



# GEOFACTS No. 30

OHIO DEPARTMENT OF NATURAL RESOURCES • DIVISION OF GEOLOGICAL SURVEY

## THE “CLINTON” OIL-AND-GAS PLAY IN OHIO

Since the discovery of coal in Ohio in 1755, the state has been a major player in the nation’s energy industry. Outside of coal, the most actively drilled, energy-bearing geologic formation has been the “Clinton” sandstone. The “Clinton” sandstone is a deposit in the subsurface of eastern Ohio consisting of interbedded sandstones and shales. Also known as the “Clinton” or “Clinton sand,” the formation has been producing oil and gas since 1887. The first “Clinton” well was sunk by citizens of Lancaster, about 30 miles southeast of Columbus, who aspired to replicate the dramatic discovery three years prior of natural gas in the older Trenton Limestone at Findlay in western Ohio. Between 1887 and 2013, more than 80,000 “Clinton” wells were drilled. Those wells have produced more than 8.7 trillion cubic feet of gas. That’s enough gas to heat all of Ohio’s roughly five million homes for more than 26 years at current consumption rates. Over the years, the “Clinton” has seen a variety of development methods and technologies which have helped to make it the most enduring and prolific oil-and-gas play in Ohio.

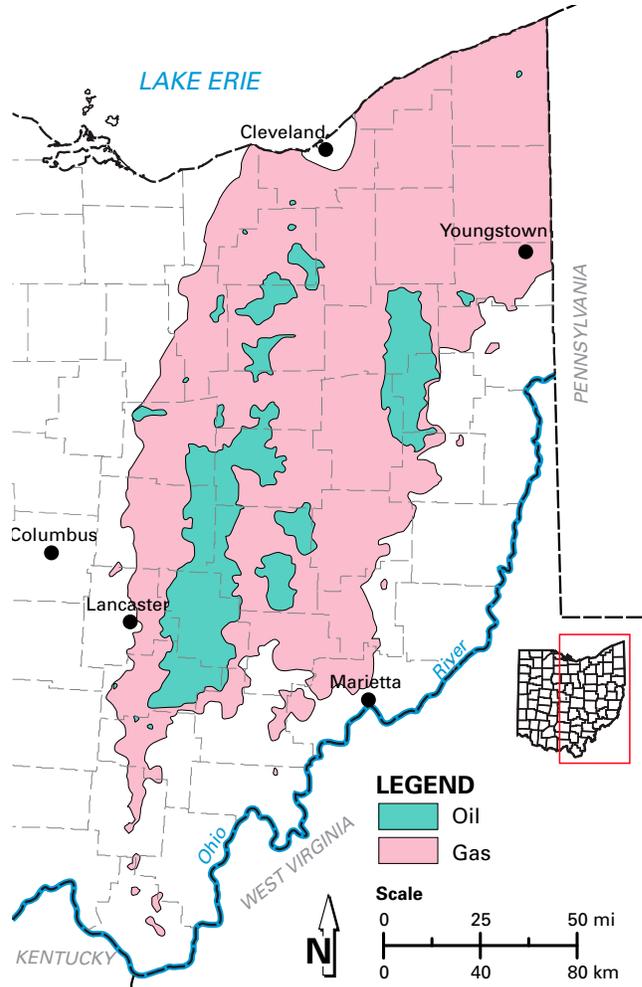
### HISTORY OF PRODUCTION

The sensational display of the powers of natural gas from the Trenton Limestone at Findlay starting in 1884 was ultimately the motivating factor leading to the discovery of gas in the “Clinton.” Residents all over Ohio were more anxious than ever to find their own supplies of the fuel. The citizens of Lancaster were the first to organize the drilling of an exploratory well which produced from the “Clinton.” Drilling began in 1886 and gas began to flow from the well in February 1887. Large discoveries of gas in the “Clinton” did not occur at Lancaster until 1889, when two high-volume wells were drilled.

The initial discoveries in the late 1800s provoked the drilling of tens of thousands of wells into hundreds of oil-and-gas fields throughout the eastern half of Ohio. Some of these oil-and-gas fields still are being developed today, not only as a source of hydrocarbons, but also for gas storage, waste disposal, and enhanced oil recovery.

During the more than 125 years of “Clinton” production, the drilling technologies applied have come a long way. Early wells were “shot” with nitroglycerine to increase production. Although this method of well stimulation worked rather effectively, the numerous accounts of massive accidental explosions encouraged the development of new technologies. Prior to the 1950s, the cable tool method was the most common method of drilling oil-and-gas wells in the Appalachian Basin. But by 1949, the hydraulic fracturing method of well stimulation was patented. Hydraulic fracturing, now popularly known as “fracking,” stimulates wells by pumping drilling fluids into a borehole with enough pressure to create fractures in the producing rocks. Tight formations such as the “Clinton” have insufficient permeability to allow oil and gas to flow freely into the borehole and to the surface. These formations require additional stimulation treatments to make the well commercially profitable. Throughout most of the 1950s, hydraulic fracturing was researched and applied to the “Clinton” with great success. After fracking, wells became almost twice as likely to be successful in this decade alone, with greater odds as research continued.

Another development which stimulated industry interest in



Map showing locations of the “Clinton” oil-and-gas fields in Ohio.

the “Clinton” was the rotary drilling method. Rotary drilling uses a bit attached to the end of a heavy steel drill stem. The bit is forced into the formation by the weight of the drill stem, which is rotated by a motor at the surface. As the bit rotates, it crushes the rocks into cuttings that are flushed out of the borehole with drilling mud—a mixture of water, minerals, and other additives. This method made well drilling more efficient and even safer.

In 1978, after rotary drilling had become a more standard practice, the Natural Gas Policy Act (NGPA) was passed by the federal government. In response to rising oil-and-gas prices, this new law offered a tax credit for “high cost natural gas” production from tight sandstones such as the “Clinton.” In the decade following the NGPA, interest in the “Clinton” peaked like never before. In 1981, companies drilled over 4,300 wells targeting the “Clinton” in Ohio alone.

During the time since the NGPA was enacted, “Clinton” drilling and production has slowed as exploration efforts have covered much of the extent of the sandstone. Other more profitable oil-and-gas plays, such as the Utica-Point Pleasant, have taken precedence over the “Clinton.” In 2013, however, 121 new “Clinton” wells were drilled. Additionally, after recent successes with horizontal drilling

in the development of shale gas plays, operators began applying this method to “Clinton” fields in 2014. This new technology could lead to additional development of some older “Clinton” oil-and-gas fields and hold potential for discovery of new fields. If horizontal drilling proves to be profitable, Ohio could see yet another spike in “Clinton” production like that following the NGPA.

## GEOLOGY

The abundant oil-and-gas deposits in the “Clinton” sandstone were predicated upon the geologic history of the unit. The “Clinton” is known as a fluvial-deltaic deposit, similar to deposits of the modern-day Mississippi River delta. The “Clinton,” however, was deposited during the Early (Llandovery) Silurian Period, making it nearly 444 million years old. At this time, the Taconic Mountains stood tall along the eastern margin of the continent in place of the modern Appalachian Mountains. Sediments were transported via rivers from the Taconic highlands into the shallow sea covering Ohio. The rivers met the sea and formed deltas along a sandy shoreline across northeastern Appalachia, including the eastern margin of Ohio. As time passed, more sediment came in causing this sandy shoreline to extend westward into the shallow sea.

After the sediments were deposited, they were buried by thousands of feet of additional sediments over the next few hundred million years. During this time, the loose sediments were lithified into the solid rocks we now know as the “Clinton” sandstone. Meanwhile, the underlying and organic-rich Utica Shale had been generating oil and gas. Oil and gas are less dense than the saline water that typically fills the pores and fractures of formations in the subsurface. As a result of this difference in density, oil and gas flow upward toward the surface of the water, much like cooking oil in a soup. In the subsurface, hydrocarbons migrate upward until they either reach the surface or get trapped in a reservoir. The “Clinton” generally contains between three and five sandstone units, typically less than 35 feet thick. These units are interbedded with shales, making the “Clinton” roughly 50 to 120 feet thick. In this case, the sandstones within the “Clinton” had sufficient porosity and permeability to retain oil and gas sourced from the Utica Shale until it could be produced.

Within Ohio, the “Clinton” is present only between 2,000 and 6,500 feet deep in the eastern half of the state. The strata reach these depths in eastern Ohio as a result of subsidence of the Appalachian Basin, a structural depression in Earth’s crust that formed in response to mountain-building events to the east. Basins like the Appalachian Basin can make rock units such as the “Clinton” difficult to study. The nearest exposures of “Clinton” equivalents are two states away in western New York. The only way to study the “Clinton” in Ohio is with the use of subsurface data.

The most abundant subsurface data available for the “Clinton” come from the more than 80,000 wells drilled over the years. Well data include the depths at which the “Clinton” was encountered while drilling from the surface. Drillers record the depths at which they penetrate the tops of distinctive formations. Data from these so-called “picks” have gotten better with technological advances and as modern geophysical logs advanced the accuracy of subsurface data. Geophysical logs are measurements of numerous characteristics along the entire borehole of a well, and they possess much more accuracy and detail than even the most experienced drillers with the most modern technology. All of these subsurface data are integrated by geologists to identify geospatial trends and reservoir characteristics of the “Clinton,” as well as other rock units in the subsurface.

SYSTEM/ PERIOD	SERIES	GROUP	LITHOSTRATIGRAPHIC UNITS	
			SIGNIFICANT UNITS	DRILLERS' TERMS
SILURIAN	WENLOCK	CLINTON	Dayton Ls	“Packer Shell”
	LLANDOVERY	MEDINA	“Clinton” ss	“Stray Clinton” “Red Clinton” “White Clinton” “Medina ss”
ORDOVICIAN	UPPER	CINCINNATI	Queenston Sh	“Red Medina”
			Utica sh	
	MIDDLE		Point Pleasant Fm	

Fm = Formation Gp = Group Sh = Shale Ss = Sandstone Ls = Limestone  
 ~~~~~ Unconformity

*Simplified lithostratigraphic units of the “Clinton” oil-and-gas field and vicinity.*

Despite dwindling hydrocarbon reserves in the “Clinton,” the reservoirs are used for several other purposes. One such use is natural gas storage. Depleted reservoirs have natural gas pumped into them by gas companies. This way, gas companies have plenty of gas readily available to constantly supply the residents and industries of Ohio. In winter, for instance, when residents have a high demand for gas in order to heat their homes, these “Clinton” gas storage fields allow gas companies to meet the demand without interruption.

Depleted reservoirs in the “Clinton” also are used to dispose of wastewater from oil-and-gas production. Not only are production wastes disposed of in the “Clinton,” but captured CO<sub>2</sub> may be sequestered in depleted reservoirs as well. The placement of these fluids in depleted reservoirs keeps them out of fresh-water supplies and the atmosphere. Not only are these environmental benefits achieved, but under the right circumstances, the injection of water and/or CO<sub>2</sub> can help operators recover more of the hydrocarbon reserves from nearby “Clinton” wells through enhanced oil recovery.

Ongoing research by government agencies, universities, and industry helps us to better understand the “Clinton” sandstone and surrounding rock units. The “Clinton” will continue to be used for gas storage and waste disposal, in addition to its remaining oil-and-gas potential and CO<sub>2</sub> sequestration potential. Although its existence as Ohio’s most important oil-and-gas play likely has passed, the “Clinton” is still an important geologic unit in Ohio.

## FURTHER READING

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• This GeoFacts compiled by Dominique M. Haneberg-Diggs • June 2015 •  
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