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MIGRATION OF OIL FROM ARBUCKLE LIMESTONE INTO CHATTANOOGA SHALE IN THE CHETOPA POOL OF KANSAS

by

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Wells drilled in the Chetopa oil pool in southeastern Kansas (Sec. 36, T. 34 S., R. 20 E., Labette County) indicate that oil has migrated from the Arbuckle limestone into the lower part of the overlying Chattanooga shale. Inasmuch as some geologists believe that oil in certain Arbuckle limestone reservoirs originated in the Chattanooga shale, the conditions found in the Chetopa pool are especially interesting.

The oil-bearing zone in the Chetopa pool lies at or near the unconformable contact of the Arbuckle limestone, of Ordovician age, with the overlying Chattanooga shale of Late Devonian (?) age. The oil zone lies about 850 feet below the surface and is 6 to 30 inches thick.

1/ By permission of the Director of Kansas Geological Survey.

2/ Kansas Geological Survey, Pittsburg, Kansas.

In part of the pool the Chattanooga shale lies directly on the oil-bearing zone but in most of the producing area the Chattanooga is separated from the pay by a "cap rock" that is about 2 feet thick. The oil-bearing rock consists of soft porous to cavernous dolomite containing numerous calcite crystals and a small amount of white chert and sand. The "cap rock" is a dolomite like the oil-bearing zone except that it is denser, harder and contains more chert. It is a very impervious rock.

Wells that encountered "cap rock" on the higher park of the structure found oil just below the "cap rock." The oil was under pressure ranging from 300 to 400 pounds per square inch and some of these wells flowed for a time. Wells that failed to encounter the "cap rock" passed from the Chattanooga shale directly into oil-bearing porous dolomite but these wells failed to produce oil, even though some of them were well located on the structure and though the Chattanooga shale in each well was so saturated with oil that it oozed out when the shale was squeezed in the hands. In contrast to the oil-saturated condition of the shale in these wells, the Chattanooga shale in the wells that penetrate a "cap rock" seems to contain no oil and it does not emit an oily odor.

Wells drilled within a few miles of the Chetopa pool have not been oil producers, but wells that were drilled on favorable structure failed to encounter a "cap rock" above the oil-producing zone of the Arbuckle, and the overlying Chattanooga shale was found to be well saturated with oil and produced a good oil show. Wells that were not favorably located on structure not only failed to produce oil, but the Chattanooga shale was found not to be oil-bearing and it emitted no oily odor regardless of the presence of a "cap rock."

These facts indicate that in the portion of the Chetopa oil pool containing no "cap rock" the oil has migrated from the oil-bearing zone of the Arbuckle limestone into the overlying Chattanooga shale. The Chattanooga shale in this pool and elsewhere in the vicinity consists of dense black fissile shale 8 to 20 feet thick. The shale has less porosity than the underlying Arbuckle limestone, but it does not contain any water and on sharp folds probably has numerous joint planes that would allow oil to migrate into the shale.

The oil in the Chetopa pool and in other Arbuckle limestone pools in southeastern Kansas is peculiar in that it contains none of the lighter fractions (gasoline) that are common to most crude oil of the region. It is marketed for diesel fuel.

The following analysis of oil produced from the discovery well of the Chetopa pool was made by the Kansas City Testing Laboratory, Kansas City, Missouri:

Analysis of Oil from the Chetopa Pool.

Flash point (Cleveland open cup).....	230° F.
Fire test (Cleveland open cup).....	260° F.
Saybolt Universal viscosity at 100° F...	143
Saybolt Furol viscosity at 122° F.....	13
Sediment.....	0.2 %
Water.....	0.0 %
Sulpher (S).....	0.61%
Cold test.....	-25° F.
Weight per gallon at 60° F.....	7.554 lbs.
British thermal units per pound.....	19,266
British thermal units per gallon at 60°F.	144,668
Specific gravity.....	0.907%
A. P. I. gravity.....	24.5
Distillate (34.4° A. P. I.).....	25.0%
Gas oil (20.2° A. P. I.).....	15.0%
Viscous distillate.....	35.0%
Residuum (asphalt).....	25.0%

The analysis of the water from the oil-producing zone is significant because of its small content of dissolved solids. A sample collected by me from a depth

of 904 feet in the Chetopa Oil and Gas Company well in Sec. 36, T. 34 S., R. 20 E., Labette County, Kansas, and analyzed by R. T. Rolufs, for the Missouri Geological Survey and Water Resources, showed the following composition:

Analysis of Water from the Chetopa Pool.

Turbidity	Turbid
Color	None
Odor	Oil
Total suspended solids	ND
Total dissolved solids	1583.0
Loss on Ignition	ND
Chloride radicle (Cl)	593.3
Nitrate radicle (NO_3)	ND
Sulphate (SO_4)	1.2
Bi-carbonate radicle (HCO_3)	576.5
Carbonate radicle (CO_3)	00
Sodium (Na) potassium (K) as Na	551.5
Magnesium (Mg)	10.1
Iron (Fe)	ND
Silica (SiO_2)	13.6
Calcium (Ca)	21.8
Total hardness	95.9
Carbonate hardness	95.9

Alkalinity.....	472.7
Precipitated iron (Pp't. Fe.).....	ND
Temporary hardness.....	ND
Al_2O_3, Fe_2O_3.....	.80
Bromine (Br).....	2.8
Fluorine (F).....	3.4

Remarks: Sample from Cotter formation; Canadian system of E. O. Ulrich. Gravity of oil 27^{o}-28^{o}.