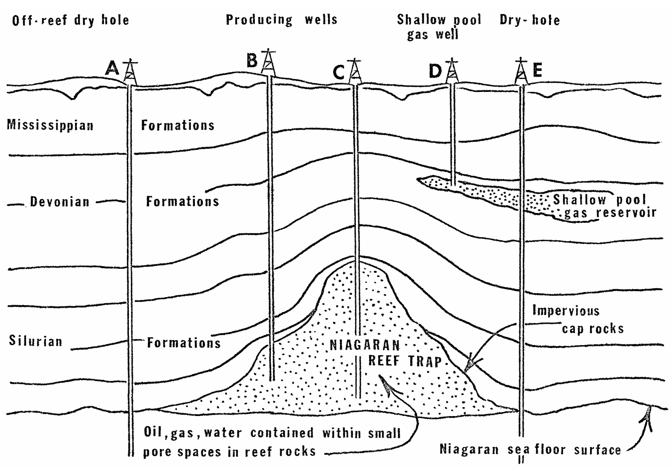
OIL AND GAS ACCUMULATIONS

This brief circular is in response to frequent inquiries concerning the nature of oil and gas accumulations. Accumulations (or pools) of oil and gas, like those of gold, silver and many other minerals, are rare. And those that have commercial significance are even more so. The geology of oil and gas deposits is complicated and cannot be fully told herein. Pools form over millions of years when a certain set of geological conditions exists or are fulfilled. Among others, important factors are: *1) source rocks, primarily marine, wherein oil and gas are formed from organic materials such as microscopic plant and animal remains; 2) porous and, permeable rocks to provide a route for oil and gas migration from source rock to a place of entrapment or accumulation; 3) a suitable trap containing sufficient porosity and permeability to allow migration and accumulation or storage, and an impervious cap rock to prevent escape; 4) an energy source such as gas or water under pressure sufficient to move the fluids from pore space to pore space and out into the well bore once the trap, or reservoir, has been penetrated by the drill.*

There are different kinds of oil and gas traps. In Michigan the most common kind is related to relatively small areas where the rocks have been folded into domes or anticlines. Another type of trap found in Michigan is related to small reefs. These are found at many places in Michigan besides the northern part of the Southern Peninsula. The sketch, not drawn to scale, shows a reef trap and how it relates to overlying rock layers.



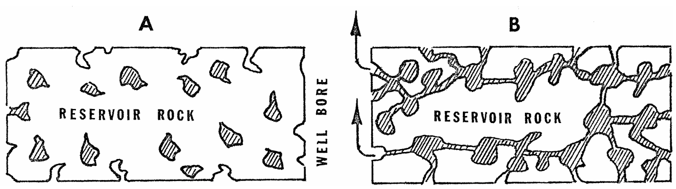
As well as in northern Michigan, many productive reefs have been found in St. Clair, Macomb, Oakland, Wayne, Ingham, Calhoun and other counties of the state. The reefs found in these areas were formed during Silurian-Niagaran time, about 400 million years ago when Michigan and much of the continent was covered by shallow seas. These ancient, buried reefs, formed from the hard parts of numerous kinds of sea life, are similar in most respects to reefs found in present-day warm seas. Geologic data from hundreds of wells show that most Michigan reefs are small in areal extent, seldom covering more than a few hundred acres of productive reservoir. Individual reefs may be several hundred feet in height above the surrounding Niagaran sea floor surface. In this respect they resemble mounds or small hills on the ancient sea floor. The preceding sketch shows how the reefs relate to the rocks that overly them.

The general land area overlying an oil or gas filled reef trap (or some other type) is called a "field". The word "pool" means an underground reservoir containing a common accumulation of oil or gas or both. A field may be underlain by more than one pool, each being a separate reservoir with its own characteristics and not connected to reservoirs above or below, or in some cases laterally. The preceding sketch shows that wells A and E were drilled into Niagaran rocks but did not encounter any reef build-up because they were drilled off-reef. No reservoirs were found in the rocks overlying the Niagaran in well A, thus it would be plugged to the surface and abandoned. Well E, however, did drill through a shallower pool on the way to the Niagaran objective. It could be plugged back to this shallower reservoir and completed as a gas well in the same pool as well D. Wells B and C found no gas in the shallower formation but did penetrate an oil reservoir in a reef trap. Well B was drilled on the flank of the reef, so it has a thinner interval of reservoir rock. Well C was drilled on the higher part of the reef and thus penetrated a full reef section.

Renewed interest in drilling for new oil and gas fields in the northern part of Michigan's Southern Peninsula has led to misconceptions among some laymen as to the nature of oil and gas entrapment in this region. Local and nation-wide publicity following the discovery of new fields in Otsego, Kalkaska and Grand Traverse counties seems to have created the impression that this northern area is one vast oil field covering several thousand square miles. It has been compared to Alaska's north slope—a comparison which has little basis in fact. Though some fields do cover many square miles, this is apt not to be the case in Michigan where most fields, especially the reef type, are of very small size in terms of land area.

Another misconception commonly held by many people is that oil and gas are contained in underground caverns, lakes, veins or some other kind of very large, open void in the rocks beneath the surface. This idea probably stems from the long-time use of the word "pool" in reference to oil and gas accumulations. Geologic data from hundreds of thousands of wells scattered all over the world do not support the view. In reality, gas, oil and associated water is held in pore spaces, most of which are very small, within otherwise solid rock. The size and shape of the voids can, and do, vary considerably but certainly they are not of "Mammoth Cave" magnitude.

Pore or void space in a reservoir rock may be compared to the pore space or holes in a sponge. The amount of pore space per unit volume of rock is referred to as porosity. Thus, if 20 per cent of a given unit volume of rock, say one cubic foot, is pore space, the rock is said to have 20 per cent porosity. But fluids or gases cannot move from pore space to pore space unless the pores are interconnected. If the pore spaces are connected the rock is said to be permeable. However, the quality of pore space connection may vary considerably. The rate or ease with which fluids or gases can move through the rock is referred to as permeability. Permeability is generally stated in terms of a unit called a millidarcy. Sketches A and B illustrate the relationship of porosity and permeability. In sketch A, fluids and gases could not escape into a well bore because there is no connection between pore spaces. In sketch B, the pore spaces are connected and gases and fluids could move out into the well bore. Virtually all rocks that are directly associated with oil and gas have some porosity and permeability. The quality and quantity of these factors generally varies, sometimes considerably, within a reservoir. The quality and distribution of these factors, among others, has a bearing on how efficiently a reservoir can be drained. Also, they may have a bearing on the size of the drilling unit or area that can be efficiently drained by a single well.



Prepared by the Petroleum Geology Unit
Geological Survey Division, Department of Natural Resources
Garland D. Ells
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