

GEOLOGY OF THE NORTHEAST WAKEFIELD AREA,
CLAY COUNTY, KANSAS

by

GLENN THOMAS BESHEARS

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INTRODUCTION

Location of the Area

The area covered in this investigation is located in southeast Clay County, Kansas (Plate I). The area is bounded on the north by Clay county highway 398. The eastern boundary is the Clay-Riley county line. Range three east is the western boundary and the southern boundary is township ten south. The area is a rectangle which is four miles from east to west and six and one-half miles north to south.

Physiography

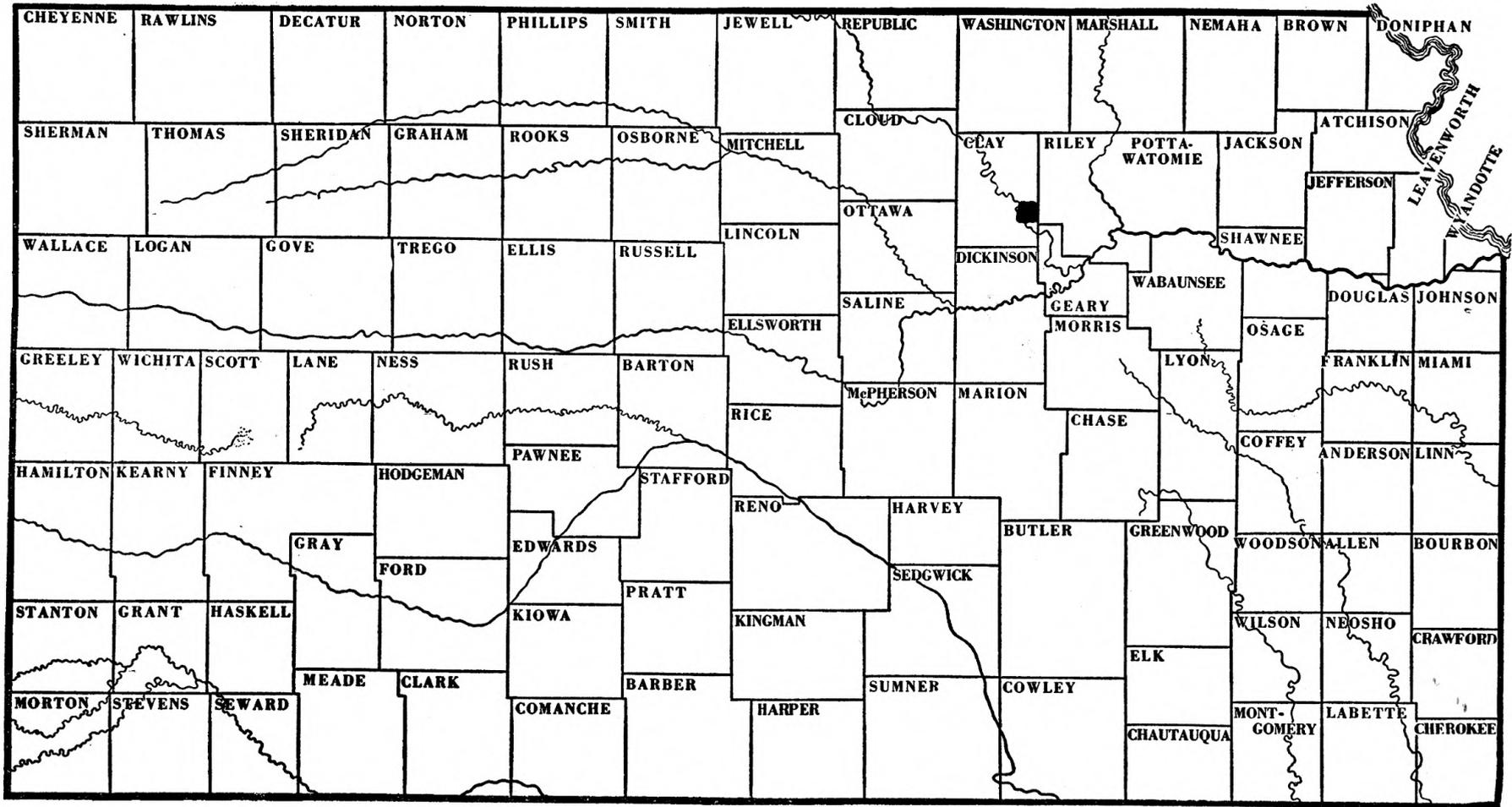
Southeast Clay county is within the extreme western margin of the Flint Hills Uplands. The Flint Hills Uplands are within the Osage Plain, which is a subdivision of the Central Lowlands physiographic province (Schowe, 1949). The Flint Hills Uplands extend in a north-south belt across the state from the Oklahoma state line in Cowley county to the Nebraska state line in Marshall county. This north-south belt effectively separates the Central Lowlands on the east from the Great Plains on the west (Frye and Leonard, 1952). The "Flint Hills" typically are made up of a series of eastward facing escarpments and dip slopes developed on resistant limestones of Permian age. Directly west of the problem area, the outcrop of the Dakota sandstone (Cretaceous) marks the beginning of the Smoky Hill Uplands. The drainage throughout the area is well developed and exhibits a dendritic pattern. The Republican River, Mall Creek, and Timber Creek drain the problem area.

The main structural feature of the area is the Abilene anticline. To the east of the Abilene anticline is the larger Nemaha anticline. Between the two

EXPLANATION OF PLATE I

Map of Kansas showing the area covered by this investigation.

PLATE I



anticlinal structures is the Irving syncline. To the west of the Abilene anticline is the Salina basin and to the south is the Voshell anticline.

Purpose of the Investigation

The Abilene anticline is described in much of Kansas geological literature as a subsurface ridge which parallels the Nemaha anticline. This structure extends from Marshall county southwesterly through Riley, Clay, and Dickinson counties in Kansas (Jewett, 1951). The northern extension of this structure into Nebraska is referred to as the Barneston anticline (Jewett, 1951). The purpose of this paper is to describe the surface expression of the Abilene anticline in the area of investigation.

MAPPING PROCEDURE

An extensive reconnaissance was made of the problem area and adjacent areas to obtain information concerning the stratigraphy and structural expression of the anticline. Formations were identified, sections measured, and descriptions taken at that time. The geologic map (Fig. 1¹) was prepared from aerial photographs and a pantographic enlargement of an unpublished geologic map of Clay county that was obtained from the Kansas State Geological Survey. The two sources of information are combined on a base map that has a scale of four inches to the mile. The stratigraphic units were mapped on the aerial photographs and then transferred to the base map by use of a vertical sketchmaster. Prior to the construction of the structure map (Fig. 2), it was necessary to establish a series of bench marks in the area which was carried out with a spirit level. The bench marks thus established were used to run

¹All Figures in the Appendix.

side traverses to obtain elevations for the construction of the structure map. The base of the Fort Riley limestone member of the Barneston limestone formation was chosen as the datum. This was done because the Fort Riley limestone is fairly well exposed throughout the problem area and is easily identified. Wherever possible the elevation of the Fort Riley limestone was taken; but where it does not outcrop, another limestone was used and the proper stratigraphic interval subtracted from the elevation to obtain the elevation of the base of the Fort Riley limestone. The points where elevations were obtained were plotted on aerial photographs and the points transferred to a base map by the use of a vertical sketchmaster. The points were contoured with a contour interval of ten feet. The geologic cross section (Fig. 3) was made with the use of a plane table and alidade. The cross section has a vertical exaggeration of 16.5.

STRATIGRAPHY

The stratigraphic units that crop out in the area of investigation are all of sedimentary origin and range in age from Permian to Quaternary (Plate II). The Wymore shale, outcropping along Timber Creek in section 27, T.9 S., R. 4 E., and along Mall Creek in section 17, T. 9 S., R. 4 E., is the oldest Paleozoic rock exposed. The valleys of the Republican River, Timber Creek, and Mall Creek contain deposits of Pleistocene terrace material and Recent alluvium.

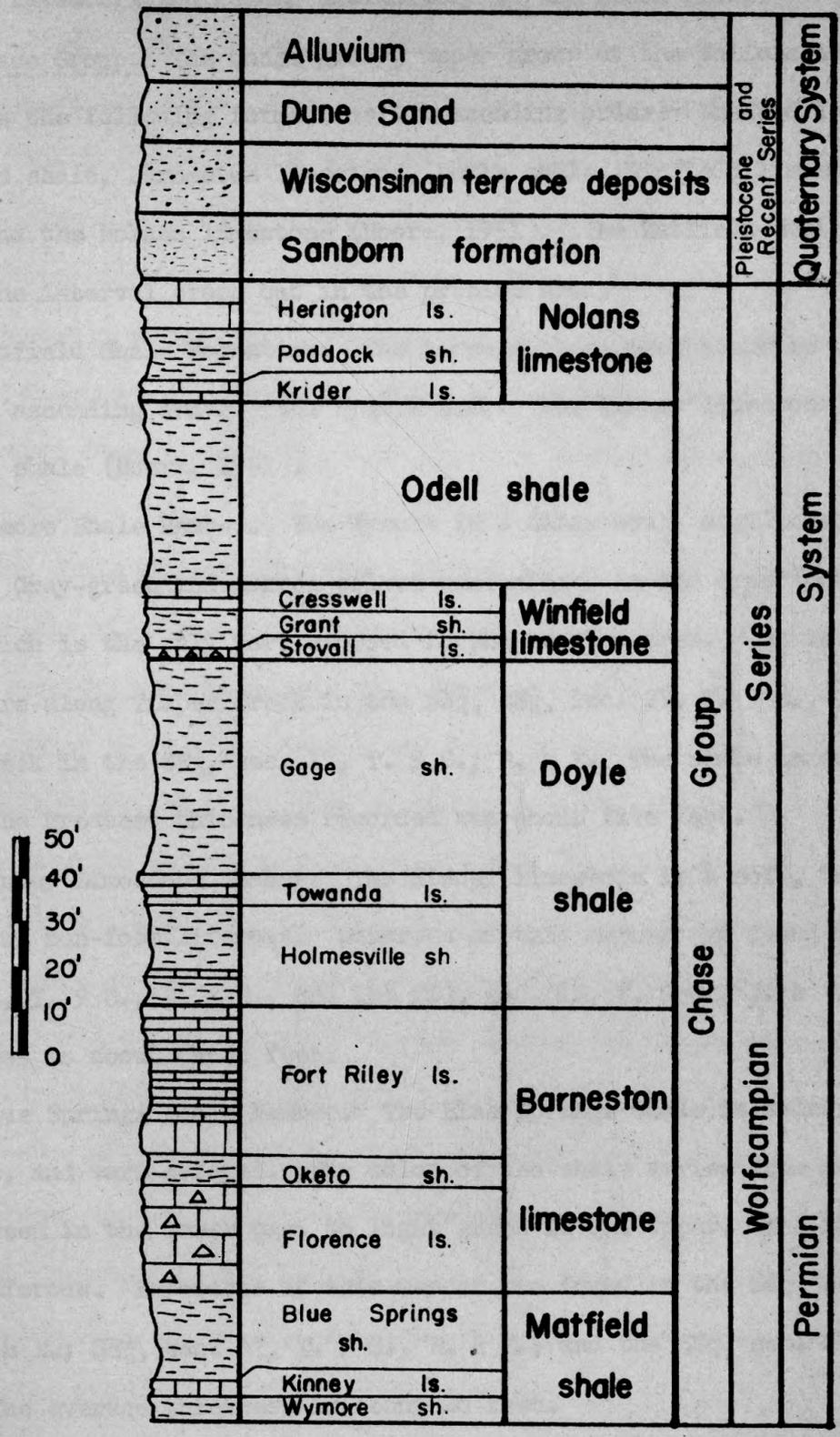
Permian System

The Permian system includes the Wolfcampian, Leonardian, and Guadalupian series, in ascending order. Only the Wolfcampian series is represented in the problem area. The Wolfcampian series contains the following groups, in

EXPLANATION OF PLATE II

Generalized stratigraphic column of the
northeast Wakefield area.

PLATE II



ascending order: Admire, Council Grove, and Chase. The Permian rocks of the area of investigation belong exclusively to the Chase group.

Chase Group. The Chase group, upper group of the Wolfcampian series, contains the following formations in ascending order: Wreford limestone, Matfield shale, Barneston limestone, Doyle shale, Winfield limestone, Odell shale and the Nolans limestone (Moore, 1951). The Matfield shale to Nolans limestone interval crops out in the problem area.

Matfield Shale Formation. The three members that comprise the formation are, in ascending order: the Wymore shale, the Kinney limestone, and the Blue Springs shale (Moore, 1951).

Wymore Shale Member. The Wymore is a calcareous, argillaceous, blocky shale. Gray-green and maroon colors predominate in the upper part of the member, which is the only part exposed in the problem area. The isolated outcrops are along Timber Creek in the SW $\frac{1}{4}$, SE $\frac{1}{4}$, sec. 27, T. 9 S., R. 4 E. along Mall Creek in the SE $\frac{1}{4}$, sec. 17, T. 9 S., R. 4 E. The shale is non-fossiliferous. The greatest thickness recorded was about five feet.

Kinney Limestone Member. The Kinney limestone is a soft, tan-gray limestone and non-fossiliferous. Outcrops of this member are found in the SW $\frac{1}{4}$, sec. 27, T. 9 S., R. 4 E., and the SE $\frac{1}{4}$, sec. 17, T. 9 S., R. 4 E. The average thickness is about three feet.

Blue Springs Shale Member. The Blue Springs shale is calcareous, argillaceous, and vari-colored. The color of the shale varies from maroon and gray-green in the lower part to light green in the upper. The shale is non-fossiliferous. Exposures of this member are found in the SE $\frac{1}{4}$, sec. 32, T. 9 S., R. 4 E.; SE $\frac{1}{4}$, sec. 17, T. 9 S., R. 4 E.; and the SE $\frac{1}{4}$, sec. 27, T. 9 S., R. 4 E. The average thickness is about 20 feet.

Barneston Limestone Formation. The Barneston limestone consists of the following members, in ascending order: Florence limestone, Oketo shale, and the Fort Riley limestone (Moore, 1951).

Florence Limestone Member. The Florence limestone is composed of massive beds of limestone containing numerous chert bands and nodules. The limestone is light gray to white in color. Fossils found in this member are: Dictyoclostus americanus, Derbyia crassa, Meekella striatocostata, Aviculopecten occidentalis, and Fenestrellina sp. Good outcrops of the Florence limestone are found along Mall Creek in sec. 17, T. 9 S., R. 4 E. and along Timber Creek in sec. 27, T. 9 S., R. 4 E. The average thickness is about 30 feet.

Oketo Shale Member. The Oketo shale is light gray to blue-gray and calcareous. Fossils found in this member are: Dictyoclostus americanus, Derbyia crassa, Meekella striatocostata, Allorisama terminale, and crinoid columnals. Good exposures of the Oketo shale are found at the Gatesville quarry in the SE $\frac{1}{4}$, SW $\frac{1}{4}$, sec. 17, T. 9 S., R. 4 E. and in the SE $\frac{1}{4}$, SW $\frac{1}{4}$, sec. 32, T. 9 S., R. 4 E. The average thickness is about six feet.

Fort Riley Limestone Member. The Fort Riley limestone is light gray to white, massive in the lower part and thin bedded in the upper. The lower massive zone forms a conspicuous "rim rock" throughout the southern part of the area of investigation. Fossils found in the Fort Riley limestone are: Dictyoclostus americanus, Derbyia crassa, brachiopod fragment, Fenestrellina sp., echinoid spines, and crinoid columnals. Good exposures of Fort Riley limestone are found in the SE $\frac{1}{4}$, SW $\frac{1}{4}$, sec. 17, T. 9 S., R. 4 E.; along Timber Creek in sec. 27, T. 9 S., R. 4 E. and in the SE $\frac{1}{4}$, SW $\frac{1}{4}$, sec. 32, T. 9 S., R. 4 E. The average thickness is about 30 feet.

Doyle Shale Formation. The three members of the Doyle shale are: the Holmesville shale, the Towanda Limestone and the Gage shale (Moore, 1951).

Holmesville Shale Member. The Holmesville shale consists of two shales and an impure limestone. The shales are calcareous, argillaceous and gray-green to maroon in color. The separating impure limestone is light gray and upon weathering becomes porous and cavernous. The Holmesville is non-fossiliferous. Exposures of this member are found in the SW $\frac{1}{4}$, SE $\frac{1}{4}$, sec. 34, T. 9 S., R. 4 E., in the NW $\frac{1}{4}$, NW $\frac{1}{4}$, sec. 9, T. 9 S., R. 4 E., and the NE $\frac{1}{4}$, sec. 34, T. 9 S., R. 4 E. The average thickness is about 18 feet.

Towanda Limestone Member. The Towanda limestone is blocky, hard, orange-brown to tan, and non-fossiliferous. The outcrop in NW $\frac{1}{4}$, sec. 34, T. 9 S., R. 4 E. shows intraformational breccia. This feature was not observed at any other outcrop. Another good outcrop is in the NW $\frac{1}{4}$, NW $\frac{1}{4}$, sec. 9, T. 9 S., R. 4 E. The average thickness is about 18 feet.

Gage Shale Member. The Gage shale is vari-colored, predominantly maroon in the lower two-thirds and light gray in the upper one-third. The upper gray zone is calcareous and highly fossiliferous. Fossils found in the upper zone are: brachiopod fragments, Dictyoclostus americanus, Derbyia crassa, and Aviculopecten occidentalis. Good exposures of the Gage shale are found in the NW $\frac{1}{4}$, NE $\frac{1}{4}$, sec. 8, T. 9 S., R. 4 E., and in the NW $\frac{1}{4}$, sec. 34, T. 9 S., R. 4 E. The average thickness is about 50 feet.

Winfield Limestone Formation. The Winfield limestone is composed of two limestones and a separating shale. The members are, in ascending order: Stovall limestone, Grant shale, and Cresswell limestone (Moore, 1951).

Stovall Limestone Member. The Stovall limestone is light gray, dense, and contains abundant chert nodules. Fossils found in the Stovall limestone are: Dictyoclostus americanus, brachiopod fragments, and crinoid columnals.

Exposures of this member are found in the NW $\frac{1}{4}$, NE $\frac{1}{4}$, sec. 8, T. 9 S., R. 4 E., and the NE $\frac{1}{4}$, sec. 34, T. 9 S., R. 4 E. The average thickness is about two feet.

Grant Shale Member. The Grant shale is light gray and calcareous. Fossils found in this shale member are: Dictyoclostus americanus, Chonetes granulifera, Composita ovata, and Aviculopecten occidentalis. Outcrops of the Grant shale are found in the NE $\frac{1}{4}$, sec. 34, T. 9 S., R. 4 E., and the NW $\frac{1}{4}$, sec. 34, T. 8 S., R. 4 E. The average thickness is about 12 feet.

Cresswell Limestone Member. The Cresswell is a light gray to tan limestone that weathers blocky in the lower part and to thin plates in the upper. The upper zone often becomes porous and cavernous when badly weathered. The lower zone is fossiliferous and contains crinoid columnals, echinoid spines and some brachiopod fragments. Outcrops of the Cresswell are found in the NW $\frac{1}{4}$, sec. 34, T. 8 S., R. 4 E. and the NE $\frac{1}{4}$, sec. 34, T. 9 S., R. 4 E. The average thickness is about 12 feet.

Odell Shale Formation. The Odell shale is vari-colored from gray-green to maroon in the lower parts and gray to green in the upper part. The shale is non-fossiliferous. Good exposures of the Odell shale are found in the SW $\frac{1}{4}$, sec. 3, T. 9 S., R. 4 E. and the NW $\frac{1}{4}$, of sec. 5, T. 9 S., R. 4 E. The average thickness is about 29 feet.

Nolans Limestone Formation. The Nolans limestone formation consists of two limestones and a separating shale. The members are, in ascending order: the Krider limestone, the Paddock shale, and the Herington limestone (Moore, 1951).

Krider Limestone Member. The Krider is a soft, light tan limestone. The Krider is composed of two thin limestones separated by a shale. Good exposures of the Krider limestone are found in the NW $\frac{1}{4}$, sec. 5, T. 9 S., R. 4 E.

and in the NW $\frac{1}{4}$, sec. 3, T. 9 S., R. 4 E. The average thickness is about three feet.

Paddock Shale Member. The Paddock shale is gray, calcareous and commonly contains numerous calcite geodes and veins. The fossil Aviculopecten occidentalis occurs on some of the bedding planes of the shale. A good exposure of the member is in the SW $\frac{1}{4}$, sec. 3, T. 9 S., R. 4 E. The thickness is about 17 feet.

Herington Limestone Member. The Herington is a soft, porous, tan limestone. The lower part of the member tends to be fossiliferous and contains abundant Aviculopecten occidentalis and Myalina sp. Good exposures of the Herington limestone are found in the SW $\frac{1}{4}$, sec. 3, T. 9 S., R. 4 E. and in the NE $\frac{1}{4}$, sec. 34, T. 8 S., R. 4 E.

Quaternary System

Pleistocene Series. Wisconsinan Terrace Deposits. Terrace deposits of Wisconsin age occupy portions of the valleys of the Republican River, Mall Creek and Timber Creek. This terrace may correlate with the Newman terrace of the Kansas River valley.¹ The thickness is undetermined.

Sanborn Formation. The Sanborn formation contains deposits from two stages of the Pleistocene. The two stages are the Illinoian and the Wisconsinan. The Sanborn contains the following members, in ascending order: the Crete gravel, the Loveland loess, the Peorian loess, and the Bignell loess (Frye and Leonard, 1952). The Sanborn occurs throughout the area of investigation as a very thin deposit on some of the divides. A large deposit was mapped in sections 7, 8, 17, and 18, T. 9 S., R. 4 E. This deposit is possibly Loveland or Peorian loess.¹

¹Personal communication, Dr. H. V. Beck.

Recent Series. Dune Sand. Dune sands are discussed as part of the Recent series because in most areas the last episode of dune formation occurred during Recent time, although the dunes may have had their major development during Wisconsin time (Frye and Leonard, 1952). An area of dune sand occurs along the eastern bank of the Republican River in sections 32 and 33, T. 9 S., R. 4 E. The dunes are now stabilized by the growth of vegetation. The thickness is undetermined.

Alluvium. Recent alluvium occurs in the valleys of the Republican River and its tributaries. The Recent alluvium of the Republican River is considered to be a minor insertion into the upper part of the late Wisconsin alluvium (Frye and Leonard, 1952). The alluvium of the present cycle of erosion consists of sand, gravel, and silt. the thickness is undetermined.

GEOLOGIC HISTORY

The discussion of the geologic history is derived from Lee (1956) and Lee et al. (1948). Lee determined the structural deformation of Kansas by the use of isopachous maps. From his work Lee developed the premise: that if a sequence of rocks is warped and folded before the later development of a second horizontal surface, the variations in the thickness of the rocks between the two surfaces will reveal the amount and place of deformation.

Paleozoic Era

The Paleozoic era was a time of deposition, erosion, and faulting in Clay county. Rocks of Cambrian to Permian are represented. Lee (1956) stated that there were three different periods of folding that affected the rocks during this era. The first period of deformation affected the rocks between the Precambrian surface and the base of the St. Peter sandstone of middle Ordovician

age. The second period of folding affected the strata between the St. Peter sandstone and the base of the Mississippian. The third and most important period of deformation started in early Mississippian and increased in intensity until early Pennsylvanian and continued with decreasing emphasis through the Permian. The last period of deformation produced the Nemaha anticline, the Salina Basin and the Abilene anticline. Periods of erosion occurred at intervals throughout the era, but the two major erosional intervals occurred during late Ordovician and late Mississippian. The erosion is revealed in the subsurface by the weathered surface of the Arbuckle limestone and the Mississippian "Chat".

Mesozoic Era

The events of the Mesozoic are not too well known in this area of the state. A period of deformation occurred after Permian time and before Cretaceous time. The deformation involved synclinal development in southwest Kansas which gave the Permian and Pennsylvanian rocks of eastern Kansas a southwesterly dip. In Clay county the Mesozoic is represented by deposits of the Dakota sandstone (Cretaceous). This formation is presently restricted to the western part of the county. The presence of outliers of the Dakota sandstone north of the problem area and in northern Riley county suggests that at one time the formation covered the whole county.

Cenozoic Era

The Cenozoic was an era of deposition and erosion. The Tertiary was a period of erosion. An undetermined thickness of Cretaceous and Permian rocks were stripped away by erosion. The Pleistocene epoch of the Quaternary commonly known as the "ice age". The first two of the four ice sheets of this

epoch extended into Kansas, but only the second, called the Kansas, penetrated as far south as the Kansas River and as far west as the Big Blue River in neighboring Riley county (Frye and Leonard, 1952). The nearness of such a body of ice no doubt had influence on the fluvial and eolian sedimentation in the problem area. Since the close of this epoch the streams have eroded their valleys and now are flanked by deposits of alluvium.

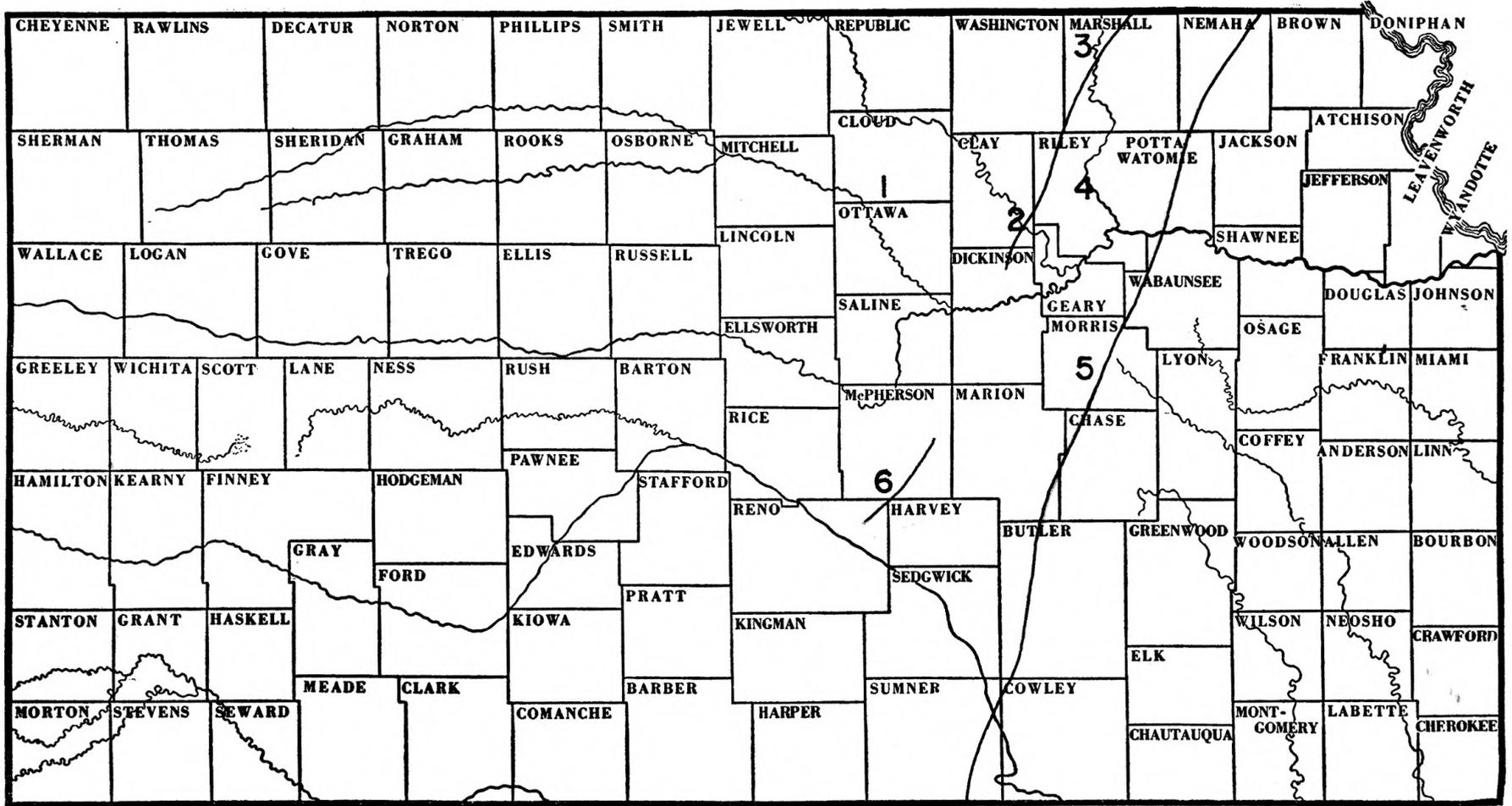
STRUCTURE

Regional Structures

Salina Basin. The Salina basin is a regional structure to the west of the problem area (Plate III). The Salina basin occupies an area in north-central Kansas between the northern end of the Nemaha anticline and the Central Kansas Uplift (Jewett, 1951). It is an area of depressed Mississippian and older rocks between two anticlinal areas. The principal structural movement was at the end of Mississippian time. Several northwest trending structures were formed in the Salina basin with strikes parallel to the Nemaha anticline during post-Mississippian deformation. These structures are the Voshell anticline, the Abilene anticline, and the Barneston anticline (Lee, 1956).

Nemaha Anticline. The Nemaha anticline is a regional structure to the east of the problem area (Plate III). It is a post-Mississippian structure that plunges to the south and extends from a point near Omaha, Nebraska, to a point south of Oklahoma City, Oklahoma. The structure is asymmetrical with the steep side to the east (Jewett, 1951). The anticlinal movement started early in Mississippian time and after initial folding the area was peneplained. At the close of peneplanation, the area west of the Nemaha anticline was raised above the area on the east by faulting (Lee, 1948). The fault has been mapped in the subsurface by Koons (1955), Kotoyantz (1956), and Nelson (1952).

PLATE III



EXPLANATION OF PLATE III

Regional and local structures.

1. Salina Basin
2. Abilene Anticline
3. Barneston Anticline
4. Irving Syncline
5. Nemaha Anticline
6. Voshell Anticline

Voshell Anticline. To the south of the problem area is the Voshell anticline (Plate III). This structure is parallel to the Nemaha anticline and approximately in line with the Abilene anticline (Jewett, 1951).

Irving Syncline. A synclinal fold west of the Nemaha anticline and east of the Abilene anticline (Plate III) has been called the Irving syncline (Jewett, 1951).

Local Structures

Abilene Anticline. The Abilene anticline was named by Barwick (1928). He described it as a fold of considerable size paralleling the larger Namaha anticline to the east. Barwick (1928) showed the Abilene anticline extending from the southern part of Marshall county to northeast Kingman county. In the light of data now available, the southward extension of the Abilene anticline as described by Barwick, is too great (Jewett, 1951). The anticline as described by Barwick probably included two separate structures. The northern structure in Marshall, Riley and Clay counties is the Abilene anticline, but the southern structure in Kingman and McPherson counties is the Voshell anticline. The Voshell anticline is approximately in line with the Abilene anticline, but the two are considered to be two independent and separate structures (Lee et al., 1948). The Abilene anticline is believed by many to be the surface expression of a fault in the Pre-Cambrian basement complex. The subsurface geology of the Abilene anticline is not well known, due to the lack of drilling activities in the area. Koons (1955), using what information was available, prepared a structural contour map of the Pre-Cambrian surface and inferred a hinge fault. This fault has 400 feet displacement upward to the west in Marshall county and disappears completely in Clay county. The overlying strata are draped over the escarpment to produce a supratenuous fold. Nelson (1952)

described the fault as a normal type with oblique slip. The strike-slip element was minor and effected a clockwise rotation of the joint pattern. Rieb (1954) described it as a rotational fault, the west side being elevated to the north and depressed to the south. He proposed the fault be named the Big Blue Fault. Neff (1949) describes the causal stresses of the Abilene and Nemaha faults and concludes that they are the result of tension resulting from the subsidence of the basins to either side of the Nemaha anticline. Merryman (1957) mapped the surface expression of the Abilene anticline in the area of Winkler, Riley County, Kansas, and found it to be of the monoclinial type. The strata to the west dip away from the crest at low angles, while on the east the dip increases to a maximum of six degrees. Mendenhall (1958) mapped the surface expression of the Abilene anticline in the area of Bala, Riley County, Kansas, and also found it to be of the monoclinial type. The westerly dip from the crest was under one degree, while the easterly dip reached a maximum of two degrees.

Surface Geology of the Abilene Anticline. The strike and dip of the surface rocks of the area of investigation is controlled chiefly by the trend of the Abilene anticline. The axis of this structure trends approximately N. 40° E. through sections 33, 34, and 27, T. 9 S., R. 4 E. The flanks dip from ten minutes to 54 minutes west of the axis to a maximum of two degrees fifty-four minutes east. This gives the structure a monoclinial appearance. The change in dip is presumed to be the result of the drape effect of the sediments over the subsurface Abilene fault scarp. Local warping is observed in the Towanda limestone member of the Doyle shale formation and the Cresswell limestone member of the Winfield limestone formation. No faults were found within the area of investigation. Thinning of the stratigraphic units over the crest of the anticline is not very noticeable, but some thinning was noted in the

Doyle shale formation. The thinning may be the result of compaction of the shale unit over the crest by the overlying sediments or it may be the result of some uplift along the axis of the anticline during the deposition of the Doyle shale.

A system of structural highs paralleling the Abilene anticline was noted on the structural contour map (Fig. 3). The same type of parallelism was mapped by Mendenhall (1958) for the Bala area. The exact relationship that these features have with the Abilene anticline is not known.

Age of Folding. Incomplete subsurface data places the age of folding of the Abilene anticline during post-Mississippian time contemporaneously with the formation of the Nemaha anticline. The time of maximum displacement took place during the post-Mississippian-pre-Pennsylvanian period of deformation (Lee, 1956). Movement along this zone of weakness presumably continued intermittently until the end of the Paleozoic era.

PETROLEUM PRODUCTION

The northeast Wakefield area has been the site of exploratory drilling for petroleum since 1923. The first producing well for Clay county was discovered in the northeast Wakefield area in 1928 (Jewett, 1954). This well was the Roth and Faurot No. 1 Bradbury well drilled in sec. 21, T. 9 S., R. 4 E. and was the discovery well of the Wakefield oil pool (Jewett, 1954). There is no record of the production from this field and it is now abandoned. A second pool, the Wakefield northeast, was discovered in 1951 with the drilling of the K. I. Turner No. 1 Tannehill well in the NW $\frac{1}{4}$, sec. 15, T. 9 S., R. 4 E. (Jewett, 1954). The pool is now abandoned and no production records are available.

A very active drilling program was started in the area in the spring of

1957. To date eleven wells have been drilled and of the eleven only four have been producers. The four producing wells are all located in sec. 3, T. 9 S., R. 4 E. At the present time, there are no production records available for these wells. The four wells are situated on one of the previous mentioned highs that parallel the Abilene anticline. This group of wells is known locally as the "Bala field".

The surface structure of the Abilene anticline suggests ideal structural conditions for the subsurface accumulation of oil. Prolific petroleum production has been obtained from the Central Kansas Uplift, forming the western boundary of the Salina basin. This suggest the Abilene anticline, forming the eastern boundary may be equally prolific, but it has been virtually unexplored. Thus, it seems possible that the future potential for petroleum production of the Abilene anticline is very good.

CONCLUSION

This surface investigation has shown that a low asymmetrical anticline crossed the southeastern corner of the problem area. This structure is considered to be the Abilene anticline. This structure is a post-Mississippian deformation feature that parallels the larger Nemaha anticline to the east. The structure strikes approximately north 40 degrees east. There is no evidence of movement during the Quaternary. The youngest rocks to be folded belong to the Chase group, Wolfcampian series of the Permian system. The dip of the exposed rocks is considered to be due to the drape effect of the sediments over the subsurface fault scarp. The exact type of fault is not precisely known but as more subsurface data becomes available a more exact determination can be made.

PHOTOGRAPH

Salina basin of north-central Kansas. Am. Assoc. Petrolog. Geol. Bull. 30, Nov. 1919-1920, 1921.

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21.8 feet shale, non-calcareous, colored; non-fossiliferous

1.0 feet limestone, dense; gray

APPENDIX

1.5 feet shale, calcareous; thin bedded; top surface buff; fossiliferous

Character: Limestone

Form: thin bedded

24.7 feet limestone, fossiliferous; thin bedded

1.0 feet limestone, thin bedded; weathered

Thin shale member

7.1 feet shale, thin bedded; fossiliferous

Thin limestone member

1.0 feet

Thin limestone member

Thin limestone member

Thin limestone member

1.0 feet

The following measured sections are from the Chase group, Wolfcampian series, Permian system, in Clay and Riley Counties, Kansas.

(1). SE $\frac{1}{4}$, NE $\frac{1}{4}$, Sec. 27, T. 9 S., R. 4 E.

Doyle shale formation

Towanda limestone member (incomplete)

4.3 feet limestone, hard, dense in part; massive, weathers blocky to platy; gray-orange to gray, weathers same; limonite stains; porous in part; non-fossiliferous.

Holmesville shale member

8.2 feet shale, non-calcareous; thin bedded; varicolored; non-fossiliferous.

1.0 feet limestone, dense; gray weathers tan to gray.

4.5 feet shale, calcareous; thin bedded and platy; tan weathers buff; non-fossiliferous.

Barneston limestone formation

Fort Riley limestone member

23.7 feet limestone, finely crystalline, dense; platy to blocky; tan to gray; partly covered.

7 feet limestone, dense; massive; "rim rock"; gray, weathers light gray; fossiliferous.

Oketo shale member

7.1 feet shale, calcareous; thin bedded to platy; fossiliferous.

Florence limestone member

1.0 feet limestone, cherty; massive.

(2). SW $\frac{1}{4}$, NE $\frac{1}{4}$, Sec. 27, T. 9 S., R. 4 E.

Barneston limestone formation

Florence limestone member (incomplete)

10 feet limestone, dense; massive; numerous nodules of chert; fossiliferous; upper portion of section covered.

(2). continued

Matfield shale formation

Blue Springs shale member

20 feet shale, calcareous; thin bedded; varicolored; non-fossiliferous.

Kinney limestone member

1.2 feet limestone, finely crystalline; gray to light gray; non-fossiliferous.

2 feet limestone, argillaceous; tan to buff; non-fossiliferous.

Wymore shale member (incomplete)

5 feet shale, calcareous; thin bedded; varicolored; non-fossiliferous.

(3). SW $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 3, T. 9 S., R. 4 E.

Nolans limestone formation

Herington limestone member (incomplete)

1.5 feet limestone, argillaceous; orange-gray to gray; fossiliferous.

Paddock shale member

14 feet shale, calcareous; gray-green to tan; numerous calcite geodes and stringers; thin bedded.

Kridler limestone member

0.5 feet limestone, soft; light tan to light gray; non-fossiliferous.

2 feet shale, calcareous; light tan to gray; non-fossiliferous.

1.2 feet limestone, dense; blocky; light gray to tan; non-fossiliferous.

- (4). NW $\frac{1}{4}$, NE $\frac{1}{4}$, Sec. 17, T. 9 S., R. 4 E.

Winfield limestone formation

Cresswell limestone member

13 feet

limestone, soft, marly to shaly in the upper two-thirds with numerous calcite geodes, thin bedded and platy; dense crystalline limestone in lower part; lower part is massive, weathers blocky; gray to buff, weathers light buff; non-fossiliferous throughout.

- (5). SE $\frac{1}{4}$, NE $\frac{1}{4}$, Sec. 11, T. 9 S., R. 4 E.

Doyle shale formation

Towanda limestone member

8 feet

limestone, hard; gray-orange; massive, weathers platy to blocky; limonite stain abundant; non-fossiliferous.

3 feet

limestone, hard, dense in part; massive, weathers vuggy; non-fossiliferous.

2 feet

limestone, arenaceous; weathers blocky; yellow tan to buff; non-fossiliferous.

- (6). NE $\frac{1}{4}$, SE $\frac{1}{4}$, Sec. 35, T. 9 S., R. 4 E.

Winfield limestone formation

Cresswell limestone member (incomplete)

2.5 feet

limestone, finely crystalline; massive, weathers blocky; gray to tan; fossiliferous.

Grant shale member

10.1 feet

shale, calcareous; platy to blocky; gray; weather buff; fossiliferous.

Stovall limestone member

2.2 feet

limestone, hard, dense; numerous chert nodules; massive, weathers blocky; gray, weathers buff; fossiliferous.

(7). NW $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 31, T. 8 S., R. 4 E.

Winfield limestone formation

Cresswell limestone member

11.9 feet

limestone, soft; light tan to buff; numerous calcite geodes and veins; badly fractured; non-fossiliferous.

Grant shale member (incomplete)

3.5 feet

shale, calcareous; tan to light gray; non-fossiliferous.

(8). NE $\frac{1}{4}$, NW $\frac{1}{4}$, Sec. 36, T. 8 S., R. 3 E.

Nolans limestone formation

Herington limestone member (incomplete)

3.7 feet

limestone, arenaceous; orange-gray to light gray; fossiliferous.

Paddock shale member

13.4 feet

shale, argillaceous; light gray to tan, weathers tan; thin bedded; non-fossiliferous.

Krider limestone member

1.2 feet

limestone, finely crystalline; tan to light gray, weathers tan to buff; non-fossiliferous.

Odell shale formation

28 feet

shale, calcareous, impure limestone ledges; maroon; non-fossiliferous.

5.7 feet

shale, calcareous; light gray to gray-green.

Winfield limestone formation

Cresswell limestone member (incomplete)

(9). SW $\frac{1}{4}$, NW $\frac{1}{4}$, Sec. 5, T. 9 S., R. 4 E.

Nolans limestone formation

Herington limestone member (incomplete)

1.5 feet limestone, argillaceous; light gray to tan; blocky.

Paddock shale member

17.1 feet shale, calcareous; light gray to gray-green; numerous geodes, calcite veins and boxwork; non-fossiliferous.

Krider limestone member

1.4 feet limestone, finely crystalline; tan to light gray.

Odell shale formation

29 feet covered.

Winfield limestone formation

Cresswell limestone member

10.7 feet limestone, soft; light tan to gray; numerous calcite geodes and veins; vuggy; non-fossiliferous.

(10). SE $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 17, T. 9 S., R. 4 E.

Barneston limestone formation (incomplete)

Fort Riley limestone member (incomplete)

12 feet limestone, dense; massive; light tan to buff; fossiliferous.

Oketo shale member

6 feet shale, calcareous; blocky to thin bedded; blue-gray to light gray; fossiliferous.

Florence limestone member (incomplete)

4 feet limestone, dense; numerous nodules of chert; light tan to light gray; fossiliferous.

(11). SW $\frac{1}{4}$, NW $\frac{1}{4}$, Sec. 31, T. 9 S., R. 4 E.

Barneston limestone formation (incomplete)

Florence limestone member

30 feet limestone, dense; light gray to tan; abundant nodules and bands of chert; fossiliferous.

Matfield shale formation

Blue Springs shale member (incomplete)

5.7 feet shale, calcareous; light gray to gray; non-fossiliferous.

(12). SW $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 34, T. 9 S., R. 4 E.

Winfield limestone formation

Cresswell limestone member (incomplete)

2 feet limestone, soft; blocky; light tan to gray; non-fossiliferous.

Grant shale member

10.4 feet shale, calcareous; tan to light gray; thin bedded; non-fossiliferous.

Stovall limestone member

1.3 feet limestone, dense; light gray to tan, numerous chert nodules; fossiliferous.

WELLS DRILLED IN THE NORTHEAST WAKEFIELD AREA

Name of Well	Location	Year Completed	Depth
*K.I. Turner no. 1 Hower	NE SE SW 10-9-4E	1952	1935'
*K.I. Turner no. 2 Tannehill	Cen. E $\frac{1}{2}$ NW 15-9-4E	1952	1934'
*K.I. Turner no. 1 Tannehill	Cen. NW 15-9-4E	1952	1922'
*El Capitan Oil Co. no. 1 Hill	NW NW SW 15-9-4E	1950	2650'
*Perly Oil Co. no. 1 McNeil	SW NW 15-9-4E	1929	2156'
*Skow Bros. Ritchey & Wentworth. no. 1 Gates	SE SE SW 15-9-4E	1929	2662'
*J.F. Boggess no. 1 Bradbury	NE NE 20-9-4E	1924	1855'
*Roth Faurot no. 1 Bradbury	SE SE NW 21-9-4E	1928	1777'
*Veeder Supply Co. no. 1 Glace	CNL 21-9-4E	1946	1850'
*J.F. Boggess no. 1 Younkin	SW SW SE 21-9-4E	1923	2792'
*Siedl Bros. no. 1 Younkin	SE NW 21-9-4E	1935	1778'
*Henderson, Holden & Snow Bros. no. 2 Younkman	NW SE 21-9-4E	1925	1952'
*Mendenhall Drlg. Co. no. 1 Glace	Cen. NE 21-9-4E	1950	1824'
*K.I. Turner no. 1 Glace	NE SW NE 21-9-4E	1951	?
*K.I. Turner no. 2 Glace	SE NE NW 21-9-4E	1952	1801'

Name of Well	Location	Year Completed	Depth
*Mahoney & Fehr no. 1 Wiese	NW SE NW 27-9-4E	1952	1920'
*Nelson Synd. no. 1 Peter Yarrow	SW SW 29-9-4E	?	2443'
*J.F. Boggess no. 1 Fleming	SE NE NE 32-9-4E	?	1890'
Pure Oil Co.	SW SW NW 34-9-4E	1957	?
" " "	SW NE 10-9-4E	1957	?
" " "	SW NE 33-8-4E	1957	?
" " "	NW SE 34-8-4E	1957	?
" " "	NE NW 3-9-4E	1957	?
" " "	NE SW 3-9-4E	1957	?
" " "	NE SE 3-9-4E	1957	?
" " "	SE SE 3-9-4E	1957	?
" " "	SW NE 10-9-4E	1957	?
" " "	NE SE 31-8-4E	1957	?
" " "	NW NW 8-9-4E	1957	?

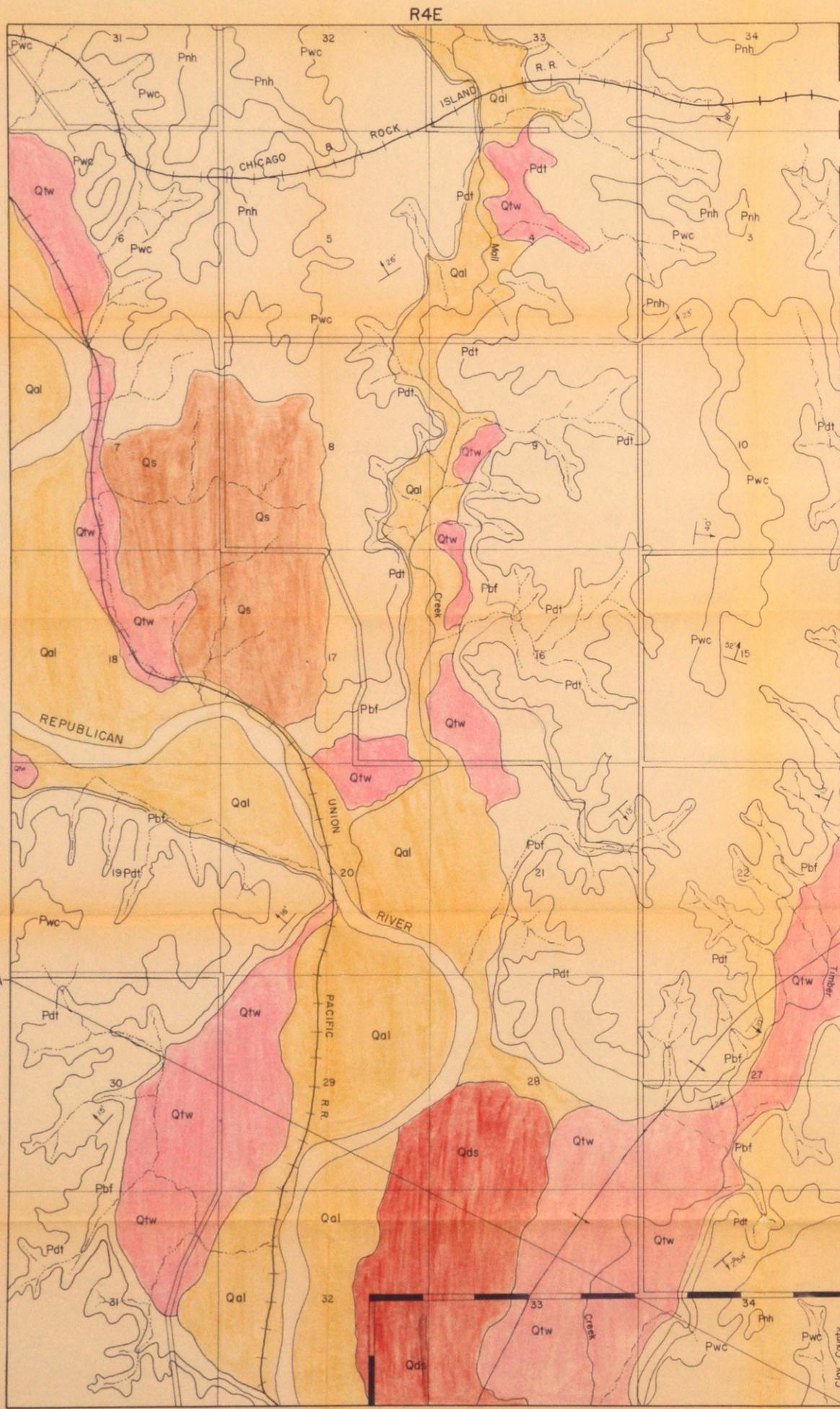
* (Jewett, 1954)

Fig. 1. Geologic Map of the Northeast Wakefield
Area, Clay County, Kansas

6 1/2 x 9 1/2

PEERLESS
CLASP
FEDERAL ENVELOPE CO.

Geologic Map of the Northeast Wakefield Area, Clay County, Kansas

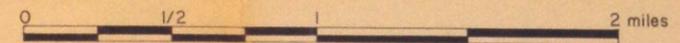


EXPLANATION

Qal	Alluvium	Quaternary System
Qds	Dune Sand	
Qtw	Wisconsinan terrace deposits	
Qs	Sanborn formation	
Pnh	Herrington ls Paddock sh Krider ls	Permian
	Nolans limestone	
	Odell shale	Wolfcampian Series
Pwc	Cresswell ls Grant sh Stovall ls	
	Winfield limestone	Chase Group
	Gage sh	
Pdt	Towanda ls	Permian
	Doyle shale	
	Holmesville sh	Permian
Pbf	Fort Riley ls	
	Barneston limestone	Permian
	Oketo sh	
	Florence ls	Permian
	Matfield shale	
	Blue Springs sh	Permian
	Kinney ls	
	Wynona sh	Permian

(Quaternary System not to scale)

County Line	---
Section Line	—
Bituminous Surfaced Road	▬
Gravel Surfaced Road	▬▬
Railroad	—+—+—+—
Permanent Stream	~~~~~
Intermittent Stream	- - - - -
Strike and Dip	↘ 10°
Contact Line	~
Cross Section	A — A'
Anticlinal Axis	↑



Scale
Four inches equal one mile

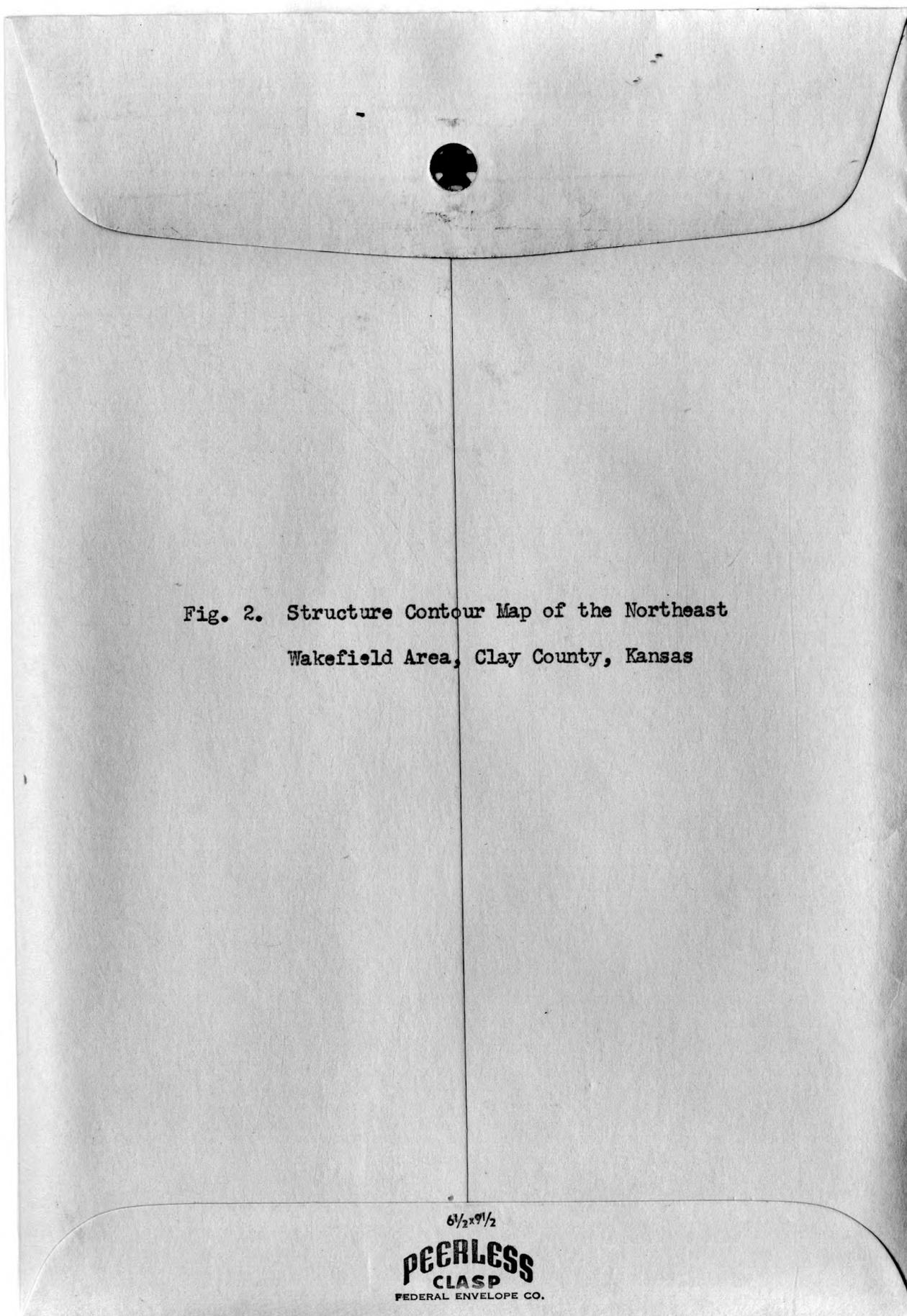
The image shows a large, light-colored envelope with a flap at the top and a circular hole near the center of the flap. A vertical line runs down the center of the envelope, dividing it into two halves. The text is printed in the center of the envelope.

Fig. 2. Structure Contour Map of the Northeast
Wakefield Area, Clay County, Kansas

6 1/2 x 9 1/2

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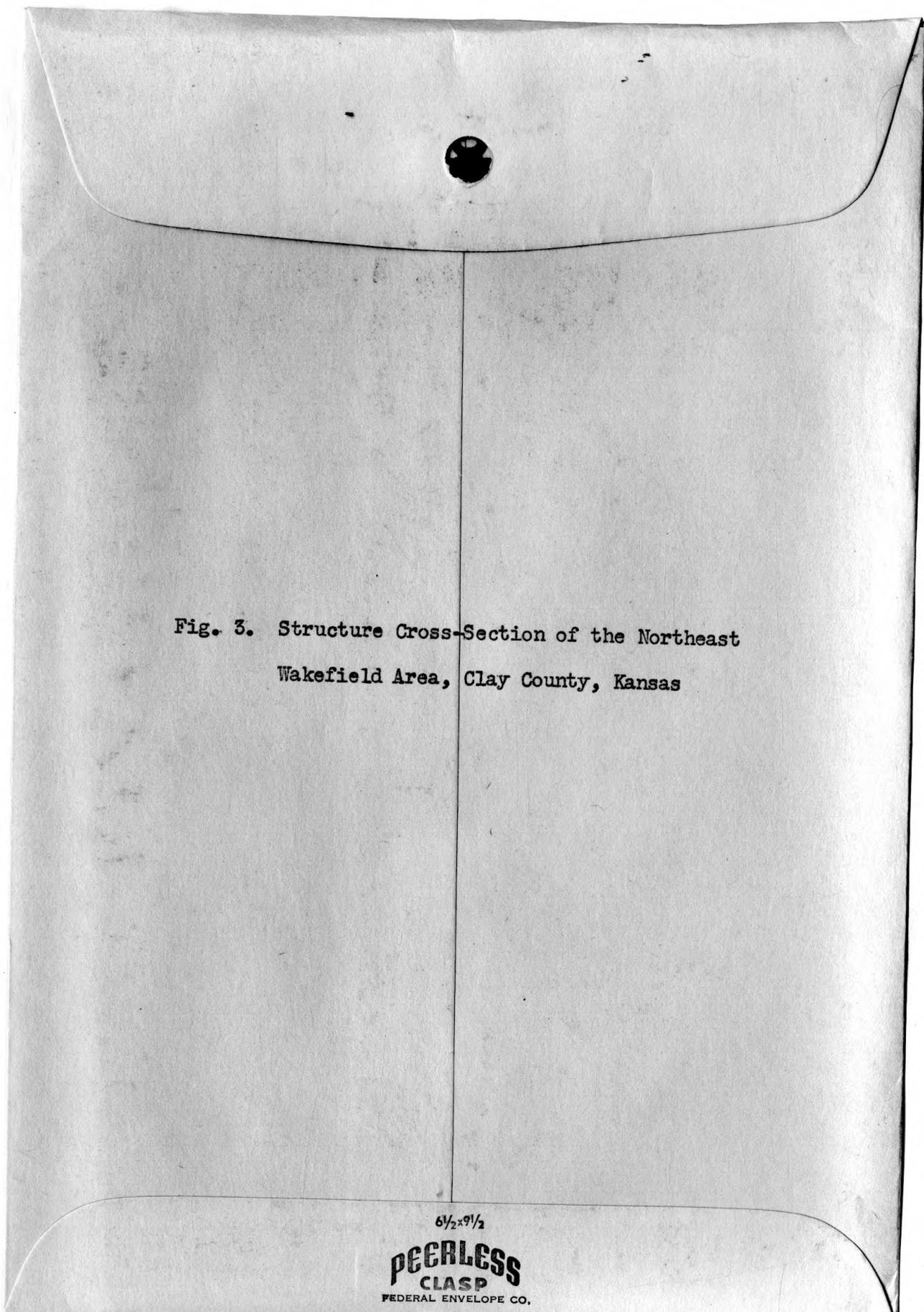
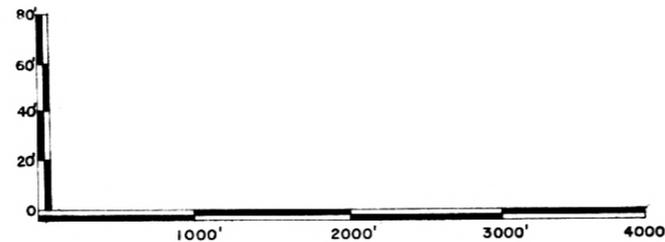
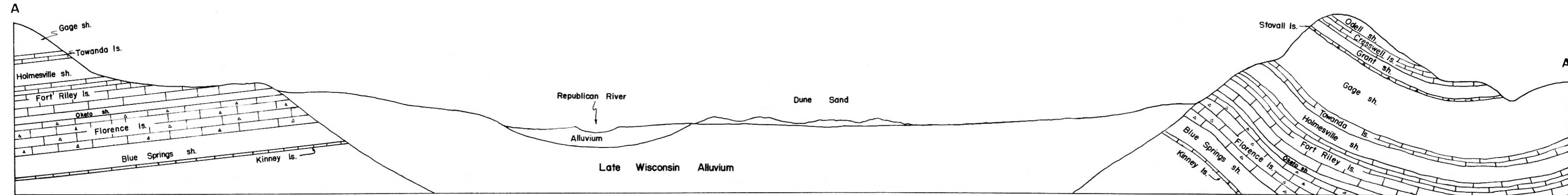


Fig. 3. Structure Cross-Section of the Northeast
Wakefield Area, Clay County, Kansas

6 1/2 x 9 1/2
PEERLESS
CLASP
FEDERAL ENVELOPE CO.

Structure Cross Section

Northeast Wakefield Area, Clay County, Kansas



Vertical Exaggeration 16.5

GEOLOGY OF THE NORTHEAST WAKEFIELD AREA,
CLAY COUNTY, KANSAS

by

Glenn Thomas Beshears

B. S. Kansas State College
of Agriculture and Applied Science, 1957

AN ABSTRACT OF A THESIS

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requirements for the degree

MASTER OF SCIENCE

Department of Geology and Geography

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OF AGRICULTURE AND APPLIED SCIENCE

1958

This investigation covers a 26 square mile area northeast of the small community of Wakefield, Clay County, Kansas. The crest of an anticlinal structure crosses the southeast corner of the area. This structure is thought to be the surface expression of the subsurface Abilene anticline.

The Abilene anticline has been described in Kansas geological literature as a subsurface ridge that parallels the larger Nemaha anticline to the east. The Abilene anticline trends northeasterly through the counties of Dickinson, Clay, Riley and Marshall. The surface and subsurface geology of the Abilene anticline has been briefly described by several geologists, but the subsurface geology is not well known due to lack of drilling activity in the area. The purpose of this investigation is to describe and map the surface expression of the Abilene anticline in the area of investigation. An area was selected along the believed crest of the anticline and sections measured, formations identified and structure elevations obtained with the use of a plane table and alidade. An asymmetrical anticline, with low westerly dips and steeper dips to the east, trending north 40 degrees east was established.

The outcropping rocks in the area are all sedimentary in origin. The stratigraphic units measured belong to the Chase group, Wolfcampian series of the Permian system. The valleys of the Republican River, Mall Creek, and Timber Creek contain deposits of Pleistocene terrace material and recent alluvium.

The folding of the Abilene anticline originated in post-Mississippian time contemporaneously with the formation of the larger Nemaha anticline. The movement continued intermittently along the fault zone until the end of the Paleozoic era. There is no visible indication of movement later than the Paleozoic.

The change in dip within the outcropping Permian strata is considered to be the result of a draping of the rocks over the fault scarp and periodic movement along the zone of weakness. The thinning of the Doyle shale over the crest may be the result of compaction.