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THE SUBSURFACE GEOLOGY OF CANADIAN COUNTY, OKLAHOMA

A THESIS

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BY

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CHAPTER I

INTRODUCTION

Location

This paper includes an area located in west-central Oklahoma, (Figure 1), lying principally in Canadian County with one tier of east-west townships in northern Grady and Caddo counties. Specifically, the area includes all of townships T. 10 N. through T. 14 N. and ranges R. 5 W. through R. 10 W. El Reno is the largest town and the county seat of Canadian County. Geologically, the area is situated on the eastern flank of the Anadarko Basin.

Topography and Drainage

The topography of most of the area is gently rolling hills which are typical of the western plains. The gypsum hills occupy the northwestern part of Canadian County and their topography is fairly rough, presenting dissected escarpments peculiar to the gypsum hills region of western Oklahoma.[1]

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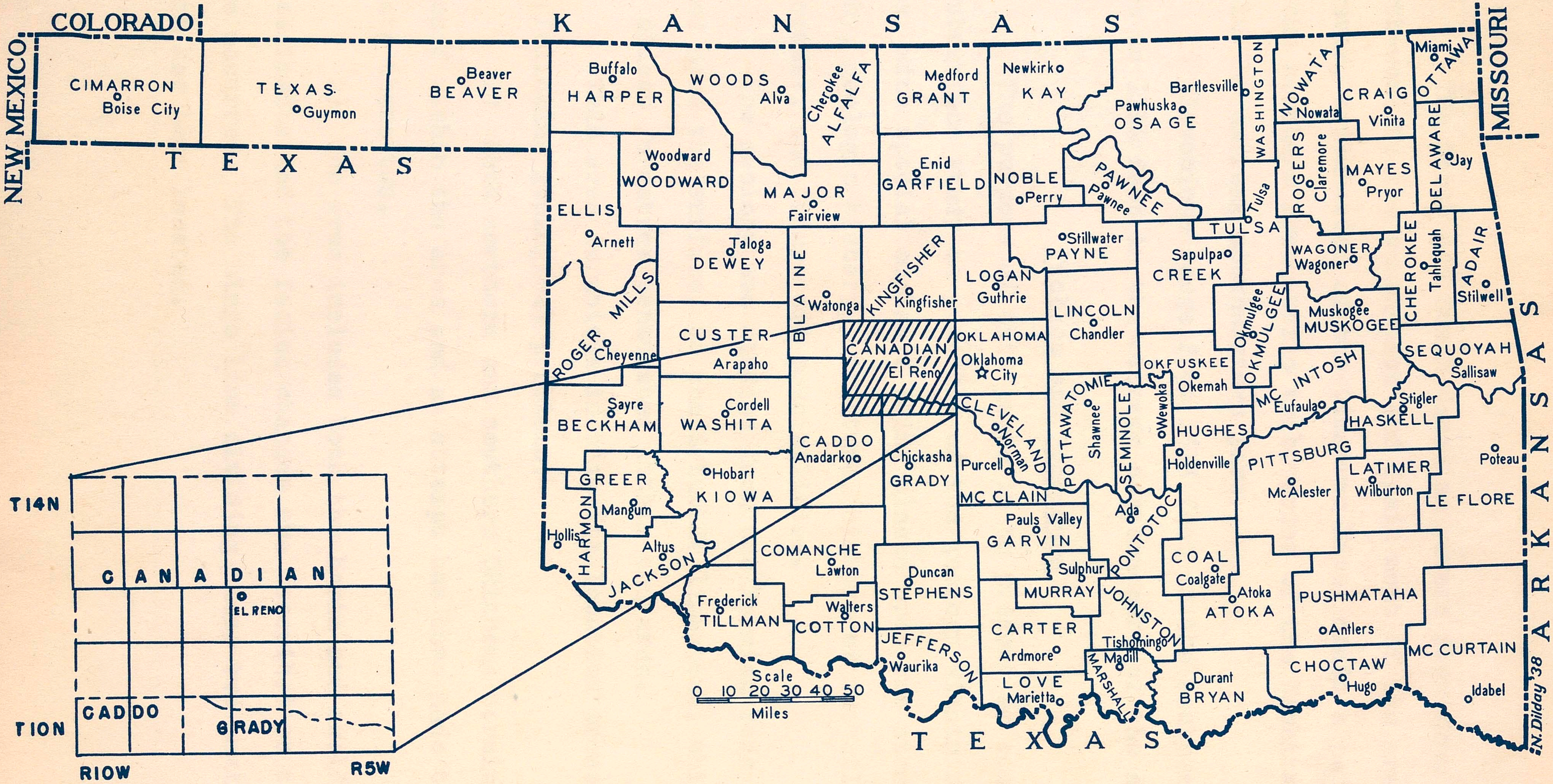
[1] Kite, W. C., "The Geology of Kingfisher and Canadian Counties," Oklahoma Geological Survey, Bulletin 40, July, 1927, pp. 7-10.



LOCATION MAP

FIGURE I

The North and South Canadian rivers flow from the north-west to the south-east and drain most of the area. However, tributaries of the Cimarron River drain a portion of the northern area, while tributaries of the Washita River drain the extreme southwestern part.

Elevations range from 1535 feet in the southwestern part to 1114 feet in the extreme eastern part of the area.

Problem and Procedure

The purpose of this paper is to present as complete a subsurface study as possible of the geology within the area, with special emphasis being placed upon the stratigraphy, geologic history, structure, history of the oil development, and future oil possibilities.

The geology was studied from the Permian beds exposed upon the surface, to the Arbuckle limestone, which is the oldest formation penetrated within the area.

This area is unique in that its location presents the following geological problems:

1) Both northern and southern Oklahoma terminology is used within the area and an attempt has been made to correlate these two.

2) The area includes both the basin and shelf facies of sediments and the facies changes are described as they have occurred. The hinge line dividing these two environments has been located.

3) The eastern limit of the basinward formations that wedge out is defined.

In order to accomplish this investigation, electric logs were examined and the tops of formations were picked. Two electric log cross-sections were drawn. All of the available well samples of the key wells were examined under the binocular microscope and Ostracoda and Foraminifera were picked from the samples. Information from the scout cards of oil companies was gathered and compiled. The structural contour and isopachous maps were tied into wells located outside of the area. As presented, the geologic interpretations are those solely of the author.

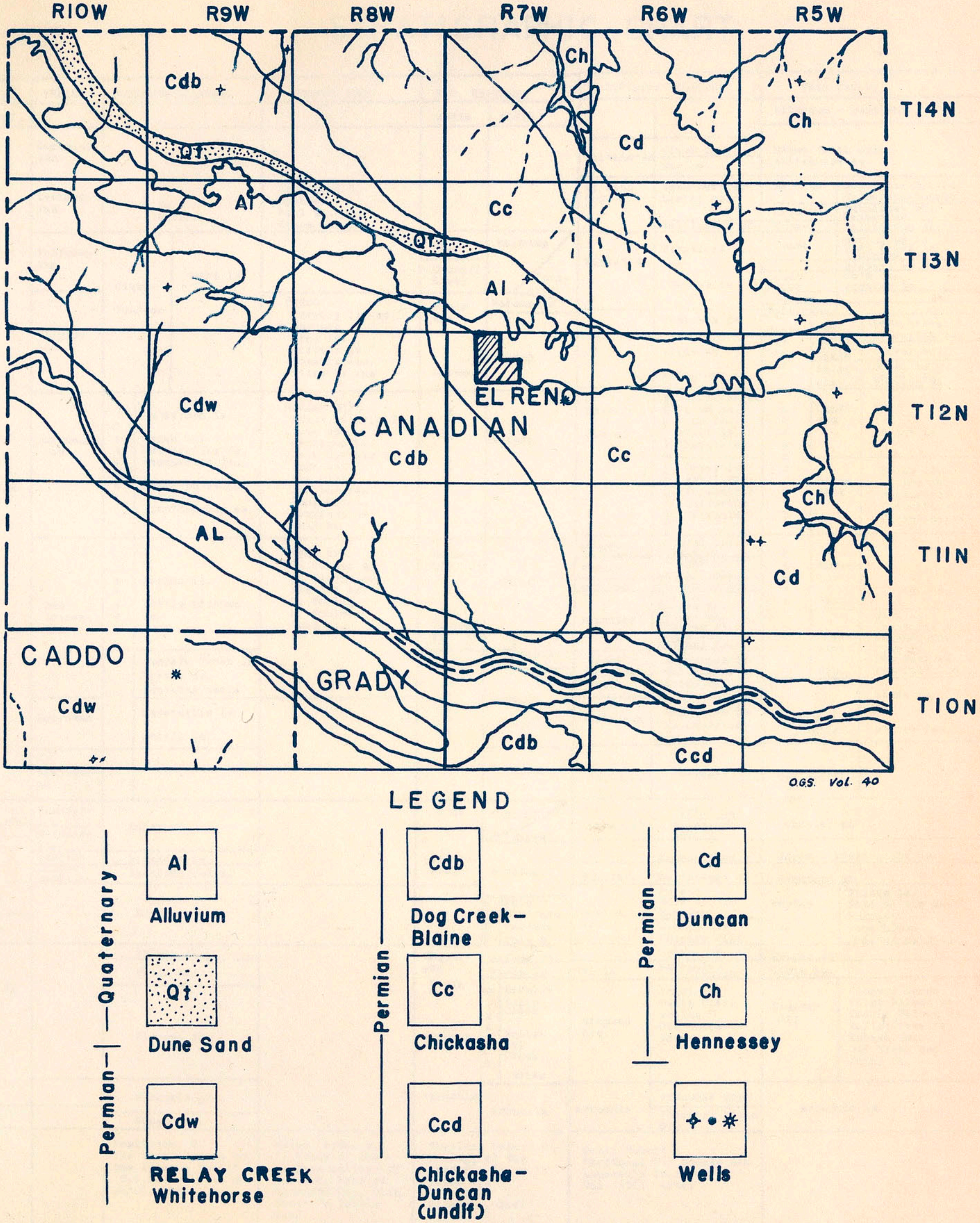


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FIG. 2

STRATIGRAPHIC CHART

SYSTEM	SERIES	SOUTHERN OKLAHOMA		CEMENT AREA	R.R. WHEELER			NORTHERN OKLAHOMA		THIS THESIS		
QUATERNARY					NORTH	SOUTH				Alluvium - Dune Sand		
PERMIAN	Guadalupian			Schooland C. Spencer Roll ss. Cline ss.				Whitehorse	Cloud Chief Marlow	Relay Creek dolo.- Whitehorse ss.		
	Leonardian	Wichita - Clearfork						El Reno Grp.	Hennessey sh. Garter ss.	El Reno		Dog Creek-Blaine Chickasha-Duncan
										Enid Gro.		Hennessey sh. Garber ss.
									Wellington sh.	Sumner		Wellington sh.
	Wolfcampian	Cisco- Ponotoc	Hart ls.		Chase	Wolfcamp Pontotoc		Pontotoc	Stratford fm.	Chase		Herington ls Fort Riley ls Florence ls.
												Wreford ls.
					Council Grove				Vanoss fm.	Council Grove		Neva ls. Foraker ls.
										Admire		
	Virgilian			CISCO Gregory ls.-ss. Gardner ss. Grey ls. Griffin ls. Rowe ls.-ss. Niles ls.-ss	Wabunsee Shawnee	Wabaunsee				Wabaunsee		
						CISCO			Pawhuska fm. Elgin ss. Nelagoney fm.	Shawnee Douglas	Pawhuska	Deer Creek ls. LeCompton ls.
											Elgin	Hoover ss.
											Nelagoney	Oread ls. Lovell ls. Tonkawa ss.
PENNSYLVANIAN	Missourian	Hoxbar	Zuckerman ls. Daube ls. Crinerville ls. Westheimer fm. Union Dairy fm. Confederate ls.	HOXBAR GRP. First Oolitic ls. Yule ss. Ostracod ls. Main Oolitic ls. Wade ss. Big Shale Medrano ss. Healand ss. Marchand ss. Culp ss.	Missouri	HOXBAR		Hoxbar-Canyon	Ochelata Wildhorse ls Okesa ss. Wann fm. Avant ls. Chanute sh.	Hoxbar Grp	Ochelata	Avant ls.
									Skiatook Dewey ls. Nelli Bly Hogshooter Coffevile Seminole		Skiatook	Dewey ls. Layton ss, Hogshooter ls. Checkerboard ls. Cleveland ss.
	Des Moinesian	Deese	Arnold ls. Devils Kitchen fm.	DEESE GRP. U. Glover ss. L. Glover ss. Kistler ss. U. Pooler L. Pooler Mona ss.	Marmaton Cherokee	DEESE		Holdenville	Lenapah ls. Nowata sh.	Deese Grp	Marmaton Grp.	Oswego ls.
								Wewoka	Oolagah fm. Labette sh.			
								Wetumka	Ft. Scott ls.			
						ATOKA		Cherokee	Calvin Senora fm. Stuart sh. Thurman ss. Boggy fm. Savanna fm.		Cherokee Grp.	Prue ss. Verdigris ls. Skinner ss. Pink ls. Red Fork ss. Bartlesville ss.
			Pumpkin Creek ls. Lester ls. Bostwick congl.		Morrow	DORNICK HILLS		Upper Dornick Hills	McAlester fm. Hartshorne ss. Atoka fm.	Dornick Hills		Atoka fm.
	Morrowan		Otterville ls. Joliff ls.					Morrowan	Wapanucka fm. Union Valley fm.			Morrow fm.
	Springeran					SPRINGER		Springeran	Springer	Springeran		
MISSISSIPPIAN	Chesterian Meramecian	Caney sh.			MISS.	CHESTER Mayes		Caney sh.	Pitkin ls. Fayetteville sh.	Chesterian		
									Mayes- Miss.	Mayes - Mississippi ls.		
	Osagian	Sycamore ls.			Kinderhook	Woodford		Woodford	Chattanooga sh.	Woodford sh.		
	Kinderhookian	Woodford chert.										
DEVONIAN		Hunton				Hunton	Frisco B.d' arc Har-Hen Chim H.	Hunton Grp.	Frisco Bois d' Arc Haragan	Hunton Grp.		Frisco ls. Bois d' Arc ls. Haragan Henryhouse Chimney Hill ls.
SILURIAN									Henryhouse Chimney Hill			
ORDOVICIAN		Sylvan sh.			Maquoketa Viola Simpson	Sylvan sh.			Sylvan sh.	Sylvan sh.		
		Viola ls.				Viola ls.		Viola	Fernvale-Trenton	Viola ls.		
		Simpson fm.				SIMPSON	Bromide Tulip Creek McLish Oil Creek Joins	Simpson Grp.	Bromide Tulip Creek McLish Oil Creek Joins	Simpson Grp.		Simpson Dense First Wilcox ss. Second Wilcox ss. Tulip Creek fm. McLish fm. Oil Creek fm. Joins fm.
		Arbuckle grp.			Arbuckle	Arbuckle		Arbuckle	Arbuckle Grp.	Arbuckle ls.		
CAMBRIAN		Reagan ss.							Timbered Hills Grp.			
		Tomlinson, C. W. "The Penn. System in the Ardmore Basin" O.G.S. Bulletin 46 March, 1929		Hayes, Lyman N. "A Study of Sub - surface Geology of the N.E. Part of Comanche Co., Okla. Master's Thesis 1952	Wheeler, Robert B. "Geology of the Anadarko Basin." World Oil Vol. 127 November, 1947			Dott, Robert H. "National Oil Scouts and Landmen's Yearbook." Vol. XVII 1948.				

FIG.3

CHAPTER II

STRATIGRAPHY

Surface

General Statement.--Surface formations recognized within the area are Quaternary, Tertiary, and Permian in age.

Quaternary

The valleys of the North and South Canadian rivers are filled with Quaternary alluvium, composed of sands, silts, and clay. Bordering the northern side of the North Canadian River valley, there exists a narrow band of dune sand deposits.

Tertiary

Tertiary sands and gravels are believed to cap some of the hills in western Canadian County.[2]

Permian System

Relay Creek Dolomite and Whitehorse Sandstone.--These are the youngest Permian formations mapped within the area

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[2] Kite, W. C., "Geology of Kingfisher and Canadian Counties." Oklahoma Geological Survey, Bulletin No. 40-O, July, 1927.

and they are located in the extreme western sector where they are mapped as a single unit, (Figure 2).

Relay Creek dolomite is composed of an upper and lower dolomite member, separated by brown and maroon shale. It is from 5 to 35 feet thick.[3]

Whitehorse sandstone is medium soft and dark orange-red in color. The grains are generally fine, and are coated with iron oxide and calcareous material, both of which make up the cementing material. Topography on this formation is rough, forming small escarpments in the southwestern part of the area.

El Reno Group

Dog Creek Shale and Blaine Gypsum.--These formations are found in the west-central part of the county, and they are also mapped as a single unit, (Figure 2).

The Dog Creek shale is dull red in color, and contains dolomite beds in the upper part and gypsum stringers in the lower part.

The Blaine gypsum is composed of beds of red, gypsiferous, sandy shales, with thin beds of dolomite throughout the horizon.

Chickasha Formation.--This is a series of soft, friable, loosely cemented sands in the upper part and massive

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[3] Becker, Clyde M., "Geology of Caddo and Grady Counties, Oklahoma." Oklahoma Geological Survey, Bulletin No. 40-1, March, 1927.

bedded, dark red mudstone lenses separated by red shales in the lower part.

Duncan Sandstone.--The upper portion of the Duncan sandstone is composed of red, well cemented sandstone, while the basal portion consists of alternate beds of very soft, green and red shales, with sandstone lenses.

Enid Group

Hennessey Shale.--This formation is composed of a series of blocky, sandy, red shales with streaks of white or light green shale. It weathers to a dark, loamy soil which forms a relatively flat, fertile, prairie belt in the eastern part of the area.

Subsurface

Garber Sandstone.--The youngest bed found in the subsurface is the Garber sandstone. In the upper portion it is a red, fine grained, angular, porous sandstone with beds of orange-red, blocky shales. This sandstone can be differentiated from the overlying Hennessey shale on electric logs by an increase in the self potential curve and a very slight increase in the resistivity. The Garber sandstone is approximately 750 feet thick in this area.

Sumner Group

Wellington Shale.--In the upper portion, it is a maroon to light purple, blocky shale with thin streaks of very fine grained yellow sandstone. In the middle, the shale becomes predominately light gray and brown, with thin streaks of green and dull yellow shale, while the basal portion is composed of brown and light gray shale, with numerous streaks of thin white gypsum and anhydrite. High resistivity readings on the electric log are characteristic of these gypsum and anhydrite beds. The thickness of the Wellington shale is approximately 900 feet.

Chase Group

General Statement.--The top of the Chase group is picked just below the base of the Wellington anhydrite. In the upper part it is light gray, blocky and splintery shale. Crinoid stem fragments and Ostracods, Cytherella, were consistently found near the top of this group. These fossils are not index fossils, but they mark the first horizon of abundant life in the subsurface Permian formations in this area.

Herington Limestone.--This is a thin, white, fine to medium crystalline limestone. It is often so thin that it is difficult to recognize in samples and to pick on electric logs. Below the Herington limestone is a sequence of gray, blocky, arenaceous, and micaceous shale.

Fort Riley Limestone.--This limestone is off white to tan in color, finely granular, soft, slightly porous, and fossiliferous,(Ostracods). Below the Fort Riley limestone is a sequence of gray, slightly calcareous, blocky and platy, often pyritic, fossiliferous, (Crinoid fragments), shale.

Florence Limestone.--In this area the Florence does not contain sufficient siliceous material to be classified as a flint as it is farther to the north in Kansas. It is a mottled gray and white, rather hard, finely crystalline limestone, often sandy at the base and is usually porous. As it is traced basinward, it becomes increasingly arenaceous. Below the Florence is a succession of gray, blocky shales with numerous thin limestone beds. This sequence also develops a number of white, medium grained, angular, clean, porous sandstones in the western part of the area.

Wreford Limestone.--The Wreford limestone is white, finely granular and rather hard. It is difficult to recognize in samples because it is very thin and it becomes increasingly arenaceous basinward.

Council Grove Group

Neva Limestone.--This is off white to snow white in color, fine to medium crystalline, hard, and fossiliferous, (Fusulinids). Below the Neva limestone is a group of gray, blocky shales and thin, but prominent, fossiliferous limestones. This group thickens basinward.

Foraker Limestone.--Located near the base of the Council Grove group, this is white to very light gray in color, finely crystalline, hard, and slightly dolomitic. It grades into white, fine grained, calcareous sandstone in the deeper portion of the basin.

Admire Group

This group consists of gray and brown, fusulinid-bearing limestones and gray, blocky, slightly calcareous shales.

Pennsylvanian System

Virgilian Series

Wabaunsee Group

The top of the Wabaunsee group is placed at the top of a thin gray brown, finely crystalline, very fossiliferous, limestone. Below this, the group is composed of gray, blocky shales, and light brown, medium granular, slightly calcareous, porous sandstones and gray, finely crystalline, fossiliferous limestones.

Douglas-Shawnee Group

Pawhuska Formation.--The top of the Pawhuska formation in the eastern part of the area is a thin, light tan, finely crystalline limestone. It grades into a light tan, medium grained, slightly calcareous, porous sandstone as it dips into the deeper part of the basin.

Deer Creek Limestone.--The Deer Creek limestone member of the Pawhuska formation is gray in color and has a green tinge. It is a soft limestone in the shelf area, but grades into a calcareous sandstone in the basin.

LeCompton Limestone.--This limestone is mottled white and dark brown, finely crystalline and hard, and shows a distinctive character on the lateral resistivity curve of the electric log. It is equivalent to the Rowe limestone in the Cement area to the southwest.

Elgin Sandstone Formation.--The Elgin sandstone is a series of dark gray and black blocky shales with numerous streaks of tan, finely crystalline, soft, slightly porous limestones. A locally developed sandstone which drillers have named the Hoover sand, is often found within the area. This sandstone locally contains commercial oil production in the Oklahoma City Field when it develops sufficient thickness and porosity. In Canadian County, the sandstone is white and green in color, angular, medium grained, slightly calcareous and is porous.

Nelagoney Formation.--The Nelagoney formation includes two distinctive limestones and a basal sandstone member, separated by dark gray, finely micaceous, blocky shales.

Oread Limestone.--This limestone may be distinguished throughout the entire area. It is tan to dark brown in color, finely crystalline, slightly dolomitic, slightly arenaceous, and fairly soft.

Lovell Limestone.--The Lovell limestone can be identified only on the shelf area. It is a white to tan, thin, finely crystalline, and soft limestone.

Tonkawa Sandstone.--This sandstone is light brown, fine grained, becoming calcareous towards the base in the eastern part of the area. The thickness varies from 50 to 120 feet.

Missourian Series

This series contains the Hoxbar group of southern Oklahoma and the Ochelata and Skiatook groups of northern Oklahoma.

Ochelata Group

This group is composed of dark gray, slightly micaceous, blocky shales with the Avant limestone located in the basal portion.

Avant Limestone.--The Avant limestone is blue-gray and brown, finely crystalline, and rather soft. It contains many small black Ostracods (?). On the shelf, it is an easily distinguished marker bed, but it grades into a sandstone in the basin area.

Skiatook Group

The Skiatook group is composed of gray, blocky, micaceous shales with thin pyritiferous horizons and alternate beds of limestone and sandstone.

Dewey Limestone.--This bed is found near the base of the Avant limestone in the eastern part of the area. It is a brown with blue gray speckles, finely crystalline, hard limestone.

Below the Dewey limestone and above the Layton sandstone, there occurs a distinctive bed of brown, fine to coarse grained, angular and very slightly frosted sandstone that contains milky blue chert fragments.

Layton Sandstone.--This sandstone can be correlated throughout the entire area. On the shelf area it is called the Layton sandstone, but basinward it is often termed the Medrano sandstone, which is recognized in the Cement area of southern Oklahoma. The Layton is dark brown in color, fine grained near the top, micaceous and slightly calcareous. In the basal portion, it is made up of large grains of white, loosely consolidated, sub-rounded and slightly frosted, often pyritic and very micaceous sandstone. Large cubes of pyrite were observed in the Layton in Sinclair No. 1 Hutchemon, Section 14, T. 12 N. R. 7 W. This sandstone may later prove to be a producing horizon within the area.

Hogshooter Limestone.--In the Ramsey No. 1 Mansfield, Section 16, T. 14 N. R. 7 W., this limestone bed is dark brown and mottled brown and white, medium crystalline, fossiliferous, and hard. It is not a marker bed throughout the area.

Below the Hogshooter limestone and above the Checkerboard limestone there is a very dark brown, oolitic, and hard limestone that is easily picked in samples and serves as a good marker.

Checkerboard Limestone.--The Checkerboard limestone is white to tan, medium crystalline, slightly arenaceous, and hard.

Cleveland Sandstone.--This sandstone is tan, fine grained, slightly calcareous and porous. It occurs near the base of the Skiatook group, but is only locally developed throughout the area.

Hoxbar Group

In southern Oklahoma, the Hoxbar group is equivalent in age to both the Ochelata and the Skiatook groups. The Ochelata and Skiatook groups contain formations that are more easily recognized on the shelf area, while the Hoxbar-type sediments, thick sandstones and shales, are more typical of the basin area.

Des Moinesian Series

Contained here are the Marmaton and Cherokee groups of northern Oklahoma and the Deese group of southern Oklahoma. Again, the northern Oklahoma terminology is typical of the shelf sediments while southern Oklahoma terminology is typical of the basin type sediments. The Deese is equivalent in age to both the Marmaton and Cherokee groups.

Marmaton Group

This group is composed of gray and black, often pyritic, and slightly micaceous shales, with thin beds of brown, hard, oolitic limestones.

Oswego Limestone.--The Oswego limestone is an excellent marker bed both in samples and in the distinctive resistivity curve on the electric log. It is tan to light brown in color, slightly porous, and becomes arenaceous at the base. Traced basinward, it becomes a calcareous sandstone and is probably equivalent to one of the upper Deese sandstones.

Cherokee Group

The Cherokee group comprises a series of dark gray, blocky shales and alternate beds of sandstone and limestone. It includes important oil horizons in the West Edmond Field along the eastern edge of Canadian County.

Prue Sandstone.--fine to medium grained, light brown in color, often developing sufficient thickness and porosity to produce oil.

Verdigris Limestone.--off-white to tan, finely crystalline, and rather hard.

Skinner Sandstone.--similar in character to the Prue sandstone. It may also be a possible producing horizon within the area.

Pink Limestone.--off-white to brown in color, finely crystalline, and fairly hard. It is often difficult to recognize in samples because it is relatively thin.

Bartlesville Sandstone.--produces oil and gas distillate along the east edge of Canadian County. The sandstone is tan to brown in color, fine to medium grained, porous, and varies in thickness from 0 to 35 feet. Basinward, the sandstone is consistently present, but upon the eastern shelf it is often absent, which is due to the sandstone facies being replaced by a sequence of shales as is illustrated in the Fox and Fox No. 1 Robson, Section 12, T. 13 N. R. 5 W.

Deese Group

The basinward Deese group is equivalent to the Marmaton and Cherokee groups on the shelf area. These latter groups are approximately 500 feet thick on the shelf, while the Deese may reach a thickness of 1,000 feet in the basin area of this thesis. Thick, light brown, angular, clean but often calcareous, porous sandstones and dark gray, blocky shales develop in the basin area as the Deese thickens. As illustrated on electric logs, these beds are shaly at the base and grade into calcareous and relatively clean sandstones in the upper portion.

Dornick Hills Group

This group of formations is found only in the basin part of the thesis area. The Atoka formation comprises the upper Dornick Hills and the Morrow formation the lower Dornick Hills.

Atoka Formation.--The top of the Atoka is placed at a thin but persistent, brown to dark gray, finely crystalline limestone which marks the top of a series of sediments whose electric log characteristics differ from the overlying Deese sediments. The Atoka formation is composed of dark brown to gray, often glassy, finely crystalline, hard, dolomitic limestones and dark gray to black, bituminous, blocky shales. As the shelf area is approached, this group of sediments wedges out by a combination of on-lap and truncation. The uplift, which was responsible for the truncation of the Atokan sediments, occurred during post-upper Dornick Hills, pre-Deese time.[4]

Morrowan Series

Morrow Formation.--Possible lower Dornick Hills sediments can be identified in only one well within the area, in the Denver Producing and Refining No. 1 Sah-cam, Section 33, T. 10 N. R. 10 W. They consist of dark brown and black, fine grained, calcareous, slightly porous, and finely glauconitic sandstones.[5] The beds of sandstone are separated by black, often waxy, blocky shale. The division of the upper and lower Dornick Hills was based mainly upon the change in lithology of the two formations. Outside of the

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[4] Jacobsen, Lynn. "Structural Relations on the East Flank of the Anadarko Basin, Cleveland and McLain Counties, Oklahoma." A.A.P.G. Vol. 33, No. 5, 1949, p. 695.

[5] The sandstones were examined under a petrographic microscope and the green grains in the sandstone were identified as glauconite.

thesis area a similar change in lithology was described in Superior Oil No. 51-11 Weller, Section 11, T. 8 N. R. 12 W. where the upper Dornick Hills was described as containing Atokan shales with dense, brown limestone beds becoming more abundant at the base, while the lower Dornick Hills was composed of highly glauconitic, siliceous limestones in the upper part and thick glauconitic sandstones in the basal portion.[6]

Only glauconitic sandstones are present in this area because the upper sediments were truncated by the Dornick Hills orogeny.[7]

Springeran Series

Springeran sediments in this area are found only in the Denver Producing and Refining No. 1-A Schoolland, Section 16, T. 10 N. R. 9 W. where it is made up of 250 feet of shale. This shale has a characteristically low resistivity reading on the electric log. No Springeran sandstones are present in this well evidently because they were truncated by the Dornick Hills orogeny.

Mississippian System

Chesterian-Meramecian Series

The upper part of this series is composed of dark brown and black, often oolitic, dense limestones, inter-

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[6] Wheeler, Robert R. "Geological Significance of the World's Deepest Well Bore." <u>World Oil</u>, Vol. 120 No. 10, February, 1949.

[7] The age of the Dornick Hills orogeny is post-lower Dornick Hills, pre-upper Dornick Hills.

bedded with black, blocky shales. The middle portion contains tan, milky colored, finely crystalline, hard and slightly cherty limestones. In the basal section, these limestones are dark brown to black in color, finely crystalline, and arenaceous, while the black shales in the lower part of this series are very pyritic.

The Chesterian-Meramecian formations range from 0 to 1,150 feet thick and wedge out upon the shelf area, where they are truncated by the Dornick Hills orogeny.

Osagian Series

Both the Mayes limestone, which is a southern Oklahoma term, and the Mississippi limestone, which is a northern Oklahoma term, are recognized within this area. The Mississippi limestone is equivalent in age to the Mayes limestone plus some older Mississippian sediments.

Mississippi Limestone.--This is found in the northeastern part of the area in the West Edmond Field. It is white, finely crystalline, and often slightly porous, and ranges from 50 to 250 feet thick.

Mayes Limestone.--This limestone is dark brown, granular, arenaceous, and hard, with a thin bed of very hard, dark brown, glauconitic sandstone at the base. It is approximately 300 feet thick in the Denver Producing and Refining No. 1-A Schoolland, Section 16, T. 10 N. R. 9 W. and grades laterally into the Mississippi limestone in the eastern part of the area.

Kinderhookian Series

Woodford Shale.--The Woodford shale comprises the Kinderhookian series and is very dark brown, greasy, sporaceous, and pyritic in this horizons. It is characterized by a high resistivity and a low self potential value on electric logs. The Misener sandstone usually found at the base is not well developed within this area, as its thickness ranges from 0 to 5 feet. The Woodford is approximately 100 feet thick in this area.

Silurian-Devonian Systems

Hunton Limestone.--The Hunton is composed of five members: the Frisco chert at the top, the Bois d'Arc limestone, Haragan dolomitic limestone, Henryhouse shaly limestone, and the Chimney Hill limestone.[8] In the West Edmond Field, the Frisco chert has been eroded. The Hunton is approximately 400 feet thick.

Frisco Chert.--The Frisco chert is difficult to identify within this area. Fragments of fine, white, milky chert, which might be remnants of the Frisco chert, were observed near the top of the Hunton in a few wells.

Bois d'Arc Limestone.--In the Sinclair No. 1 Hutch-

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[8] Reeds, Chester A. "The Hunton Formation of Oklahoma." American Journal of Science, 4th Series, XXXII (October, 1927).

emon, Section 14, T. 12 N. R. 7 W. the Bois d'Arc member is white to tan in color, finely crystalline to chalky, and dolomitic in zones. Along the eastern edge of Canadian County in the West Edmond Field it develops sufficient porosity to produce oil.

Haragan-Henryhouse Limestone.--The Haragan-Henryhouse members are not differentiated within this area. They are tan to gray, marly limestones and exhibit a lower resistivity reading on electric logs than do the Bois d'Arc limestone and the underlying Chimney Hill limestone.

Chimney Hill Limestone.--This limestone may be divided into four beds. At the top is the pink crinoidal limestone that has a white matrix with pink splotches, and it is finely crystalline and porous. The next horizon is composed of a thin streak of fine, white, milky chert. Below this bed is a layer of off-white, oolitic, soft, porous limestone. Near the base is a thin bed of white, glauconitic, soft, porous limestone.

Ordovician System

Sylvan Shale.--The Sylvan shale is black to dark green, and blocky. It is from 60 to 75 feet thick within the area.

Viola Limestone.--The Viola is off-white to tan in color, coarsely crystalline, often slightly dolomitic, and hard in the upper portion. The middle part is white, chalky, and very slightly arenaceous. A bed of brown chert is often present above and below this middle bed. Near the base, there is a distinctive bed of limestone that is black, white, brown and white mottled, dolomitic, hard and dense. The Viola is approximately 350 feet thick.

Simpson Group

The group is composed of a sequence of sandstones, shales, and dolomitic limestones. It has been completely penetrated in only one well, Sinclair No. 1 Hutchemon, Section 14, T. 12 N. R. 7 W., where it was 1,178 feet thick, however basinward, the group may be expected to be considerably thicker.

Simpson "Dense."--This horizon is pearl gray in color, dense, hard, and carries thin dolomitic beds. The zone can be recognized on the electric logs by its low self potential. It is from 80 to 100 feet thick.

First Wilcox Sandstone.--The First Wilcox sandstone is clear and glassy in color and composed of medium to large, sub-rounded, frosted, and often dolomitic grains. It may vary from a few feet to 40 feet thick.

Second Wilcox Sandstone.--This Wilcox sandstone is tan, medium grained, angular to sub-rounded, slightly frosted, compact but not well cemented, and is porous. The basal portion of the sandstone is snow white, coarse grained, subrounded, frosted, clean, and resembles small golf balls. It produces gas distillate in the Sinclair No. 1 Hutchemon, Section 14, T. 12 N. R. 7 W. where it is approximately 200 feet thick.

Tulip Creek Formation.--This is predominantly a white, medium grained, glassy and soft sandstone, which becomes dolomitic and argillaceous at the base. It is approximately 70 feet thick in this area.

McLish Formation.--The McLish contains upper, middle, and basal sandstones, separated by dark brown, dense, dolomitic limestones in the upper part and dark green, waxy, blocky, and platy shales in the lower portion. The sandstones are tan and gray, medium grained, sub-rounded, and dolomitic. The McLish formation is approximately 225 feet thick.

Oil Creek Formation.--The upper part of the Oil Creek formation is a mottled, oolitic, often glauconitic, slightly arenaceous, dolomitic limestone, while the basal portion is black and gray, medium grained, rounded, frosted sandstone. The thickness of the Oil Creek formation ranges from 160 to 180 feet.

Joins Formation.--This is a brown and gray, fine, hard, dolomitic limestone. It is 80 feet thick in the Sinclair No. 1 Hutchemon, Section 14, T. 12 N. R. 7 W.

Arbuckle Group

Arbuckle Limestone.--The only well within the entire area that has penetrated the Arbuckle limestone is the Sinclair No. 1 Hutchemon, Section 14, T. 12 N. R. 7 W. A total of 145 feet were drilled, which represents only the top of the formation. In this well, the Arbuckle is very dark brown and gray, finely crystalline, hard, and dolomitic. The micro-log which was run in the well showed the top ten feet of the Arbuckle to be porous, with the remaining section showing little or no porosity.

CHAPTER III

GEOLOGIC HISTORY AND SEDIMENTATION

General Statement

During the long interval from Cambrian into early Pennsylvanian time the western portion of Canadian County subsided steadily, while in contrast, the eastern margin subsided relatively little, remaining above the sea during several epochs. Therefore, the basin area received a continuous sequence of sediments, while the Chesterian, Springeran, Morrowan, and Atokan seas evidently did not transgress upon the eastern shelf area, (Figure IX).

Cambro-Ordovician

No wells have reached lower Cambrian sediments. Probably most of the area was undergoing erosion during the early Cambrian time, and it was not until the close of this period that the seas transgressed northward from the Cambro-Ordovician geosyncline located to the south. The Arbuckle limestone, which was deposited by the initial advance of the Cambro-Ordovician seas, has in its top portion finely crystalline limestone, which indicates the sea was shallow and the surrounding positive areas were relatively flat and contributed little or no clastic material.

The entire Simpson group is represented, and there is no evidence of a major erosional surface separating the Arbuckle limestone and the Simpson group. On the eastern shelf, an interval ranging from the top of the Oil Creek to the base of the Viola, was found to be 750 feet thick in the Anderson-Prichard No. 1 Replogle, Section 18, T. 11 N. R. 5 W., while the same interval 23 miles to the west in the Denver Producing and Refining No. 1-A Schoolland, Section 16, T. 10 N. R. 9 W. is approximately 1,000 feet thick.[9] This is the first indication that the western area had already begun to subside more than the eastern side.

Because of the variety of sediments, sandstones, dolomitic limestones and shales found within the Simpson group, it is inferred that the sea was shallow and the area was unstable. The "golf ball" sandstones would indicate the waters were turbulent, thus attributing to the roundness of the sand grains to corrasion, and the sea was oscillating, frequently exposing the sands to aeolin action which further contributed to the rounding and frosting of the grains.

The Viola limestone and the Sylvan shale were likewise deposited by northward transgressing seas under constant depositional conditions as is illustrated by the homogeneity of both of these formations. However, the Viola-Sylvan in-

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[9] The entire Simpson group could not be measured because it was not completely penetrated in either well.

terval tends to thin to the north and northeast, as is illustrated by the thickness of the interval in the Denver Producing and Refining No. 1-A Schoolland, Section 16, T. 10 N. R. 9 W., where it is approximately 670 feet thick; in the Anderson-Prichard No. 1 Replogle, Section 18, T. 11 N. R. 5 W., where it is 370 feet thick; and to the north in the Sinclair No. 1 Hutchemon, Section 14, T. 12 N. R. 7 W. where the interval has thinned to approximately 250 feet thick. This indicates that the source of the Viola-Sylvan sediments was from the south.

Siluro-Devonian

During this period the eastern part of the area remained relatively high while the western basin area continued to subside as is illustrated in Figure XI. The entire Hunton group should be expected to be found in the basin part of the area while the Frisco chert and upper part of the Bois d'Arc limestone are absent in the West Edmond Field along the eastern edge of Canadian County. This is due in part to non-deposition and erosion, for evidently there was a slight uplift along the shelf area during post-Hunton, pre-Woodford time and the seas retreated to the west. Fragments of Frisco chert are believed to have been found near the top of the Hunton formation in the Sinclair No. 1 Hutchemon, Section 14, T. 12 N. R. 7 W. This well is located near the hinge line which is the transitional zone that divides the basin and shelf.

Mississippian

In early Mississippian time the Kinderhook seas deposited the Woodford shale unconformably upon the Hunton formation. The Misener sandstone found at the base of the Woodford is very thin, varying from zero to four or five feet. The dark brown to black, bituminous, and pyritic character of the Woodford indicates that it was deposited under anaerobic, marine conditions.[10]

Following the deposition of the Woodford the area was blanketed by the Mayes and Mississippi limestones. The Mayes limestone is southern Oklahoma terminology, while the Mississippi limestone is northern Oklahoma terminology, the distinction being based mainly upon a change in sedimentation which resulted in a difference of lithology.

The Chesterian and Meramecian seas advanced from the south and deposited sediments conformably upon the Mayes limestone in the basin part of the area. That these seas were confined to the basin area is noted in the absence of late Mississippian deposits upon the shelf. The thickening of the Chesterian sediments to the south and west would indicate that the basin was continuing to subside.

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[10] Pettijohn, F. J. Sedimentary Rocks, New York: Harper & Brothers.

Pennsylvanian

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There is no evidence that important orogenic movements occurred between late Mississippian and early Pennsylvanian time. The seas again advanced during lowermost Pennsylvanian from the south and were confined to the basin area, for Springeran deposits are not found east of T. 11 N. R. 8 W., neither are they found in the Exploration Oil No. 1 Hadlock, Section 30, T. 13 N. R. 9 W., within the thesis area. The Springeran sediments are found only in the Denver Producing and Refining No. 1-A Schoolland. In this well the Springer is represented by only 120 feet of shale, which infers that seas were retreating and thus the upper sandstones were not deposited or that they were eroded by the Dornick Hills orogeny.

The Morrowan sediments were also confined to the basin area and they off-lap Springeran deposits, (Figure XI). The lower Dornick Hills is thin in this area, which is due in part to the subsidence of the sea level, movements along the axis of the Nemaha Ridge during the Dornick Hills orogeny that resulted in the uplift and westward tilting of the eastern shelf area, and subsequent truncation of sediments ranging in age from lower Dornick Hills to Woodford.

A late Morrowan orogeny initiated the formation of the southern Oklahoma structural system[11] and movement along

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[11] The southern Oklahoma structural system comprises the Arbuckle, Wichita, and buried Amarillo mountains.

the axis of the Pauls Valley uplift.[12]

Succeeding the orogenic pulsations there appears to have been a general rise in the sea level that resulted in the on-lap of upper Dornick Hills sediments. The seas, however, were still confined to the negative basin area as the sediments thin and wedge out as the eastern shelf is approached. Additional movements along the axis of the Nemaha Ridge during post-upper Dornick Hills, pre-Deese time resulted in the truncation of a portion of the upper Dornick Hills formation.

The Anadarko Basin was probably connected to the south with the McAlester Basin until post-Atokan, pre-Deese time.[13] It seems significant that the Atokan as well as the Morrowan and Mississippian (Caney-Mayes) sediments in this area all have affinities with the McAlester Basin facies to the southeast.[14]

Also during the pre-Deese orogenic movements, the Arbuckle-Wichita fold system developed with the subsequent truncation of some 14,000 feet of rock to expose granite in the structurally highest areas.[15] Therefore there was an enormous thickness of shales and sandstones deposited by the

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[12] Jacobsen, Eloise T., <u>Reconnaissance Study of Subsurface Geology of Northwestern Oklahoma</u>. Master's Thesis, University of Oklahoma, 1948.

[13] Wheeler, Robert R. <u>op. cit</u>.

[14] <u>Ibid</u>.

[15] <u>Ibid</u>.

Des Moinesian seas as they advanced from the south. The negative basin area received the greatest amount of deposits as is indicated in the cross-section, (Figure XI). The seas deposited predominately shales and sandstones in the basin area and these grade into a limestone facies upon the shelf.

During Missourian time, the Wichita-Amarillo structural system was again rejuvenated, thus lifting the mountains to their greatest height and supplying abundant sediments for the advancing seas. Again the majority of the sediments were deposited in the basin and they tended to fill the basin to the approximate level of the shelf area.

At the close of the Pennsylvanian period, Virgilian time, the seas deposited sediments of uniform thickness over the entire area which indicates that the basin was no longer subsiding more rapidly than the shelf area.

Permian

Permian seas (Wolfcampian) covered the area and deposited a series of shales and thin marine limestones. These seas were probably warm and shallow for the Wolfcampian series contains abundant fossils. Obviously, the basin suffered post-Herington, Permian, movements of some importance. These movements probably occurred before middle Permian time when an important regional change occurred from normal marine sedimentation to evaporitic deposition (anhydrite and gypsum) of an enclosed basin without free access to the open seas.[16]

The "Red Beds" that were deposited in this evaporitic basin are practically void of fossil life, which indicates that the salinity of the waters had reached a point such that the conditions were adverse to animal life. It is interesting to note that the evaporation did not reach the phase where salt was deposited in this area. This might be explained by a climate that consisted of short seasons of rainfall that tended to refill the basin, followed by long periods of drouth that tended to evaporate the basin.

Post-Permian tilting resulted in the present attitude of the sediments in this area. This westward tilting is termed the Prairie Plains homocline.

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[16] Wheeler, Robert R. op. cit.

CHAPTER IV

STRUCTURE

Local Structure

Due to the great distance between wells it is not possible to study any local structural features.

Regional Structure

In discussing regional structure, the subsurface structure of the area is monoclinal towards the south-southwest. The structural contour maps, (Figures V, VIII) show a normal basinward dip from the foreland shelf area. Upon the shelf, all formations show a small dip which increases rapidly along the "hinge line" separating the shelf and basin area. This hinge line varies slightly in location according to the age of the formations involved.

The structure of the area can be separated into two distinct time divisions: pre-Pennsylvanian and Pennsylvanian-Permian formations. These dip in the same direction but at different angles.

Characteristic of the structure dips of the pre-Pennsylvanian formations, the structural contour map on the top of the Viola, (Figure VIII), indicates average dips of 1½ degrees upon the shelf, increasing to 3¼ degrees in the basin. The hinge line may be traced from T. 14 N. R. 7 W. in the northwestern part of the area, southeastward into T. 10 N. R. 5 W.

The Oswego limestone structural contour map is chosen as being characteristic of the Pennsylvanian and Permian formations, (Figure V). Upon the shelf, the Oswego has an average dip of 1 degree, increasing in the basin area to 1¼ degrees. On this map, the hinge line extends from T. 14 N. R. 8 W. to T. 10 N. R. 5 W.

Dips of the Permian formations upon the surface do not always reveal the presence of pre-Pennsylvanian structures because the erosional surface that resulted from the Dornick Hills orogeny leveled the formations and then the Pennsylvanian and Permian beds were deposited horizontally upon this surface of erosion.

Unconformities

In this paper, Billings[17] definition of an unconformity is used as being a surface of erosion or non-deposition. There are three important unconformities within the area.

The largest unconformity within the area was created by the Dornick Hills orogeny, when beds ranging from lower

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[17] Billings, Marland P. Structural Geology, Prentice Hall Inc., p. 240.

Dornick Hills to Woodford were exposed and eroded. The electric log cross section, (Figure XI), shows that in the extreme southwestern part of the area, beds of Atokan age (upper Dornick Hills), rest upon the eroded surface of the lower Dornick Hills in the Denver Producing and Refining No. 1 Sah-cam, Section 33, T. 10 N. R. 10 W.; progressing to the east, in Cities Service No. 1 Petree Ranch, Section 18, T. 11 N. R. 9 W., Atokan formations rest upon Mississippi Chesterian sediments; lastly, in Sinclair No. 1 Hutchemon, Section 14, T. 12 N. R. 7 W., basal Pennsylvanian formations of Des Moinesian age (Cherokee group), rest upon the Mayes formation.

In the southeastern part of the area in Amerada No. 1 Lawson, Section 18, T. 11 N. R. 5 W., basal Pennsylvanian formations of Des Moinesian age (Cherokee group), rest upon the Woodford shale, therefore it is in this area that the greatest unconformity exists.

The two other unconformities are more difficult to recognize because they represent a smaller hiatus. The first, is between the upper Dornick Hills and Deese sediments, in the southwestern part of the area where the upper Dornick Hills shows evidence of truncation as it thins eastward, (Figure XI Cross Section A-A').

The second is confined to the shelf area where the Frisco chert and the Bois d'Arc limestone are eroded in the West Edmond Field. It is post-Hunton, pre-Woodford in age.

Faulting

A heretofore unmapped subsurface fault, trending northwest, southeast, is located between Sinclair No. 1 Hutchemon, Section 14, T. 12 N. R. 7 W. and J. E. Trigg No. 1 Tennery, Section 22, T. 13 N. R. 7 W. An electric log cross-section between these two wells revealed first, a change in dip of the lower formations. Secondly, the thinning of the Mississippi Chesterian formations in the Sinclair No. 1 Hutchemon as compared to the normally thick Chester in the J. E. Trigg No. 1 Tennery, indicates the Sinclair well is on the upthrown side of the fault. The production of gas distillate in the Sinclair No. 1 Hutchemon, further supports the presence of the fault in that it is producing high on the upthrown side of the fault.

The age of the fault is post-Chesterian, pre-Des Moinesian as seen by the fact that the fault does not extend above the unconformity at the base of the Pennsylvanian.

Canadian County experienced earth tremors in the spring and fall of 1952, which indicates the presence of quasi-dormant faults. The first and most severe tremor which lasted only a few seconds, was noted to be most severe just east of El Reno, Oklahoma; however, the shock was felt as far north as Kansas and to the south in Texas. Numerous other quakes of minor severity were recorded in this same area in the fall of 1952.

Gravimetric Anomaly

In the initial exploration of the eastern part of the Anadarko Basin, a number of gravimetric anomalies were found to be aligned in a north-south line, parallel to and some 25 miles west of the well known Nemaha Ridge at Oklahoma City.[18]

Continuing exploration, both with seismograph and drilling, has tended to verify the presence of a second ridge or anomaly, some 25 miles west and related to the Nemaha Granite Ridge.

This anomaly may be shown in eastern Canadian County extending from T. 14 N. R. 6 W., southward to T. 10 N. R. 5 W. where it becomes poorly defined.

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[18] Moore, Carl A. Personal Communication.

CHAPTER V

THE HISTORY OF THE DEVELOPMENT OF THE AREA

The first drilling activity of which there is any record was initiated in the early months of the year 1918, when the Yukon Co-operative Company started its No. 1 Little, Section 12, T. 11 N. R. 6 W. The well was drilled to a total depth of 3,075 feet and abandoned as a dry hole after losing the drilling tools in the hole. The well was still drilling in lower Permian or upper Pennsylvanian formations when abandoned. Numerous other shallow wells were drilled in the proceeding years without finding commercial production.

First commercial production to be found within the area was obtained in 1934, in the Denver Producing and Refining No. 1 Ada-Noe, Section 34, T. 10 N. R. 10 W., that was drilled to test a block of 13,000 acres covering the crest of a surface structure. This was called the Binger Area, for Binger, Oklahoma, and was located in Townships 9 and 10 North, Ranges 10 and 11 West, Caddo County. A contract was let to drill the well to a depth of at least 7,500 feet; however, the well was drilled to a depth of 9,238 feet and nine-inch casing was cemented.

During the winter of 1933, the leases were subject to a $2.00 per acre rental. They re-leased 8-9,000 acres at 50 cents an acre and agreed to carry the well deeper and pay within a year a total of $3.00 per acre, and also drill a 10-acre offset to the west if commercial production were obtained. This agreement explains the reason that the No. 1 Sah-cam was later drilled on the adjoining 10 acres.

After reaching a depth of 9,540 feet, the well became a "tight hole" in that all information on drilling was withheld. It was eventually drilled to a total depth of 11,230 feet. On February 27, 1934, the hole was cored from 9,974 feet to 9,986 feet, recovering seven feet of saturated sandstone from an unidentified formation, the name or age of which was never agreed upon by geologists.[19] No electric log was run in this well. In twelve days the formation pressure rose to 5,000 pounds per square inch. On March 11, 9,900 feet of 6 5/8-inch casing was cemented with 3,000 sacks. When the plugs were drilled and the well bailed down, the well failed to show the previous formation pressures recorded before the casing was set.

The well was completed flowing by heads 50 barrels of oil per day, cutting 3 to 5 percent rotary drilling fluid. This well was of particular interest to geologists

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[19] Becker, Clyde M.; Wells, Murray J.; and Fulton, F. J. "The Binger Structure." Oil and Gas Journal, September 8, 1934, p. 15.

because it was one of the first deep tests drilled in the Anadarko Basin that obtained commercial production. It also gave geologists a concept of how deep the Anadarko Basin might be and the type of sediments that were expected to be found in the deep part of the basin. There is not yet complete agreement upon the producing horizon in this well because of the paucity of information. It is believed that it is producing from an upper Deese sandstone of Pennsylvanian age.

An electrical rig drilled the No. 1 Sah-cam which was the 10-acre offset to the Ada-Noe.[20] It was drilled to a total depth of 13,882 feet and abandoned as a dry hole, while in the lower Dornick Hills formation. This failure ended the drilling activity in the area and thus the Binger Pool remained a one-well field. The Ada-Noe is reported to have been abandoned as an exhausted producer in July, 1944.

Canadian County did not record any production until 1944, when the West Edmond Field expanded into the eastern sections of T. 14 N. R. 5 W. Forty-five wells were drilled into the Bois d'Arc member of the Hunton limestone in the county.

In 1945, the drilling activity was increased in the West Edmond Field upon the discovery of high gravity dis-

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[20] Swindell, Floyd. "Interesting Drilling Plan Being Used on the Second Deep Binger Test." Oil World, June 24, 1935, p. 24.

tillate in the Bartlesville sandstone in wells located in sections 11, 12, 25, 35, and 36 in T. 14 N. R. 5 W. Twelve wells were subsequently completed from this producing horizon.

In February, 1948, the Denver Producing and Refining Company staked its No. 1-A Schoolland, Section 16, T. 10 N. R. 9 W., and the well was drilled to a total depth of 17,094 feet, a near record depth for Oklahoma. After drilling into the Joins formation, casing was set in the Sylvan shale at 15,239 feet. The Hunton limestone and a Pennsylvanian sandstone were perforated and the well was completed for an initial potential of 5 million cubic feet of gas per day. This new field has been designated as the Cogar Pool by the Oklahoma Corporation Commission.

The latest development in the area is the Sinclair No. 1 Hutchemon, Section 14, T. 12 N. R. 7 W. The well was drilled into the Arbuckle limestone at a total depth of 11,700 feet, the first time this deep horizon has been penetrated in this area. The well was perforated in the Second Wilcox from 10,318 to 10,476 feet and completed flowing 10,500,000 cubic feet of gas and 50 barrels of high gravity distillate per day. An offset well is being drilled at the time of the writing of this thesis.

CHAPTER VI

FUTURE POSSIBILITIES FOR OIL EXPLORATION

The discovery of commercial production within the deeper part of the Anadarko Basin, created a new region for future oil exploration. Canadian County and its associated area shares in its bright future. The area is especially attractive to oil operators because it is a virgin area, with less than one deep test drilled per township of 36 square miles.

The area contains the necessary features to warrant further exploration. First, as mentioned in Chapter II, there is an abundant supply of dark organic marine shales below the Permian formations to qualify as possible source beds for petroleum. Fossils found throughout the horizon substantiate the fact that they are of marine origin.

Secondly, abundant reservoir-type sediments are present within the area. Thick, clean, porous, Pennsylvanian sandstones offer excellent possible reservoirs for petroleum. The Bartlesville sandstone, (Cherokee group), has already proven productive in the West Edmond Field and in the Fox and Fox No. 1 Simpson, Section 9, T. 14 N. R. 5 W.

It produces both oil and gas distillate.

A sandstone of Atokan age produced an estimated 50,000 cubic feet of gas and a rainbow of oil on a drill stem test in the Ransey No. 1 Mansfield, Section 16, T. 14 N. R. 9 W. This may prove to be another producing horizon.

The Hunton formation has been proven productive of both oil and gas in the West Edmond Field and also on the other side of the area in the Denver Producing and Refining No. 1-A, Schoolland, Section 16, T. 10 N. R. 9 W.

Likewise, the Simpson group has been proven productive in the Sinclair No. 1 Hutchemon, Section 14, T. 12 N. R. 7 W., which produces distillate from the Second Wilcox. Drill stem tests have revealed that the First Wilcox sandstone tested an estimated 2 or 3 million cubic feet of gas in the J. E. Trigg No. 1 Tennery, Section 22, T. 13 N. R. 7 W. A drill stem test in the Anderson-Prichard No. 1 Replogle, Section 18, T. 11 N. R. 5 W., yielded gas-cut mud in the Second Wilcox and also when the well was cored in the Joins (?) formation a dead oil stain was observed. Thus lower Simpson sandstones may also prove to be productive.

Thirdly, the general structure of the area as described in Chapter IV, presents ideal conditions for the trapping of oil. As is illustrated by the pre-Cherokee distribution map, (Figure IX), the wedging out of Pennsylvanian and Mississippian formations as they are traced northward out of the basin onto the shelf, creates ideal possibilities for stratigraphic traps. The faults and unconformities that are present within the area create additional places for the accumulation of petroleum.

Seismic work has revealed the presence of numerous structural traps. The large gravimetric anomaly, located west of the buried Nemaha Ridge offers a large and interesting area for future exploration.

Thus, the area contains source beds, reservoir beds that comprise at least six possible producing horizons, and the structural conditions necessary to trap the oil. With these characteristics, the area will continue to hold the attention of oil operators as a new province for future oil exploration.

CHAPTER VII

CONCLUSIONS

From the study of the subsurface geology of Canadian County and its associated area the following conclusions have been reached:

1) The Anadarko Basin was initiated as early as late Ordovician.

2) Regional structure of the thesis area is that of a large monocline, with beds dipping south and southwest.

3) The hinge line, which is an imaginary line separating the basin and shelf environments, is recognizable from T. 14 N. R. 8 W. into T. 10 N. R. 5 W.

4) Pre-Pennsylvanian formations have an average dip of 1½ degrees upon the shelf area and an average dip of 3¼ degrees in the basin. The Pennsylvanian-Permian formations have an average dip of 1 degree upon the shelf and 1¼ degree dip in the basin.

5) Southern Oklahoma terminology is most appropriate for the description of the basin facies of sediments and northern Oklahoma terminology is descriptive of the shelf facies of sediments. Formations within each group can be correlated within the area.

6) The Virgilian-Missourian-Des Moinesian limestones upon the foreland shelf area grade into the Hoxbar and Deese sandstones in the basin.

7) These sediments in the Hoxbar and Deese groups thicken basinward.

8) The greatest unconformity within the area resulted from the Dornick Hills orogeny, (post-lower Dornick Hills, pre-upper Dornick Hills). Sediments ranging in age from Morrowan (lower Dornick Hills) to Kinderhookian (Woodford) were exposed and truncated by this uplift.

9) The eastern limit of the Springeran, Morrowan, Atokan, and Chesterian formations has been shown on the pre-Cherokee distribution map, (Figure IX).

10) Pre-Pennsylvanian structures are not necessarily indicated by Permian surface structures because the early Pennsylvanian erosion surface leveled the older sediments and caused the Pennsylvanian-Permian sediments to be deposited with much less dip.

11) There are evidences of numerous faults within the area. The fault described in cross-section (Figure XI), is post-Mississippi Chesterian and pre-Des Moinesian in age. Future drilling within the area will probably locate additional faults.

12) The area contains source beds, reservoir beds, and the structural features that are favorable for the accumulation of oil.

13) The Pennsylvanian sandstones (Des Moinesian), the Hunton limestone and the Simpson group are proven producing horizons. All of these horizons offer excellent possibilities for future oil production within the area.

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