1940-01

The Structure and Thickness of the Clinton and Berea Formations in the Vicinity of Wooster, Ohio

Ver Steeg, Karl

The Ohio Journal of Science. v40 n1 (January, 1940), 25-30

http://hdl.handle.net/1811/3062

THE STRUCTURE AND THICKNESS OF THE CLINTON AND BEREA FORMATIONS IN THE VICINITY OF WOOSTER, OHIO

KARL VER STEEG
College of Wooster

INTRODUCTION AND ACKNOWLEDGMENTS

The data used in the construction of the structure maps were obtained from well records, filed at the field offices of the oil and gas companies operating in the area, and from the Ohio State Geological Survey. The purpose is to give one information on the structure of the Clinton and Berea formations and their thickness throughout the area. With the exception of an earlier report,[1] based on available well records at that time, no other information has been published. Many wells have been drilled since 1915 and more complete information is now available.

The writer acknowledges the aid given by Alan Leeper and George Miner, students in the Department of Geology, who plotted the structure obtained from data based on well records.

THE CLINTON AND BEREA FORMATIONS

The Clinton sand is the horizon from which the oil and gas are produced in largest quantities in the area. This formation is composed of sandstones, shales and interbedded limestone. The color of the Clinton is gray to reddish and the thickness may be as much as 85 feet. To the south this formation is more calcareous; crinoid stems are abundant and there is much resemblance to marble in some localities. The sand from which production is greatest is near the bottom of the group and some geologists consider it a part of the Medina. At several places, stray sands are found just above the Clinton, and are often reported as "red rock." Perhaps this is the bed which thickens to the east and becomes iron ore. To the westward the Clinton thins out and is a shale just beyond the center of Ohio. Here it is a fine-grained deposit which requires that the well be shot in order to obtain any production. In the southern part of Ohio, the Clinton is not a good reservoir and contains more limestone; the sand is more porous in central

[1]Bonine. Structures in the Clinton Sand. Bull. U. S. G. S. 1915, pp. 89–92.

Ohio and is consequently more productive there. The composition of the Clinton, varying as it does in different areas, has been a foremost factor in the determination of the oil and gas fields. Productive areas occur as far to the northwest as Sandusky but the best field in the Clinton is in central Ohio.

The Berea formation is described with the Clinton because of its importance as a key for that horizon. The Berea Grit is of lower Carboniferous age and in the Wooster area lies about 600 feet below the surface. The Berea underlies more than one-third of the state, with little variation in its composition. It is a moderately fine, siliceous sandstone, which is widely

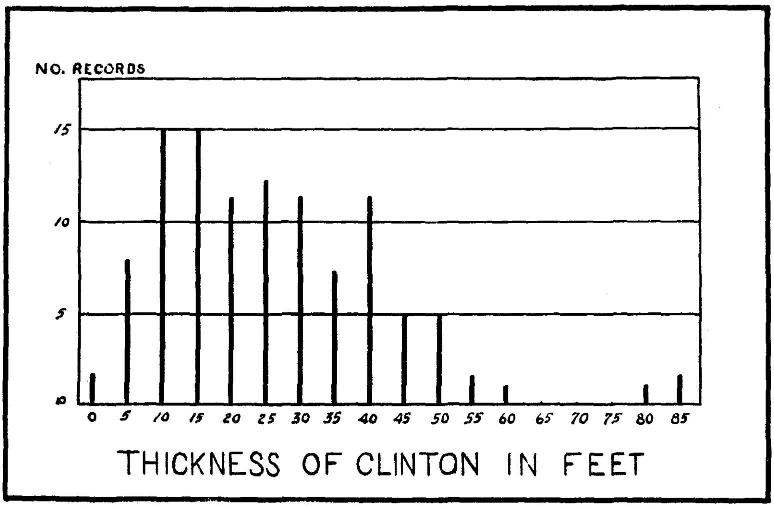

Fig. 1. Thickness of Clinton in feet.

used as a building stone. It is important as a reservoir for oil, gas and salt water. In the Wooster area, only small producers of oil and gas are present. Here it serves as an important key to the drillers seeking the Clinton. Although the Berea does not show as much folding as the Clinton, enough similarity does exist so that the Clinton structure can be interpreted by drilling to the Berea. It averages about 30 feet in thickness, varying from nothing to 150 feet. It is medium-grained and gray to buff in color; except for small areas having a high carbonate of lime content, the composition is quite uniformly a siliceous sandstone. The variation in thickness of the Berea is probably explained by the fact that it lies on an uneven surface. The data is from well records in Wooster, Plain and Franklin Townships, all in Wayne County.

GEOLOGIC STRUCTURE

In the Wooster field, the granite base upon which lie the sedimentary rocks is probably 5,000 or more feet below the surface. The area lies along the east flank of the Cincinnati arch, the strata dipping eastward as much as 50 feet per mile in some places. Erosion has removed most of the Allegheny and Pottsville formations which originally covered the area.

The most important feature of the structure is the cross-folding which has occurred; this is true over nearly all of Ohio. The existing folds are at right angles to each other, having general trends of northeast-southwest and northwest-southeast.

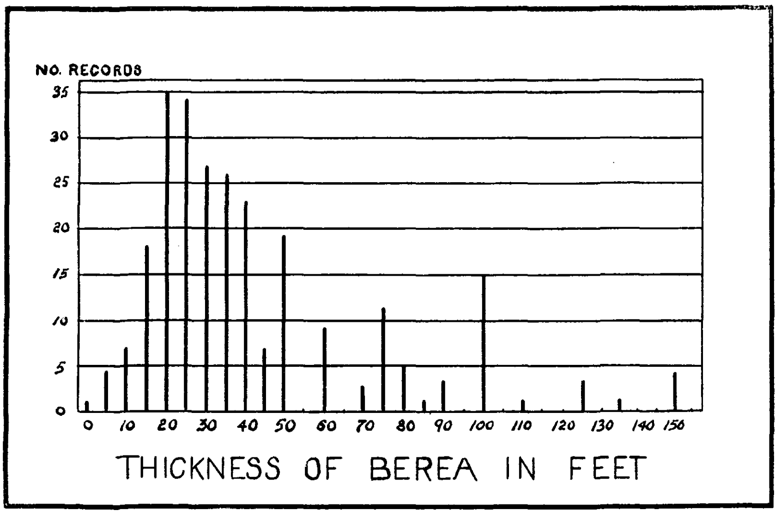

Fig. 2. Thickness of Berea in feet.

It would be a very interesting study to determine the exact nature of the two sets of forces involved in the formation of these anticlines. The folds trending northeast-southwest, in all probability, were developed by the same forces which produced the Appalachian folds. The anticlines of this region represent the gradually declining waves as the forces diminished to the westward. Less is known about the folds trending northwest-southeast, and it is this particular group which would bear more investigation. Both sets of folds occur widely distributed throughout Ohio, and it is possible that other stresses besides those which formed the Appalachians are responsible for the northwest-southeast folds. The existence of the two systems of anticlines complicates the geologic structure and makes drillers less certain of successful results. Evidence points to the fact that the Clinton has been folded more than the Berea, probably because the Clinton was subjected to folding forces before the deposition of the Berea. Such a high degree of similarity exists in the structure of the Clinton and Berea, that drillers often use the latter to determine the structure of the Clinton. There is a belief by many that

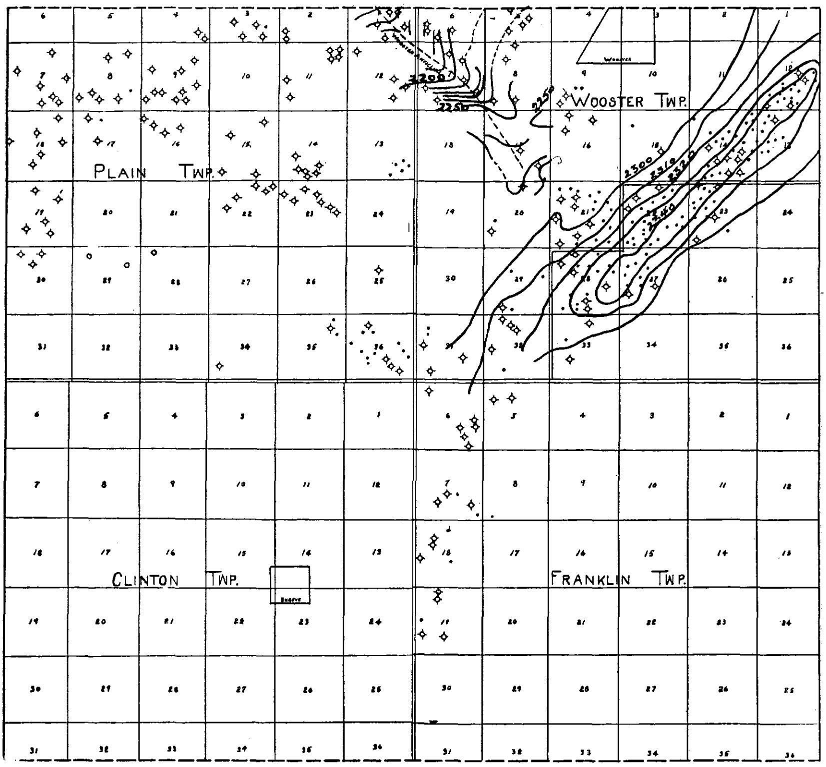

Fig. 3. Structure of the Clinton sand. Structural contours indicate the elevation below sea-level of the Clinton sand.

no relation exists between the folds and the oil and gas pools in the region. In the vicinity of Wooster this is not the existing condition. Extensive drilling has proved that the production of a well depends upon its location with respect to geologic structure. In the field southwest of Wooster, production has been best along the axis and flanks of an anticline. In supporting the view that structure is most important, one must consider the numerous pools caused by terrace structure or "arrested dips," as they are sometimes called. These are the results of a leveling-off of the strata which otherwise dip about 50 feet per mile. Slight folding or change in dip toward horizontality is sufficient to prevent further migration up-dip of the oil or gas. Small pools exist where variations in thickness occur. Since the Clinton sandstone varies considerably in thickness within short distances, a thick patch of the formation

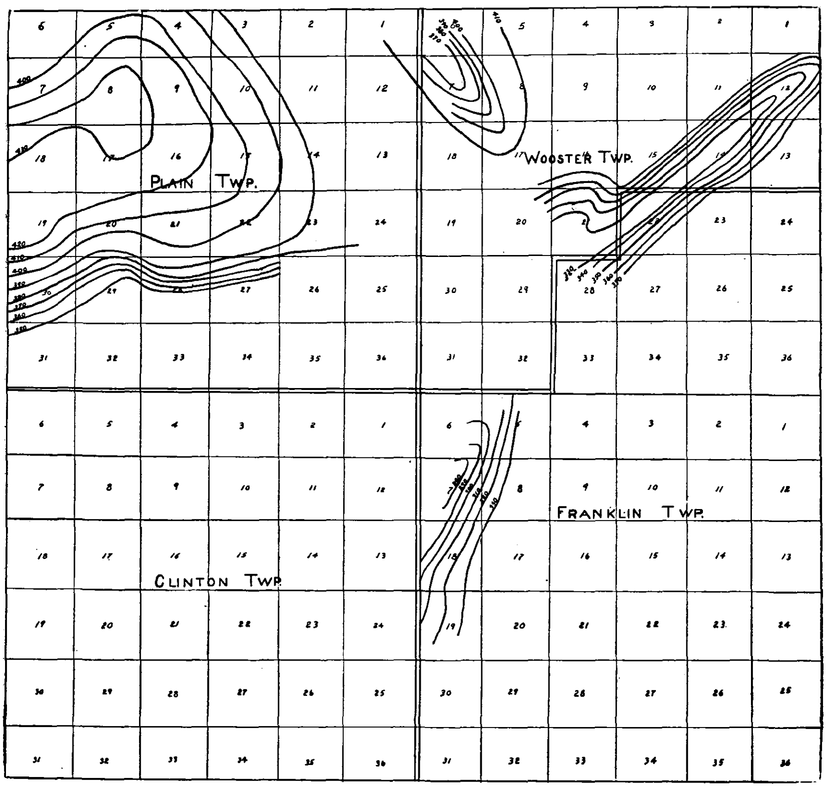

Fig. 4. Structure of the Berea sand. Structural contours indicate the depth of the top of the Berea sand from the well-head elevations.

can serve as a reservoir for oil and gas in the same manner as an anticline. As wells do not maintain their initial production very long in this area, strength was given at first to the theory that structure is not important. It is sufficient to say that best results are obtained where structure is given consideration.

The composition of the Clinton is also a deciding factor in determining where oil and gas can accumulate. A coarse-grained sandstone is better than a compact shale or limestone.

Not only does the Clinton vary in thickness in this area, but it changes in composition. A complete change is found to the west where it becomes shale, or to the south where it is calcareous. On the whole, the composition of the Clinton, as far as its oil-bearing possibilities are concerned, is at its best in the central portion of the state.

Wells in the Wooster area are considered very good producers if their initial production is above 10,000,000 cubic feet of gas per day. To obtain these results, a rock pressure of about 1,200 lbs. per square inch is required. A well is considered to be doing well if it operates at 500,000 cubic feet after 20 months, as the rock pressure has probably diminished to about 200 lbs.

GENERALIZED SECTION OF THE ROCKS PENETRATED IN DRILLING FOR OIL AND GAS IN THE WOOSTER AREA.

SYSTEM	FORMATION	DRILLERS NAME	THICKNESS	CHARACTER
Quarternary	Glacial	Sand and Gravel	0–100	Boulder, clay, sand, pebbles, shale fragments and boulders.
Carboniferous	Logan and Cuyahoga	Shale and Sandstone	500–650	*Dark shale with sandstone and* shale interbedded.
	Sunbury			Black argillaceous bituminous shale.
	Berea s. s.	Berea Grit	30–60	Medium grained gray to buff sandstone.
Devonian or Carboniferous	Bedford sh.	Shale	20–50	Black and brown shale.
Devonian	Ohio Shale: Cleveland shale	Ohio shale	1,300–1,370	Thickens to the East. Black and brown carbonaceous shale, with numerous "iron stone" concretions. Some oil and gas.
	Ohio Shale: Chagrin form			
	Ohio Shale: Huron shale			
	Olentangy shale			
	Delaware Limestone	Big Lime	1,030–1,080	Brown, gray, and blue limestones with few thin sandstone and shale beds in the lower half of the formation. A 40 foot salt bed lies 600 feet below top of Delaware limestone. Thickening takes place toward the East.
Unconformity	Columbus Limestone			
	Monroe			
	Salina form			
	Niagara form			
Silurian	Clinton	Little Lime	150–170	Grey and red sandstone, dark shale with interbedded layers.
		Clinton Sand	5–45	Important oil and gas. Grey or red sandstone.
	Medina shales	Medina Red Rock	?	Red clay and shale. Little known as the drilling stops here.