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Chas. N. Gould, Director

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OIL AND GAS IN OKLAHOMA

KIOWA AND WASHITA COUNTIES

By
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NORMAN
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CONTENTS

ILLUSTRATIONS

FOREWORD

In 1917 the Oklahoma Geological Survey issued Bulletin 19, Part II, entitled "Petroleum and Natural Gas in Oklahoma." This volume was so popular that the supply was soon exhausted and for several years copies have not been obtainable.

The present Director has seen the need of a revision of this bulletin. On account of the lack of appropriations he has not been able to employ sufficient help to compile the data, and has called on some twenty representative geologists throughout the State to aid in the preparation of reports on separate counties. These gentlemen, all busy men, have contributed freely of their time and information in the preparation of these reports.

It will be understood that the facts as set forth in the various reports represent the observation and opinion of the different men. The Oklahoma Geological Survey has every confidence in the judgment of the various authors, but at the same time the Survey does not stand sponsor for all statements made or for all conclusions drawn. Reports of this kind, are at best, progress reports, representing the best information obtainable as of the date issued, and doubtless new data will cause many changes in our present ideas.

Mr. Roger W. Sawyer, who wrote this bulletin, has had wide field experience in various parts of western Oklahoma, and is considered by many as having perhaps as wide acquaintance with certain stratigraphic problems in this area as any geologist working in the State. The results of his observations and experience in Kiowa and Washita counties have been embodied in this report.

CHAS. N. GOULD,
Director.

Norman, Oklahoma
December, 1929

OIL AND GAS IN OKLAHOMA

KIOWA AND WASHITA COUNTIES

ACKNOWLEDGMENTS

The writer has read all available literature pertaining to this area, especially the writings of Chas. N. Gould,[1] Trout and Shannon,[2] R. L. Clifton, Frank C. Greene,[4] Frank Gouin,[5] Gould and Lewis,[6] and Noel Evans,[7] and has discussed it with S. B. Cloyes, O. E. Nordman and O E. Brown. Glenn Clark furnished correlations of some formations in wells in sec. 3, T. 7 N., R. 17 W., and sec. 13, T. 7 N., R. 16 W. A part of the surface work on the structure map was given to the writer by Clyde Becker and Allen Gray. Chas. N. Gould and C. L. Cooper have aided in preparing the manuscript for publication. The

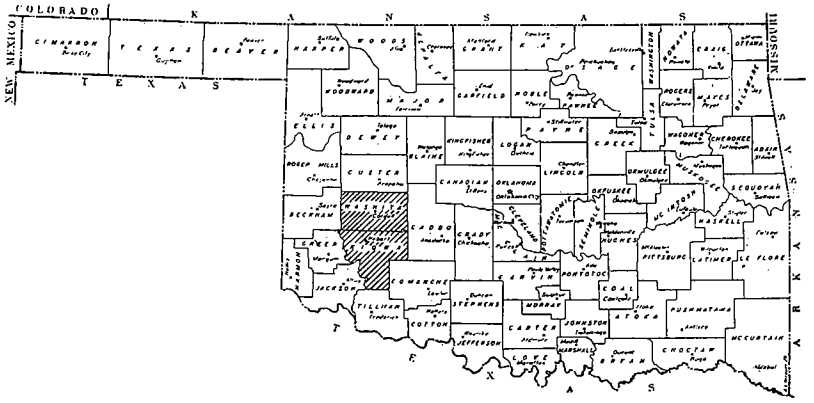


Fig. 1. Index map of Oklahoma showing area covered by this report.

1. Gould, Chas. N., Index to the stratigraphy of Oklahoma: Oklahoma Geol. Survey, Bull. 35, 1925.
2. Trout, L. E., and Shannon, C. W., Oklahoma Geol. Survey, Bull. 19, Pt. II, 1917.
3. Clifton, R. L., Oklahoma Geol. Survey, Bull. 40-A, 1926.
4. Greene, Frank C., Subsurface stratigraphy of western Oklahoma: Oklahoma Geol. Survey, Bull. 40-D, 1926.
5. Gouin, Frank, Geology of Beckham County: Oklahoma Geol. Survey, Bull. 40-M, 1927.
6. Gould, Chas. N., and Lewis, Frank E., The Permian of Western Oklahoma and the Panhandle of Texas: Oklahoma Geol. Survey, Circ. 13, 1926.
7. Evans, Noel, Notes on the geology of the Weatherford district of Oklahoma: Bull. Amer. Assoc. Pet. Geol., July, 1928.

writer wishes to express thanks to these men for their assistance, and to the Skelly Oil Company for permission to publish.

TOPOGRAPHY AND DRAINAGE

The Wichita Mountains trend about N. 50° W. through the center of Kiowa County, consisting for the most part of granite ridges, peaks, and knobs. To the north and south of the mountains are found the red bed plains. These plains extend to the very foot of the mountains, and isolated ridges and peaks are found entirely surrounded by the red beds plains which are nearly level up to the foot of the mountains. In the northern part of Kiowa County, and extending locally into Washita County, are some south-facing escarpments maintained by calcareous sandstones of the Duncan and by dolomite ledges of the Blaine formation. Washita County is largely covered by the Whitehorse sandstone and the Quartermaster formation, into which many small streams have cut deep narrow canyons. The Cloud Chief gypsum, which outcrops over a considerable area, forms rounded hills. In the northeastern part of Washita County, the Weatherford dolomite and dolomitic beds of the Quartermaster form prominent escarpments.

GEOLOGY

Stratigraphy

Formations found in this area are shown in the table on page 7. (See also Plate I.)

PRE-CAMBRIAN

The central and southeastern parts of the Wichita Mountains are composed largely of pre-Cambrian igneous rocks, with minor amounts of older pre-Cambrian sedimentary rocks consisting of quartzite and sandstone.[8] Granite is reported to have been found in at least three wells north of the mountains in sec. 1, T. 5 N., R. 18 W., sec. 2, T. 6 N., R. 10 W., and in sec. 34, T. 8 N., R. 18 W.

REAGAN SANDSTONE

This formation outcrops in some outlying hills in T. 6 N., R. 14 W., Kiowa County. According to Taff[9], it "is approximately 300 feet thick and is made up of conglomerate composed of porphyry pebbles and included basic rocks, gritty light brown to gray and greenish sandstone, greenish clay shales, and siliceous limestones interstratified. The limy layers contain many species of Cambrian fossils. The conglomerate occurs invariably near the base as local beds or lentils, while the calcareous sandstones and limestone beds are, without exception, in the upper part of the formation."

8. Taylor, C. H., Granites of Oklahoma: Oklahoma Geol. Survey, Bull. 20, 1915.
9. Taff, J. A., Preliminary report on the geology of the Arbuckle and Wichita Mountains in Indian Territory and Oklahoma: Oklahoma Geol. Survey, Bull. 12, p. 75, 1927.

Table of Formations

AGE	FORMATION
QUATERNARY AND RECENT	Reworked red beds, river alluvium and sands
TERTIARY	Tertiary gravel
COMANCHEAN	Outliers of oyster shell beds
PERMIAN	Quartermaster formation
	Cloud Chief formation
	Whitehorse sandstone
	Dog Creek shale
	Blaine formation
	Flower Pot shale
	Duncan sandstone
	Hennessey shales
	Garber sandstone
PENNSYLVANIAN	Wellington shale
	Panhandle "Big Lime" (predominantly anhydrite)
	Pontotoc series
ORDOVICIAN	Viola limestone
	Simpson formation
	Arbuckle limestone
CAMBRIAN	Reagan sandstone
PRE-CAMBRIAN	Pre-Cambrian sedimentary (?) and igneous rocks

ARBUCKLE LIMESTONE

The northeastern part of the Wichita Mountains is formed largely by outcrops of this formation. "In general it may be said that the upper and middle parts consist of limestone, siliceous and shaly in part, and two major and three minor masses of nearly pure dolomite

near the base, the dolomites being separated from each other by limestones and the lower one separated from the Reagan sandstone by limestone in a similar manner."[10]

Thickness of this formation in the Arbuckle Mountains is given as 7,992 feet by Decker and Merritt.

SIMPSON FORMATION

This formation outcrops in a small area in secs. 20 and 21, T. 6 N., R. 15 W.

Taff's[11] general description of the Simpson formation in the Arbuckle Mountain area is as follows:

> After the Arbuckle limestone was deposited there was a general change in the nature of the sediments. The top of the limestone seems to have been slightly eroded locally and upon the surface were deposited beds of pure sand. At other places the Arbuckle limestone is overlain by shaly and impure lime—the basal beds of the Simpson formation. On these local sandy beds at the base there were deposited greenish shales and then crystalline and shelly limestones interstratified with a number of beds of sandstone, making a total thickness ranging from about 1,200 to 2,000 feet.

The well in sec. 13, T. 7 N., R. 16 W., showed the thickness of this formation to be 1,360 feet.

VIOLA LIMESTONE

There are a few scattered outcrops of Viola limestone in T. 6 N., Rs. 15 and 16 W. They consist of 500-700 feet of limestones which are thin-bedded to massive. The Viola limestone has been found in several wells in T. 7 N., R. 16 W.

POST-VIOLA—PRE-PONTOTOC FORMATIONS

There are no outcrops of rocks from Viola to Pontotoc age in this area, nor have they been identified from wells so far as the writer is aware. Representatives of these periods may be present in parts of this area where they may not have been removed by erosion prior to deposition of the late Pennsylvanian and Permian beds.

PONTOTOC SERIES

Many wells in this area encounter a series of granite wash, arkosic sands, shales, and limestones, which correlate with the Pontotoc terrane of Morgan.[12] Farther away from the mountains this series grades to red, blue, and brown shales and limestones. Production in the Carson County field of the Texas Panhandle is obtained from this

10. Decker, Charles E., and Merritt, Clifford A., Physical characteristics of the Arbuckle limestone: Oklahoma Geol. Survey, Circ. 15, p. 7, 1928.
11. Op. cit., p. 20.
12. Morgan, Geo. D., Geology of the Stonewall Quadrangle: Bureau of Geology, Bull. 2, p. 132, 1924.

series of beds. The thickness of this formation varies greatly. In general it is thin on structurally high areas, and thick on the low areas. The Outhier Petroleum Company No. 1 J. M. McConnell, sec. 34, T. 7 N., R. 20 W., shows 1,580 feet of Pontotoc.

THE PANHANDLE BIG LIME AND THE WELLINGTON SHALE[13]

These two formations have a combined thickness of 1,360 feet in the Ritter Oil Company well in sec. 21, T. 11 N., R. 19 W. The Panhandle Big Lime, generally logged as a lime, consists of limestone, dolomite, anhydrite, gypsum, and shale. In the Hutchinson County, Texas, and the Sayre, Oklahoma fields the lower part of this formation produces some oil and much gas.

The overlying Wellington shale consists of gray or blue shale with a few lime shells. It is impossible to draw an exact line between the Wellington shale and the Panhandle Big Lime. The contact of the Wellington shale and the superjacent red beds is one of the best markers in well logs in western Oklahoma.

The Panhandle Big Lime and the Wellington shale are very thin or absent on the high areas of Kiowa County.

GARBER SANDSTONE AND HENNESSEY SHALES

These two formations cannot be separated in the area. They consist of several hundred feet of red shales with a few thin sandstones. In Kiowa County they rest unconformably on older formation from Wellington to Pre-Cambrian. The upper 30 or 40 feet of the Hennessey is locally gray or buff in color.

DUNCAN SANDSTONE

The Duncan sandstone consists of about 40 feet of gray, calcareous, cross-bedded sandstone, interbedded with red and gray shales. It forms a prominent escarpment north of Lone Wolf, Hobart and Komalty. In the Anadarko basin it is probably red in color and soft, and because of these changes is not recognizable with certainty in well logs.

FLOWER POT SHALE

The Flower Pot shale consists of about 150 feet of shales, mostly red, with minor amounts of gray shale. There is no sharp boundary between this formation and the Duncan sandstone, the change being gradual from sand to shale. The term Flower Pot is used in preference to the term Chickasha formation, because, in the opinion

13. In using this nomenclature, the writer uses the correlation given by Frank C. Greene in Bulletin 40-D, Oklahoma Geological Survey. Greene considers that the lime series in western Oklahoma is the equivalent of the Panhandle Big Lime, and that the Wellington shale is absent from the Amarillo fold. Some geologists differ with this view, believing that the combined Wellington shale and the underlying lime series in western Oklahoma are together the equivalent of the Panhandle Big Lime.

of the writer, the Chickasha in its type locality at the east end of the Anadarko basin is the near-shore equivalent of the Flower Pot shale, Blaine formation, and the Dog Creek shale. Some geologists differ in this correlation, and consider the Chickasha and the Flower Pot shale equivalent.

BLAINE FORMATION

This formation contains two dolomite beds, about 40 feet apart, which are very useful in surface mapping. These dolomites thin and disappear just east of the Kiowa County line south of Carnegie. The gypsums of this formation are not conspicuous in the central and eastern parts of Kiowa County, but thicken and increase in number toward the west and are easily seen in the bluffs north of the North Fork of Red River. Most of the logs of wells drilled in the Anadarko basin show the Blaine formation. Its thickness averages about 150 feet.

Below is a section of the Blaine which probably is representative of this formation in the northeastern part of Washita County.

Section of Blaine Formation, sec. 23, T. 15 N., R. 10 W.

	Ft.	in.
Purplish-white dolomite	....	3
Red shale	4	0
Purplish-white dolomite	....	3
Red shale	3	6
Red dolomite	....	6
Red shale	5	0
White dolomite (sometimes yellow)	....	6
Red shale	8	0
Satin spar	....	3
Red shale	8	0
Soft gray gypsum	2	0
Red shale	5	0
Soft green gypsum and red shale	3	0
Red shale	5	0
Green gypsum	....	6
Red shale	11	0
Gray gypsum	3	0
Fossiliferous dolomite	2	0
Red shale	46	0
Gray gypsum	2	0
Dolomite	1	0
Red shale	15	0
Gypsum	2	0
Red shale	18	0
Gypsum	2	0
Red shale	6	0
Gypsum underlain by thin dolomite	1	0
Total	154	9

Base of the Blaine is indefinite. There are a few thin gypsums, apparently lenticular, below this section.

DOG CREEK SHALES

This formation consists of red shale with a few lenses of fine-grained red and white sand. Its thickness at the outcrop along the Kiowa-Washita County line is estimated to be 150 feet or less. This probably increases toward the north, possibly reaching 300 feet in northeastern Washita County. Observations in Blaine and northern Caddo counties show that it thickens toward the south.

WHITEHORSE SANDSTONE

Two divisions of this formation can be recognized; a lower, the Marlow member, which consists of red, even-bedded sandstones and red shales, with some regular bands of fine white sand, and much disseminated gypsum; and an upper, the Rush Springs member, which consists almost entirely of red cross-bedded sandstone and has little or no shale or gypsum in this area. The Rush Springs member is the Whitehorse sandstone of Reeves.[14]

In Grady County, thicknesses are 110 feet for the Marlow member and 240-280 feet for the Rush Springs member. The Whitehorse appears to thicken in Washita County. The well in sec. 25, T. 12 N., R. 14 W., just north of Washita County, shows 670 feet of Whitehorse and Dog Creek. To this must be added 120 feet of Whitehorse eroded (since the top of the well is 120 feet below the base of the Cloud Chief) which would give a total of 790 feet. The Dog Creek is probably 300 feet thick, which would give 490 feet of Whitehorse. The contact of the Whitehorse and the Dog Creek shale is a good marker on the surface where erosion is good and would probably be of use in core drill work. Certain dolomite members of the Whitehorse, which outcrop on the hills above Greenfield in Blaine County[15] might also be useful in mapping. These Greenfield dolomites are near the boundary of the Marlow and Rush Springs members. Another dolomite member occurs 40 feet below the top of the Whitehorse. It enters Washita County from the north in sec. 2, T. 11 N., R. 14 W., and is herein referred to as the Weatherford dolomite. Traced northward to Weatherford it disappears and its place is taken by a gypsum bed.[16] It can be traced a few miles south of Colony, and may occur much farther south. It thins out and disappears along the east line of R. 14 W. The term "Day Creek dolomite" of Cragin has been applied to this dolomite, and to the dolomites above the town of Greenfield, in Blaine County, and to the Quartermaster dolomites which are discussed below. It is believed that its continued use will only serve to confuse. The writer does not know what bed, if any, in southwestern Oklahoma, corresponds to the Day Creek of Kansas.

14. Reeves, Frank, Geology of the Cement oil field: U. S. Geol. Survey, Bull. 726, p. 41, 1922.
Greene. F. C., and Sawyer, R. W., Stratigraphy of the middle-Permian.
15. Stephenson, D. C., Observations on the Verden sandstone of southwestern Oklahoma: Bull. Amer. Assoc. Pet. Geol., Vol. IX, No. 2, 1925.
16. Evans, Noel, Notes on geology of the Weatherford district, Oklahoma: Am. Assoc. Pet. Geol. Bull., Vol. 12, No. 7, 1928.

CLOUD CHIEF FORMATION

This formation, in the type locality near the village of Cloud Chief, consists of massive white or pink gypsums interbedded with red sandstone and shales. Its thickness varies considerably. The well in sec. 23, T. 9 N., R. 17 W. shows 160 feet of gypsum and interbedded sandstones. The Ritter well in sec. 21, T. 11 N., R. 19 W., shows no gypsum. In the south and southwestern parts of Washita County, outcrops of gypsum are not as massive as in the eastern and northeastern parts. These variations are probably due to lenticularity of the gypsum members, to solution, or to a possible post-Cloud Chief—pre-Quartermaster erosional period.

The gypsums of the Cloud Chief slump badly and are not reliable for accurate surface work.

QUARTERMASTER FORMATION

This formation consists of red shale and red sandstone with white streaks in the lower part, and of hard platy sandstones and shales in the upper part. Total thickness is 400 to 500 feet. This formation is characterized by erratic dips caused by slumping.

Hastings Moore showed the writer an area near Alfalfa where Quartermaster sandstones and shales rest directly on Whitehorse sandstones. Evans has shown that the dolomites capping the Caddo County buttes in Tps. 10, 11, and 12 N., R. 13 W., and the heavy dolomitic beds above the Weatherford dolomite in eastern Washita County are composed of Quartermaster material. These beds of Quartermaster material are found east of the Cloud Chief outcrops, and rest on the Whitehorse. The writer traced the Quartermaster-Whitehorse contact in the northwestern part of T. 9 N., R. 13 W., and recorded elevations along the contact. Contours were drawn on these elevations. The contours thus obtained corresponded closely with the topography. The re-entrants coincided with the creeks and draws and the noses coincided with the divides. This would prove that the unusual position of the Quartermaster material is due largely to slumping rather than to erosional unconformity. The slumping is due to two things: first, inadequate support of the gypsum and Quartermaster by the underlying soft Whitehorse sandstone; and second, the solution and disappearance of the gypsum.

If the Quartermaster material rested on horizons below the top of the Cloud Chief only along the eastern margin of the Quartermaster outcrop, then it would look like a progressive eastward overlap of the Quartermaster. However, in the Washita River Valley, across from Hammon, and thence west, up the valley, there are many localities where Quartermaster material rests on beds below the Cloud Chief Gypsum.

COMANCHEAN

Comanchean limestone is found on a few hills in Washita County. It is composed largely of fossil oyster shells.

TERTIARY

On tops of hills beds of coarse gravel are found locally. These gravel beds are referred to the Tertiary. Loose gravel, weathered, from these beds is widely distributed over the area.

QUATERNARY AND RECENT

The lower beds are often covered with reworked red beds in the valleys of both small and large streams. There is a considerable area covered by alluvium in the valley of the Washita, and by loose sand in the valley of the North Fork of Red River.

STRUCTURE

The larger structural features of the area are the Wichita Mountains and the Anadarko basin. The mountains occupy the greater part of Kiowa County. Adjacent to the mountains, both on the north and the south, the pre-Pennsylvanian rocks are folded steeply, but the surface red beds which cover them, dip very gently away from the mountains at the rate of 10 to 60 feet per mile. Along the line between Kiowa County and Washita County the red beds dip more steeply northward (100 to 150 feet per mile) into the Anadarko basin. In central Washita County the surface beds dip gently westward and in northern Washita County they dip southwestward 20 to 40 feet per mile. A map in the folder shows structure on the Blaine formation. (Plates I and II).

DEVELOPMENT

THE GOTEBO FIELD

In 1904 the Whitewater Oil and Gas Co. found oil in a well drilled in sec. 27, T. 7 N., R. 16 W. Since that time fifty or sixty wells have been drilled in this field, chiefly in secs. 21, 22, 23, 26, 27, 28, and 34, T. 7 N., R. 16 W. A smaller area which has had several wells drilled lies in secs. 5, 7, 8, and 18, T. 6 N., R. 16 W. and section 12, T. 6 N., R. 17 W.

Production has been in shallow sands, 300-600 feet deep. The oil wells were reported to have from 1 to 15 barrels initial production, most of them being very small. The largest gas wells produced 550,000 cubic feet.

Present production is about 14 barrels per day from 14 wells. At one time the town of Gotebo was supplied with gas from the wells, but these have been exhausted.

On the surface rocks, south dip, which is reverse dip, can be observed in section 27, just south of Gotebo. The area has not been mapped so far as the writer is aware and the relation of surface structure to production is not known.

In section 27 there are about 500 feet of red beds (probably Garber) underlain by about 300 feet of beds recorded as limestone, sandstone, and red and blue shales. This group is probably equivalent to the Pontotoc, though there may be remnants of any post-Viola—pre-Garber formations. Viola limestone is found at 800 feet. Five wells have penetrated the Viola limestone and at least three have passed through it. No commercial production was found in these deep wells.

RECOMMENDATIONS

The small amounts of oil and gas already obtained in Kiowa County will cause many more wells to be drilled. All of Kiowa county, except that covered by the mountains, and all of Washita County is possible oil territory. There are many sands, already mentioned, which could serve as reservoirs for oil. To summarize, these are: sands of the red beds, which produce at Gotebo, the Panhandle Big Lime which produced at Sayre, the Pontotoc beds which produce in Carson County, Texas, and probably at Gotebo, the upper Pennsylvanian sands, the Viola limestone and the Simpson formation and the porous top of the Arbuckle limestone.

Kiowa County, north of the mountains, has possibilities of commercial shallow production. There has been much folding and some faulting, with possible local structure favorable to accumulation. There are also possible accumulations along unconformities. Prospecting is hazardous, however, due to the possibility of encountering solid granite at shallow depths.

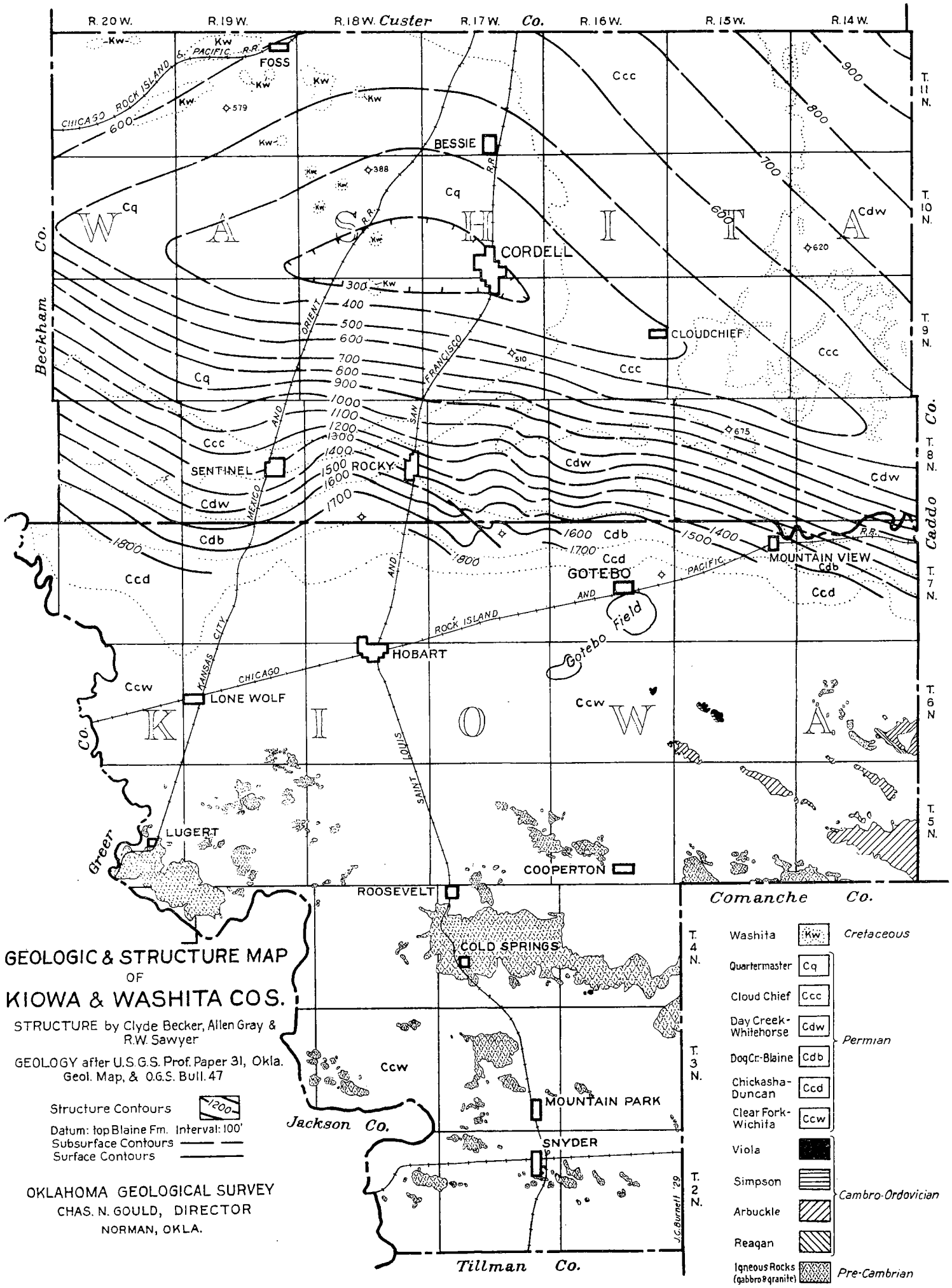
Depths of formations increase in general, northward to central Washita county, and then rise very gradually again toward the north. The deepest part of the Anadarko basin is located in central Washita County.

In Washita County if a well is not to be drilled to pre-Pennsylvanian, it is believed that a surface structure of considerable closure is necessary to warrant a test. Due to unconformities, however, it is possible for favorable pre-Pennsylvanian structures to underlie little or no structure at the surface.

In considering the surface structure it should be remembered that the Cloud Chief formation is not reliable for accurate mapping, and the Quartermaster is not reliable at all. Any supposed structure mapped on these formations should be core-drilled to deeper formations such as the Weatherford or Greenfield dolomites, the base of the Whitehorse sandstone, or the Blaine formation.

Completed Wells in Kiowa and Washita Counties

LOCATION	COMPANY	Total Depth	Top Blaine	Base Red	Top Pontotoc	Top Viola	Top Simpson	Top Arbuckle	Granite	Formation in Bottom of Well	REMARKS
SE-SW 1-5-18	Caudill	1236	.....	480	480	None	None	None	1188	Granite	
SE-SW 2-6-19	Alert Pet.	1634	.....	878	878	None	None	None	1404	Granite	
SW-SW-NE 18-6-16	Obermeyer	434	.....	?	.....	.....	395?	.....	.....	Simpson?	Est. 10-45 bbls. No log above 395.
NW-SE 8-7-15	Hartman	2310	.....	1102	None?	1102?	1826?	.....	.....	Simpson	Shows 1140 and 1850-1920.
NE-SE-SW 13-7-16	Marland	3230	.....	665	.....	1085	1740	3100?	.....	Arbuckle	Shows 545, 675, 1320, 1900-2000, 2821.
SW-NW SW-NE 19-7-16	Conner	985	.....	766?	840	.....	.....	.....	.....	Pontotoc	Shows 645-770.
SE-SW 20-7-16	Conner	1130	.....	922?	None	922	.....	.....	.....	Viola	Shows 558 and 850.
SE-SW 22-7-16	Nations	2500	.....	850?	None	850	1425?	.....	.....	Simpson	Shows 2140-2255.
SW-SW 27-7-16	Kraer	2603	.....	.....	.....	.....	.....	.....	.....	Simpson?	Upper log missing.
SW-SE 27-7-16	Conner	1230	.....	825?	None?	825	.....	.....	.....	Viola	Shows 605-765.
NW-NE-SW 34-7-16	Conner	1560	.....	875?	875?	1090?	1442?	.....	.....	Simpson?	Shows 600, 900, 1100-1200, 1445.
NW-NE-NW 34-7-16	Conner	1752	.....	.....	.....	1100	1640?	.....	.....	Simpson?	Shows 1720-1742.
SW-NE 3-7-17	Sunray-Aubyme	3737	.....	1875	.....	.....	.....	.....	.....	Penn.	Shows 785, 1220, 2M gas 1080 ft.
NW-SW 10-7-20	St. Louis, Okla.	3094	.....	1325	.....	.....	.....	.....	.....	?	Poor log, well may have reached Simpson
SE-SW-SW 19-7-20	C. and O.	1320	.....	894	894	.....	.....	.....	.....	Pontotoc?	Oil show 894.
SE-NE 34-7-20	Outhier	2682	.....	1105?	1105?	.....	.....	.....	.....	Pontotoc	Gas show 2600.
SE-NW 9-8-15	Morton	3130	825	3027?	.....	.....	.....	.....	.....	Wellington?	
SW-NE 20-8-16	Santrock	3260	?	?	.....	.....	.....	.....	.....	.....	Poor log.
SE-SE 33-8-18	Sunray-Aubyme	2185	.....	1112	1455	None	None	None	2040	Granite	Gas show 860, 1050.
23-9-17	Cincinnati	4141	1070	3273	.....	.....	.....	.....	.....	"Big Lime"	Gas show 1355.
NE 3-10-18	Roxana	3034	1330	.....	.....	.....	.....	.....	.....	Garber	
SE-SW-SW 21-11-19	Ritter	5085	1174	3430	4794	.....	.....	.....	.....	Pontotoc	


R. 20 W.
R. 19 W.
R. 18 W.
Custer Co.
R. 17 W.
R. 16 W.
R. 15 W.
R. 14 W.
T. 11 N.
T. 10 N.
T. 9 N.
T. 8 N.
T. 7 N.
T. 6 N
T. 5 N.
T. 4 N.
T. 3 N.
T. 2 N.
Beckham Co.
Caddo Co.
Comanche Co.
Jackson Co.
Tillman Co.
Greer Co.
WASHITA
KIOWA
FOSS
BESSIE
CORDELL
CLOUDCHIEF
SENTINEL
ROCKY
GOTEBO
MOUNTAIN VIEW
HOBART
LONE WOLF
LUGERT
COOPERTON
ROOSEVELT
COLD SPRINGS
MOUNTAIN PARK
SNYDER
Gotebo Field
CHICAGO, ROCK ISLAND & PACIFIC R.R.
ORIENT R.R.
SAN FRANCISCO AND MEXICO R.R.
KANSAS CITY AND SAINT LOUIS R.R.
CHICAGO, ROCK ISLAND AND PACIFIC R.R.
Kw
Cq
Ccc
Cdw
Cdb
Ccd
Ccw
600
700
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1000
1100
1200
1300
1400
1500
1600
1700
1800
GEOLOGIC & STRUCTURE MAP
OF
KIOWA & WASHITA COS.
STRUCTURE by Clyde Becker, Allen Gray & R.W. Sawyer
GEOLOGY after U.S.G.S. Prof. Paper 31, Okla. Geol. Map, & O.G.S. Bull. 47
Structure Contours
Datum: top Blaine Fm. Interval: 100'
Subsurface Contours
Surface Contours
OKLAHOMA GEOLOGICAL SURVEY
CHAS. N. GOULD, DIRECTOR
NORMAN, OKLA.
J.G. Burnett '29
Washita
Quartermaster
Cloud Chief
Day Creek-Whitehorse
Dog Cr.-Blaine
Chickasha-Duncan
Clear Fork-Wichita
Cretaceous
Permian
Viola
Simpson
Arbuckle
Reagan
Cambro-Ordovician
Igneous Rocks (gabbro & granite)
Pre-Cambrian