or gas deposit, and often using the same clues.

A geologist whether employed directly by the oil company, or working as a hired contractor is interpreting known **surface features**, inspecting **rocks and terrain**, identifying specific **rock and soil types**, and **drilling for samples**.

Oil and gas deposits do not exist in "liquid pools" beneath the surface of the earth. Oil and gas are stored in porous rock formations. The number of pores in a rock indicates how much oil or gas they can store.

Not only must an oil bearing rock have **pores** to trap the petroleum but the pores must be connected (**porosity**) for the oil or gas to be able to travel through the rock. *Sandstone, limestone and carbonate* are common bearers of oil.

On land the search for oil is conducted by ground, from the air, and even using **satellite imagery** to locate terrain that may conceal a *petroleum deposit*. Once the search for oil or gas has narrowed to a likely geographical area, geologists now have an array of instruments from which to choose.

Oil and Gas Detection Equipment

A **sniffer** is an ultra-sensitive *electronic nose* used to detect the smell of hydrocarbons. **Gravity meters** are used to measure minute changes in the Earth's magnetic field which can be *caused by flowing oil*. And the most common method for narrowing the search for oil is using seismology.

Seismic surveys are conducted by sending a shock wave beneath the Earth's surface which is reflected back by various layers of rock. Reflections sent back to the Earth's surface travel at different speeds depending on *rock layer density*. Seismologists working in concert with geologists use highly sensitive **geophones** or **vibration detectors** to listen for *shock wave reflections*. The signals are collected and sent to a **seismograph** for reading. The readings are then interpreted for signs of oil or gas traps.

Shock waves for seismic surveys are created using explosives over land or water, **Thumper Trucks** (slamming heavy plates into the ground) over land, or **compressed air guns** for oil and gas exploration over water.

GPS on land or over water, or marker buoys on water are used to mark spots identified as a prospective oil or gas deposit. Once the oil company's selection criteria have been met an **exploration hole** is drilled to conclusively determine the presence of an oil or gas deposit.

Drilling for Oil or Gas

Oil Drilling Preparation

After a likely oil or gas deposit has been located **environmental impact studies** are done, and **seismic surveys** are conducted to assess the size and likely boundaries of the oil deposit. The oil company works with the land owner to purchase or lease the property, and arrange rights of way if needed to access the location of the potential drilling site.

If the oil deposit is underwater or offshore legal jurisdiction is determined with the respective government and arrangements made.

For a drilling site on land the area selected is cleared, roads are built, a water source is located, and a **reserve pit** is created to dispose of rock and **drilling mud**. Naturally, an environmentally sensitive area will dictate that byproducts of the drilling operation are *taken off-site for disposal*.

A drilling crew next prepares the site for the drilling rig. A small **drill truck** is used to drill the initial hole in which a **conductor pipe** is inserted. Once the main hole is prepped the **main drilling equipment** is brought in to commence the drilling operation.

For remote locations often a helicopter, barge, or truck is required to haul in the drilling equipment. **Offshore drilling rigs** are mounted on ships or barges and then either towed to the main drilling site, and or move under their own power depending on the type of rig.

Drilling for Oil

Prior to commencing drilling operations the **drilling rig** needs to be assembled. Assembly of the rig consists of **diesel-powered generators** for electricity, and a **mechanical system** including *rotating equipment, turntable, hoisting system, swivels, 30-foot sections of pipe called a drill string, and drill bits.*

As the hole is drilled its lined with a **casing** to *prevent collapse*, and a **circulation system** is installed including *pumps, pipes and hoses, a shale slide, reserve pit, mud pit, and mixing hoppers.* A **derrick** or support structure is assembled to feed sections of pipe into the hole as it is drilled, and a **blow-out preventer** is used under the rig to seal the hole in the event of and to prevent a blowout of uncontrolled oil or gas.

New drilling technologies are under development using **lasers** to drill wells, and **horizontal drilling** techniques that'll allow access to oil or gas under **environmentally sensitive areas.**

How Deep Do You Go?

Drilling must be done in stages as the hole is bored, and a casing cemented in place to prevent collapse. The drilling crew continually **tests core samples** or **rock cuttings** for the *presence of oil.* Once oil has been identified in the rock cutting drawn up from the well, further tests are done to confirm the presence of oil at that depth. If **production levels** of oil or gas are confirmed present then the *drilling apparatus is removed,*

Various methods are employed to facilitate the flow of oil depending on the type of rock or soil in which the oil or gas is trapped. The deposit must be drawn to the surface for collection in a controlled manner to *prevent a blow-out.* To accommodate the flow into the casing, holes are punched through the casing at production depth using explosives from a **perforating gun.** **Tubing** is then lowered to production depth within the casing, and a **packer** is run down the outside of the tubing. A seal is formed between the tubing and casing thus allowing a controlled flow of oil or gas up the tubing to the surface.

Starting the Flow of Oil

Acid is pumped down the well and out the casing perforations for **reservoir oil** in **limestone.** Channels are created in the limestone using the acid to *guide the flow* of oil into the well.

Reservoir rock in **sandstone** requires a special *blend of aluminum pellets, sand and walnut shells* (called **proppants**) which when pumped into the casing under pressure forces small fractures in the sandstone. Oil travels through the sandstone fractures into the well casing.

Oil Recovery

The rig is removed from the well once the oil is flowing, and replaced by ***production equipment*** including a ***pump*** to allow for oil or gas ***extraction***.