GEOLOGY OF NORTH BUFFALO OIL AND GAS FIELD HARPER COUNTY, OKLAHOMA

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The North Buffalo oil and gas field, is situated six miles north of the town of Buffalo in northern Harper County, Oklahoma. It lies five miles south of the Oklahoma-Kansas state boundary line.

The most important discovery in Oklahoma during 1958 out of 98 oil and gas fields opened that year, North Buffalo field crowns three decades of exploration effort along the northern limb of the Anadarko basin.

Sinclair Oil and Gas Company, the discovery operator, initiated its own program first with core drill followed by reflection seismograph surveys in the early 1940's. In October 1954, Sinclair reintensified its seismic exploration of the area and the ensuing four years led to the discovery of the North Buffalo anomaly.

The discovery well was its Murray A. Holcomb 1, C NE NW/4 Section 7-28N-22W, which was completed on July 7, 1958 for an initial completion potential of 314 bbl. of 48.5° A.P.I. oil from the Arbuckle formation of Ordovician age encountered at 7,649 ft. and penetrated to 7,719 ft. Completion was made through casing perforations from 7,666-7,668 ft., and through open hole from 7,668-7,719 ft. Initial produced gas-oil ratio was 723 cu. ft. per bbl.

Subsequent development has resulted in completion of 10 oil and gas-distillate wells from the Arbuckle dolomite, the Viola dolomite, the Chester formation of Mississippian age, and the Morrow sandstone, the Oswego limestone, the Kansas City limestone and the Lansing limestone, all of Pennsylvanian age.

Basement rocks underlying the North Buffalo structure are believed to be Huronian granites and Sioux quartzites although no wells have been drilled to the basement in Harper County, Oklahoma. Regional correlations suggest the presence of about 1,100 feet of Arbuckle formation carbonates of Cambro-Ordovician age but the maximum penetration of Arbuckle in the vicinity of the anomaly is only 147 feet.

Principal feature of the pre-Pennsylvanian structure at North Buffalo is existence of a 50 ft. normal tension fault exhibiting a strike of N. 64° W. intersecting the major axis of the anticline which strikes N. 42° E. The principal field fault may be compared with the similar position of the major field fault of the Yellowstone field (N. 70° W.) situated 33 miles east and slightly north in northern Woods County, Oklahoma. North Buffalo is genetically related with the Yellowstone structure as part of a postulated structural hinge-line affecting the pre-Pennsylvanian carbonates throughout the northern limb of the Anadarko basin. (Yellowstone produces gas-distillate from the Viola and Arbuckle formations).

An unusual feature of the Ordovician reservoirs at North Buffalo is the occurrence of commercial oil production from the Arbuckle on either side of the principal field fault. Produced oil gravities from the downthrown side of the fault range from 41.0 to 43.9° A.P.I., while at that produced from the upthrown side test from 50 to 51° A.P.I.

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Arbuckle lithology from the upthrown side of the fault is fine to very fine, sucrosic to crystalline dolomite with some oolitic chert and green shale streaks. Porosity types include vugular, fractured and pinpoint. Maximum oil column is 45 ft. on the upthrown side.

Simpson group of Ordovician age is represented by about 121 to 145 feet of Oil Creek and McLish members in the North Buffalo field. The base is gray to tan, fine to medium-grained dolomitic sandstone with rounded, frosted quartz grains interbedded with olive to dark-green, waxy shale.

Viola formation is represented by 258 to 280 ft. of carbonates which rest unconformably upon the Simpson group. Although comprised of three members, Viola lithology ranges through fine to medium, fossiliferous, sucrosic to crystalline dolomite with chert inclusions, intercalated with layers of fine to dense dolomite. Viola formation is productive of 60.1° to 72° gravity distillate from the upthrown side of the major field fault.

Sylvan shale is not represented on the North Buffalo structure due to regional truncation. A 30-ft. thickness of black, carbonaceous Woodford shale separates the upper, truncated Viola surface from the overlying Mississippian rocks.

Structurally, North Buffalo exhibits the greatest amount of relief in any geologic system of any anomaly in northwestern Oklahoma, including Yellowstone. Maximum structural closure at North Buffalo, after consideration of regional dip, is 150 ft. on top of the Arbuckle, and 137 ft. on top of the Kinderhookian shale.

Normal tension faulting persists as high as the top of the Osage subseries of the Mississippian. Thus, North Buffalo may be represented as a truncated, buried Osagean hill, with a maximum structural closure of 103 ft. measured on top of that surface.

Although the younger members of the Mississippian system, i.e. Ste. Genevieve, Meramec, and Chester, are draped over this buried hill, subsurface expression throughout the Mississippian rocks is that of an elongate anticline striking N-NE with a maximum structural closure of 100 ft. measured on top of the Chester surface.

Intensity of folding persists strongly throughout the Pennsylvanian system with little convergence, reflecting a major anomaly in the Pennsylvanian rocks as that of an asymmetrical anticline with the steeper limb being the northwestern side. Maximum structural closure on top of the Heebner shale measures 102 feet.