

thickness as a result of the post-Hunton unconformity, and Woodford rests unconformably on rocks varying from Arbuckle in the Hollis basin in southwest Oklahoma to Upper Hunton in south-central Oklahoma. A unique carbonate sequence with maximum thickness of 125 feet in the subsurface occurs at the base of the Woodford shale, and rests unconformably on beds as old as Viola along the Mansville-Aylesworth trend in Marshall County, Oklahoma. This carbonate is an oil reservoir on the north flank of the Aylesworth anticline, and has been informally called "Misener" and "Hunton detritum" in the Ardmore area. This carbonate occurrence, its lithologic description, and its possible relationship with the outcrop are briefly discussed.

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Stratigraphic Traps along Northern Shelf of Anadarko Basin

Extensive stratigraphic accumulations of oil and gas along the northern shelf of the Anadarko basin have been the visions of petroleum geologists for more than two decades; however, only recently have these visions become a reality. Prolific discoveries at Laverne, Southwest Stockholm, Woodward, and pools of the "Cherokee trend" have focused the attention of all exploration men to the stratigraphic trap possibilities of the northern shelf area.

Early exploration along the shelf area was derived from surface indications and geophysical study. Test wells were drilled without the aid of gas detectors and modern methods of surveying the bore hole. Consequently, many prolific gas reservoirs were penetrated with the drill without evaluation.

The remedy for this situation has come from the many advancements made in the field of research which has developed new evaluation tools for the geologist.

Numerous deep tests along the shelf area and in the basin proper have enabled the geologist to familiarize himself with the vast possibilities of stratigraphic traps in sediments throughout the Middle and Upper Paleozoics, from the Silurian-Devonian into early Permian.

Convergence due to truncation and onlap, and interruption in deposition of sands and "reef" type limestones provide most of the stratigraphic traps of the northern shelf area. Multiple traps of this nature in any area are not uncommon. Two wells in Laverne have as many as four prolific gas horizons, all stratigraphic, which will gross the operator approximately \$4,000,000 per well. More than 50 per cent of the completions in this pool are dual.

The area has a great future, and the returns will be gratifying to those adept in delineating stratigraphic traps.

CHARLES H. GLIDDEN AND W. MARTIN BORG, Union Oil Company of California, Tulsa, Oklahoma
Morrow Formation of Northwestern Oklahoma

Morrow sediments occupy the northwestern Anadarko basin-Hugoton embayment area southwest of a northwest-southeast diagonal line extending from north-central Harper County to the southeastern corner of Dewey County. More than 1,400 feet of Morrow has been encountered in a deep well in southern Ellis County. The formation thins to zero, due to transgressive overlap northeast.

Very few of the wells that drilled the entire Morrow section have failed to encounter shows. Production now extends along a 60-mile trend. Both oil and gas have been found. At present it is felt that the gas reserves are by far the more important.

Maps and cross sections illustrate the structure, distribution and thickness of the Morrow formation.

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Morrow Rocks of Western Kansas and Panhandle Counties of Oklahoma

The Morrow rocks of Western Kansas and the Oklahoma Panhandle have a maximum thickness of 700 feet and pinch out northeast on the flank of the Anadarko basin.

Sands within the Morrow series occur in two basic intervals designated as upper and lower. Upper sands are very lenticular but usually produce where present. They account for production in the Camrick pool, Texas County, Oklahoma; Light pool, Beaver County, Oklahoma; Interstate pool, Morton County, Kansas; and the Leslie pool, Meade County, Kansas. Lower sands produce in the Mocane pool, Beaver County, Oklahoma; Keyes pool, Cimarron County, Oklahoma; and the Sparks pool, Stanton County, Kansas.

Morrow sands produce more than half of the area's crude oil and a large percentage of the pre-Permian gas. Production from the 60 pools in the area is from simple anticlinal to complex stratigraphic traps. Common completion practice is through casing with fracture treatment following a light-mud acid wash. Some excellent quality sands are completed natural.

Wells sufficient to test the Morrow range in depth from 4,600 to 8,500 feet. Well costs average \$10 per foot dry and \$15 per foot completed. Reservoirs range from 3 to 90 feet in thickness, resulting in non-commercial to excellent wells with fast payout (less than 1 year). Average porosity is 14%; average connate water saturation is 25% with instances of 40% in commercial wells. Reserves in place