



## Finding and Producing Petroleum Resources

What sort of activities are necessary to isolate and extract the various non-renewable resources our society is economically dependent upon? Are these resources immediately ready for use, or are they in need of refinement?

Petroleum is formed when ancient plant- and animal-remains (primarily microscopic plankton), which have been buried for millions of years in anoxic conditions, decay. Over time, these organic materials fuse into a characteristically black hydrocarbon-rich mixture, which when combusted, will yield large quantities of energy. The fact that compaction resulting from burial must occur over relatively long periods of time, explains why it is usually necessary to drill deep wells in order to obtain the oil.

Contrary to popular belief, oil does not reside in underground lakes; rather, it is stored in the pore spaces of sedimentary rocks.<sup>1</sup> Many of the largest reservoirs can be found in upward-facing folds between layers of impermeable rock, called anticlines (see Fig. 1). In such a reservoir, the petroleum products are able to separate into two distinct layers: an extremely light gas layer floating atop a denser layer of liquid oil. Drilling into these reservoirs breaks the impermeable rock seal, and the lowered pressure allows the petroleum to flow to the surface and be collected.<sup>2</sup>

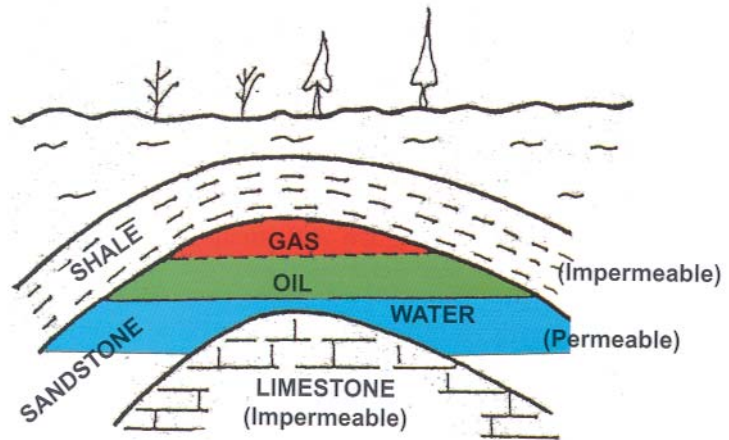
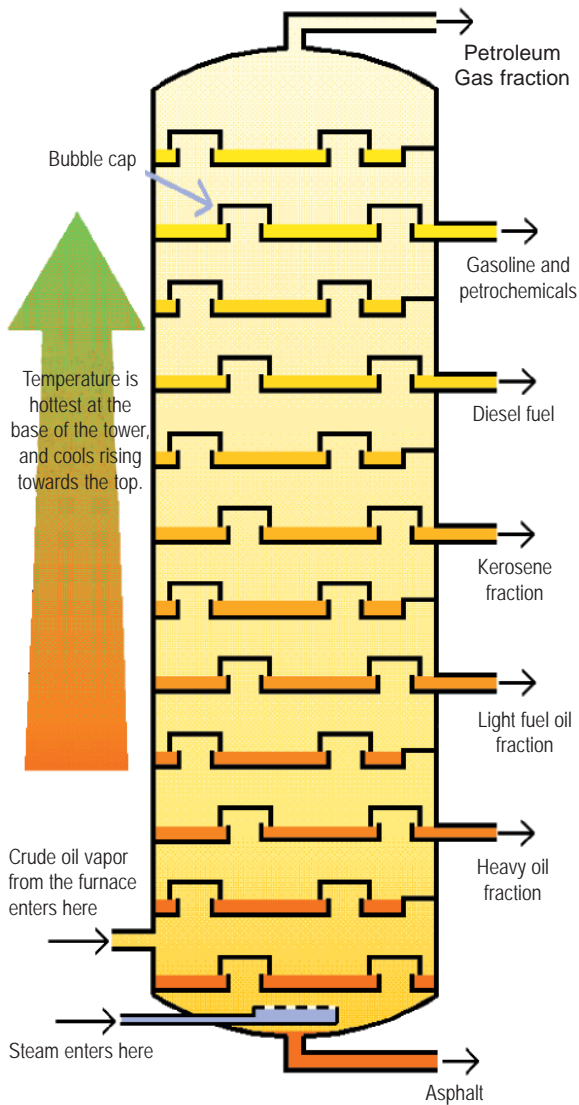


Figure 1. Anticlinical Trap

How do geologists locate areas that may contain petroleum? Initial exploration was based solely on surface indicators (for example, oil seeps or obvious anticlinal structures) and geologic maps. More recent techniques incorporate and utilize gravitational fluxes, wireline logs, and seismic information to develop subsurface computer models to identify areas of high oil potential.<sup>2</sup> Once a suitable area has been located, drilling rigs are erected. A rotary bit attached to the end of a long chain of steel pipes is the typical

method of boring modern oil wells.<sup>2</sup> Lubricants, such as mud or water, are pumped down through the pipes to reduce frictional heat and wash rock cuttings back up to the surface along the outside of the pipes.<sup>2</sup> Average drilling rates range between 30-60 feet per hour.<sup>1</sup> In the United States, well depths can be more than a mile, with the deepest one approaching nearly seven miles.<sup>1</sup> When the drill reaches oil-bearing rocks, natural pressure differences may force the oil to the surface, or it can be pumped.





**Figure 2. The Fractioning Distillation of Petroleum**

## REFINEMENT

The process of refining separates crude oil into the various distinct petroleum products (fuel oil, diesel fuel, gasoline, petrochemicals, etc.) while at the same time removes any impurities that may be present.<sup>1</sup> The refining process encompasses several steps: fractional distillation, cracking, coking, and purification.<sup>1</sup> Fractional distillation makes use of boiling point differences between the various hydrocarbon-chain components in petroleum to separate them into "heavy" and "light" fractions, and residuals (Fig. 2). Light fractions consist of butane, gasoline, and petrochemicals, whereas heavy fractions include fuel oils and lubricants. Residuals are the leftovers from the fractional distillation process, and are used to make asphalt. Other steps in petroleum refinement include "cracking" heavier fractions to produce lighter ones through heat and pressure, and utilizing cokers to change light fractions into heavy ones through alkylation and polymerization.<sup>1</sup> One final step may consist of adding certain chemicals to the petroleum products to promote cleaner and more efficient burning.

## ENVIRONMENTAL CONCERNS AND LAND USAGE

Increased concern for the environment has led to more and better modes of transportation and maintenance of equipment used in the production of petroleum resources, as well as closer regulation of activities at extraction

sites. Computerized cleaning devices, called "smart pigs" traverse pipelines checking for stress or damage, and underground storage tanks are monitored for leaks to prevent groundwater contamination.<sup>1</sup> Contemporary sea-faring oil tankers are routinely built with dual hulls to lessen the likely-hood of spills like that of the Exxon Valdez. At drill sites where petroleum under pressure has the potential to shower the surrounding landscape with toxic oils, carbon dioxide or water is pumped into the wells to maintain pressure.<sup>1</sup>

The petroleum industry is strictly regulated by state and federal agencies in order to ensure responsible usage and management of our natural resources and environment. In consultation with geological experts, these agencies have developed "field rules" relating to the treatment and disposal of wastes, spill management and cleanup, and safety and operational procedures, all the way from the drill site through distribution.<sup>2</sup>

## REFERENCES

1. Moldauer, B. Ed., 1998, All About Petroleum, American Petroleum Institute.
2. AIPG, 1999, Petroleum: Issues and Answers.