LOCAL DEPOSITIONAL TRENDS OF "CHEROKEE" SANDSTONES, PAYNE COUNTY, OKLAHOMA

By

RAYMOND DALE SHIPLEY

Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

1972

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
May, 1975

LOCAL DEPOSITIONAL TRENDS OF

"CHEROKEE" SANDSTONES,

PAYNE COUNTY, OKLAHOMA

Thesis Approved:

John W. Shelton
Thesis Adviser

Gary F. Stewart

John Trammell

D. D. Durham
Dean of the Graduate College

PREFACE

This thesis is primarily a study of the trends and geometry of sandstones in the Middle Pennsylvanian "Cherokee" Group. These sandstones, known in descending order as the Prue, Upper Skinner, Lower Skinner, Red Fork, and Bartlesville, were examined by use of a structural contour map, correlation sections, isopach maps of net sandstone, and log maps prepared for this study.

The writer is grateful to the many individuals who assisted in this study. Dr. John W. Shelton suggested the problem and provided assistance both in the preparation of the maps and during the writing of the paper. Advisory committee members, Dr. Gary F. Stewart, and Prof. John W. Trammell made helpful suggestions, comments, and criticisms of the study. Subsurface data were made available by Mr. Guy D. Rising of Thomas N. Berry and Company and the Oklahoma City Geological Society Well Log Library. Mr. Gary W. Hart generously provided the use of his drafting facilities during the writer's visits to Oklahoma City. Appreciation is extended to Mr. Darrell Haston for drafting and to Mrs. Frank Roberts for final typing of the manuscript. Many enlightening ideas were gained through discussions with fellow graduate students, especially Art Astarita, C. C. Candler, Khalid Ngah, and Todd Wilson. Very grateful thanks are extended to Mr. Thomas E. Berry, who provided both encouragement and support. Finally, this thesis could never have been completed without the understanding, patience, sacrifices, and dedication of the writer's parents and, most importantly, his wife, Carol.

TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER I

ABSTRACT

The Middle Pennsylvanian (Desmoinesian) "Cherokee" Group consists of cyclothemic sequences which represent transgressive-regressive couplets. Regressions, which interrupted an overall transgression of the Cherokee sea, are marked by the presence of five lenticular sandstone units in the study area. In descending order, these sandstones are known to the practitioner as the Prue, Upper Skinner, Lower Skinner, Red Fork, and Bartlesville. The geometry of each of the "Cherokee" sandstones was determined from subsurface data which served as the basis for estimation of depositional environments and interpretation of sandstone trends.

Each of the sandstones in the area is thought to be representative of deltaic environments, and the sandstone bodies are classified as major and minor distributary channel deposits and delta-fringe deposits. The latter includes a variety of sandstone bodies such as distributary-mouth bars and offshore bars. The Bartlesville and Prue sandstones have dominant northeasterly trends, whereas, trends for the Red Fork, Lower Skinner, and Upper Skinner are north-south. Stacking of genetic units in some of these sandstones resulted in a complicated geometry associated with multistoried and multilateral units.

Local structural trends are a reflection of basement-fault configuration at depth and possibly differential compaction, although the

latter has not been clearly demonstrated. Rocks of the "Cherokee" Group are the oldest Pennsylvanian units in the area and unconformably overlie a Mississippian surface which was extensively eroded during Late Mississippian and Early Pennsylvanian time. Paleotopography influenced the distribution of lower "Cherokee" sediments, particularly the trend of the Bartlesville Sandstone in the eastern part of the area. Paleostructural control, characterized by differential compaction, structural movement, or a combination of both influenced the distribution of upper "Cherokee" sediments.

Log maps are thought to improve the accuracy of determining sandstone trends and estimating sandstone edges. They represent a more useful exploration tool for delineating subtle sandstone trends than conventional isopach maps.

CHAPTER II

INTRODUCTION

The Middle Pennsylvanian "Cherokee" Group, in north-central Oklahoma, is composed of cyclothemic sequences which include five lenticular sandstones. In descending order these sandstones are known to the practitioner as the Prue, Upper Skinner, Lower Skinner, Red Fork, and Bartlesville. The rectangular area of this subsurface investigation (T18N - T19N, R1W - R2E) encompasses approximately 216 square miles in the western part of Payne County and a small portion of northeastern Logan County (Fig. 1).

Although the "Cherokee" Group is an informal designation for the Krebs and Cabaniss Groups (Oakes, 1953), this study follows Jordan (1957) in regarding the "Cherokee" as the strata between the base of the Oswego Limestone and the base of the Desmoinesian Series. In north-central Oklahoma a prominent unconformity is at the base of the Desmoinesian Series, which corresponds to the top of the "Mississippi" Limestone, except on prominent structural features where the limestone is absent.

The stratigraphic positions of the five "Cherokee" sandstones, thin, persistent limestones, and one coal are illustrated on the type log (Fig. 2). These thin units, considered in this thesis as stratigraphic markers, are known informally, in descending order, as Verdigris Limestone, Henryetta Coal, Pink Limestone, Inola Limestone, and Brown Limestone.

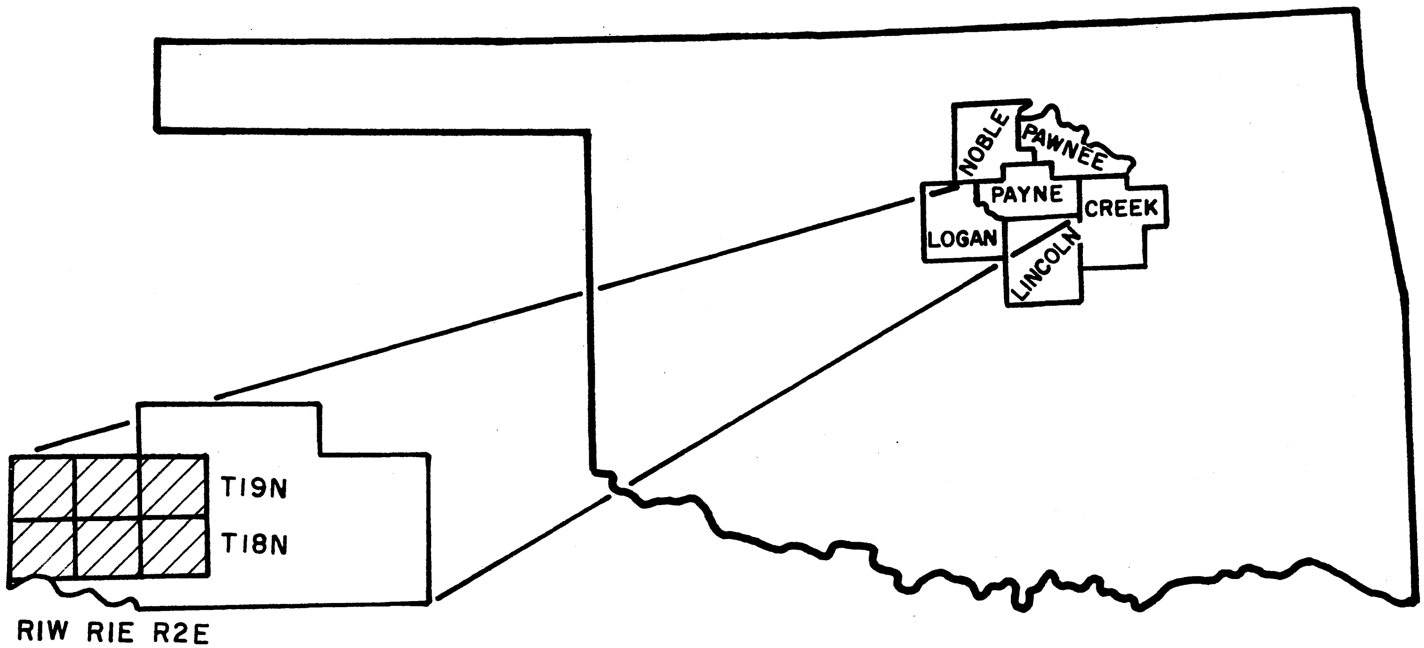


Fig. 1.-Location map of area of study.

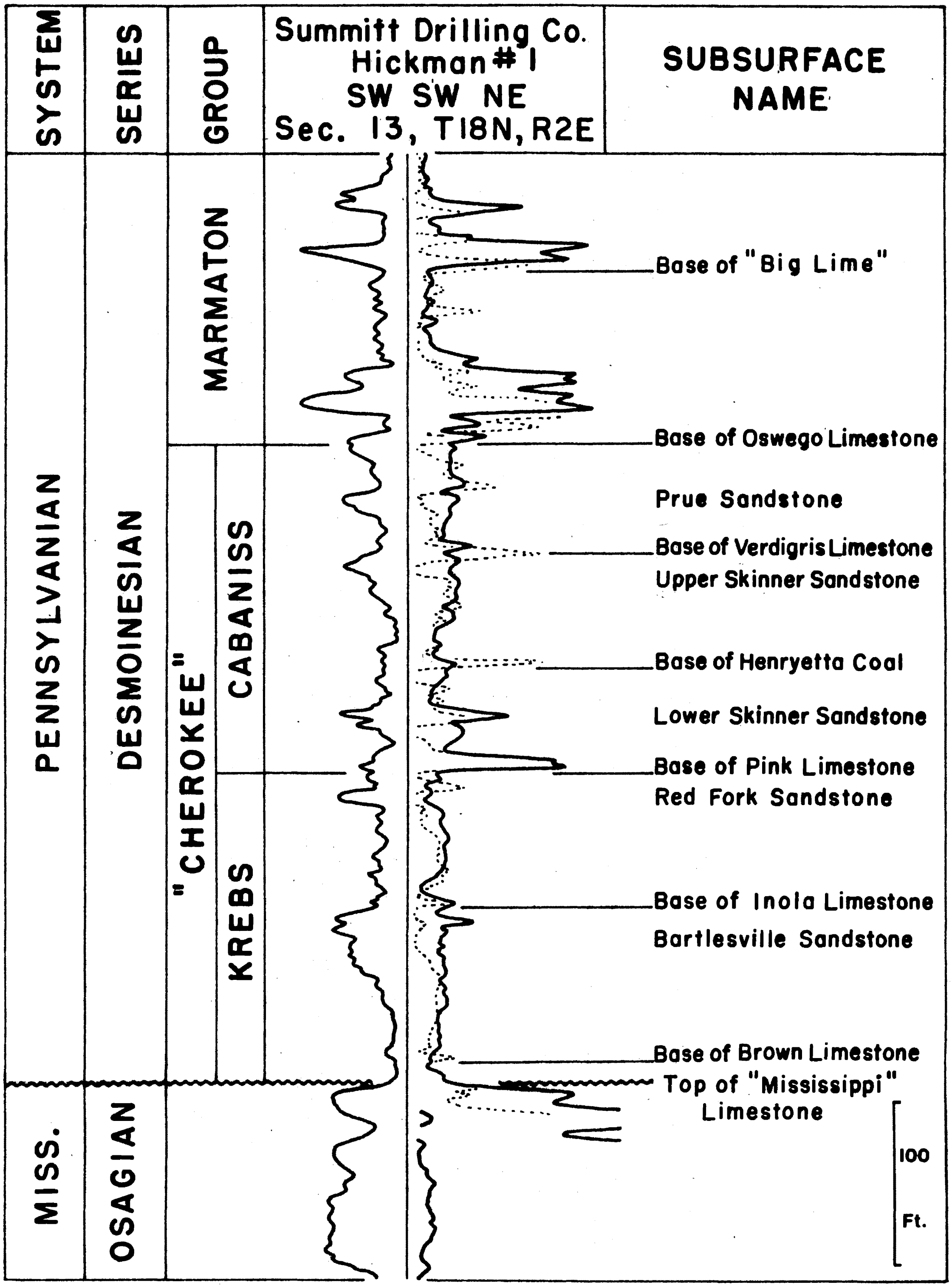


Fig. 2.-Type electric log.

Objectives

The objectives of this research are: (1) to determine the trend and geometry of sandstones in the study area, (2) to determine relationships between sandstone distribution and possible paleotopographic or paleostructural influences, (3) to estimate environments of sandstone deposition, and (4) to compare certain techniques for mapping sandstones.

Methods

Data for the preparation of maps and correlation sections were obtained from 425 electric well logs. More than 110 electric logs were used in the preparation of seven correlation sections for establishment of grid correlation and for illustrating the stratigraphic-sedimentologic relationships of sandstones.

A structural contour map, with the base of the Oswego Limestone as the reference surface, was prepared to illustrate the present structural attitude of the "Cherokee" Group. Two isopach maps were constructed to determine possible paleotopographic and/or paleostructural control of sediment distribution.

Isopach maps of net sandstone were prepared for each of the five sandstones. Net sandstone is herein defined as that portion of the SP curve on the electric log with a minimal deflection of 20 millivolts from the shale base line. For comparison in determining sandstone geometry, log maps were also prepared for each of the five sandstones.

Previous Investigations

The "Cherokee" Group has been the subject of many investigations since 1894, when Haworth and Kirk named the type area in Cherokee County, Kansas (Clayton, 1965). Oakes (1953) divided the "Cherokee" Group on outcrop into the Krebs and overlying Cabaniss Groups. The division was made at the base of the Tiawah Limestone, the surface equivalent of the Pink Limestone, which is a prominent, persistent surface in north-central Oklahoma. Although it is recognized that the term "Cherokee" is not now regarded as a formal geological unit, it is used in this thesis because of its widespread usage and acceptance by subsurface workers.

The earliest publication of a comprehensive subsurface investigation of the study area is that by Stringer (1957), who gave a general description of the "Cherokee" Group. Clayton (1965) and Hawisa (1965) dealt exclusively with the "Cherokee" Group and the depositional environments of sandstones within portions of the thesis area. Studies of the subsurface geology of nearby areas include those by Akmal (1953), Graves (1955), Page (1955), Bowman (1956), Sartin (1958), Dalton (1960), and McElroy (1961). Frost (1940) and Umpleby (1956) examined the Ramsey oil field in some detail. Berg (1969) and Cole (1969), in companion studies, made regional investigations of the Marmaton and "Cherokee" Groups on the west and east sides of the Nemaha ridge, respectively, in northern Oklahoma. The Marmaton Group, Desmoinesian in age, overlies the "Cherokee" Group and encompasses strata between the top of the "Big Lime" and the base of the Oswego Limestone (Clayton, 1965). The "Cherokee" Group in northern Noble County was studied by Scott (1970).

The origin of the Bartlesville Sandstone has been of interest since the classical studies of Bass (1934) and Leatherock (1937). The Skinner and Red Fork Sandstones in portions of Noble and Kay Counties were studied in some detail by Clements (1961).

CHAPTER III

STRUCTURAL FRAMEWORK

Structurally, the area of investigation is part of the Northeastern Oklahoma platform, which is north of the Arkoma basin and east of the Nemaha ridge.

A structural contour map was constructed with the base of the Oswego Limestone as the reference surface (Fig. 3). Regional strike is generally north-northwest, and the average dip is west-southwest at approximately 50 feet per mile. The steepest dips are associated with the prominent nose in the north half of T19N, R1W, and the nose in the eastern part of T18N, R1E.

The surface of the base of the Oswego Limestone is generally undulating, represented by gentle noses and saddles. The dominant feature, however, is the west-northwest-plunging nose which extends from the vicinity of the Orlando field in the northwest corner of the study area to the Stillwater area in T19N, R2E. Another significant structural feature is the dome-like nose, with a west-southwest plunge, associated with the Ramsey field in Sec. 13, T18N, R1E, and Sec. 18, T18N, R2E.

With the contour interval of 25 feet, structures with closure are present in Secs. 20 and 21, T18N, R1E; Sec. 20, T19N, R2E; and Secs. 30-32, T19N, R2E. A small, closed depression is present in Sec. 25, T18N, R1E.

The only fault mapped at the position of the reference surface is located in Sec. 17, T19N, R2E. It is associated with the prominent west-northwest-plunging nose which extends across much of the northern half of the map. Displacement is about 20 feet along this fault, which is thought to be normal.

The previously mentioned west-northwest-plunging nose in the northern part of the study area is thought to be associated with a west-northwest-trending basement fault mapped by Lyons (1950). The trend of the basement fault is expressed in pre-Pennsylvanian beds by a fault bounding Orlando field on the north (Stringer, 1957). A north-northeast-trending basement fault is shown by Lyons (1950) to be associated with the east side of the Ramsey structure. The fault is possibly reflected also at the position of the reference surface by (1) the closed depression in Sec. 25, T18N, R1E, (2) the closure located in Secs. 30-32, T19N, R2E, and (3) the small closure in Sec. 20, T19N, R2E, associated with the nose across West Stillwater field.

The southwest-plunging nose across Stillwater field (Secs. 22-27, T19N, R2E) is parallel to the west-southwest-plunging nose extending from the northeast part of T18N, R2E to Ramsey field. These two noses may represent an en echelon arrangement of noses which may, in turn, reflect some en echelon fault configuration at depth.

Most fault movement within the study area was probably before deposition of the Oswego Limestone; however, Umpleby (1956) contends that some post-Oswego movement has occurred along the north-northeast-trending fault adjacent to the Ramsey structure. It is thought that post-Oswego tectonic movement was restricted primarily to gentle drape folding over the older, deep-seated faults.

Regionally, the structure expresses dip away from the Ozark uplift to the northeast. Trends of local structures reflect the configuration of the basement faults. Structures due to differential compaction undoubtedly exist, but specific examples are not clearly demonstrated.

CHAPTER IV

STRATIGRAPHIC FRAMEWORK

Regionally, the "Cherokee" Group is represented as an overall transgression marked by extensive regressions (Visher et al., 1971). Within the Arkoma basin and on the eastern part of the Northeastern Oklahoma platform, Pennsylvanian rocks rest comformably upon Mississippian rocks. However, on a considerable part of the platform, rocks of Desmoinesian age lie unconformably upon progressively older, truncated Mississippian strata (Visher, 1968).

Regional investigations of the "Cherokee" and Marmaton groups by Berg (1969) and Cole (1969) have shown the thickness of "Cherokee" strata to increase both southwestward and southeastward away from the Nemaha ridge. Berg used the base of the Pennsylvanian as the basal marker in his study west of the Nemaha ridge. Strata below the Brown Limestone were mapped as a single unit. The unconformity at the base of the Desmoinesian Series was recognized throughout Cole's area of study east of the Nemaha ridge. He divided strata below the Brown Limestone; the oldest "Cherokee" unit recognizable in his study area is the Gilcrease Sandstone.

Correlation

Seven correlation sections were prepared to establish grid correlation and illustrate the stratigraphic-sedimentologic relationships of sandstones. The base of the Oswego Limestone was chosen as a datum for each section because of its consistent appearance on electric logs and its position at the top of the interval of study. The locations of four north-south and three west-east sections are shown by the index map of correlation sections (Fig. 4).

Within the area of this study rocks of the "Cherokee" Group lie unconformably upon Mississippian carbonates of Osagian age, except where these carbonates are absent locally. The oldest correlatable "Cherokee" unit is the Brown Limestone, which, because of onlap is generally present only in the northeastern and eastern parts of the area.

The thin limestones and the Henryetta Coal are easily recognizable units which provide the basis for subdivision of the "Cherokee" Group. The base of each is considered to represent the initiation of a transgression, and each sandstone is the regressive part of a transgressive-regressive couplet. The base of the Pink Limestone has been selected as the reference surface for dividing the "Cherokee" into two units.

Correlation Sections

Thicknesses. On the correlation sections, thickness of the "Cherokee" interval is relatively uniform on each north-south section (Figs. 5-8), but it increases in an eastward direction on the west-east sections (Figs. 9-11). Thickness varies from approximately 200 feet in the northwestern part of the area to greater than 500 feet in the northeastern part.

Greatest changes in thickness are in the interval between the unconformity at the base of the "Cherokee" and the base of the Pink Limestone. Markers between the base of the Pink Limestone and the base of

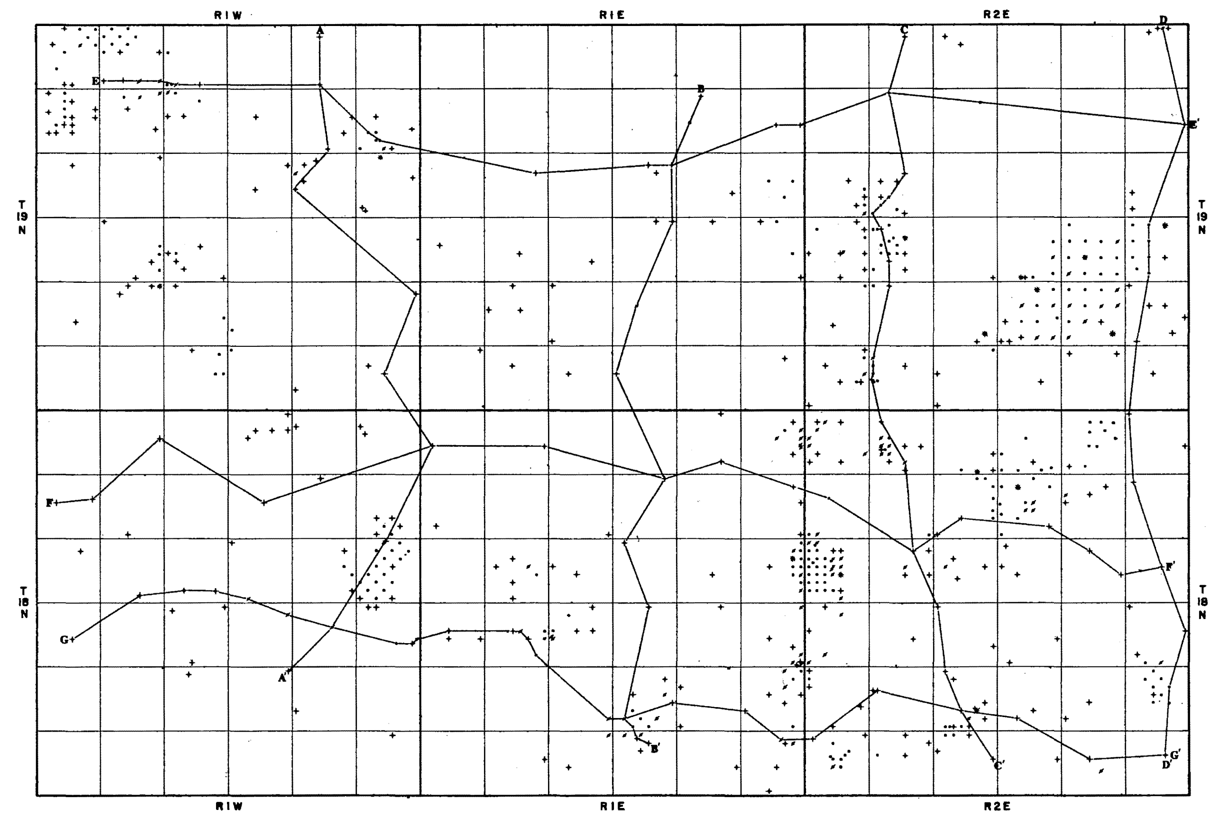


Fig. 4.-Index map of correlation sections.

the Oswego Limestone show an apparent parallelism; however, an eastward increase in thickness does occur, with the greatest thickness being in the northeastern part of the area.

Although marked variations in thickness are generally absent on the north-south sections, some exceptions are worthy of note. The interval between the unconformity and the base of the Inola Limestone is thin in wells 2-4 on section A-A' (Fig. 5) due to onlap of this interval onto the positively expressed pre-Pennsylvanian fault block associated with Orlando field. Within the same interval, a marked increase in thickness is evident north of well 3 on section C-C' (Fig. 7), where the Brown Limestone is associated with onlap. An unusually thick interval between the unconformity and the base of the Pink Limestone, in well 2 on section D-D' (Fig. 8), is thought to reflect a paleotopographic, or paleobathymetric, depression in which the Brown Limestone and associated strata were deposited. Strata between the Brown Limestone and the unconformity are not subdivided.

Some variations to the eastward direction of increasing thickness are illustrated on the west-east correlation sections, such as the two examples of local eastward thinning in wells 12 and 14 on section F-F' (Fig. 10). Along section E-E' (Fig. 9) an abrupt increase in thickness in the interval between the unconformity and the base of the Pink Limestone can be observed between wells 4 and 5 and wells 10 and 11. Well 4 is located on the upthrown fault block of the fault bounding Orlando field, whereas well 5 is on the downthrown side. The reasons for the increase in thickness between wells 10 and 11 and between wells 13 and 14 are undetermined.

Evidence that the undulations of the unconformable surface, with respect to the Pink Limestone, represent pre-Pennsylvanian paleotopography includes: (1) onlap of Brown Limestone from the east, (2) westward thinning of the interval between the unconformity and the base of the Pink Limestone, (3) essential parallelism of marker beds, and (4) an abnormally thick interval between the unconformity and the base of the Pink Limestone in well 13 on section F-F' (Fig. 10), which contains a channel-like deposit of Bartlesville Sandstone. The slight folding of the marker beds on local parts of some sections may be explained by drape over the pre-Pennsylvanian unconformity.

Sandstone Bodies. On the basis of interpretation of electric-log characteristics, sandstone bodies are classified as channel or non-channel in origin. Channel deposits are represented by sharp basal contacts, erosion of underlying units, and lenticular shape in cross section. Trends established by isopach and log maps prepared in this study were used to supplement characteristics of individual logs.

The Bartlesville Sandstone is a 30-foot channel deposit and associated overbank deposits in wells 3 and 4 on section A-A' (Fig. 5). The channel deposit, located above the upthrown fault block of Orlando field, suggests limited control of sandstone distribution by the underlying paleotopography. A Bartlesville channel deposit, which apparently represents erosion down to the Mississippian unconformity, is shown in wells 9-12 on section B-B' (Fig. 6) and wells 16-18 on section G-G' (Fig. 11). The large channel unit in wells 11-13 on section F-F' (Fig. 10) displays stacking of genetic units in well 13. A channel deposit with sharp upper and basal contacts is shown in well 7 on section D-D' (Fig. 8).

Non-channel Bartlesville Sandstone is well developed in wells 9-11 on section D-D' (Fig. 8) and wells 12-15, 19, and 20 on section G-G' (Fig. 11). The basal contact of these sandstone bodies is gradational with a serrated, "funnel-shaped" SP curve which suggests a delta-fringe or offshore-bar deposit.

Multistoried development of the Red Fork Sandstone is evident in well 19 on section C-C' (Fig. 7), wells 5, 7-9, 12, and 13 on section D-D' (Fig. 8), and wells 25 and 26 on section G-G' (Fig. 11). In each of these wells the lower marker bed, the Inola Limestone, is absent, apparently due to erosion. Deposition of the Red Fork, after erosion of the uppermost part of the Bartlesville, has resulted in very thick multistoried units, as shown by almost 150 feet of sandstone in well 19 on section C-C' (Fig. 7), and well 13 on section D-D' (Fig. 8). Sharp basal contacts of Red Fork Sandstone are shown in wells 10-14 on section C-C' (Fig. 7), well 2 on section D-D' (Fig. 8), in which one genetic unit may be as much as 60 feet thick, and wells 12 and 13 on section F-F' (Fig. 10).

Channel deposits in the Lower Skinner Sandstone are commonly difficult to distinguish from non-channel sandstones except where the Pink Limestone has been eroded, such as in wells 1 and 3-9 on section D-D' (Fig. 8). Logs of some of these wells apparently express stacking of genetic units. The Lower Skinner is also developed as channel deposits associated with only slight downcutting. This relationship is illustrated in well 3 on section A-A' (Fig. 5), where a channel has partially cut into the uppermost part of the Pink Limestone, and in wells 5-8 on section E-E' (Fig. 9). The Lower Skinner Sandstone, where it is not developed as channel deposits, is sheet-like and essentially constant in position above the Pink Limestone.

Channel deposits represented by the Upper Skinner Sandstone include sandstone bodies in well 7 on section B-B' (Fig. 6), well 19 on section C-C' (Fig. 7), wells 15 and 16 on section F-F' (Fig. 10), and wells 12-15, and 24 on section G-G' (Fig. 11). These units show sharp basal contacts, whereas other channel deposits appear to be in the upper parts of sandstone bodies which have gradational basal contacts and "funnel-shaped" SP curves (well 13 on section D-D', Fig. 8). Erosion of the underlying Henryetta Coal by channeling prior to Upper Skinner deposition has not been observed in the study area.

A sharp basal contact and the inferred erosion of the Verdigris Limestone by channeling are shown by the Prue Sandstone in well 11 on section D-D' (Fig. 8). Prue channel sandstones associated with limited erosion, which did not affect the underlying Verdigris Limestone, are shown in several wells, such as wells 16 and 17 on section C-C' (Fig. 7) and well 24 on section G-G' (Fig. 11). Prue Sandstone of non-channel origin is in the majority of the wells on each correlation section.

Paleotopographic and Paleostructural Control of "Cherokee" Sediments

Paleotopography of the pre-Desmoinesian unconformity is expressed by an isopach map (Fig. 12) of the interval between the unconformity and the base of the Pink Limestone, the lowest persistent marker above the unconformity. Where the interval is thickest, erosion of Mississippian rocks is interpreted to have been most extensive; topographic "highs" or divides are thought to be represented by areas where the interval is abnormally thin.

Thickness of the interval increases from less than 60 feet in the northwest corner of the area to approximately 280 feet in the northeast corner. The trends of thick sediments suggest the drainage courses of streams which flowed across the Mississippian surface away from the Nemaha ridge on the west. The drainage is thought to have been dendritic and to have included southwest and northwest branches. The major stream extended across the northern part of T18N, R1W-R2E. The isopach pattern is well developed in the northern part of T18N, R2E, where thicknesses exceed 200 feet. This trend is northeasterly in the southeastern part of T19N, R2E, where it extends east of Stillwater field.

The area of Stillwater field may have acted as a divide between this large drainage feature on the east and a feature represented by a northeasterly increase in thickness west of the field. The trends merge in the northeast part of T19N, R2E.

An east-southeasterly increase in thickness is present in the southeast corner of T18N, R2E, where thickness of the interval exceeds 200 feet. Abrupt changes in thickness coincide with the pre-Pennsylvanian fault bounding the north side of Orlando field in the northern part of T19N, R1W.

An area of a significantly thin interval, located in the northwest corner of T19N, R1W, corresponds approximately to the upthrown fault block at Orlando field. Another area with a thin interval, in Secs. 17-20, T19N, R2E, projects to the northeast away from West Stillwater field. Two other areas of inferred paleotopographic "highs" are shown in Secs. 5 and 6, T18N, R2E, and Secs. 10, 15, and 16, T18N, R2E.

An isopach map (Fig. 13) of the interval between the base of the Pink Limestone and the base of the Oswego Limestone, was prepared for the purpose of showing possible paleostructural control of deposition.

Paleostructure apparently reflects differential compaction, structural movement, or a combination of both. The mapped interval is thought to be thick enough to illustrate the effects of paleostructure and sufficiently removed from the underlying unconformity to be outside the major influence of paleotopography.

As part of a regional expression of differential subsidence, the interval increases in thickness from approximately 140 feet along the western edge of the area to greater than 200 feet along the eastern edge and northeastern corner. Significant features shown by the map include three trends with northeasterly increases in thickness in T19N, R1W-R2E. The westernmost of these trends extends northeastward from the eastern half of T19N, R1W. The second trend is present between the southern part of T19N, R1E and the northeast corner of T19N, R1E. Located west of Stillwater field, the third feature extends from Sec. 29, T19N, R2E, toward the northeast corner of T19N, R2E. An easterly increase in thickness is present in Secs. 11-14, T18N, R2E. A local area with a thickness of more than 200 feet is present in the southern part of T18N, R2E.

One of three prominent, northeasterly-trending belts of significantly thin upper "Cherokee" strata forms as an arc from Sec. 34, T19N, R1E, to the eastern part of West Stillwater field in the west half of T19N, R2E. Another belt extends from Sec. 33, T19N, R2E, across Stillwater field in the eastern part of T19N, R2E. The third trend is a narrow, east-northeast-trending feature in the northern part of T18N, R2E. Two small, locally closed areas present in Sec. 4, T19N, R1W and in Sec. 17, T19N, R2E, are apparently associated with faulting.

Interpretations of the relationships between paleotopography and paleostructure are based on the general assumption that a thick sedimentary section filling a paleotopographic depression should compact more than the equivalent section overlying a paleotopographic "high." A different relationship might exist where the sedimentary section filling the depression is dominantly sandstone. Features on the isopach map (Fig. 13) of the interval between the base of the Oswego Limestone and the base of the Pink Limestone are classified as to the type of paleostructural activity each feature is thought to illustrate. The correlation of inferred paleotopography and paleostructure is shown on Figures 14 and 15.

Informally designated trends 1 and 2 of increased thicknesses apparently have no relation to the underlying paleotopography (Fig. 14); they are thought to be the result of structural movements. Trends 3 and 4, corresponding approximately to older paleotopographic trends, are thought to reflect differential compaction. Trend 5 does not correspond closely to a paleotopographic trend. However, its proximity to a trend may reflect a combination of differential compaction and structural movement.

Because trend 1 of decreased thickness shows no apparent relation to paleotopography southwest of the boundary between T19N, R1E, and T19N, R2E (Fig. 15), some degree of structural movement is inferred. The eastern end of this trend corresponds, to some extent, to the paleotopographic "high" associated with West Stillwater field, possibly as a result of differential compaction and some structural movement. Differential compaction is thought to be responsible for trend 2 because of its correspondence to a paleotopographic trend. However, the area along the eastern part of Stillwater field, with no relation to

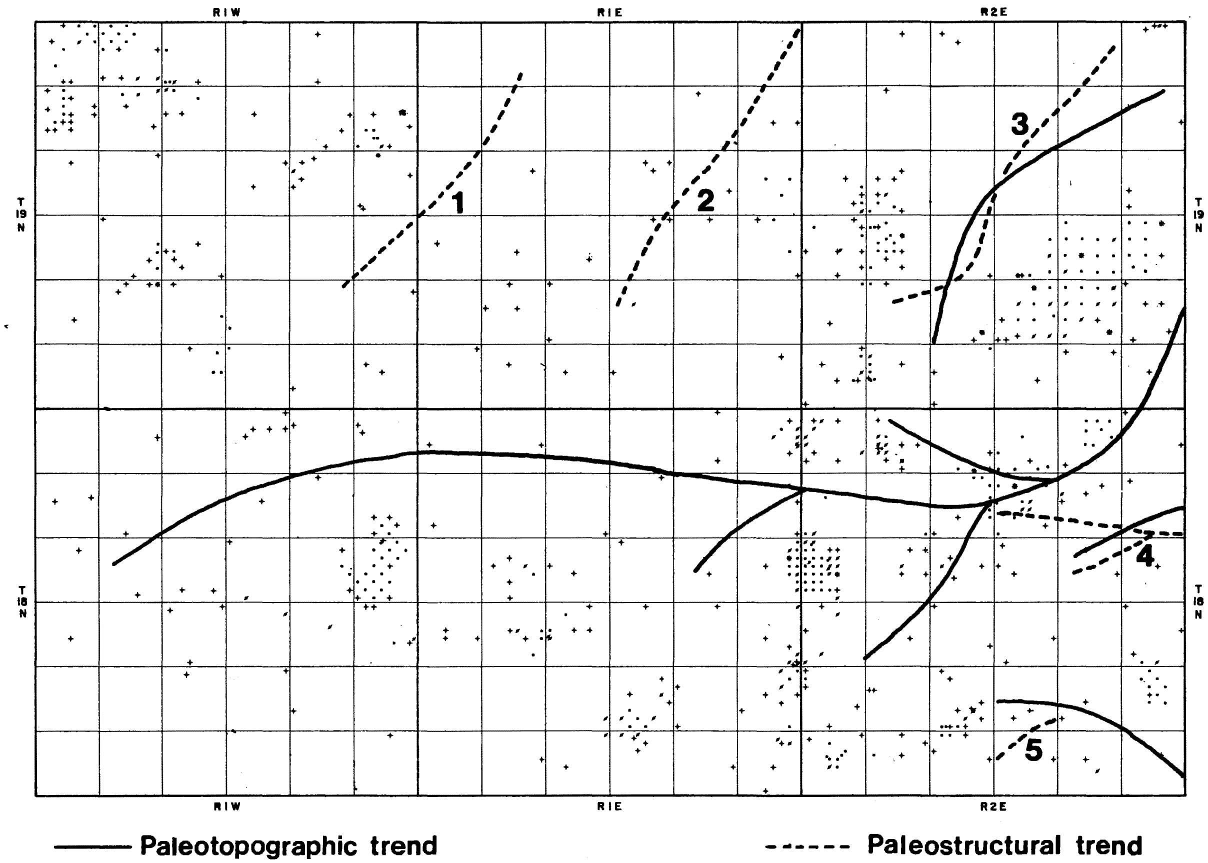


Fig. 14.-Relationship of paleostructural and paleotopographic trends involving anomalously thick intervals of "Cherokee" strata. Numbers are explained in text.

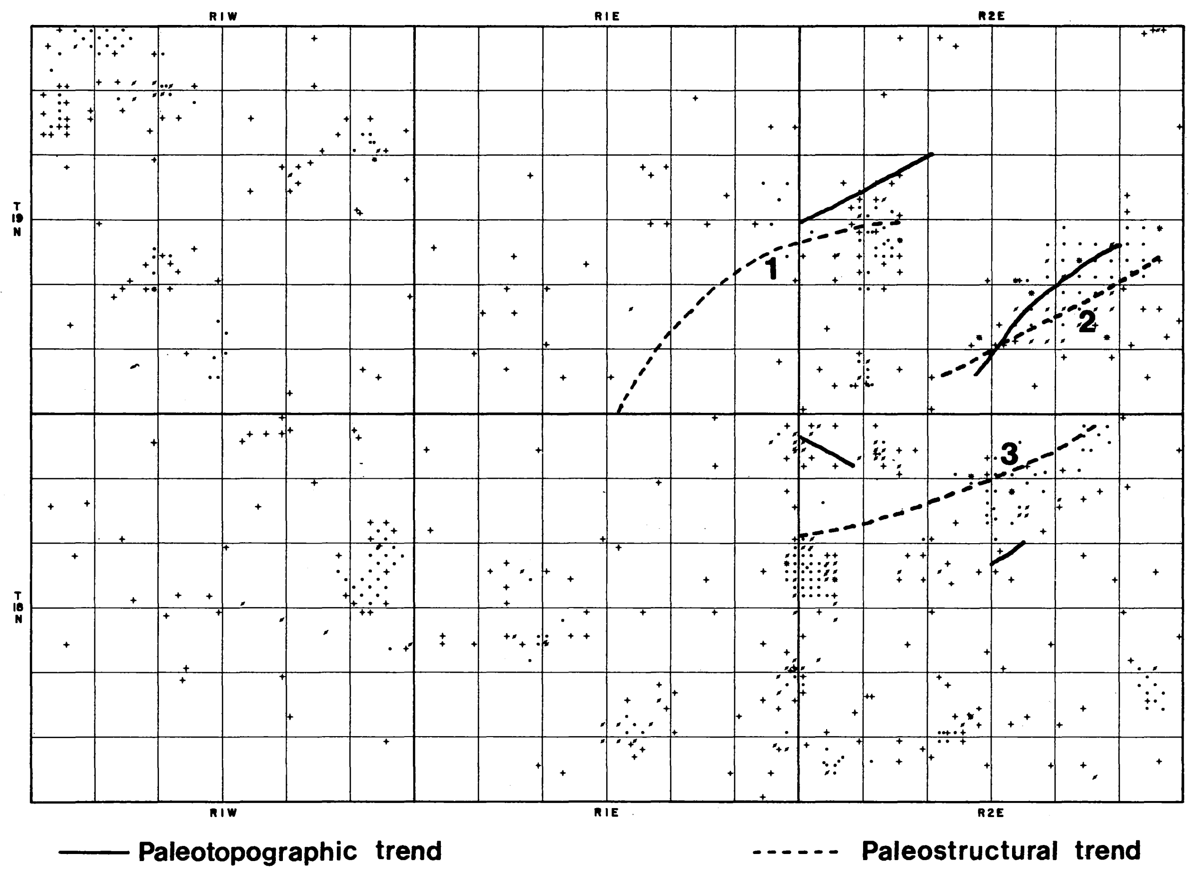


Fig. 15.-Relationship of paleostructural and paleotopographic trends involving anomalously thin intervals of "Cherokee" strata. Numbers are explained in text.

paleotopography at depth, probably reflects structural movement. Trend 3 shows some relationship to the extensive paleodrainage feature in T18N, R2E, but apparently no relationship to trends of thin interval. It may be related to subtle structural movements or to an uncommonly high percentage of sandstone along the older paleotopographic trend of increased thickness.

CHAPTER V

SANDSTONE TRENDS AND DISTRIBUTION

An isopach map of net sandstone and a log map were prepared for each sandstone in the "Cherokee" Group. The log maps are based on the idea that a particular SP curve is a reflection of a vertical sedimentary sequence deposited under characteristic depositional conditions. Because particular log shapes can commonly be recognized and delineated according to areal distribution, it is thought that the use of log shapes permits greater accuracy for determining sandstone trends and in estimating sandstone edges. As numerical values of thickness are the only data utilized in preparation of the isopach maps, they are thought to represent a less definitive means of delineating subtle sandstone trends.

Bartlesville Sandstone

During Late Mississippian and/or Early Pennsylvanian time, Mississippian limestones, in north-central Oklahoma, were affected by epeirogenic uplift and local displacement by faulting. Rocks of the Chesterian and Meramecian Series were apparently removed by stream erosion, which was responsible for development of an irregular surface on strata of the underlying Osagian Series and a well developed drainage system across the limestone terrain. Deposition of the Brown Limestone on this irregular surface is the first evidence of a transgression of the

"Cherokee" sea into the study area. Bartlesville Sandstone was deposited during a major regression following the deposition of the Brown Limestone as an onlapping transgressive unit.

The Bartlesville Sandstone is included in the interval between the base of the Inola Limestone and the top of the Brown Limestone (Jordan, 1957). The unconformity at the top of the "Mississippi" Limestone lies at the base of the Bartlesville interval over much of the study area. Due to the relief of the unconformity, this interval shows much variation in thickness, increasing from almost 15 feet in the northwestern part of the area to approximately 180 feet in the northeastern part of T19N, R2E.

Clayton (1965) has described the Bartlesville as light gray, very fine- to medium-grained, angular to subangular, and slightly argillaceous with fragments of chert. Thick Bartlesville Sandstone in the study area may be similar to that observed in a core from East Cushing field, Sec. 3, T17N, R7E, Creek County, Oklahoma. Common features include massive bedding, medium-scale crossbedding, fine- to medium-grain size, and scour surfaces, along with carbonized filaments, clay pebbles, and current ripple marks.

The Bartlesville interval contains very little sandstone in the northern half of the area, except for minor development in T19N, R1W-R1E and in the ~~north~~south eastern part of T19N, R2E (Fig. 16). A prominent east-northeasterly trend of thick sandstone extending across T18N, R1W-R2E, contains branches which intersect the large system from the southwest and northwest. This system extends northward into the southeastern part of T19N, R2E. In the southeastern part of T18N, R2E, a narrow trend extends as a northerly arc in Secs. 33-36, T18N, R2E.

Sandstone is absent locally within the general belt of sandstone development. A maximum thickness of sandstone of about 90 feet is present in Sec. 10, T18N, R2E. Other areas of significant sandstone development are parts of major trends in the western half and southern parts of T18N, R1E, the northern and southeastern parts of T18N, R2E, and the southeastern part of T19N, R2E.

The Bartlesville Sandstone is characterized by two distinct log shapes: (1) a sharp deflection corresponding to the basal contact, and (2) a gradual deflection corresponding to the lower contact (Fig. 17). The former is suggestive of deposition in a channel environment, and the latter reflects an upward increase in grain size characteristic of regressive, non-channel conditions.

A belt of channel deposits extends across most of the area in a west-southwest direction from the northeastern part of T18N, R2E. The belt bifurcates in the central part of T18N, R1E, with one branch continuing to the west into the eastern part of T18N, R1W, and the other branch extending south and westward as a bifurcating pattern. A major channel deposit is present as an arcuate belt in Secs. 33-36, T18N, R2E.

A narrow channel deposit in the upper part of the Bartlesville interval trends northeastward through Secs. 20 and 21, T18N, R1E. A gradational lower contact of the sandstone is developed in Secs. 17, 20, and 21, T18N, R1E. This belt may be delta-fringe in origin.

The major trend of channel deposits is thought to extend from the southeastern part of T19N, R2E, into the northeastern part of T18N, R2E, because Bartlesville Sandstone with characteristics similar to the channel sandstone in Sec. 10, T18N, R2E, is present in Sec. 25, T19N, R2E. The trend on the log map also corresponds closely to the paleotopographic trend in the northern half of T18N, R2E, reflected by the isopach map (Fig. 12) of the lower part of the "Cherokee" Group.

The sandstone trends shown on the isopach map of net sandstone (Fig. 16) and the log map (Fig. 17) suggest one of two different depositional frameworks: (1) a bifurcating system which extends into the area from the northeast, or (2) a system extending from the west side of the area toward the east-northeast, which is intersected along its course by tributaries.

The Bartlesville Sandstone and its surface equivalent, the Bluejacket Sandstone, were deposited in Kansas and Oklahoma as part of a large, deltaic complex with a dominant source from the north (Visher, 1968; Visher, et al., 1971). The Nemaha ridge, west of the study area, could have been only a minor source area for Bartlesville clastics due to the small size of positive areas along the ridge, the dominance of pre-Pennsylvanian carbonate rocks exposed in the positive areas, and the absence of significant concentrations of clastics west of the ridge (Berg, 1969). Trends of Bartlesville Sandstone, extending across the study area, are therefore considered to represent relatively minor, bifurcating, deltaic distributaries which entered the area from the northeast and east. Associated with these channels may be delta-fringe, overbank, and other deltaic non-channel deposits.

Red Fork Sandstone

The Red Fork Sandstone was deposited during the regression which followed the ~~deposition of the~~ Inola Limestone as a thin, transgressive unit. The sandstone is included in the interval between the base of the Pink Limestone and the top of the Inola Limestone (Jordan, 1957). The interval generally thickens toward the east from about 60 feet in the western part of the area to approximately 95 feet in the northeastern part of T19N, R2E.

Clayton (1965) described the Red Fork Sandstone as light gray, very fine- to medium-grained, subangular to subrounded, micaceous, argillaceous, and loosely cemented. Poorly developed sandstone which occurs outside major trends may be similar to that observed in a core from the Butcher field, Sec. 36, T19N, R4E, Payne County, Oklahoma. Characteristics of the Red Fork in this core include interbedding of shale and sandstone, flaser bedding, and extensive burrows.

The isopach map of net sandstone for the Red Fork Sandstone shows an extremely complex network of sandstone trends, especially in T18N-T19N, R2E, and the eastern part of T19N, R1E (Fig. 18). The overall trend is generally north-south. Most of T18N-T19N, R1W-R1E, is characterized by sandstone less than 20 feet thick. Sandstone exceeding 60 feet in thickness is present in the eastern part of T19N, R1E, and locally in Sec. 16, T18N, R2E. More than 80 feet of sandstone occurs in the eastern part of T19N, R2E, and near the southeast corner of T18N, R2E. The complicated geometry illustrated on this map reflects the presence of multistoried units, elements of which have a rather wide range of trends.

In several areas, channeling, preceding deposition of the Red Fork, has apparently eroded the Inola Limestone. Distribution of Inola Limestone, based on the deflection of the lateral curve on electric logs, is shown in Figure 19. Several additional factors which may account for the absence of Inola Limestone include local nondeposition of the marker bed, facies changes which do not involve channeling, and failure of

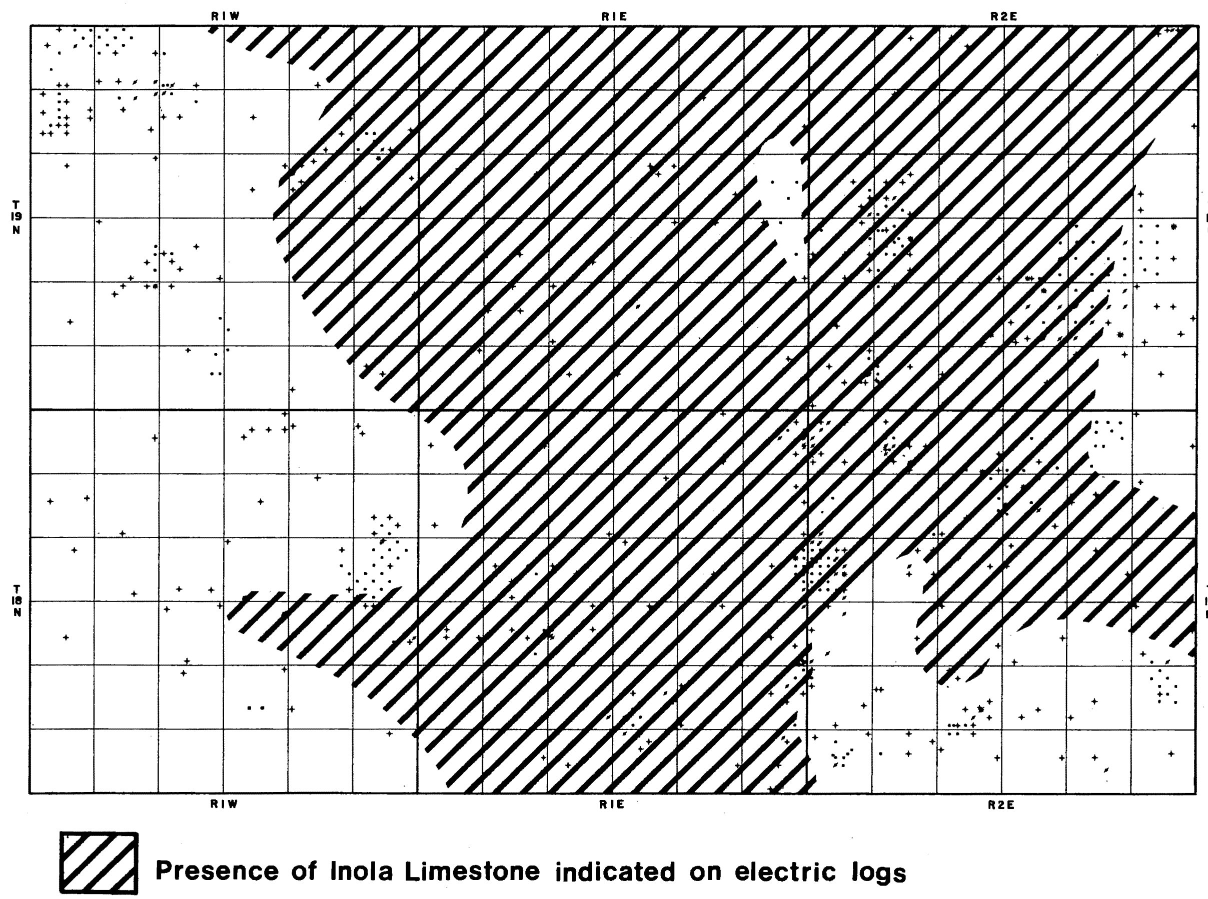


Fig. 19.-Distribution of Inola Limestone.

logging tools to detect the thin limestone.

An area of multistoried units in the southeastern part of T18N, R2E, and three major north-south trends are shown on the log map of Red Fork Sandstone (Fig. 20). The sandstone trends have been interpreted as channel deposits because log shapes show sharp deflections at the basal contacts and underlying units were apparently eroded prior to sand deposition.

Two channel deposits in the lower part of the Red Fork interval have been recognized within the multistoried body. One of these units extends from the vicinity of Sec. 12, T19N, R1E, toward the south-southeast to Sec. 27, T18N, R2E, where the trend bifurcates. One trend continues southward through Sec. 33, T18N, R2E, whereas the other branch extends into the area of undifferentiated, multistoried units. The second unit in the lower part of the Red Fork interval is present along the eastern edge of the area from Sec. 12, T19N, R2E, to Sec. 12, T18N, R2E. The location of the western edge of the deposit is difficult to distinguish due to the stacking of the lower and an upper channel deposit into multistoried units; it is, however, estimated to be in the easternmost tier of sections in T19N, R2E.

A channel deposit in the upper part of the interval extends from the vicinity of Sec. 13, T19N, R2E, to Sec. 2, T18N, R2E, where it bifurcates. One branch of the deposit continues to the south into the area of multistoried units; the second branch extends to the southwest, where it apparently intersects the trend of the lower unit in Secs. 9 and 16, T18N, R2E. The intersection of the two different channel deposits is thought to be required by the presence of sandstone in the upper part of the Red Fork interval in a well in Sec. 16, T18N, R2E, and the presence of the lower sandstone in an adjacent well.

Undifferentiated sandstone units in the southeastern part of T18N, R2E may be related to a major northeast-trending system. In several of the wells in this area, erosion into the underlying Bartlesville Sandstone and subsequent Red Fork deposition has resulted in abnormally thick sandstone bodies.

The trend of a minor sandstone body, mapped in Figure 20, extends from Sec. 5, T18N, R2E, into Sec. 18, T18N, R2E. The Red Fork Sandstone is characterized by several areas where sandstone is not developed or where the sandstone is interpreted to be without reservoir qualities. Some of the areas adjoin the trends of major sandstone development. Other areas apparently represent local patches of fine-grained deposits which formed before the channel units.

Both the isopach map of net sandstone (Fig. 18) and the log map of Red Fork Sandstone (Fig. 20) show a complex sandstone geometry. The trends of thick Red Fork Sandstone within the study area represent deposition in channels, which were probably major and minor distributaries of a deltaic system. The source area apparently lay to the northeast (Berg, 1969; Cole, 1969). The few remaining positive areas of the Nemaha ridge only served as a minor source of sediments during deposition of the Red Fork; the absence of large concentrations of sandstones on the west side of the ridge suggests that it may have acted to some extent as a sediment barrier (Berg, 1969).

Lower Skinner Sandstone

The Pink Limestone was deposited as a widespread transgressive unit preceding the regression during which the Lower Skinner Sandstone was deposited. The sandstone is included in the interval between the base of the Henryetta Coal and the top of the Pink Limestone (Jordan, 1957). The interval thickens toward the east from about 50 feet in the western part of the area to approximately 65 feet in the eastern part.

Lower Skinner Sandstone has been described as white, buff, brown, gray, or green, very fine- to medium-grained, clear to frosted, angular to subangular, and micaceous, commonly with a considerable amount of clay (Stringer, 1957; Clayton, 1965). Sandstone, which may be representative of the Lower Skinner in the southern part of Stillwater field, was observed in three cores from the March field, Secs. 28, 29, and 32, T18N, R5E, Payne County, Oklahoma. Common characteristics of the Lower Skinner in these cores include an overall upward increase in grain size from very fine- to fine-grained, small-scale crossbedding, interbedded shale and sandstone, convolute structures, burrows, abundant carbonaceous material, and mica.

A complex pattern of sandstone distribution is shown by the isopach map of net sandstone for the Lower Skinner Sandstone (Fig. 21). An overall north-south trend appears to be dominant for three primary trends in the study area. The first of these trends is shown as a branching system in T18N-T19N, R1W, which extends into the southwest corner of T18N, R1E. Areas of sandstone exceeding 20 feet in thickness are shown within the trend. The second of the three trends is best developed in the southwest corner of T19N, R2E, and the north-central part of T18N, R2E. Sandstone exceeds 40 feet in thickness in Sec. 5, T18N, R2E. This system shows extensive bifurcation, with southwesterly, southerly, and southeasterly trends. The third trend extends along the east side of T19N, R2E, into the northeast corner of T18N, R2E, where it continues toward the southwestern part of T18N, R2E. More than 60 feet of sandstone is present in this trend in the northeastern part of Stillwater field. A narrow body of sandstone, exceeding 40 feet in thickness, is also located within the trend in the southern half of T18N, R2E. Trends of minor sandstone bodies are associated with each of the large, extensive systems.

A narrow, elongated, north-south-trending sandstone body is shown on the log map of Lower Skinner Sandstone (Fig. 22) to extend along the eastern side of T19N, R2E, toward the south-central part of T18N, R2E. This system has been interpreted as a channel deposit because of the presence of thick sandstone at a lower stratigraphic position than sandstone outside the deposit and the apparent erosion of the Pink Limestone within the trend. It is thought that this channel deposit is younger than the widespread sheet-like sandstone outside the trend. A west-east section across Stillwater field indicates erosion of the sheet-like sandstone and the Pink Limestone prior to deposition of the thick channel body (Fig. 22). Bifurcation of the trend in Sec. 33, T18N, R2E, is based on the presence of Lower Skinner Sandstone in Secs. 15 and 18, T17N, R2E, with characteristics similar to the major channel deposit.

Thick sandstone bodies which were deposited apparently after erosion affecting underlying Pink Limestone are also present in adjacent wells in Sec. 5, T18N, R2E. Although it is difficult to determine the trend of this channel deposit, it is thought to extend toward the minor deposit in Secs. 9 and 16, T18N, R2E. Another minor trend, which may represent a splay-like deposit, is shown in a well in Sec. 26, T19N, R2E, where erosion, preceding sand deposition, may have removed the upper part of the Pink Limestone.

Sandstone is absent locally in association with both major and minor channel deposits. The Lower Skinner is poorly developed in two trends which separate trends of sheet-like sandstone. This type of sandstone is thought to be composed primarily of delta-fringe units, but thin channel deposits may also be present within the sheet-like bodies.

Geometry of the Lower Skinner Sandstone, as suggested by the isopach map of net sandstone (Fig. 21) and the log map (Fig. 22), may represent deposits of a deltaic environment. Most sandstone in the area is thought to have been deposited by major and minor distributary units. A source area to the north appears to have been dominant. The Nemaha ridge may not have been an effective barrier to the distribution of the Lower Skinner Sandstone (Berg, 1969).

Upper Skinner Sandstone

The wide extent of the Henryetta Coal suggests that it may be regarded as a transgressive deposit. The Upper Skinner Sandstone was deposited during the subsequent regression. This unit is included in the interval between the base of the Verdigris Limestone and the top of the Henryetta Coal (Jordan, 1957). The interval generally thickens toward the east from almost 50 feet along the west side of the study area to approximately 70 feet in the northeastern and southeastern parts.

The Upper Skinner Sandstone has been described by Stringer (1957) as white, buff, light or dark gray, very fine- to fine-grained, subangular, clear, micaceous, argillaceous and silty, poorly sorted, and tight.

An almost complete absence of sandstone in T18N-T19N, R1W, is shown by the isopach map of net sandstone (Fig. 23). An overall north-south channel system is inferred to be the dominant mechanism for deposition of significant sandstone within the area. Three narrow, thin sandstone bodies are thought to extend into the area from the north. The belt in the north half of T19N, R2E, splits into at least four separate bodies, showing an anastomosing network. A similar pattern is present in T18N, R1E-R2E.

An area of significant sandstone development extends across Stillwater field through Secs. 22, 26, and 35, T19N, R2E. Along this narrow trend thicknesses exceeding 30 feet are present; more than 40 feet of sandstone is shown in Sec. 26, T19N, R2E. Another narrow sandstone body, greater than 30 feet thick, extends through Secs. 30 and 31, T19N, R2E, into the northwest corner of Sec. 6, T18N, R2E.

The log map of Upper Skinner Sandstone (Fig. 24) shows the presence of a narrow, thick channel body extending through Sec. 31, T19N, R2E, into Sec. 6, T18N, R2E. The boundaries of this trend are well defined. This channel deposit, which is possibly a major distributary unit, exhibits a sharp basal contact, and erosion of underlying units is thought to have preceded sand deposition.

The gradational basal contact of sandstones outside this major trend contrast sharply with those within the channel body. The "funnel-shaped" SP curve suggests an upward increase in grain-size characteristic of regressive marine conditions, possibly delta-fringe. A sharp deflection of the SP near the top of many of these "funnel-shaped" curves suggests permeable channel sandstones, which may have been deposited in minor distributaries or tidal channels as progradation continued. Trends of these sandstones are delineated in several areas in T18N-T19N, R1E-R2E (Fig. 24).

Upper Skinner Sandstone, thought to be of poor reservoir quality, is associated locally with the trends of the sandstone bodies. Other areas represent deposits which preceded deposition of the channel units.

The geometry of the Upper Skinner Sandstone, as shown on the isopach map of net sandstone (Fig. 23) and the log map (Fig. 24), closely resembles Cole's (1969) description of the Upper Skinner Sandstone as a complex pattern of narrow, elongated, bifurcating, and anastomosing dendroids. Sandstone in the study area was probably deposited in major and minor distributary channels, delta-fringe, and other related environments. A northerly source appears to have been dominant. The Nemaha ridge was no longer an effective barrier to sediment distribution (Berg, 1969).

Prue Sandstone

The Prue Sandstone was deposited during the final regressive phase to occur within the "Cherokee" Group after deposition of the Verdigris Limestone, a widespread, transgressive unit. The sandstone is included in the interval between the base of the Oswego Limestone and the top of the Verdigris Limestone (Jordan, 1957). The interval thickens toward the northeast from about 40 feet in the southwestern part of the study area to approximately 80 feet in the northeastern part of T19N, R2E.

Clayton (1965) has described the Prue as gray, fine- to very fine-grained, subangular, micaceous, and argillaceous. Thick Prue Sandstone in the study area may be similar to that observed in a core from the Butcher field, Sec. 36, T19N, R4E, Payne County, Oklahoma. Characteristics of the Prue Sandstone in this core include thick, massive bedding, medium-scale and small-scale crossbedding, and a uniform grain size.

The Prue Sandstone is apparently absent in the western third of the study area (Fig. 25). Three separate sandstone trends, which show a pattern of elongation and bifurcation, are thought to extend into the area from the north and east. Two bifurcating trends which extend from the north are characterized by sandstone less than 20 feet thick. Extensive bifurcation is shown by the trend which extends into the area from the east in T18N, R2E. Sandstone thicknesses of this branching system commonly exceed 20 feet, with more than 30 feet present in Secs. 24 and 26, T18N, R2E.

A narrow, elongated sandstone body is shown by the log map of Prue Sandstone (Fig. 26) to extend from Sec. 24, T18N, R2E, toward the southwest into Sec. 34, T18N, R2E. This sandstone body has been interpreted as a channel deposit because of the presence of thick sandstone at a significantly lower stratigraphic position than the sandstone outside the deposit and the apparent erosion of the underlying Verdigris Limestone within the trend.

In the area adjacent to the major channel trend, sandstone bodies, as suggested by the sharp deflection of the SP curve opposite the basal contact, may be associated with minor channel deposits. The major channel deposit formed after deposition of fine-grained sediments in local areas adjacent to the trend.

The complex geometry of sandstone bodies in the area, as shown by the isopach map of net sandstone (Fig. 25), suggests deltaic depositional environments. Some of the sandstone may have been deposited by distributary channels after erosion of underlying sediments. The Oswego Limestone was deposited during a major transgression which terminated deposition of the "Cherokee" Group.

CHAPTER VI

SUMMARY

The principal conclusions of this study are as follows:

1. Rocks of the Middle Pennsylvanian (Desmoinesian) "Cherokee" Group are the oldest Pennsylvanian units in the study area and unconformably overlie Mississippian limestone of Osagian age.

2. The "Cherokee" Group is composed of cyclothemic sequences, representing transgressive-regressive couplets, which developed during an overall transgression.

3. Local structural trends reflect the configuration of basement faults at depth and possibly some differential compaction.

4. Extensive erosion, which followed regional uplift, resulted in the formation of a well-developed drainage pattern upon the Mississippian surface.

5. Distribution of lower "Cherokee" sediments, particularly the trend of Bartlesville Sandstone, was influenced to some extent by paleotopography. Paleostructure, characterized by differential compaction, structural movement, or a combination of both, influenced the distribution of upper "Cherokee" sediments.

6. The five "Cherokee" sandstones in the study area are thought to have been deposited primarily in deltaic environments which are categorized as distributary channels and delta-fringe.

7. The trends of "Cherokee" sandstones are generally north-south;

however, the Bartlesville and Prue have pronounced east-northeasterly trends.

8. Stacking of genetic units resulted in a complicated geometry associated with multistoried and multilateral sandstone bodies.

9. The use of log maps permits a greater accuracy in determining sandstone trends and in estimating sandstone edges than conventional isopach maps.

SELECTED BIBLIOGRAPHY

Akmal, M. G., 1953, Subsurface geology of northeast Lincoln and southeast Payne Counties, Oklahoma: Okla. City Geol. Soc., Shale Shaker, v. 3, p. 5-16.

Albano, M. A., 1973, Subsurface stratigraphic analysis of "Cherokee" Group (Pennsylvanian), northeast Cleveland County, Oklahoma: Unpub. M.S. thesis, Univ. Oklahoma, 61 p.

Andresen, M. J., 1962, Paleodrainage patterns - their mapping from subsurface data, and their paleographic value: Am. Assoc. Petroleum Geologists Bull., v. 46, p. 398-405.

Bass, N. W., 1934, Origin of Bartlesville shoestring sands, Greenwood and Butler Counties, Kansas: Am. Assoc. Petroleum Geologists Bull., v. 18, p. 1313-1345.

Berg, O. R., 1969, Quantitative study of the Cherokee-Marmaton groups, west flank of the Nemaha ridge, north-central Oklahoma: Okla. City Geol. Soc., Shale Shaker, v. 19, p. 94-110.

Berry, C. G., 1965, Stratigraphy of the Cherokee Group, eastern Osage County, Oklahoma: Okla. City Geol. Soc., Shale Shaker, v. 16, p. 78-92.

Bowman, E. A., 1956, The subsurface geology of southeastern Noble County, Oklahoma: Unpub. M.S. thesis, Univ. Oklahoma, 42 p.

Busch, D. A., 1971, Genetic units in delta prospecting: Am. Assoc. Petroleum Geologists Bull., v. 55, p. 1137-1154.

________, 1974, Stratigraphic traps in sandstones - exploration techniques: Am. Assoc. Petroleum Geologists Memoir 21, 174 p.

Clayton, J. M., 1965, Paleodepositional environments of the "Cherokee" sands of central Payne County, Oklahoma: Okla. City Geol. Soc., Shale Shaker, v. 16, p. 50-66.

Clements, K. P., 1961, Subsurface study of the Skinner and Red Fork sand zones (Pennsylvanian) in portions of Noble and Kay Counties, Oklahoma: Unpub. M.S. thesis, Univ. Oklahoma, 62 p.

Cole, J. G., 1969, Stratigraphic study of the Cherokee and Marmaton sequences, Pennsylvanian (Desmoinesian), east flank of the Nemaha ridge, north central Oklahoma: Okla. City Geol. Soc., Shale Shaker, v. 19, p. 134-146, 150-161.

Dalton, D. V., 1960, The subsurface geology of northeast Payne County, Oklahoma: Unpub. M.S. thesis, Univ. Oklahoma, 69 p.

Dogan, N., 1970, Subsurface study of Pennsylvanian rocks in east central Oklahoma (from the Brown Limestone to the Checkerboard Limestone): Okla. City Geol. Soc., Shale Shaker, v. 20, p. 192-213.

Fisher, W. L., L. F. Brown, Jr., A. J. Scott, and J. H. McGowen, 1969, Delta systems in the exploration for oil and gas, a research colloquium: Univ. Texas Bur. Econ. Geology, 78 p.

Forgotson, J. M., Jr., 1957, Nature, usage, and definition of marker-defined, vertically segregated rock units, Am. Assoc. Petroleum Geologists Bull., v. 41, p. 2108-2113.

Frost, V. L., 1940, Ramsey oil pool, Payne County, Oklahoma: Am. Assoc. Petroleum Geologists Bull., v. 24, p. 1995-2005.

Galloway, W. E., and L. F. Brown, Jr., 1972, Depositional systems and shelf-slope relationships in Upper Pennsylvanian rocks, north-central Texas: Univ. Texas Bur. Econ. Geology Rept. Inv. No. 75, 62 p.

Graves, J. M., 1955, Subsurface geology of a portion of Lincoln and Payne Counties, Oklahoma: Okla. City Geol. Soc., Shale Shaker, v. 6, p. 1-38.

Hanke, H. W., 1967, Subsurface stratigraphic analysis of the Cherokee Group in north-central Creek County, Oklahoma: Okla. City Geol. Soc., Shale Shaker, v. 17, p. 150-167.

Hawisa, I. S., 1965, Depositional environment of the Bartlesville, the Red Fork, and the Lower Skinner Sandstones in portions of Lincoln, Logan, and Payne Counties, Oklahoma: Unpub. M.S. thesis, Univ. Tulsa, 35 p.

Heinzelmann, G. M., 1964, Mississippian rocks in the Stillwater-Chandler area, Oklahoma: Okla. City Geol. Soc., Shale Shaker, v. 15, p. 18-30.

Horne, J. C., 1968, Detailed correlation and environmental study of some Late Pennsylvanian units of the Illinois basin: Unpub. Ph.D. thesis, Univ. Illinois, 49 p.

Jordan, L., 1957, Subsurface stratigraphic names of Oklahoma: Okla. Geol. Survey Guidebook VI, 220 p.

________, 1962, Geologic map and section of pre-Pennsylvanian rocks in Oklahoma, showing surface and subsurface distribution: Okla. Geol. Survey Map GM-5.

Leatherock, C., 1937, Physical characteristics of Bartlesville and Burbank sands in northeastern Oklahoma and southeastern Kansas: Am. Assoc. Petroleum Geologists Bull., v. 21, p. 246-258.

LeBlanc, R. J., 1972, Geometry of sandstone reservoir bodies, _in_ Underground waste management and environmental implications: Am. Assoc. Petroleum Geologists Memoir 18, p. 133-190.

Lyons, P. L., 1950, A gravity map of the United States: Tulsa Geol. Soc. Digest, v. 18, p. 33-43.

McElroy, M. N., 1961, Isopach and lithofacies study of the Desmoinesian Series of north central Oklahoma: Okla. City Geol. Soc., Shale Shaker, v. 12, p. 2-22.

Mikkelson, D. H., 1966, The origin and age of the Mississippian "Chat" in north central Oklahoma: Okla. City Geol. Soc., Shale Shaker, v. 17, p. 23-33.

Oakes, M. C., 1953, Krebs and Cabaniss Groups of Pennsylvanian age, in Oklahoma: Am. Assoc. Petroleum Geologists Bull., v. 37, p. 1523-1526.

Page, K. G., 1955, The subsurface geology of southern Noble County, Oklahoma: Okla. City Geol. Soc., Shale Shaker, v. 5, p. 5-22.

Potter, P. E., 1967, Sand bodies and sedimentary environments: a review: Am. Assoc. Petroleum Geologists Bull., v. 51, p. 337-365.

Sartin, J. P., 1958, A cross sectional study of the oil producing rocks of Desmoinesian age in northeastern Oklahoma: Unpub. M.S. thesis, Univ. Oklahoma, 91 p.

Scott, J. D., 1970, Subsurface stratigraphic analysis, "Cherokee" Group, northern Noble County, Oklahoma: Unpub. M.S. thesis, Univ. Oklahoma, 56 p.

Shelton, J. W., 1972, Correlation sections and log maps in determination of sandstone trends: Am. Assoc. Petroleum Geologists Bull., v. 56, p. 1541-1544.

________, 1973, Five ways to explore for sandstone reservoirs: The Oil and Gas Journal, v. 71, p. 126-128.

________, 1973, Models of sand and sandstone deposits: Okla. Geol. Survey Bull. 118, 122 p.

Shulman, C., 1966, Stratigraphic analysis of the Cherokee Group, in adjacent portions of Lincoln, Logan, and Oklahoma Counties, Oklahoma: Okla. City Geol. Soc., Shale Shaker, v. 16, p. 126-140.

Stringer, C. P., Jr., 1957, Subsurface geology of western Payne County, Oklahoma: Okla. City Geol. Soc., Shale Shaker, v. 7, p. 3-20.

Terrell, D. M., 1972, Trend and genesis of the Pennsylvanian Elgin Sandstone in the western part of northeastern Oklahoma: Unpub. M.S. thesis, Oklahoma State Univ., 80 p.

Umpleby, S. S., 1956, Faulting, accumulation, and fluid distribution in Ramsey pool, Payne County, Oklahoma: Am. Assoc. Petroleum Geologists Bull., v. 40, p. 122-139.

Visher, G. S., 1965, Use of vertical profile in environmental reconstruction: Am. Assoc. Petroleum Geologists Bull., v. 49, p. 41-61.

________ (ed.), 1968, A guidebook to the geology of the Bluejacket-Bartlesville Sandstone, Oklahoma: Okla. City Geol. Soc. Field Trip Guidebook, 72 p.

________, Saitta, B., Sandro, and R. S. Phares, 1971, Pennsylvanian delta patterns and petroleum occurrences in eastern Oklahoma, Am. Assoc. Petroleum Geologists Bull., v. 55, p. 1206-1230.

APPENDIX

LOCATION OF ELECTRIC LOGS USED IN PREPARATION OF CORRELATION SECTIONS

North-South Correlation Section A-A'

No.	Operator and Well Number	Location
1.	Earlsboro Oil & Gas Co., Inc., Forney-Wetzel #1	SE NE NW Sec. 2-19N-1W
2.	Summitt Drilling Co., Blietow #1	SE SE SW Sec. 2-19N-1W
3.	Summitt Drilling Co., Randolph #2	SW SW SE Sec. 11-19N-1W
4.	Tennessee Gas Transmission Co., Whittaker #1	NW NW SW Sec. 14-19N-1W
5.	Breco Oil Co., Wilcox #1	SE NE NE Sec. 25-19N-1W
6.	Southern Producing Co., State Schoolland #1	SE SE NW Sec. 36-19N-1W
7.	Cree Oil & Exploration Co., Sherman #1	NW NW SW Sec. 6-18N-1E
8.	W. F. Gorman, Katschor #1	NE NE NW Sec. 13-18N-1W
9.	Mid-Continent Petroleum Co., Neher #1	C SW NE Sec. 23-18N-1W
10.	B. M. Heath, Henderson #1	NE NE NE Sec. 27-18N-1W

North-South Correlation Section B-B'

No.	Operator and Well Number	Location
1.	Dave Morgan Drilling Co., Eades #1	C NE NW Sec. 11-19N-1E
2.	Mid-Continent Petroleum Co., Correll #1	SE NE NE Sec. 15-19N-1E
3.	William J. Sherry, Keith #1	NE NE NE Sec. 22-19N-1E
4.	T. N. Berry & Co., McQuain #1	C SE NW Sec. 27-19N-1E
5.	T. N. Berry & Co., Oldham #1	SW SW NW Sec. 34-19N-1E
6.	Davidor & Davidor, U.S.A. #1	NW NE NE Sec. 10-18N-1E
7.	Hall-Jones & Jones & Shelburne, Wetzel #1	NE NW NW Sec. 15-18N-1E
8.	Kingwood Oil Corp., Downey #1	NW NW NE Sec. 22-18N-1E
9.	Russell Cobb, Jr., Phillips #3	NE SW SW Sec. 27-18N-1E
10.	Russell Cobb, Jr., Phillips #1	SW SE SW Sec. 27-18N-1E
11.	Helmerich & Payne, Richey #1	C NE NW Sec. 34-18N-1E
12.	Skelly Oil Co., Collins #1	SW NW NE Sec. 34-18N-1E

North-South Correlation Section C-C'

No.	Operator and Well Number	Location
1.	Mitchell & Gage, Friedman #1	SW NW NE Sec. 5-19N-2E
2.	Summitt Drilling Corp., Arnold #1	NW NE NW Sec. 8-19N-2E
3.	Warren Oil Co., Flesher #1	NW SW NE Sec. 17-19N-2E
4.	Texcan Oil Co., Heid #1	SW NE SW Sec. 17-19N-2E
5.	Hanlon-Buchanan Oil Co., Schroeder #2	NE SW SW Sec. 17-19N-2E
6.	Hanlon-Buchanan Oil Co., Schroeder #1	SW SW SW Sec. 17-19N-2E
7.	Portable Drilling Co., Murphy #2	SE NW NW Sec. 20-19N-2E
8.	F. N. Schonwald, Murphy #1	SW NE SW Sec. 20-19N-2E
9.	J. E. Crosby, Inc., Moore #1	NW NE NW Sec. 29-19N-2E
10.	Delta Petroleum Co., Lester #1	SW NW NW Sec. 32-19N-2E
11.	Massey & Moore, Whitmore #2	SW SW NW Sec. 32-19N-2E
12.	Massey & Moore, French #1	N½ NW SW Sec. 32-19N-2E
13.	Raymond Oil Co., Inc., Flohr #2	SE NW NW Sec. 5-18N-2E
14.	Ketal Oil Producing Co., Shenold #A-1	NW SW SE Sec. 5-18N-2E
15.	Appleton Oil Co., Regina #1	SE NW NE Sec. 17-18N-2E
16.	Don Jones, Judge #1	NW NW NW Sec. 21-18N-2E
17.	Woods Petroleum Corp., Nottingham #1	NE NW NW Sec. 28-18N-2E
18.	Callery & Hurt, Burton #1	SE NE SW Sec. 28-18N-2E
19.	Heath, Dudley & Leach, Downey #1	SE SE NE Sec. 33-18N-2E

North-South Correlation Section D-D'

1.	Heath & Dudley, Kinyon #1	NW NW NE Sec. 1-19N-2E
2.	Warren Bradshaw Exploration Co., Walker #1	NE NE SE Sec. 12-19N-2E
3.	Apache Oil Corp., Morningside #2	C NE NW Sec. 24-19N-2E
4.	Apache Oil Corp., Hoyt #2	C SE NW Sec. 24-19N-2E
5.	Apache Oil Corp., Fairgrounds #1	C NE SW Sec. 24-19N-2E
6.	Apache Oil Corp., Katz #1	C SE SW Sec. 24-19N-2E
7.	T. N. Berry, Patco, & W. W. Wolfe, Tilford #1	SE SW SW Sec. 25-19N-2E
8.	Cherokee Resources, Inc., Leachman #1	NW NW NW Sec. 1-18N-2E
9.	Culp & Copple Oil Co., Caldwell #1	C NW NW Sec. 12-18N-2E
10.	Summitt Drilling Co., Hickman #1	SW SW NE Sec. 13-18N-2E
11.	Goff-Leeper Drilling Co., Marshall #1	SE SE NE Sec. 24-18N-2E
12.	Fullerton Oil Co., Nelson #1	NE SW NE Sec. 25-18N-2E
13.	Payne Inc., OSU Cowboy #1	C SW NE Sec. 36-18N-2E

East-West Correlation Section E-E'

1.	Lou B. Turk, <u>et al</u>., Finnell #1	W½ SW SW Sec. 5-19N-1W
2.	T. N. Berry & Co., Watkins #1	E½ SE SE Sec. 5-19N-1W
3.	Alladin-Morrison, Henke #1	SE SW SW Sec. 4-19N-1W
4.	Alladin Petroleum Co., Greathouse #1	SW SW SE Sec. 4-19N-1W
5.	Summitt Drilling Co., Blietow #1	SE SE SW Sec. 2-19N-1W
6.	Olean Petroleum Co., Lowry #4	SE NW SW Sec. 12-19N-1W

No.	Operator and Well Number	Location
7.	Gardiner Petroleum Co., Lowry #1	N½ SE SW Sec. 12-19N-1W
8.	Gulf Oil Co., Flora #1	NW SE NE Sec. 17-19N-1E
9.	Ketchup-Whan Drilling Co., Correll #1	SW NW NE Sec. 15-19N-1E
10.	Mid-Continent Petroleum Co., Correll #1	SE NE NE Sec. 15-19N-1E
11.	Wilcox Oil Co., Brown #2	NW NW SE Sec. 12-19N-1E
12.	Wilcox Oil Co., Brown #1	NE NE SE Sec. 12-19N-1E
13.	Summitt Drilling Co., Arnold #1	NW NE NE Sec. 8-19N-2E
14.	Warren Bradshaw Exploration Co., Walker #1	NE NE SE Sec. 12-19N-2E

East-West Correlation Section F-F'

1.	Texas Crude Oil Co., Yates #1	SW SE NW Sec. 7-18N-1W
2.	T. W. & J. M. Loffland, Jr., Meyers #1	C SE NE Sec. 7-18N-1W
3.	Cyclone Drilling Co., Taylor #1	SE SE NE Sec. 5-18N-1W
4.	Russell McGuire, Marsh #1	SW SW NE Sec. 10-18N-1W
5.	Cree Oil & Exploration Co., Sherman #1	NW NW SW Sec. 6-18N-1E
6.	Bill Lignon Drilling Co., & Belco Petroleum Corp., Murphy #1	NE NE SE Sec. 5-18N-1E
7.	Davidor & Davidor, USA #1	NW NE NE Sec. 10-18N-1E
8.	Gardiner Petroleum Co., Ahrberg #1	NE SW SE Sec. 2-18N-1E
9.	Mid-Continent Petroleum Co., Jones #1	SW NE NE Sec. 12-18N-1E
10.	Fain-Porter Drilling Co., O'Haver #1	C SE NW Sec. 7-18N-2E
11.	Appleton Oil Co., Regina #1	SE NW NE Sec. 17-18N-2E
12.	Appleton Oil Co., Greiner #1	SW SW SW Sec. 9-18N-2E
13.	The Texas Co., Wetzel #1	SE NE SW Sec. 9-18N-2E
14.	Wilcox Oil Co., Caldwell #2	NW SE SE Sec. 10-18N-2E
15.	Morton & Duncan, Caldwell #1	SE NE NW Sec. 14-18N-2E
16.	Sunray D-X Oil Co., Marshall #1	NE NE SE Sec. 14-18N-2E
17.	Summitt Drilling Co., Hickman #1	SW SW NE Sec. 13-18N-2E

East-West Correlation Section G-G'

1.	An-Son Petroleum Corp., Fallin #1	NW NW SE Sec. 19-18N-1W
2.	Sunray D-X Oil Co., Aufleger #1	C SW SE Sec. 17-18N-1W
3.	Midwest Oil Corp., State #1	NW SE SW Sec. 16-18N-1W
4.	Big Four Petroleum Co., Cordis-State #1	NW SE SE Sec. 16-18N-1W
5.	L. B. Jackson Co., Shoemaker #1	SW NE SW Sec. 15-18N-1W
6.	Jones, Shelburne, & Pellow Oil Co., Grindle #1	SE NE NE Sec. 22-18N-1W
7.	Mid-Continent Petroleum Co., Neher #1	C SW NE Sec. 23-18N-1W
8.	Appleton Oil Co., Long #2	C NW SE Sec. 24-18N-1W
9.	Lewis Production Co., Nesslin #1	C NE SE Sec. 24-18N-1W
10.	J. T. Miers, Long #1-A	NE NE SE Sec. 24-18N-1W
11.	Derby Oil Co., Persing #1	SE SE NW Sec. 19-18N-1E
12.	Anderson-Prichard, McGuire #1	SE SE NW Sec. 20-18N-1E
13.	An-Son Petroleum Corp., Goodman #1	SW SW NE Sec. 20-18N-1E
14.	Simpson & Tarr, et al., Berry #1	NE NW SE Sec. 20-18N-1E
15.	Saltmount & Barrett, McCormick #1	NW SE SE Sec. 20-18N-1E

No.	Operator and Well Number	Location
16.	Simon Lebow, Carrier #1	NE SE SE Sec. 28-18N-1E
17.	Russell Cobb, Jr., Phillips #3	NE SW SW Sec. 27-18N-1E
18.	Kingwood Oil Corp., Murphy #2	NE NE SE Sec. 27-18N-1E
19.	Helmerich & Payne, & Berry, & Reisner, Inc., Cook #1	SW NW SW Sec. 25-18N-1E
20.	Phillips Petroleum Co., Laco #1	C NW NE Sec. 36-18N-1E
21.	Adair & Jenkins, Moorman #1	C NW NW Sec. 31-18N-2E
22.	Shaw, Hughes & Guffey, Kinzie #1	C SW NW Sec. 29-18N-2E
23.	Callery & Hurt, Burton #1	SE NE SW Sec. 28-18N-2E
24.	Bradford & Mayo, Blumer #1	NW SE SW Sec. 27-18N-2E
25.	Harper & Turner, Cundiff #1	SE SE NW Sec. 35-18N-2E
26.	Payne, Inc., OSU Cowboy #1	C SW NE Sec. 36-18N-2E

VITA

Raymond Dale Shipley

Candidate for the Degree of

Master of Science

Thesis: LOCAL DEPOSITIONAL TRENDS OF "CHEROKEE" SANDSTONES, PAYNE COUNTY, OKLAHOMA

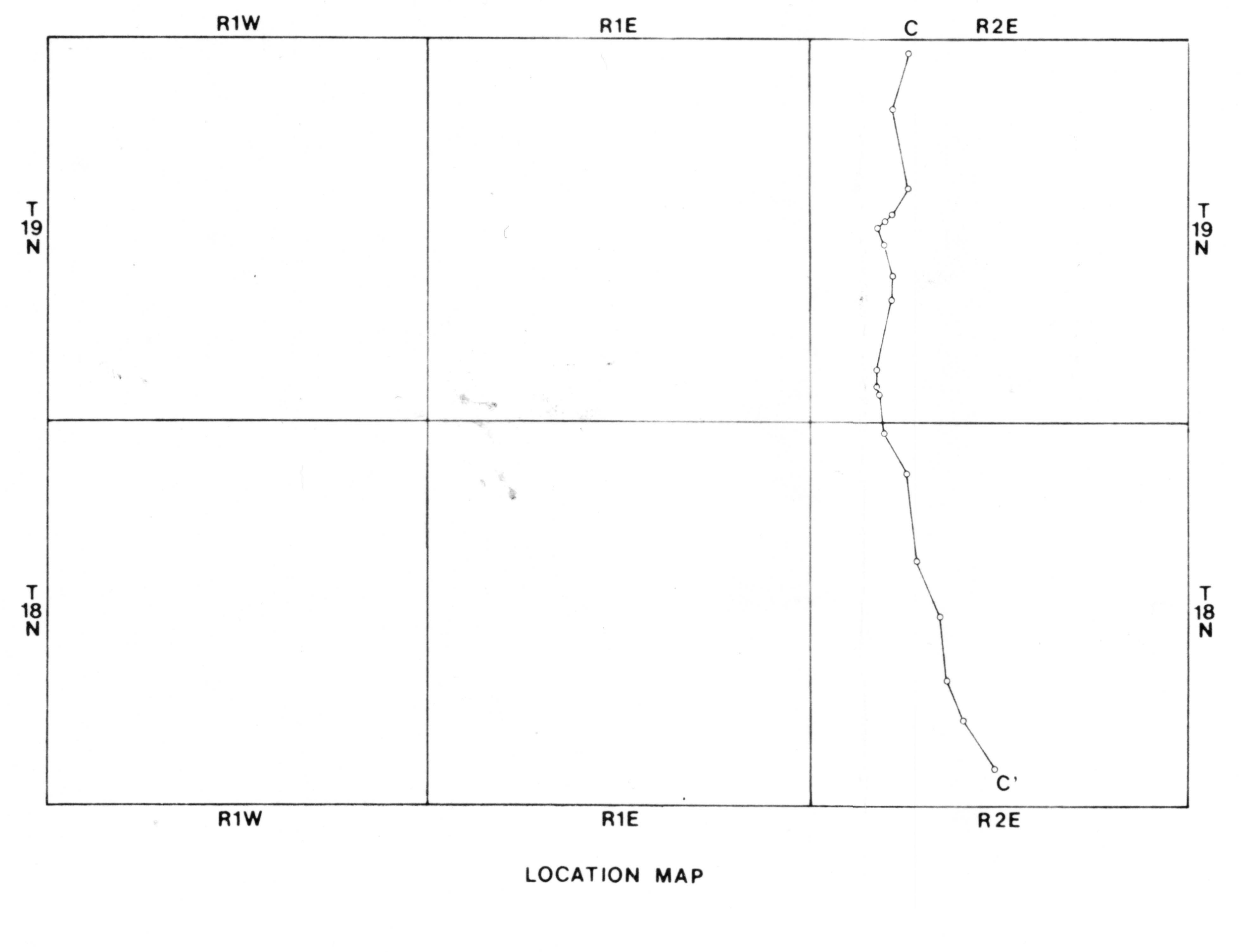
Major Field: Geology

Biographical:

Personal Data: Born in Duncan, Oklahoma, February 24, 1950, the son of Mr. and Mrs. Raymond H. Shipley.

Education: Graduated from Ardmore High School, Ardmore, Oklahoma, in May, 1968; completed the requirements for a Bachelor of Science degree in geology from Oklahoma State University, Stillwater, Oklahoma, in December, 1972; completed requirements for the Master of Science degree at Oklahoma State University in May, 1975, with a major in geology.

Professional Experience: Junior member of the American Association of Petroleum Geologists; member of the Oklahoma City Geological Society.



NORTH SOUTH CORRELATION SECTION C-C'

Datum: Base of Oswego Limestone

No Horizontal Scale

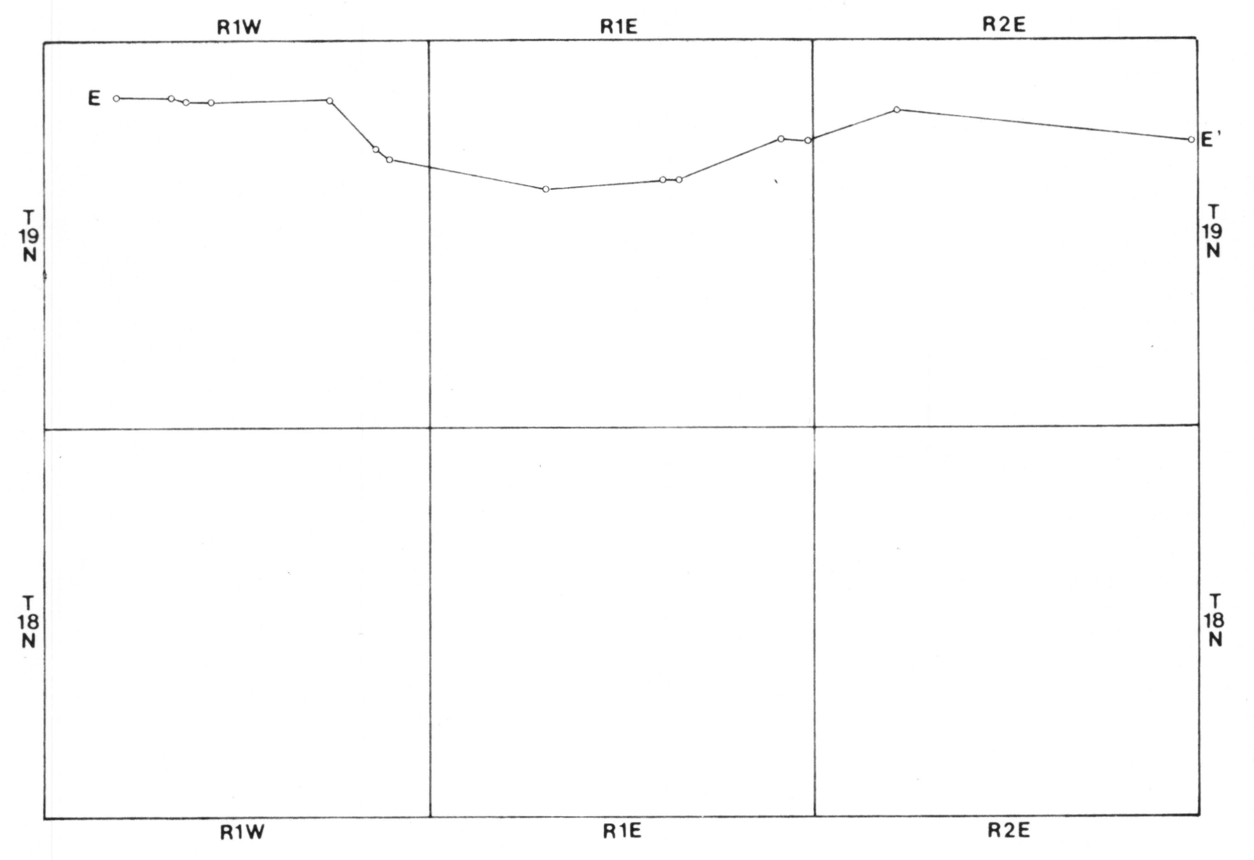
100 ft

Vertical Scale

0

Raymond Dale Shipley, 1975

Figure 7



LOCATION MAP

WEST-EAST CORRELATION SECTION E-E'

Datum: Base of Oswego Limestone

No Horizontal Scale

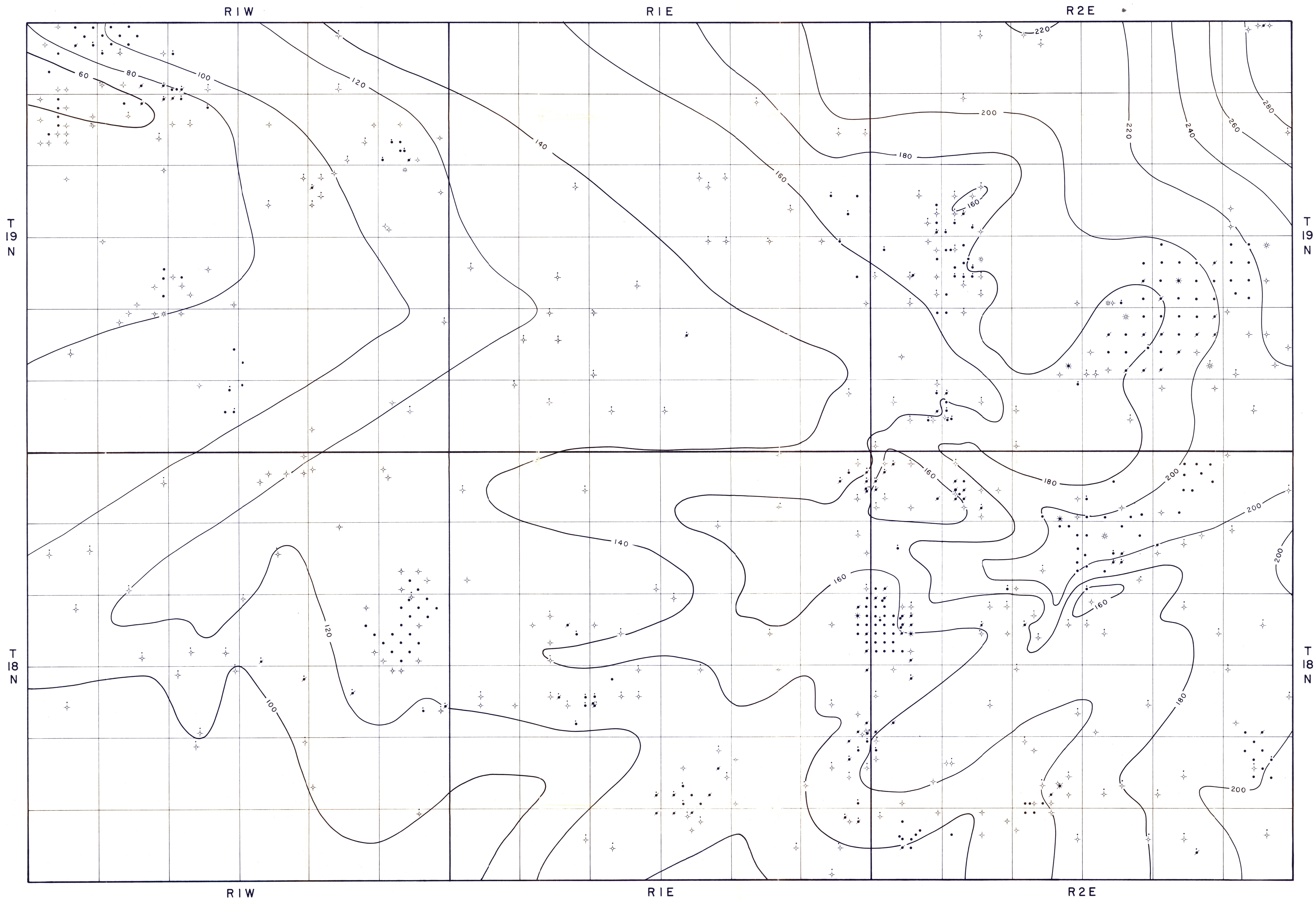
100 ft.

Vertical Scale

0

Raymond Dale Shipley, 1975

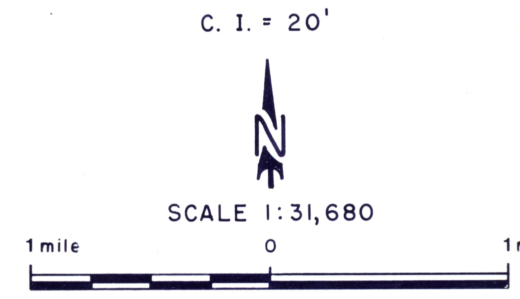
Figure 9



ISOPACH MAP

Base of Pink of Limestone to Top of "Mississippi" Limestone

C. I. = 20'

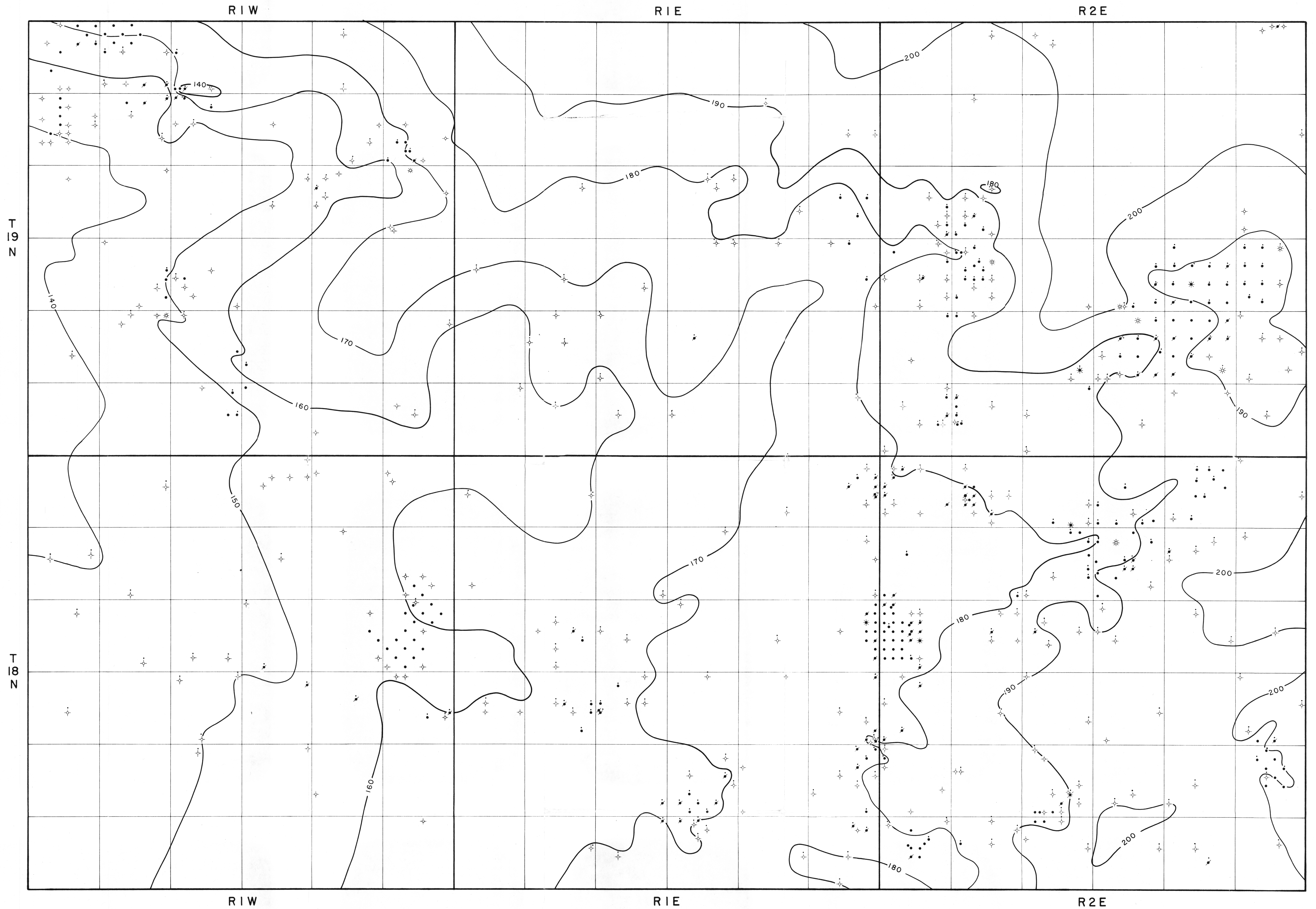


EXPLANATION

- Oil Well
- Abandoned Oil Well
- Dry and Abandoned
- Control Well
- Gas Well
- Oil and Gas Well
- Abandoned Oil and Gas Well

Raymond Dale Shipley, 1975

Figure 12



ISOPACH MAP

Base of Oswego Limestone to Base of Pink Limestone

C. I.= 10'

N

SCALE 1:31,680

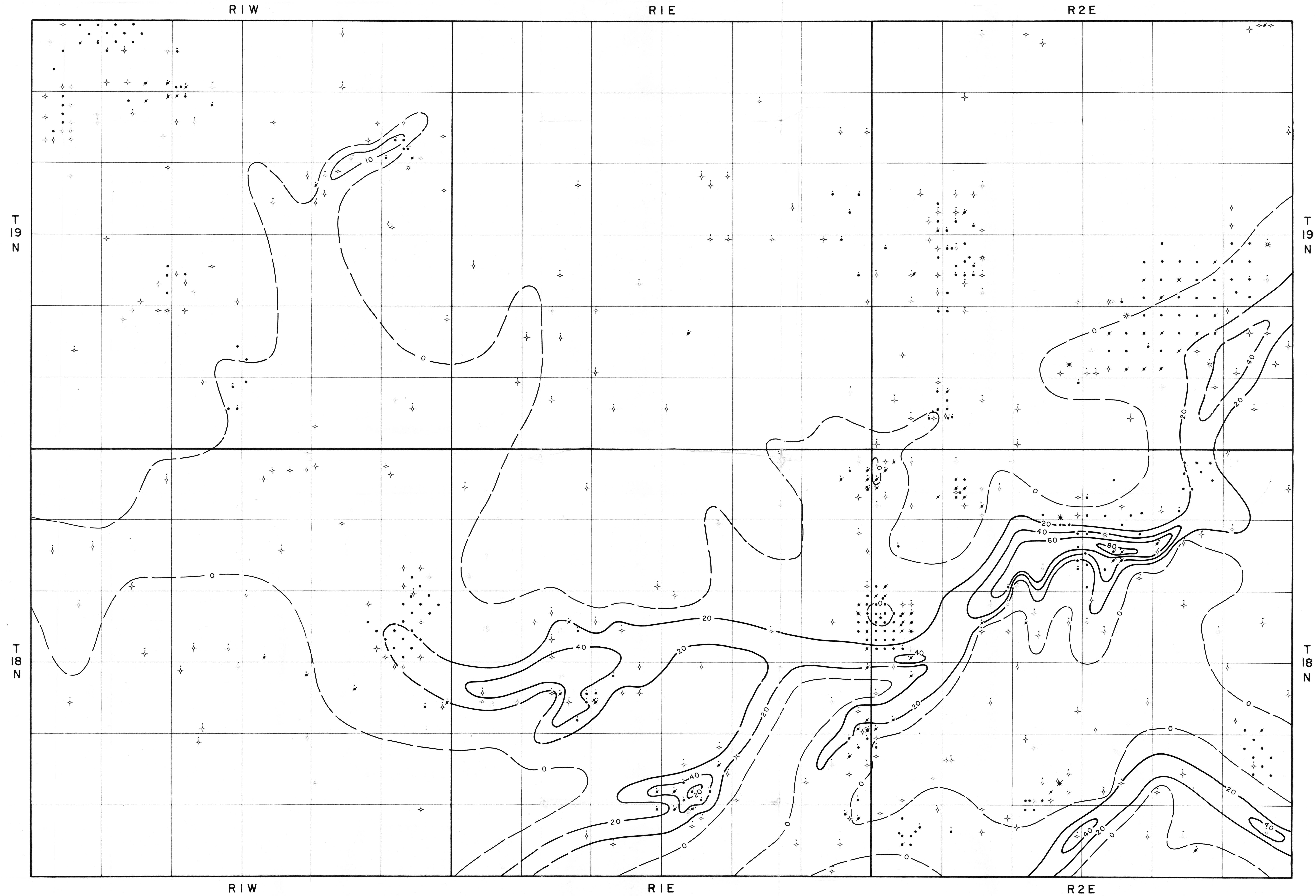
1 mile 0 1 mile

EXPLANATION

- Oil Well
- Abandoned Oil Well
- Dry and Abandoned
- Control Well
- Gas Well
- Oil and Gas Well
- Abandoned Oil and Gas Well

Raymond Dale Shipley, 1975

Figure 13



ISOPACH MAP OF NET SANDSTONE

Bartlesville Sandstone

C. I. = 20' and 10'

N

SCALE 1:31,680

1 mile 0 1 mile

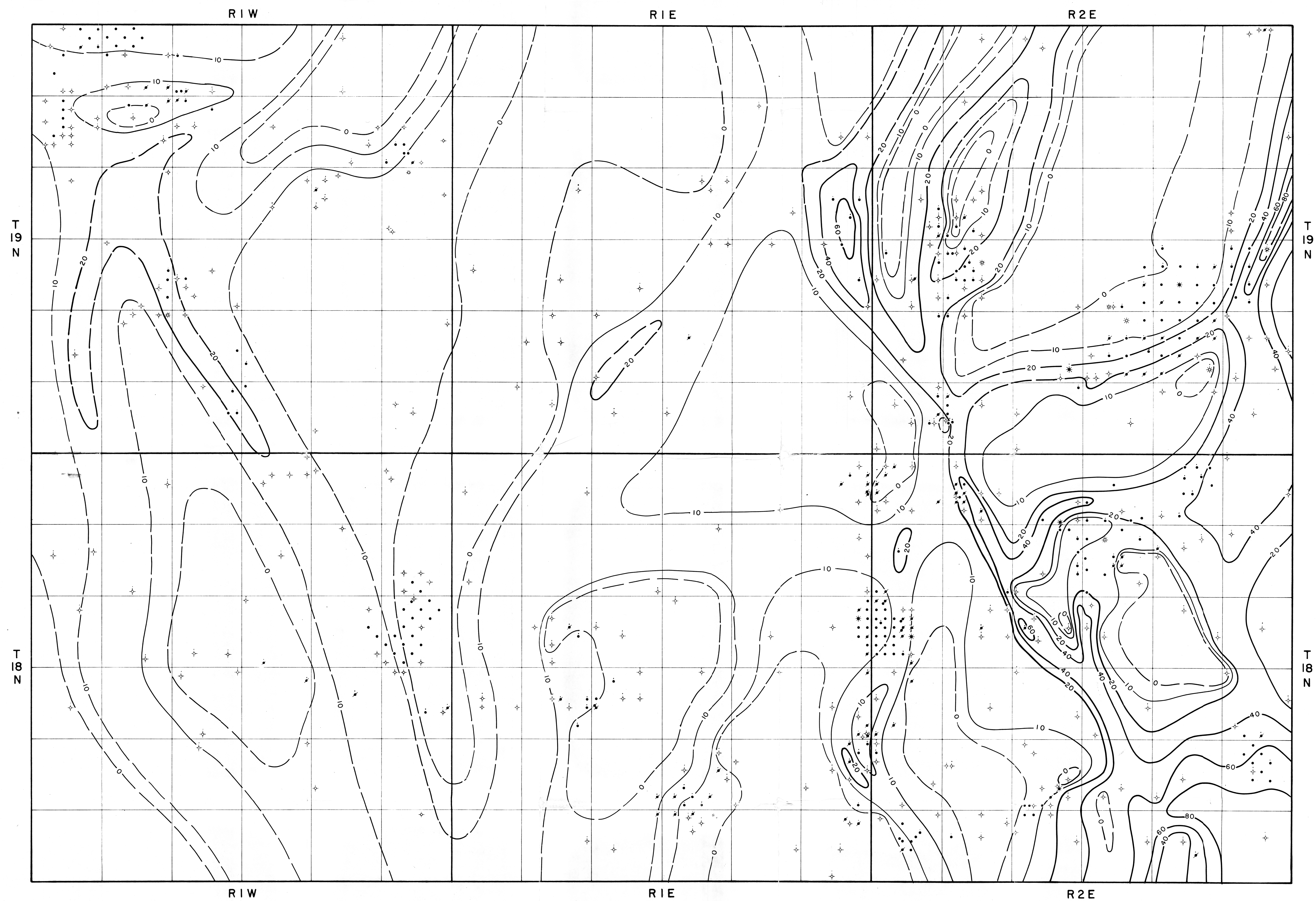
EXPLANATION

- Oil Well
- Abandoned Oil Well
- Dry and Abandoned
- Control Well
- Gas Well
- Oil and Gas Well
- Abandoned Oil and Gas Well

Raymond Dale Shipley, 1975

Figure 16


R1W
R1E
R2E
T 18 N
LOG MAP
BARTLESVILLE SANDSTONE
N
1 : 15,840
0
1/2
1 mile
100 ft.
Vertical Scale
0
Datum: Base of Inola Limestone
* Original position of datum based on nearby control
Raymond Dale Shipley, 1975
Figure 17
LOCATION MAP
NO PERMEABLE SANDSTONE
EASTERN EDGE OF DELTA FRINGE
UPPER CHANNEL DEPOSIT
DEPOSITS
MAJOR CHANNEL DEPOSIT
NO PERMEABLE SANDSTONE
NO PERMEABLE SANDSTONE
NO PERMEABLE SANDSTONE
MAJOR CHANNEL DEPOSIT
NO PERMEABLE SANDSTONE
NO PERMEABLE SANDSTONE
1
6
1
36
31
36
31
R1W
R1E
R2E



ISOPACH MAP OF NET SANDSTONE

Red Fork Sandstone

C. I. = 20' and 10'

N

SCALE 1:31,680

1 mile 0 1 mile

EXPLANATION

- Oil Well
- Abandoned Oil Well
- Dry and Abandoned
- Control Well
- Gas Well
- Oil and Gas Well
- Abandoned Oil and Gas Well

Raymond Dale Shipley, 1975

Figure 18

LOG MAP

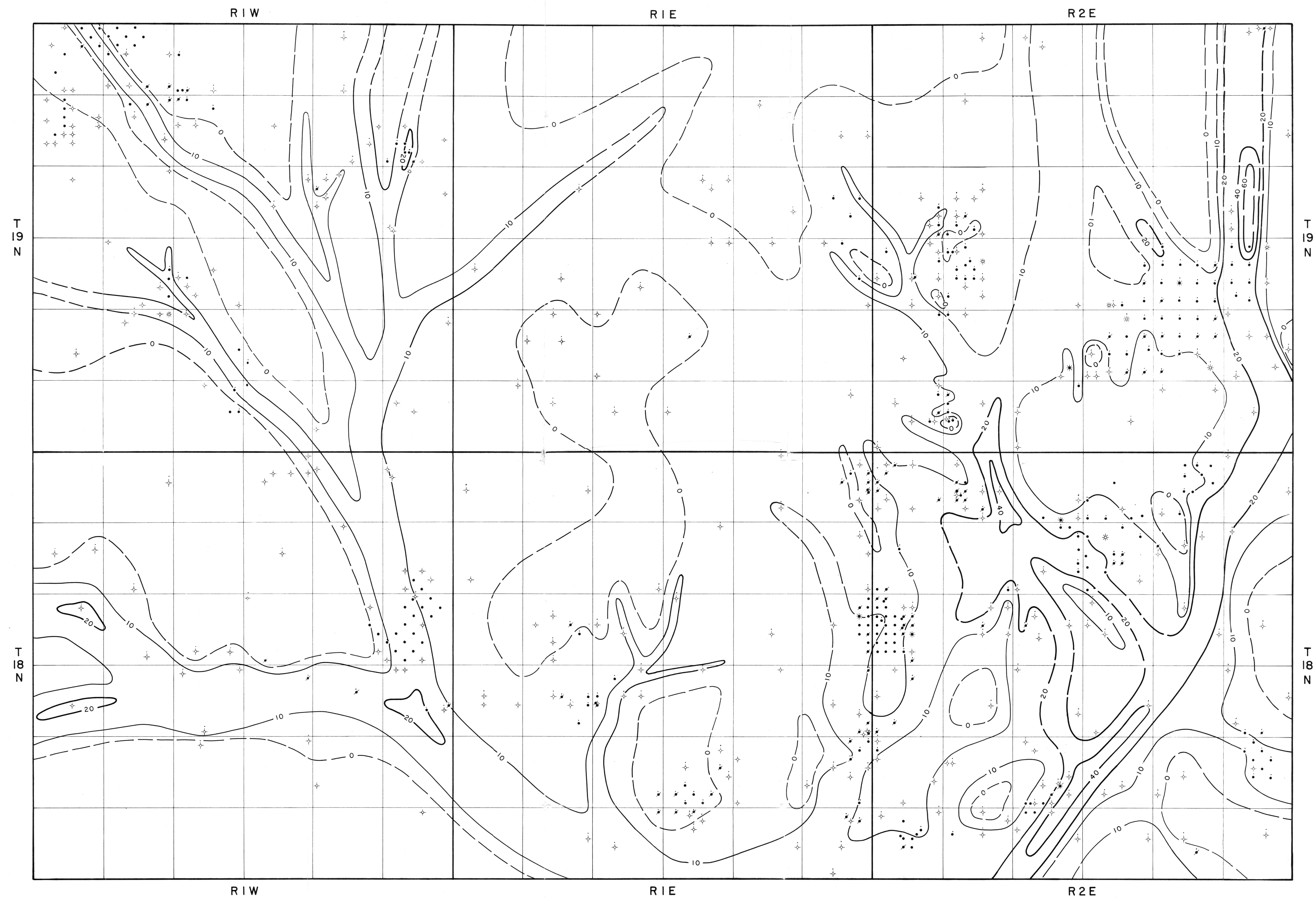
RED FORK SANDSTONE

Datum: Base of Pink Limestone

* Original position of datum based on nearby control
■ Original position of base of Inola Limestone based on nearby control

Raymond Dale Shipley, 1975

Figure 20



ISOPACH MAP OF NET SANDSTONE

Lower Skinner Sandstone

C. I. = 20' and 10'

N

SCALE 1:31,680

1 mile 0 1 mile

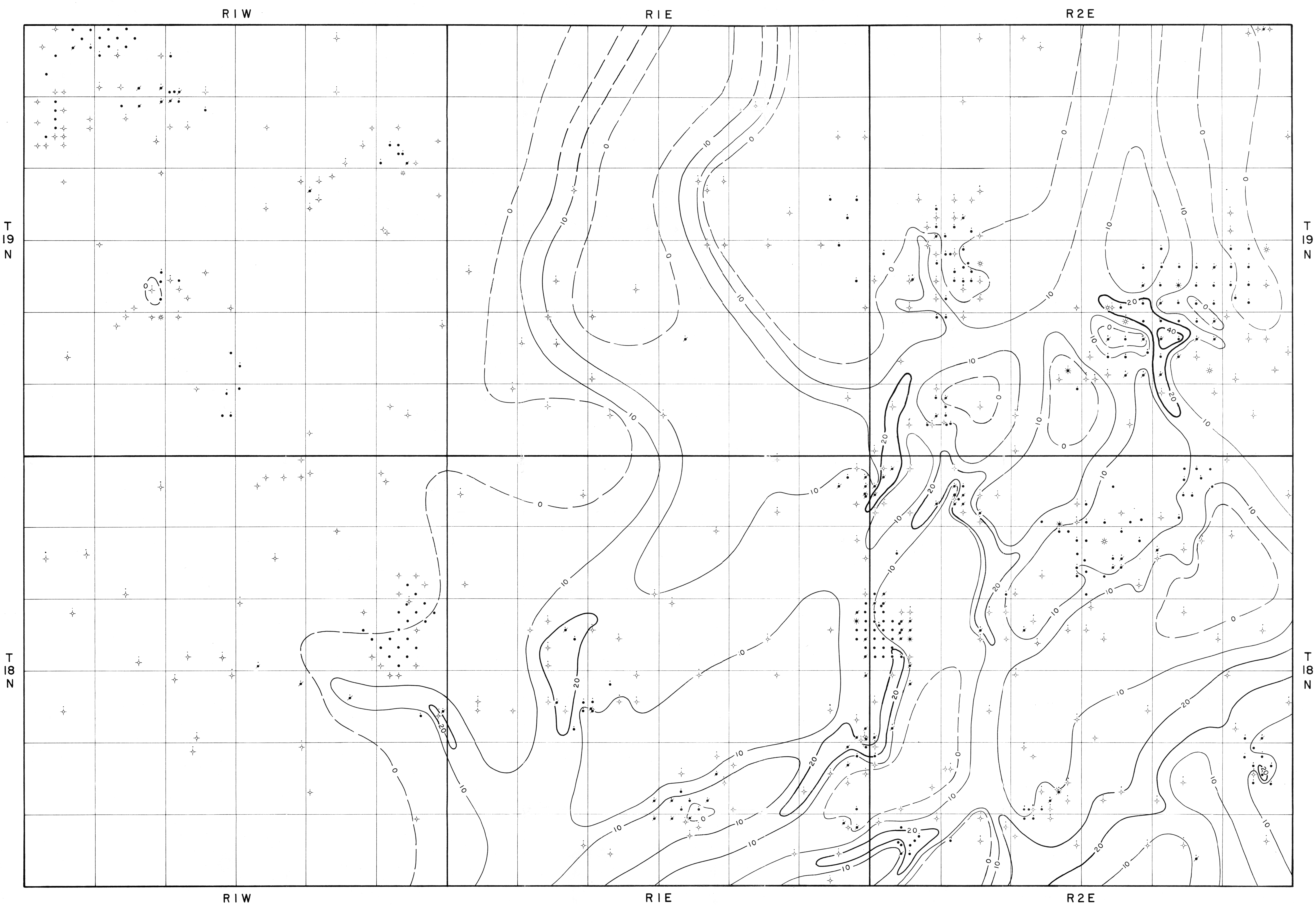
EXPLANATION

- Oil Well
- Abandoned Oil Well
- Dry and Abandoned
- Control Well
- Gas Well
- Oil and Gas Well
- Abandoned Oil and Gas Well

Raymond Dale Shipley, 1975

Figure 21


LOG MAP
LOWER SKINNER SANDSTONE
1:15,840
0
1/2
1mile
100 ft.
0
Vertical Scale
N
Datum: Base of Henryetta Coal
■ Original position of base of Pink Limestone based on nearby control
Raymond Dale Shipley, 1975
Figure 22
CROSS SECTION SHOWING LOWER SKINNER CHANNELING
X
X'
LOWER SKINNER SANDSTONE
PINK LIMESTONE
CHANNEL DEPOSIT
LOCATION MAP
R1W
R1E
R2E
MAJOR CHANNEL DEPOSIT
MINOR TREND
NO PERMEABLE SANDSTONE
MINOR DEPOSIT
R2E
R2E
T18N
T19N



ISOPACH MAP OF NET SANDSTONE

Upper Skinner Sandstone

C. I.= 20' and 10'

SCALE 1:31,680

1 mile 0 1 mile

EXPLANATION

- Oil Well
- Abandoned Oil Well
- Dry and Abandoned
- Control Well
- Gas Well
- Oil and Gas Well
- Abandoned Oil and Gas Well

Raymond Dale Shipley, 1975

Figure 23

LOG MAP

UPPER SKINNER SANDSTONE

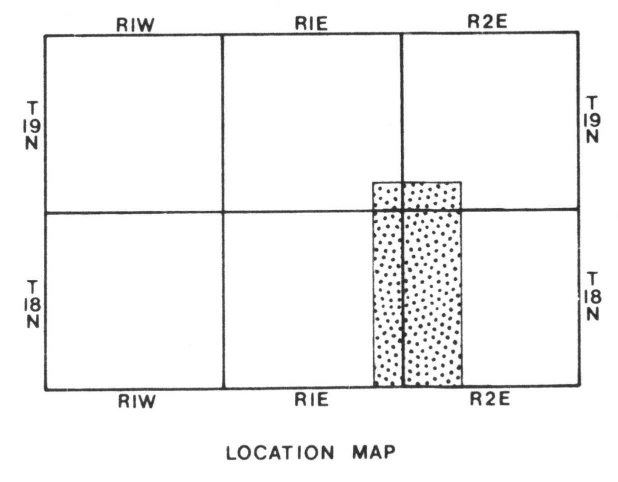
N

1: 15,840

0 ½ 1mile

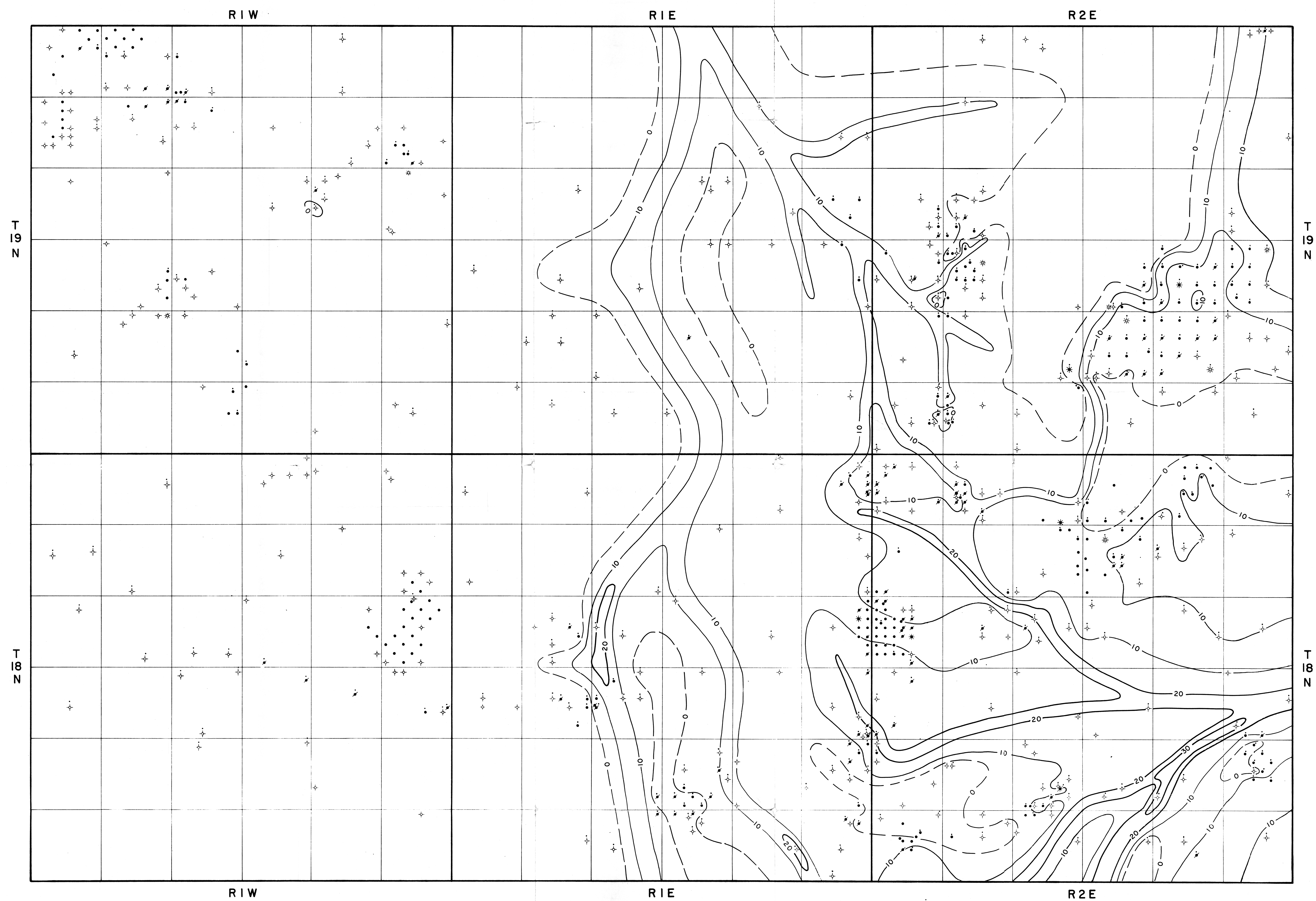
100 ft.
Vertical Scale
0

Datum: Base of Verdigris Limestone



Raymond Dale Shipley, 1975

Figure 24



ISOPACH MAP OF NET SANDSTONE

Prue Sandstone

C.I. = 10'

N

SCALE 1:31,680

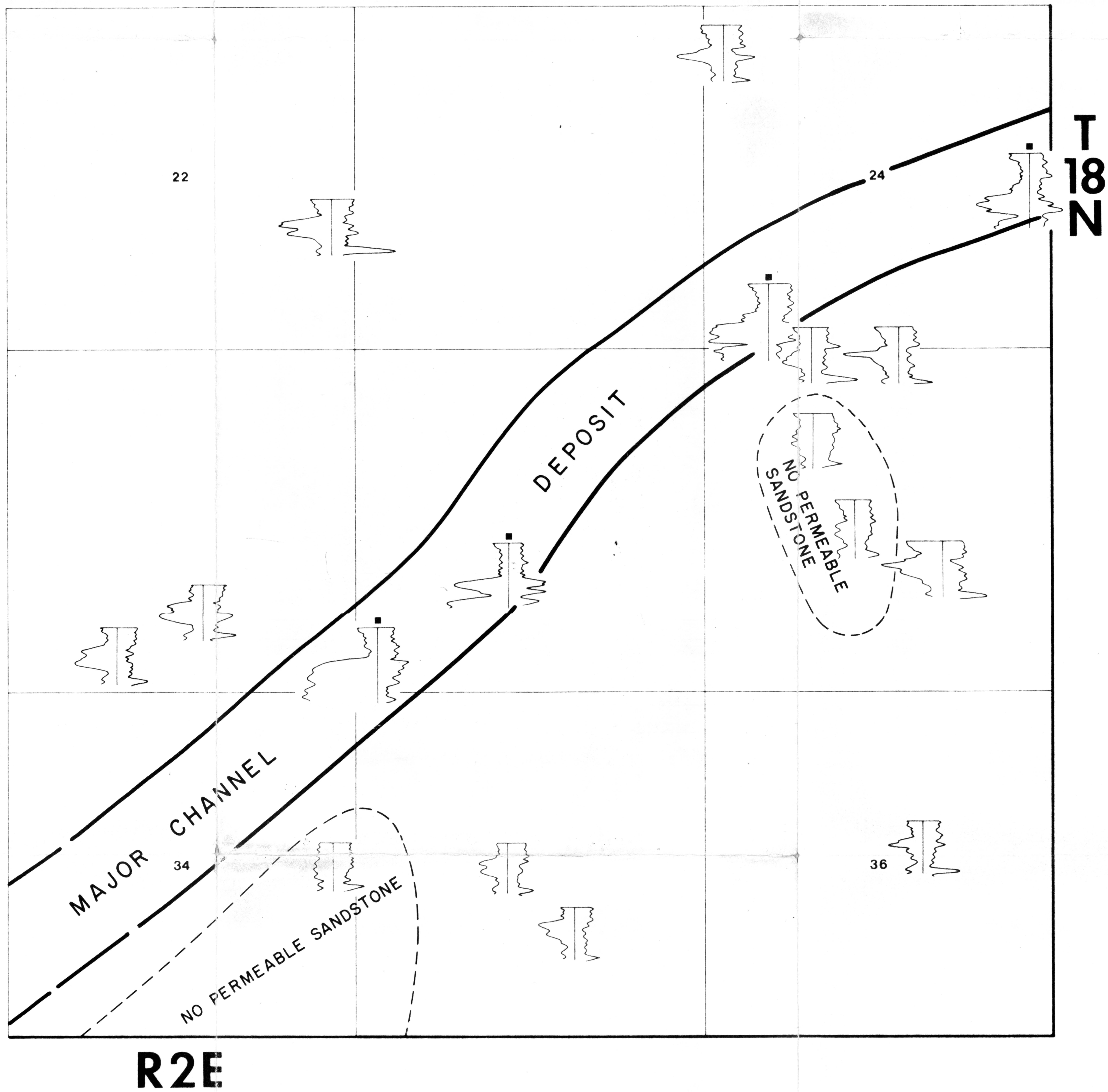
1 mile 0 1 mile

EXPLANATION

- Oil Well
- Abandoned Oil Well
- Dry and Abandoned
- Control Well
- Gas Well
- Oil and Gas Well
- Abandoned Oil and Gas Well

Raymond Dale Shipley, 1975

Figure 25



LOG MAP

PRUE SANDSTONE

N

1 : 15,840

0 ½ 1 mile

100 ft.
Vertical Scale
0

Datum: Base of Oswego Limestone

■ Original position of base of Verdigris Limestone based on nearby control

Raymond Dale Shipley, 1975

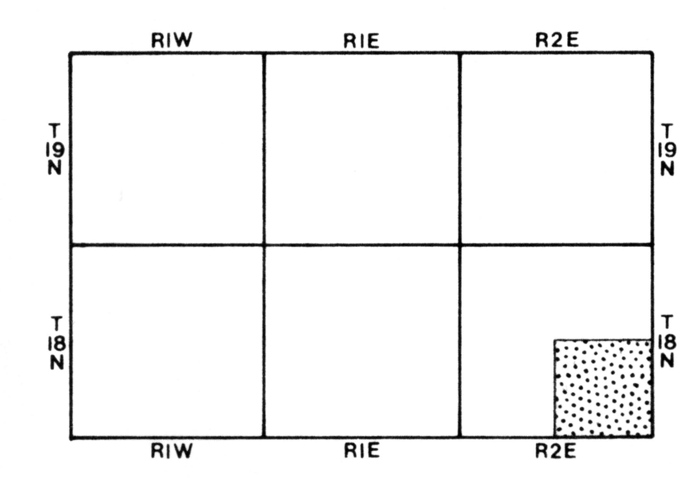


Figure 26