DISTRIBUTION OF SUBMARINE FAN FACIES OF THE UPPER RED FORK INTERVAL IN THE ANADARKO BASIN, WESTERN OKLAHOMA

BY

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Dedication

This thesis is dedicated in loving memory to Mrs. Lillian M. Fox, a very dear, lifelong friend who helped fund the research necessary for this thesis.

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Thesis Approved:

Thesis Adviser

Dean of the Graduate College

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TABLE OF CONTENTS

LIST OF FIGURES

Figure | Page

Figure		Page

Figure Page

Figure Page

Figure | Page

LIST OF TABLES

LIST OF PLATES

PLATES

CHAPTER I

ABSTRACT

Upper Red Fork sandstones within the study area exhibit a variety of facies associated with submarine fan development. Determination of submarine fan facies and their possible distribution may help to delineate depositional trends and stratigraphic trap plays of gas reservoir sandstones.

The upper Red Fork interval is defined by marker beds above and below, each representing transgressive episodes. Thicknesses of this interval exceed 1,100 feet in a local upper Red Fork depocenter within the Anadarko Basin. Regional subdivision of this interval could not be made due to the absence of continuous stratigraphic marker beds.

Data from 1,028 wire-line logs were used to construct various geologic maps and stratigraphic cross-sections vital to understanding the depositional facies trends. Core and petrographic analysis provided information used to interpret specific depositional facies.

Rocks of the upper Red Fork interval consist primarily of interbedded siltstones and shales with intervals of fine to very fine-grained sandstones. Sandstones are composed predominantly of monocrystalline quartz, metamorphic rock fragments, and feldspar grains with lesser amounts of micas, polycrystalline quartz, chert, carbonaceous material, granophyre grains, shale clasts, and heavy minerals such as

zircon. Primary porosity has been reduced significantly by compaction and cementation. Secondary porosity occurs as the result of dissolution of unstable grains and minor amounts of matrix. Pore-filling clay minerals include illite, chlorite, and kaolinite.

CHAPTER II

INTRODUCTION

Limited investigations concerning Red Fork deposition have been made in and near the study area. Within the last decade, increased drilling and production activity has generated stratigraphic and core data allowing for a more detailed study of the upper Red Fork interval in western Oklahoma.

The surface area of study includes 30 townships within the Anadarko basin; Townships 12-16 North, Ranges 19-24 West. Included in this study are portions of Roger Mills, Custer, Dewey, Beckham, and Ellis Counties in Oklahoma (Figure 1).

The age of the Red Fork interval is considered to be part of the early Desmoinesian Epoch (Series) of the Pennsylvanian Period (System), (Figure 2). The base of the Pink limestone and equivalent biomicrite/shale facies serves as the boundary of the upper Red Fork interval whereas the lower boundary is considered to be a radioactive "hot" shale marker bed. This marker bed may represent a time-stratigraphic unit of a transgressive episode which distinguishes upper Red Fork from lower Red Fork deposition (see Busch, 1971; Udayashankar, 1985).

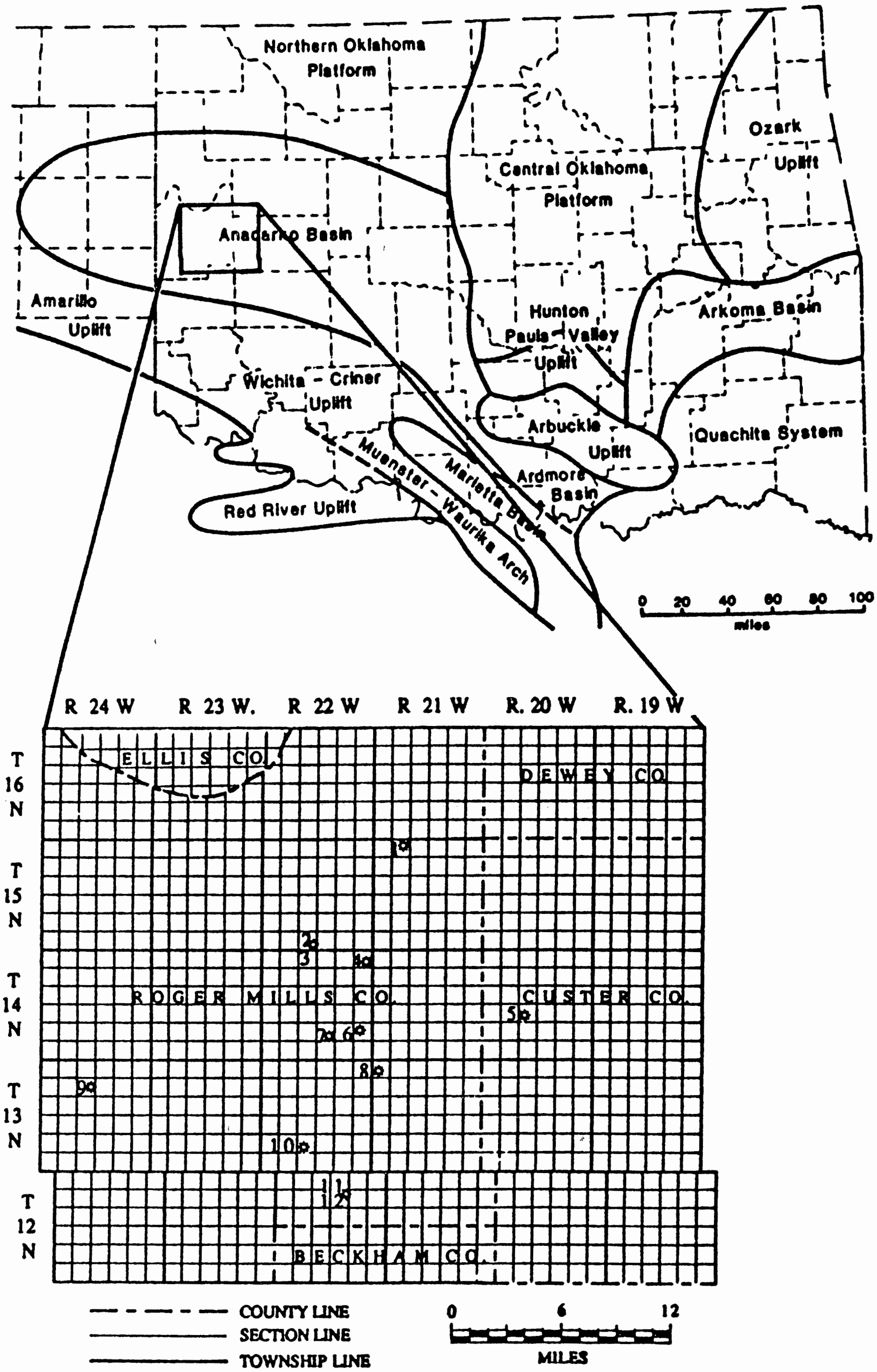


Figure 1. Map Depicting Location of Study Area with Core Locations (after Al-Shaieb and Shelton, 1977; Arbenz, 1956).

SYSTEM	SERIES	GROUP	FORMAL NAME (FORMATIONS)	FORMAL NAME (MEMBERS OR MARKER BEDS)	SUBSURFACE NAME
PENNSYLVANIAN	DESMOINESIAN	MARMATON	OOLOGAH LIMESTONE LABETTE SHALE FORT SCOTT LIMESTONE	OOLOGAH LIMESTONE FORT SCOTT LIMESTONE	BIG LIMESTONE OSWEGO LIMESTONE
		"UPPER" "CHEROKEE" KREBS	SENORA FORMATION	EXCELLO SHALE BREEZY HILL LMST LAGONDA SANDSTONE VERDIGRIS LIMESTONE CHELSEA SANDSTONE TIAWAH LIMESTONE	"CHEROKEE" HOT SHALE PRUE SANDSTONE VERDIGRIS LIMESTONE SKINNER SANDSTONE PINK LIMESTONE
		"LOWER" "CHEROKEE" CABANISS	BOGGY FORMATION	TAFT SANDSTONE INOLA LIMESTONE	RED FORK SANDSTONE INOLA LIMESTONE
	ATOKAN	ATOKAN	ATOKA FORMATION		THIRTEEN FINGER LIMESTONE

Figure 2. Stratigraphic Names of the "Cherokee Group" (after Lojek, 1983).

Objectives

The primary objectives of this study are: 1) to determine proper correlations and boundaries of the interval under study; 2) to define the geometry of the most likely hydrocarbon-bearing reservoirs; 3) to examine sedimentary structures and lithologies observed in cores and relate their facies implications; 4) to recognize facies distributions based on depositional models; 5) to analyze thin sections obtained from core to find sandstone composition and determine diagenetic changes; and 6) to suggest a depositional facies model which may be applicable to the search for stratigraphically trapped gas reservoirs.

Methods of Investigation

In order to understand and recognize the depositional facies of the upper Red Fork interval, the following methods were used. A literature search was conducted involving previous studies of the Red Fork interval in and near the study area to help discern local depositional trends and interpretations. Information regarding submarine fan depositional environments was useful in evaluating upper Red Fork sediment deposition. Numerous stratigraphic cross-sections were constructed utilizing gamma ray, dual-induction, and neutron-density porosity wire-line logs to determine acceptable correlations for the upper and lower boundary of the interval under study. Wire-line log data was used to construct net sandstone isolith, interval isopach, and structural subsurface geologic maps illustrating reservoir widths, thicknesses,

geometries, and boundaries. Analyses of 12 cores (1,300 ft.) enabled recognition of distinct depositional episodes based on sedimentary structures and lithologic changes. Petrography and diagenetic relationships were discerned by analyzing thin-sections taken from selected core intervals.

CHAPTER III

PETROLEUM GEOLOGY

The upper Red Fork sandstones are prolific gas and condensate reservoirs within the study area. Upper Red Fork sandstones produce from "tight" fine- to very fine-grained sandstones associated with stratigraphic traps. Impermeable shales encase reservoir sands and may serve as source rock (Hatch and Leventhall, 1982). Better porosity is developed in channel-type sandstones. Many of these sandstones show gas effect crossover in neutron-density porosity wire-line logs.

The first well drilled to the Red Fork interval in the study area is the United Carbon Company Clark Unit No. 1, located in Section 32, T.12N., R.21W. It was completed in November 1951 and produced from shallower "Deese" sandstones.

The first Red Fork well cored was reported in March of 1951 by the Gulf Oil and Sinclair Oil & Gas Companies. The Sprowls No. 1, located in Section 28, T.13N., R.23W., was dry and abandoned with gas shows in upper zones. Interestingly, had this well been drilled just to the southeast (down dip), the companies would have encountered much thicker sandstones with good gas reservoirs and exploration might have been established much earlier within the area.

Red Fork gas production was discovered when wells were drilled to test Morrowan age sediments. The first Red Fork gas well was completed December 29, 1976, by Apexco and is located in Section 11, T.12N., R.24W. Labeled the Bowers State No. 1, this well produced from lower Red Fork perforations at depths from 13,982 to 14,036 ft. Initial production was reported at 2,959 mcf gas per day with total cumulative production reaching 630,892 mcf. The longest producing lower Red Fork gas well is the Inexco, Inc., Lippencott No. 1, located in Section 4, T.13N., R.24W. Completed June 6, 1977, this well has produced 602,695 mcf of gas as of July 1, 1990.

Earliest upper Red Fork gas production began September 22, 1977, when Hoover & Bracken, Inc., completed the South Unit No. 1-8. This well, located in Section 8, T.16N., R.20W, was an extension of the Leedey Field. Production is commingled Oswego and upper Red Fork with upper Red Fork perforations at depths of 10,751 to 10,756 ft. As of July 1, 1990, production from this well had reached 1,114,029 mcf. On March 11, 1978, Apache Corporation completed the Vick No. 1 in Section 31, T.13N., R.22W. This was the discovery well of the South Strong City Field, which was later integrated into the extensive Strong City Field District. This well has produced 4,142,439 mcf of gas as of July 1, 1990, and 237,944 mcf from January 1 to July 1, 1990, from Red Fork sandstones at depths from 13,476 to 13,662 ft. Numerous wildcat wells were subsequently drilled and gas discoveries made within the Red Fork sandstones.

The most extensive and productive gas field is the Strong City Field. Cumulative gas production for this field as of July 1, 1990, was 343,748,406 mcf (Petroleum Information). Numerous gas fields have been developed within the study area (Figure 3).

The most productive Red Fork sandstones are located in T.15 & 16N., R.21W. The Woods Petroleum Corporation, Smith No. 1-33, Section 33, T.16N., R.21 W., was completed on January 10, 1980, and has produced 17,058,784 mcf of gas (Petroleum Information). Cumulative gas production from Red Fork sandstones within the study area as of July 1, 1990, was 736,467,111 mcf of gas (Table II, Appendix A). Total field production within the area is listed in Table 1.

The potential for future gas production and development within the area is very good as the depositional environment and sandstone trends become more discernible with subsequent drilling.

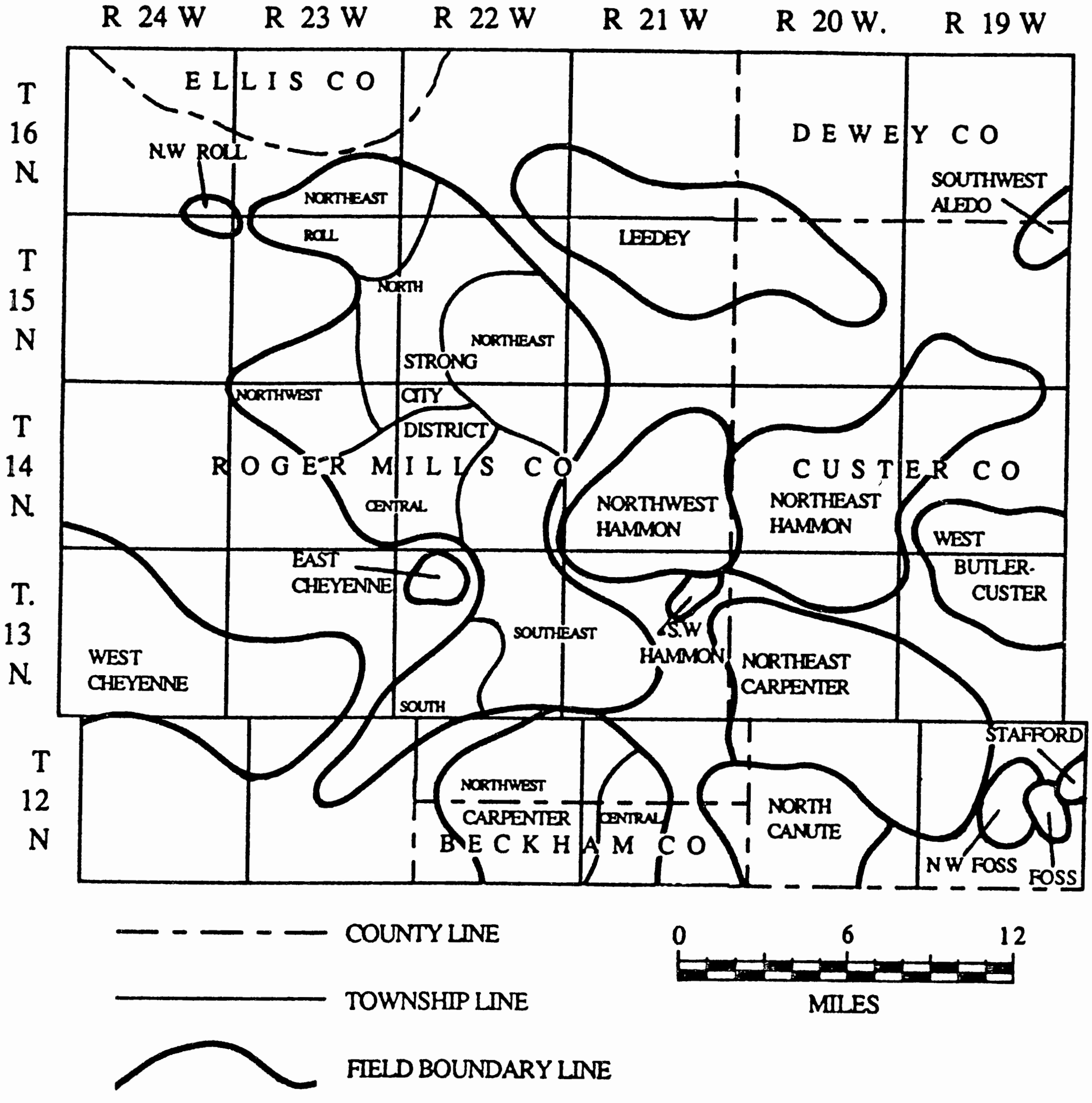


Figure 3. Map Delineating Locations and Names of Gas and Condensate Fields Which Produce from Red Fork Sandstones.

TABLE I

TOTAL PRODUCTION BY FIELD*

Field Name	Discovery Date	Cumulative Gas (MCF)	Cumulative Cond. (bbl)
S.W. Aledo	5/72	18,551,865	498,911
West Butler-Custer	2/82	13,683,896	568,096
North Canute	9/62	90,782,329	1,208,189
Carpenter	1/71	270,664,071	641,773
N.E. Carpenter	11/80	50,292,856	858,601
East Cheyenne	4/81	878,512	7,259
West Cheyenne	11/76	359,198,838	41,698
Foss	10/82	9,803,300	18,993
N.W. Foss	10/82	6,883,120	62,862
East Hammon	2/82	40,879,433	748,333
N.W. Hammon	8/81	13,643,851	158,136
S.W. Hammmon	8/80	932,128	243
Leedey	8/70	27,606,553	314,057
N.W. Roll	12/69	505,271	10,823
Stafford	3/82	12,157,233	175,503
Strong City	7/80	343,748,406	3,684,714

* Red Fork producing fields are listed, although production may include other producing formations.

From Petroleum Information, July, 1990.

CHAPTER IV

PREVIOUS INVESTIGATIONS

Numerous geologic studies have been completed in or near the area of investigation (Figure 4). McElroy (1961) studied the Cherokee Group on a regional scale to the northeast of the study area. His interpretations of the Red Fork were highly generalized. He determined that the sandstones occurred in lenses and thinned by onlap over structures. Withrow (1967) interpreted his regional study of the Red Fork sandstones in the Wakita Trend as deposition of offshore bar and beach deposits. Thalman (1967) examined the Oakdale Field to the west of Withrow's (1967) area and suggested that the sandstone trends represented erosional channels of a delta distributary channel with associated bar fingers or river bars. Berg's (1969) regional study concluded the Red Fork sandstones were deposited in a distributary system in the northeast area, barrier-island facies in the north, and marine-shelf facies in the western area. He also suggested that the Nemaha Ridge may have acted as a structural barrier for sediment sources to the north and east, evidenced by thicker sandstone deposits on the east side of the Nemaha Ridge. Glass (1981) determined his study area consisted predominantly of a fluvial system. Lyon (1981) divided the Red Fork sandstones into an upper, middle, and lower interval. He interpreted the depositional environment as channels deposited between episodes of

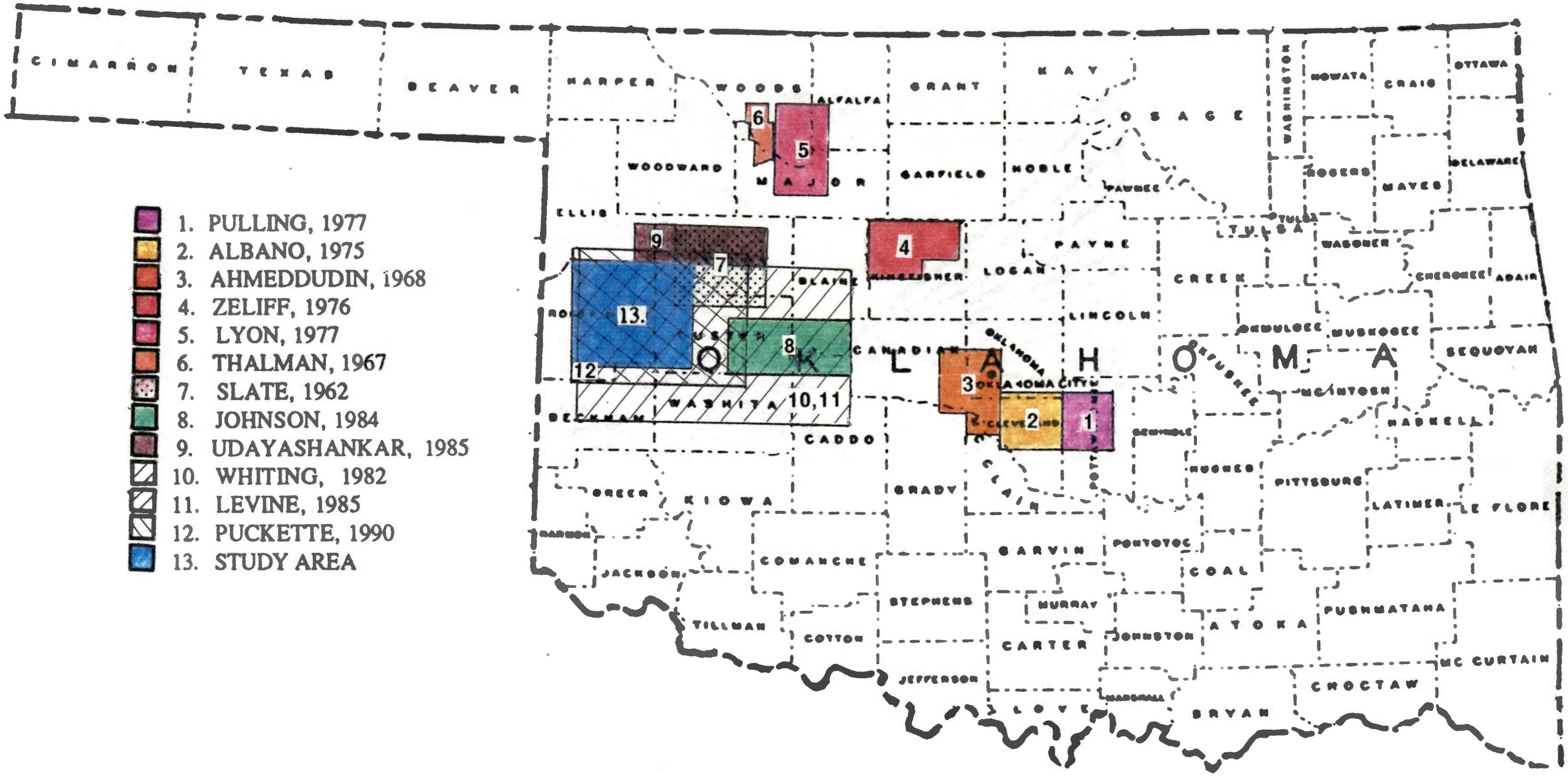


Figure 4. Map Showing Selected Previous Investigations in and near the Study Area.

transgression.

To the east, Zeliff (1976) interpreted the Red Fork environment of deposition as that of fluvial, downcutting, meandering channels with the upper Red Fork recording possible shallow marine deposition along with channeling.

Ahmeddudin (1968), Dogan (1969), Albano(1975), and Pulling (1977) agreed that the Red Fork sandstones were deposited primarily in deltaic distributary environments. Slate (1962) studied the petroleum geology in and to the east of the study area and described the Pink Limestone and Red Fork sandstone but did not infer a depositional environment.

Recent studies include Johnson (1984) and Udayashankar (1985). Johnson suggested possible lower Red Fork depositional environments in his area as being those of delta front, submarine channel fill, and submarine-fan. He mapped a lower Red Fork hinge line within this area. Upper Red Fork deposition was interpreted as deltaic in origin with the East Clinton field possibly representing the maximum progradation of a deltaic complex (Johnson 1984). Udayashankar delineated an upper and lower Red Fork based on a calcareous marker bed separating the two. His interpretation was that of a deltaic distributary channel depositional setting (Udayashankar, 1985).

Whiting (1982), Levine (1985), and Puckette (1990) completed regional studies. Whiting (1982) suggested the entire Red Fork interval within his area of study was deposited as channelized turbidity currents. His study was based on examination of 5 cores and a limited number of well-logs. One core of Whiting's study was examined in this study. Levine (1985) used the same cores from Levine's study for a provenance study of the Red Fork. He determined the source for the upper Red Fork sandstones (within this area of investigation) was to the south and implied deposition due to turbidites. Puckette (1990) used the upper Red Fork and Pink Limestone to define the Krebs-Cabaniss boundary of the Cherokee Group in his study area.

CHAPTER V

GEOLOGIC SETTING

Regional Structural Geology

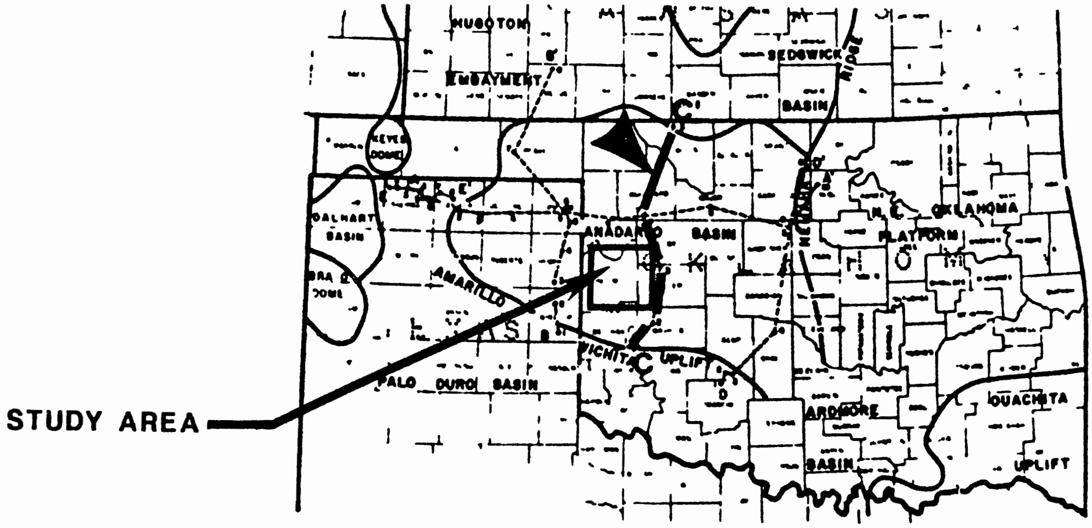
This study area consists of 30 townships situated centrally within the Anadarko Basin (Figure 1, p. 4). The area is bounded to the east by the Nemaha Ridge, to the north by the Northern Oklahoma Platform, and to the south by the Wichita-Amarillo Uplift (Arbenz, 1956).

The Anadarko Basin axis trends west-northwest paralleling the Amarillo-Wichita Mountains. The basin covers much of western Oklahoma and contains a maximum thickness of sediments in excess of 40,000 ft. (Hill, 1980). A gently dipping northern flank and steeply dipping southern flank form the asymmetrical basin (Figure 5).

The southern faulted margin of the basin is characterized by thrusting (Good, et al., 1983) and by strike-slip faulting (Hansen, 1978). The northern boundary of the Wichita frontal system is the Mountain View Fault (Figure 6). This fault is located just to the south of the study area (Figure 7).

Local Structural Geology

Structural geologic maps were constructed using the base of the Pink Limestone and equivalent biomicrite/shale (Plate I) and the base of the upper Red Fork interval



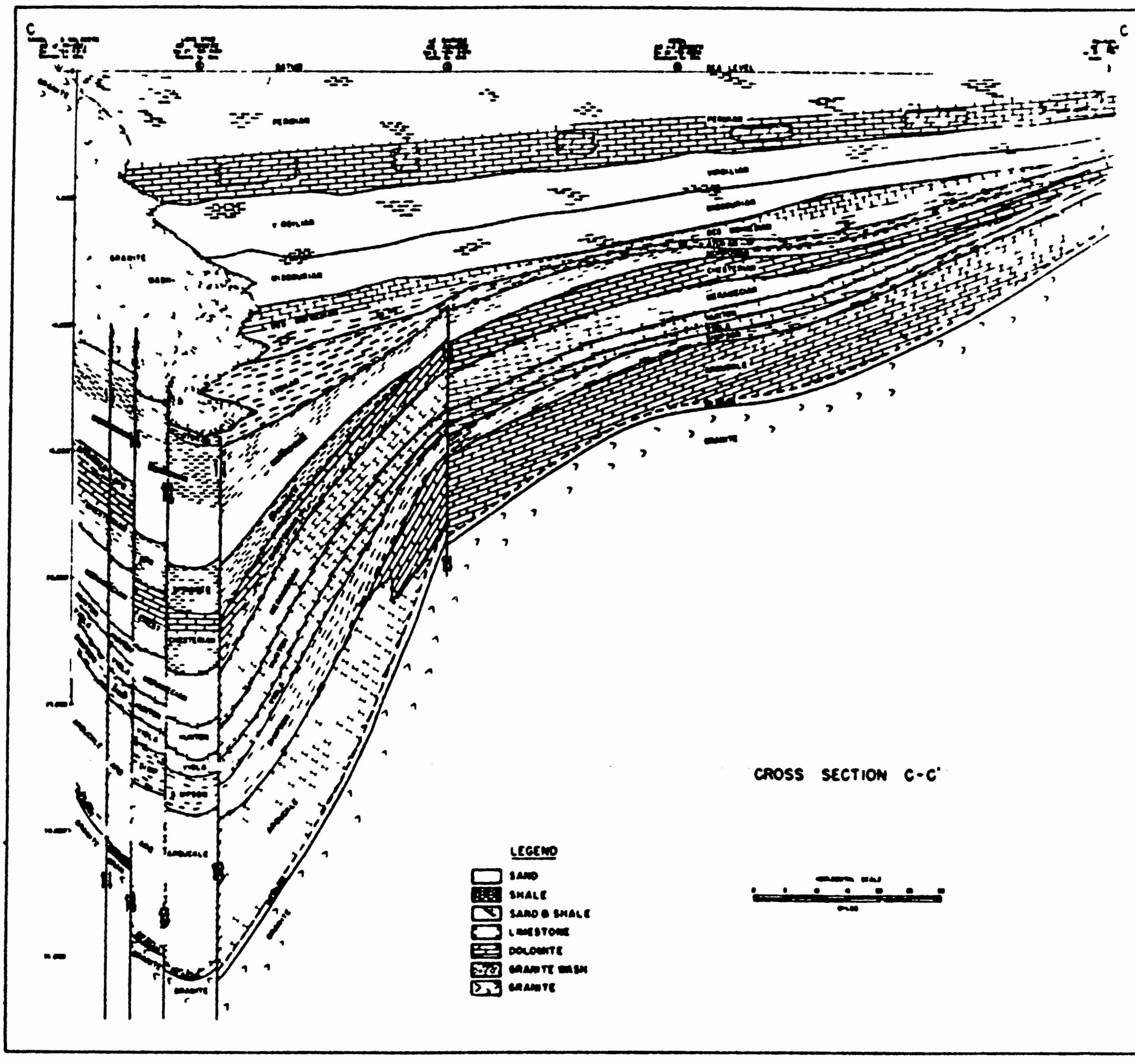


Figure 5. Cross-Section Illustrating the Asymmetrical Profile of the Anadarko Basin (from Hill, 1980).

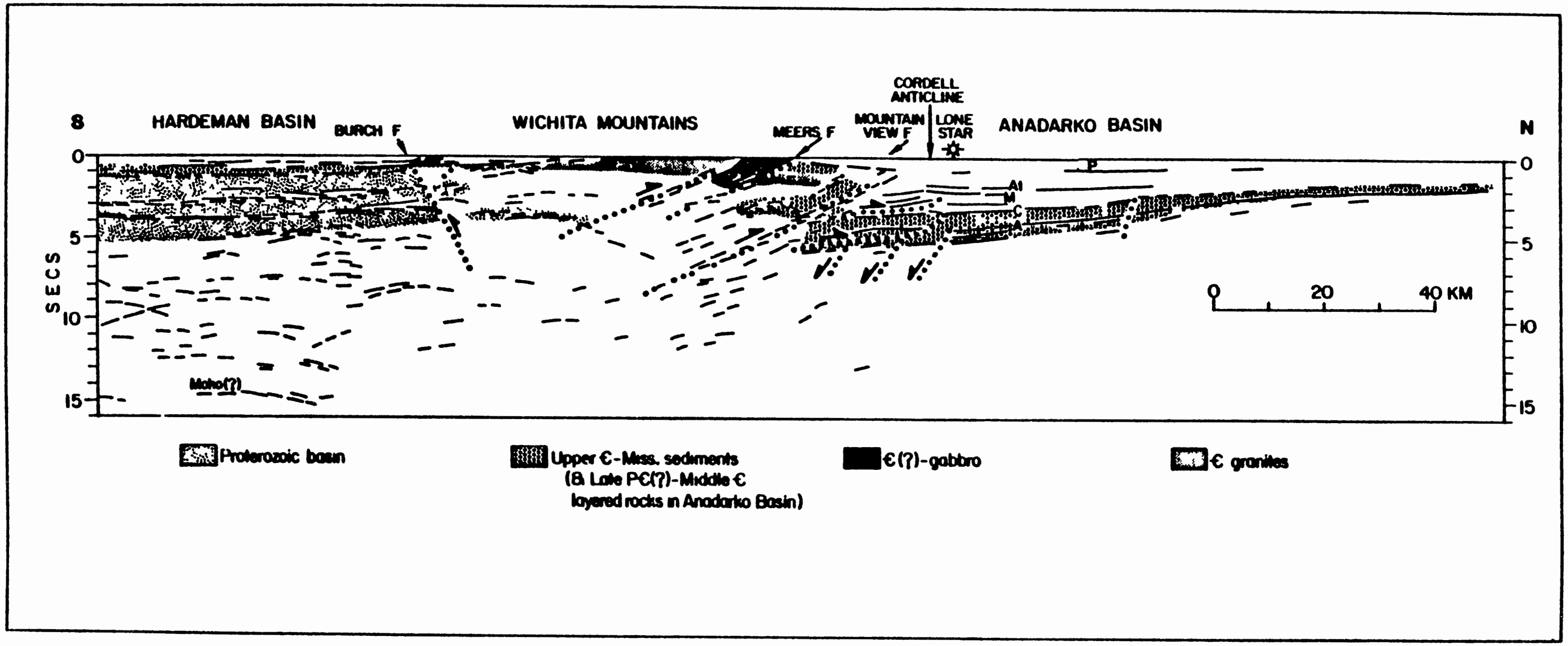


Figure 6. Interpreted Seismic Structures of the Wichita Mountain Thrust Faults and Northern Boundary of the Wichita Frontal System; Location in Figure 7. (from Good, Brown, Oliver, and Kaufman, 1983).

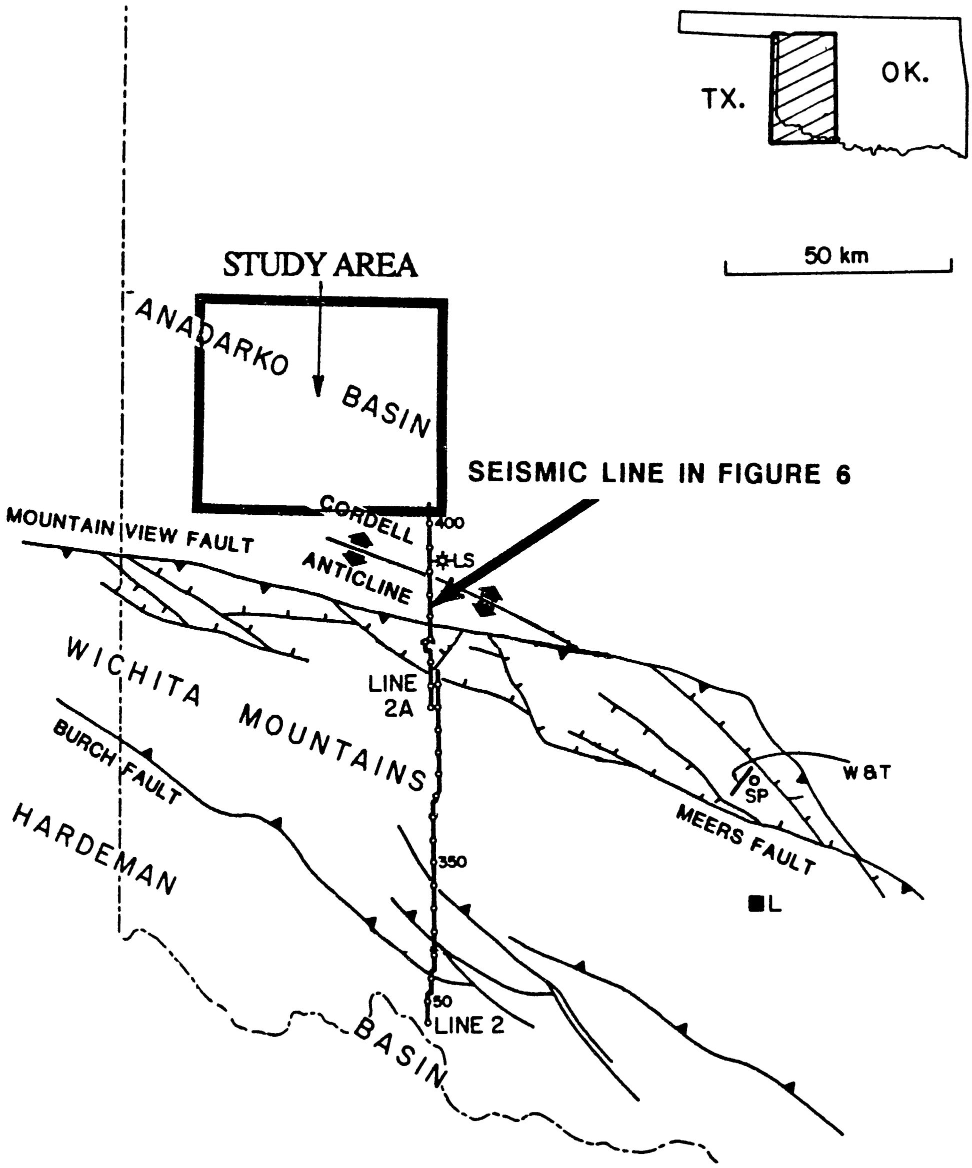


Figure 7. Location of the Study Area Relative to the Mountain View Fault and Other Local Structures. (from Good, Brown, Oliver, and Kaufman, 1983).

(Plate II).

The top of the upper Red Fork interval (base of the Pink Limestone) structure map shows west-northwest striking beds in the extreme eastern and western areas with predominantly east-west strike in the central areas (Figure 8). Dip ranges from approximately 100 feet per mile in the central portion of the map to approximately 300 feet per mile in the southwest area. Dips of approximately 150 feet per mile occur in the northeastern portion of the study area. Anticlinal and synclinal structures occur throughout the mapped area but are more easily recognized in the northeastern area. An anticlinal structure is interpreted in T.12N., R.20 W.

Structural contouring on the base of the upper Red Fork interval indicates primarily east-west striking beds with west-northwest strike in the eastern areas of the map (Figure 9). Dip angles range from approximately 1^{o} in the south-central areas to 3^{o} degrees in the southwestern area The best developed anticlinal and synclinal features occur in the southeastern and northeastern portions of the map.

Faulting is not readily evident within the study area due to sparse well control.

Pre-Red Fork Sedimentation

Originally referred to as a possible aulacogen (Schatski, 1946), the Anadarko Basin has undergone significant subsidence since the basin began forming approximately 525 million years ago (Feinstein, 1981).

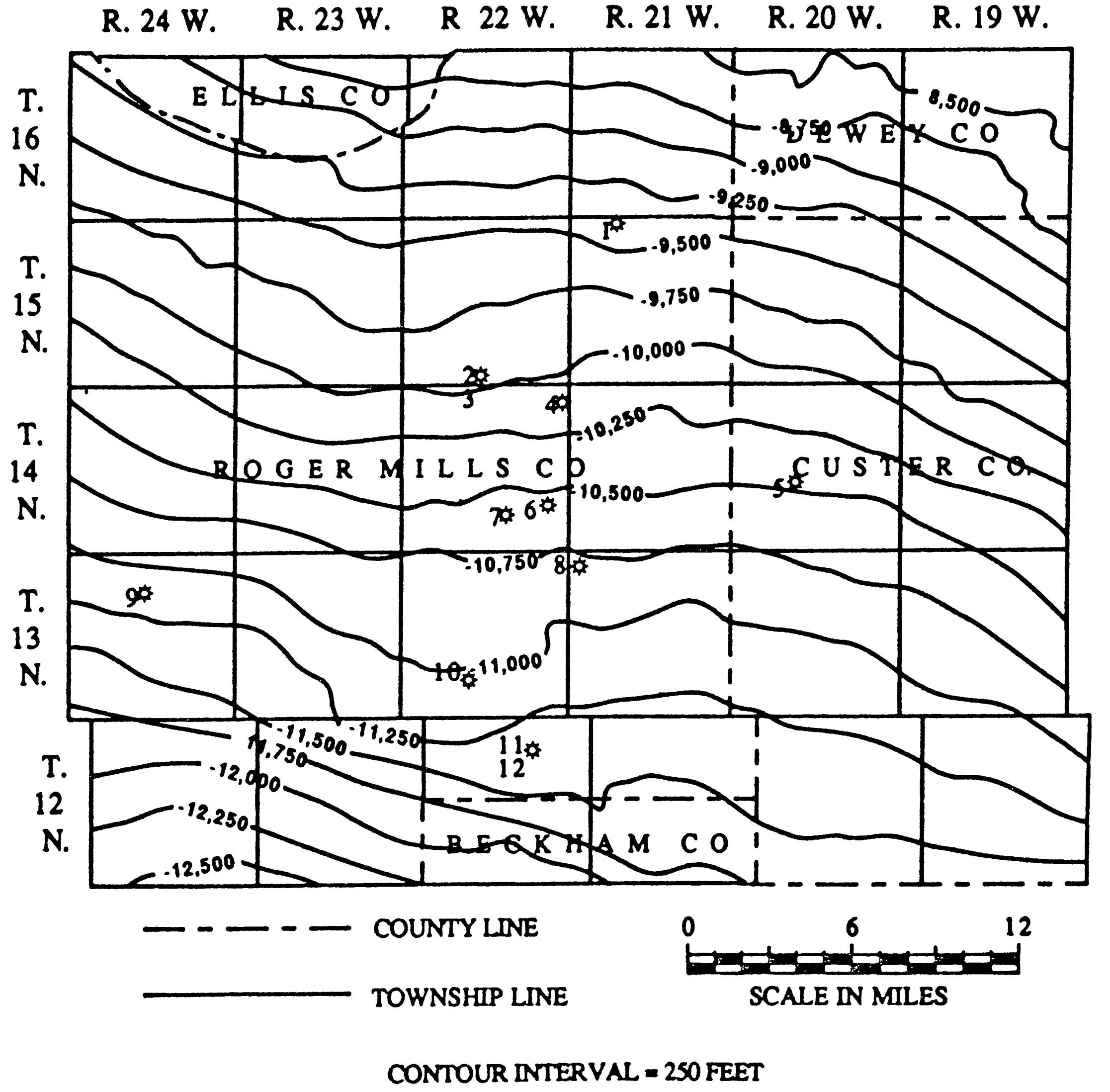


Figure 8. Structural Subsurface Map of the Top of the Upper Red Fork Interval (Constructed on the Base of the Pink Limestone and Equivalent Biomicrite/Shale).

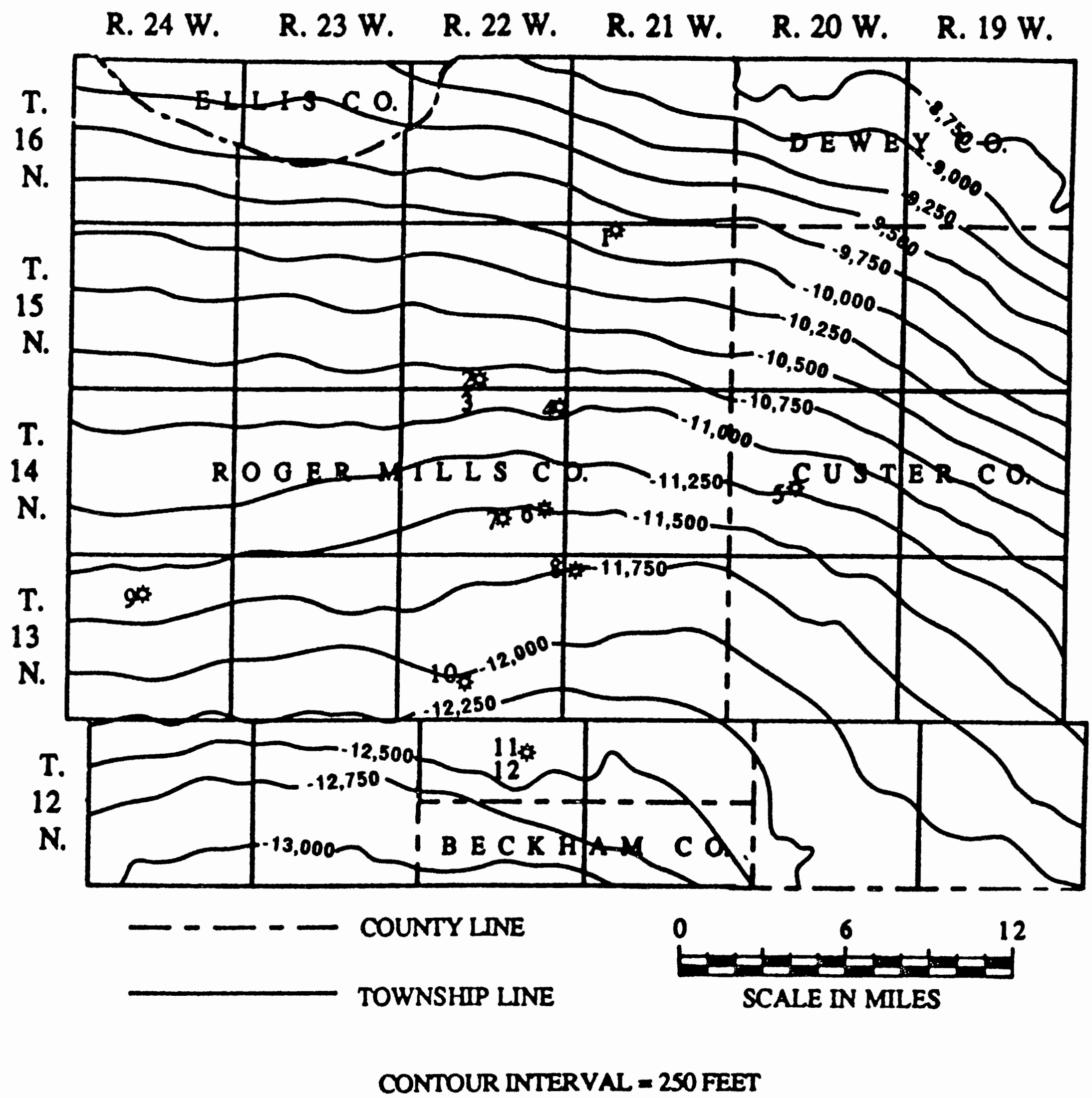


Figure 9. Structural Subsurface Map of the Base of the Upper Red Fork Interval (Constructed on the "Hot" Shale Marker Bed).

Described as part of the Southern Oklahoma Aulacogen (Burke and Dewey, 1973), the failed arm of the Dallas Triple Junction began during the Cambrian System with the rifting stage. This stage was characterized by the formation of intrusive and extrusive rocks followed by subsidence and deposition of thick carbonates with intervals of clastic sedimentation.

Subsidence from late Devonian-Mississippian through Permian ages was due to the closure of the Proto-Atlantic Ocean (Garner and Turcotte, 1984). Epeiric sea development during early Mississippian times covered much of the craton and resulted in deposition of dark shales within the Anadarko Basin (Ham and Wilson, 1967). The Upper Mississippian Chesterian Series represents regression of the epeiric seas covering the continent (Rascoe and Adler, 1983). Subsidence in the basinal areas and deposition of clastic sediments occurred during the Mississippian (Garner and Turcotte, 1984).

The Pennsylvanian System deformational episodes produced the present-day structural elements in Oklahoma. The pre-Pennsylvanian unconformity of the mid-continent formed as a result of the pre-Morrowan epeirogeny in which regional areas were uplifted and erosion occurred (Ham and Wilson, 1967). Onlapping sediments were formed during the lower Pennsylvanian Morrowan marine transgression. The presence of clean, well-sorted, non-glauconitic, and non-calcareous sandstones deposited in the Anadarko Basin indicate minor marine regressive episodes with relative high energy environments (Rascoe and Adler, 1983).

Atokan-age sediments represent the period of extensive uplift and erosion of the Wichita-Amarillo Mountains. Uplift along the Frontal Wichita Mountains, as much as 30,000 feet (Webster, 1980), allowed for extensive erosion and deposition of extreme thicknesses of granite wash sediments (Moore, 1979).

A more detailed depositional analysis of pre-Red Fork and post-Red Fork sediments is beyond the scope of this study.

CHAPTER VI

STRATIGRAPHIC FRAMEWORK

The Red Fork sandstone is a member of the Krebs Group, the lowest group of the Desmoinesian Series of the Pennsylvanian System (Oakes, 1953). The Krebs and Cabaniss groups of Oklahoma are nearly stratigraphically equivalent to the Cherokee Group in Kansas (Oakes, 1953). In Kansas, the term "Cherokee" group was first used by Haworth and Kirk (1894) for the sequence of black shales below the Pennsylvanian "Oswego" (Fort Scott) Limestone and above the Mississippian age strata in Cherokee County, Kansas (Withrow, 1968). This term was adopted by Kansas and Missouri in 1956 with the "Krebs" and "Cabaniss" reduced to subgroups (Howe, 1956). Though technically incorrect, numerous studies in Oklahoma have referred to the Krebs and Cabaniss Groups as the "Cherokee" Group. Widespread usage of this term in the petroleum industry still persists.

Early Red Fork sandstone subsurface equivalents include the Chicken Farm sandstone of Oklahoma County and the Earlsboro sandstone of Pottawatomie County, Oklahoma (Jordan, 1957), while the general term "Deese" was applied to all of the Cherokee group sandstones. The surface equivalent of the Red Fork sandstone is the Taft sandstone.

The Red Fork interval is defined as the interval from the base of the Pink Limestone to the top of the Inola Limestone on the shelf. These limestone units are easily recognizable in the extreme northeast portion of the study area (Figure 10). The Pink and Inola limestones change lithologically into dark biomicrite and shales and become difficult to recognize basinward (Figure 11).

Correlations

Studies near the thesis area have subdivided the Red Fork interval into upper and lower Red Fork (Johnson, 1984; Udayashankar, 1985). The marker bed used to differentiate these intervals is used in this study area. The upper Red Fork interval may be further subdivided (Anderson, pers. comm., 1990). However, the absence of a regionally recognized marker bed does not allow for easy subdivision of the upper Red Fork interval. Therefore, the interval is referred to as upper Red Fork throughout this study.

The top of the upper Red Fork interval is defined as the base of the Pink Limestone in the northeast and its equivalent dark biomicrite/shale in the remainder of the area. The biomicrite/shale is easily recognizable on 1" = 40' large scale gamma-ray and dual-induction wire-line logs and is fairly distinguishable on neutron-density porosity logs as well. Examination of core suggests that this interval may contain a disconformity surface between the overlying Pink Limestone equivalent biomicrite/shale and the top of the Red Fork interval (see Figure 104, App. C, p. 187). This biomicrite/shale is unrecognizable in western areas due to Skinner deposition, but the characteristic decrease in resistivity is recognized for correlation.

The lower boundary of the upper Red Fork interval is a

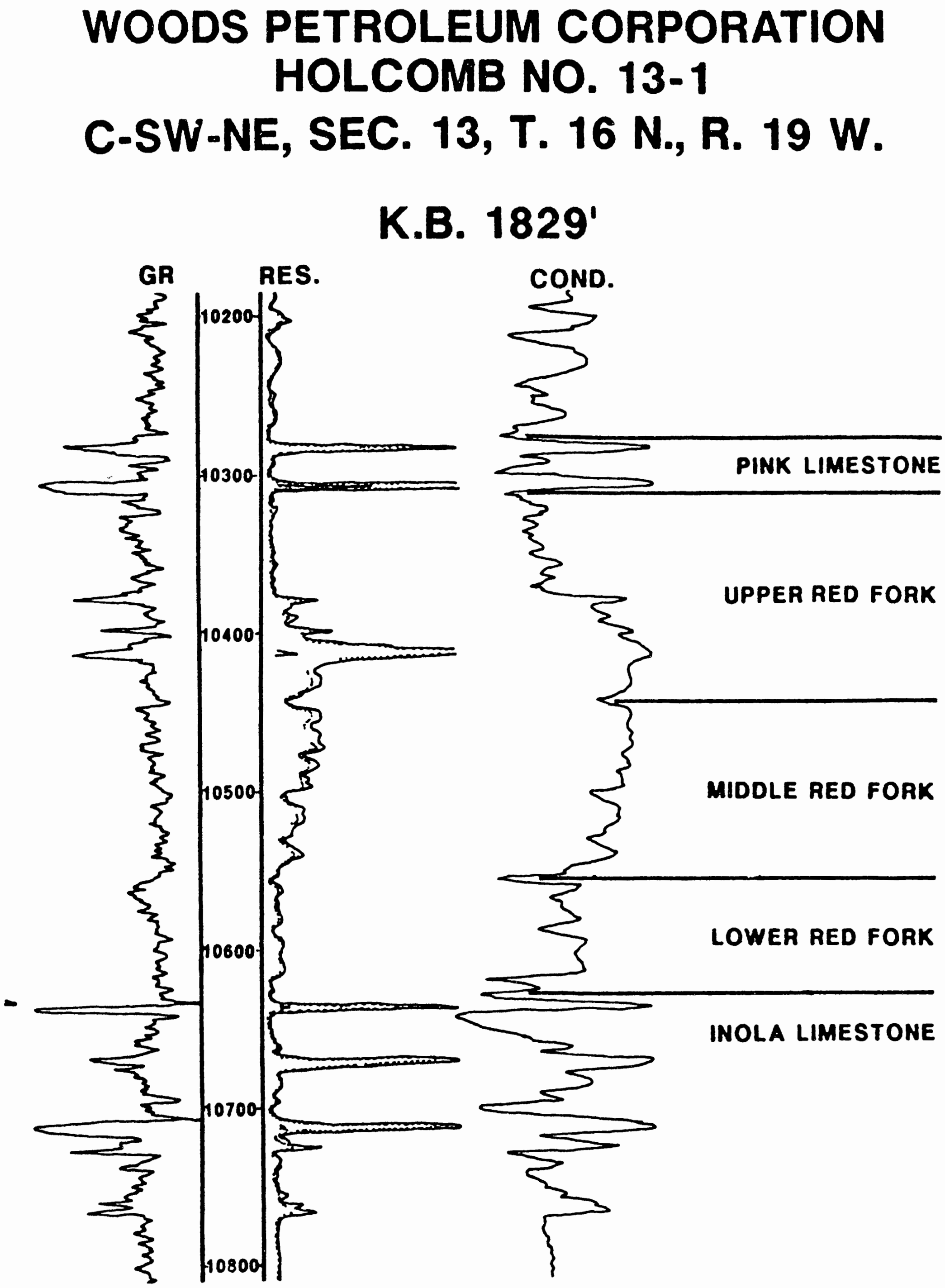


Figure 10. Type Wire-Line Log Showing Stratigraphic Markers on Shelf Area in Northeastern Portion of Study.

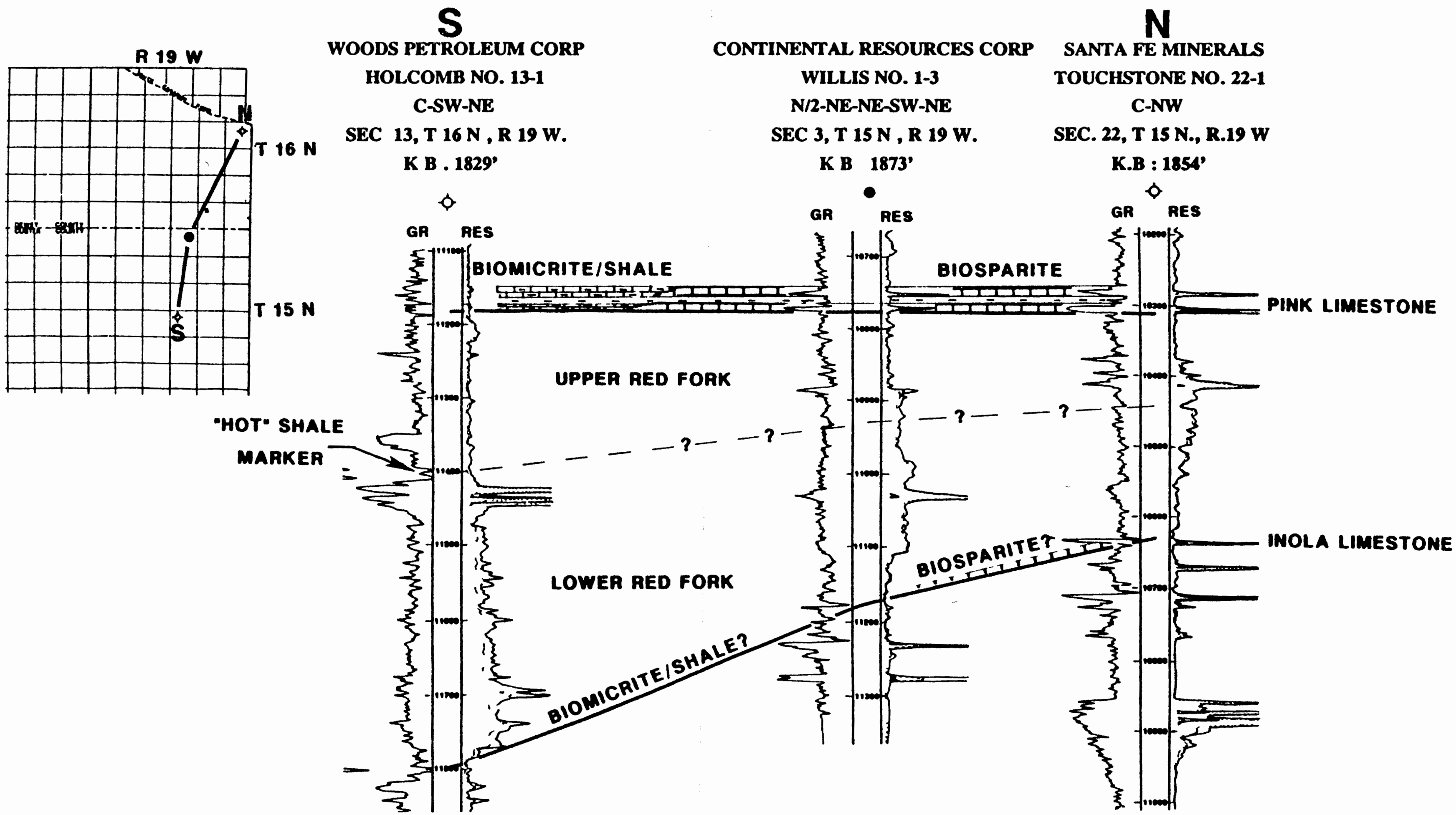


Figure 11. Local Stratigraphic Cross-Section in North-eastern Portion of Study Area Showing Changes in Wire-Line Log Signatures of Pink and Inola Limestones Due to Lithologic Changes.

"hot" radioactive shale separating the upper from the lower Red Fork interval. This hot shale is assumed to be a time-stratigraphic marker bed and is used to delineate a genetic increment of strata (see Busch, 1971). This hot shale is present and correlative throughout the study area with exception to the northeast area (Figure 12). Difficulty in correlating the boundary between the upper and lower Red Fork in the extreme northeast corner is attributed to poor well control, as well as changes in depositional environments. This boundary was also recognized by Udayashankar (1985) to the north and Johnson (1984) to the east of the study area.

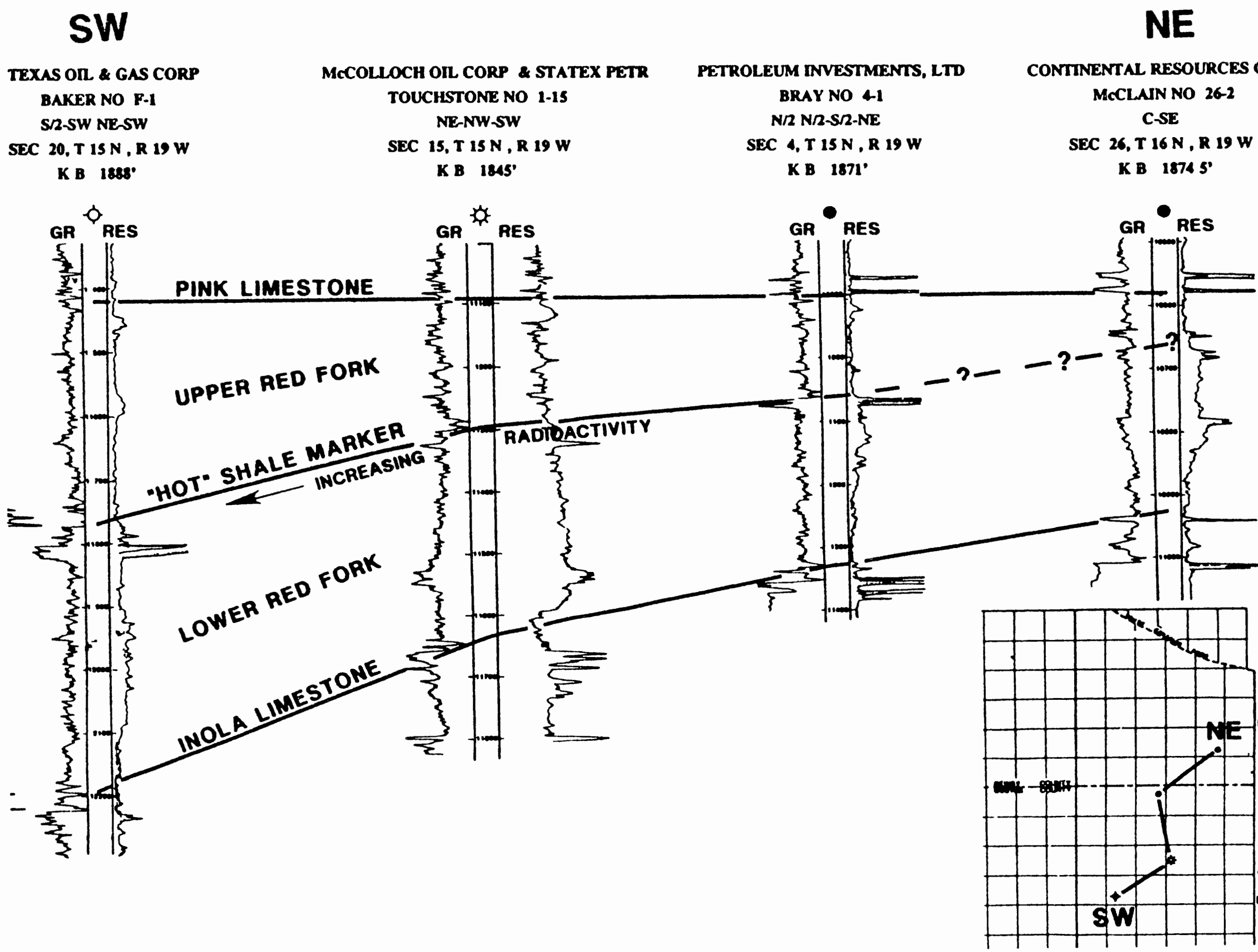


Figure 12. Local Stratigraphic Cross-Section Illustrating Absence of "Hot" Radioactive Shale Marker Bed in the Northeastern Area of Study on the Outer Deltaic Margin.

CHAPTER VII

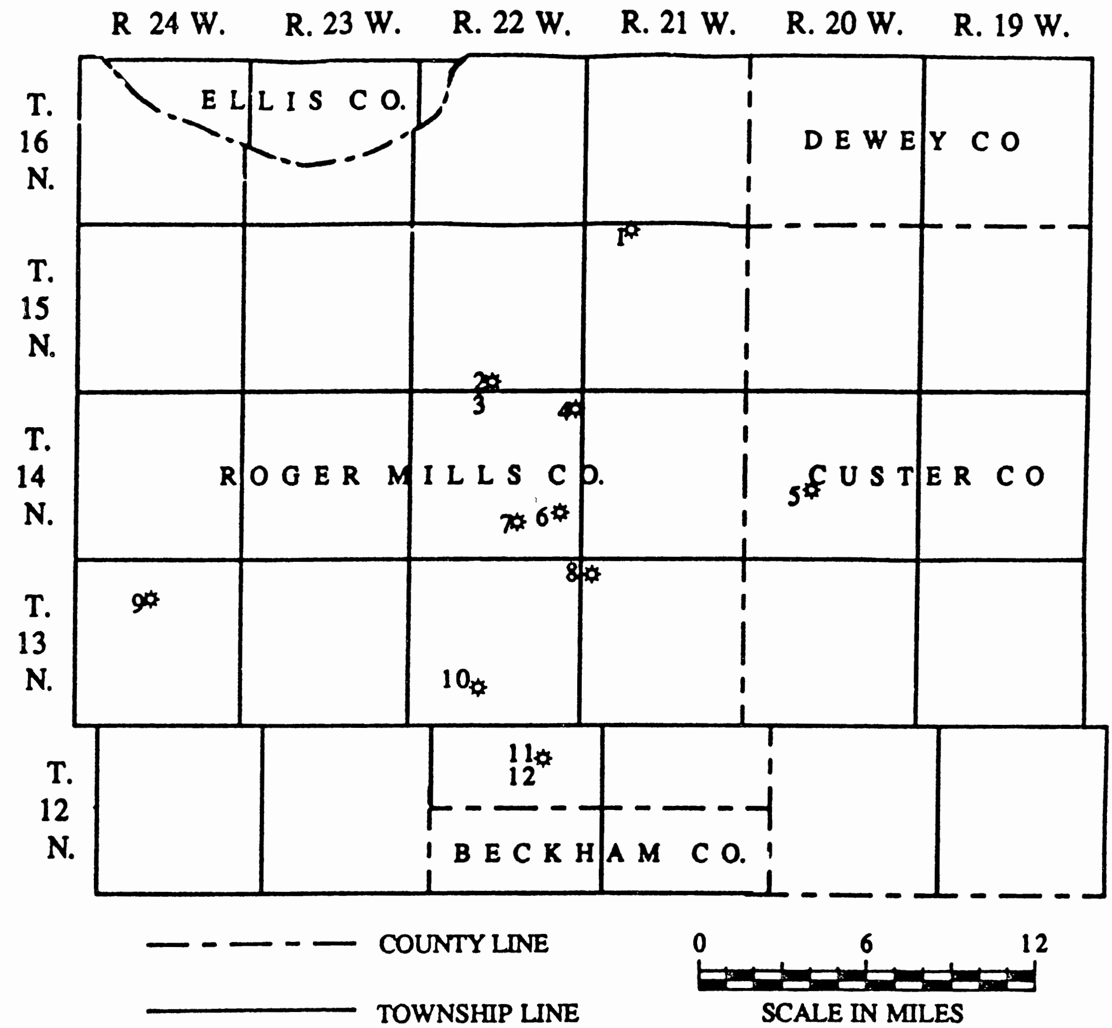
SEDIMENTARY STRUCTURES

Analysis of 12 cores was used to aid in the interpretation of the environments of deposition described in Chapter X. These cores and their locations are shown in Figure 13. Approximately 1,300 feet of slabbed core were used for detailed analysis and pictorial representation (Appendix C, P. 185).

Eleven cored intervals of the upper Red Fork and one core from the lower Red Fork were examined. The lower Red Fork interval is not included in this study, although descriptions and pictures of the Tenneco Oil Co., Griffen No. 1-9 core, located in Section 9, T.13N., R.24W., are included in the appendixes (App. C, p. 222).

Pink Limestone and Biomicrite/Shale Facies

The base of the Pink limestone interval is composed of dark biomicrite and shales containing abundant pyrite. Three cores include this lithology of the Pink limestone. These cores are the Woods Petroleum Corp., Switzer "C" No. 5-1, located in Section 5, T.15N., R.21W., the Inexco Oil Co., Trent No. 1-25, located in Section 25 of T.14N., R.22W.; and Tenneco Oil Co., Lester No. 1-6, located in Section 6, T.13N., R.21W.



CORE INFORMATION

	COMPANY	WELL NAME	LOCATION	INTERVAL
1	WOODS PETR. CORP	SWITZER "C" NO 1 5	T 15 N R. 21 W., SEC. 5	11,375 FT TO 11,503 FT
2	LOUISIANA LAND & EXPL.	GATES NO 2 33	T 15 N R. 22 W., SEC. 33	12,170 FT TO 12,224 FT
3	LOUISIANA LAND & EXPL.	GATES NO 2 33	T 15 N., R. 22 W., SEC. 33	12,393 FT TO 12,513 FT
4	LOUISIANA LAND & EXPL.	SAVAGE NO 2-1	T 14 N , R. 22 W SEC. 1	12,382 FT TO 12,500 FT
5	INTERNORTH, INC.	SMITH "B" 21 NO. 1	T 14 N., R. 20 W., SEC. 21	12,209 FT TO 12,532 FT
6	INEXCO, INC.	TRENT NO 1 25	T 14 N., R. 22 W., SEC. 25	12,501 FT TO 12 672 FT
7	TENNECO OIL CO.	MERRICK NO 1 27	T 14 N R. 22 W., SEC. 27	12,695 FT TO 12,786 FT
8	TENNECO OIL CO.	LESTER NO 1-6	T 13 N , R. 21 W , SEC. 6	12,731 FT TO 12,771 FT
9	TENNECO OIL CO.	GRIFFEN NO 1 9	T 13 N., R. 24 W., SEC. 9	13,767 FT TO 13 882 FT
10	LOUISIANA LAND & EXPL.	RUTH NO 1 28	T 13 N R. 22 W., SEC. 28	13,055 FT TO 13,097 FT
11	SOUTHPORT EXPL., INC.	MERRICK NO 1 10	T 12 N R. 22 W., SEC. 10	13 898 FT TO 13 957 FT
12	SOUTHPORT EXPL., INC.	MERRICK NO 1 10	T 12 N , R. 22 W., SEC. 10	14,029 FT TO 14,068 FT

Figure 13. Location and Well Information for Cores Used in Study.

Upper Red Fork Sediments

A variety of sedimentary structures were observed in cores with lithologies of interbedded sandstones, siltstones and shales. In order of decreasing abundance, sedimentary structures observed are: 1) inclined laminae; 2) ripple laminae commonly accentuated by mica and dark carbonaceous material; 3) wavy or undulating ripple laminae; 4) lenticular bedding; 5) soft- sediment-deformation, convolute structures; 6) penecontemporaneous "micro-faulting"; 7) soft-sediment-deformation "slump" structures; 8) parallel horizontal laminae; 9) "dish and pillar" structures commonly enhanced by micaceous and carbonaceous laminae; 10) "massive" bedding primarily in sandstones but also occurring in shales; 11) small scale trough cross-bedding; 12) tabular cross-bedding; 13) climbing ripples associated with ripple-drift; 14) flaser bedding (clay drapes in ripple toughs); 15) alternating light and dark laminated sediment; 16) burrowing trace fossils; 17) rounded and oriented shale clasts; 18) angular shale clasts indicating "rip-up" high flow regime; 19) load casts ("ball and pillow structures); 20) flame structures; 21) fluid escape "pipe" structures; and 22) fossils.

Inclined Laminae

Parallel to subparallel inclined laminae are found in all cores. The angle of bedding planes ranged from approximately 3° to more than 10°. Higher angled laminae tend to be associated with the increased occurrence of soft-sediment-deformation related to slumping. The

Southport Merrick No. 1-10 upper core is composed almost entirely of inclined bedding (Figure 14).

Ripple Laminae

Ripple laminae are formed by traction transport of silt and sand. These structures are found in all cores examined and tend to decrease basinward. Ripple laminae was commonly observed in sandstones and in lenticular sandstones in siltstone/shale beds (Figure 15).

Wavy or Undulating Laminae

Wavy or undulating laminae are seen in all cores with exception of the Southport Exploration, Inc., Merrick 1-10 and the lower Red Fork core in the Tenneco Oil Co., Griffen No. 2-9. The Woods Switzer "C" No. 5-1 and Louisiana Land & Exploration Ruth No. 1-28 illustrate the wavy characteristic associated with ripple laminae (see App. C, p. 186). Interbedded sandstones, siltstones and shales enhance the structures (Figure 16).

Lenticular Bedding

Lenticular bedding is evident in all cores and commonly is associated with ripple laminae. Basinward, lenticular sandstones and siltstones become much more elongated within shales (Figure 17).

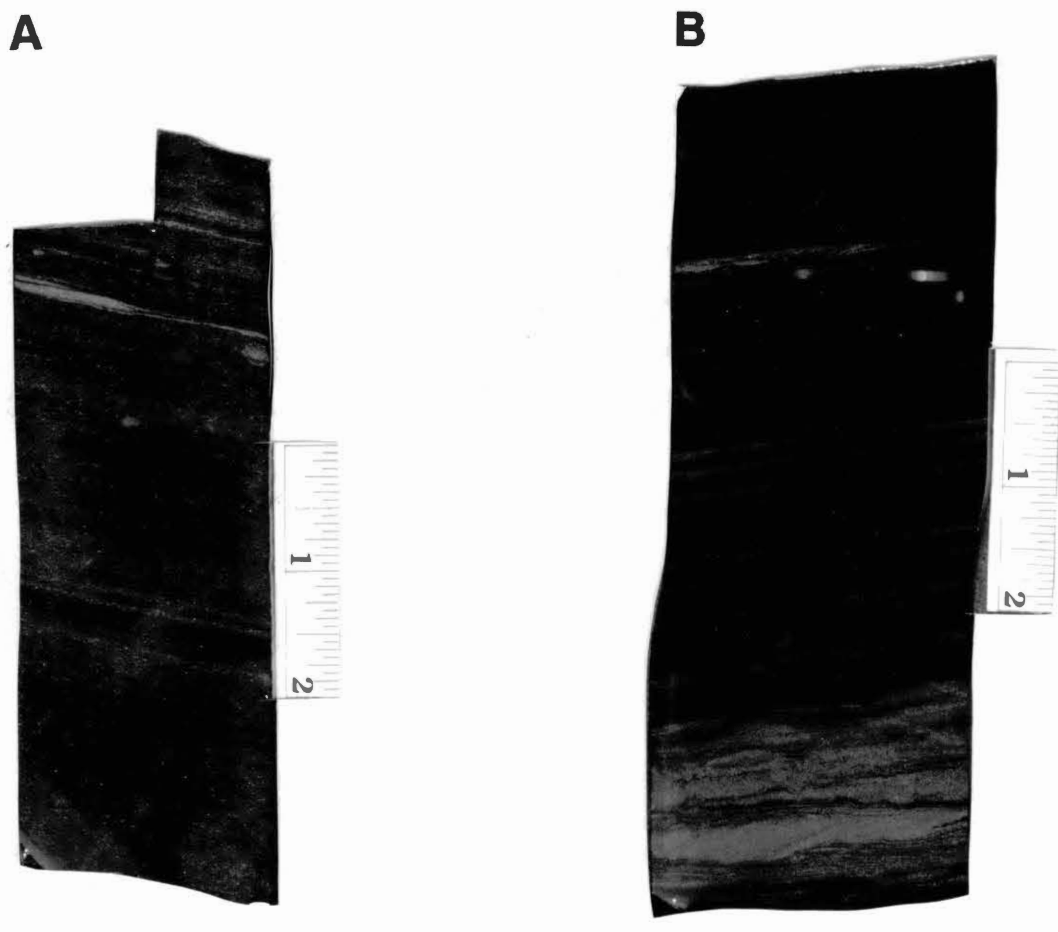


Figure 14. Inclined Laminae Defined by Interlaminated Siltstone and Shale.
A. Southport Expl., Inc., Merrick No. 1-10, 13,898'4".
B. Inexco, Inc., Trent No. 1-25, 12,660'.

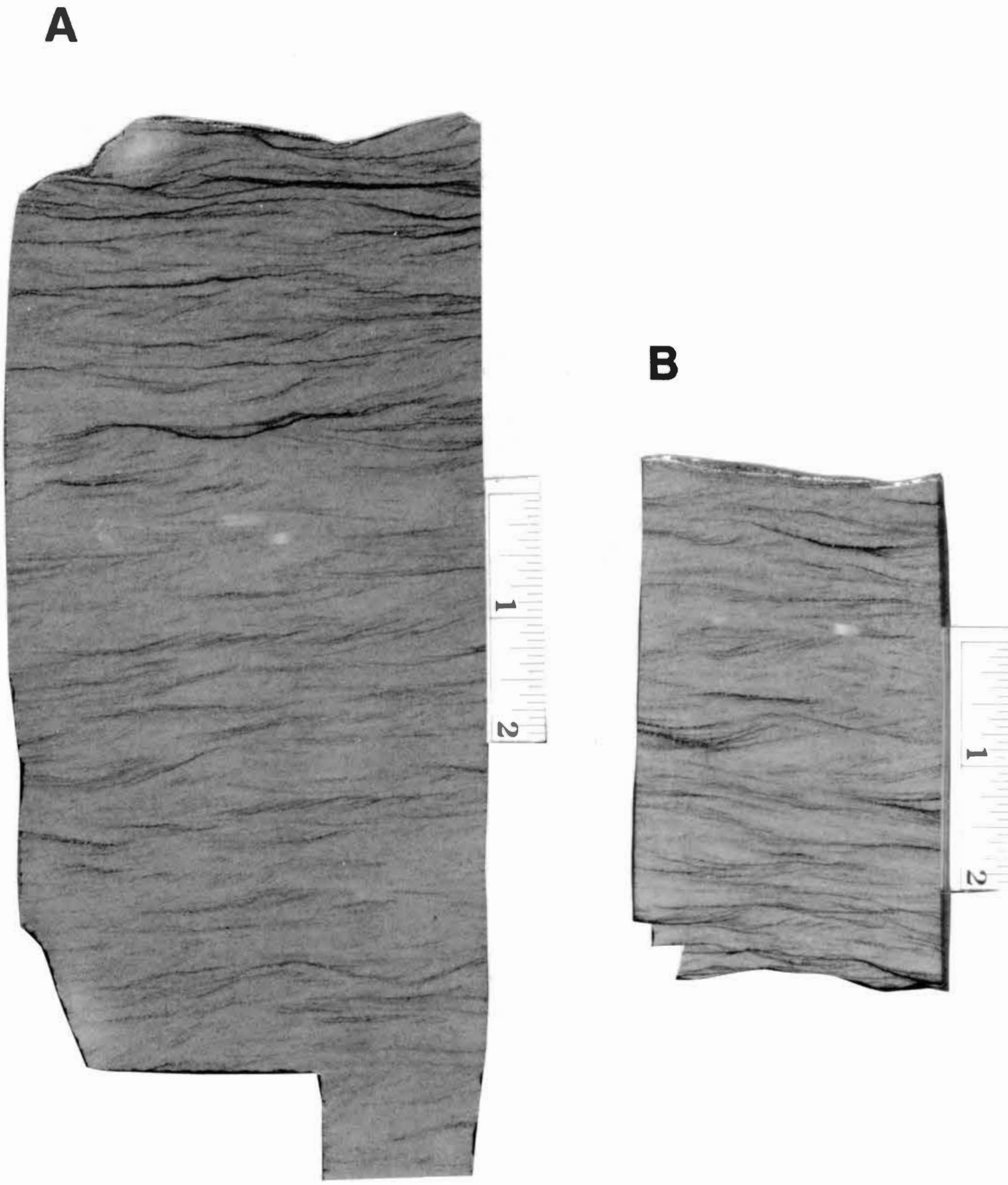


Figure 15. Ripple Laminae Accentuated by Micaceous and Carbonaceous Material.
A. Louisiana Land & Expl., Gates No. 2-33, 12,434'.
B. Tenneco Oil Co., Trent No. 1-25, 12,576'.

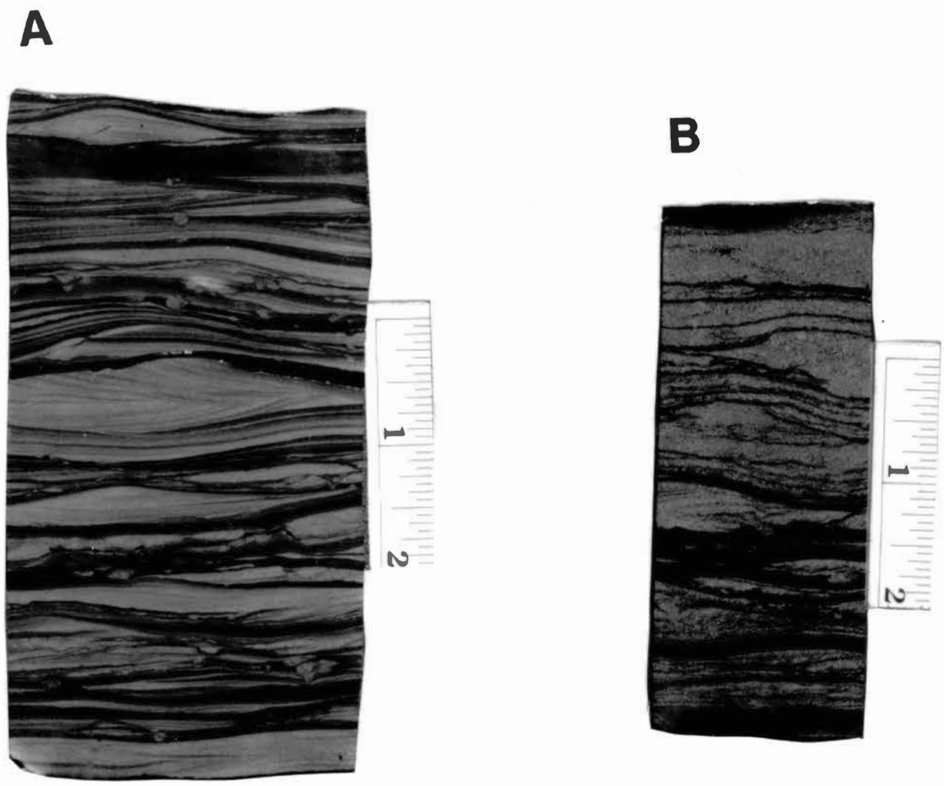


Figure 16. Wavy or Undulating Laminae.
A. Woods Petr. Corp., Switzer "C" No. 1-5, 11,474'. Note Burrowing.
B. Louisiana Land & Expl., Ruth No. 1-28, 13,085'.

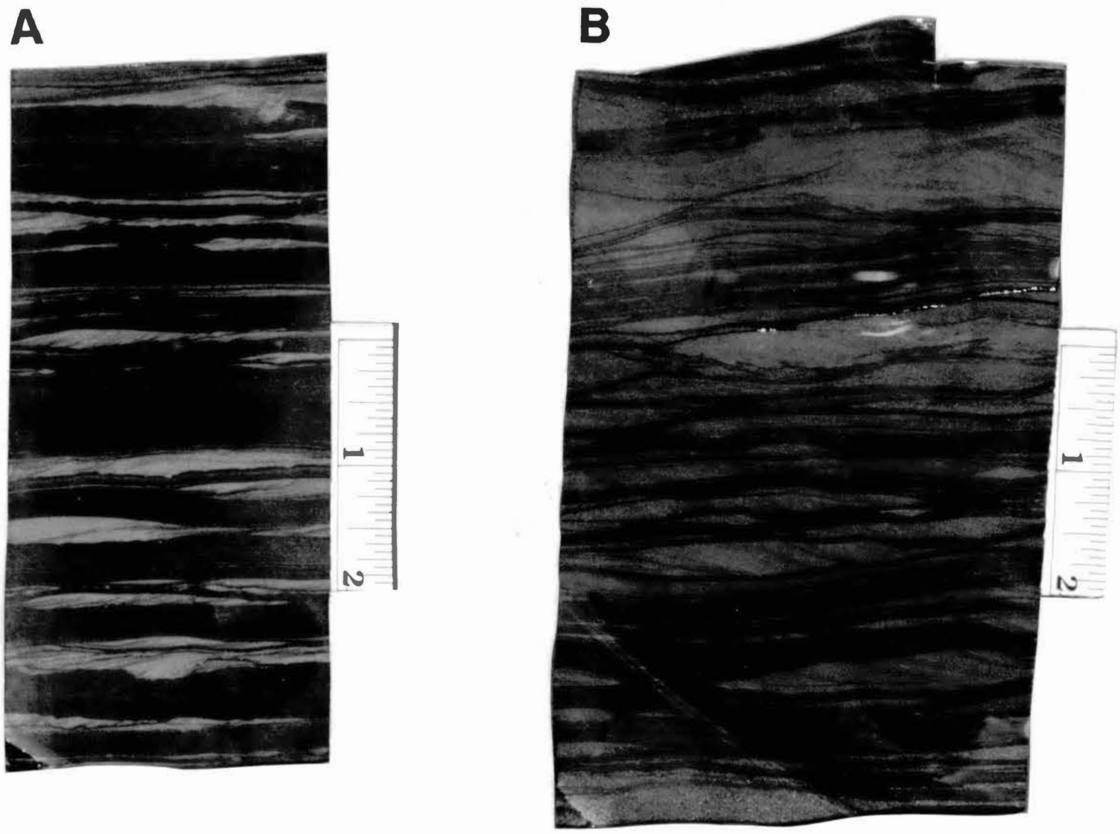


Figure 17. Lenticular Bedding. Very Fine-grained Sandstone Showing Ripple Drift Laminae in Shale.
A. Internorth, Inc., Smith "B" 21 No. 1, 12,243'9".
B. Louisiana Land & Expl., Savage No. 2-1, 12,411'.

Soft-Sediment-Deformation, Convolute Structures

Convolute structures are formed by fluidized flow. Sandstones in the Woods Petr. Corp., Switzer "C" No. 1-5 and the Tenneco Oil Co., Lester No. 1-6 exhibit this feature (Figure 18). Shales exhibiting "slurry" deposition are present to some extent in all cores. Zones within the Internorth, Inc., Smith "B" No. 21-1 and the Tenneco Oil Co., Merrick No. 1-27 display these structures (Figure 19).

Penecontemporaneous "Micro-Faulting"

"Micro-faulting" appears most commonly as micro-normal faulting with offsets of less than one-half inch. Thinly interbedded shales, siltstones, and sandstones enhance the faulting (Figure 20). Present in all cores, this structure is best developed in cores with greatest initial dip. The Southport Exploration, Merrick No. 1-10 cores and the Tenneco Oil Co., Griffen No. 2-9 lower Red Fork core illustrate this relationship (see App. C).

Soft-Sediment-Deformation, Slump Structures

Slump structures in these cores are defined by plastic movement of sediment just after deposition. Though closely related to the above micro-faulting, the sediments tend to behave more plastically and one can infer low sediment cohesion. They may appear to be convoluted but are not likely to be directly related to fluidized flow (Figure 21).

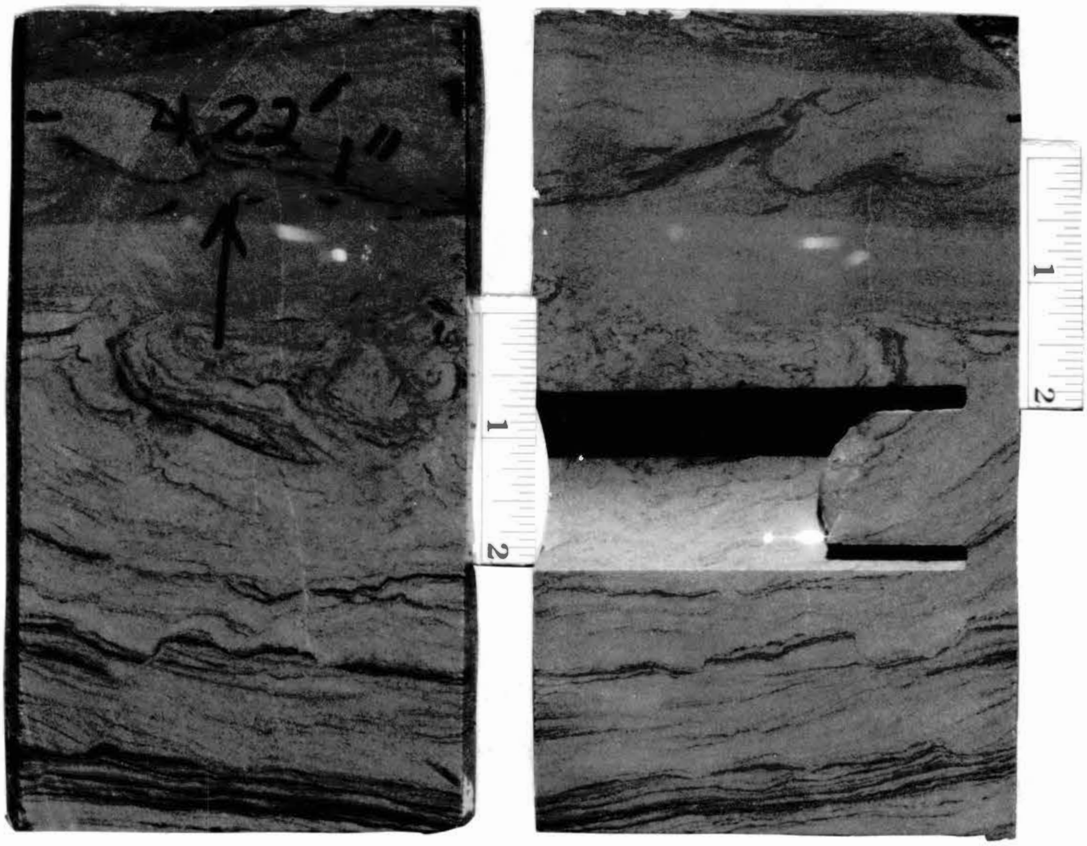


Figure 18. Soft-Sediment-Deformation, Convolute Structures. Front and Back of Core Slab Shown. Note Flame Structure at Top and Slumping in Lower Area. Louisiana Land & Expl., Gates No. 2-33, 12,422'.

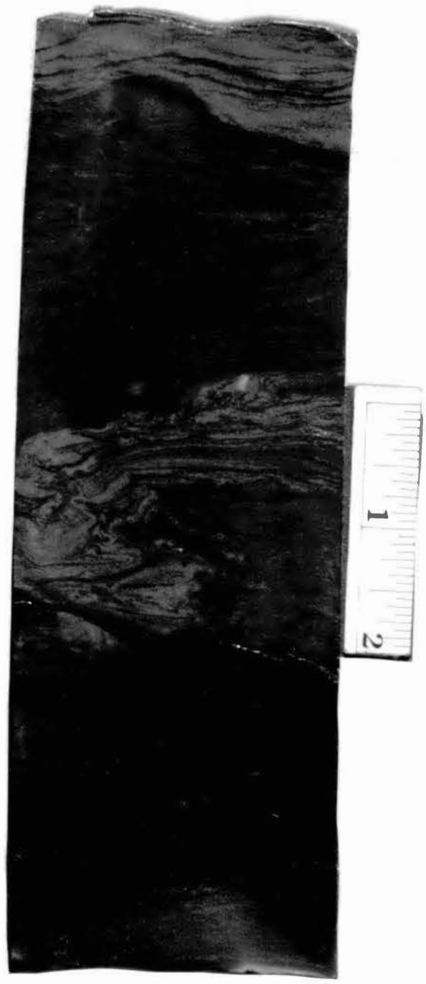


Figure 19. Soft-Sediment-Deformation, "Slurry" Structures Defined by Lighter Colored Siltstones in Darker Siltstones/Shales. Internorth, Inc., Smith "B" 21 No. 1, 12,272'6".

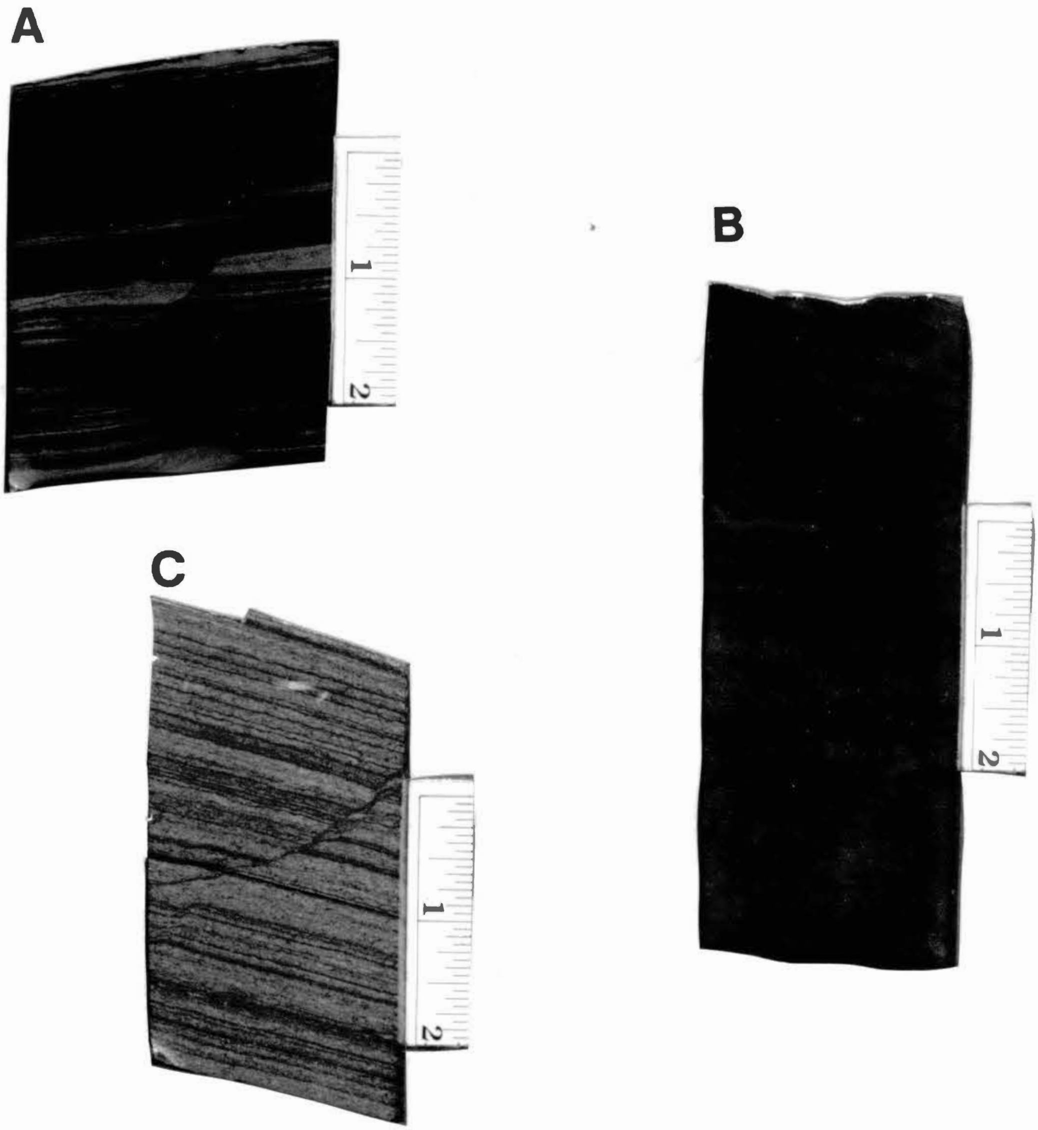


Figure 20. Penecontemporaneous "Micro-Faulting".
A. Tenneco Oil Co., Merrick No. 1-27, 12,736'1".
B. Southport Expl., Merrick No. 1-10, 13,037'.
C. Southport Expl., Merrick No. 1-10, 13,946'.

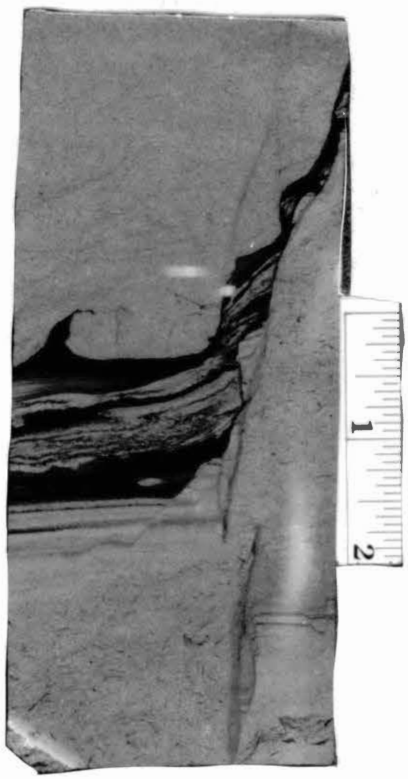


Figure 21. Soft-Sediment-Deformation, Slump Structures. Note Flame Structure and Deformation of Shale Along Slump. Tenneco Oil Co., Griffen No. 1-29, 13,736'4", Lower Red Fork.

Parallel horizontal streaky laminae occur primarily in the Louisiana Land & Exploration Savage No. 2-1, Gates No. 2-33 and in zones of the Internorth Smith "B" No. 1-21 as well as the Woods Switzer "C" No. 1-5 (Figure 22).

"Dish and Pillar" Structures

Dish and pillar structures are formed by dewatering of a fluidized sediment flow. These structures are best developed in the Louisiana Land & Exploration, "upper" Gates No. 2-33 (Figure 23). Relative occurrence of these structures increases with shallower depth.

"Massive" Bedding

Massive bedding is defined as having no visibly apparent structures. Very thin beds of shale and sands associated with turbidite deposition may show this as well as thicker sandstone units which may not be of turbidite origin. Most sandstones exhibiting this type of feature have sharp basal contacts with underlying sediments. The best examples of massive sandstones are found in the Louisiana Land & Exploration, Gates No. 2-33, the Internorth Smith "B" No. 21-1, and the lower Red Fork Tenneco, Griffen No. 2-9 (Figure 24).

Small-Scale Trough Cross-bedding

Small-scale trough cross-bedding occurs in all core excluding the Merrick No. 1-10. These zones are generally

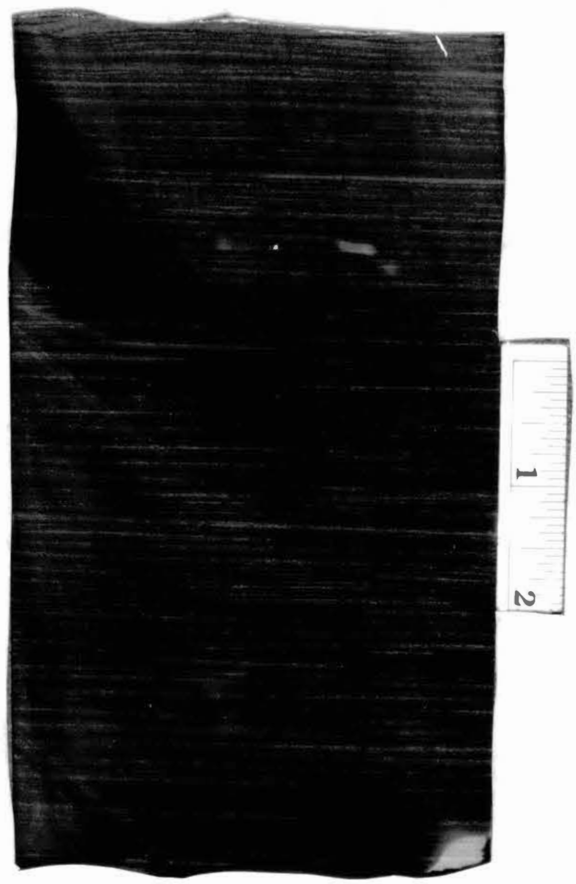


Figure 22. Parallel Horizontal Streaky Laminae. Interbedded Sandy, Coarse Siltstone and very Fine Siltstone. Louisiana Land & Expl., Savage No. 2-1, 12,469'.

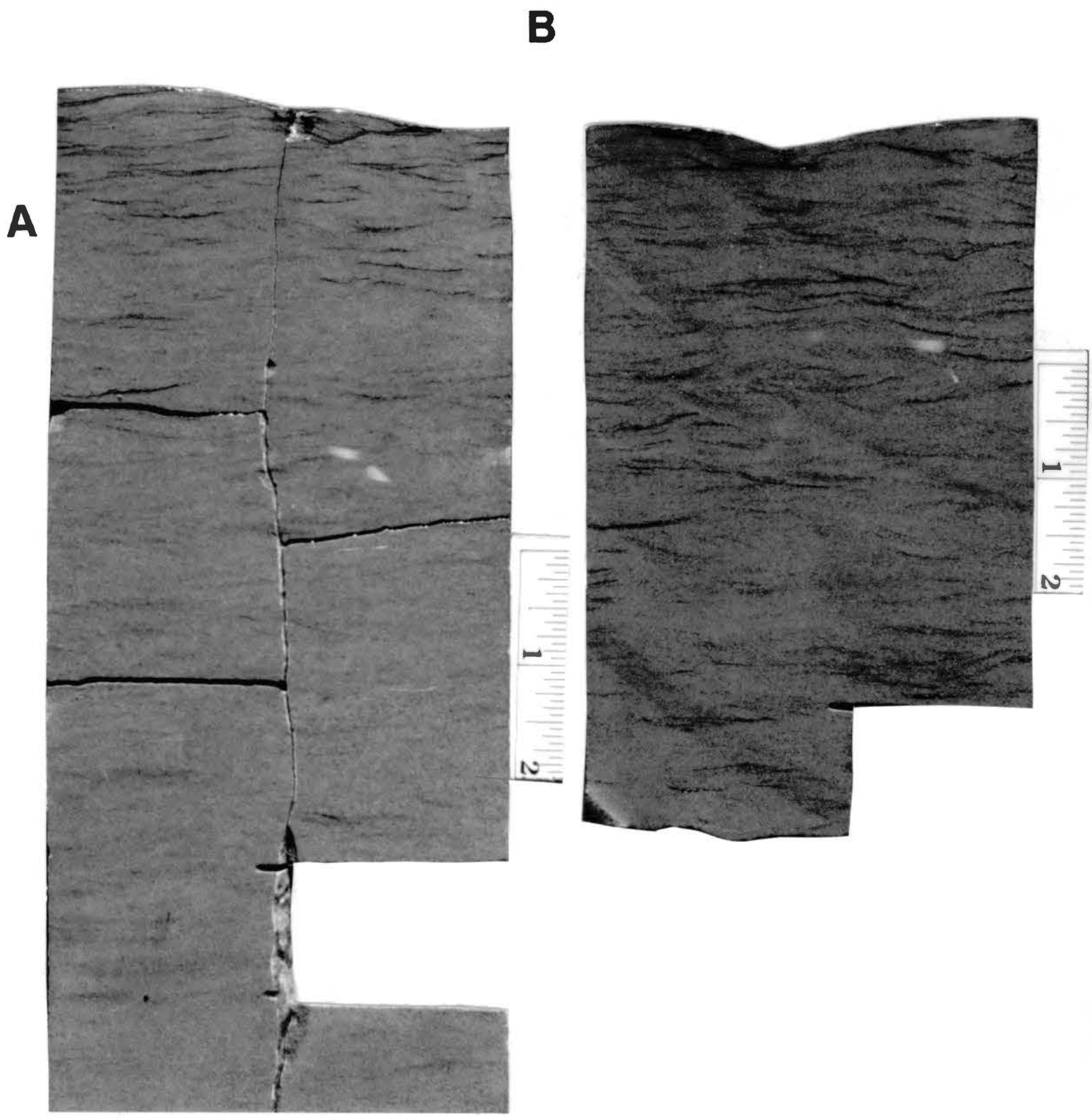


Figure 23. Dish and Pillar Structures.
A. Louisiana Land & Expl., Gates No. 2-33, 12,209'.
B. Louisiana Land & Expl., Savage No. 2-1, 12,434'.

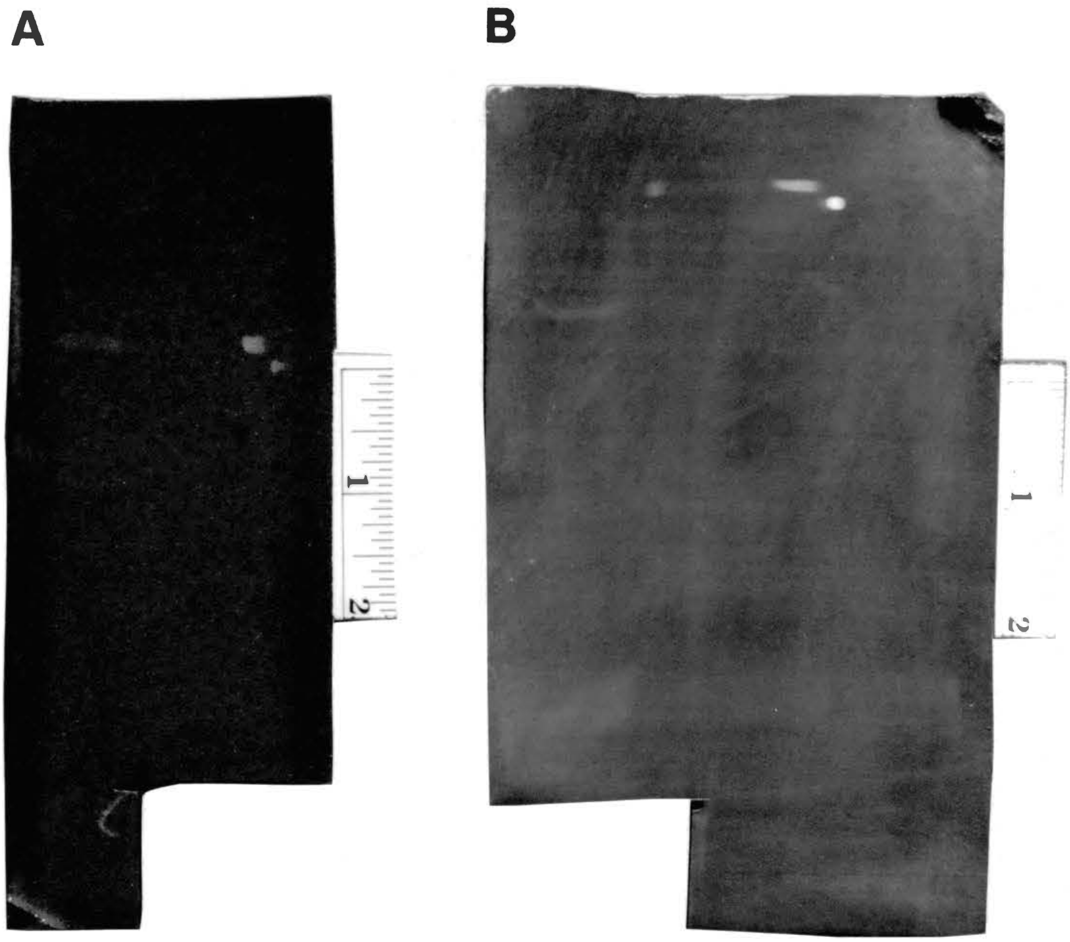


Figure 24. Massive Bedding.
A. Massive Sandstone. Internorth, Inc., Smith "B" 21 No. 1, 12,323'6".
B. Massive Siltstone. Louisiana Land & Expl., Gates No. 2-33, 12,407'.

less than one foot in thickness. Figure 25 shows a typical small-scale cross-bed feature.

Tabular Planar Cross-Bedding

Tabular planar cross-bedding in sandstones was recognized in all core except the Merrick No. 1-10 lower core. Horizontal and inclined tabular planar cross-bedding may represent a portion of medium and large scale trough cross-bedding (Figure 26).

Climbing Ripples

Climbing ripples are developed to some extent in all cores. Though not extensive, dark micaceous and carbonaceous laminae on ripple planes enhance these structures (Figure 27).

Flaser Bedding

Flaser bedding occurs predominantly in the structurally shallower cores. Flaser bedding develops when mud infills ripple troughs and is then covered by subsequent ripples (Potter and others, 1980). Figure 28 displays this sedimentary structure.

Alternating Light and Dark Colored Sediment

All of the cores show interlaminated lighter and darker color sediments. Lighter color sediment is usually very fine-grained sandstone or siltstone and darker sediment is composed of organic micaceous siltstones and shales (Figure 29).

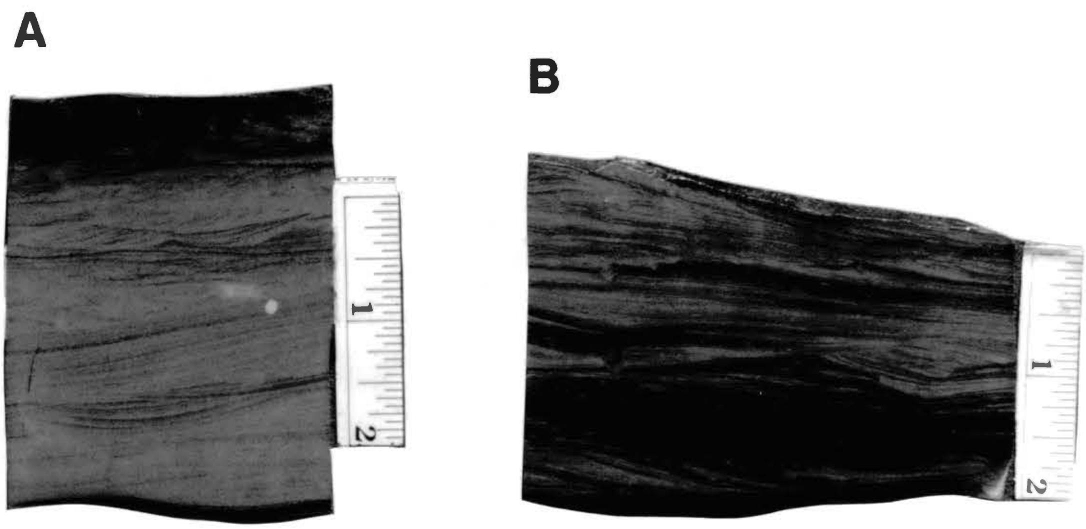


Figure 25. Small-Scale Trough Cross-Bedding.
A. Tenneco Oil Co., Lester No. 1-6, 12,756' 10".
B. Louisiana Land & Expl., Gates No. 2-33, 12,192'. Note Burrowing.

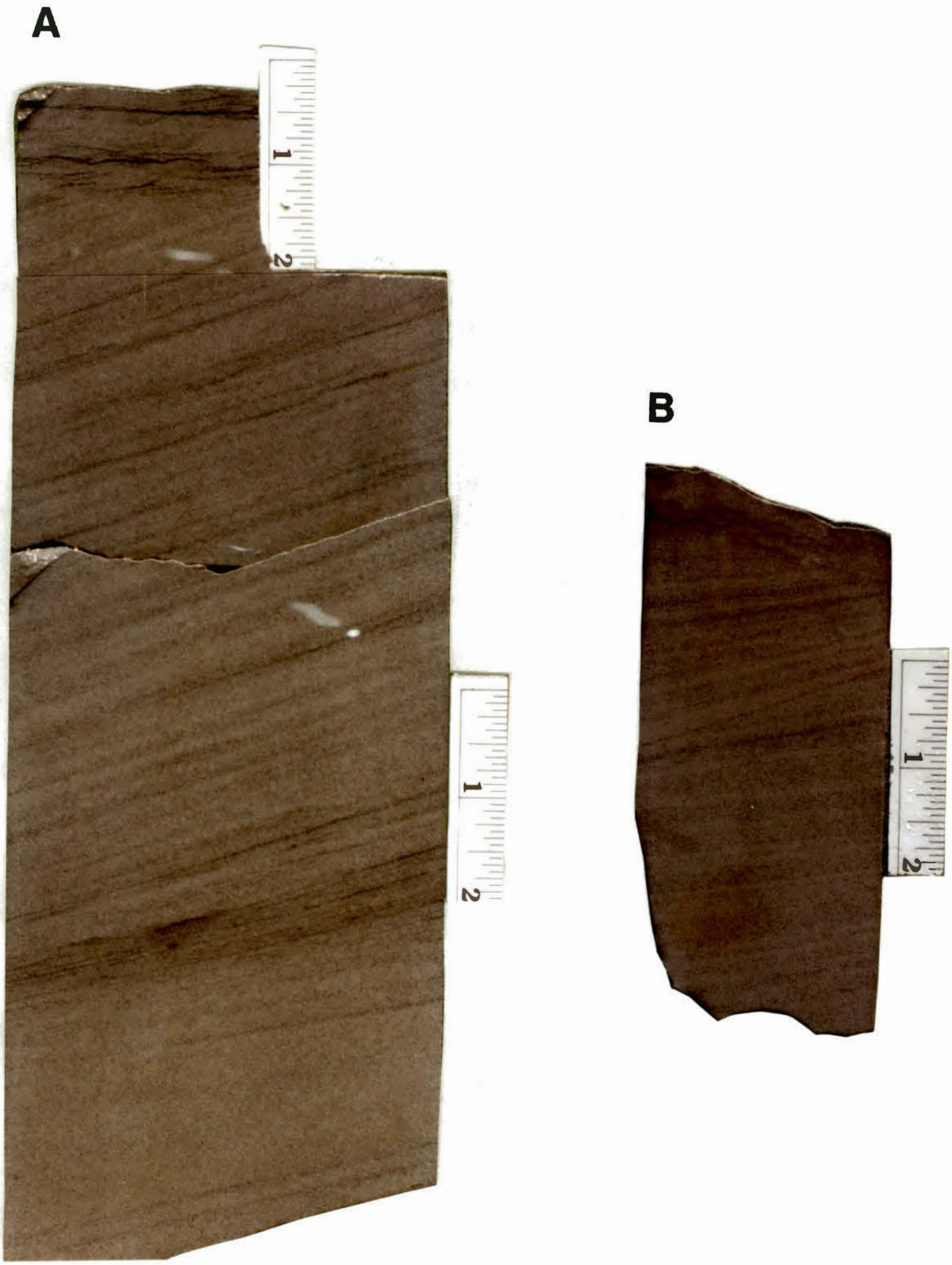


Figure 26. Tabular Planar Cross-Bedding, Possible Medium- to Large-Scale Trough Cross-Bedding.
A. Louisiana Land & Expl., Gates No. 2-33, 12,438'.
B. Tenneco Oil Co., Lester No. 1-6, 12,750'.

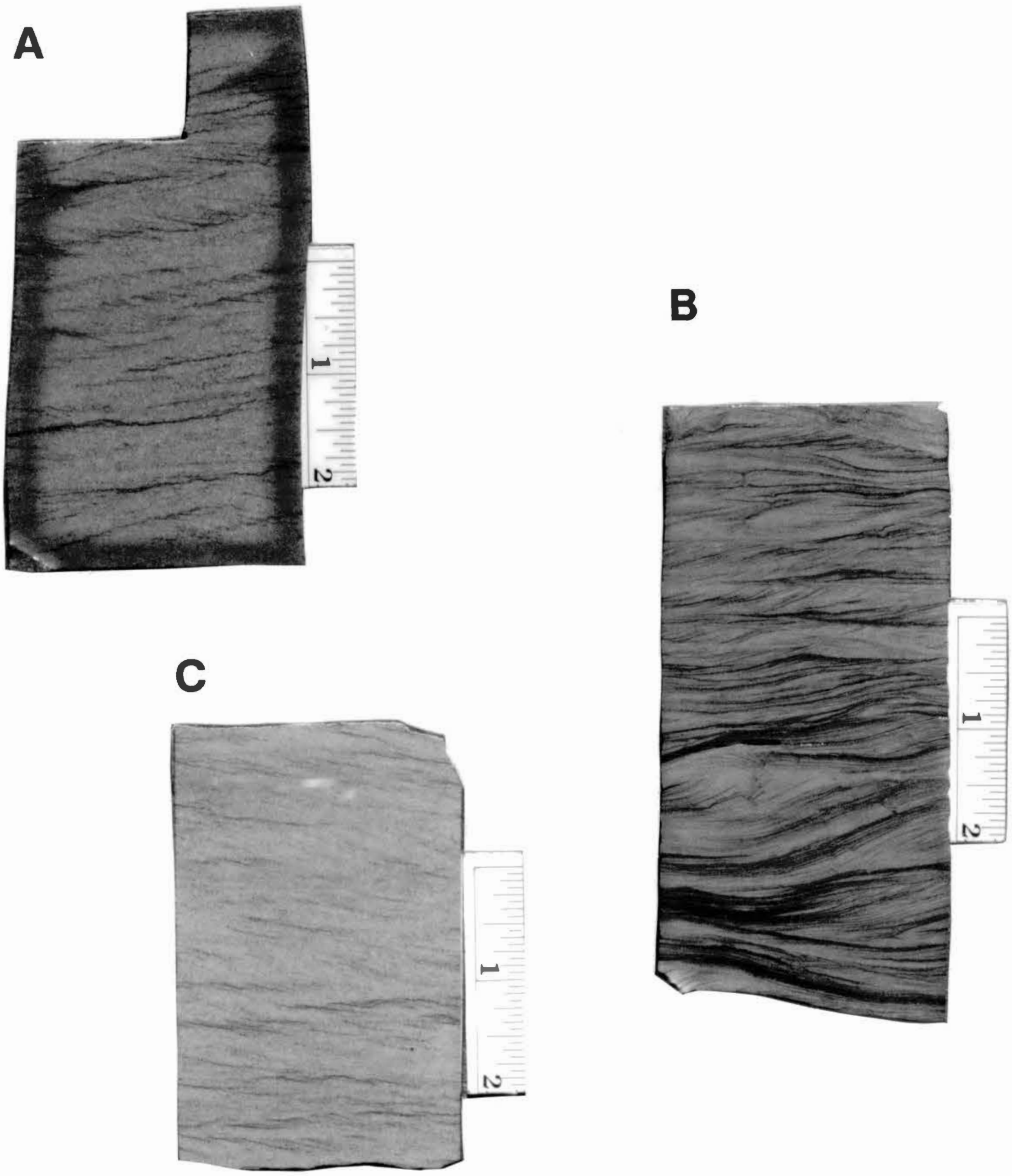


Figure 27. Climbing Ripples.
A. Internorth, Inc., Smith "B" 21 No. 1, 12,508'6".
B. Internorth, Inc., Smith "B" 21 No. 1, 12,228'.
C. Inexco, Inc., Trent No. 1-25, 12,605'.

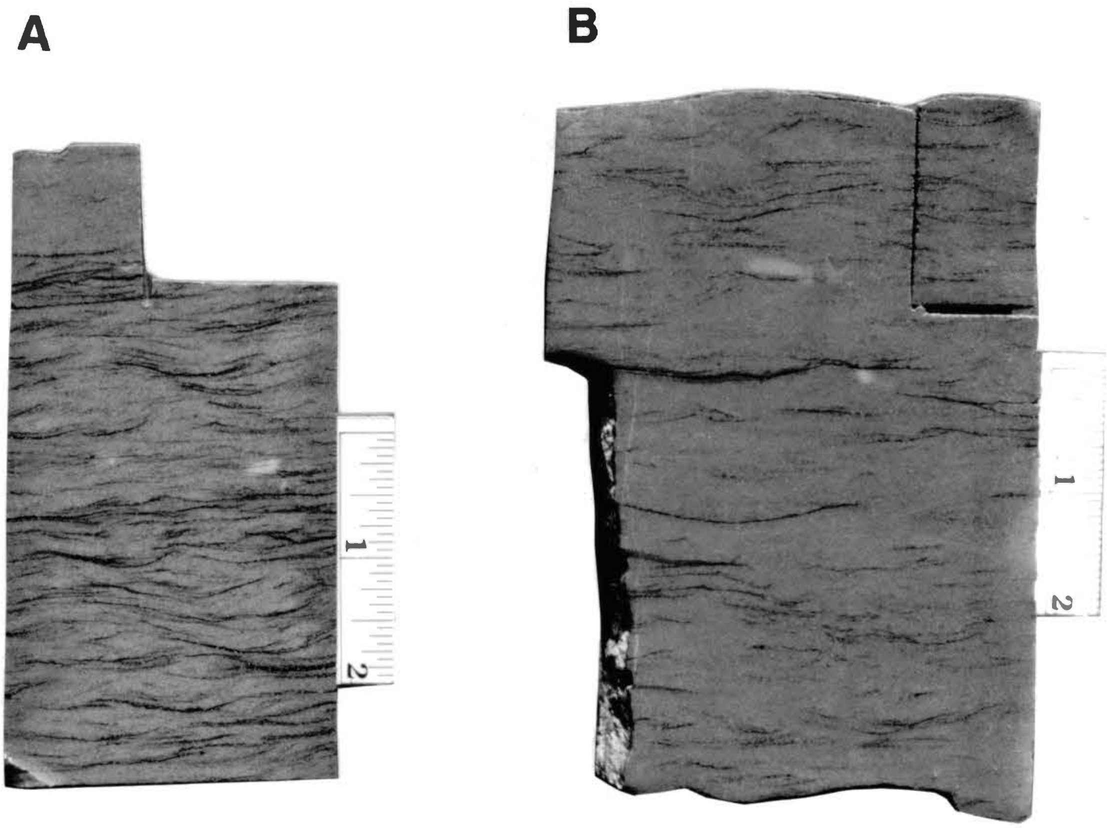


Figure 28. Flaser Bedding Associated with Ripples and/or Dish Structures.
A. Internorth, Inc., Smith "B" 21 No. 1, 12,529'.
B. Louisiana Land & Expl., Gates No. 2-33, 12,468'.

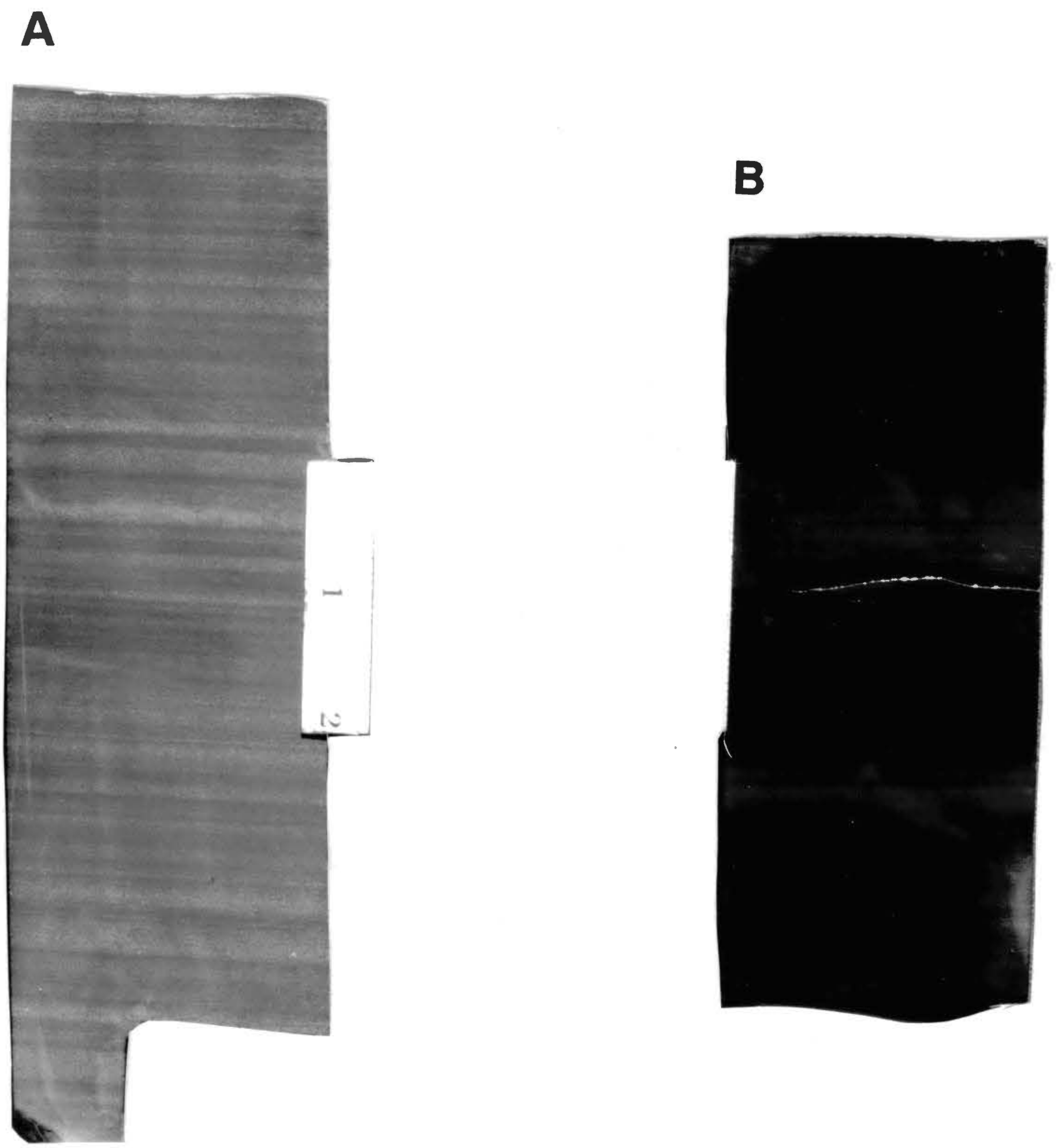


Figure 29. Alternating Light and Dark Sediments
A. Interbedded Light and Dark Siltstones and Shales. Internorth, Inc., Smith "B" 21 No. 1, 12,468'6".
B. Interlaminated Dark Gray and Dark Brown Shales. Internorth, Inc., Smith "B" 21 No. 1, 12,015'.

This lithologic feature also is recorded in the Merrick No. 1-10, Smith "B" No. 1-21 and the Inexco, Inc., Trent No. 1-25 as alternating dark gray and dark brown shales (Figure 29, p. 54).

Burrowing Trace Fossils

A variety of burrowing occurs within the cores studied. The amount of burrowing within each core tends to decrease with inferred increase in water depth. Figures 30, 31, 32, and 33 illustrate various types of burrowing found in the cores studied. Further explanation is covered in Chapter IX.

Shale Clasts

Shale clasts are observed in all core but the lower Merrick No. 1-10 and the Lester No. 1-6. These clasts generally range in size from approximately 1/16" to 1" (Figure 34). One clast in the Gates No. 1-33 equals the width of the core (3.5"). Clasts are often oriented with the long axis in the direction of dip of bedding planes and do not appear to be composed of underlying siltstone/shale.

Shale clasts are observed in the lower Red Fork Southport Exploration, Merrick No. 1-10 and in the lower Tenneco Oil Co., Griffen No. 1-9 cores. These clasts appear to be derived from underlying shales and may be considered "rip-up" clasts due to high flow regimes (Figure 35).

Load Casts, "Ball-and-Pillow Structures"

Ball-and-pillow structures are formed due to a density

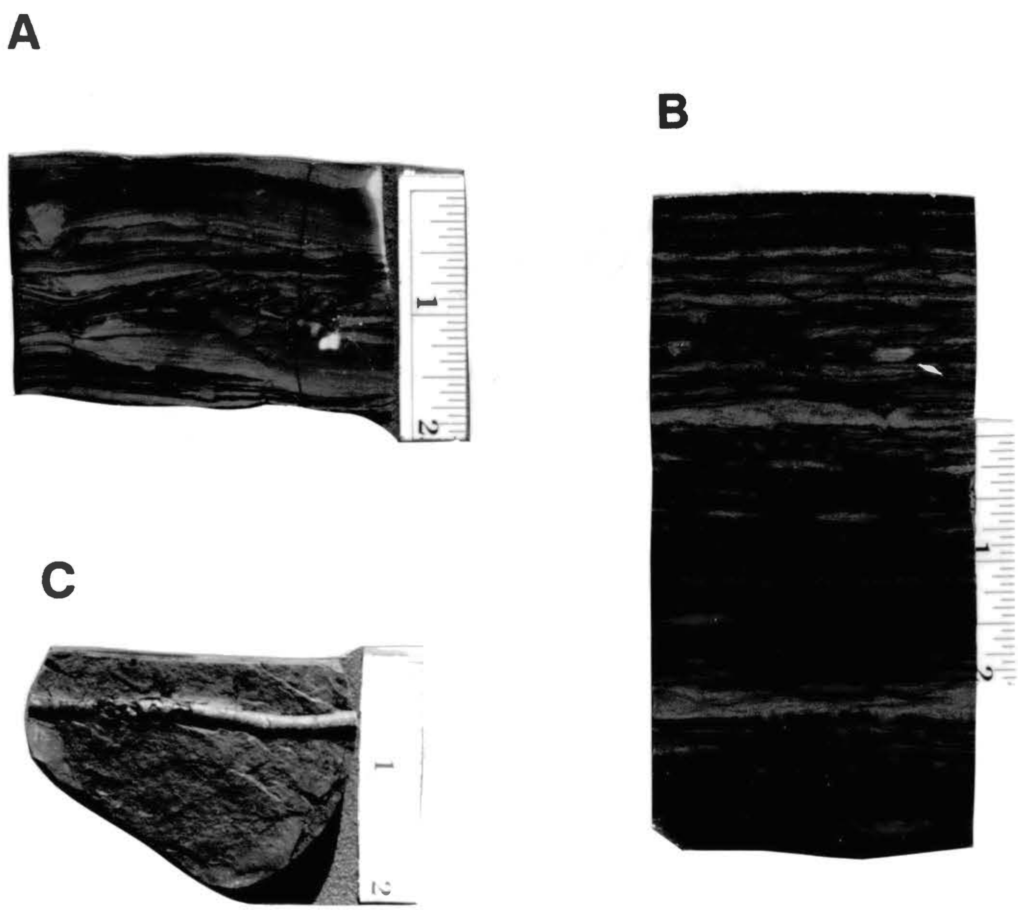


Figure 30. Various Types of Burrowing in Shale.
A. Woods Petr. Corp., Switzer "C" No. 1-5, 11,488'.
B. Internorth, Inc., Smith "B" 21 No. 1, 12,276'.
C. Pyritized Burrow in Pink Limestone Equivalent Biomicrite/Shale Facies. Tenneco Oil Co., Lester No. 1-6, 12,732'.

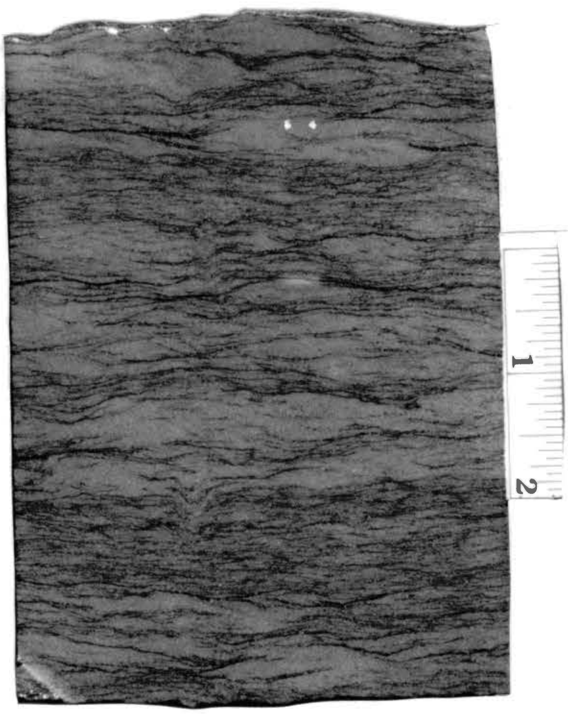


Figure 31. Vertical Burrowing in
Rippled Sandstone.
Louisiana Land & Expl.,
Gates No. 2-33, 12,461'.

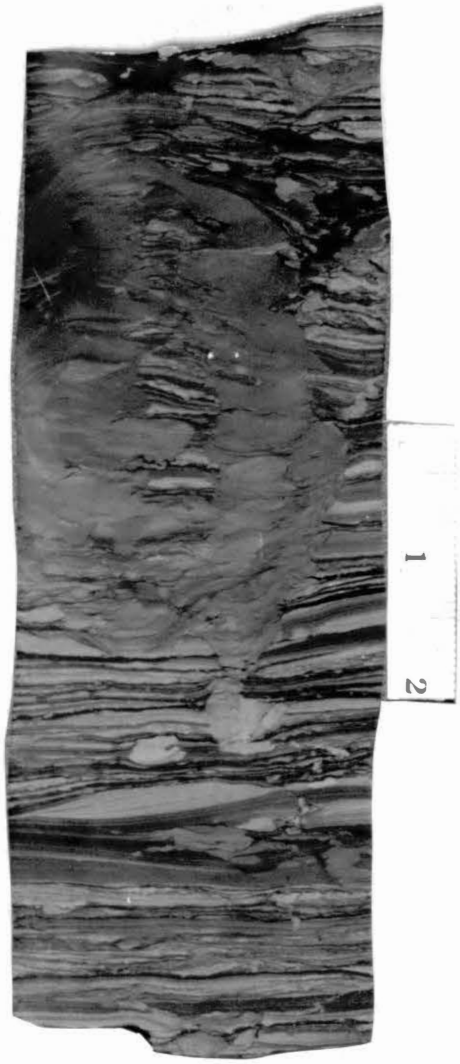


Figure 32. Extensive Burrowing Possibly Related to Shallower Water Depths. Woods Petroleum Corp., Switzer "C" No. 1-5, 11,486'.

A B

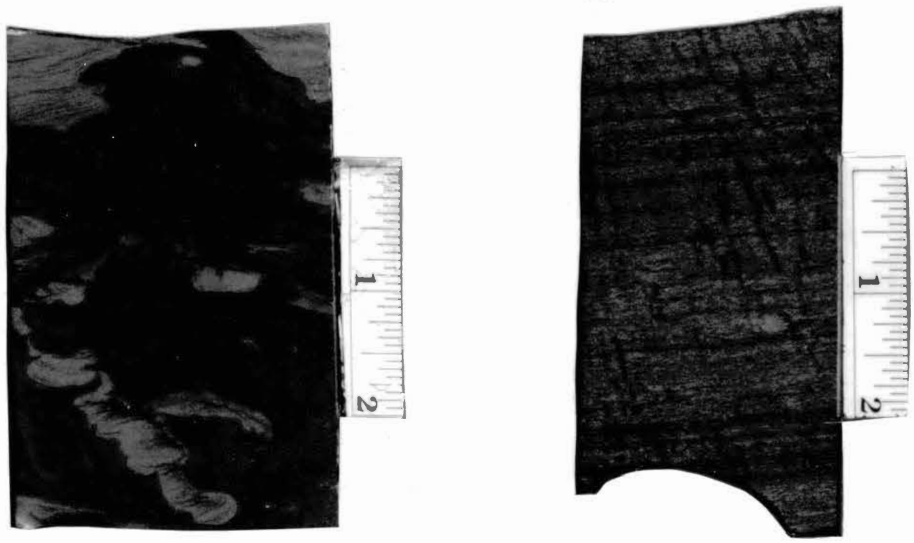


Figure 33. Burrowing Trace Fossils.
A. Possible Zoophycus Burrow. Tenneco Oil Co., Lester No. 1-6, 12,746'5".
B. Possible Arenicolite Burrows. Southport Expl. Inc., Merrick No. 1-10, 13,910'.

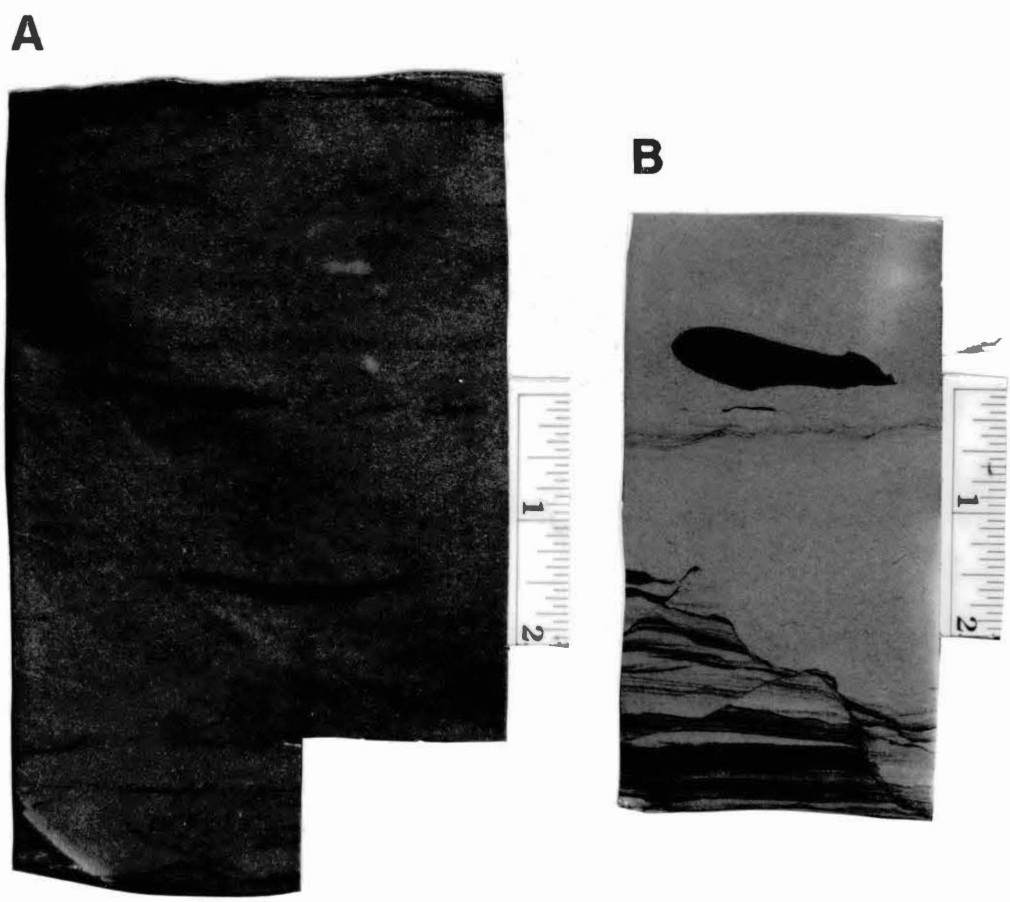


Figure 34. Rounded and Oriented Shale Clasts.
A. Modified by Dewatering of Sands. Louisiana Land & Expl., Savage No. 2-1, 12,499'.
B. Oriented Shale Clast Above Deformed Bedding. Note Bedding Plane just Below Shale Clast. Tenneco Oil Co., Griffen No. 1-9, Lower Red Fork, 13,839'3".

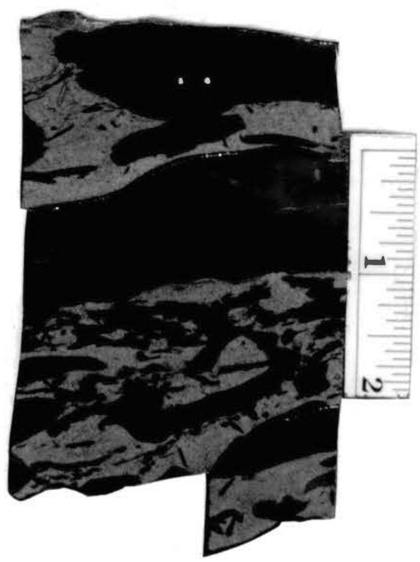


Figure 35. "Rip-up" Clasts Derived from Underlying Shale. Tenneco Oil Co., Merrick No. 1-27, 12,704'11".

contrast of overlying sandstones into shales. These structures are commonly associated with flame structures (Potter and other, 1980). An example of this shown in Figure 36. Sole marks in the Louisiana Land & Exploration, Gates No. 2-33 upper core may be attributed to this type of structure (Figure 37).

Sole Marks

Structures that appear to be sole marks occur on basal sandstone bedding planes. These sole marks may be grooves, scours, or flutes (Figure 37).

Flame Structures

Flame structures are minor and very localized. They are formed by displacement of sands into underlying shales and shales into overlying sands. An excellent example is illustrated in Figure 38.

Fluid Escape "Pipe" Structures

Fluid escape "pipe" structures are recognized in core. This type of structure is very uncommon. An interpreted fluid escape pipe is shown in Figure 39.

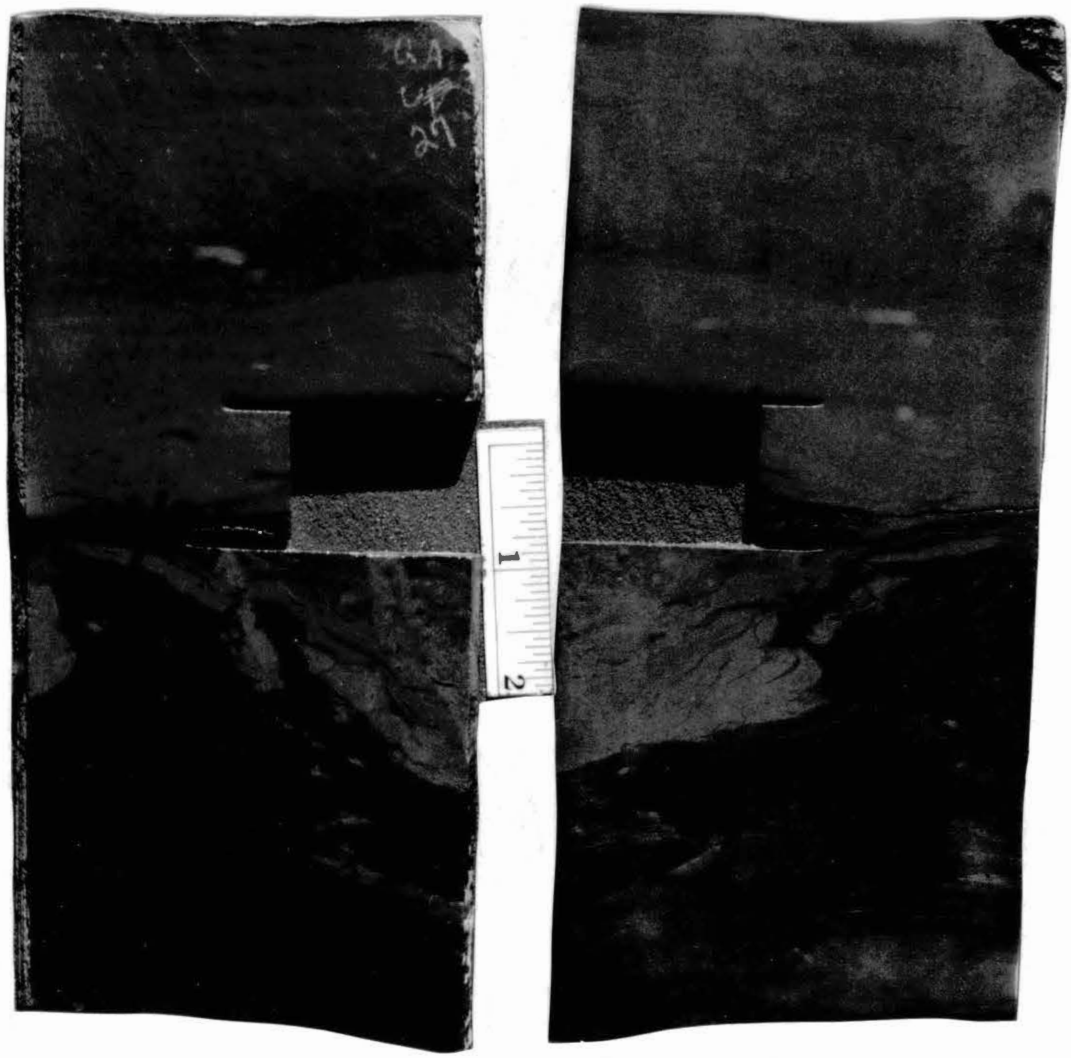


Figure 36. Ball-and-Pillow Structures. Front and Back View of Core Slab. Louisiana Land & Expl., Gates No. 2-33, 12,421'.

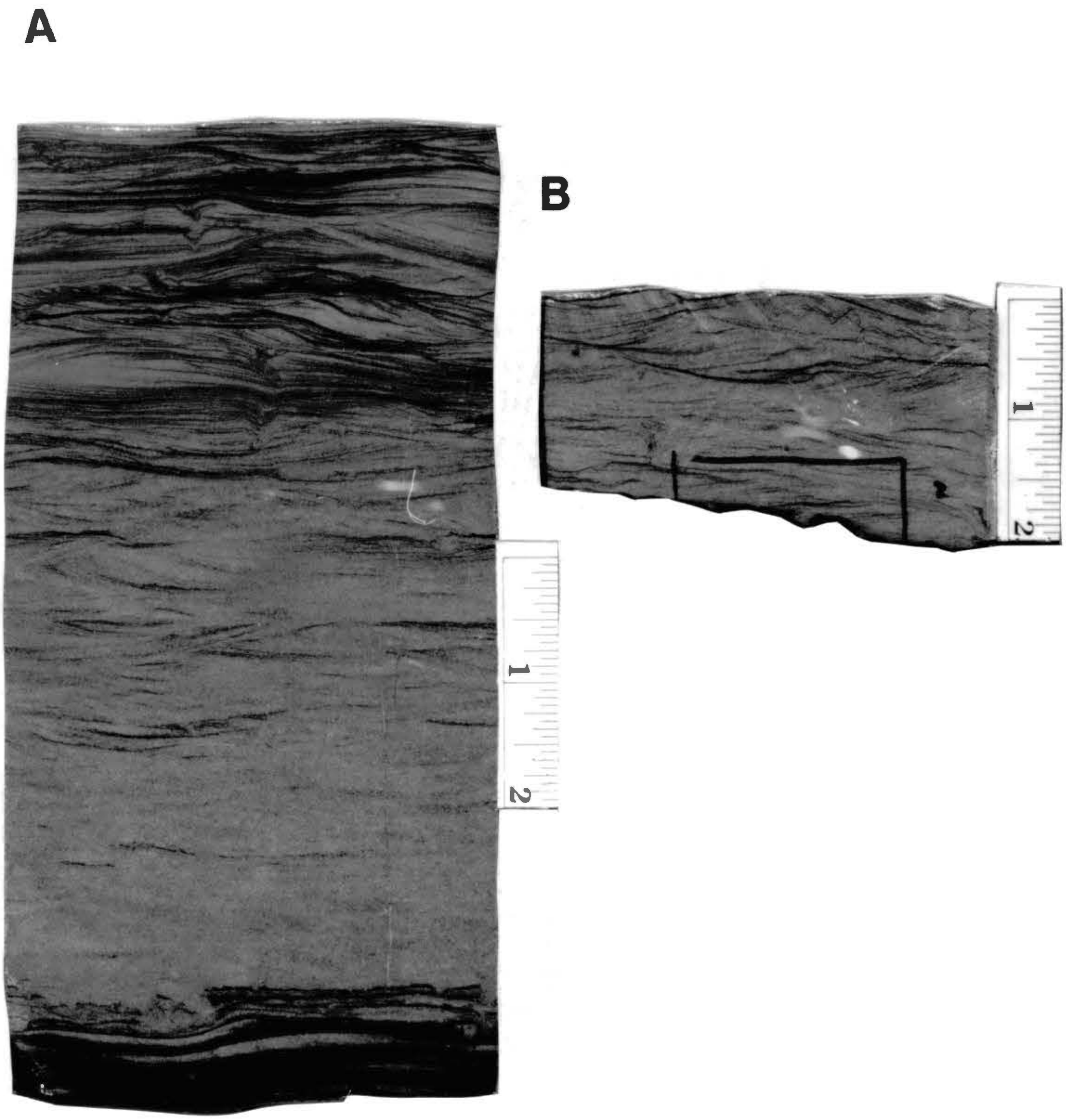


Figure 37. Sole Mark Types.
A. Loading and Burrowing? Louisiana Land & Expl., Gates No. 2-33, 12,199'.
B. Flute or Scour Marks. Louisiana Land & Expl., Gates No. 2-33, 12,180'3".

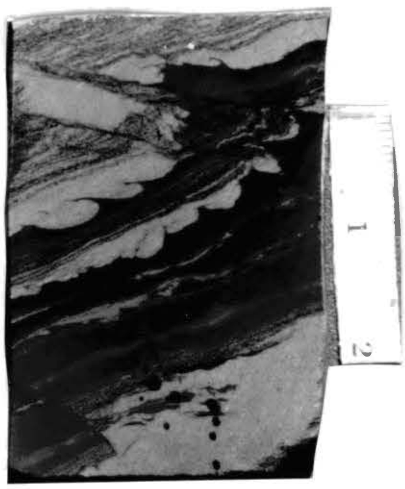


Figure 38. Flame Structures. Tenneco Oil Co., Griffen No. 1-9, 13,826'2". Lower Red Fork.

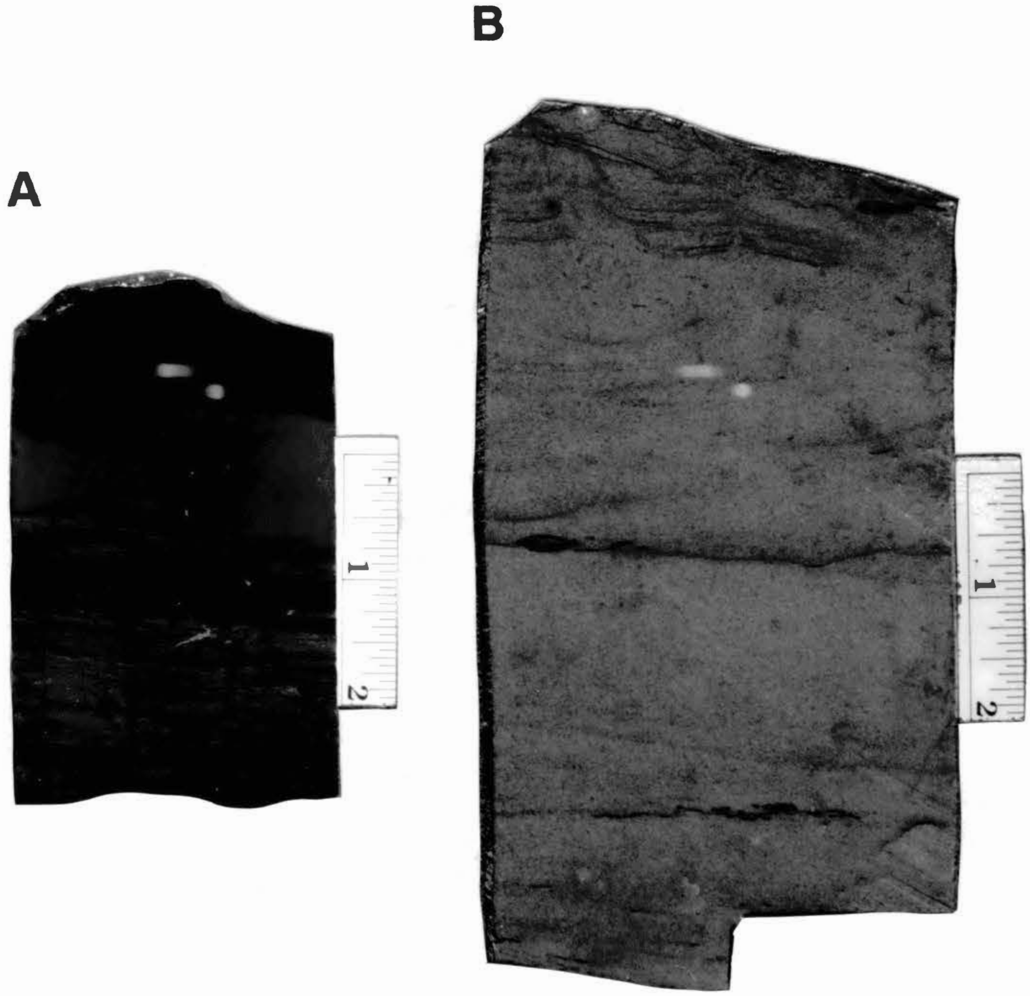


Figure 39. Fluid Escape "Pipe" Structures.
A. Internorth, Inc., Smith "B" 21 No. 1, 12,225'10".
B. Louisiana Land & Expl., Gates No. 2-33, 12,174'.

CHAPTER VIII

PETROLOGY AND DIAGENESIS

Introduction

Petrographic analysis of the upper Red Fork sandstones and selected shales was performed in order to determine mineralogical constituents, textural fabric, and diagenetic changes affecting porosity and permeability within sandstone reservoirs.

Commercially prepared thin sections were examined from 12 cores located within the study area. Modal analysis of selected thin sections are listed in Appendix B, p. 181. All thin sections were impregnated with blue dye to more easily observe porosity. A polarizing microscope was utilized to determine amounts of detrital and diagenetic constituents, porosity, and textural relationships. Powdered bulk and clay extracted samples were analyzed using X-ray diffraction to identify clay minerals present. Scanning electron microscopy and polarizing microscope slide pictures were used to investigate various diagenetic relationships and constituents.

Diagenetic changes have greatly altered porosity and permeability within the Red Fork reservoir sandstones. Dissolution of unstable grains has allowed for development of secondary porosity. Ductile deformation of metamorphic rock fragments and shale clasts, precipitation of silicate and carbonate cements, and diagenetic clay minerals have almost completely destroyed primary porosity.

Petrology and Petrography

The upper Red Fork sandstones observed in thin section are dominantly very fine-grained and moderately sorted. Grain sizes range from .4 mm (very uncommon) to less than .05 mm with an average grain size of .15 mm. Poorly sorted fabrics occur most frequently in contorted bedding and convolute structures. Poor to moderate sorting occurs in interbedded siltstones and very fine grain sandstones. Well sorted sandstones are characteristic of bedding that exhibits ripple laminae, tabular planar, and trough cross-bedding.

Quartz, feldspars, and rock fragments are the major detrital constituents. Ternary diagrams, normalized for quartz, rock fragments, and feldspars (Folk, 1974), were prepared to determine rock classifications (Figure 40).

The most abundant detrital constituent is mono-crystalline quartz with approximate ranges of 63 to 85% of detrital composition (Figure 41). Many individual quartz grains contain inclusions such as rutile needles (Figure 42), while others exhibit strained fabric with undulose extinction. Poly-crystalline quartz amounts are less than 5%, with an average of 2%, and were generally found to occur with increased feldspar content.

The dominant feldspar type observed is twinned plagioclase (Figure 42). Twinned and untwinned potassium feldspar (recognized by its "dirty" appearance), and

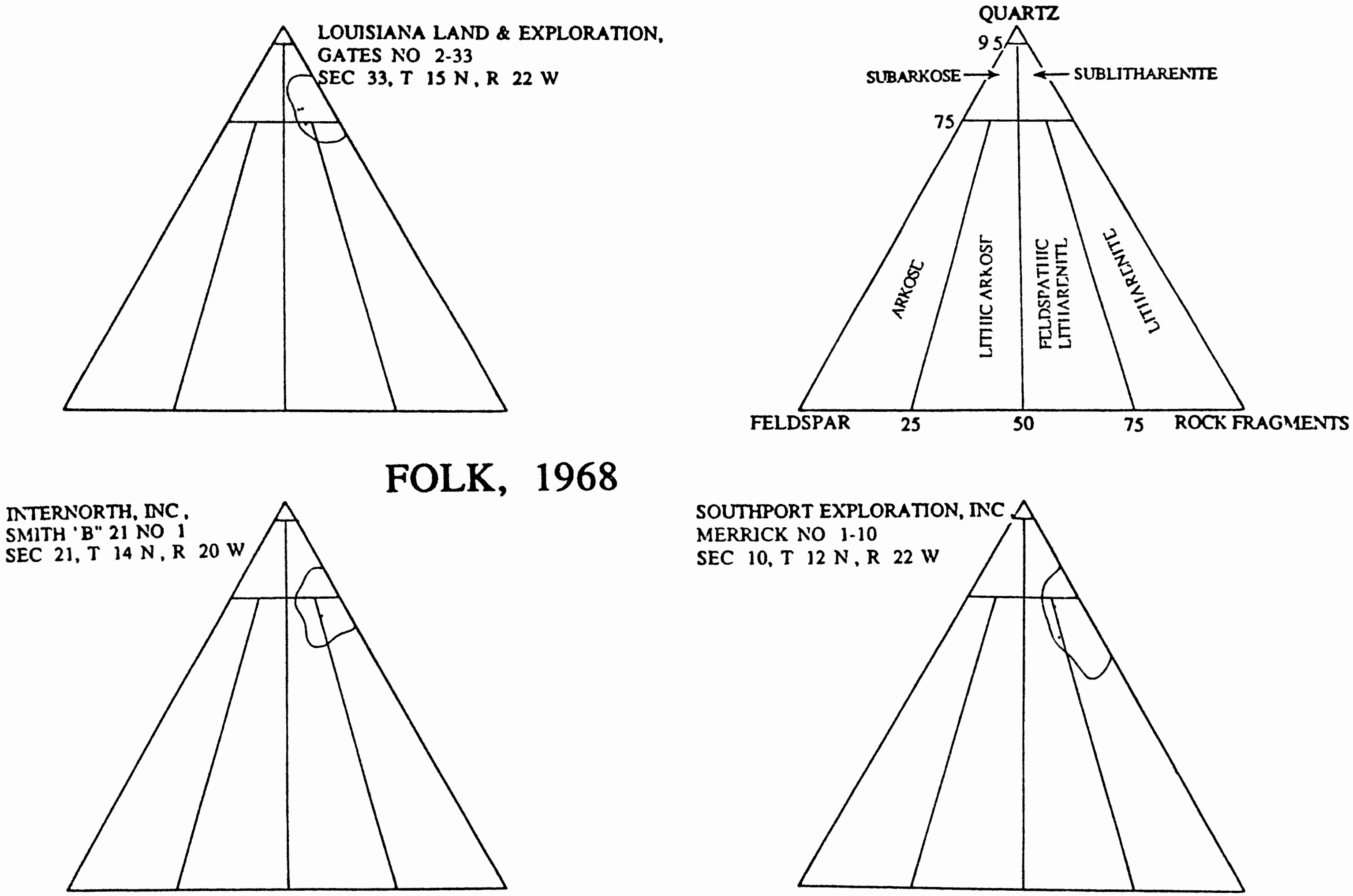
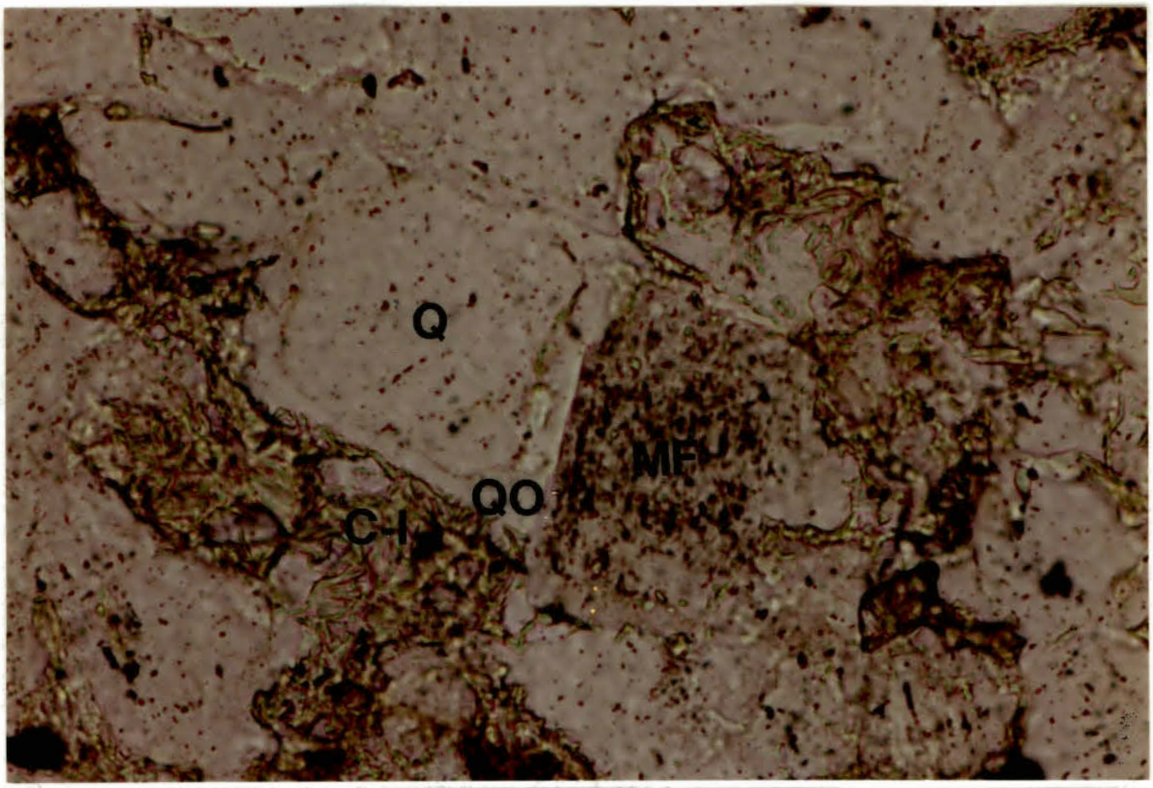


Figure 40. Ternary Diagrams of Selected Core Samples Illustrating Rock Classification.



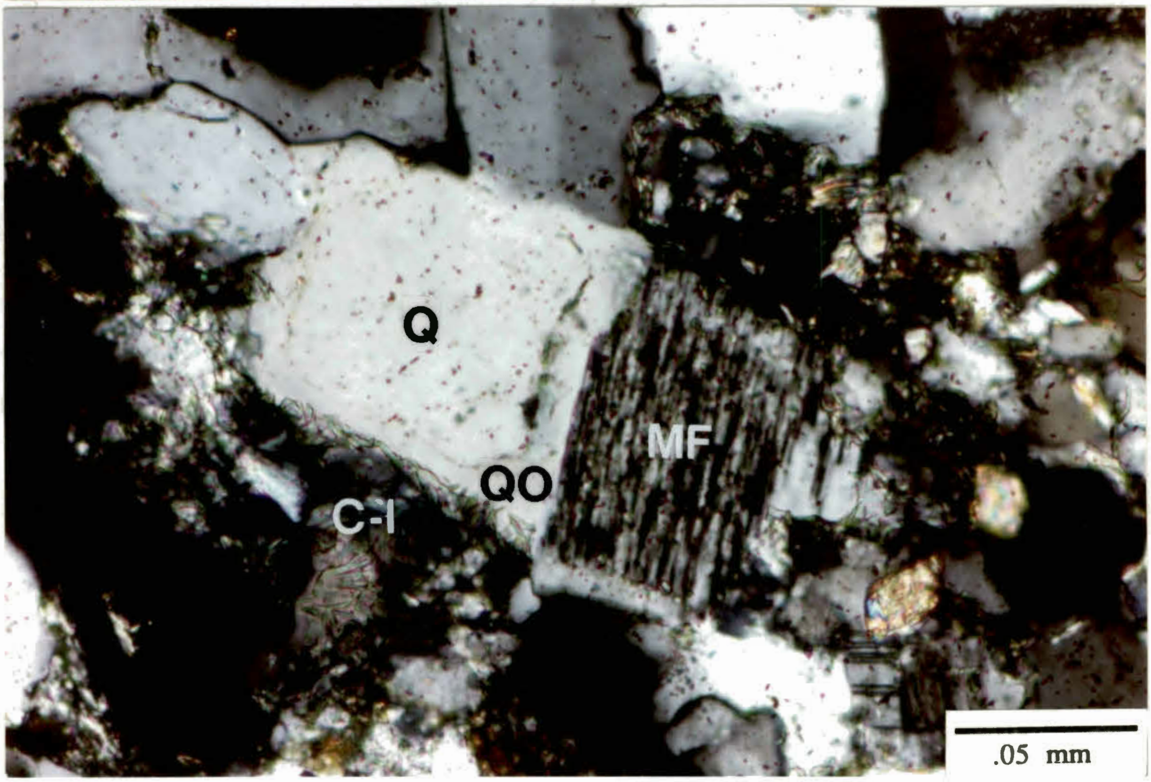


Figure 41. Monocrystalline Quartz (Q) with Dust Rim and Quartz Overgrowth (QO), Microperthite Feldspar (MF), and Chlorite-Illite Pore Linings (C-I). Top PP. Bottom X-N. 20X. Louisiana Land & Expl., Ruth No. 1-28, 13,083'2".

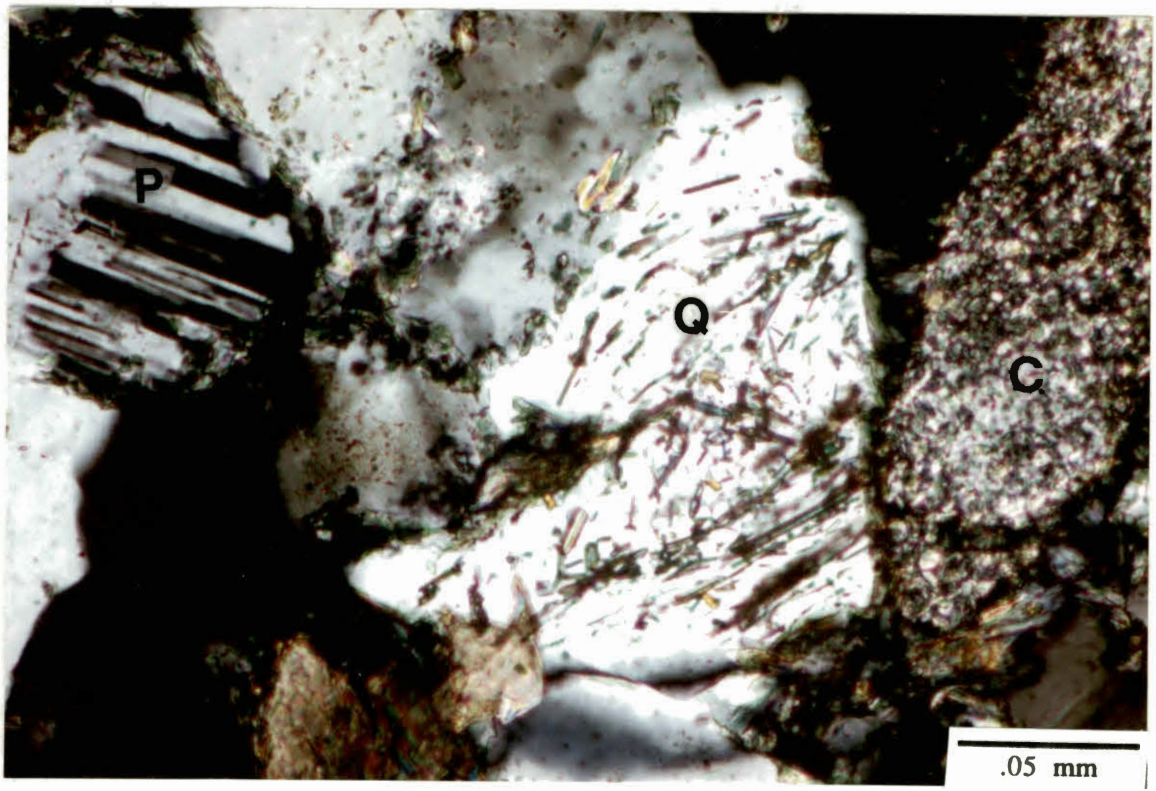


Figure 42. Quartz Grain (Q) with Rutile Needle Inclusions, Plagioclase (P), and Chert (C). PP. 20X. Louisiana Land & Expl., Ruth No. 1-28, 13,083'2"

microperthite (Figures 41, 43) feldspars are found in minor quantities generally less than 3% each. Total feldspar content ranges from 1% to approximately 13% of detrital composition.

Low grade metamorphic rock fragments composed of phyllites, schists, and quartzose rock types comprise 10 to 30% of the detrital constituents (Figure 43). Siltstone and illitic shale clasts are found in minor amounts (< 5%). Psuedomatrix, up to 13% of total rock fabric, formed as a result of ductile deformation of metamorphic rock fragments and shale clasts (Figure 44). Rounded chert rock fragments average 1% of the detrital constituents. Micas composed of biotite and muscovite occur in concentrations on ripple bedding planes and in siltstone sediments (Figure 45). Mica composes < 1% to 5% of total detrital constituents. Granophyre rock fragments are found in trace amounts but in some samples comprise 1% of the detrital constituent grains (Figure 46). Mudstone (micritic limestone) fragments occur in minor amounts along ripple laminae (Figure 47). Zircon appears to be concentrated along ripple laminae and is present in trace amounts in all samples examined (Figure 48). Accessory mineral grains of glauconite (Figure 49), detrital chlorite, phosphate (collophane), tourmaline, garnet, and pyrite occur in trace amounts of less than 1%.

Sedimentary structures recognized in thin section include burrows (Figure 50) and load structures (Figure 51).

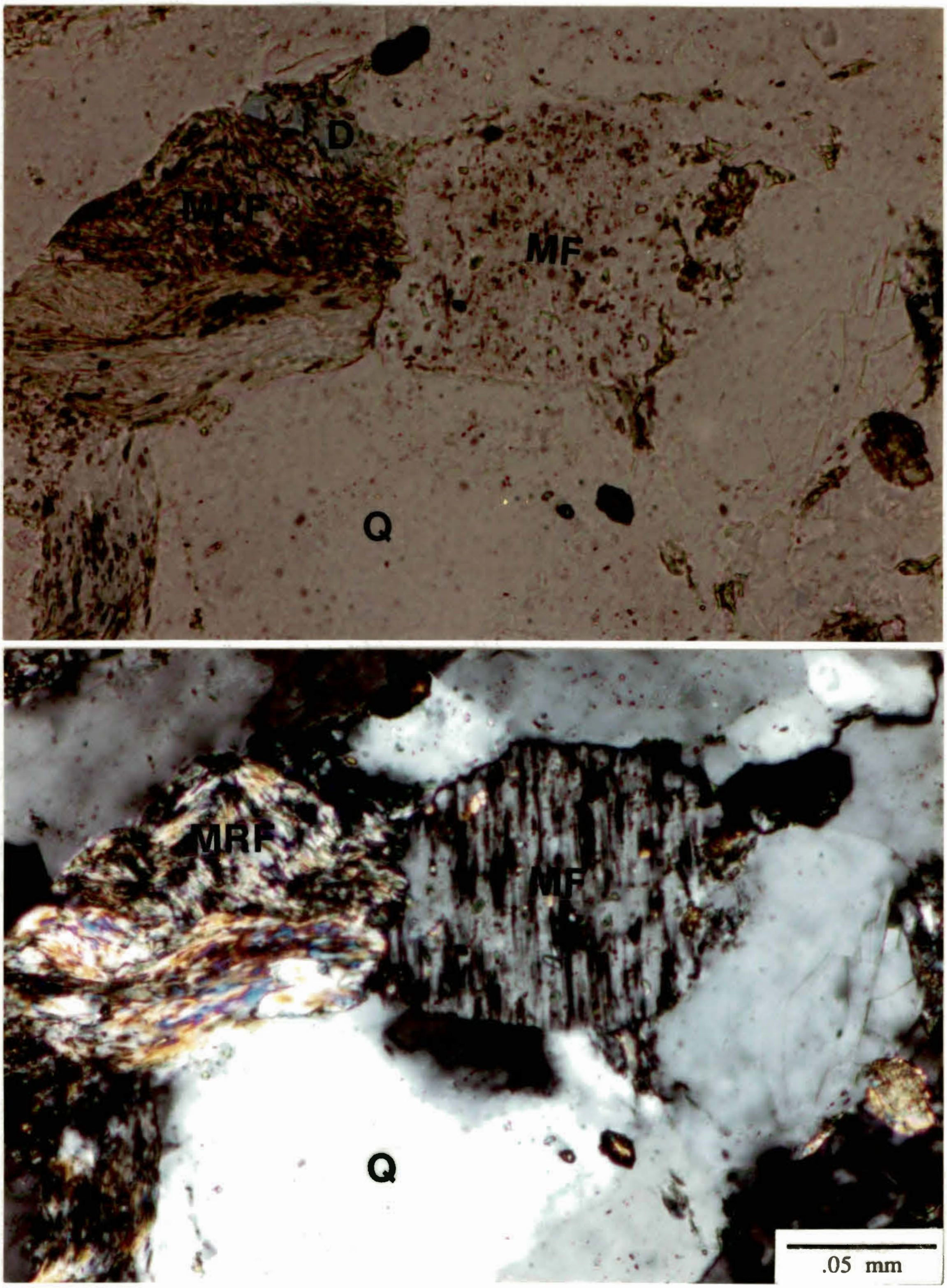


Figure 43. Microperthite Feldspar Grain (MF) with Quartz (Q) and Metamorphic Rock Fragment (MRF) with Partial Dissolution (D). Top PP. Bottom X-N. 20X. Southport Expl., Inc., Merrick No. 1-10, 13,944'3".

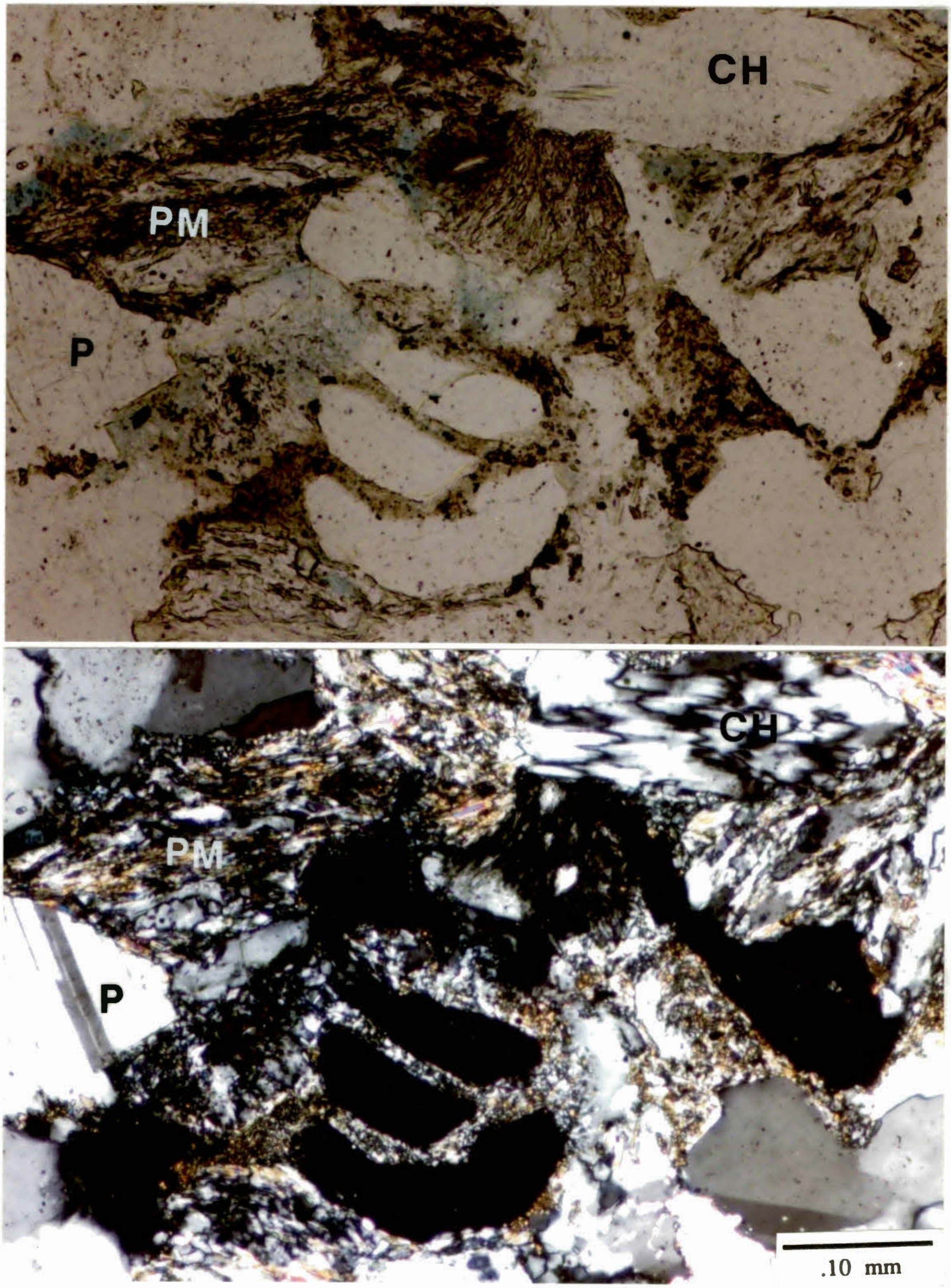


Figure 44. Psuedomatrix (PM) Formed by Ductile Deformation of Metamorphic Rock Fragments and Shale Clasts. Chalcedony (CH) and Plagioclase (P) Top PP. Bottom X-N. 10X. Internorth, Inc., Smith "B" 21 No. 1, 12,493'7".

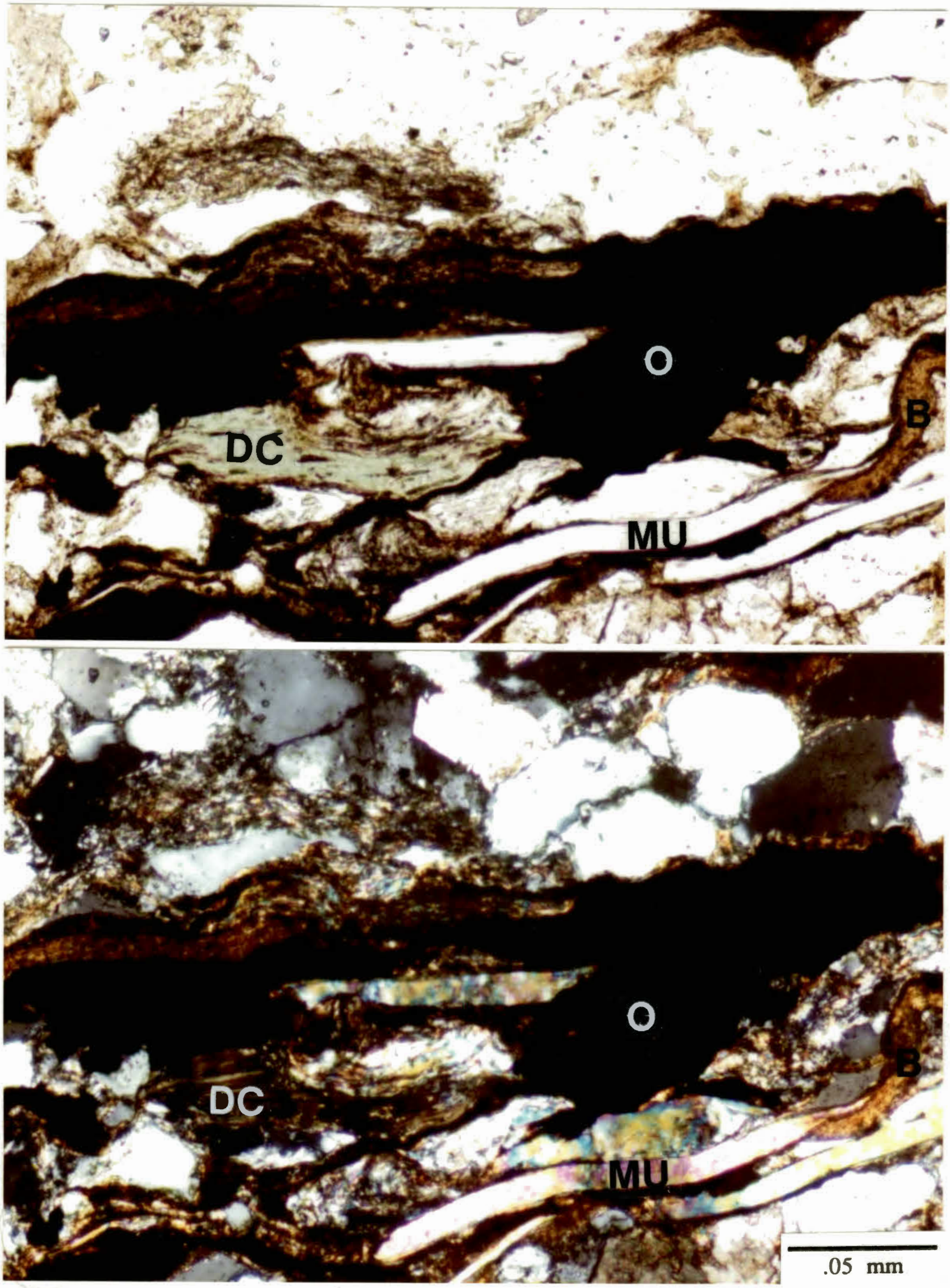


Figure 45. Micas Concentrated on Ripple Laminae. Biotite (B), Muscovite (MU), Detrital Chlorite (DC), and Black Organics (O). Top PP. Bottom X-N. 20X. Louisiana Land & Expl., Ruth No. 2-1, 13,079'4".

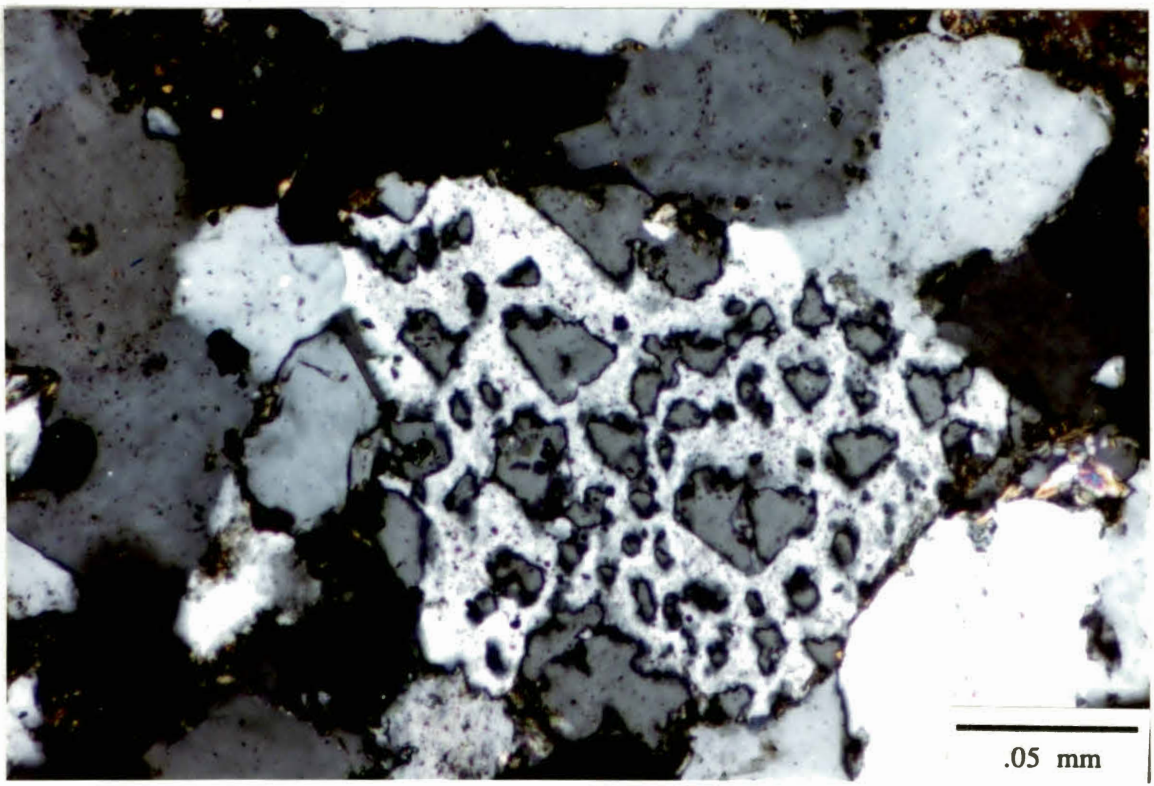


Figure 46. Granophyre Grain. X-N. 20X. Louisiana Land & Expl., Gates No. 2-33, 12,172'4".

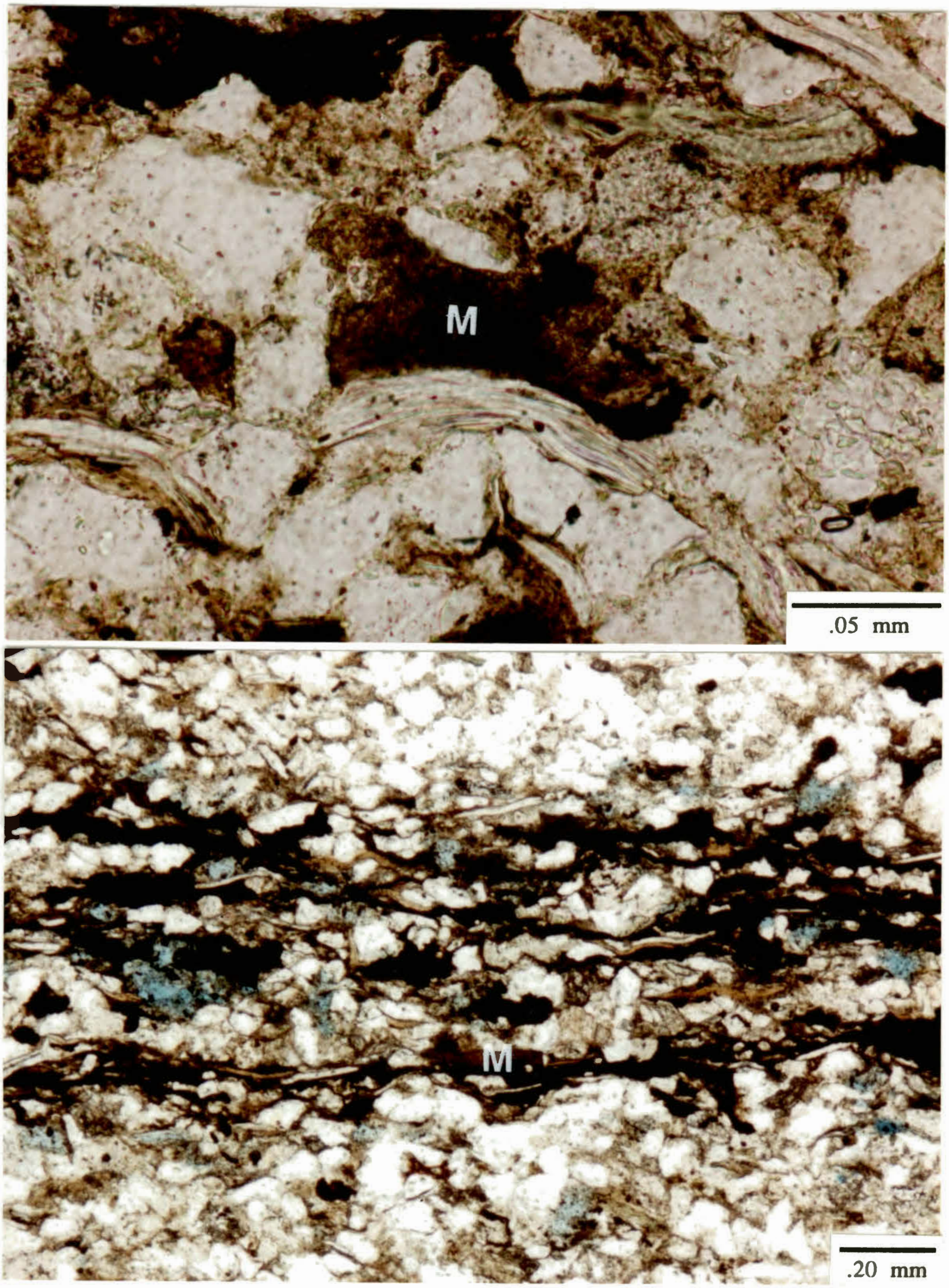


Figure 47. Micritic Fragments (M) Possibly Derived from Algal Material. Top PP. 20X. Southport Expl., Inc., Merrick No. 1-10, 13,951'4". Bottom PP. 4X. Louisiana Land & Expl., Gates No. 2-33, 12,201'7".

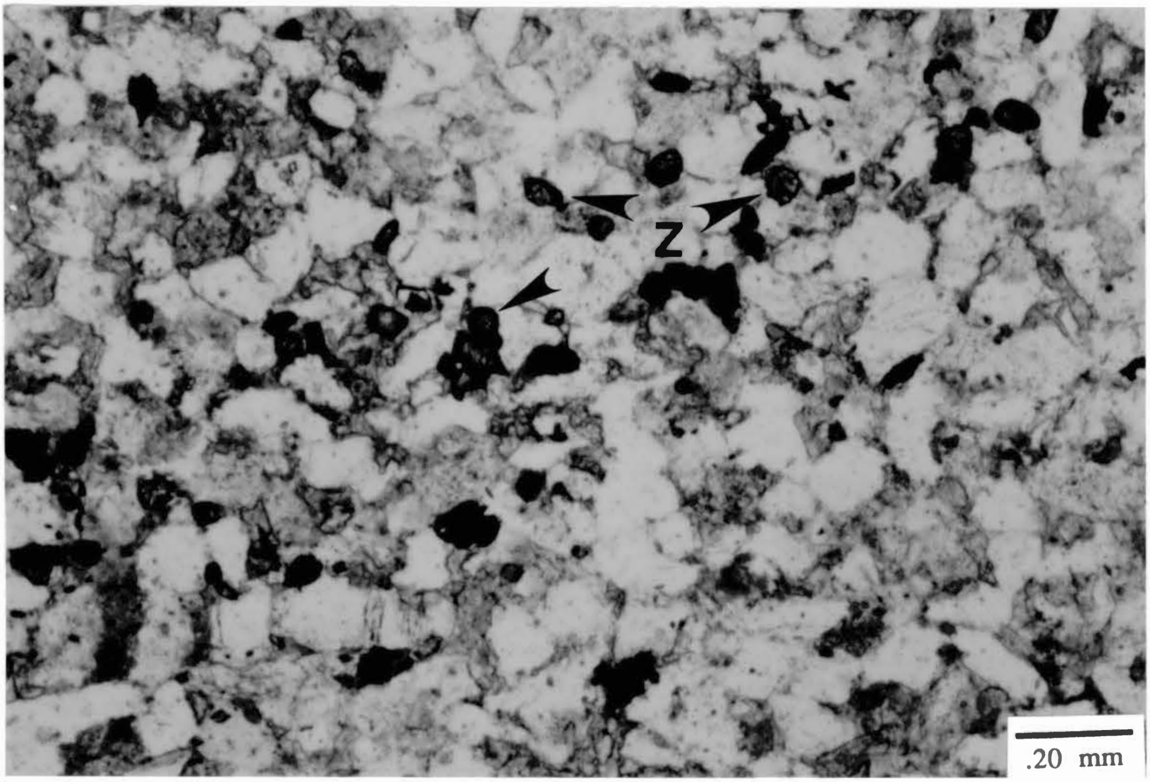


Figure 48. Zircons (Z) and Heavy Minerals Along Ripple Laminae. PP. 4X. Louisiana Land & Expl., Gates No. 2-33, 12,180'11".

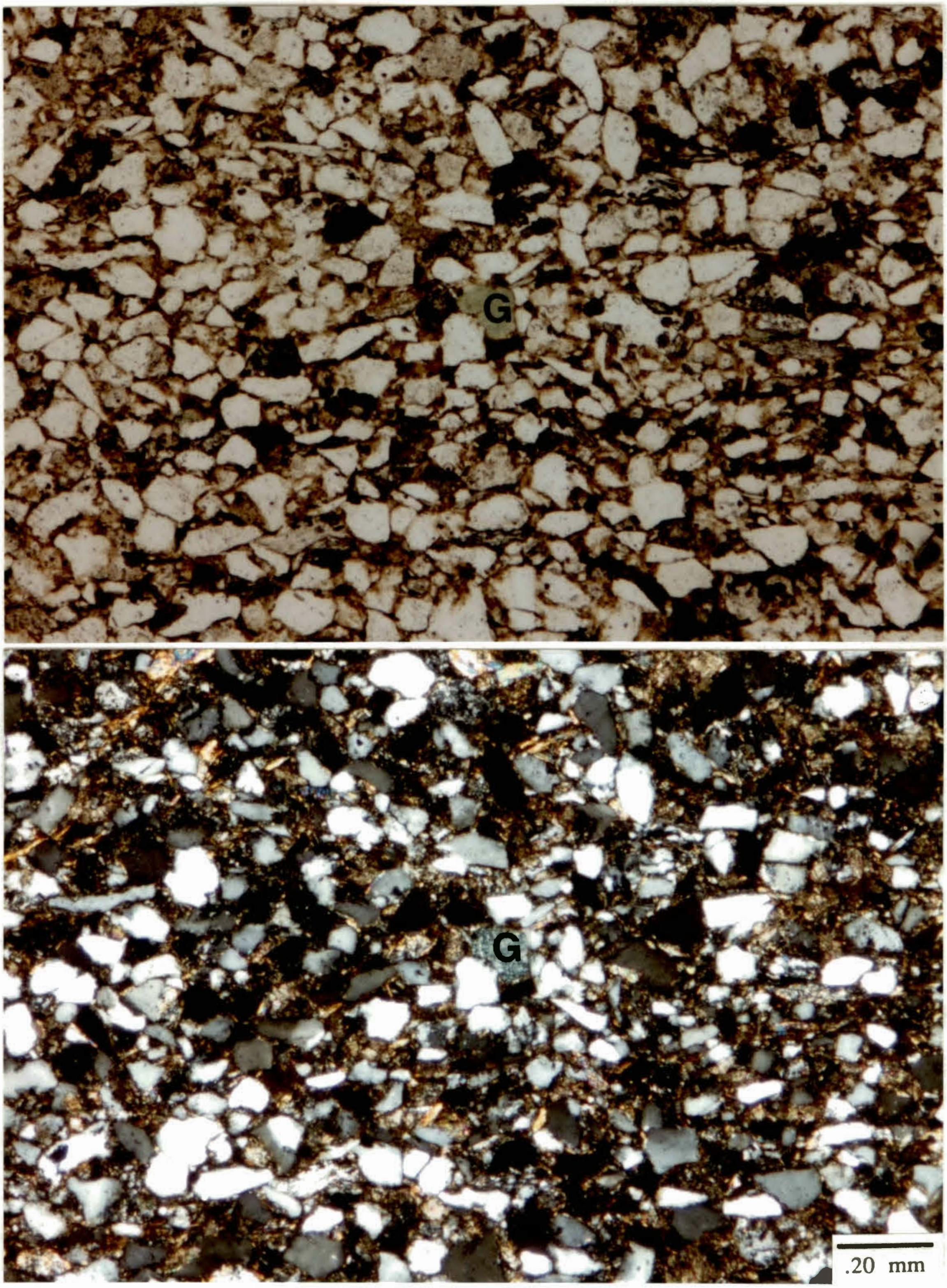


Figure 49. Quartzose Sediment with Detrital Glauconite Grain (G). Siderite and Dolomite Cement. Top PP. Bottom X-N. 4X. Internorth, Inc., Smith "B" 21 No. 1, 12,367'7".

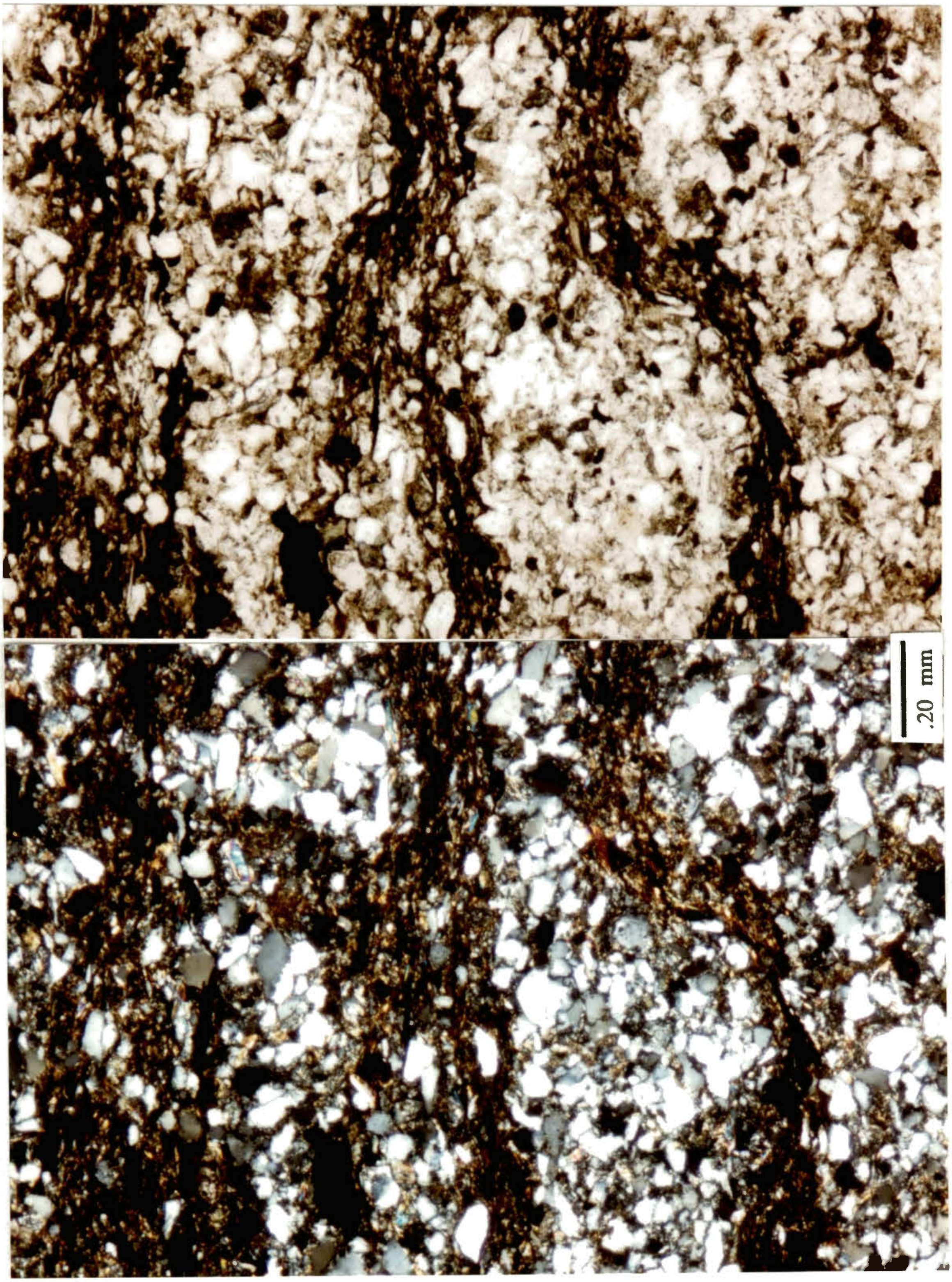


Figure 50. Very Fine-Grained Sandstone Infilling Burrows. Top PP. Bottom X-N. 4X. Louisiana Land & Expl., Savage No. 2-1, 12,252'6".

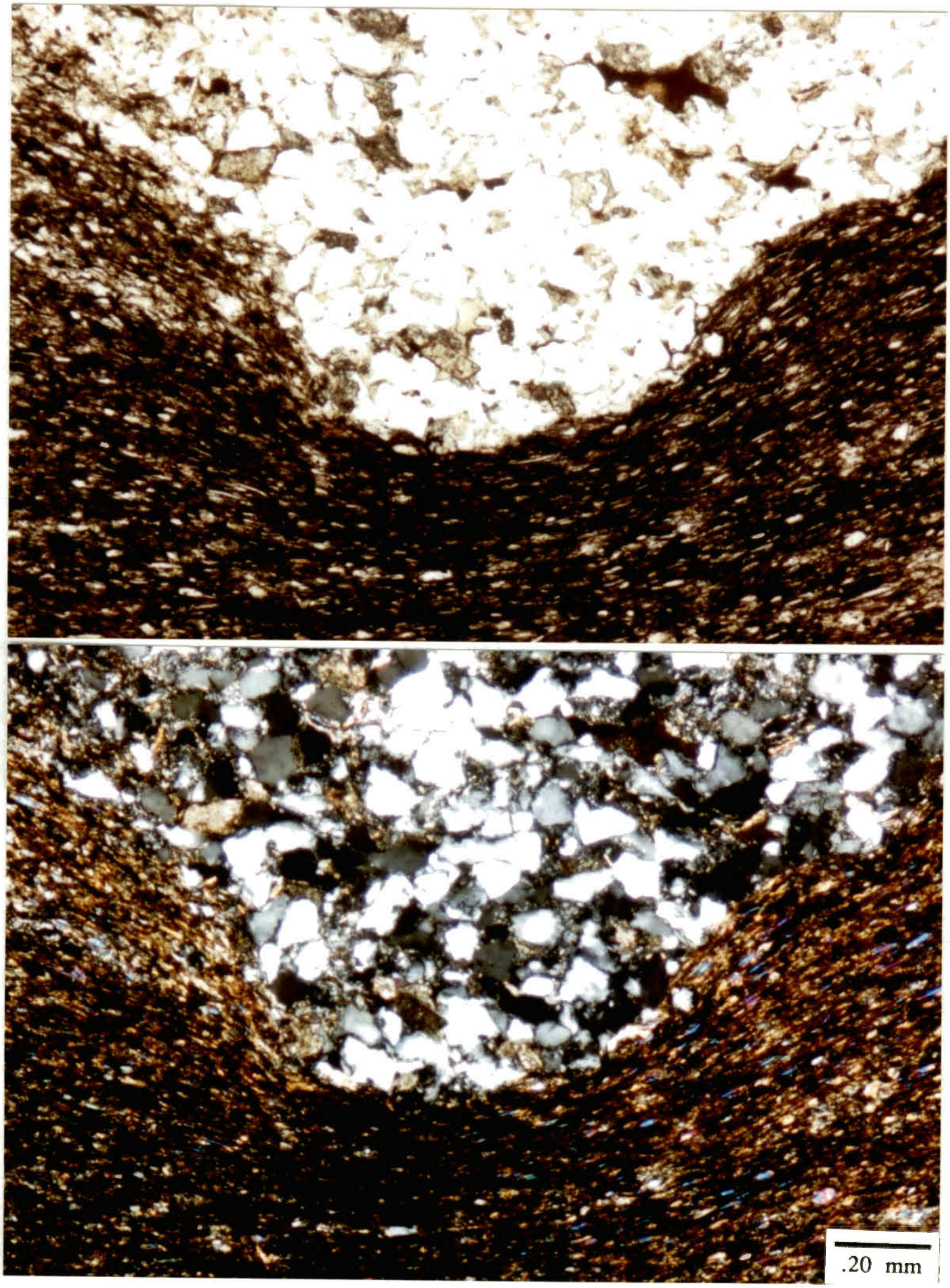


Figure 51. Load Structures. Note Micaceous Siltstone Fabric at Bottom. Top PP. Bottom X-N. 4X. Louisiana Land & Expl., Gates No. 2-33, 12,209'2".

Diagenetic Constituents

The sandstones of the upper Red Fork exhibit extensive diagenetic modifications recognized in thin section.

Authigenic silica is recognized by syntaxial quartz and feldspar overgrowths. Syntaxial quartz overgrowths, averaging 2% of rock fabric, are recognized by chlorite/ illite dust rims on original grains and by straight edges representing crystal faces (Figure 42, p. 70). Minor amounts of feldspar overgrowth is recognized as "cleaner" rims around individual grains (Figure 52) and by differences in original grain texture.

Carbonate cements are composed primarily of calcite and dolomite with lesser amounts of siderite. Siderite, with its characteristic morphology, is present as an early diagenetic mineral partially coating detrital quartz grains (Figure 53). When calcite cement is abundant, quartz grains appear to be totally enclosed by calcite forming typical poikilotopic texture (Figure 54). In addition, patchy sparry calcite is also observed (Figure 55). Dolomite cement occurs as replacement of calcite and feldspar grains (Figure 56).

Illite, chlorite, and kaolinite are observed in thin section analysis and confirmed by x-ray diffraction analysis (Figure 57) as well as by scanning electron microscope (Figures 58, 59). Chlorite occurs as grain coatings as well as pore lining. Illite is recognized as grain coating and as laths extending into pore spaces. Kaolinite occurs as pore space filling and as a product of feldspar alteration (Figure 60).

Figure 52. Feldspar (F) Overgrowth (FO) Recognized by Cleaner Outer Rim. Top PP. Bottom X-N. 20X. Southport Expl., Inc., Merrick No. 1-10, 13,948'7.5".

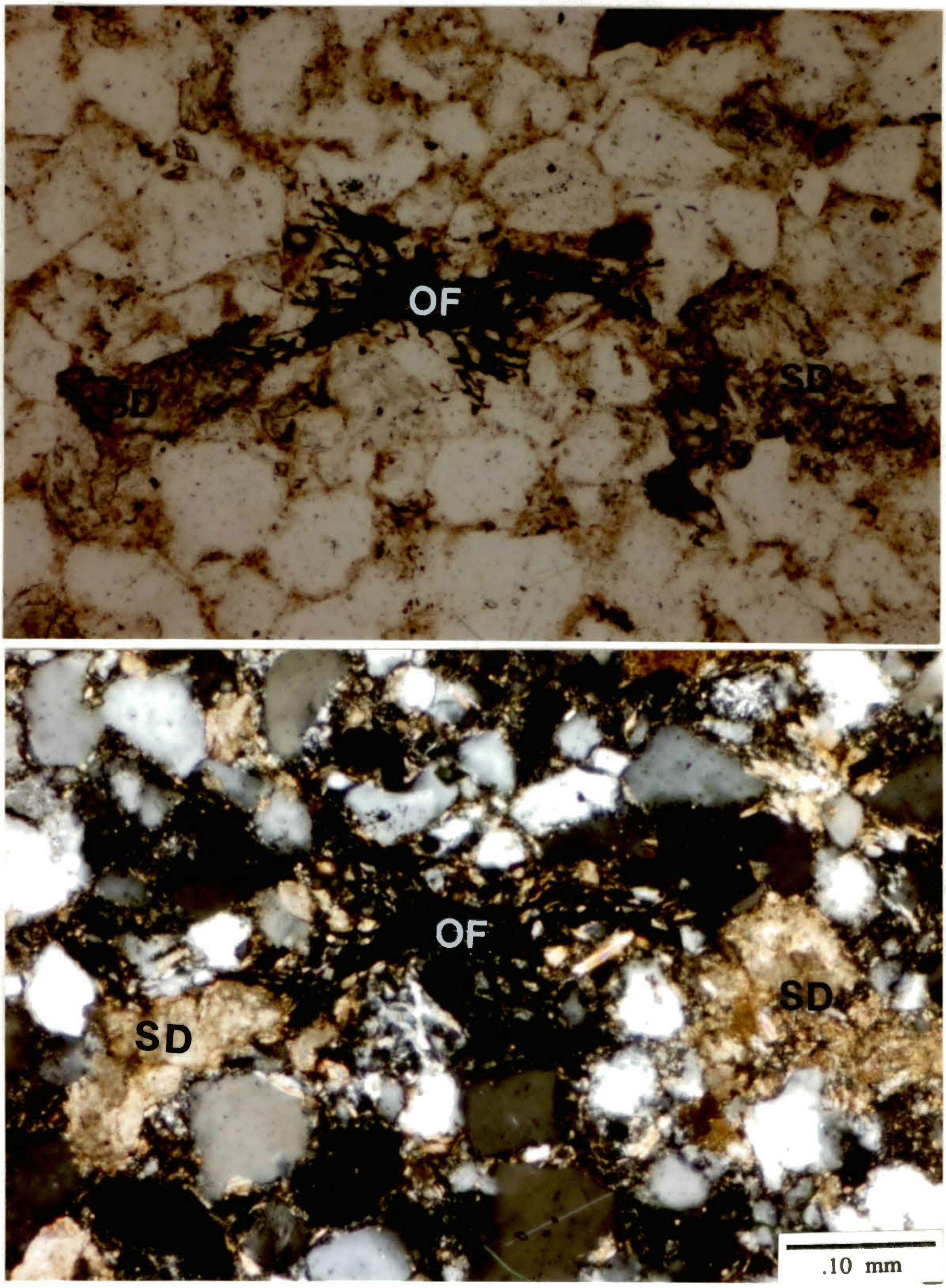


Figure 53. Siderite and Dolomite Cement. (SD) Organic Fragment (OF) in Center. Top PP. Bottom X-N. 10X. Internorth, Inc., Smith "B" 21, No. 1, 12,367'7".

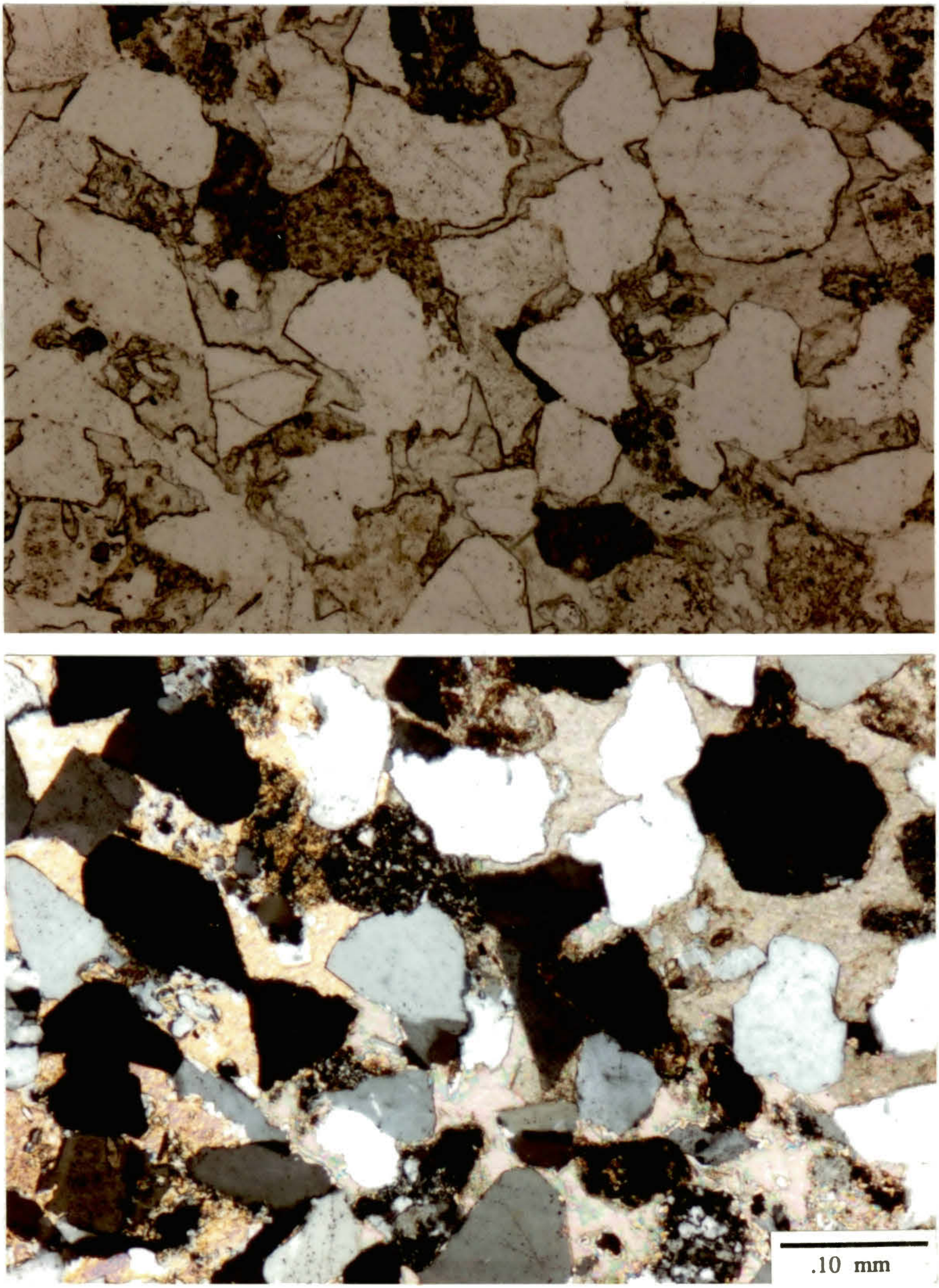


Figure 54. Poikilotopic Texture of Early Calcite Cement. Top PP. Bottom X-N. 10X. Louisiana Land & Expl., Savage No. 2-1, 12,404'2.5"

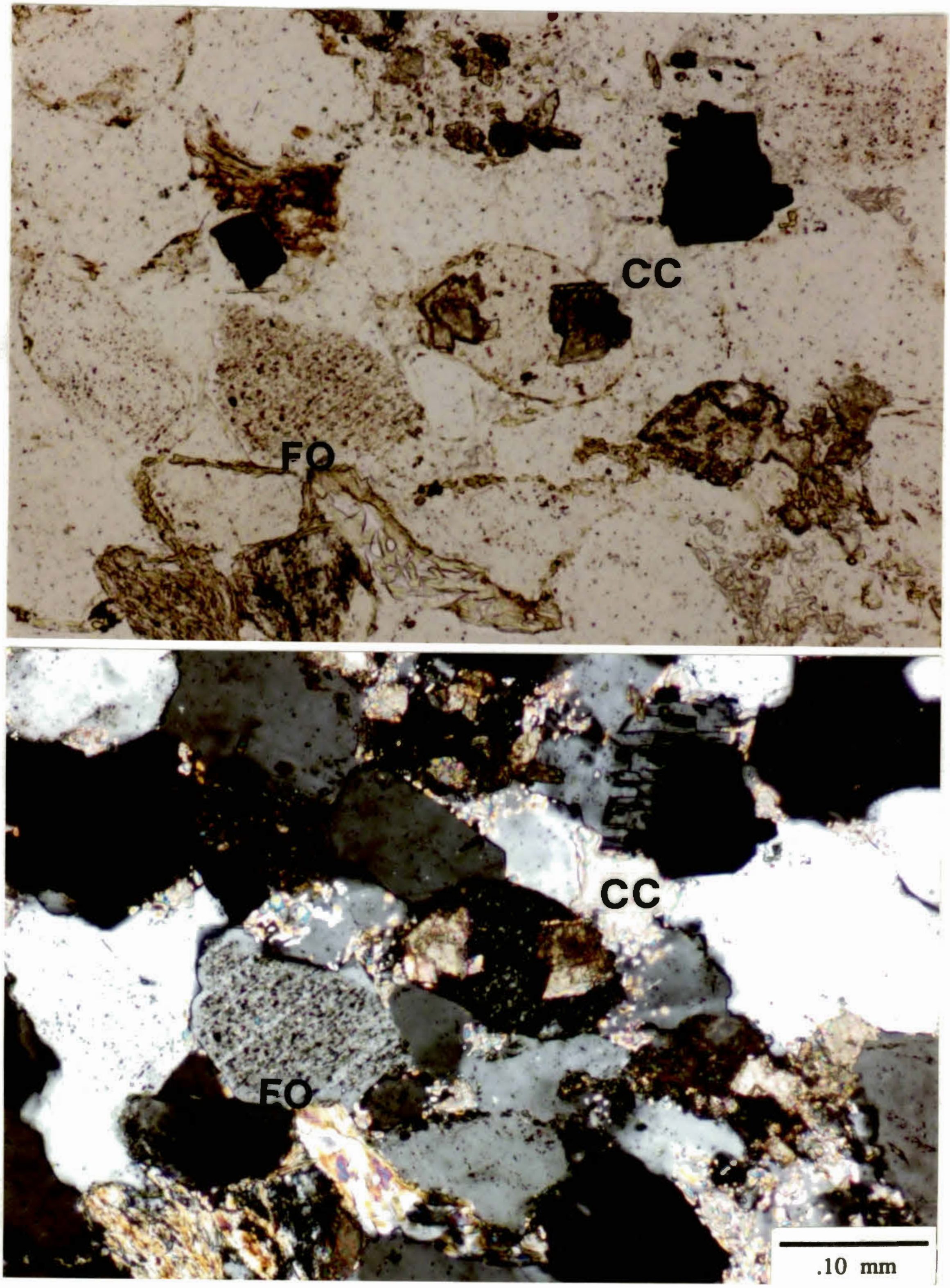


Figure 55. Patchy Sparry Calcite Cement (CC). Note Clean Outer Rim of Feldspar Overgrowth (FO). Top PP. Bottom X-N. 10X. Tenneco Oil Co., Merrick No. 1-27, 12,699'11".

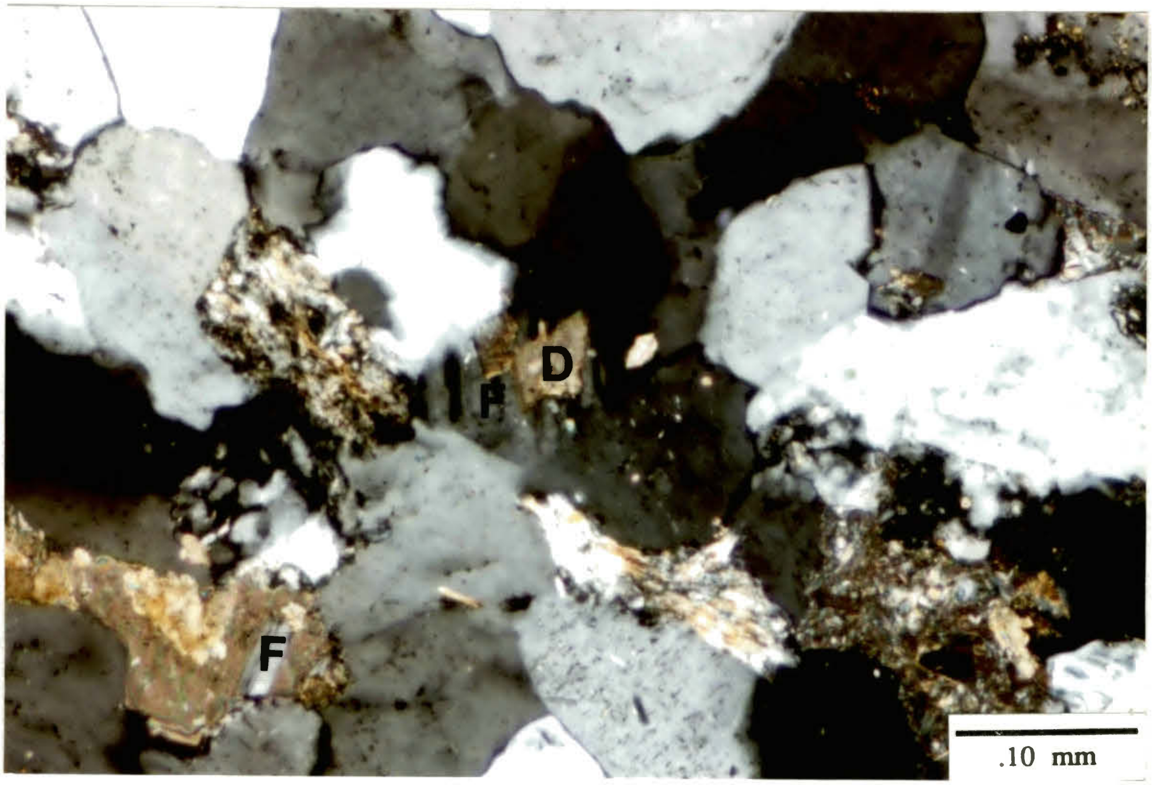


Figure 56. Dolomite Rhomb (D) Replacing Feldspar (F). Note Dissolution of Feldspar Grain in Lower Left. X-N. 10X. Louisiana Land & Exploration, Gates No. 2-33, 12,209'2".

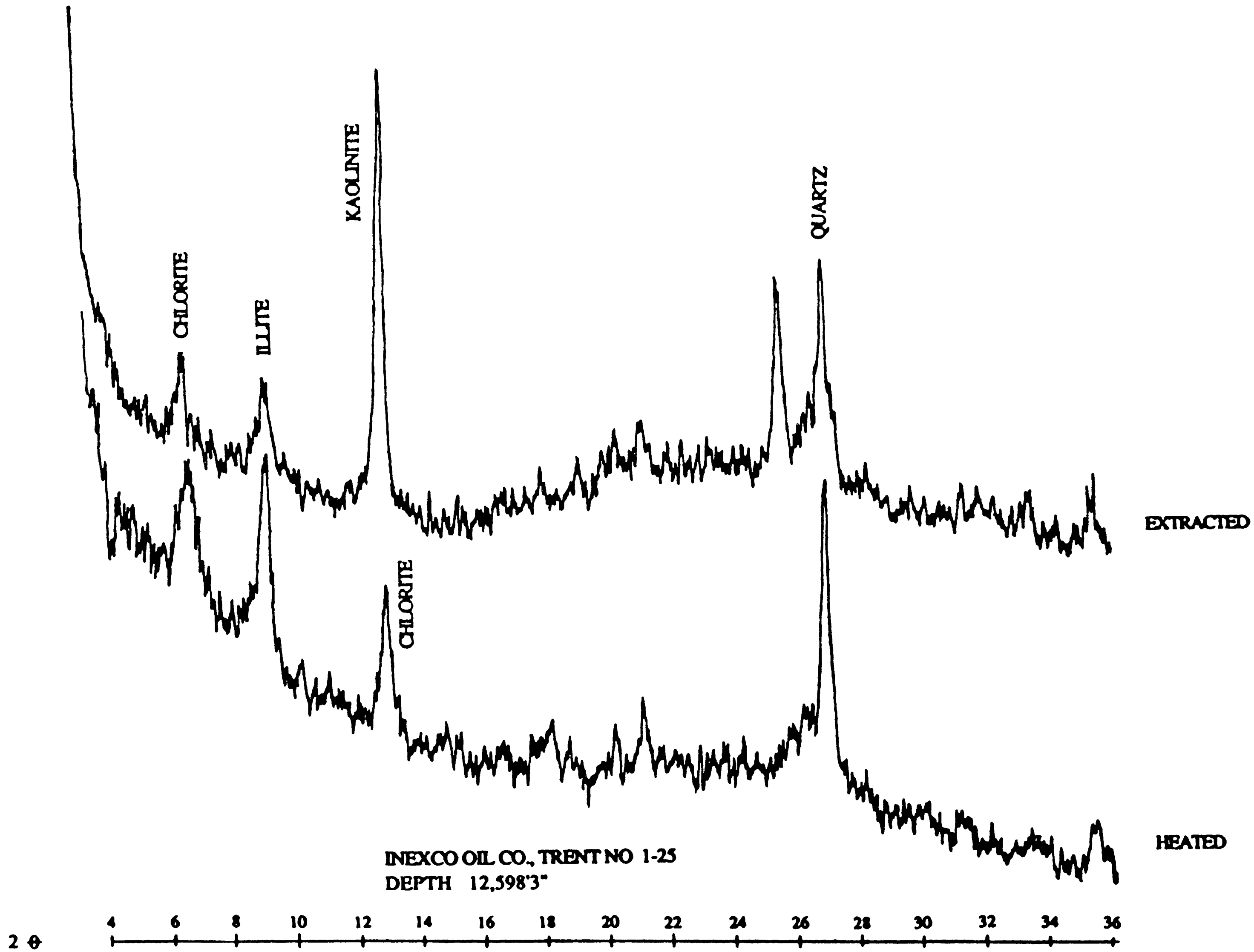


Figure 57. X-Ray Diffractogram Illustrating Clay Types Present in Samples.

A

B

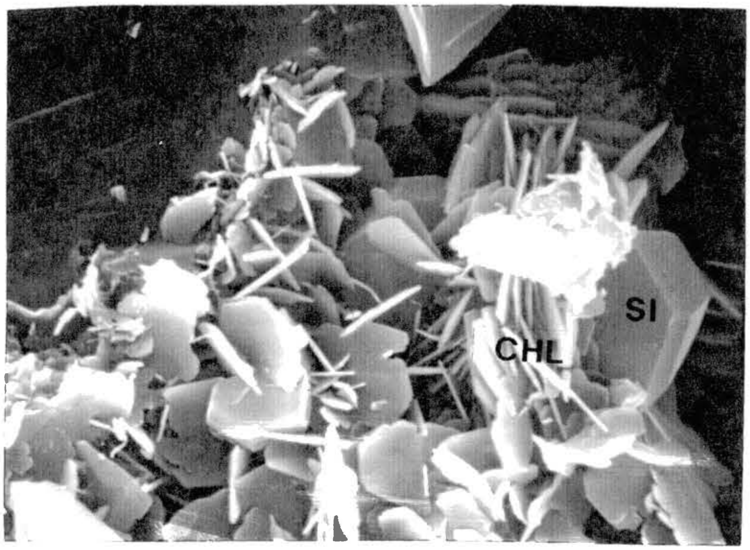


Figure 58. Scanning Electron Microscope Photographs of Selected Samples From the Louisiana Land & Expl. Gates No. 2-33 Core, 12,172'4".
A). Rock Fragment Altering to Abundant Chlorite. 750X.
B). Close-up View of Chlorite Laths (CHL) with Silica (SI). 3000X.

Figure 59. Scanning Electron Microscope Photograph From a Sample of the Louisiana Land & Expl. Gates No. 2-33 Core, 12,172′4". Illite (I) Lining Pores. 4300X.

Porosity

Secondary porosity is the main porosity type observed in thin sections. This porosity type occurs as a result of dissolution of metastable grains such as feldspars, metamorphic rock fragments (Figures 61, 62), matrix, and quartz (Figure 63). Secondary porosity values range from less than 1% to 18%, averaging 3%. Enlarged intragranular secondary porosity is observed when feldspar grains exhibit partial dissolution and alteration to kaolinite. Microporosity is seen between authigenic kaolinite booklets. Primary intergranular porosity occurs in trace amounts.

The presence of psuedomatrix formed by ductile deformation of shale clasts and metamorphic rock fragments results in the decrease of primary porosity. Quartz overgrowths, carbonate cement, and pore filling clays also contributed to the reduction of porosity. Observed porosity tends to increase with abundance of well sorted detrital grains.

Paragenesis

The upper Red Fork sandstones have been subjected to extensive diagenetic modification. The paragenetic sequence of diagenetic events is shown in Figure 65. Diagenetic processes were initiated with burial. Ductile deformation and compaction of low grade metamorphic rock fragments and shale clasts formed psuedomatrix that resulted in decreased primary porosity.

Siderite formed as an early diagenetic mineral

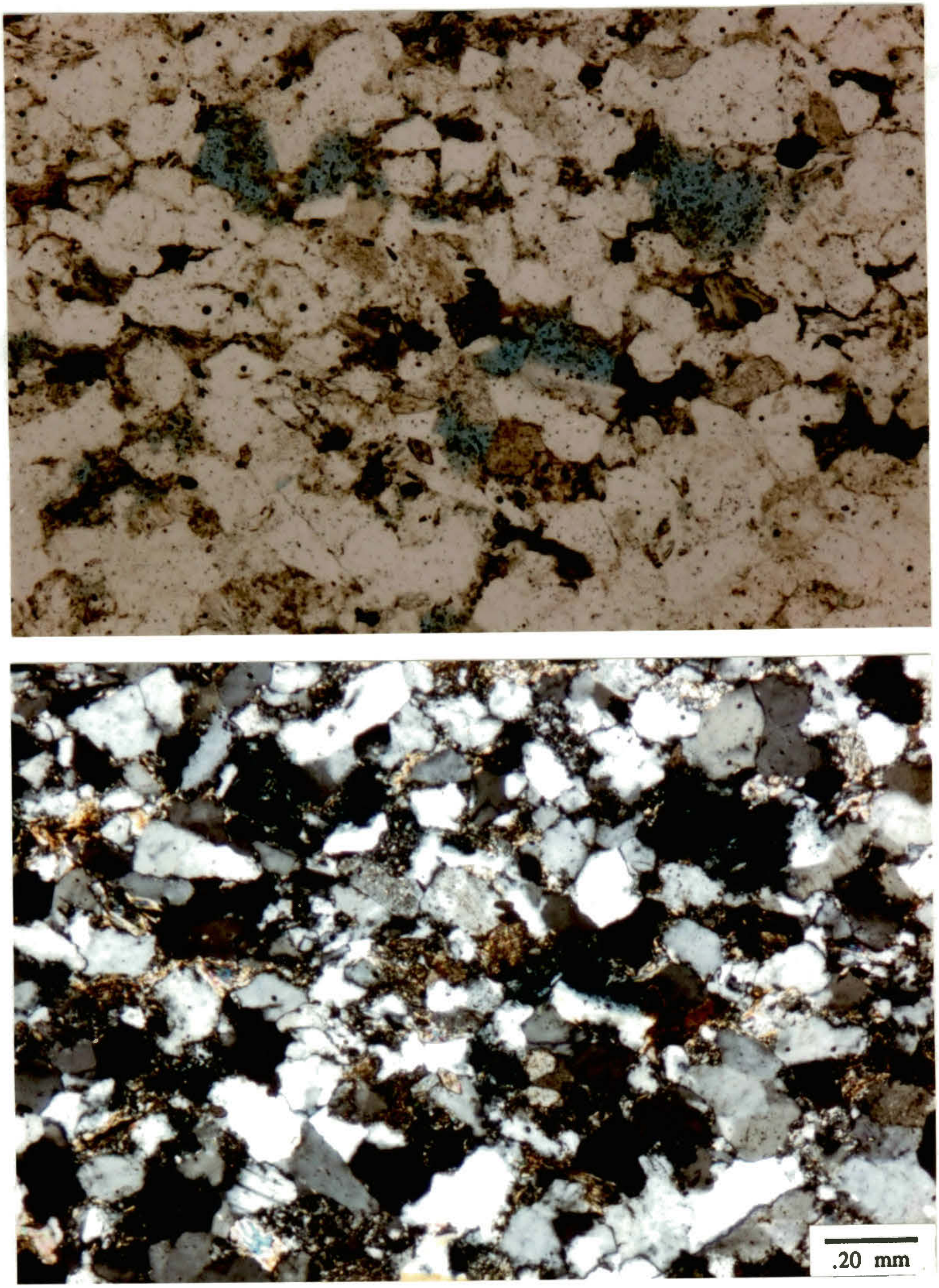


Figure 61. Dissolution of Rock Fragments Forming Secondary Porosity. Top PP. Bottom X-N. 4X. Louisiana Land & Expl., Gates No. 2-33, 12,437'7".

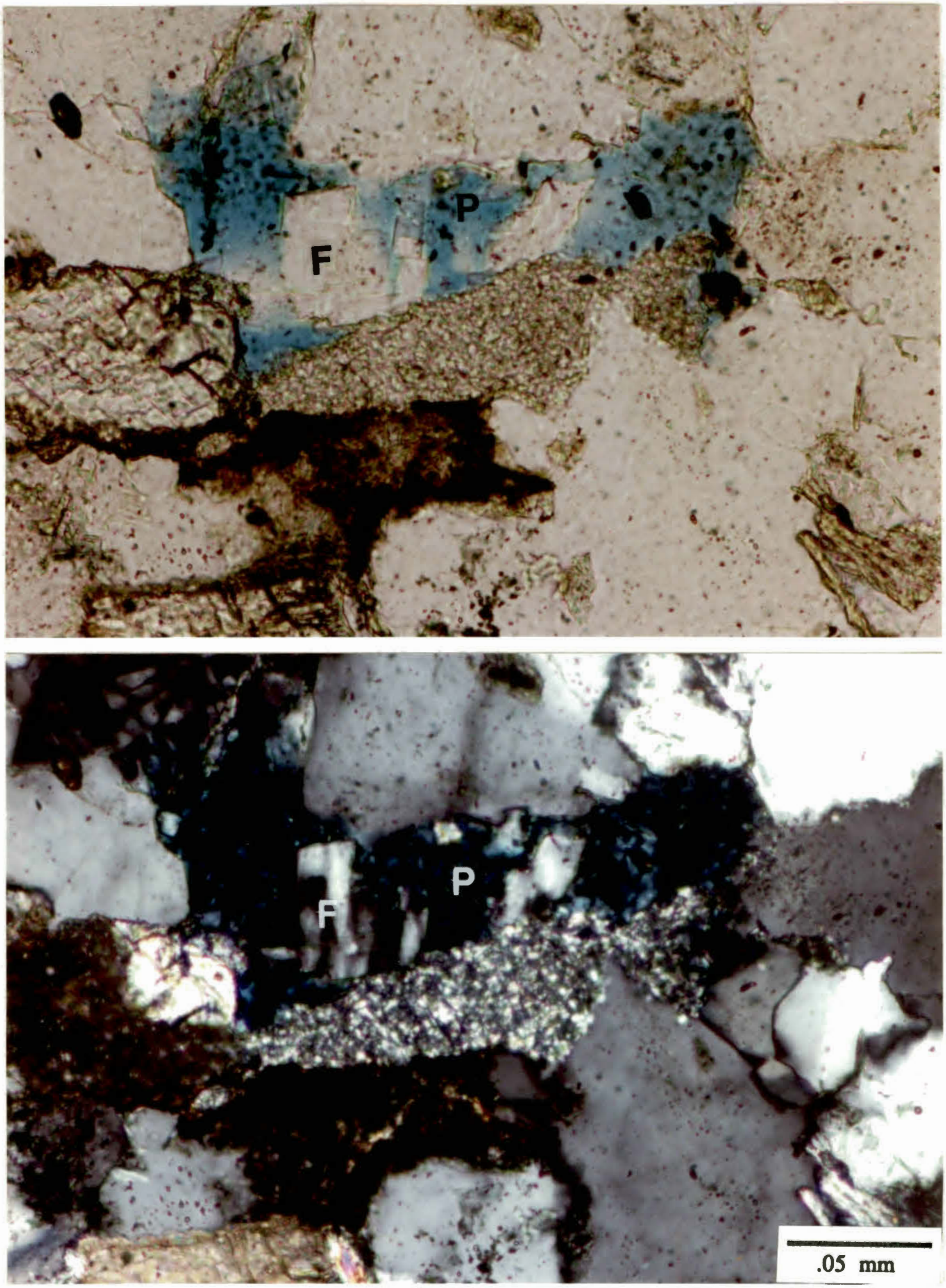


Figure 62. Feldspar (F) Dissolution with Porosity (P). Top PP. Bottom X-N. 20X. Inexco, Inc., Trent No. 1-25, 12,541'10".

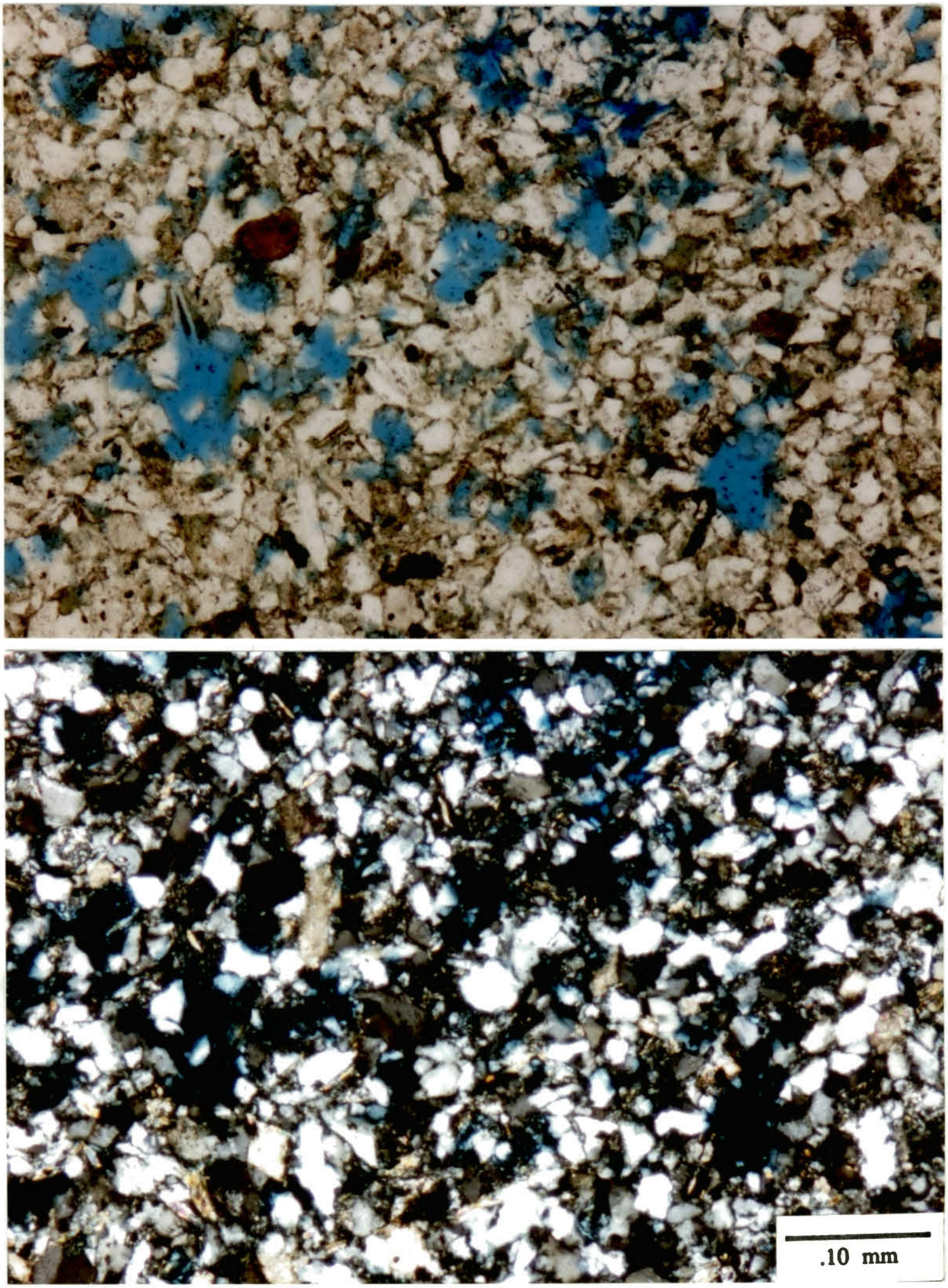


Figure 63. Dissolution of Quartz and Matrix. Porosity Defined by Blue Color. Top PP. Bottom X-N. 10X. Woods Petroleum, Inc., Switzer "C" No. 1-5.

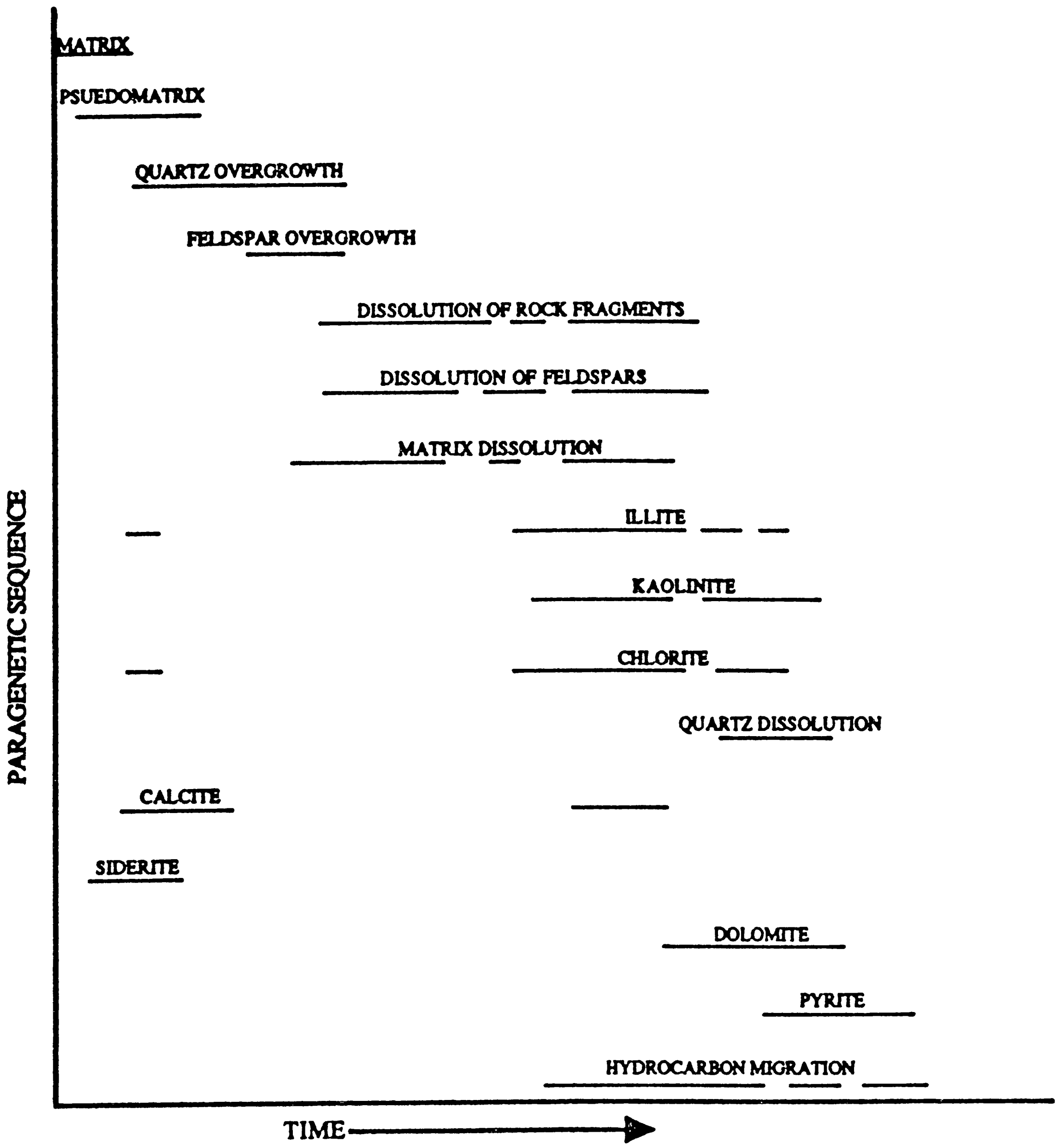


Figure 64. Paragenetic Sequence of Diagenetic Events with Time.

partially coating quartz grains. Precipitation of extensive calcite cements also resulted in substantial decreases of primary porosity.

With increased burial and overburden pressure, silica cement in the form of syntaxial quartz overgrowths formed around detrital grains. Illite and chlorite formed dust rims separating overgrowth from quartz grains. Insignificant amounts of feldspar overgrowths were also formed at this time.

Secondary porosity developed in response to dissolution of metamorphic rock fragments, feldspar, and matrix. Patchy calcite cement formed in some areas occluding secondary pore space.

During the late diagenetic stage, authigenic clays precipitated in pore space and around detrital grains. They also formed as alteration products of metastable components.

Dolomite occurs as authigenic cement and as replacement of calcite and feldspars during this late stage.

Hydrocarbon generation was initiated by the thermal maturation of organic rich shales. This may have been the major source of hydrogen ions in fluids which caused the dissolution of rock fragments. Minor amounts of pyrite formed during the latest stages of diagenesis.

CHAPTER IX

DISTRIBUTION AND GEOMETRY OF THE UPPER RED FORK SANDSTONES

Subsurface geologic maps consisting of net sandstone isolith and interval isopach were constructed to delineate distribution patterns and geometries of the upper Red Fork sandstones using information derived from wire-line logs (Plates I-IV).

Net sandstone thicknesses were determined from gamma-ray curves having deflections greater than 30 A.P.I. units from the shale base line and corresponding increases in resistivity greater than 10 ohm-m above the shale resistivity base line.

The interval isopach map was constructed using the top of the Red Fork interval (base of the Pink Limestone and equivalent dark biomicrite/shale) and the top of the lower Red Fork "hot" radioactive shale marker bed. This "hot" shale was not present in portions of T.15-16N., R.19-20W. so the top of the underlying less-resistive bed was used as the lower Red Fork boundary marker.

Sandstone Trends

All sandstone units within the upper Red Fork interval were combined to determine total net sandstone thickness. This grouping generalizes the distribution of the sandstones into regional trends (Plate IV). Individual sandstone bodies must be studied separately to determine their local depositional trends (Anderson, pers. comm., 1990).

Net sandstone thicknesses range from less than 5 feet to greater than 200 feet (Plate IV). The greatest thicknesses are due to stacking of numerous sandstone units (Figure 65).

The overall geometry of the net sandstone thicknesses shows an elongated pattern to the north and northwest culminating from an implied sediment source to the east and north (Figure 66). Several trends are observed on the isolith map which may reflect these multiple sediment sources and possible overall flow directions. East-west trends occur in T.12N., R.19W. and T.14N., R.20W. A general northeast-southwest trend is evident in T.13N., R.21-22W. Sandstone thicknesses show northwest-southeast trends in T.15N., R.23W. extending into T.14N., R.21-22W. Thinning to the southwest occurs in T.12N., R.23-24W. and T.13N., R.23W. Sandstone thicknesses in T.15-16N., R.21W. show pod shaped geometry. However, sandstone distribution in T.15-16N., R.19-20W. does not show discernible trends with current data.

Upper Red Fork Interval Isopach Thickness

The thickness of the upper Red Fork interval increases from less than 150 feet in T.16N., R.19W. to over 1,100 feet in T.12N., R.22W. (Figure 67, Plate III). Total interval thicknesses in T.16N., R.19-20W. and part of T.15N., R.19W. delineate thinner intervals with more gradual

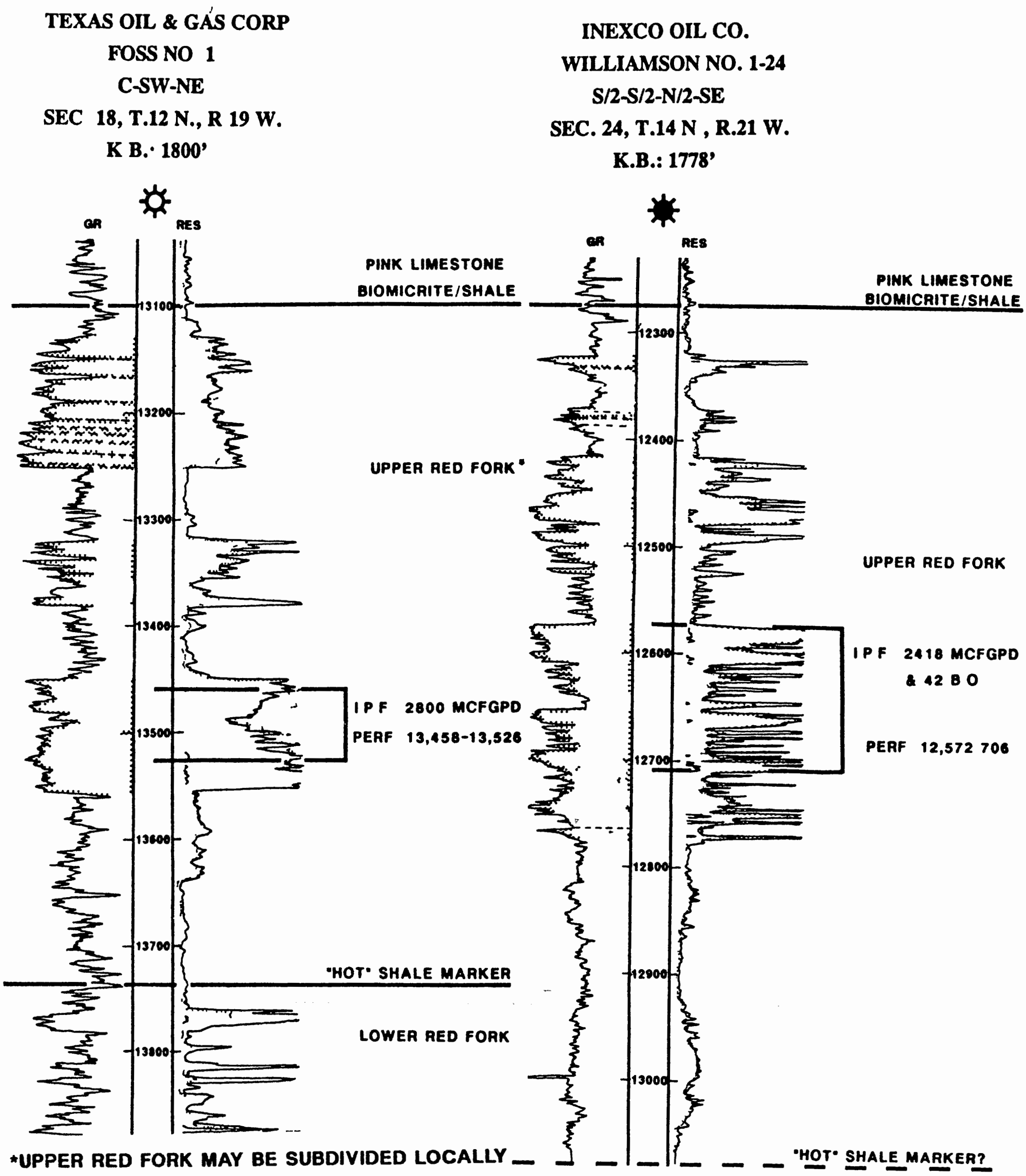
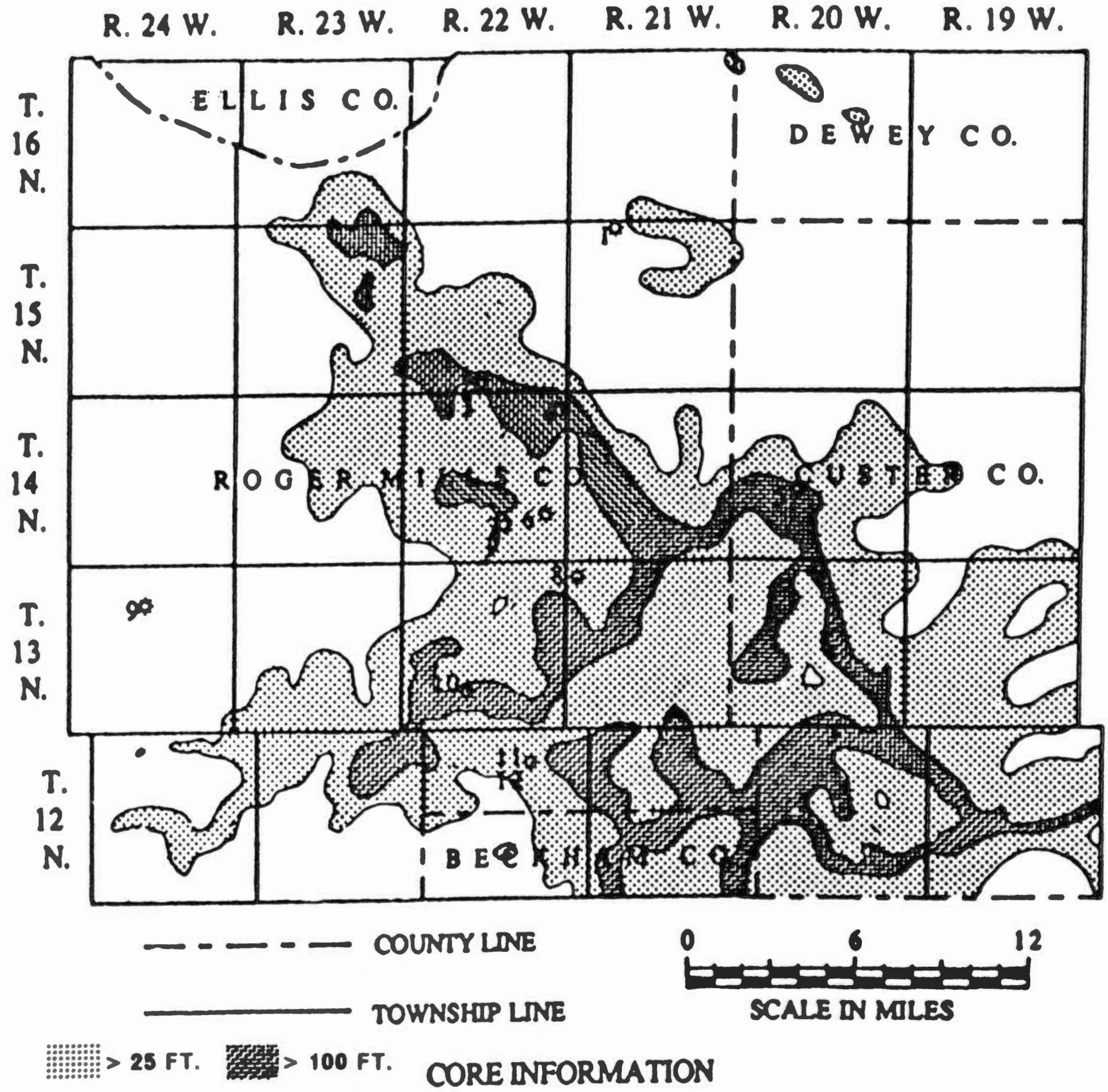


Figure 65. Wire-line Logs Illustrating Multiple Sandstone Units Used to Determine Net-Sandstone Thicknesses.



CORE INFORMATION

	COMPANY	WELL NAME	LOCATION	INTERVAL
1	WOODS PETR. CORP.	SWITZER "C" NO. 1-5	T. 15 N., R. 21 W., SEC. 5	11,375 FT. TO 11,503 FT.
2	LOUISIANA LAND & EXPL.	GATES NO. 2-33	T. 15 N., R. 22 W., SEC. 33	12,170 FT. TO 12,224 FT.
3	LOUISIANA LAND & EXPL.	GATES NO. 2-33	T. 15 N., R. 22 W., SEC. 33	12,393 FT. TO 12,513 FT.
4	LOUISIANA LAND & EXPL.	SAVAGE NO. 2-1	T. 14 N., R. 22 W., SEC. 1	12,382 FT TO 12,500 FT.
5	INTERNORTH, INC.	SMITH "B" 21 NO. 1	T. 14 N., R. 20 W., SEC. 21	12,209 FT. TO 12,532 FT.
6	INEXCO, INC.	TRENT NO. 1-25	T. 14 N., R. 22 W., SEC. 25	12,501 FT. TO 12,672 FT.
7	TENNECO OIL CO.	MERRICK NO. 1-27	T. 14 N., R. 22 W., SEC. 27	12,695 FT. TO 12,786 FT.
8	TENNECO OIL CO.	LESTER NO. 1-6	T. 13 N., R. 21 W., SEC. 6	12,731 FT. TO 12,771 FT.
9	TENNECO OIL CO.	GRIFFEN NO. 1-9	T. 13 N., R. 24 W., SEC. 9	13,767 FT. TO 13,882 FT.
10	LOUISIANA LAND & EXPL.	RUTH NO. 1-28	T. 13 N., R. 22 W., SEC. 28	13,055 FT. TO 13,097 FT.
11	SOUTHPORT EXPL., INC.	MERRICK NO. 1-10	T. 12 N., R. 22 W., SEC. 10	13,898 FT. TO 13,957 FT.
12	SOUTHPORT EXPL., INC.	MERRICK NO. 1-10	T. 12 N., R. 22 W., SEC. 10	14,029 FT. TO 14,068 FT.

Figure 66. Geometry of the Upper Red Fork Sandstones in the Study Area with Core Locations.

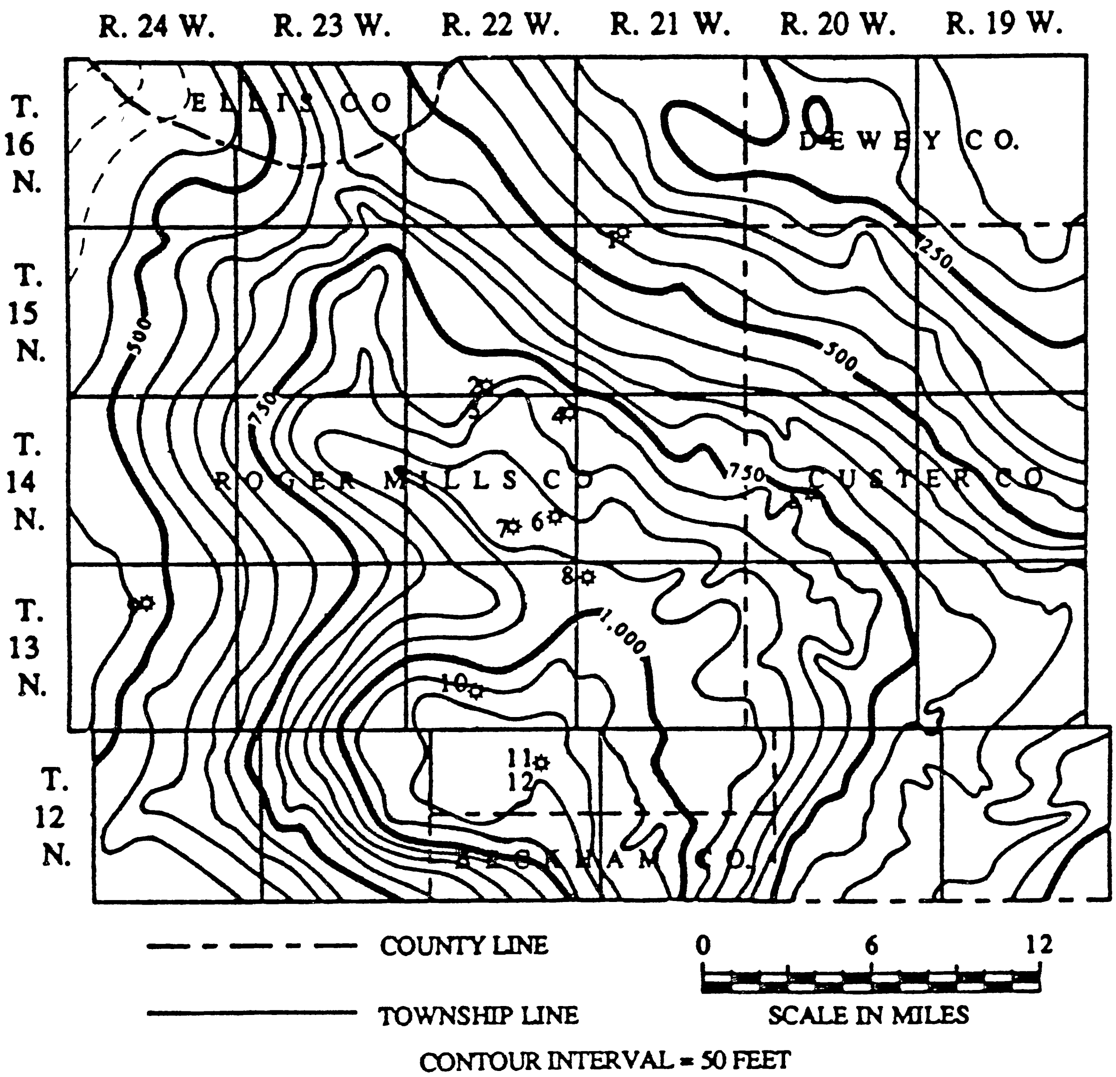


Figure 67. Upper Red Fork Interval Isopach Map with Core Locations.

changes in thicknesses. A marked increase in thickening basinward may represent the upper Red Fork interval hinge line (Figure 68). This possible shelf-to-slope-break hinge line trends northwest-southeast and can be extended to the north outside the study area (See Udayashankar, Plate VII, 1985). The hinge line for the upper Red Fork interval has similar characteristics to the hinge line described by Johnson (1984) for the lower Red Fork interval.

Upper Red Fork isopach thicknesses show increased total sediment deposition that trends north-northwest (Figure 69). The interval thins outward from T.12N., R.22W. delineating maximum sediment thicknesses deposited in a local Red Fork depocenter.

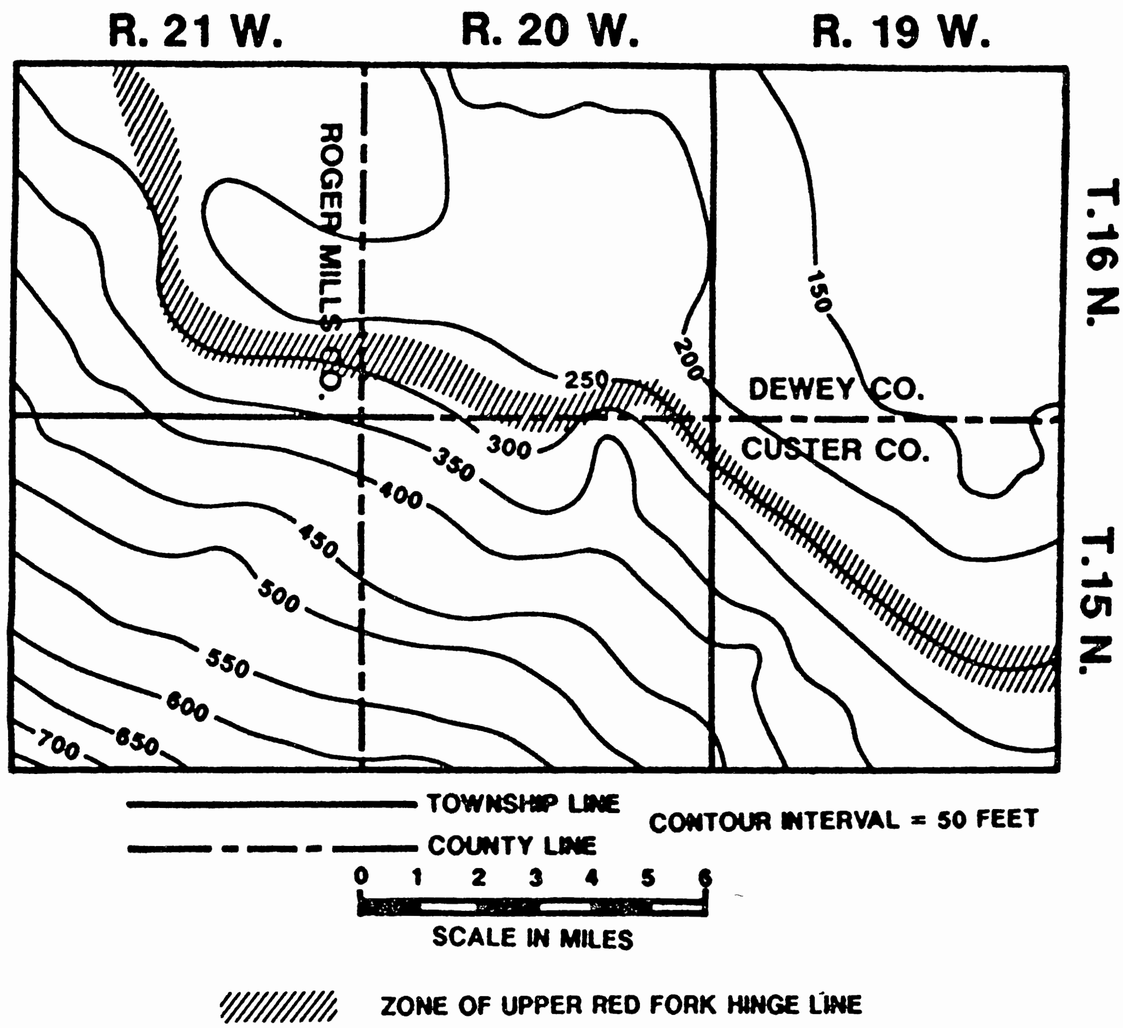


Figure 68. Zone of Upper Red Fork Hinge Line Within the Study Area.

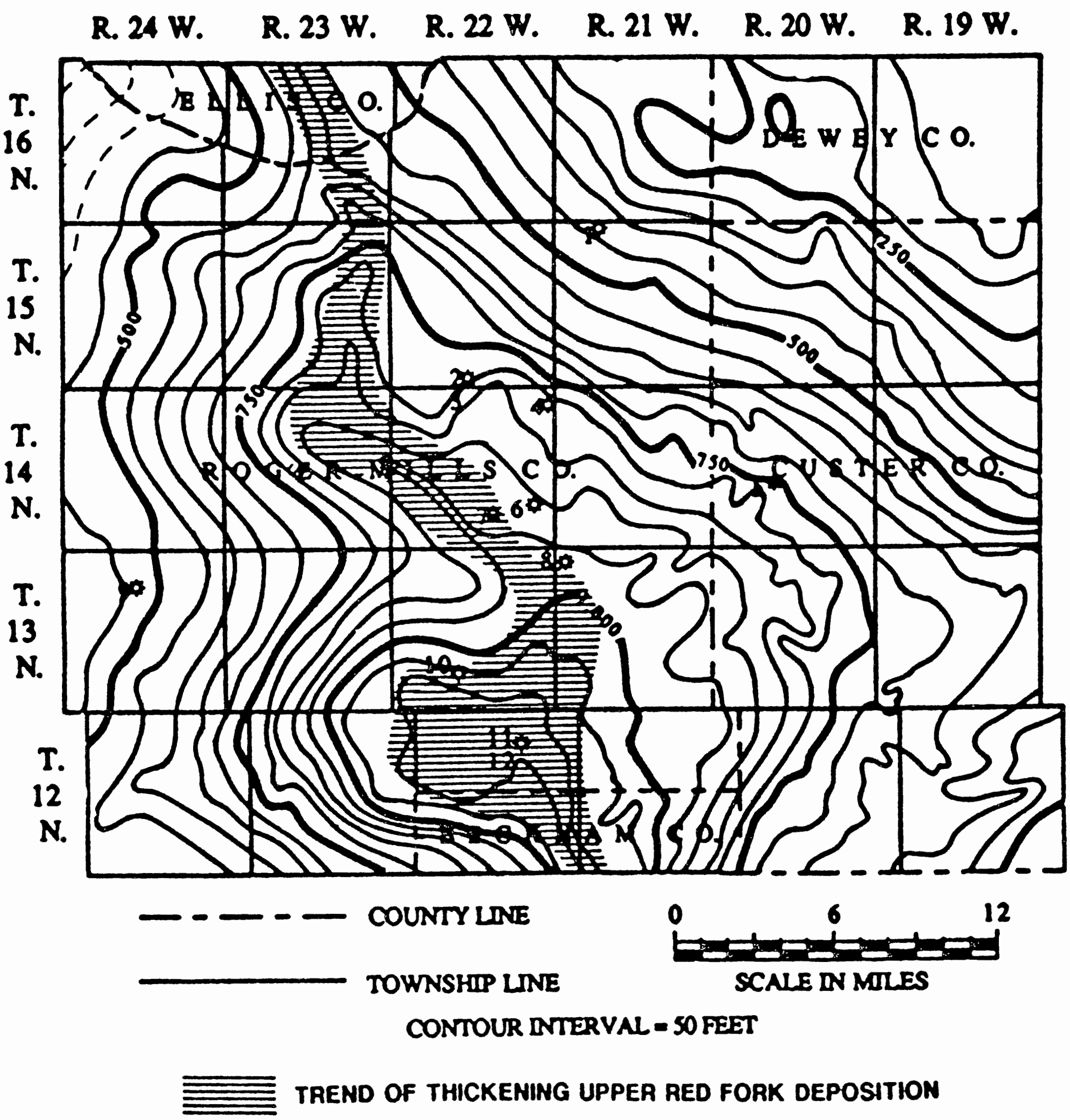


Figure 69. Upper Red Fork Interval Trend of Greatest Sediment Thicknesses.

CHAPTER X

FACIES ANALYSIS OF THE UPPER RED FORK INTERVAL

Introduction

The upper Red Fork sandstones are interpreted to have been deposited in a variety of submarine environmental settings, with the exception of the northeastern part of the study.

Numerous submarine fan models are available in literature that describe modern and ancient submarine fan sedimentation and morphologies. Parameters from two of these models were used to help interpret the upper Red Fork depositional environment.

Sedimentary structures, bedding types, and grain size observed in core exhibit distinct similarities to those described by Mutti and Lucchi (1972). Therefore, the Mutti-Lucchi facies and terminology was adopted to provide detailed description of the submarine facies found in cores.

General sedimentation patterns and sandstone geometries are the principal reasons for use of the Walker (1978) model for submarine fan deposition. Facies interpretations of the upper Red Fork sediments are applied to the Walker (1978) morphology of submarine fan development.

An overview of previous investigations to the east of the study area is given to support the interpreted submarine depositional environment.

Interpretations of Studies Near the Area of Investigation

Investigations in the vicinity of the study area have determined that the upper Red Fork interval consists of sediments deposited in deltaic depositional environments (see Chapter IV).

To the east of the study area, Johnson (1984) interpreted upper Red Fork sediments to be deltaic distributary deposits. The hinge line for the upper Red Fork interval within Johnson's study area may exist in T.12N., R.16W. Thickening of the upper Red Fork interval is apparent in cross-sections (Johnson, 1984, Plates III & IV, wells 1 & 2) between wells located in T.13N., R.15W. and T.12N., R.16W. The hinge line is also reflected by the Pink Limestone facies change from limestone to probable dark biomicrite/ shale in these wells. Johnson (1984) did not document a hinge or slope area for the upper Red Fork but inferred the maximum progradation of the delta lobe may be located in T.12N., R.16W. A sedimentation pattern change may occur in the southwestern corner of his study area in T.12N., R.16W. This change occurs at approximately the location of the Pink Limestone facies change. The Pink Limestone facies change was mapped by Puckette (1990) in T.13N., R.16W. (Figure 70).

Based on Johnson (1984) and data obtained within this study area, the following general depositional model is proposed for the upper Red Fork sandstones deposited to the east of the study area (Figure 71).

Deltaic distributary channels flowed into a main channel depositing fine- to very fine-grained sands, muds,

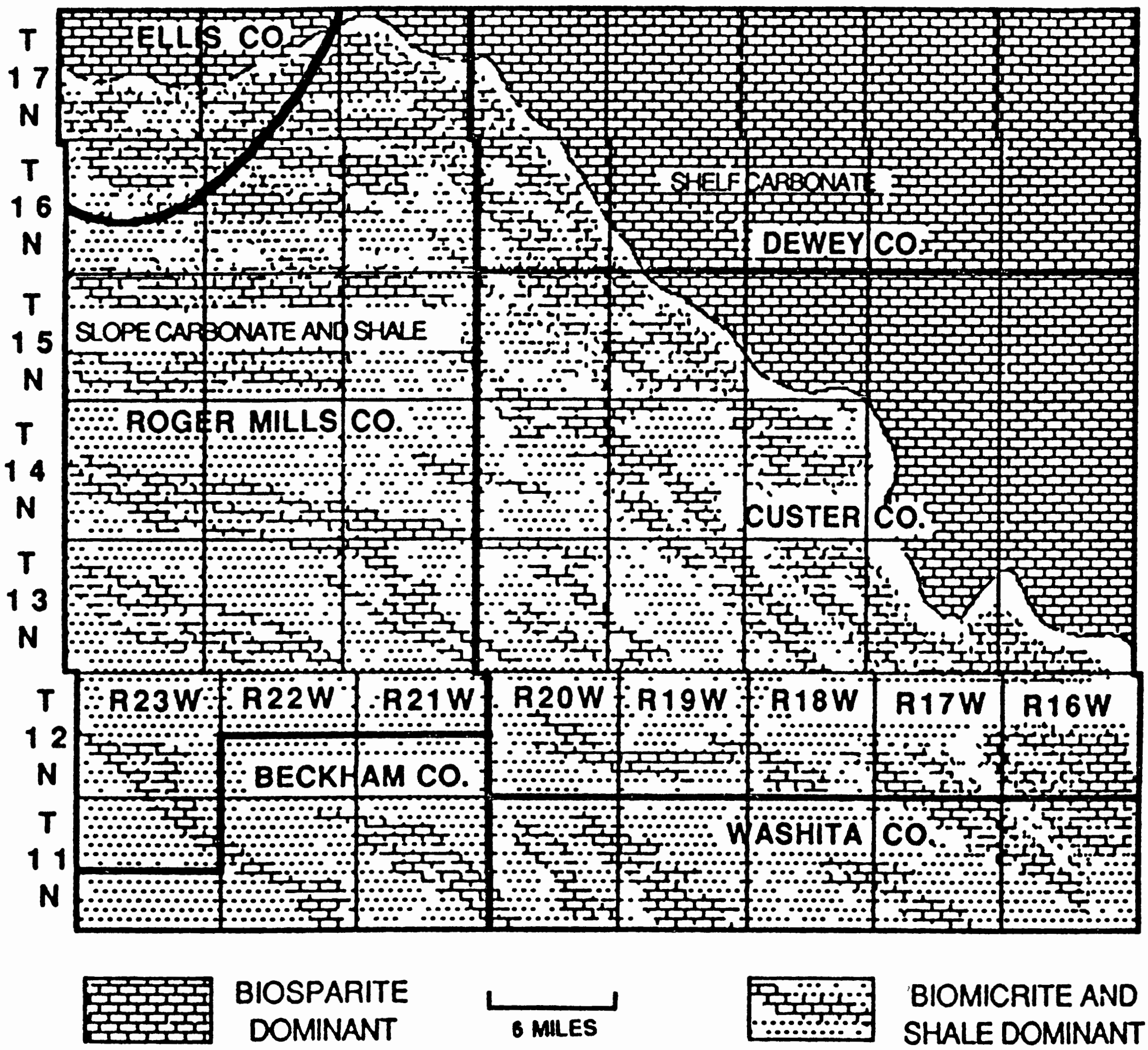


Figure 70. Facies Distribution of the Pink Limestone and Equivalent Biomicrite/Shale (Puckette, 1990).

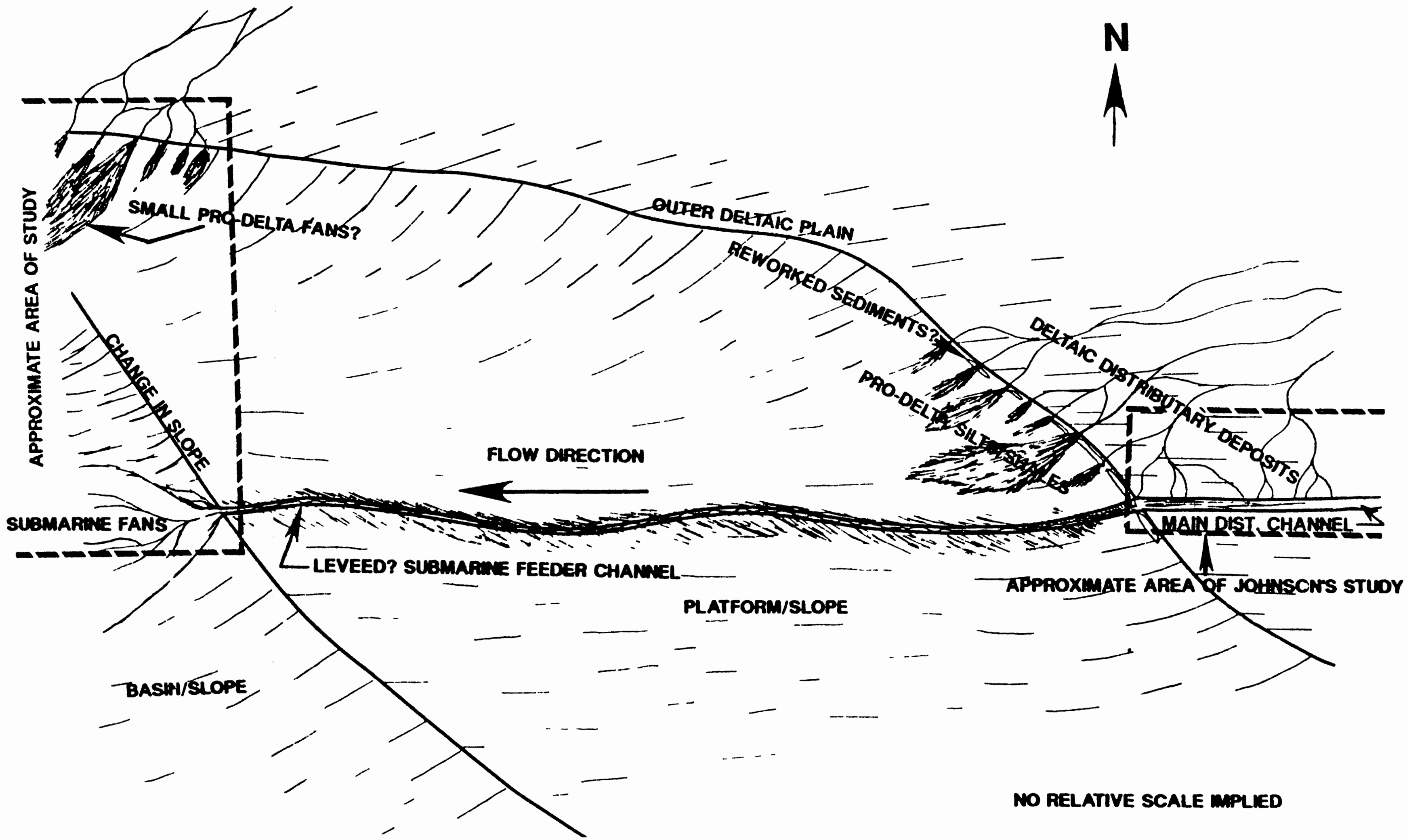


Figure 71. Interpretational Sketch of the Generalized Model for Upper Red Fork Deposition to the East of the Study Area.

and silts. The main channel flowed westward to the outer deltaic margin. The outer deltaic margin was characterized by a change in slope with deeper waters and a submarine channel formed directly off the mouth of the main river. Partial reworking of the sediments may have occurred along the outer deltaic margin with sediment inflow into canyon heads as well as direct sedimentation from the main distributary channel into the submarine channel. The submarine channel transported very fine- and fine-grained sediments westward to the southeastern corner of the study area.

It may be possible that the western area of Johnson's study is the area where the interpreted submarine channel formed, which extends into T.12N., R.19W. Similarities exist between sedimentary structures and thin-section photomicrographs observed in this study and those described by Johnson (1984). However, this westward trending channel has been interpreted as fluvial-deltaic (see Petzet, 1987). (Figure 72). Further examination in the area between the studies may help in understanding the depositional environments.

Upper Red Fork Facies Interpretations Within the Study Area

The Mutti and Lucchi (1972) turbidite facies (A-F) and related sedimentary structures are used here to describe similar features of the upper Red Fork interval. These facies are shown in Figure 73. Facies associations with respect to submarine fan terminology are given in Table 3.

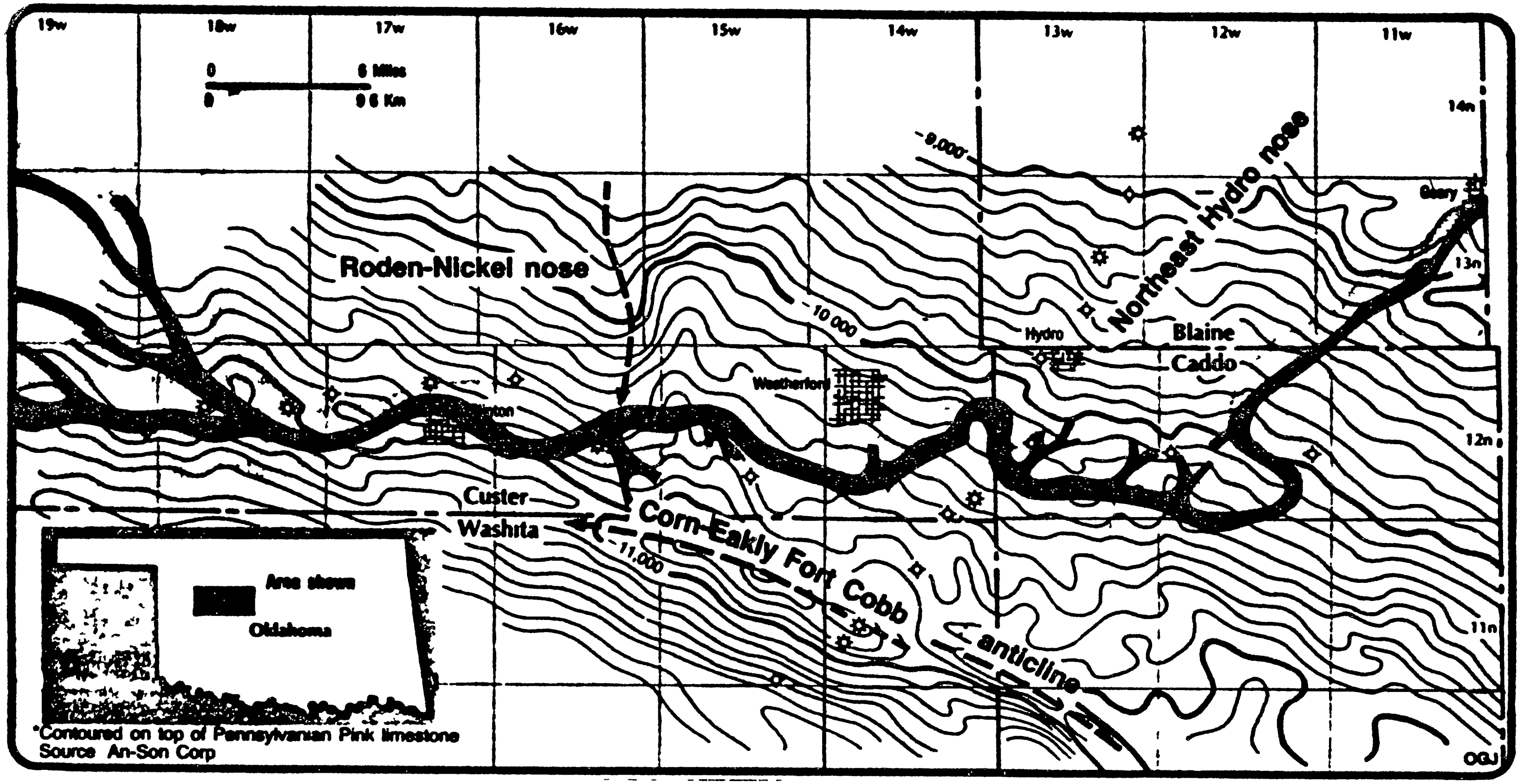


Figure 72. Depositional Trend of the Upper Red Fork Sandstones to the East of the Study. (From Petzet, 1988)

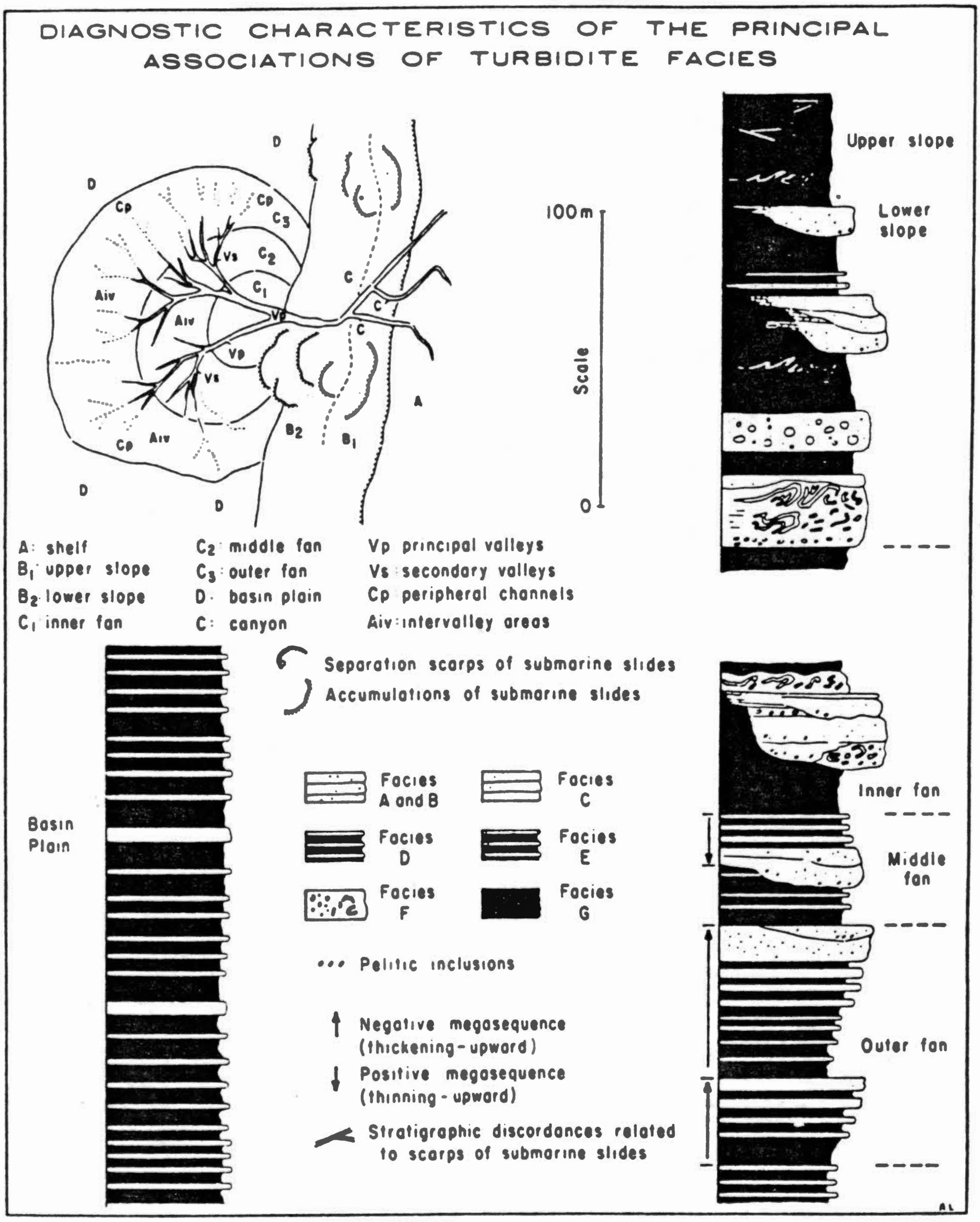


Figure 73. Facies of the Mutti-Lucchi Submarine Fan Deposits. (Mutti, Lucchi, 1972).

TABLE III

ASSOCIATIONS OF TURBIDITE FACIES AND RELATIVE ENVIRONMENTS OF DEPOSITION

Facies types	General characteristics	Environments and subenvironments		Significant examples
G A E F (B, C, D)	Massive or plane-parallel stratified pelites in places with discordant surfaces from slump scarps and/or sediment onlap on the slope, these pelites can include channelized sandstone bodies (A), chaotic horizons (F), thin shaly or sandy turbidites (D, E) and more rarely, thick and graded turbidites (C)	slope		Pribbenìano Marls (Stanley, 1961 1967), Grindslow Shale (Walker 1966a, b), Ranzano Sandstone Montepiano Marl (Mutti et al 1965, Mutti and de Rosa, 1968), Member 5 of the Marnoso-arenacea (Ricci Lucchi, 1969a), 'Colombacci" (Borsetti et al , 1974)
A, B G E, D (C, F)	Sandstones and conglomerates (A, B) limited to filling of large submarine valleys incised in pelites (G), thin channel and overbank turbidites (E, D)	Fan or proximal basin	inner	Upper part of Member 4 of the Marnoso-arenacea (Ricci Lucchi 1969a), Annot Sandstone (Stanley 1967), Vallcavga Formation (van Hoorn 1969 1970), Messanagros Sandstone (Mutti 1969,
A, B D (C, E, F)	Coarse-grained filling of large submarine valleys (A, B), cut into facies D turbidites, positive megasequences (fining-upward and/or thinning-upward cycles)		middle	"Series marneuse" (Dupuy et al 1963), Delaware Mountain Group (Jacka et al 1968), Caban Group (Kelling and Woollands, 1969), Doheny Channel (Normark and Piper 1969), Member 4 of the Marnoso-arenacea (Ricci Lucchi, 1969a), Messanagros Sandstone (Mutti, 1969)
C (D, E, F)	Arenitic-pelitic turbidites (C) in lenticular bodies, little or not at all erosive with respect to the enclosing pelitic-arenaceous turbidites (D), predominance of negative megasequences (thickening-upward and/or coarsening-upward cycles)		outer	San Salvatore Sandstone (Mutti and Chibaudo in prep), Members 1 and 3 of the Marnoso-arenacea (Ricci Lucchi, 1969a), Gottero Sandstone (Mutti unpub data)
D G (C) (F)	Alternation of pelitic-arenaceous (D) turbidites with hemipelagites (G), with sporadic intercalations of thick arenaceous-pelitic turbidites (C), sometimes exclusively hemipelagic pelites (G)	Submarine plain or distal basin		"Helminthoid" flysch (Parea 1965), Val Luretta Formation (de Rosa et al , 1966, Mutti and de Rosa, 1968), Member 2 of the Marnoso-arenacea (Ricci Lucchi, 1969a), "Schlier" and "Marne of Letto" (Selli, 1954, Borsetti et al., 1971), Mt Antola flysch, (Scholle, 1971a, 1971b)

From Mutti & R. Lucchi, 1972
Translated by T. Nelson, 1978

Facies A

The arenaceous-conglomeratic facies is composed of medium- to very coarse-grained sandstones with locally abundant pebbles. Bedding thicknesses range from 1 to greater than 10 meters. Massive and graded bedding with local, large intraformational clasts are the dominant bedding features. Basal sedimentary structures include scour and tool marks, flame structures, and loading structures. These structures are commonly very large. Deposits are produced from erosive mass and grain flows.

Cores described in Appendix C and D do not display overall grain size of the magnitude described above. Sandstone grain size observed in all core studied ranges from medium- to very fine-grained with very fine-grained sandstones dominant.

Facies B

The arenaceous Facies B consists of medium- to fine-grained sandstone. Bedding units are thinner than those of Facies A. Sedimentary structures include massive bedding, parallel laminae, dish structures, and cross-bedding. Parallel laminae are the most significant characteristics of this facies (Mutti and Lucchi, 1972).

Core analysis shows that zones of massive sandstones are generally less than 4 feet thick as seen in the Louisiana Land & Expl., Gates No. 2-33, 12,214-14'8", 12,424-24'6", 12,427-31'3"; Internorth, Inc., "B" 21 No. 1, 12,322-25', 12,326'6-10", 12,332-33'4", 12,338-39'; Tenneco Oil Co., Lester No. 1-6, 12,747'7"-12,749'8"; and Louisiana

Land & Expl., Ruth No. 1-28, 13,081-82′11".

Examples of core zones containing slightly pebbly fine-grained sandstones with tabular planar cross-bedding are found in the Inexco Oil Company, Trent No. 1-25, 12,892′10"; and Louisiana Land & Expl., Gates No. 2-33, 12,173′, 12,174-4.5′, and 12,190′. Other planar cross-bedding is found in the Woods Petr. Corp., Switzer "B" No. 1-5, 11,463′; Louisiana Land & Expl., Gates No. 2-33, 12,170′, 12,172, 12,426′6", 12,437′6"-38′6"; Louisiana Land & Expl., Savage No. 2-1, 12,398-12,400′, 12,407′2"-08′, 12,410′7"; Internorth, Inc., Smith "B" 21 No. 1, 12,318′6", 12,327′-7′6", 12,334, 12,478′6"-79′, 12,354′2"; Inexco Oil Co. Trent No. 1-25, 12,582-83′, 12,585-86′; Tenneco Oil Co., Lester No. 1-6, zones from 12,749′9" to 12,759′2"; Southport Expl., Inc., Merrick No. 1-10, 13,910′, 13,942′-43′9; and Louisiana Land & Expl., Ruth No. 1-28, 13,055′; 13,071′,13,083′. Tabular planar cross-bedding may be associated with turbidity currents or traction flows of upper flow regime. These structures may represent medium- to large-scale trough cross-bedding. Core zones correlated with log signatures indicate that these beds are relatively thinner and may display low gamma-ray and high resistivity readings (Figure 74).

Dish structures are associated with fluidized flows (Middleton and Hampton, 1976). An abundance of dish structures was recognized in core. Core zones that include this sedimentary feature include the Louisiana Land & Expl., Gates No. 2-33, zones from 12,175′ to 12,189′,

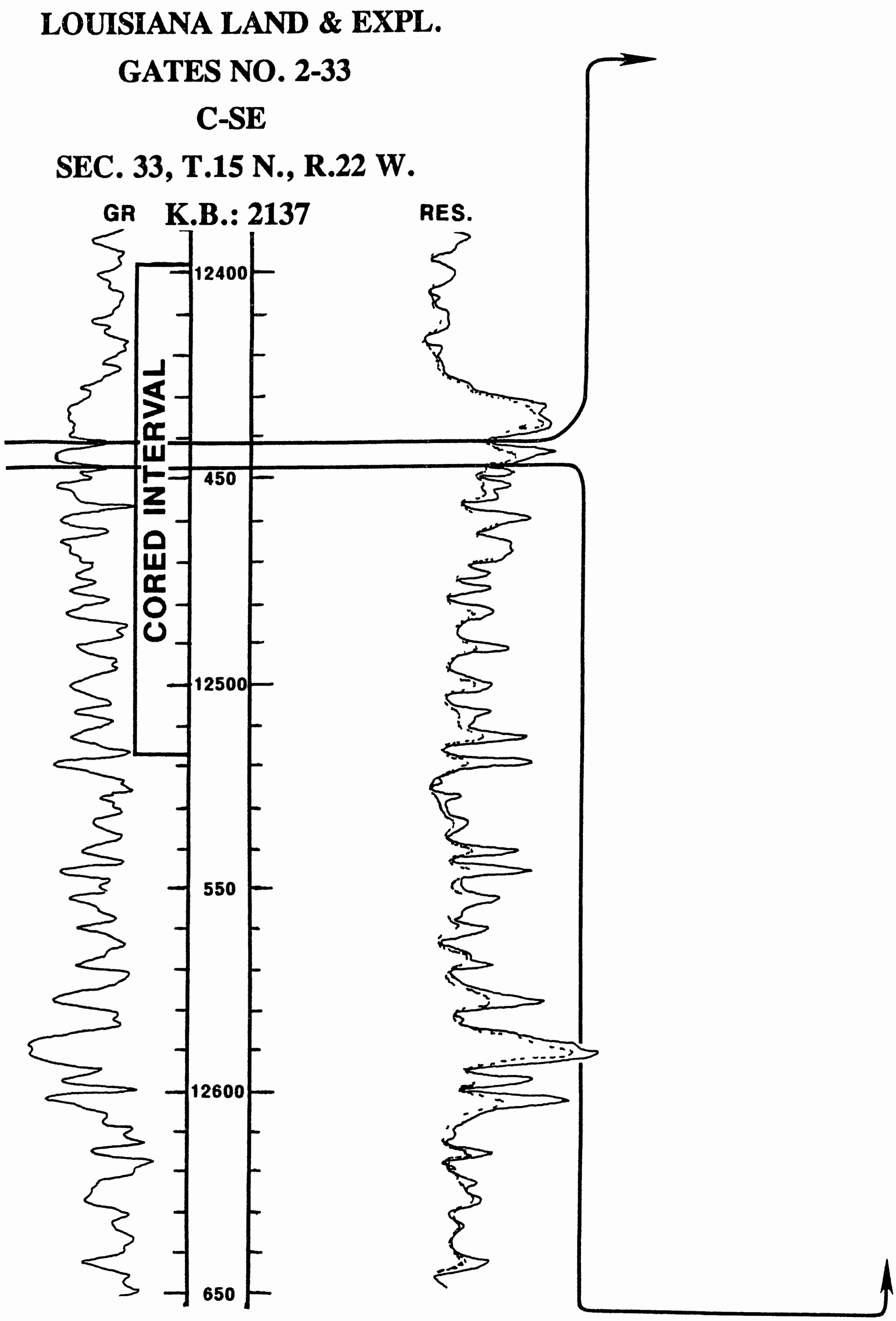


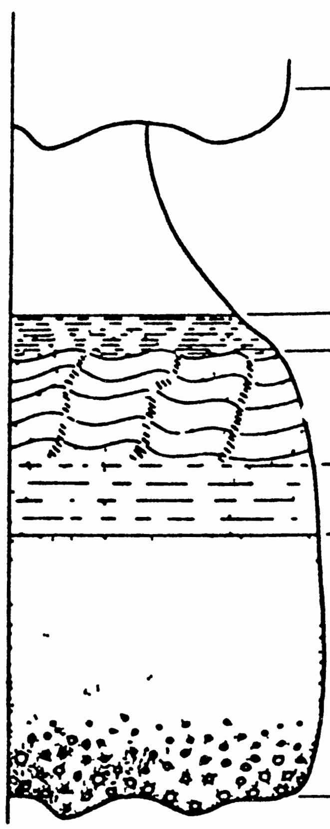
Figure 74. Wire-line Log Signature with Core Photograph Illustrating Location of Tabular Planar Cross-beds.

12,209′, 12,216-19′, 12,434′, 12,440′ to 12,448′8", 12,485-86′5", 12,400′9", 12,407′4"-08′7"; Louisiana Land & Expl., Savage No. 2-1, 12,401′, 12,420′to 12,426′, 12,429′ to 12,437′; Internorth, Inc., Smith "B" 21 No. 1, 12,248′6", 12,077′ to 12,087′6", 12,091′6" to 12,306′, 12,329′, 12,338′ to 12,348′; 12,453′4" -57′; 12,470′7"-12,473′; 12,483′ to 12,488′, 12,496′6", 12,506′7′; Inexco Oil Co., Trent No. 1-25, 12,553′, 12,576′, 12,583′6", 12,595′6"; 12,503′; and Louisiana Land & Expl, Ruth No. 1-28, 13,055′6", 13,057′4"; 13,063′3".

Facies C

The arenaceous-pelitic facies uses the classification of Bouma (1962) to describe the sedimentary structures of this facies. The complete Bouma sequence, T_a-T_e, is present (Figure 75). Bedding thicknesses usually range from 50 to 150 cm. Sandstone grain sizes range from fine to very fine and contain minor amounts of shale. Turbidity current sediments observed in core were seldom recognized as complete T_a-T_e sequences. The Louisiana Land & Expl., Ruth No. 1-28 shows a turbidite sequence with massive sandstones (T_a) at 13,082′ grading into horizontal laminae (T_b) at 13,080′10". This interval is overlain by ripple and wavy laminae (T_c) from 13,080′8" to 13,073′. The upper parallel laminae zone (T_d) is located at 13,073-72′. An increase in shale upward may indicate (T_e) pelagic sedimentation. Burrowing is evident at 13,072′.

Most cores studied contained incomplete T_{cde} sequences such as in the Internorth, Inc., Smith "B" 21 No. 1 at



Grain Size		Bouma (1962) Divisions	Interpretation
Mud	E	Interturbidite (generally shale)	Pelagic sedimentation or fine grained, low density turbidity current deposition
Sand-Silt	D	Upper parallel laminae	? ? ?
	C	Ripples, wavy or convoluted laminae	Lower part of Lower Flow Regime
Sand (to granule at base)	B	Plane parallel laminae	Upper Flow Regime Plane Bed
	A	Massive, graded	? Upper Flow Regime Rapid deposition and Quick bed (?)

Figure 75. Classical Turbidite Bouma Sequence T_a-T_e (Bouma, 1962)

12,309′ to 12,309′6". The T_c unit is the most abundant with rippling very common in sandstones as evidenced by the Smith "B′ 21 No. 1 core (App. C, Figure 108, p. 204). The T_d and T_e units of the sequence are also common in the darker, shaly siltstones.

Facies D

Facies D (pelitic-arenaceous facies I) is composed of incomplete Bouma (1962) sequences with the lower basal sequence absent. Bouma sequences of T_{bcde}, T_{cde}, T_{de}, and T_e may occur with T_{cde} the most common. Bedding is characteristically plane-parallel and 3 to 40 cm in thickness.

All cores had zones of this facies and are illustrated by the Louisiana Land & Expl., Gates No. 2-33 in the interval containing 12,412′, the Southport Expl., Inc., Merrick No. 1-10 upper core (App. C, Figs. 106, 114), and the Inexco Oil Co., Trent No. 1-25 upper and lower shales.

Facies E

Facies E (pelitic-arenaceous facies II) is characterized by sandstone lenses in shales. Sandstones show marked irregularity surfaces with sharp top and basal contacts and are generally less than 15 cm thick. Sedimentary structures include pinch and swell, flaser, and lenticular bedding. High angle-traction cross-bedding is common (Siemers, Tillman, and Williamson, 1981).

Examples of core zones that show this facies include the Louisiana Land & Expl., Ruth No. 1-28, 13,090-91′;

Louisiana Land & Expl. Gates No. 2-33, 12,502-06'6"; and Internorth, Inc., Smith "B' 21 No. 1, 12,243-47'.

Facies F

The chaotic facies is recognized by flowage structures, slumping, and sliding. Sedimentary features are related to soft-sediment-deformation and are not formed directly by turbidite deposition.

The Southport Expl., Merrick No. 1-10 (lower core) exhibits these structures. Highly dipping beds in this core may represent deposition on slopes. Examples of types of soft-sediment-deformation found in cores are given in Chapter VII.

Facies G

Hemipelagic and pelagic facies is composed of silty shales, marls, and carbonates. This facies forms as suspension settling and as dilute turbidity currents.

Core examples of silty shale facies include the Inexco, Inc., Trent No. 1-25, upper and lower shales: the Louisiana Land & Expl., Gates No. 2-33, 12,190'1", 12,200'7"; and the Louisiana Land & Expl., Savage No. 1-28, 12,481-86'.

A small limestone bed was found in the Louisiana Land & Expl. Gates No. 2-33 at a depth of 12,453'. This limestone is composed of dark micrite and contains calcite-filled fractures.

Morphological Interpretations of the Upper Red Fork Sandstones

The Walker submarine model (1978) uses the concepts of Normark (1970, 1978) and Mutti and Lucchi (1972) to combine modern and ancient submarine fan studies into a unified model. This model may be used to predict the facies distribution of the interpreted submarine fans. Modifications of the Normark model (1970, 1978) include the change from submarine canyon (Normark) to feeder channel (Walker) and the recognition of progradation of the upper fan channels and suprafan lobes long distances over preexisting fan sediments (Walker, 1978).

The model is composed of 1) a feeder channel that supplies sediment; 2) an upper fan leveed channel that may shift and transport sediment across previous depositional facies; 3) a mid-fan made up of suprafan lobes that grade outward from non-leveed, shallow, braided channels to smooth turbidity deposits; 4) and the lower fan and basin plain exhibiting smooth relief with parallel bedding and distal turbidites (Figure 76).

The Walker model (1978) is used extensively in determining possible fan morphology of the upper Red Fork facies. The geometry of the sandstones is the main reason given for use of this model. Net sandstone isolith trends show elongated patterns, which may infer progradation of submarine fans and fan channels. Interpreted Red Fork facies derived from Mutti and Lucchi (1972) facies are given with facies described by this model.

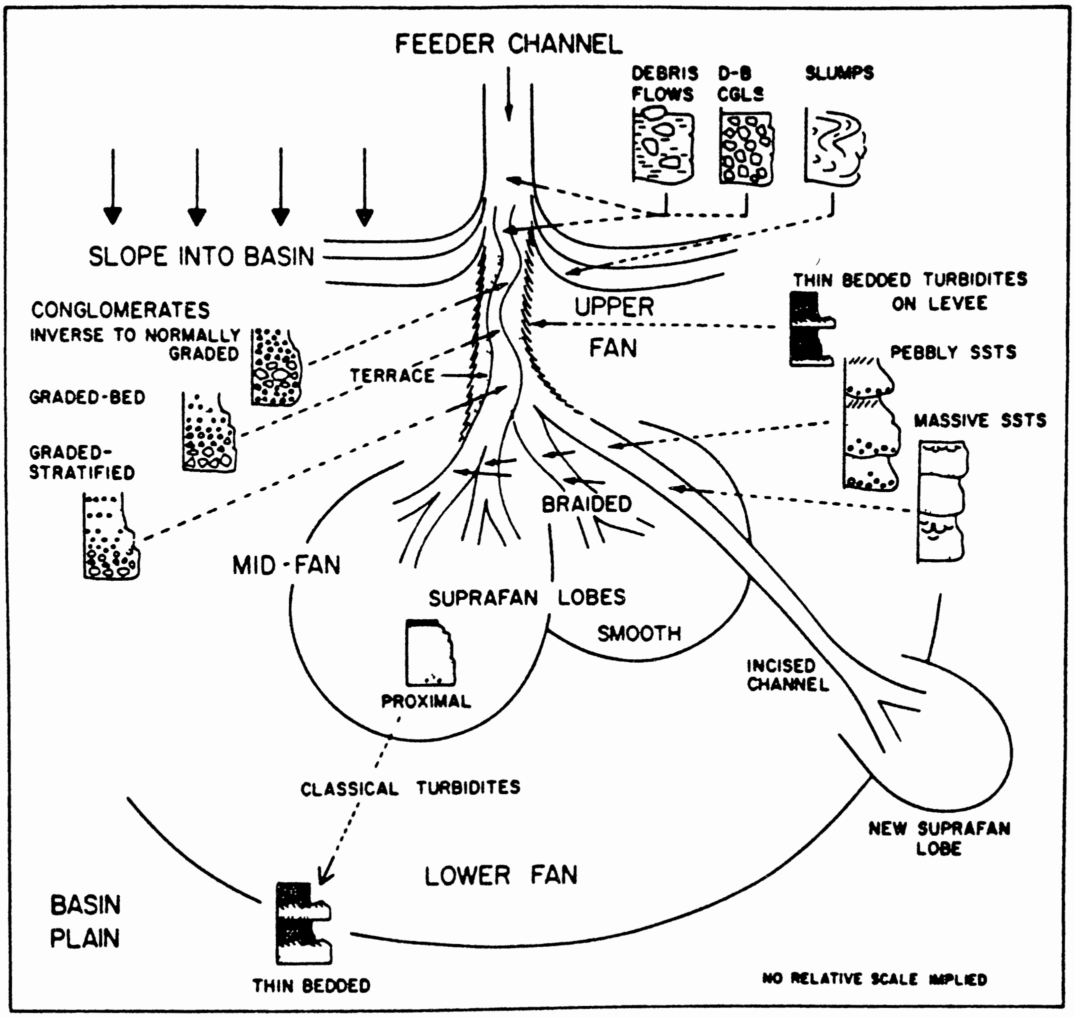


Figure 76. Walker Submarine Fan Model (Walker, 1978).

Recognition of hypothetical vertical sequences of prograding fans (Walker, 1978) are used with wire-line logs of upper Red Fork sediments to support interpretations.

Submarine Channel Facies

Sandstone thicknesses in T.12N., R.19W. indicate a linear feature interpreted as a submarine feeder (Walker, 1978) channel (Figure 77). The Walker model describes debris flows and conglomerates within the feeder channel and massive and pebbly sandstones within the upper fan leveed channels (Walker, 1978). The distinction between feeder channel and upper fan channels described by Walker (1978) may require modification for this study. The trend of the sandstone thicknesses (Figure 72, p. 111) to the east may be suggestive of a feeder channel that transported sediment to the basin (see Walker, 1978). However, the sandstones appear to be graded to graded-stratified (Walker, 1978) in the An-Son Corp., Bill No. 1-24 well (Figure 78), which is indicative of the outer portion of the upper fan (Walker, 1978). It is suggested that this area represents a transition from feeder channel to the upper fan channel. The sediments in this area will be referred to as the upper fan feeder channel throughout the remainder of this study.

Cores were not available from this area and thus sedimentary structures, sandstone composition, and grain size are inferred. Log profiles indicate very low gamma-ray signatures and high resistivity readings in the An-Son Corp., Bill No. 1-24 well (Figure 78). The wire-line log signature of the channel sandstone facies does not exhibit

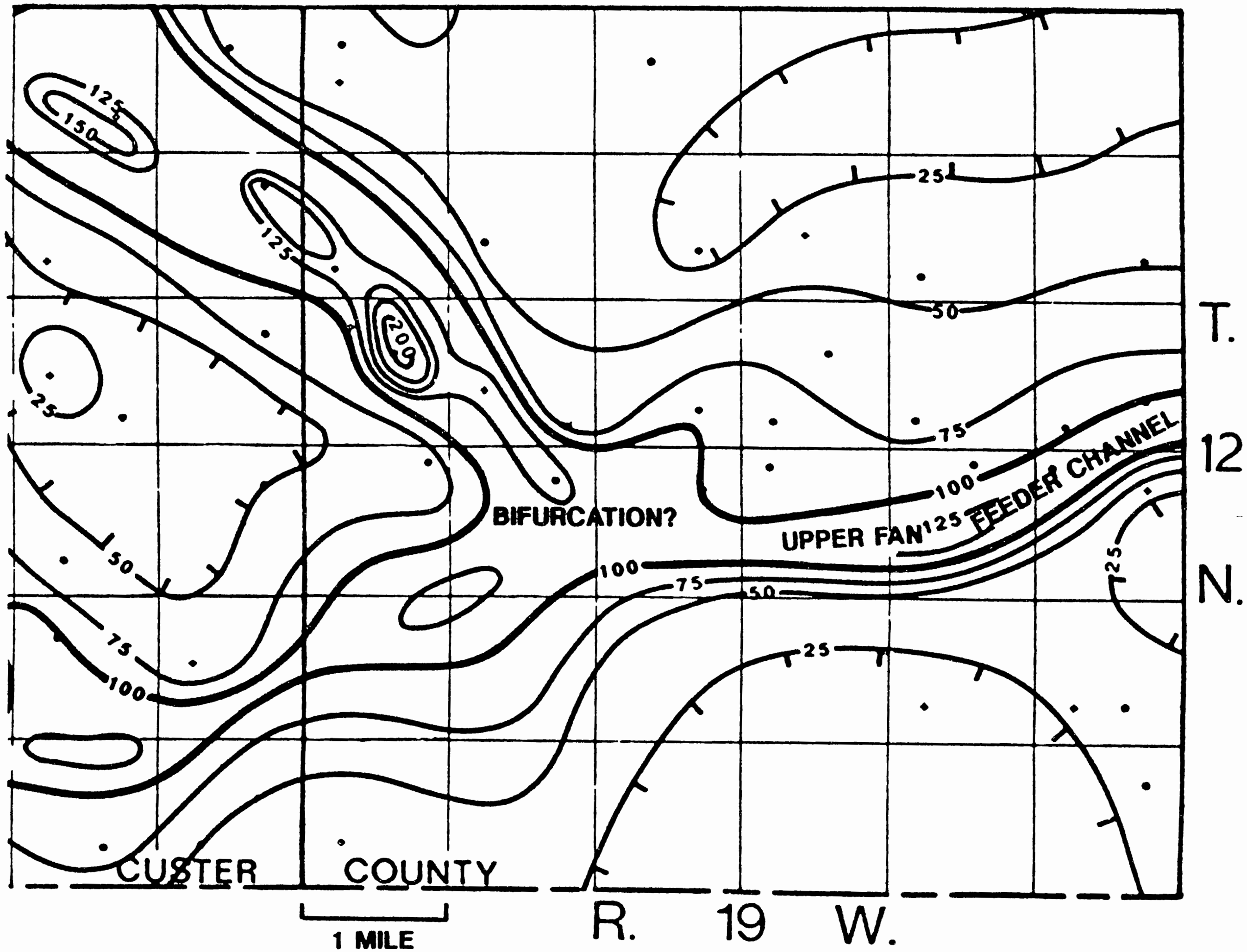


Figure 77. Net Sandstone Thicknesses and Interpreted Upper Fan Feeder Channel.

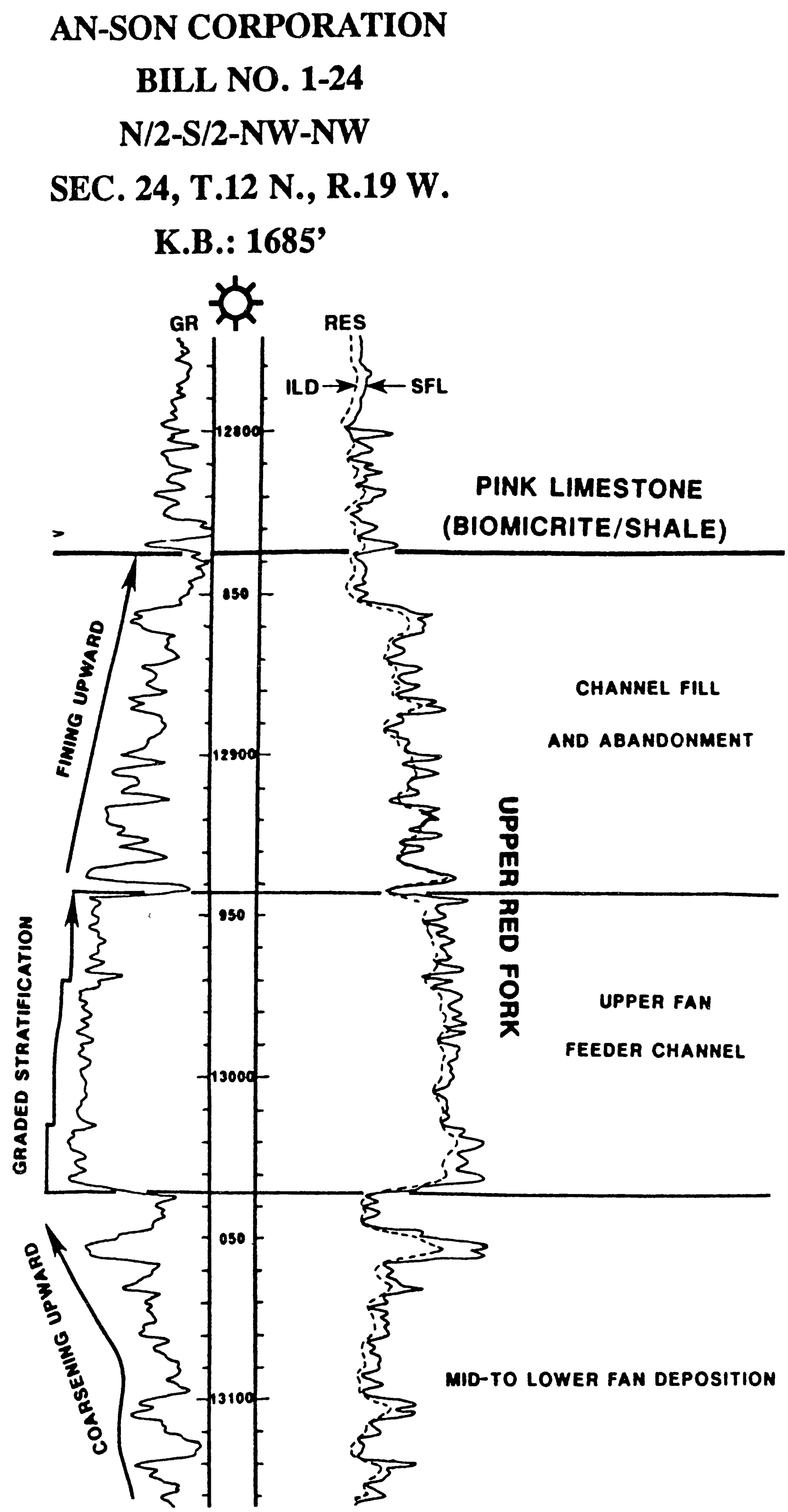


Figure 78. Wire-line Log Signature of Interpreted Upper Fan Feeder Channel. Note Possible Stratification in Channel.

the serrate appearance resulting from interbedded siltstones and shales as seen in core (Figure 108, App. C) but appears to be homogeneous with very few shale breaks in the lower section. Sandstones have sharp basal contacts with fining upward sequences. This unit could be composed of massive or pebbly sandstones (see Selley, 1979). The East Clinton Field reservoir sandstones are dominantly very fine-grained (Johnson, 1984), which may imply that the channels in the Bill No. 1-24 are composed of fine- to very fine-grained sandstones. Fine-grain channel fill is reported to occur in ancient sediments such as the Lower Permian Cook feeder channel in west Texas (Bloomer, 1977).

Differences in present-day structural elevation of the base of the Pink Limestone equivalent biomicrite/shale indicate gentle slope from the western area of Johnson's study (Plate I approximately -10,850, 1984) to the southeastern corner of the present study (-11,150'). This gives a gradient of 300'/18 miles in a direct westward direction, assuming no structural faulting has taken place. An increase in gradient occurs in the southeastern corner of the study where upper Red Fork sandstones become more dispersed. This may indicate the westward extent of the interpreted submarine feeder channel.

The Walker model suggests levee deposits with thin-bedded turbidites present on the sides of the upper fan channels. This may be evidenced by the distinct change in sediments in cross-section (Figure 79).

The upper fan feeder channel shows possible meandering

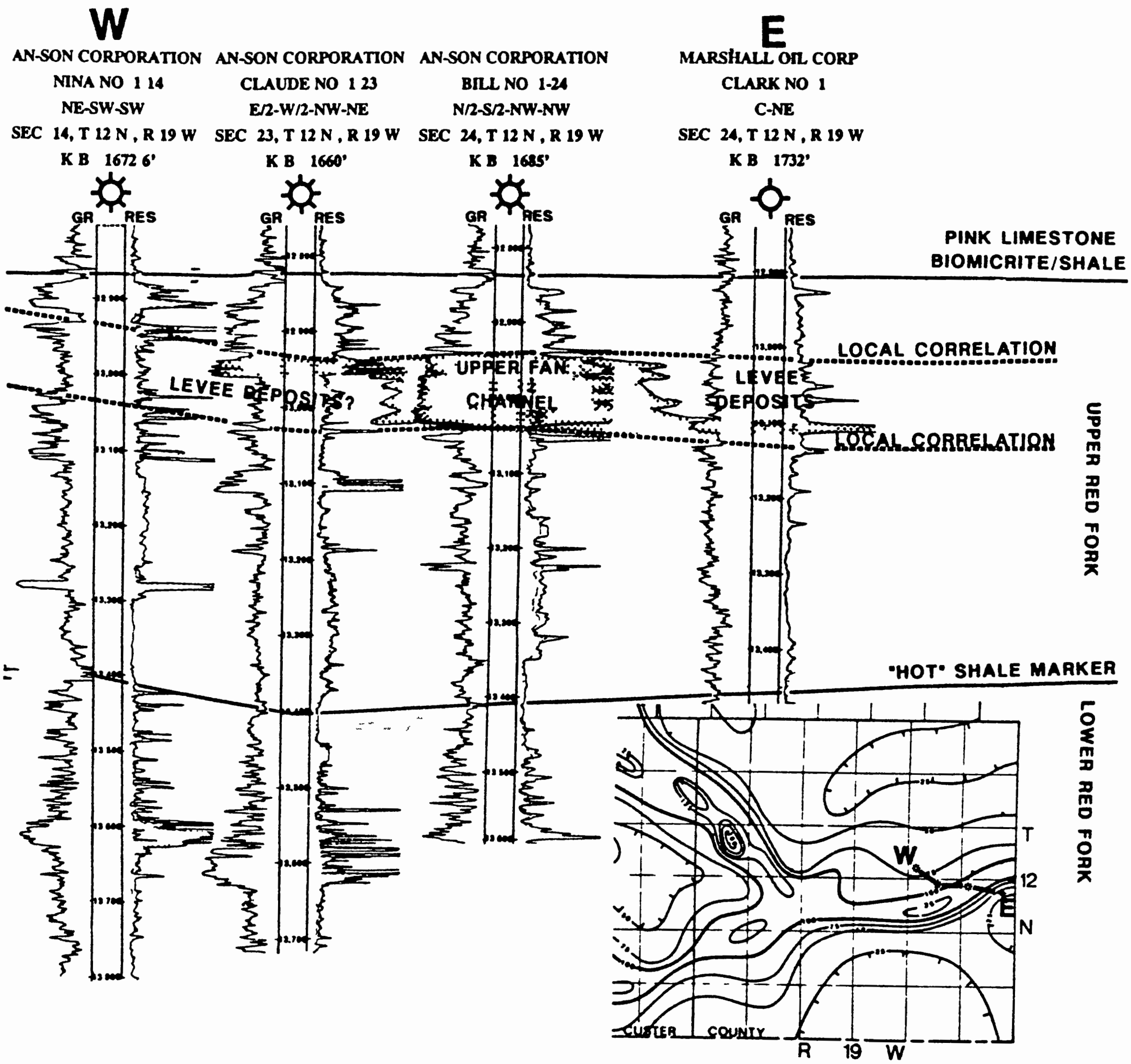


Figure 79. Cross-Section Indicating Channel and Possible Levee Deposits.

and appears to bifurcate in the western portion of T.12N., R.19W. as suggested in Figure 77, p. 124. Increased well control is needed to completely define this area.

Upper Fan Facies

The Walker model (1978) indicates that upper fan channels are composed of graded bedding and may be graded-stratified. Massive and pebbly sandstones with zones of cross-bedding and soft-sediment-deformation may compose these beds much like those described as Facies A and B of the Mutti-Lucchi Model (1972). Sandstones within this facies are likely to be composed of fine- to very fine-grained sands. Numerous studies describe the Red Fork as fine- to very fine-grained sandstones in and near the study area (Johnson, 1984; Udayashankar, 1985; Whiting, 1982; Levine, 1985).

Cores of upper fan channels were not available for examination in the study area. The upper fan interpretation is based on log signatures. Interpreted upper fan channels are located in several wells (Figure 80). Thick sandstones in excess of 20 feet show low gamma-ray and high resistivity deflections. Sharp basal contacts and few interbedded shales allow for a less serrate gamma-ray appearance than those of interpreted mid-fan deposition (Figure 81). Interpreted upper fan channels observed on wire-line logs appear to reach thicknesses greater than 150 feet. However, local correlation may be difficult with current well control (Figure 82).

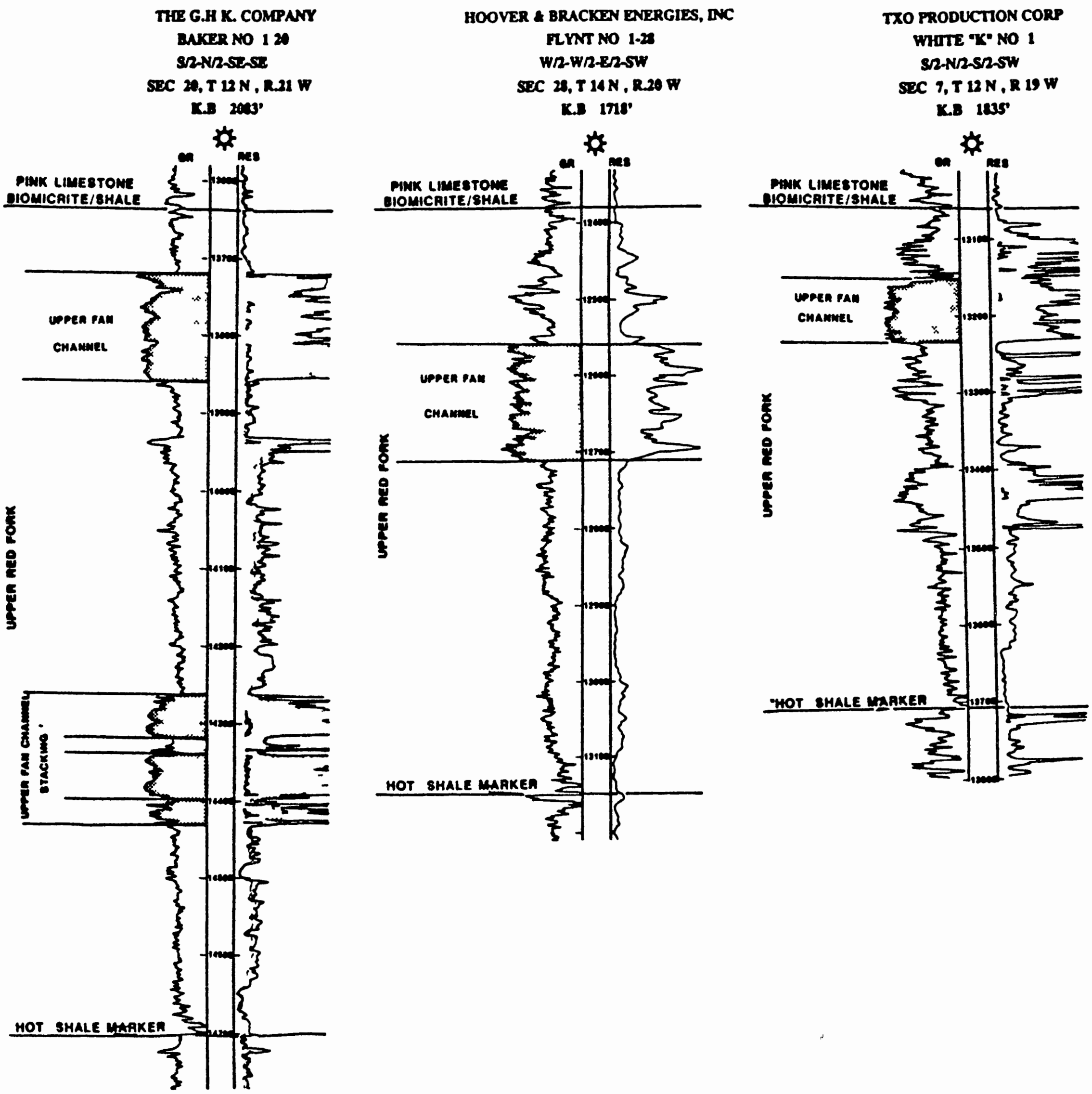


Figure 80. Wire-Line Log Signatures of Interpreted Upper Fan Channels.

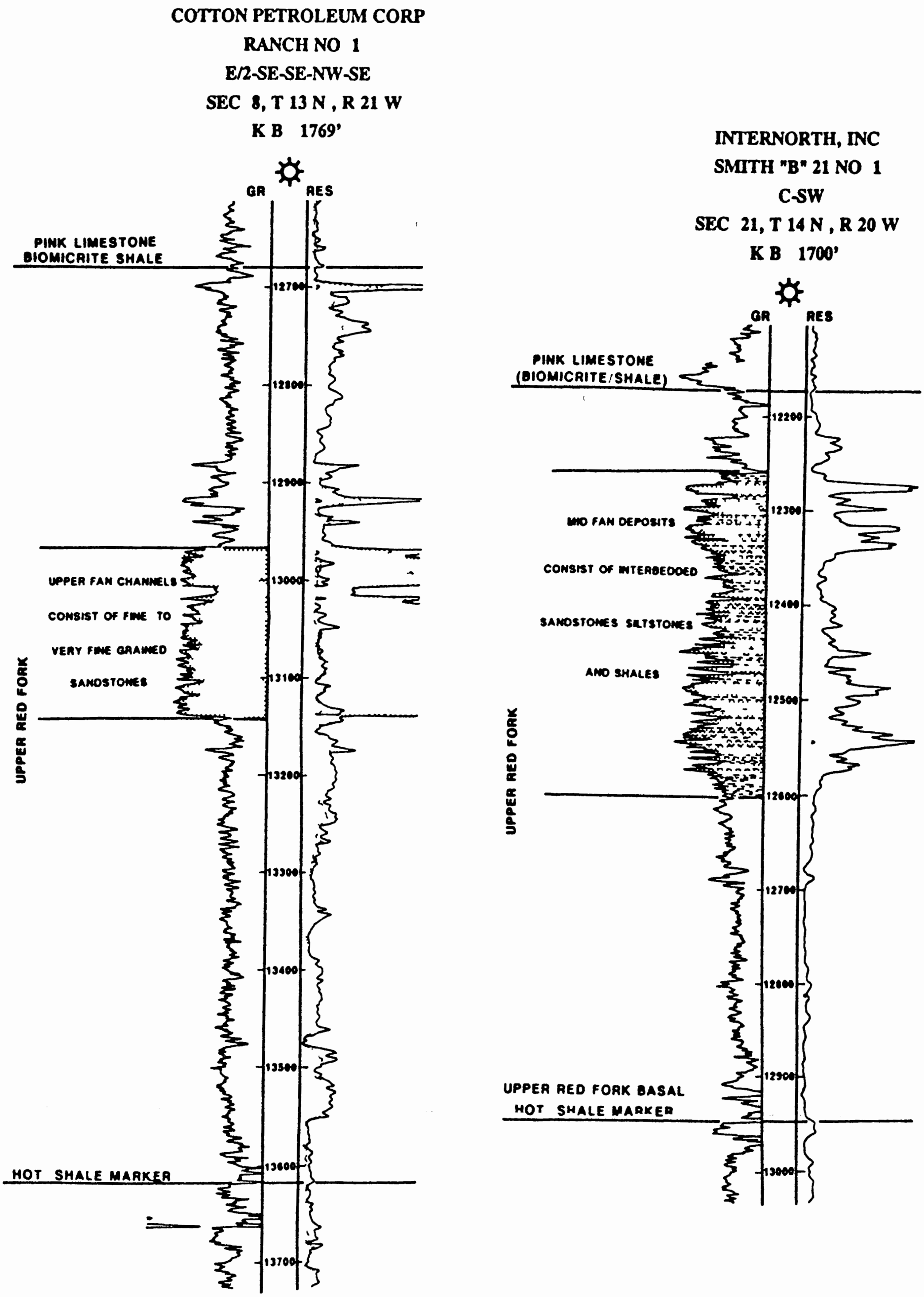


Figure 81. Comparison of Interpreted Upper Fan Deposits with Mid-Fan Deposits Using Wire-Line Log Signatures.

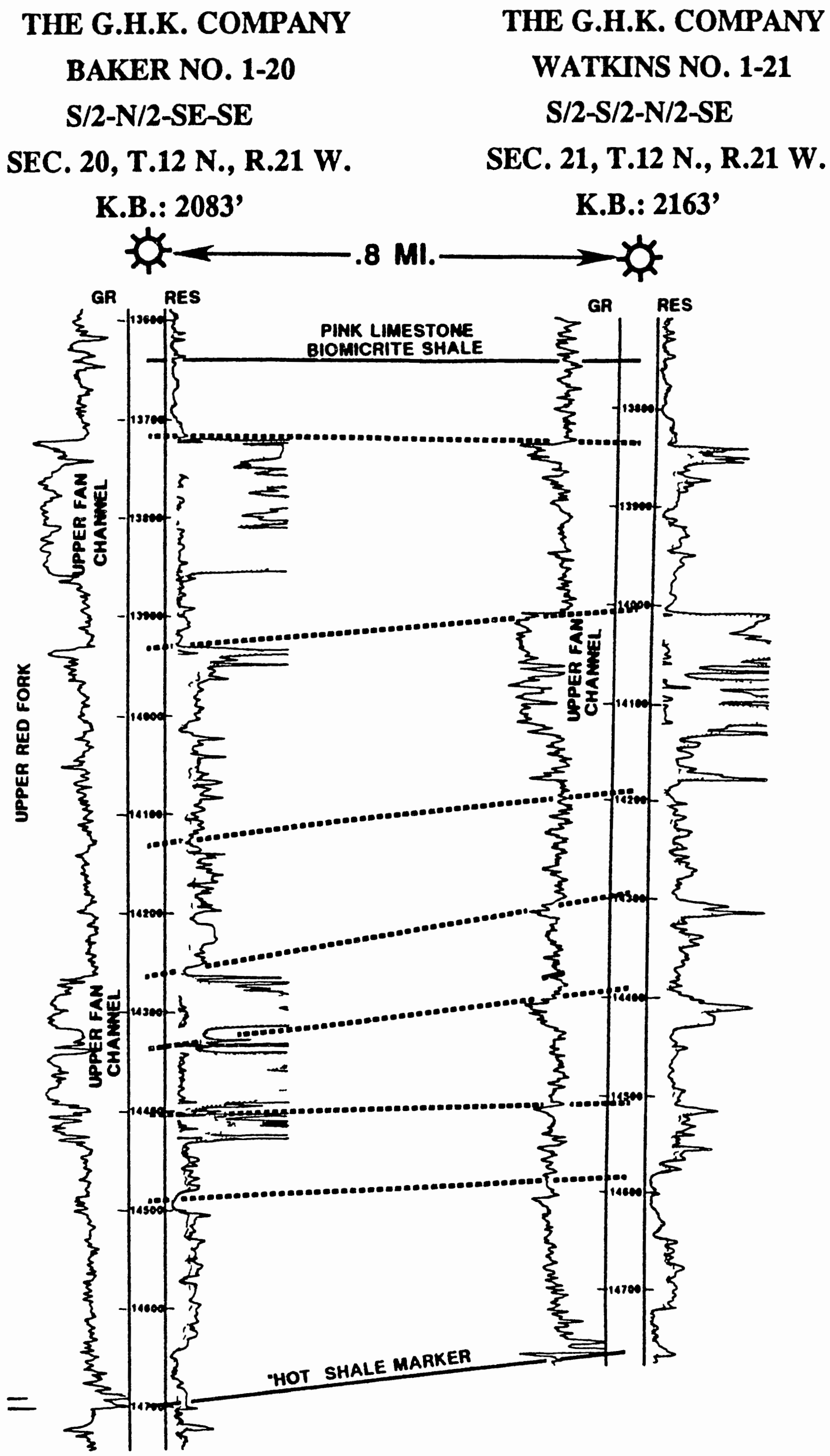


Figure 82. Local Cross-Section Showing Correlations of Upper Fan Channels. Note Variation of Sandstone Deposits.

Mid-Fan Facies

The mid-fan facies appears to be the dominant sandstone facies found in the study area. Eight cores examined contain interpreted mid-fan deposits (Figure 83).

Well-log signatures of the mid-fan facies show serrate gamma-ray and neutron log profiles as indicated in the Internorth, Inc., Smith "B" 21 No. 1 (Figure 84). Correlation of core to wire-line logs indicates the presence of interbedded, dark, silty shales that cause high gamma-ray and increased apparent porosity readings. The dark silty shales may represent periods of lower flow regimes with suspension settling and low density turbidity flow (Facies G of Mutti-Lucchi, 1972) as well as turbidity currents with incomplete Bouma sequences (Mutti-Lucchi Facies D). The Louisiana Land & Expl., Gates No. 2-33 and Savage No. 2-1, display similar sedimentary structures (App. C).

The Inexco Oil Co. Trent No. 1-25 core contains the thickest continuous sandstone sequence observed (12,540'5" -76'6"), (Figure 85). Upper sandstones in this core contain abundant dish structures and planar cross-bedding and represent Facies B of the Mutti-Lucchi model. Fine- to very fine-grained sandstones were visually identified in core and thin-section. These sandstones are interpreted to have been deposited in a transition zone between the upper fan and the mid-fan. They could also represent mid-fan channels or shallow upper fan channels.

Cores studied contain numerous interbedded sandstones that display Mutti-Lucchi Facies B, C, and D, with Facies

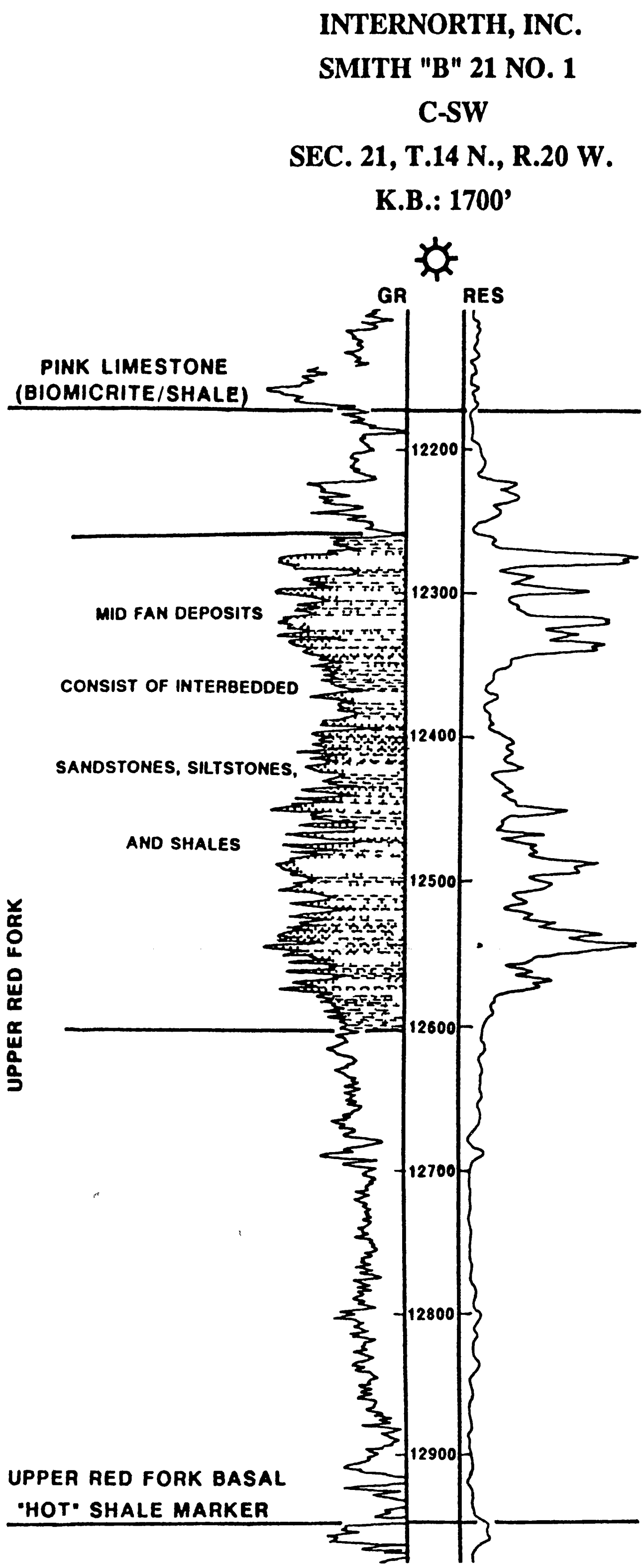
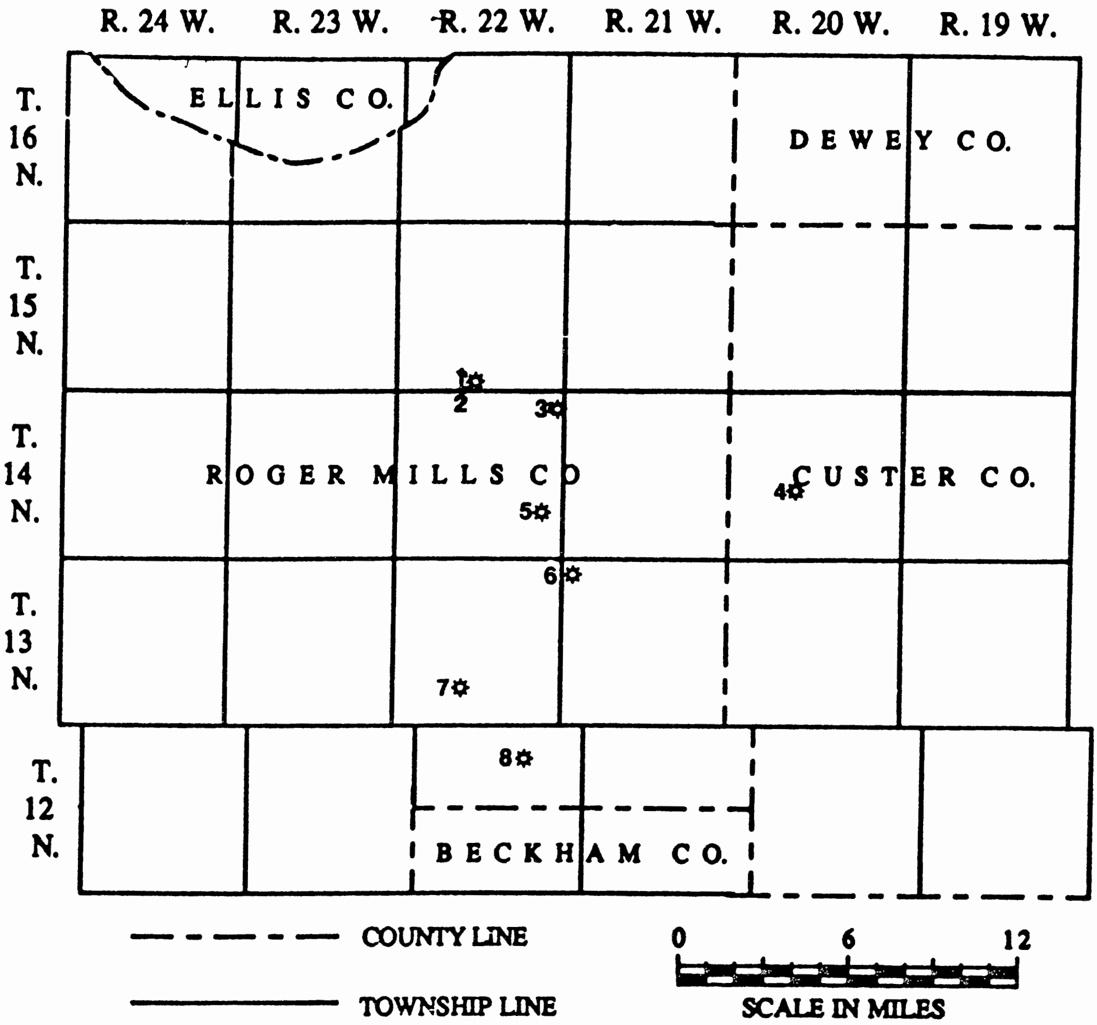


Figure 83. Wire-Line Log Signature Illustrating Interbedded Sandstones, Siltstones, and Shales of a Possible Mid-Fan Channel.



CORE INFORMATION

	COMPANY	WELL NAME	LOCATION	INTERVAL
1	LOUISIANA LAND & EXPL.	GATES NO. 2 33	T 15 N., R. 22 W., SEC. 33	12,170 FT TO 12,224 FT
2	LOUISIANA LAND & EXPL.	GATES NO 2 33	T 15 N., R. 22 W., SEC. 33	12,393 FT TO 12,513 FT
3	LOUISIANA LAND & EXPL.	SAVAGE NO 2-1	T 14 N., R. 22 W., SEC. 1	12,382 FT TO 12,500 FT
4	INTERNORTH, INC.	SMITH "B" 21 NO. 1	T 14 N., R. 20 W., SEC. 21	12,209 FT TO 12,532 FT
5	INEXCO, INC.	TRENT NO. 1-25	T 14 N., R. 22 W., SEC. 25	12,501 FT TO 12,672 FT
6	TENNECO OIL CO.	LESTER NO 1-6	T 13 N., R. 21 W., SEC. 6	12,731 FT TO 12,771 FT
7	LOUISIANA LAND & EXPL.	RUTH NO 1 28	T 13 N., R. 22 W., SEC. 28	13,055 FT TO 13,097 FT
8	SOUTHPORT EXPL., INC.	MERRICK NO 1 10	T 12 N., R. 22 W., SEC. 10	13,898 FT TO 13,957 FT

Figure 84. Core Locations of Interpreted Mid-Fan Deposits Within the Study Area.

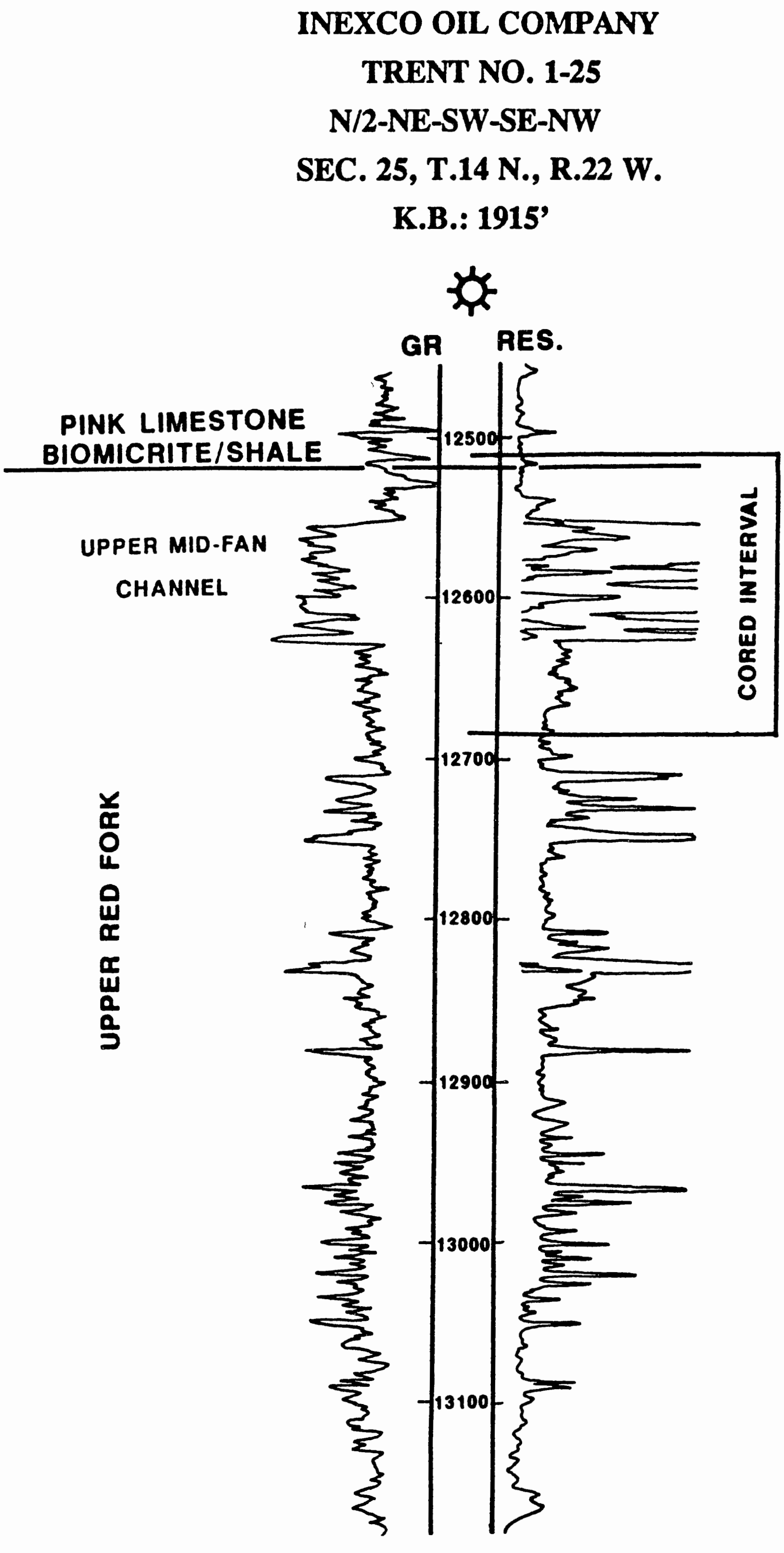


Figure 85. Interpreted Upper Mid-Fan Channel with Possible Channelized Turbidites.

B and C the most prevalent (App. C). Ripple laminae are the most common sedimentary feature found in these cores and indicate lower flow regime (Bouma, 1962; Middleton and Hampton, 1976) of the turbidity flows. Dish structures are abundant and represent fluidized flows (Middleton and Hampton, 1976). Dish structures may be part of the turbidite sequence found in Facies C of the Mutti-Lucchi model as well as Facies B associated with channels. Wire-line logs indicate stacking of sandstones with interbedded shales. This may represent the channelized turbidites of the upper mid-fan facies on the suprafan lobes. In addition, stacking of similar facies may occur, such as in the Internorth, Inc., Smith "B" 21 No. 1 (Figure 85, p. 135). The large amount of mid-fan facies (approx. 300′) observed in this core may be attributed to separate episodes of mid-fan development.

Large amounts of sandstone are present in T.15-16N., R.23W. Cores were unavailable for study in this area. Wire-line log signatures indicate interbedded sandstones and shales are dominant (Figure 86). Sandstones in this area exhibit a similar serrate appearance on wire-line logs to those of the interpreted mid-fan facies to the south (Figure 87). Occurrence of large sandstone thicknesses in the northwest portion of the study occurs along the interpreted depositional axis and may have source areas to the north (Figure 88). Local cross-sections illustrate the lateral changes between wells (Figure 89). Possible explanations for these deposits may be the deposition of turbidites in a small synclinal structure or topographically lower areas

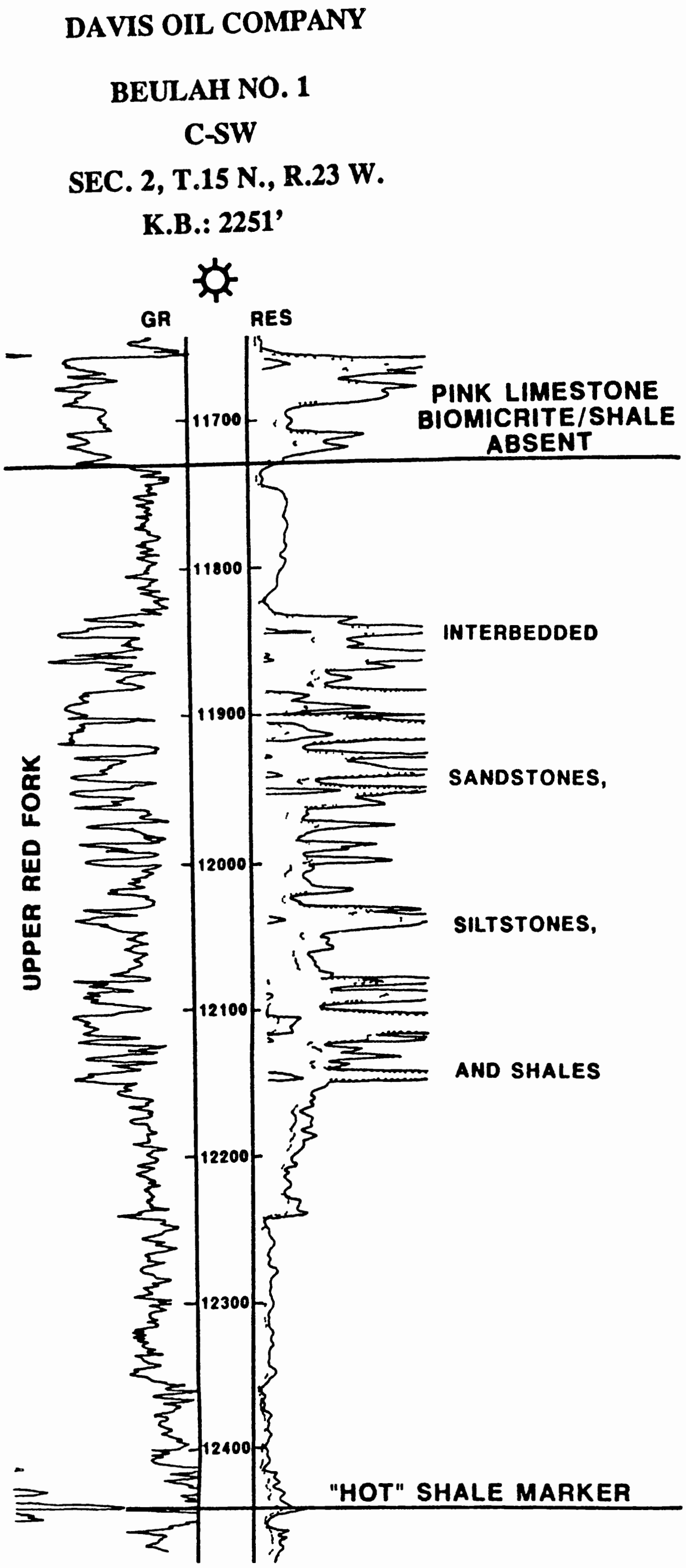


Figure 86. Wire-Line Log From Northwest Portion of Study Showing Serrate Appearance of Interbedded Sandstones, Siltstones, and Shales.

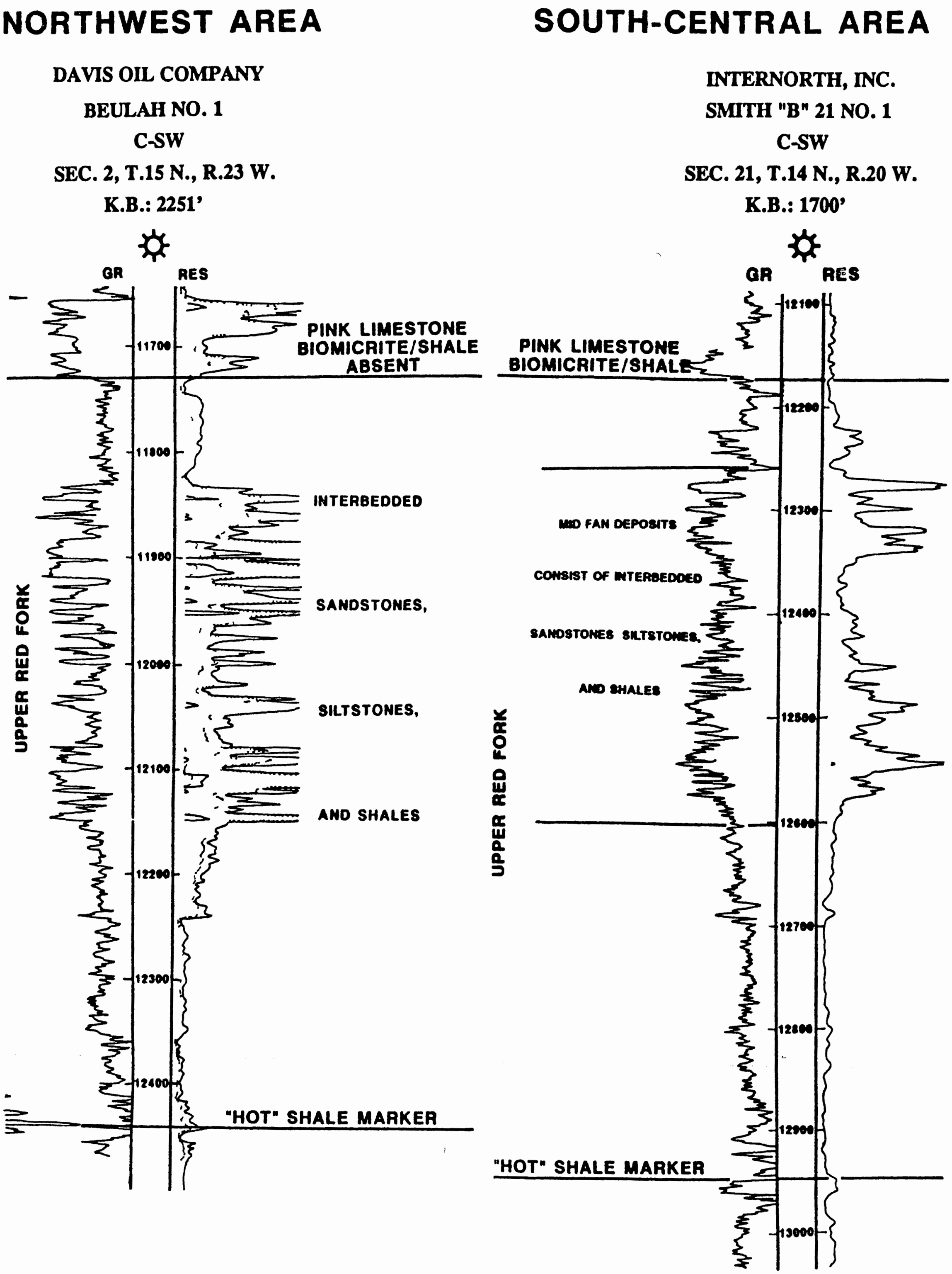


Figure 87. Comparison of Wire-Line Log in the Northwestern Portion of the Study to a Wire-Line Log of an Interpreted Mid-Fan to the South.

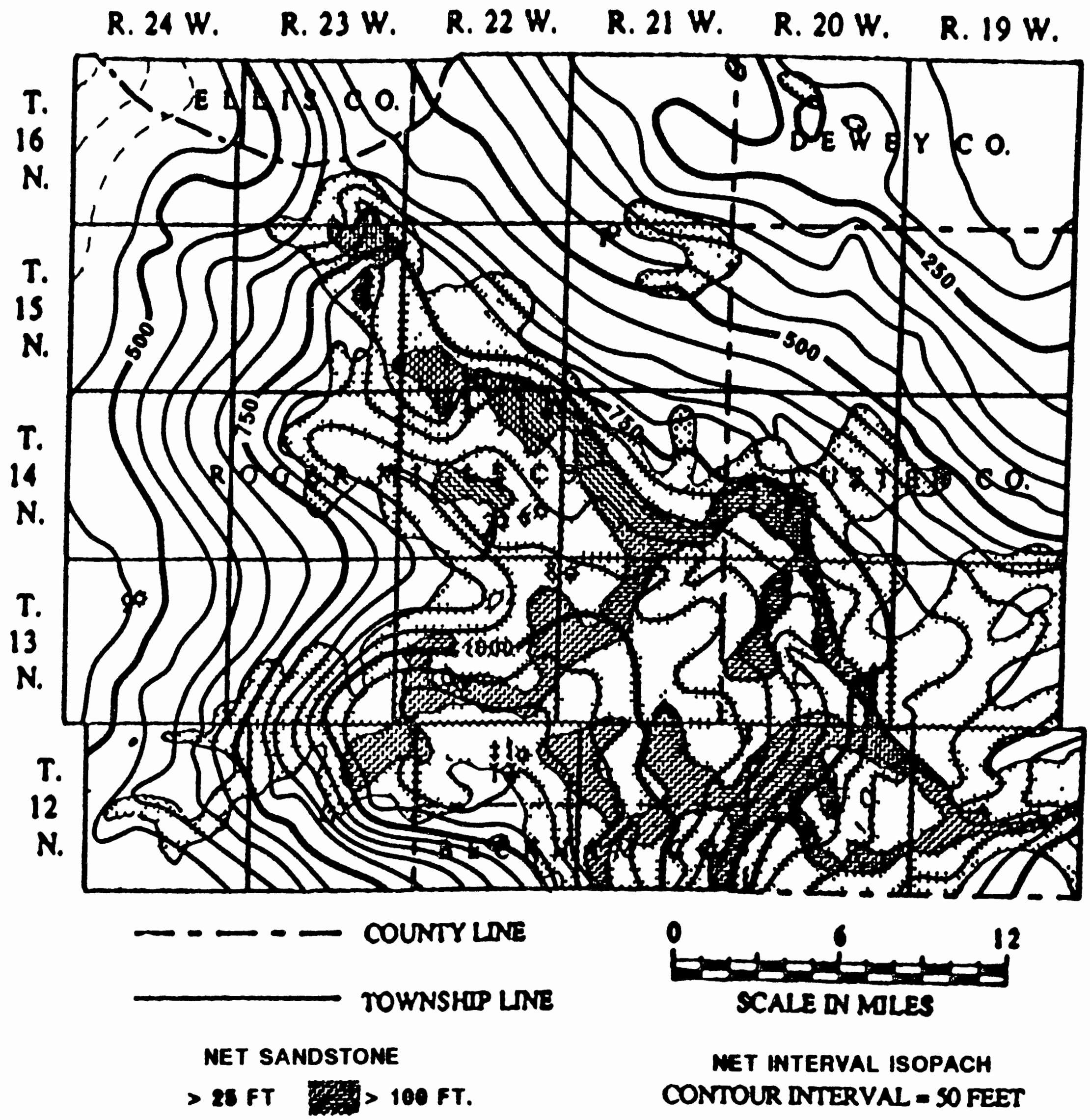


Figure 88. Net Sandstone Thicknesses with Reference to Net Interval Isopach Thicknesses. Note Sandstone Trends in Northwest and Southwest Areas Appear Similar to Net Interval Thickness Trends.

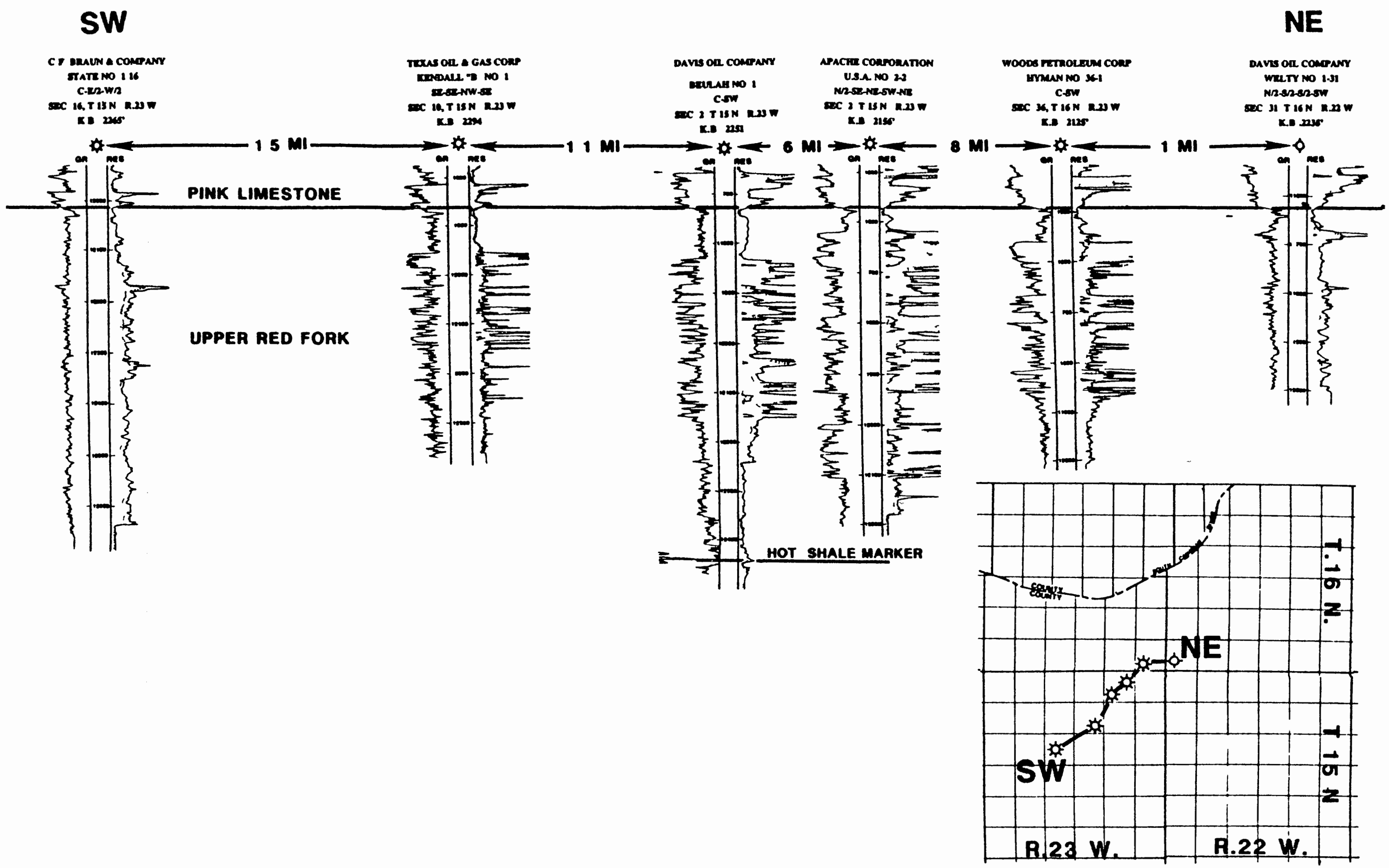


Figure 89. Local Cross-Section Illustrating Lateral Sediment Changes in Northwestern Portion of Study Area.

which act as a channeling mechanism for the turbidites These sandstones may also be interpreted as deposits of upper to mid-fan channels with channelized turbidites.

Lower Fan Facies

Lower fan facies deposits are described as parallel thin-bedded turbidites (Mutti and Lucchi, 1972; Walker, 1978). They are represented by Facies C and D of the Mutti-Lucchi model.

The lower fan facies may be recognized on wire-line logs as coarsening upward sequences with thin-bedded turbidite sandstones (Walker, 1978), (Figure 90). Wire-line logs within the area display coarsening upward sequences (Figure 91). However, the delineation of lower fan from basin plain sedimentation may be hard to distinguish due to the large amounts of interbedded thin sandstones, siltstones and shales observed on wire-line logs (Figure 92).

Cored sediments that exhibit lower fan deposition are recognized in the Southport Expl., Merrick No. 1-10 (Figure App. C, Fig. 115, p. 229). They consist of thin-bedded to laminar siltstones, shales, and sandstones with dominant sedimentary structures of plane parallel bedding with soft-sediment- deformation slump structures and micro faulting (Mutti-Lucchi Facies F).

The plane parallel bedding (Facies D of Mutti-Lucchi model) is interpreted to be formed from low-density turbidity currents (Mutti and Lucchi, 1972) with intervals of suspension settling (Walker, 1978). This results in alternating light and dark colored sediments found in core

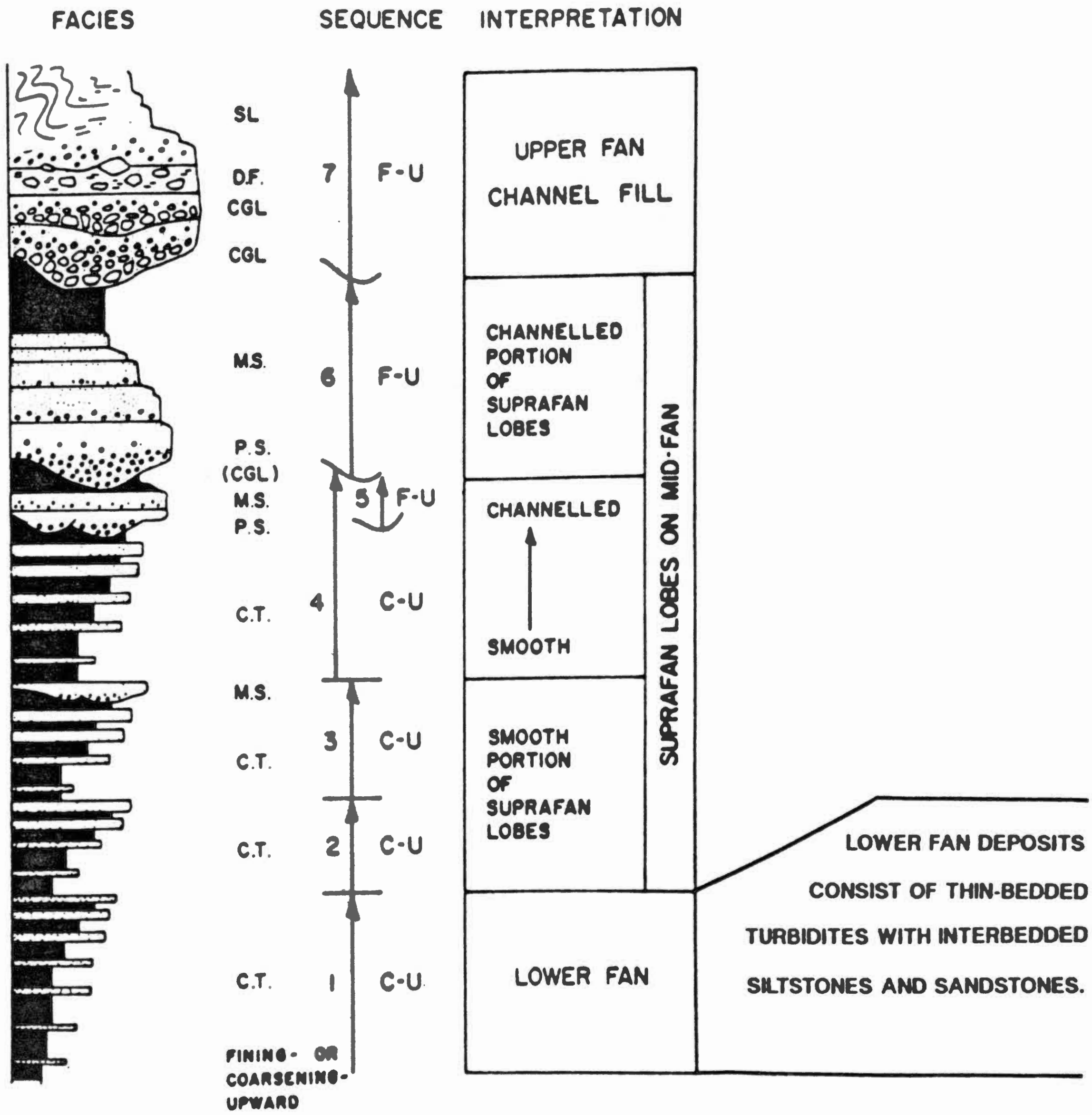


Figure 90. Hypothetical Vertical Sedimentation Profile of Submarine Fan Progradation. Note Coarsening Upward Sequence of Lower Fan Facies. C-U, Coarsening Upward; F-U, Fining Upward; C.T., Classic Turbidites; M.S., Massive Sandstone; P.S., Pebbly Sandstone; CGL, Conglomerate; D.F., Debris Flow; SL, Slumps; (Walker, 1978).

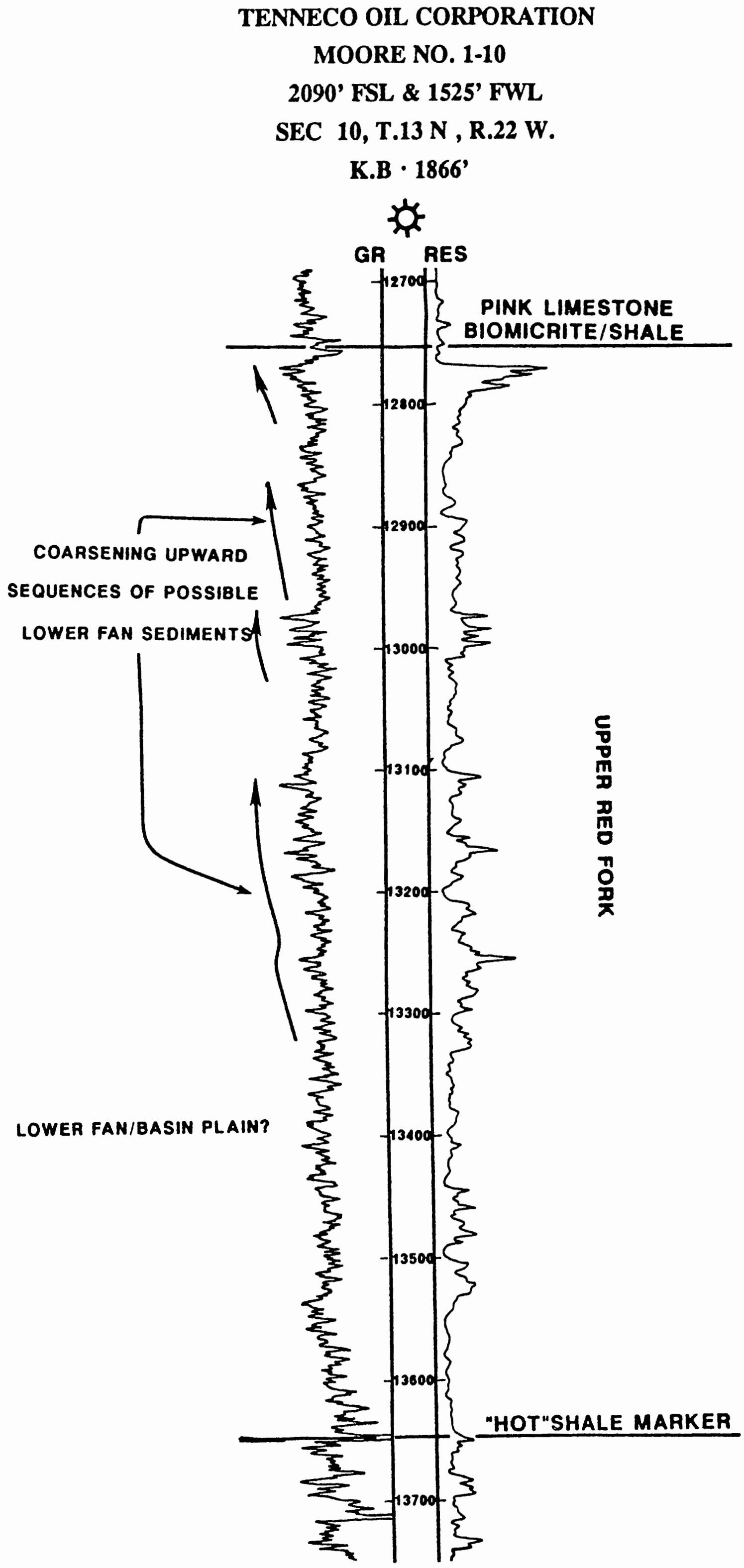


Figure 91. Wire-Line Log Signatures Illustrating Coarsening Upward Sequences of Lower Fan Deposition.

(Figure 29, p. 54).

Sandstones are interpreted to be formed from turbidity currents with T_b Bouma sequences most common. Intervals of T_{bc}, T_{bcd}, T_{cde} are locally found.

The Merrick No. 1-10 well indicates the coarsening upward interval underlies a thick sequence of abundant sandstone with interbedded siltstones and shales (Figure 92). These sandstones may have been formed as mid-fan deposits based on wire-line log interpretation. This would indicate that the mid-fan facies suprafan lobe prograded over thin lower fan/basin plain deposits.

Core structures indicate dipping bedding planes. Large amounts of micro-faulting and slump structures may indicate unstable sediment deposited on initial slopes.

Basin-Plain Facies

The basin-plain and outer fan facies are similar in morphology and may not be distinguishable. Plane parallel bedding with hemipelagic sediment and minor turbidity flows represent this basin-plain facies (Mutti and Lucchi, 1972, Walker, 1978).

The Southport Expl., Inc., Merrick No. 1-10, is interpreted to be formed in a basin-plain environment. Large amounts of interbedded brown and dark gray shales with lighter siltstones and sandstones are present (Figure 114, App. C). Soft-sediment-deformation features of the Mutti-Lucchi Facies F show flowage, slump structures, and micro-faulting sedimentary structures. Thin beds of very fine-grained sandstones (less than 2") within shales contain

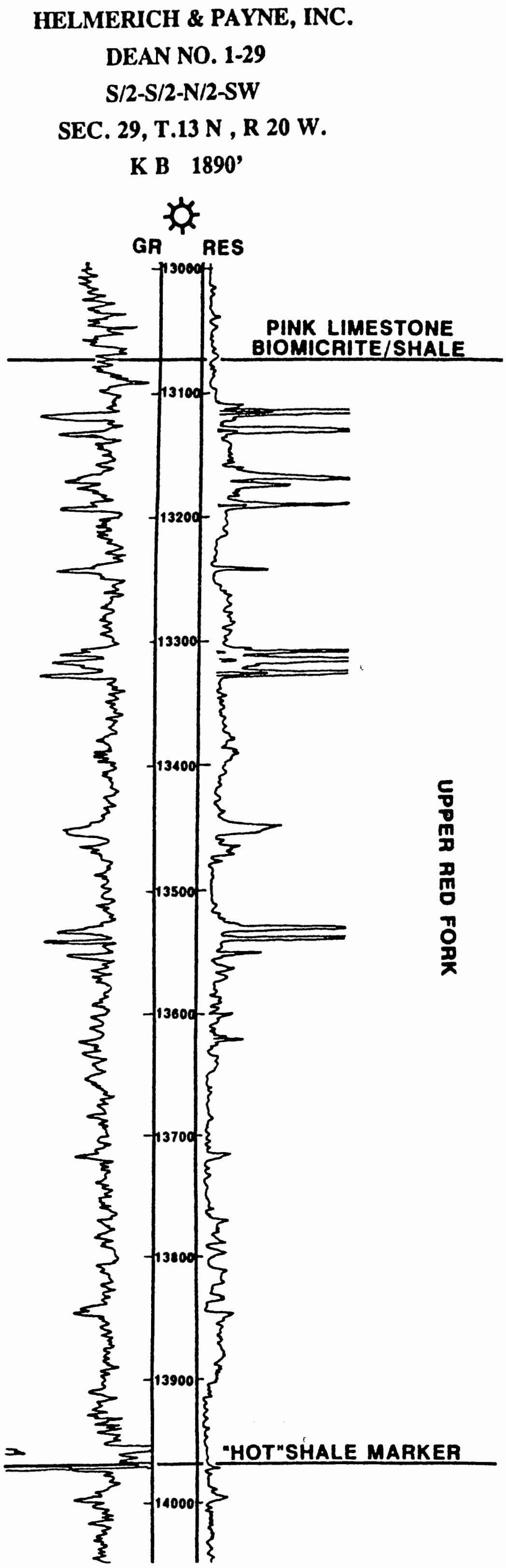


Figure 92. Wire-Line Log Signature Indicating Large Amounts of Interbedded Siltstones and Shales of Lower Fan and/or Basin Plain Deposition with Intervals of Sandstone.

ripples formed by traction currents (Mutti-Lucchi Facies E).

Wire-line log signatures show low gamma-ray and high apparent neutron porosity for basin-plain facies. Abundant shale observed in cores and wire-line logs may imply overall sediment deposition occurred in the basin-plain environment. The basin-plain facies is interpreted as the most abundant facies within the study area.

Interfingering of the basin-plain facies with other facies may serve as excellent stratigraphic traps for reservoir sandstones as well as source sediment for hydrocarbons.

Pro-Delta/Slope

Sandstone deposition in northeastern areas of the study does not seem to be related to sandstones deposited in the deeper portions of the basin. Anomalous sandstone thicknesses are located in the Southwest Leedey Field in T.15-16N., R.22W. (Figure 93). Production from wells within this field is very high (Table II, p. 171, App. A).

The Woods Petr. Corp., Switzer "C" No. 1 cored interval 11,444′ to 11,503′ is composed of sandstones displaying small-scale cross-bedding, abundant ripple laminae, and soft-sediment flowage structures (Figure 104, p. 188). Abundant burrowing is evident in lower areas of the core at 11,485′. The interval shows a "cleaning" upward sequence with less shale near the top. Sandstones within this interval are very fine-grained and contain abundant porosity (Figure 104, App. C). Shales within the sandstones do not exhibit the same color characteristic of the shales in other

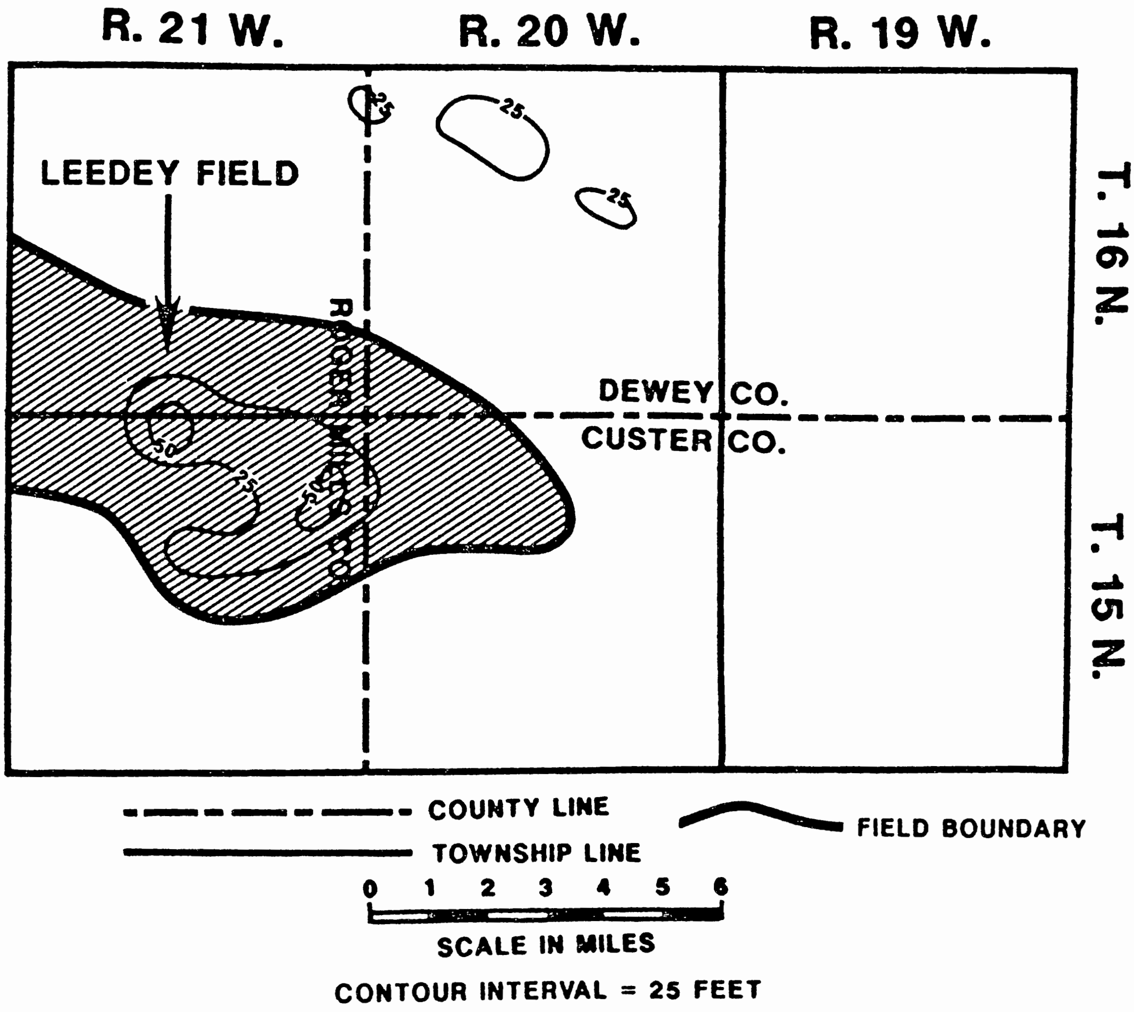


Figure 93. Location of Anomalous Upper Red Fork Sandstone Thicknesses in the Leedey Field Area.

less dark organic material. These sandstones are overlain by dark gray shales (11,407'to 11,428') that show increased burrowing upwards. Brachiopod fossils are observed at 11,426'9". This may represent a sudden rise in sea level. Further deepening resulted in deposition of black siliceous shales and dark biomicrite equivalent to the Pink Limestone (see Chapter VI).

The depositional environment of these sandstones may be related to the deltaic complex to the north. Sediment from the northeast may have been deposited downdip to form a small pro-delta fan in relatively shallow water (Figure 94).

Another hypothesis may be sediment from the East Clinton Field deltaic complex transported sediment by longshore (littoral) drift to the area (Figure 95).

Deltaic

The presence of probable outer deltaic sediments (Figure 96) occurs in the northeastern portions of the study area, based on work done by Udayashankar (1985). These deltaic sandstones form the platform for the Pink Limestone deposition. The net interval isopach thicknesses indicate much thinner total sediment deposition in the upper Red Fork interval (Figure 67, p. 102). The deltaic facies was not studied and is mentioned because it occurs in the outer limit of the study area.

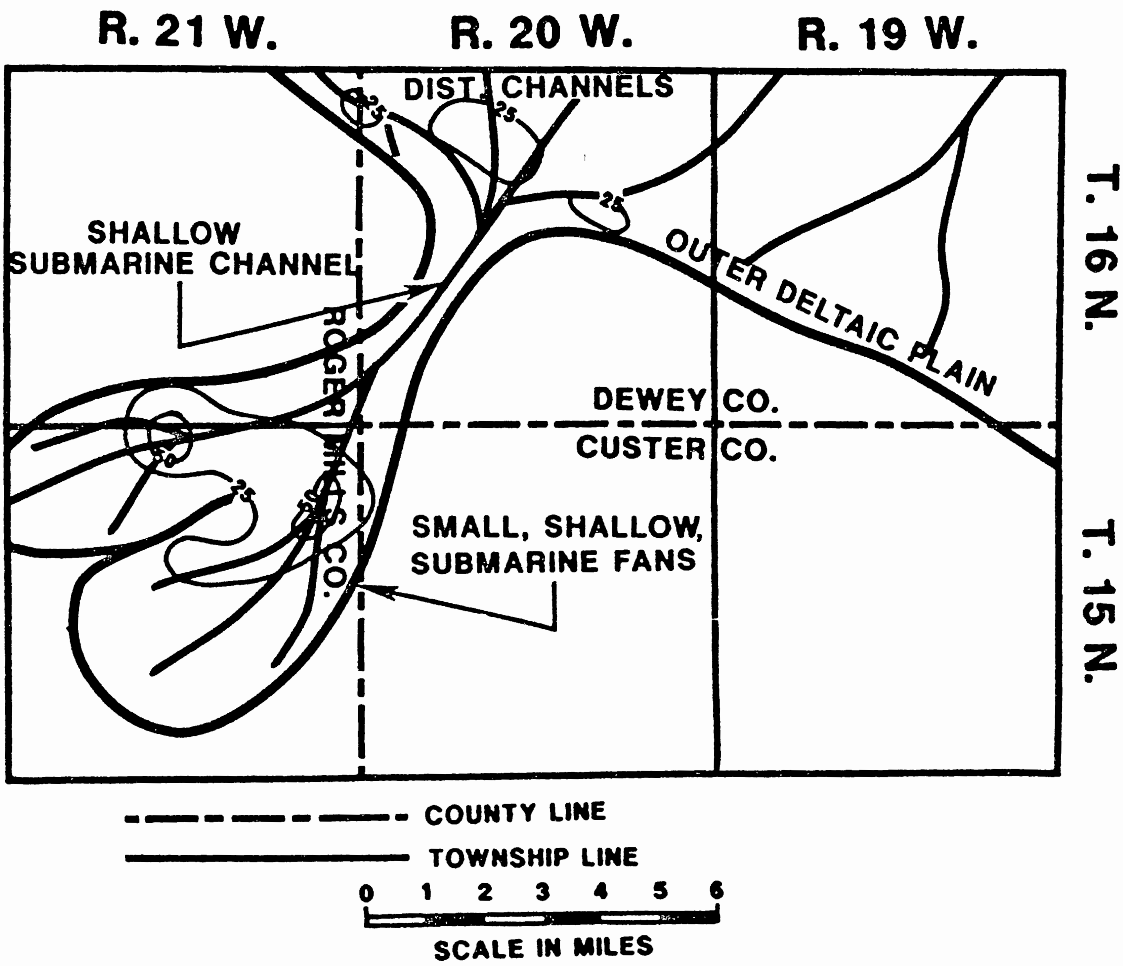


Figure 94. Deposition of Leedey Field Sandstones as Possible Shallow Submarine Fans Deposited near the Outer Deltaic Complex. Upper Red Fork Sandstone Thickness Contoured at 25' Interval.

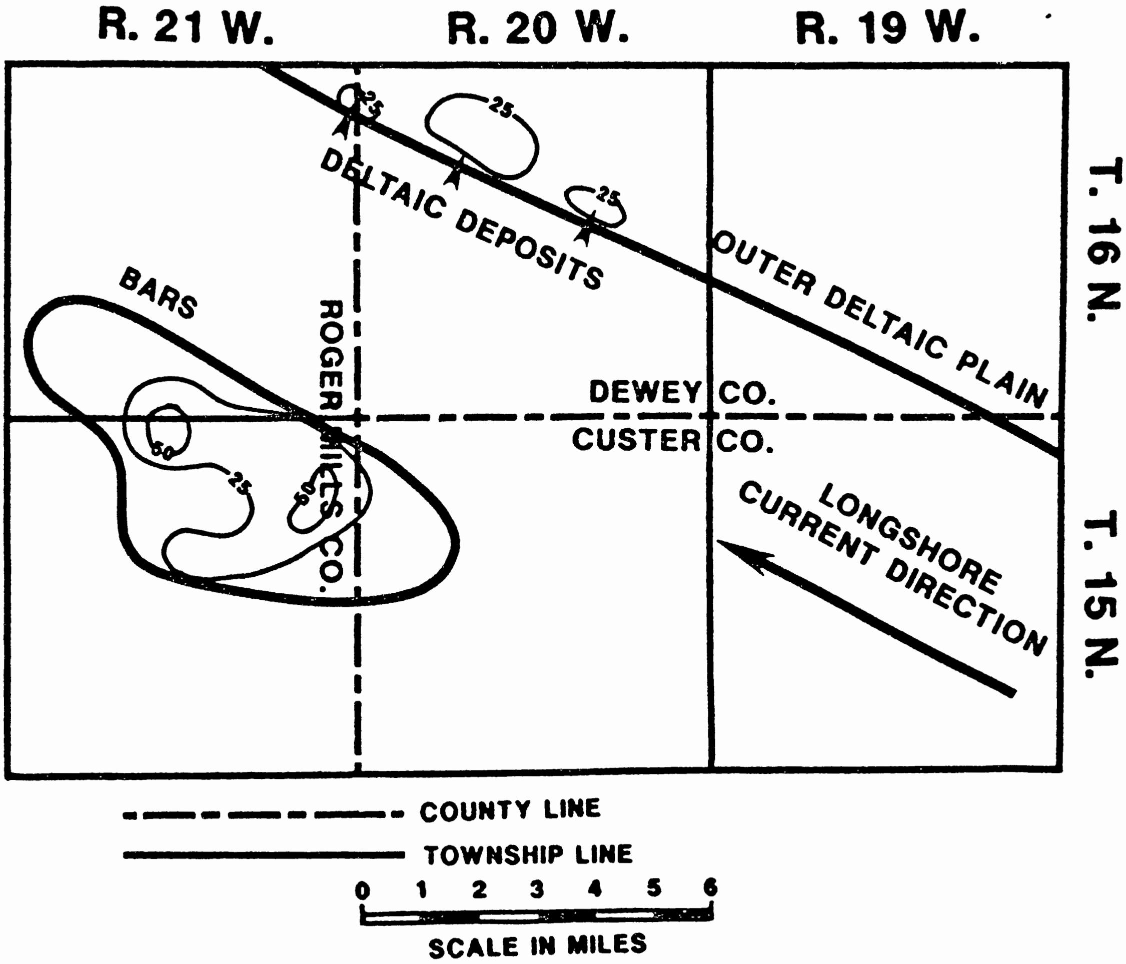


Figure 95. Alternate Interpretation of Long-Shore Drift Depositing Sandstones in the Leedey Field Area. Upper Red Fork Sandstone Thicknesses Contoured at 25′ Interval.

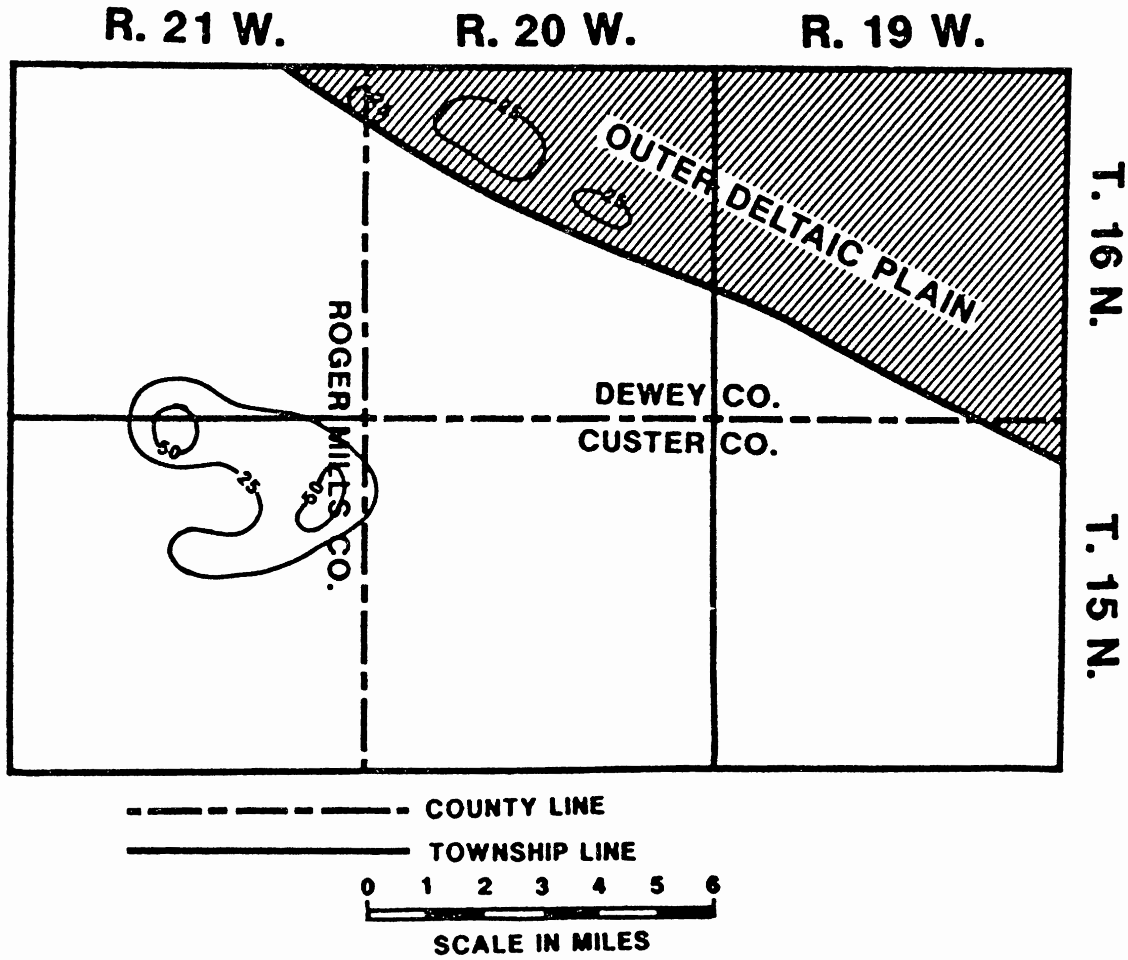


Figure 96. Location of Probable Outer Deltaic Sediments. Upper Red Fork Sandstone Thicknesses Contoured at 25 Feet Intervals.

Depositional Model for the Upper Red Fork Sandstones

The depositional model for the upper Red Fork sandstones is shown in Figures 97 - 102. This model uses fan facies previously described. It should be noted that these are generalized interpretations and that individual fans and sandstone packages must be examined locally to define their interpreted facies and extent.

Upper Red Fork sediments were deposited through the following sequence of events: 1) The submarine upper fan feeder channel formed off the mouth of a distributary of the East Clinton Field delta complex; 2) The leveed feeder channel extended from the East Clinton Field Complex to the study area; 3) Within the study area, the feeder channel sediments began forming fan complexes with upper, mid-, and lower fan facies (Figure 97); 4) The channels may have been deflected to the north due to fan aggradation which formed topographically higher areas (Figure 98); 5) Upper fan channels may have prograded across previously deposited mid- and lower fan facies resulting in interfingering of the mid-, lower, and outer fan/basin plain facies (Figure 99); 6) Sediment from a fan complex in the north may have influenced the depositional trend of the northward prograding fan complex (Figure 100); 7) The fan complexes continued prograding to the southwest to their maximum extent determined from sandstone isolith maps (Figure 101); and 8) sandstones were deposited on slope areas off the delta complex to the north (Figure 102). The timing of this

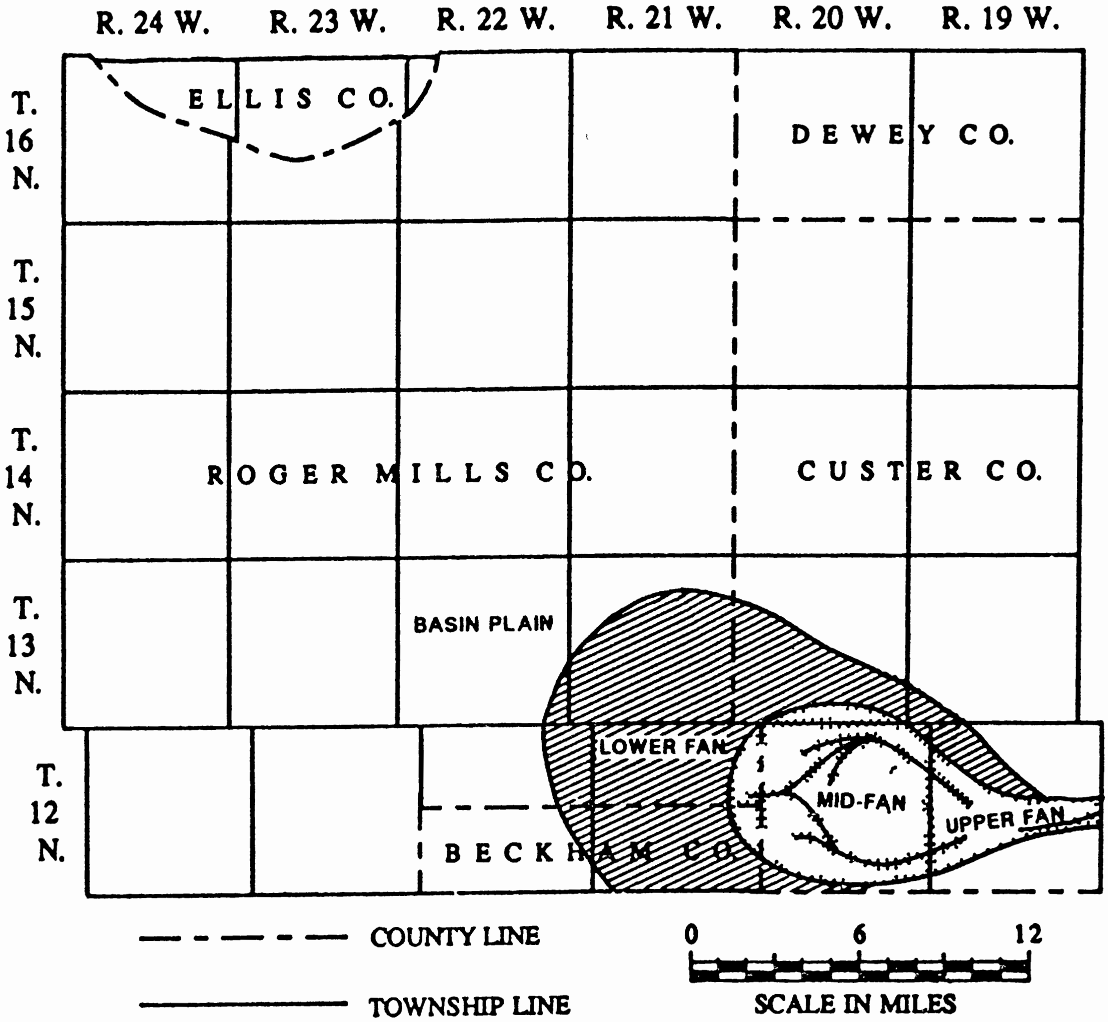


Figure 97. Formation of Upper, Mid-, and Lower Fan/ Basin Plain Facies.

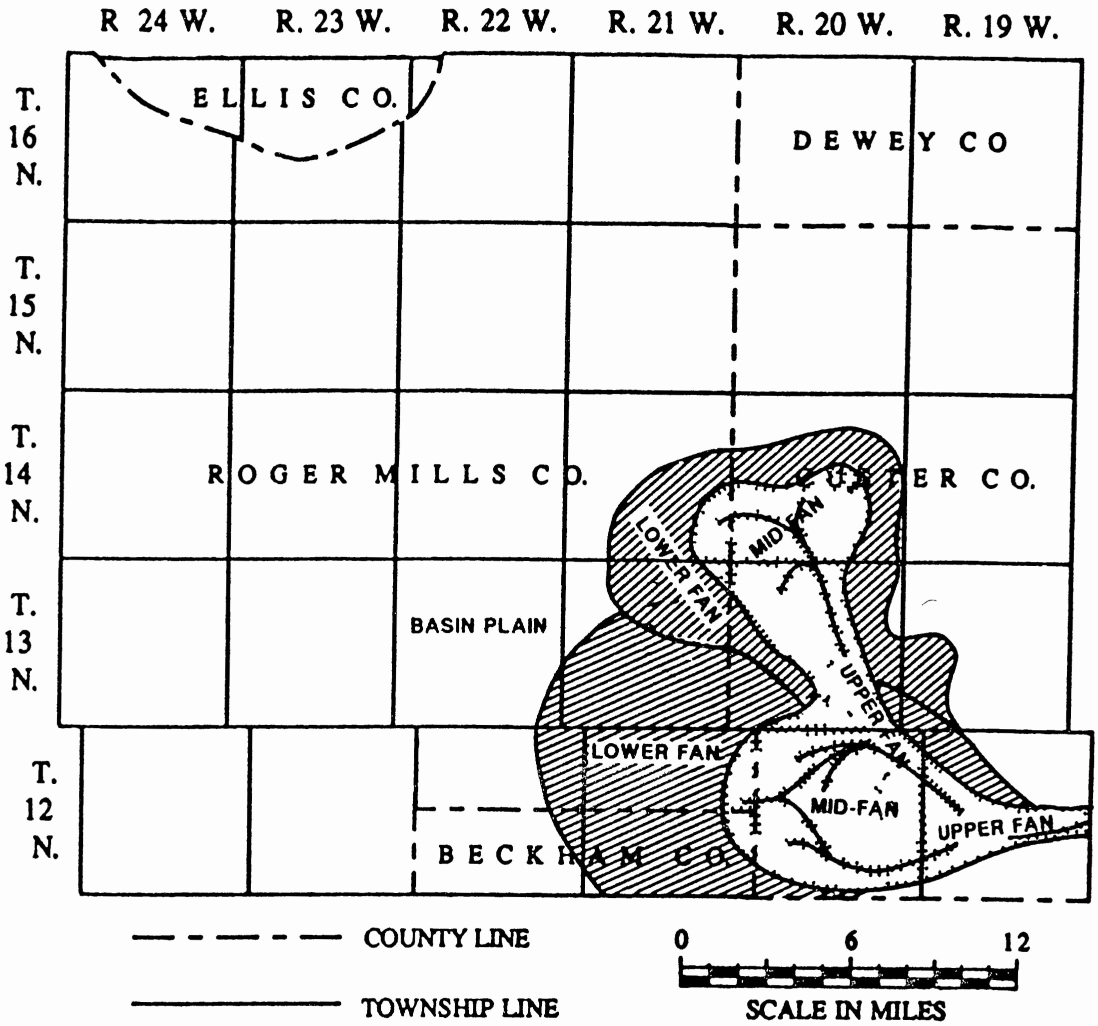


Figure 98. Deflection of Upper Fan Channels by Fan Aggradation Forming Topograhically Higher Areas.

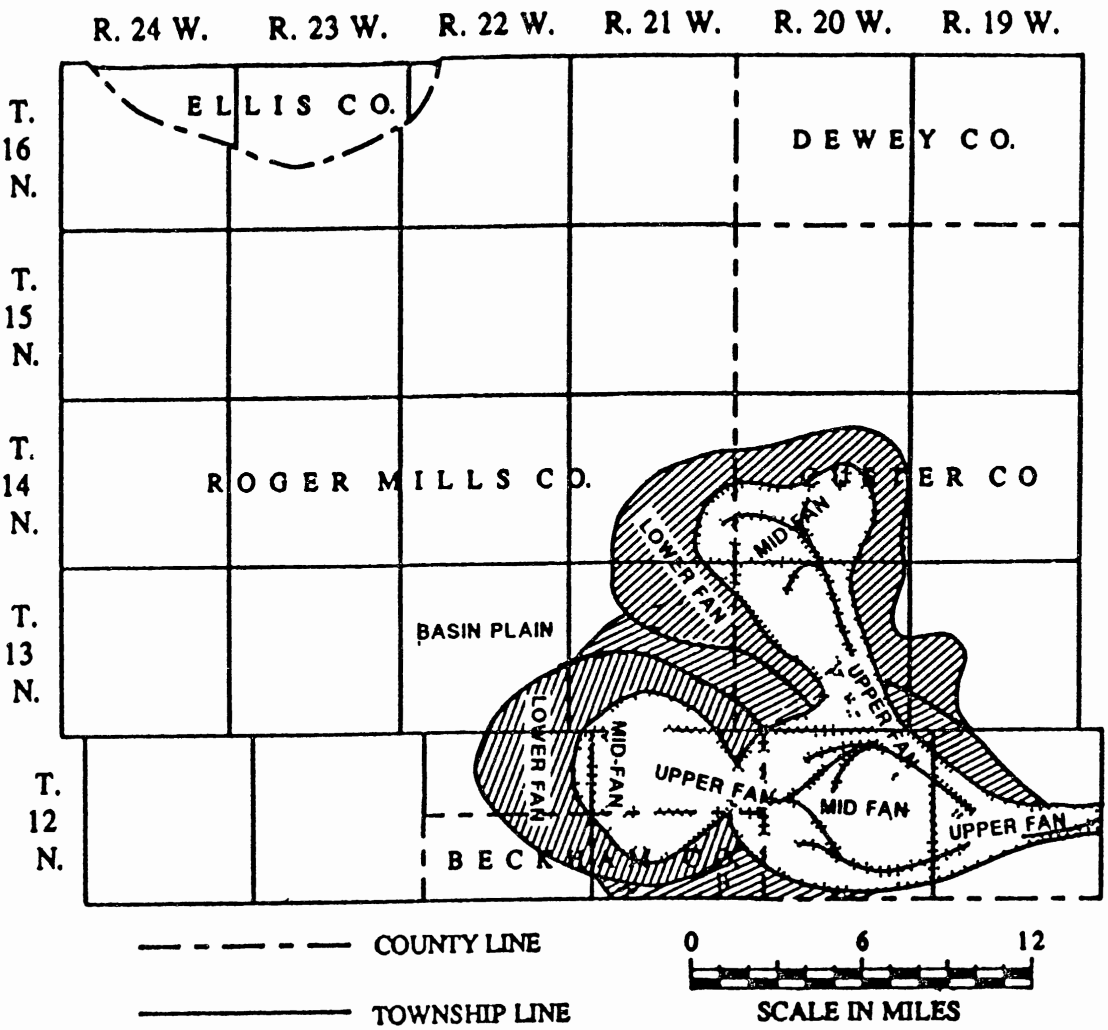


Figure 99. Progradation of Upper Fan Channels Across Mid-Fan and Lower Fan Facies.

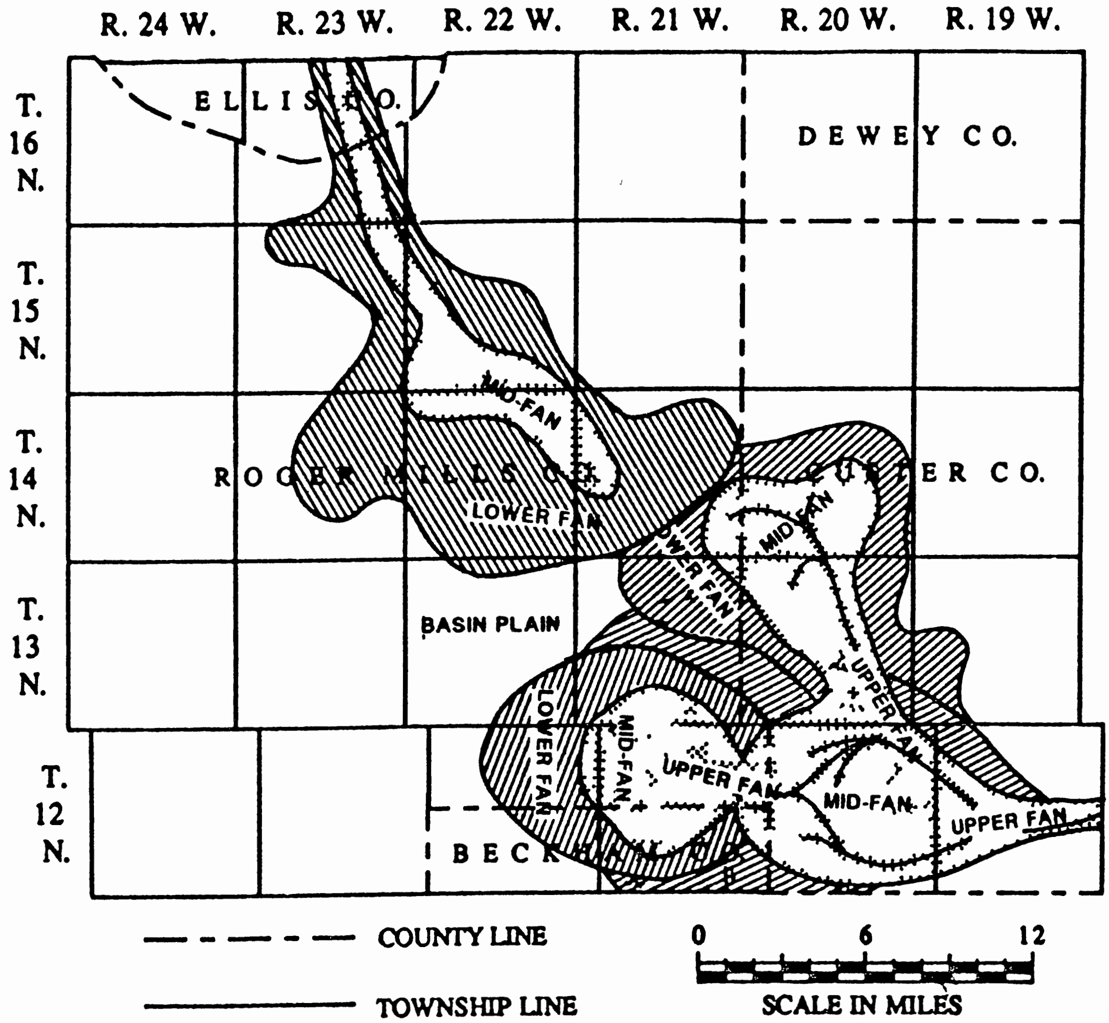


Figure 100. Possible Fan Complex in the North May Have Affected Deposition from the East.

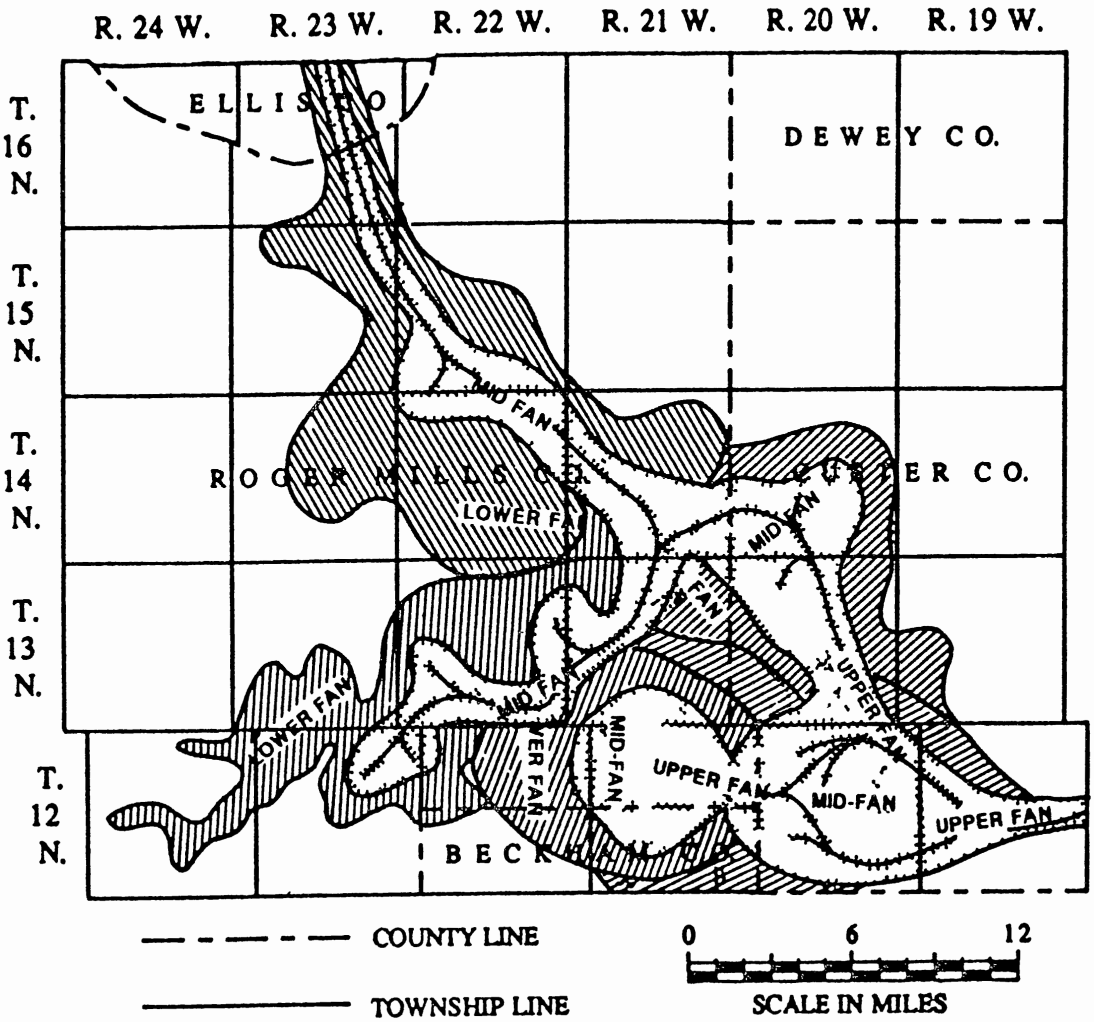


Figure 101. Extent of Submarine Fan Progradation as Determined from Net Sandstone Isolith Map.

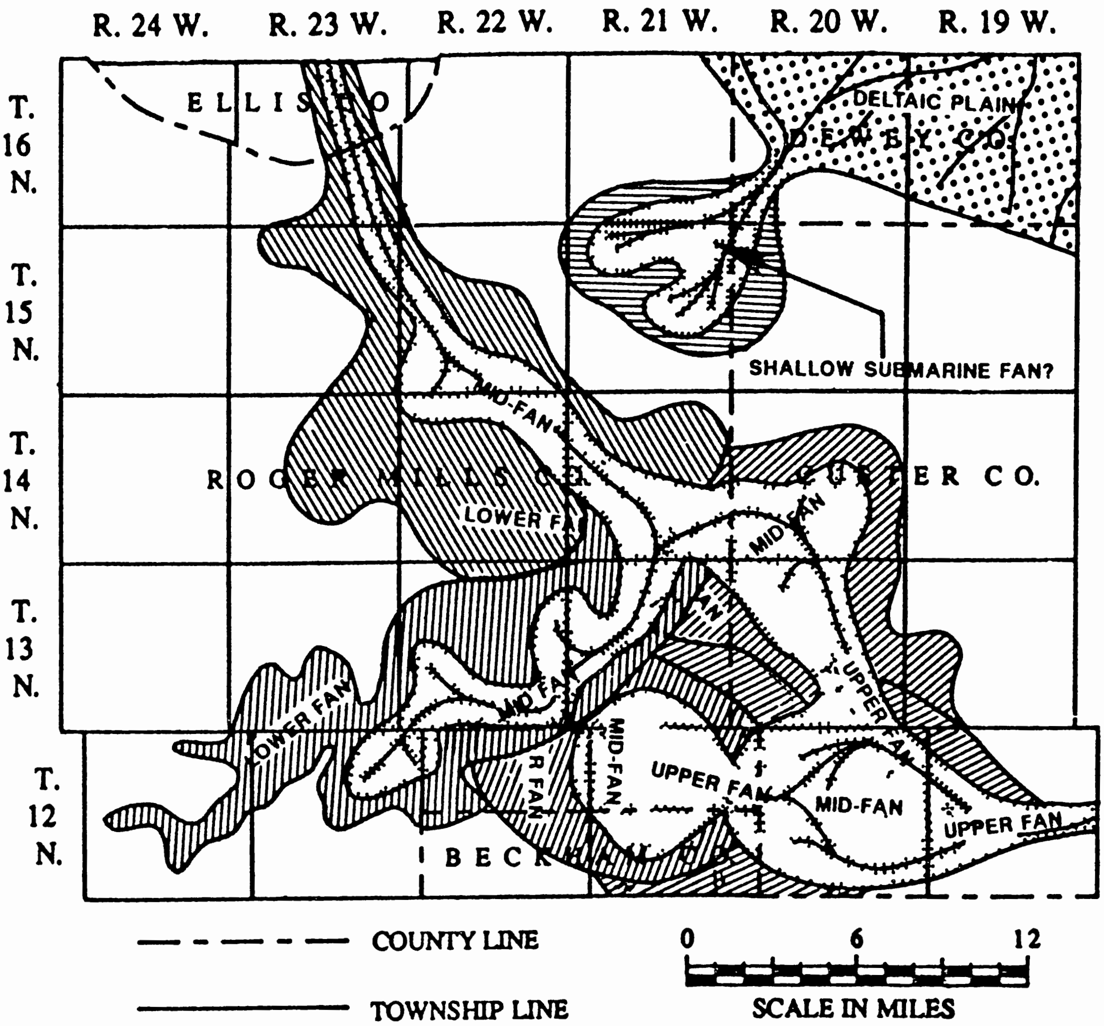


Figure 102. Sediment was Deposited in the Northeast as Possible Shallow Submarine Fans Off of the Deltaic Complex.

event likely occurred before the formation of the fan complexes to the south and west. Further study is needed to determine the origin of the sandstones occurring in the Leedey Field area.

Water Depths

Sediments within the basin are inferred to be deposited in deeper marine water settings. Marine fossils were not found in thin sections. Possible algal fragments replaced by micrite were found with dark organic material along ripple laminae. Carbonized plant (possibly wood) material is found in the Louisiana Land & Expl., Gates No. 2-33 at 12,186'5". The presence of black organic material suggests oxidation was minimal. Micro-paleontological study of cores was not performed.

Trace fossils found in core consisted of various types of burrowing structures (see Chapter 7). Possible Zoophycus and arenicolite-type trace fossils (Figure 33, p. 59) can occur at bathyal depths of 180 meters (557 ft.) and greater (Basan, et al., 1978), (Figure 103). Burrowing is most pronounced in the Woods Petroleum Corp., Switzer "C" No. 1. Sediments in this core are interpreted to be formed in shallow waters. This core represents the present-day structurally highest core studied as well as the highest interpreted paleostructure. Observed burrowing tends to decrease basinward within the core studied (see App. C)

Future paleontological studies may help to determine water depths at the time of deposition of the upper Red Fork sandstones.

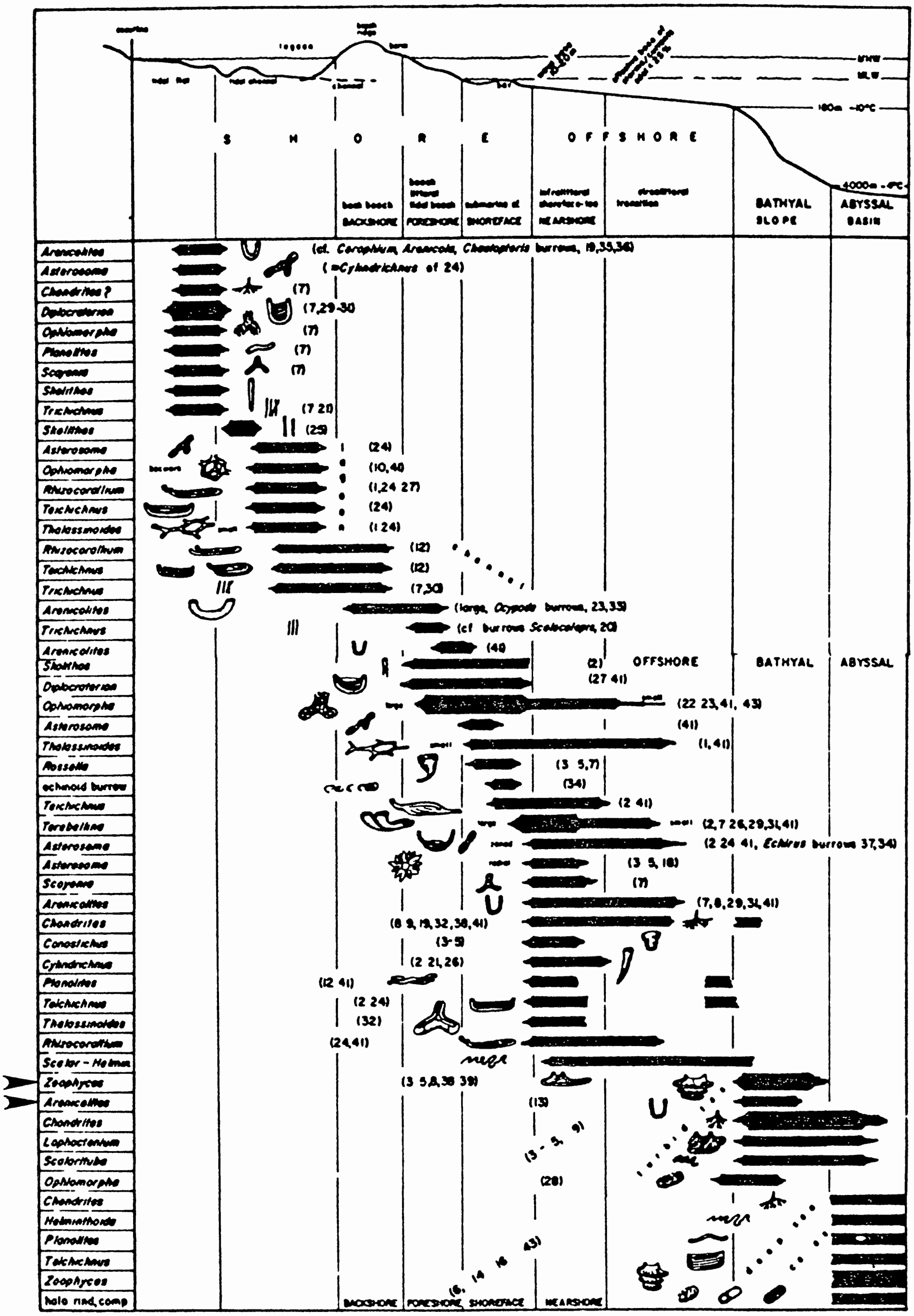


Figure 103. Trace Fossils and Associated Depositional Environments (Chamberlain, et al., 1978).

Subsurface structural maps delineate structures seen today and cannot be used to determine ancient water depths. Continued subsidence of the area after upper Red Fork deposition likely occurred.

The net thickness isopach map of the upper Red Fork interval shows thicknesses ranging from approximately 200 ft. in the northeast area to more than 1,100 ft. in the center of the depocenter. This gives a 900 ft. change in total thickness. Thicknesses of this magnitude have not been reported in other studies of the Red Fork.

The Pink Limestone facies change may indicate basin dip at the time of its formation. Dark biomicrite and black shales were deposited throughout the study area with exception to the northeastern area (Chapter VI). Decreased fossil content and increased pyrite may indicate a more reducing environment basinward and thus a deeper environment of deposition (Chapter VI). These black shales were deposited disconformably on upper Red Fork sediments suggesting submarine deposition of the upper Red Fork sediments.

Sediment Source Area

The majority of upper Red Fork sandstone is interpreted to be derived from the areas to the north and east. Sediments were transported from the north and east to the study area. The sediments observed in thin section contain significant amounts of metamorphic rock fragments (App. B) and are similar in composition to upper Red Fork sandstones to the east (Johnson, 1984) and north (Udayashankar, 1985).

Detrital grains of granophyre and microperthite, identified in thin section, are similar to those observed in the Wichita Mountains to the south (Ham, Denison, and Merritt, 1964). This may suggest a slight sediment input from the southern Wichita Mountain Uplift. Future studies to the south of the study area would likely determine to what extent the sediments derived from the Wichita Mountain Uplift may have influenced the upper Red Fork deposition within the study area.

CHAPTER XI

CONCLUSIONS

Conclusions of this study are as follows:

1. This study encloses a local depocenter of the upper Red Fork within the Anadarko Basin.
2. The upper Red Fork interval studied reflects the maximum reported thickness of this interval to date with thicknesses exceeding 1100 feet.
3. Multiple sediment sources and well control do not allow for subdivision of this interval on a regional scale. Local subdivisions may be possible and may help to define the extent and depositional facies of sandstones.
4. Correlation of sandstone bodies is extremely difficult between wells.
5. The marker bed used to delineate the upper Red Fork interval from the lower Red Fork interval is interpreted as a time-lithologic marker deposited during a highstand of sea level.
6. The upper Red Fork sandstones were deposited in a variety of submarine settings including upper, mid-, lower fan, and basin plain.
7. Upper Red Fork sandstones were deposited as submarine fans in the central portion of the study area, with mid-fan facies dominant (sandstone).
8. Upper Red Fork sandstones in the extreme southeast

corner of the study area represent a submarine feeder channel which transported sediments into the area from the east.

9. The source for a majority of upper Red Fork sandstones located within the central portions of the basin are from the Transcontinental Arch with minor amounts from the Wichita Mountain Complex to the south.
10. A submarine fan complex exists in the northwest-central area of the study area with a possible upper fan channel to the north.
11. Red Fork sandstones in the Leedey field were deposited as possible shallow submarine fans in a pro-deltaic or shelf/slope environment.
12. Red Fork Sandstones in the extreme northeastern portion of the study area were deposited in an outer fluvial-deltaic environment.
13. The outer fluvial-deltaic Red Fork facies served as the outer limit substrate for deposition of Pink limestone biosparite facies.
14. An upper Red Fork interval hinge line occurs in the northeastern portion of the study area.
15. Basin plain deposits interfinger with mid- and lower submarine fan deposition.
16. Diagenetic alterations have practically eliminated primary porosity and are responsible for secondary porosity found in Red Fork sandstone reservoirs.
17. Future drilling and coring within the area will yield valuable information for future Red Fork analysis.

18. Micropaleontological studies of core samples may help to determine water depths at the time of deposition.
19. Further Studies just to the east of this study may help to determine the depositional environment of the Upper Red Fork sandstones in that area.
20. Studies to the south should determine to what extent sediments from the Wichita Mountain Uplift influenced Upper Red Fork deposition within the area.

BIBLIOGRAPHY

Ahmeddudin, M., 1968, Subsurface Geology of the Wheatland area, Cleveland, McClain, Grady, Canadian, and Oklahoma Counties: Okla. City Geol. Soc. Shale Shaker, v. 19, no. 1, p. 2-19.

Albano, M. A., 1975, Subsurface Stratigraphic Analysis, "Cherokee" Group (Pennsylvanian), Northeast Cleveland County, Oklahoma: Okla. City Geol. Soc. Shale Shaker, v. 25, no. 1, p. 94-99, 114-120, & 134-137.

Arbenz, J. K., 1956, Tectonic Map of Oklahoma: Okla. Geological Survey Map, GM-3.

Basan, P. B., Chamberlain, etal. 1978, Trace Fossil Concepts: Soc. of Economic Paleontologist and Mineralogist, Short Course No. 5, 181 p.

Berg, O. R., 1969, Cherokee Group West Flank of the Nemaha Ridge: Okla. City Geol. Soc. Shale Shaker, v. 19, no. 6, p. 94-110.

Bouma, A. H., 1962, Sedimentology of Some Flysch Deposits: A Graphic Approach to Facies Interpretation: Elsevier Publ. Co. Amsterdam, p. 168.

Burke, K, & Dewey, J. F., 1973, Plume-Generated Triple Junctions: Key Indicators in Applying Plate Tectonics to Old Rocks: Journ. of Sedimentology, v. 55, no. 3.

Busch, D. A., 1971, Genetic Units in Delta Prospecting: The Amer. Assoc. of Petroleum Geologists Bull., v. 55, p. 1137-1154.

Dogan, N., 1969, 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, no. 10, p. 192-213.

Feinstein, S., 1981, Subsidence and Thermal History of Southern Oklahoma Aulacogen: Implications for Petroleum Exploration: The Amer. Assoc. of Petroleum Geologists Bull., v. 65, no. 12, p. 2521-2533.

Garner, D. L., & Donald, L. T., 1984, The Thermal and Mechanical Evolution of The Anadarko Basin: Tectonophysics, v. 107, no. 1 & 2, p. 1-24.

Glass, J. L., 1981, Depositional Environments, Reservoir Trends, and Diagenesis of the Red Fork Sandstone in Grant and Eastern Kay Counties, Oklahoma: Unpublished Master's Thesis, Oklahoma State University.

Good, R., Brown, L., Oliver, J. & Kaufman, S., COCORP Deep Seismic Reflection Traverse Across the Southern Oklahoma Aulacogen: Seismic Expression of Structural Styles: The Amer. Assoc. of Petroleum Geologists, Studies in Geology Series # 15, p. 3.2.2-33-37.

Ham, W. E., & Wilson, J. L., 1967, Paleozoic Epeirogeny and Orogeny in the Central United States: American Journal of Science, v. 26, no. 5, p. 332-407.

Hansen, C. A., 1978, Subsurface Virgilian and Lower Permian Arkosic Facies, Wichita Uplift-Anadarko Basin, Oklahoma: Unpublished Master's Thesis, Oklahoma State University.

Heckel, P. H., 1977, Origin of Phosphatic Black Shale Facies in Pennsylvanian Cyclothems of Mid-Continent North America: Amer. Assoc. of Petroleum Geologists Bull. v. 61, no. 7, p. 1045-1068.

Hill, G. W. Jr., & Clark, R. H., 1980, The Anadarko Basin -- A Regional Petroleum Accumulation -- A Model for Future Exploration and Development: Okla. Geol. Soc. Shale Shaker, v. 31, p. 36-39.

Johnson, C. L., 1984, Depositional Environments, Reservoir Trends, and Diagenesis of Red Fork Sandstones in Portion of Blaine, Caddo, and Custer Counties, Oklahoma: Unpublished Mater's Thesis, Oklahoma State University.

Jordan, L. 1957, Subsurface Stratigraphic Names of Oklahoma: Oklahoma Geological Survey, Guide Book VI.

Kuenen, P. H., & Migliorini, C.I., 1950, Turbidity Currents as Cause for Graded Bedding: Jour. Geol., v. 58, p. 91-127.

Kumar, N. & Slatt, R. M., 1984, Submarine-Fan and Slope Facies of Tonkawa (Missourian-Virgilian) Sandstone in Deep Anadarko Basin: Amer. Assoc. of Petroleum Geologists Bull., v. 68, no. 12, p. 1839-1856.

Levine, S. D., 1985, Provenance and Diagenesis of the Cherokee Sandstones, Deep Anadarko Basin, Western Oklahoma: Okla. City Geol. Soc. Shale Shaker.

Lowe, D. R., 1982, Sediment Gravity Flows II: Depositional Models with Special Reference to the Deposits of

High-Density Turbidity Currents: Jour. of Sed. Pet., v. 52, no. 1, p. 279-297.

McElroy, M. N., 1961, Isopach and Lithofacies Study of the Desmoinesian Series of North-Central Oklahoma: Okla. ity Geol. Soc. Shale Shaker, v. 12, no. 12, p. 2-22.

Middleton, G. V., & Hampton, M. A., 1973, Sediment Gravity Flows: Mechanics of Flow and Deposition in Soc. of Econ. Paleontologists and Mineralogists Short Course Lecture Notes, Anaheim California, May 1973, p. 1-38.

Moore, G. E., 1979, Pennsylvanian Paleogeography of the Southern Mid-Continent in Hyde, N.J.. (ed), Pennsylvanian Sandstones of the Mid-Continent: Tulsa Geol. Soc. Special. Pub., no. 1, p. 2-12.

Nilsen, T., 1980, Modern and Ancient Submarine Fans: discussion of papers by R. G. Walker and W. R. Normark; The Amer. Assoc. of Petroleum Geologists Bull., v. 64, p. 1094-1101.

Normark, W. R., 1978, Fan Valleys, Channels, and Depositional Lobes on Modern Submarine Fans: Characteristics for Recognition of Sandy Turbidite Environments: The Amer. Assoc. of Petroleum Geologists Bull., v. 62, no. 6, p. 912-931.

Oakes, M. C., 1953, Krebs and Cabiness Groups, of Pennsylvanian Age, in Oklahoma: The American Association of Petroleum Geologists Bulletin, v. 37, no. 6, p. 1523-1526.

Petzet, G. A., 1988, Upper Red Fork Trend Pays off In Oklahoma: Oil & Gas Journal, March 14, 1988, p. 78-79.

Potter, P. E., Maynard, J. B., & Pryor, W. A., 1980, Sedimentology of Shale: Springer - Verlag, N.Y., 277 p.

Puckette, J. O., 1990, Deposition Setting, Facies, and Petrology of Cabaniss (Upper "Cherokee") Group in Beckham, Dewey, Custer, Ellis, Roger Mills, and Washita Counties, Oklahoma: Unpublished Master's Thesis, Oklahoma State University.

Pulling,D. M., 1977, Subsurface Stratigraphic and Structural Analysis, Cherokee Group, Pottowatomie County Oklahoma: Okla. City Geol. Soc. Shale Shaker, v. 28, no. 2 & 3 p. 24-25, 48-55.

Rascoe, B. A., and Adler, F. J., 1983, Permo-Carboniferous Hydrocarbon Accumulations, Mid-Continent, U.S.A.:

Amer. Assoc. of Petroleum Geologists Bull., v. 67, p. 979-1001.

Slate, H. L., 1962, Petroleum Geology of the Taloga-Custer City Area Dewey and Custer Counties, Oklahoma: Okla. City Geol. Soc. Shale Shaker, v. 13, no. 3, p. 2-19.

Schatski, N. S., 1946, The Great Donets Basin and Wichita System. Comparative Tectonics of Ancient Platforms: USSR, Akad. Navk. Izv. Geol. Serial, no. 1, p. 5-62.

Sullwold, H. H. Jr., 1961, Turbidites in Oil Exploration, in Geometry of Sandstones Bodies: The Amer. Assoc. of Petroleum Geologists Bull., p. 63-81.

Thalman, A. L., 1967, Geology of the Oakdale Sand Field, Woods County, Oklahoma: Okla. City Geol. Soc. Shale Shaker, v. 18, no. 1, p. 3.

Udayashankar, K. V., 1985, Depositional Environment, Petrology, and Diagenesis of Red Fork Sandstone in Central Dewey County, Oklahoma: Unpublished Master's Thesis, Oklahoma State University.

Walker, R. G., 1978, Reply Modern and Ancient Submarine Fans: Models for Exploration for Stratigraphic Traps Exploration of Turbidites and Other Deep Water Sandstones: The Amer. Assoc. of Petroleum Geologists Bull., v. 62, no. 6, p. 1101-1108.

Webster, R. E., 1980, Evolution of Southern Oklahoma Aulacogen: Oil & Gas Journal, Feb. 18, p. 150-172.

Withrow, P. C., 1967, Wakita Trend: Red Fork Sandstone in the Wakita Trend, Grant and Alfalfa Counties, Oklahoma: Okla. City Geol. Soc. Shale Shaker, v. 17, no. 10, p. 198.

Whiting, P. H., 1982, Depositional Environment of Red Fork Sandstones, Deep Anadarko Basin, Western Oklahoma: Unpublished Master's Thesis, Oklahoma State University.

Zeliff, C. W., 1976, Subsurface Analysis, "Cherokee" Group (Pennsylvanian), Northern Kingfisher County, Oklahoma: Okla. City Geol. Soc. Shale Shaker, v. 27, no. 1,2 & 3, p. 4-6, 24-33 & 44-56.

APPENDIXES

APPENDIX A

RED FORK GAS PRODUCTION (MCF)

WITHIN STUDY AREA (1/7/90)

TABLE II

Red Fork Gas Production (MCF) Within Study Area

LEASE NAME	OPERATOR	S -T -R	I P IN MCF	CUM PROD 7/1/90	PROD. 1-7/1/90
MOUSE NO 1-6	TXO PRODUCTION CORPORATION	6-12-19	68 0		
WHITE "K" NO 1	TXO PRODUCTION CORPORATION	7-12-19	1,200 0	455,993 0	21,837 0
THOMPSON NO 1	D-I ENERGY, INC.	8-12-19	1,378 0	157,375 0	8,605 0
NORTHRIP NO 1-9	AN-SON CORPORATION	9-12-19	375 0	138,002 0	14,021 0
MINNIE NO 1-11	STANDARD OIL PRODUCTION COMPANY	11-12-19	516 0		
VESTA VINEYARD ETAL. NO 1-12	MAPCO PRODUCTION COMPANY	12-12-19	420 0	334,275 0	16,452 0
DIPPEL NO 1-13	AN-SON CORPORATION	13-12-19	7,750 0	3,737,395 0	154,574 0
DERBY NO 1-13	AN-SON CORPORATION	13-12-19	4,468 0	4,579,334 0	547,371 0
NINA NO 1-14	AN-SON CORPORATION	14-12-19	4,000 0	985,916 0	59,498 0
GHOLSTON NO 1-15	MESA PETROLEUM COMPANY	15-12-19	165 0		
LOIS MARIE NO 1-15	AN-SON CORPORATION	15-12-19	6,882 0	1,569,417 0	82,240.0
GLADYS NO 1-16	AN-SON CORPORATION	16-12-19	3,021 0	617,452 0	27,926 0
MAMIE NO 1A-17	AN-SON CORPORATION	17-12-19	5,593 0	705,261 0	54,718 0
FOSS NO 1	TXO PRODUCTION CORPORATION	18-12-19	2,800 0	1,267,855 0	51,339 0
PAULINE NO 1-19	AN-SON CORPORATION	19-12-19	552 0	876,371 0	38,358 0
J R NO 1-20	AN-SON CORPORATION	20-12-19	2,940 0	536,049 0	39,556 0
SIMMONS NO 1-21	SOHIO PETROLEUM COMPANY	21-12-19	2,800 0	745,517 0	34,365 0
LOIS NO 1-22	AN-SON CORPORATION	22-12-19	3,700 0	1,781,499 0	133,336 0
CLAUDE NO 1-23	AN-SON CORPORATION	23-12-19	6,766 0	980,021 0	43,643 0
BILL NO 1-24	AN-SON CORPORATION	24-12-19	4,292 0	845,214 0	35,492 0
WAGNON NO 1-31	WARD PETROLEUM CORPORATION	31-12-19	1,400 0	442,368 0	33,425 0
PANTHER NO 1	INEXCO OIL COMPANY	1-12-20	2,340 0	194,208 0	4,334 0
PANTHER NO 1	INEXCO OIL COMPANY	1-12-20	202 0		
K C CATTLE COMPANY NO 1-3	MOBIL OIL CORPORATION	3-12-20	150 0	564,984 0	28,445 0
K C CATTLE COMPANY NO 1-5	APACHE CORPORATION	5-12-20	390 0	477,491 0	14,787 0
RICHMOND NO 1-7	DYCO PETROLEUM CORPORATION	7-12-20	3,238 0	978,211 0	50,161 0
WELLS NO 1-8	APACHE CORPORATION	8-12-20	838 0	1,542,116 0	77,093 0
THELMA-PHILLIPS NO 1-9	GHK COMPANY	9-12-20	3,000 0	1,701,152 0	18,331 0
TEURMAN NO 1-13	AN-SON CORPORATION	13-12-20	1,805 0	590,150 0	42,509 0
ROSIE MAY NO 1	SANGUINE, LTD	15-12-20	4,217 0	89,545 0	7,635 0
HUTSON NO 1-15	SANGUINE, LTD	15-12-20	1,493 0		
ELLIOT NO 2-16	APACHE CORPORATION	16-12-20	5,667 0	1,108,102 0	164,921 0
ELLIOT NO 1-16	GHK COMPANY	16-12-20	5,066 0	5,757,428 0	310,141 0
SANDERS NO 1-17	APACHE CORPORATION	17-12-20	3,168 0	2,095,888 0	48,251 0
LIBBY-HOOVER NO 1-17	APACHE CORPORATION	17-12-20	3,757 0	309,332 0	203,473 0
KEPHART NO 1-17	APACHE CORPORATION	17-12-20	6,082 0	1,688,385 0	171,639 0
HOWE NO 1-18	GHK COMPANY	18-12-20	506 0	640,876 0	27,765 0
PRESTON NO 1-18	APACHE CORPORATION	18-12-20	7,603 0	160,279 0	160,279 0
KEPHART NO 1-18	APACHE CORPORATION	18-12-20	9,677 0	1,230,666 0	474,047 0
KENNER NO 2-19	APACHE CORPORATION	19-12-20	4,384 0	473,925 0	103,405 0
ELLIOTT NO 1-19	APACHE CORPORATION	19-12-20	3,331 0	389,156 0	63,152 0
KENNER-HALL NO 1-19	APACHE CORPORATION	19-12-20	864 0	314,505 0	0 0
KEPHART NO 1-20	GHK COMPANY	20-12-20	3,148 0	2,999,857 0	275,183 0
KEPHART NO 2	MOBIL OIL CORPORATION	20-12-20	3,056 0	23,388 0	0 0
PECK NO 1 21	GHK COMPANY	21-12-20	2,000 0	5,233,860 0	159,945 0
PECK NO 2-21	APACHE CORPORATION	21-12-20	484 0	103,263 0	24,210 0
DUNN NO 1-22	GHK COMPANY	22-12-20	825 0	774,601 0	25,548 0
JOHNSON NO 1-22	APACHE CORPORATION	22-12-20	5,558 0	524,241 0	83,152 0
HIGGINS NO 1-23	GHK COMPANY	23-12-20	137 0		
K C CATTLE COMPANY NO 1 24	POGO PRODUCING COMPANY	24-12-20	982 0	757,367 0	67,064 0
SULLIVAN NO 1-26	GHK COMPANY	26-12-20	246 0	24,677 0	0 0
NELLIE-MC CONNELL NO 1-27	GHK COMPANY	27-12-20	1,410 0	353,200 0	14,770 0
OAKS NO 1-30	APACHE CORPORATION	30-12-20	1,827 0	535,078 0	17,786 0
ALLISON NO 1-35	GHK COMPANY	35-12-20	3,200 0	524,727 0	9,409 0
MERRICK NO 5	APACHE CORPORATION	6-12-21	1,259 0	440,279 0	15,862 0
WESNER NO 2-6	APACHE CORPORATION	6-12-21	3,826 0	242,360.0	63,340 0
MERRICK NO 1	P C.X CORPORATION	7-12-21	1,300 0	4,007,074 0	261,922 0
MERRICK NO 7-B	RAM RICKS,JR INC	7-12-21	1,778 0	233,938 0	35,515 0
TRIPLE "T" NO 1	P C X CORPORATION	8-12-21	2,660 0	1,892,588 0	71,285 0
CARPENTER NO 1-9	LOUISIANA LAND & EXPLORATION CO	9-12-21	3,900 0	242,622 0	152,898 0
BILLAU NO 1-13	MOBIL OIL CORPORATION	13-12-21	1,600 0	181,501 0	3,769 0

TABLE II (Continued)

LEASE NAME	OPERATOR	S -T -R	I P IN MCF	CUM PROD 7/1/90	PROD 1-7/1/90
BEUTLER NO 1-13	DYCO PETROLEUM CORPORATION	13-12-21	4,872 0	103,895 0	103,895 0
BEUTLER NO 2-13	DYCO PETROLEUM CORPORATION	13-12-21	1,640 0		
WYNN NO 1-14	DYCO PETROLEUM CORPORATION	14-12-21			
DEAL NO 1-14	APACHE CORPORATION	14-12-21	1,325.0	926,141 0	44,008 0
K C CATTLE COMPANY NO 2-16	GHK COMPANY	16-12-21	1,700 0	384,290 0	8,584 0
THORTON NO 2-17	APACHE CORPORATION	17-12-21	8,498 0	605,739 0	169,294 0
WILKS NO 1-17	GHK COMPANY	17-12-21		3,885,635.0	186,457 0
THORNTON NO.1-18	SANGUINE, LTD	18-12-21	2,870 0	2,604,325.0	390,312 0
CHRISTIE NO 1	SANGUINE, LTD	18-12-21	4,340 0	273,514 0	273,514 0
THORTON NO 1-19	GHK COMPANY	19-12-21	1,800 0	1,693,352 0	115,033 0
BEUTLER-COOPER NO 1-20	KAISER-FRANCIS OIL	20-12-21	1,050 0	33,971 0	15,470 0
BAKER NO 1-20	GHK COMPANY	20-12-21		6,526,445 0	234,701 0
BAKER-FOWLER NO 1-20	GHK COMPANY	20-12-21	202 0	534,267 0	65,321 0
WATKINS NO 3-21	APACHE CORPORATION	21-12-21	126.0		
WATKINS NO 2-21	GHK COMPANY	21-12-21	5,650 0	980,643 0	22,290 0
GRETHEN-JOHNSON NO 1	APACHE CORPORATION	23-12-21	578 0	334,584 0	20,064.0
GREGORY NO 1-24	MOBIL OIL CORPORATION	24-12-21	2,935 0		
R C GREEN NO 1	MOBIL OIL CORPORATION	25-12-21		619,242 0	100,770 0
NICHOLS-GREGORY NO 1	AMEREX, INC.	28-12-21	7,000 0	2,016,709 0	26,246 0
NESSER NO 1-29	GHK COMPANY	29-12-21	3,125 0	2,104,926 0	102,324 0
GREGORY NO 2-29	APACHE CORPORATION	29-12-21	2,274 0	821,517 0	282,132.0
THORNTON NO 1-30	APACHE CORPORATION	30-12-21	1,420 0	1,969,379 0	57,438 0
SMITH NO 1-31	APACHE CORPORATION	31-12-21	150 0	262,894 0	0 0
CLARK NO 1-32	APACHE CORPORATION	32-12-21	2,800 0	2,280,155 0	156,881 0
CLARK NO 1	SANGUINE, LTD	33-12-21	1,025 0	1,204,730 0	0 0
CHESTER NO 1-33	SANGUINE, LTD	33-12-21	3,102 0	1,231,531 0	170,761 0
SPURLOCK NO 1	P C.X CORPORATION	35-12-21	400 0		
RUSSELL ESTATE NO 1-35	GHK COMPANY	35-12-21	18 0	27,029 0	0 0
MERRICK NO 3	APACHE CORPORATION	1-12-22	3,050 0	3,373,219 0	101,831 0
WESNER NO 1-1	APACHE CORPORATION	1-12-22	6,628 0	842,310 0	294,847 0
WALTER MERRICK NO 4-2	DYCO PETROLEUM CORPORATION	2-12-22	1,326 0		
W F MERRICK NO 2-2	APACHE CORPORATION	2-12-22	2,300 0	1,925,078 0	48,291 0
MERRICK NO 1-3	NATOMAS NORTH AMERICA, INC	3-12-22	8,101 0	837,919 0	22,636 0
MERRICK NO 1-10	SOUTHPORT EXPLORATION, INC	10-12-22	2,520 0	681,462 0	17,016 0
MERRICK NO 1-11	APACHE CORPORATION	11-12-22	1,200 0	295,600 0	10,643 0
MERRICK NO 1	MOBIL OIL CORPORATION	12-12-22		279,154 0	156,372 0
THORNTON "A" NO 1-13	HORIZON OIL & GAS CO OF TEXAS	13-12-22	2,170 0	1,710,120 0	141,106 0
HEFNER NO 1-15	GHK COMPANY	15-12-22		11,958 0	0 0
KENNEDY NO 1-16	GHK COMPANY	16-12-22		1,331,283 0	219 7
SIMMONS NO 2	NATOMAS NORTH AMERICA, INC	17-12-22	1,900 0	627,500 0	17,761 0
FOWLER NO 1-18	GHK COMPANY	18-12-22	75 0	33,464 0	0 0
RHOTON NO 1-19	DYCO PETROLEUM CORPORATION	19-12-22	462 0	341,799 0	9,693 0
POTTER STATE NO 1-20	APACHE CORPORATION	20-12-22	4,100 0	2,527,261 0	101,923 0
THURMOND NO 2-21	NATOMAS NORTH AMERICA, INC	21-12-22	1,250 0	1,398,340 0	9,793 0
MERRICK NO 1-22	DYCO PETROLEUM CORPORATION	22-12-22	5,000 0	2,890,530 0	77,496 0
MERRICK NO 2-22	DYCO PETROLEUM CORPORATION	22-12-22	1,050 0	218,098 0	141,340.0
HEFNER NO 1-23	GHK COMPANY	23-12-22	789 0		
MERRICK NO 1-25	APACHE CORPORATION	25-12-22	974 0	463,235 0	25,161 0
FOWLER NO 1	APEXCO, INC	26-12-22	1,740 0	4,532,011 0	279,491 0
THURMOND NO 1-27	GHK COMPANY	27-12-22	11,300 0	11,473,688 0	855,042 0
THURMOND NO 2-27	APACHE CORPORATION	27-12-22	8,046 0	1,268,049 0	434,415 0
MERRICK NO 1-28	GHK COMPANY	28-12-22	14,200 0	8,181,612 0	662,044 0
MERRICK NO 2-28	APACHE CORPORATION	28-12-22	5,214 0	100,280 0	17,561 0
SIMMONS NO.1-29	DYCO PETROLEUM CORPORATION	29-12-22	4,479 0	4,727,280.0	181,315 0
SIMMONS NO 2-30	APACHE CORPORATION	30-12-22	979 0	259,021 0	28,927 0
SIMMONS NO 1-30	APACHE CORPORATION	30-12-22	350.0	27,084.0	0 0
TERRY NO 1-32	SAMSON RESOURCES COMPANY	32-12-22	4,063 0	286,114.0	1,530 0
PRESTON NO 1-32	APACHE CORPORATION	32-12-22	556.0	1,776,130 0	63,018 0
REUBIN POTTER NO 1	EL PASO NATURAL GAS COMPANY	33-12-22	623.0	7,030,395.0	396,693 0
NANCY POTTER NO 1-33	MERIDIAN OIL PRODUCTION, INC.	33-12-22	1,700 0	584,003 0	281,004 0
K C CATTLE COMPANY NO 1-34	GHK COMPANY	34-12-22	12,000 0	16,762,729 0	677,099 0
JONES NO 3-35	APACHE CORPORATION	35-12-22	4,999 0	1,449,931 0	203,689 0

TABLE II (Continued)

LEASE NAME	OPERATOR	S -T -R	I P IN MCF	CUM PROD. 7/1/90	PROD. 1-7/1/90
JONES NO 2-35	GHK COMPANY	35-12-22	1,500.0	4,170,872 0	112,656 0
PAUL JONES NO 1-36	GHK COMPANY	36-12-22	718 0	431,138 0	32,151 0
TAYLOR NO 2-1	APACHE CORPORATION	1-12-23	2,891 0		
TAYLOR NO 1	APACHE CORPORATION	1-12-23	1,500 0	3,825,491 0	203,503 0
TAYLOR NO 1-2	NATOMAS NORTH AMERICA, INC	2-12-23	1,817 0	3,476,295 0	168,049 0
BOGGS NO 1-X	COTTON PETROLEUM CORPORATION	3-12-23	1,920.0	845,634 0	80,475 0
SPROWLS NO 2-5	APACHE CORPORATION	5-12-23	9,340 0	223,227 0	223,227 0
SPROWLS NO 1-5	APACHE CORPORATION	5-12-23	1,570 0	731,437 0	44,143 0
PAYNE NO 1-88	SOHIO PETROLEUM COMPANY	8-12-23	350.0	237,294 0	32,035 0
TAYLOR-NEWMAN NO 1	APEXCO, INC.	10-12-23	2,659 0	501,601 0	0 0
J TAYLOR NO.1-11	NATOMAS NORTH AMERICA, INC	11-12-23	5,030 0	909,930 0	27,677 0
TAYLOR NO 1-15	APACHE CORPORATION	15-12-23	630.0	237,192 0	10,072 0
JENCKS NO 1-18	DYCO PETROLEUM CORPORATION	18-12-23	2,600 0	33,036 0	7,987 0
BAKER NO 2-28	DYCO PETROLEUM CORPORATION	28-12-23	344 0	39,757 0	15,839 0
ARSTRONG NO 1-29	AMEREX, INC	29-12-23	556 0	30,719 0	12,124 0
HANNI NO 1-1	DYCO PETROLEUM CORPORATION	1-12-24	610 0	493,715 0	16,889 0
THURMOND NO 6	EL PASO NATURAL GAS COMPANY	4-12-24	404 0	48,498 0	0 0
BOWERS STATE NO 1	APEXCO, INC.	11-12-24	1,340 0	630,892 0	8,587 0
WILLIAMS NO 1-1	D-I ENERGY, INC	1-13-19	570 0	383,800.0	70,984 0
LEE J SMITH NO 1-1	D-I ENERGY, INC	1-13-19	1,142 0	1,368,130 0	113,852 0
MC LAUGHLIN NO 1-2	D-I ENERGY, INC	2-13-19	3,601 0	1,465,038 0	248,565 0
FRAZIER NO 1-2	D-I ENERGY, INC	2-13-19	3,432 0	2,622,437 0	240,309 0
MCLAUGHLIN NO 2-3	WARD PETROLEUM CORPORATION	3-13-19	183 0	23,106 0	2,904 0
KIKER NO 1	D-I ENERGY, INC.	3-13-19	500 0	1,422,961 0	58,752 0
NICHOLS NO 1-4	READING & BATES PETROLEUM COMPANY	4-13-19	1,050 0	355,714 0	24,278 0
FLAMING NO 1-5	READING & BATES PETROLEUM COMPANY	5-13-19	600 0	358,278 0	12,290 0
DAUGHERTY NO 1-9	INEXCO OIL COMPANY	9-13-19	2,020 0	164,534 0	0 0
BAKER NO 1-10	MESA PETROLEUM COMPANY	10-13-19	850 0	595,036 0	29,453 0
CARPENTER NO 1	READING & BATES PETROLEUM COMPANY	11-13-19	1,000 0	385,539 0	11,309 0
KLEIN NO 1-12	READING & BATES PETROLEUM COMPANY	12-13-19	700 0	422,709 0	28,824 0
NEWCOMB NO 13-1	INTERNORTH, INC	13-13-19	1,277 0	344,736 0	15,115 0
U S A WOLLMAN NO 1-18	INEXCO OIL COMPANY	18-13-19	824 0	493,835 0	32,122 0
U S A NO 1-19	EL PASO NATURAL GAS COMPANY	19-13-19	2,300 0	3,060,419 0	177,511 0
BAKER NO 1	CONTINENTAL RESOURCES CORPORATION	21-13-19	2,702 0	451,322.0	10,654 0
IRENE S JONES NO 1	SUN OIL COMPANY	25-13-19	412 0	331,438 0	28,573 0
FEDERAL NO 29-1	TXO PRODUCTION CORPORATION	29-13-19	1,100 0	589,698 0	19,983 0
U S A MILFORD NO 1-30	INEXCO OIL COMPANY	30-13-19	4,807 0	5,212,310 0	206,324 0
BADEN NO 1-30	LOUISIANA LAND & EXPLORATION CO	30-13-19	5,100 0	2,023,895 0	268,841 0
YOUNG "Y" NO 1	TXO PRODUCTION CORPORATION	31-13-19	4,550 0	934,162 0	128,167 0
YOUNG STATE NO 1	EL PASO NATURAL GAS COMPANY	31-13-19	1,116 0	342,516 0	11,837 0
MOUSE NO 1-32	BERRY PETROLEUM CORPORATION	32-13-19	550 0	545,420 0	31,962 0
LONG NO 1-2	INEXCO OIL COMPANY	2-13-20	815 0	350,308 0	9,903 0
CLIFT NO 1-3	AN-SON CORPORATION	3-13-20	3,766 0	1,228,469 0	40,490 0
FLYNT NO 1-4	AN-SON CORPORATION	4-13-20	360 0	103,179 0	4,922 0
ISAAC NO 1 5	COPELAND ENERGY CORPORATION	5-13-20	495 0	119,297 0	2,740 0
STINSON NO 1-6	HELMERICH & PAYNE, INC	6-13-20	3,003 0	724,900 0	22,958 0
DEAN NO 1-9	AN-SON CORPORATION	9-13-20	519 0	121,119 0	0 0
WHITE NO 1-11	INEXCO OIL COMPANY	11-13-20	926 0	421,147 0	14,558 0
NEIL NO 1-12	AN-SON CORPORATION	12-13-20	300 0	262,143 0	8,816 0
PAULINE NO 13-1	ESCO EXPLORATION, INC	13-13-20	368 0	35,736 0	2,255 0
TIPPENS NO 14-1	SANTA FE MINERALS, INC.	14-13-20	140 0		
GWARTNEY NO 1-17	AN-SON CORPORATION	17-13-20	150.0	113.0	0 0
K C. CATTLE COMPANY NO 1-19	DONALD C SLAWSON	19-13-20	315 0	69,445 0	15,167 0
TIPPENS NO 1-21	STEVE JERNIGAN, INC	21-13-20	2,000 0	655,570.0	0 0
TIPPEN NO 1-22	SOUTHEAST EXPLORATION CORPORATION	22-13-20	2,700 0	589,871 0	27,083 0
UPSHER NO 1-23	INEXCO OIL COMPANY	23-13-20	400 0	140,029 0	6,595 0
RAY NO 1-23	INEXCO OIL COMPANY	23-13-20	631 0	49,881 0	14,670 0
SEARCEY RAMONA NO 2-24	LOUISIANA LAND & EXPLORATION CO	24-13-20	3,533 0	73,449 0	73,449 0
SNIDER NO 1-24	LOUISIANA LAND & EXPLORATION CO	24-13-20	560 0	157,993 0	14,534 0
RAMONA SEARCY NO 1-24	INEXCO OIL COMPANY	24-13-20	4,668 0	7,232,695 0	247,404 0
CLARK NO 1-25	INEXCO OIL COMPANY	25-13-20	2,255 0	3,344,538 0	119,462 0
CLARK-STATE NO 2-26	SANGUINE, LTD	26-13-20	2,852 0	815,894 0	60,537 0
RAY CLARK NO 26-1	PORTS OF CALL OIL COMPANY	26-13-20	200 0	259,050 0	11,936 0

TABLE II (Continued)

LEASE NAME	OPERATOR	S -T -R	I P IN MCF	CUM PROD. 7/1/90	PROD. 1-7/1/90
MC REYNOLDS NO 1-28	STEVE JERNIGAN, INC	28-13-20	100.0		
K C. CATTLE COMPANY NO 1-30	APACHE CORPORATION	30-13-20	1,400 0	323,187 0	11,329 0
J.P THURMOND NO.1-31	APACHE CORPORATION	31-13-20	950.0	44,213 0	0 0
THURMOND NO 1-32	GHK COMPANY	32-13-20	2,800 0	977,345 0	33,879 0
K C. CATTLE COMPANY NO 1-33	GHK COMPANY	33-13-20	2,700 0	1,258,527 0	61,751 0
POWERS NO 1	EL PASO NATURAL GAS COMPANY	34-13-20	189 0	16,217 0	0 0
HINKLE NO 1-36	INEXCO OIL COMPANY	36-13-20	3,550 0	2,327,404 0	81,218 0
TOWN OF HAMMON	HAWKINS OIL & GAS, INC	1-13-21	1,550 0	745,374 0	33,114 0
BLOUNT NO 1-2	AVANTI ENERGY CORPORATION	2-13-21	1,122 0	172,011 0	461 0
BONNIE NO 1	COTTON PETROLEUM CORPORATION	3-13-21	1,600 0	681,307 0	32,507 0
ALLEE NO 1	COTTON PETROLEUM CORPORATION	4-13-21	7,000 0	2,714,513 0	128,364 0
LAURENCE NO 1	COTTON PETROLEUM CORPORATION	5-13-21	1,225 0	965,625 0	44,644 0
LESTER NO 1-6	TENNECO OIL COMPANY	6-13-21	5 0		
RATCLIFF NO 1-7	TENNECO OIL COMPANY	7-13-21	1,000 0	602,564 0	18,081 0
RANCH NO 1	COTTON PETROLEUM CORPORATION	8-13-21	6,140 0	4,321,742 0	168,008 0
ALLEE NO 2-9	THOMAS F MARSH, INC	9-13-21	2,572 0	768,943 0	56,359 0
ALLEE NO 9-1	HNG OIL COMPANY	9-13-21	1 0	24,165 0	0 0
STEPHENS NO 1-10	LOUISIANA LAND & EXPLORATION CO	10-13-21	1,126 0		
SAVAGE NO 10-1	HNG OIL COMPANY	10-13-21	700 0	37,072 0	0 0
OPAL NO 1-11	LOUISIANA LAND & EXPLORATION CO	11-13-21	1,462 0		
HEATHER NO 14-1	SANTA FE MINERALS, INC	14-13-21	2,796 0	386,276 0	138,194 0
HEATHER NO 15-1	SANTA FE MINERALS, INC	15-13-21	410 0	103,487 0	49,601 0
SAVAGE-CRANE NO 1-16	THOMAS F MARSH, INC	16-13-21	5,288 0	1,949,607 0	153,455 0
"A" CROSS RANCH NO 1	DAVIS OIL COMPANY	16-13-21	762 0	321,082 0	22,573 0
GWARTNEY NO 1-17	TENNECO OIL COMPANY	17-13-21	1,900 0	413,394 0	57,442 0
ALLEN NO 2-17	MESA OPERATING	17-13-21	1,678 0		
ALLEN NO 1-17	TENNECO OIL COMPANY	17-13-21	4,950 0	3,714,132 0	213,750 0
RATCLIFF NO 1	EL PASO NATURAL GAS COMPANY	18-13-21	2,044 0	234,620 0	26,411 0
ALLEN NO 2-19	TENNECO OIL COMPANY	19-13-21	5,015 0	362,266 0	34,884 0
ALLEN NO 1-19	TENNECO OIL COMPANY	19-13-21	3,829 0	1,948,765 0	51,850 0
ALLEN NO 1-20	MARSH OPERATING COMPANY	20-13-21	1,114 0	794,222 0	258,711 0
COTTON NO 1	COTTON PETROLEUM CORPORATION	21-13-21	467 0		
ELMER NO 1-23	OXLEY PETROLEUM	23-13-21	200 0	9,639 0	2,447 0
TRENT NO 1-24	OXLEY PETROLEUM	24-13-21	1,931 0	191,603 0	59,890 0
BURROWS NO 1	APACHE CORPORATION	29-13-21	4,000 0	923,515 0	27,885 0
A CROSS RANCH "B" NO 1	CITIES SERVICE COMPANY	30-13-21	1,100 0	400,050 0	17,038 0
MERRICK NO 4-31	APACHE CORPORATION	31-13-21	2,160 0	411,225 0	9,889 0
LINVILLE NO 1	APACHE CORPORATION	32-13-21	600 0	1,547,638 0	72,488 0
BURROWS NO 1-33	MAXUS EXPLORATION	33-13-21	3,335 0	418,890 0	320,043 0
BRITE KATIE ET AL NO 1-34	MAXUS EXPLORATION	34-13-21	197 0		
BAKER NO 1-35	AMEREX, INC	35-13-21	333 0	194,439 0	9,012 0
FRANCINE NO 1	DAVIS OIL COMPANY	1-13-22	159 0	37,554 0	4,668 0
MERRICK NO 1 3	TENNECO OIL COMPANY	3-13-22	3,134 0	1,804,845 0	91,738 0
MERRICK NO 2-4	TENNECO OIL COMPANY	4-13-22	3,607 0	490,636 0	5,761 0
BRADSHAW NO 1-5	TENNECO OIL COMPANY	5-13-22	327 0	62,482.0	3,532 0
BLAIR PAYNE NO 1-8	TENNECO OIL COMPANY	8-13-22	3,286 0	1,907,307 0	108,277 0
MERRICK NO 1-9	TENNECO OIL COMPANY	9-13-22	2,100 0	870,239 0	28,328 0
MERRICK NO 1-10	TENNECO OIL COMPANY	10-13-22	1,762.0	108,052.0	864 0
MOORE NO 1-10	MESA OPERATING	10-13-22	1,200 0	215,105.0	55,359 0
KELLY K ALLEN NO 1	DYCO PETROLEUM CORPORATION	11-13-22	461 0	529,841 0	275,281 0
K K NO 1	SAMSON RESOURCES COMPANY	11-13-22	2,093 0	303,176 0	148,104 0
SHELTON-STATE NO 1	DAVIS OIL COMPANY	12-13-22	3,814 0	2,456,860.0	76,705 0
DODSON NO 1	P C X. CORPORATION	13-13-22	3,500 0	1,108,590 0	38,459 0
SHELTON NO 1A-14	READING & BATES PETROLEUM COMPANY	14-13-22	1,550 0	1,417,504 0	52,816 0
CHAPMAN NO 2-15	TENNECO OIL COMPANY	15-13-22	5,850 0	3,031,523 0	68,935 0
PYATT NO 1-16	GRACE PETROLEUM CORPORATION	16-13-22	100 0	901,434 0	25,468 0
CONCHO NO 1-16	GRACE PETROLEUM CORPORATION	16-13-22	2,600 0	78,380.0	78,380 0
NISTLER NO 2-17	READING & BATES PETROLEUM COMPANY	17-13-22	2,188 0	1,942,381 0	83,629 0
SMITH NO 1-19	TENNECO OIL COMPANY	19-13-22	1,400 0	752,481 0	23,021 0
SMITH NO 2-19	MESA OPERATING	19-13-22	1,327 0		
CRONIN NO 1A-20	READING & BATES PETROLEUM COMPANY	20-13-22	4,000 0	1,729,690 0	45,005 0
PUFFINBARGER NO 2-20	READING & BATES PETROLEUM COMPANY	20-13-22	3,776 0	956,425 0	109,202 0
JASON NO 1-21	GRACE PETROLEUM CORPORATION	21-13-22	6,500 0	5,915,924 0	335,333 0

TABLE II (Continued)

LEASE NAME	OPERATOR	S -T -R	I P IN MCF	CUM PROD. 7/1/90	PROD. 1-7/1/90
BOGGES NO 1-21	GRACE PETROLEUM CORPORATION	21-13-22	3,000 0	507,721 0	57,310 0
BOGGES NO 2-21	GRACE PETROLEUM CORPORATION	21-13-22	1,028.0	68,327 0	68,327 0
CHAPMAN NO 1-22	HELMERICH & PAYNE, INC	22-13-22	3,766 0	709,868 0	213,929.0
BOGGES NO 1	HELMERICH & PAYNE, INC	22-13-22	401 0	237,944 0	18,257 0
MORTON NO 1-23	HELMERICH & PAYNE, INC	23-13-22	3,108 0	209,312 0	209,312 0
CALVERT NO 1-23	SANTA FE ENERGY COMPANY	23-13-22	595 0	537,533 0	19,460 0
ALLEN NO 1-24	TENNECO OIL COMPANY	24-13-22	3,287 0	235,628.0	35,505 0
WALKER NO 1	P C.X CORPORATION	24-13-22	3,000 0	495,284 0	12,229 0
MORTON NO 1-25	GHK COMPANY	25-13-22	1,200 0	518,219 0	24,716 0
CALVERT NO 1-26	READING & BATES PETROLEUM COMPANY	26-13-22	695.0	179,633.0	7,943 0
SAVAGE NO 1-27	HELMERICH & PAYNE, INC.	27-13-22	2,750 0	41,878 0	0 0
BOGGES NO 1-28	INEXCO OIL COMPANY	28-13-22	245 0	101,275 0	2,066 0
RUTH NO 1-28	LOUISIANA LAND & EXPLORATION CO	28-13-22	9,900 0	1,368,088 0	493,931 0
BOGGES NO 1-29	SABINE PRODUCTION COMPANY	29-13-22	550 0	659,401 0	12,652 0
BOGGESS NO 2-29	SABINE PRODUCTION COMPANY	29-13-22	6,100 0	2,508,923 0	89,205 0
CALVERT NO 1-30	DYCO PETROLEUM CORPORATION	30-13-22	2,300 0	304,966 0	193,655 0
EVANS NO 1-30	APACHE CORPORATION	30-13-22	6,800 0	9,255,748 0	218,699 0
VICK NO 1	APACHE CORPORATION	31-13-22	5,700 0	4,142,439 0	89,376 0
VICK NO 2-31	APACHE CORPORATION	31-13-22	9,464 0	2,965,683 0	116,342 0
STATE NO 1-32	APACHE CORPORATION	32-13-22	2,950 0	3,680,321 0	106,189 0
JONES NO 1-34	INEXCO OIL COMPANY	34-13-22	480 0	54,320 0	847 0
LACKEY-ALLEN NO 1-35	HORIZON OIL & GAS CO OF TEXAS	35-13-22	1,300 0	2,551,287 0	179,593 0
A CROSS RANCH "A" NO 1	CITIES SERVICE COMPANY	36-13-22	1,900 0	1,527,769 0	123,218 0
SCHOU NO 1-21	HADSON PETROLEUM CORPORATION	21-13-23	1,833 0	1,325,588 0	81,050 0
SCHOU NO 1-22	MC MORAN-FREEPORT OIL COMPANY	22-13-23	723 0	243,666 0	10,979 0
FRANCES NO 1-22	AN-SON CORPORATION	22-13-23	3,253 0	630,697 0	91,284 0
LEEROY NO 1	DAVIS OIL COMPANY	24-13-23	2,250 0	298,803 0	3,777 0
SPROWLS NO 1	APACHE CORPORATION	25-13-23	1,100 0	39,434 0	0 0
SPROWLS NO 2-27	HADSON PETROLEUM CORPORATION	27-13-23	4,575 0	1,054,588 0	102,785 0
SPROWLS NO 1-27	HADSON PETROLEUM CORPORATION	27-13-23	653 0	336,910 0	15,035 0
SPROWLS NO 4-28	ROSEWOOD RESOURCES, INC	28-13-23	3,000 0	419,713 0	73,161 0
SPROWLS NO 3-28	AN-SON CORPORATION	28-13-23	7,226 0	2,289,581 0	109,004 0
SPROWLS NO 2-28	AN-SON CORPORATION	28-13-23	780 0	2,666,007 0	91,283 0
NELLIE ANN NO 2-29	BP EXPLORATION	29-13-23	600 0	237,993 0	86,709 0
NELLIE ANN NO 1 29	MC MORAN-FREEPORT OIL COMPANY	29-13-23	16,200 0	5,548,381 0	596,420 0
JENCKS NO 1-31	EL PASO NATURAL GAS COMPANY	31-13-23	1,699 0	1,029,584 0	25,118 0
CROSS NO 3-32	APACHE CORPORATION	32-13-23	645 0	107,478 0	11,336 0
DEAN CROSS NO 1-32	APACHE CORPORATION	32-13-23	2,650 0	1,902,393 0	70,899 0
SPROWLS NO 2-33	APACHE CORPORATION	33-13-23	4,426 0	363,261 0	234,854 0
SPROWLS NO 1-33	APACHE CORPORATION	33-13-23	3,300 0	2,858,772 0	108,637 0
SPROWLS NO 2-34	APACHE CORPORATION	34-13-23	1,750 0	285,531 0	0 0
SASHA NO 1-35	PARK AVENUE EXPLORATION	35-13-23	375.0		
BRICE NO 1-35	AN-SON CORPORATION	35-13-23	5,781 0	1,154,824 0	135,786 0
SCHOU NO 1-36	SOHIO PETROLEUM COMPANY	36-13-23	400 0		
LIPPENCOTT NO 1	HOOVER & BRACKEN ENERGIES, INC	4-13-24	1,250.0	602,695 0	13,582 0
GRIFFIN NO 1-9	TENNECO OIL COMPANY	9-13-24	1,100 0	507,800 0	13,362 0
STATE NO 2-10	HELMERICH & PAYNE, INC	10-13-24	2,380 0	679,308 0	35,897 0
THURMAN RANCH NO 1-24	SUN OIL COMPANY	24-13-24	550 0	195,234 0	23,377 0
THURMOND NO 2-26	APACHE CORPORATION	26-13-24	11,750 0	2,256,290 0	57,296 0
THURMOND NO 1-36	APACHE CORPORATION	36-13-24	4,410 0	1,410,631 0	31,312 0
CLIFT NO 4-2	LEEDE OIL & GAS, INC	4-14-19	1,300 0	2,146,989 0	183,324 0
CLIFT NO 1-4	SEARCH DRILLING COMPANY	4-14-19	2,469 0	1,186,457 0	101,191 0
RAY NO 5-1	WOODS PETROLEUM CORPORATION	5-14-19	3,700 0	1,039,588 0	26,002 0
NEWCOMB NO 1-7	SANTA FE MINERALS, INC	7-14-19	216 0	47,399 0	2,327 0
GILBERT NO 1-10	INEXCO OIL COMPANY	10-14-19	1,510 0	502,730 0	17,077 0
VERNARD NO 1-11	INEXCO OIL COMPANY	11-14-19	2,300 0	905,042 0	23,486 0
NEWCOMB NO 1-17	INEXCO OIL COMPANY	17-14-19	712 0	338,110 0	5,377 0
NEWCOMB NO 2-18	BRISTOL RESOURCES	18-14-19	1,824 0	682,253 0	145,793 0
NEWCOMB NO 1-18	SANTA FE MINERALS, INC	18-14-19	163 0	600,180 0	68,485 0
HUBBART NO 1	C F BRAUN & COMPANY	19-14-19	3,100 0	2,341,671 0	130,602 0
NOBLE NO 1-20	INEXCO OIL COMPANY	20-14-19	345 0	1,231,996 0	48,681 0
FRANSEN NO 1-25	SANTA FE MINERALS, INC	25-14-19	575 0	666,247 0	30,359 0
FRANSEN FARMS NO 1-26	ONEOK RESOURCES COMPANY	26-14-19	2,408 0	714,503 0	55,805 0
MULLINS NO 1-33	READING & BATES PETROLEUM COMPANY	33-14-19	1,200 0	718,993 0	17,679 0

TABLE II (Continued)

LEASE NAME	OPERATOR	S -T -R	I P IN MCF	CUM PROD 7/1/90	PROD 1-7/1/90
MULLINS NO 1-34	READING & BATES PETROLEUM COMPANY	34-14-19	1,013 0	1,848,189 0	79,080 0
GOODALL NO 1-35	READING & BATES PETROLEUM COMPANY	35-14-19	5,400 0	2,645,697 0	133,486 0
WALKER NO 2-35	READING & BATES PETROLEUM COMPANY	35-14-19	3,356 0	2,044,382 0	370,713 0
KLEIN NO 1-36	SANTA FE MINERALS, INC	36-14-19	840 0	1,064,124 0	68,325 0
ROBERT E LEE NO 1	SABINE PRODUCTION COMPANY	7-14-20	180 0		
HOLDER NO 1-10	INEXCO OIL COMPANY	10-14-20	444 0	188,621 0	8,514 0
JOHNSON NO 1-11	DONALD C SLAWSON	11-14-20	1,275 0	537,424 0	24,552 0
ARTHUR NEWCOMB NO 1-13	INEXCO OIL COMPANY	13-14-20	1,100 0	399,657 0	22,253 0
KELLEY NO 1-14	INEXCO OIL COMPANY	14-14-20	1,995 0	969,514 0	48,034 0
MC CLURE NO 1-15	INEXCO OIL COMPANY	15-14-20	800 0	977,551 0	31,476 0
LEE 17 NO 1	INTERNORTH, INC	17-14-20	1,400 0	873,824 0	42,699 0
LEE "A" 18 NO 1	INTERNORTH, INC	18-14-20	868 0	474,284 0	14,341 0
FLICK NO 1-19	INEXCO OIL COMPANY	19-14-20	7,289 0	3,444,801 0	103,056 0
HODGE FARMS NO 1-20	LOUISIANA LAND & EXPLORATION CO	20-14-20	856 0	146,169 0	6,792 0
HODGE NO 1-20	INEXCO OIL COMPANY	20-14-20	2,600 0	727,991 0	29,214 0
SMITH B-21 NO 2	ENRON OIL & GAS CORPORATION	21-14-20	700 0		
SMITH "B" 21 NO 1	INTERNORTH, INC	21-14-20	2,480 0	622,881 0	22,492 0
LONG NO 1-22	ENRON OIL & GAS CORPORATION	22-14-20	900 0		
HODGE NO 22-1	INTERNORTH, INC	22-14-20	1,325 0	669,575 0	88,874 0
GWARTNEY NO 1-23	INEXCO OIL COMPANY	23-14-20	2,545 0	983,823 0	150,619 0
FANCHER NO 1-24	DONALD C SLAWSON	24-14-20	1,900 0	1,454,252 0	81,844 0
DAVIS 7 FARMS, INC NO 1-26	WOODS PETROLEUM CORPORATION	26-14-20	2,200 0	786,921 0	41,777 0
HODGE NO 1	LEEDE OIL & GAS, INC	27-14-20	76 0		
BLACKWOLF NO 28-2	ENRON OIL & GAS CORPORATION	28-14-20	1,900 0	29,589 0	29,589 0
BLACKWOLF 28 FEDERAL NO 1	ENRON OIL & GAS CORPORATION	28-14-20	2,068 0	1,099,214 0	103,850 0
FLYNT NO 1-28	HOOVER & BRACKEN ENERGIES, INC	28-14-20	900 0	2,508,343 0	47,141 0
REDMOON INDIAN RES NO 1-29	READING & BATES PETROLEUM COMPANY	29-14-20	3,156 0	2,099,898 0	78,402 0
HUGHES NO 2-29	READING & BATES PETROLEUM COMPANY	29-14-20	10,750 0	2,243,909 0	266,117 0
"A" CROSS RANCH NO 1-30	ZINKE & TRUMBO, LTD	30-14-20	750 0	606,944 0	20,334 0
MENNONITE NO 1-31	HELMERICH & PAYNE, INC	31-14-20	1,420 0	296,506 0	11,293 0
INDIAN SCHOOL NO 1-32	READING & BATES PETROLEUM COMPANY	32-14-20	2,100 0	725,774 0	30,677 0
DORIS FLYNT NO 1	HARPER OIL COMPANY	33-14-20	882 0	488,787 0	37,618 0
RED SANDS NO 1-34	INEXCO OIL COMPANY	34-14-20	708 0	100,299 0	21 0
VIGNAL NO 1-35	INEXCO OIL COMPANY	35-14-20	320 0	132,495 0	4,076 0
DYKES NO 1-6	INEXCO OIL COMPANY	6-14-21	8,700 0	4,847,053 0	186,714 0
FARNI NO 2-7	LOUISIANA LAND & EXPLORATION CO	7-14-21	1,572 0	95,047 0	79,784 0
FARNI NO 1-7	INEXCO OIL COMPANY	7-14-21	1,450 0	1,504,892 0	56,873 0
PORTERFIELD NO 1-8	INEXCO OIL COMPANY	8-14-21	1,396 0	638,685 0	30,995 0
BAKER NO 1-9	INEXCO OIL COMPANY	9-14-21	2,775 0	165,485 0	1,131 0
LOVELACE NO 1-11	HELMERICH & PAYNE, INC	11-14-21	1,037 0	305,813 0	16,321 0
BOAL NO 1-14	DAVIS OIL COMPANY	14-14-21	1,584 0	426,844 0	15,390 0
HUGHES NO 1-16	INEXCO OIL COMPANY	16-14-21	1,820 0	391,871 0	18,530 0
HUGHES NO 17-1	WOODS PETROLEUM CORPORATION	17-14-21	2,600 0	1,036,860 0	29,415 0
LAMB NO 18-1	WOODS PETROLEUM CORPORATION	18-14-21	1,100 0	822,607 0	39,576 0
GASS NO 20-1	WOODS PETROLEUM CORPORATION	20-14-21	2,050 0	565,327 0	16,895 0
FARNI NO 1-21	HELMERICH & PAYNE, INC	21-14-21	2,203 0	682,721 0	46,492 0
HUGHES NO 1-22	DONALD C SLAWSON	22-14-21	353 0	75,302 0	2,551 0
CRIBBS NO 1-23	DONALD C SLAWSON	23-14-21	1,250 0	55,425 0	0 0
WILLIAMSON NO 1-24	INEXCO OIL COMPANY	24-14-21	2,418 0	1,724,269 0	71,660 0
WILLIAMSON NO 1-25	NATOMAS NORTH AMERICA, INC	25-14-21	1,680 0	1,263,688 0	41,190 0
SAVAGE NO 1-27	APACHE CORPORATION	27-14-21	1,600 0	546,240 0	20,529 0
HARDEN NO 1-28	APACHE CORPORATION	28-14-21	1,643 0	531,366 0	21,379 0
HARDEN NO 2-29	APACHE CORPORATION	29-14-21	545 0	411,925 0	19,455 0
HARDEN NO 1-30	DONALD C SLAWSON	30-14-21	2,386 0	2,185,967 0	104,589 0
HARDEN NO 1-31	DONALD C SLAWSON	31-14-21	447 0	499,826 0	28,515 0
LOVELACE NO 1-31	DONALD C SLAWSON	31-14-21	490 0	79,111 0	2,474 0
RUTHER NO 1-32	APACHE CORPORATION	32-14-21	259 0	187,382 0	12,040 0
NOBLITT NO 1-33	VIERSEN & COCHRAN	33-14-21	980 0	943,215 0	39,605 0
WOODHOUSE NO 1-34	VIERSEN & COCHRAN	34-14-21	3,000 0	920,705 0	24,469 0
HOLLINGSWORTH NO 1-35	VIERSEN & COCHRAN	35-14-21	529 0	502,116 0	18,775 0
DUPREE NO 1-36	ZINKE & TRUMBO, LTD	36-14-21	2,700 0	1,548,746 0	75,621 0
SAVAGE NO 1	INEXCO OIL COMPANY	1-14-22	3,596 0	1,772,387 0	85,806 0
SAVAGE NO 2-1	LOUISIANA LAND & EXPLORATION CO	1-14-22	1,800 0	335,145 0	177,126 0
MOONEY "A" NO 1	TXO PRODUCTION CORPORATION	2-14-22	4,810 0	2,224,564 0	101,324 0

TABLE II (Continued)

LEASE NAME	OPERATOR	S -T -R	I P IN MCF	CUM PROD. 7/1/90	PROD 1-7/1/90
GATES "D" NO 1	TXO PRODUCTION CORPORATION	2-14-22	1,940 0	671,672 0	130,810 0
CORDUM "B" NO 1	TXO PRODUCTION CORPORTION	2-14-22	3,100 0	1,545,202 0	114,787 0
GATES NO 1-3	INEXCO OIL COMPANY	3-14-22	610 0	1,588,463 0	53,859 0
ILENE NO 2-4	INEXCO OIL COMPANY	4-14-22	3,100 0	1,478,333 0	61,124 0
MERRICK "C" NO 1	TXO PRODUCTION CORPORATION	5-14-22	1,020 0	494,475 0	22,456 0
NANNETTE NO 1-6	INEXCO OIL COMPANY	6-14-22	1,355 0	249,818 0	9,246 0
HENDERSHOT NO 1-8	POGO PRODUCING COMPANY	8-14-22	928 0	467,574 0	30,878 0
HAY NO 1-9	POGO PRODUCING COMPANY	9-14-22	300 0		
CLOVIS NO 1-10	INEXCO OIL COMPANY	10-14-22	400 0	398,614 0	15,112 0
LAMB NO 1-11	INEXCO OIL COMPANY	11-14-22	3,420 0	1,645,719 0	85,441 0
CLOVIS MILLER NO 1-12	LOUISIANA LAND & EXPLORATION CO	12-14-22	700 0	56,006 0	21,213 0
CORDUM NO 12-1	WOODS PETROLEUM CORPORATION	12-14-22	1,735 0	517,387 0	10,852 0
WILSON NO 1-13	INEXCO OIL COMPANY	13-14-22	1,530 0	251,249 0	1,342 0
MILLER "A-B" NO 1	TXO PRODUCTION CORPORATION	14-14-22	1,336 0	674,070 0	41,227 0
MILLER NO 1-15	INEXCO OIL COMPANY	15-14-22	1,350 0	350,895 0	14,869 0
DAVIS NO 1-16	INEXCO OIL COMPANY	16-14-22	760 0	120,308 0	65,798 0
KIMSEY NO 1-17	INEXCO OIL COMPANY	17-14-22	5,544 0	2,865,340 0	139,065 0
KIMSEY NO 2-17	MERIDIAN OIL PRODUCTION, INC	17-14-22	994 0		
ROGER MILLS NO 1-18	INEXCO OIL COMPANY	18-14-22	1,750 0	2,851,476 0	108,380 0
CAFFEY NO 19-1	WOODS PETROLEUM CORPORATION	19-14-22	2,100 0	376,780 0	54,565 0
TUNE NO 20-1	WOODS PETROLEUM CORPORATION	20-14-22	1,900 0	1,595,093 0	157,649 0
GOVIE MILLER NO 1	SUN OIL COMPANY	21-14-22	1,683 0	3,676,958 0	245,743 0
GOVIE MILLER NO 2	ORYX ENERGY	21-14-22	730 0	27,779 0	27,779 0
MERRICK NO 1-22	SUN OIL COMPANY	22-14-22	4,200 0	4,834,846 0	468,093 0
W F MERRICK NO 2-22	SUN OIL COMPANY	22-14-22	208 0	267,542 0	132,354 0
MERRICK NO 2-23	MESA OPERATING	23-14-22	2,700 0		
MERRICK NO 1-23	TENNECO OIL COMPANY	23-14-22	2,600 0	968,239 0	52,641 0
TRENT NO 1-24	DONALD C SLAWSON	24-14-22	810 0	612,211 0	40,282 0
TRENT NO 1-25	LOUISIANA LAND & EXPLORATION CO	25-14-22	1,090 0	1,084,906 0	70,388 0
MERRICK NO 1-26	TENNECO OIL COMPANY	26-14-22	2,520 0	1,130,443 0	81,547 0
MERRICK NO 1-27	TENNECO OIL COMPANY	27-14-22	2,908 0	544,802 0	18,115 0
GOVIE MILLER NO 1	EXXON CORPORATION	28-14-22	371 0	94,300 0	8,380 0
GENEVA NO 1-29	INEXCO OIL COMPANY	29-14-22	1,909 0	605,670 0	19,679 0
GWARTNEY NO 2-30	DIAMOND SHAMROCK CORPORATION	30-14-22	3,700 0	59,322 0	2,710 0
GWARTNEY NO 1-30	DIAMOND SHAMROCK CORPORATION	30-14-22	18,000 0	2,729,735 0	64,358 0
MERRICK NO 1-33	TENNECO OIL COMPANY	33-14-22	1,650 0	193,484 0	4,747 0
MERRICK NO 1-34	TENNECO OIL COMPANY	34-14-22	3,000 0	1,367,496 0	69,908 0
MERRICK NO 1-35	TENNECO OIL COMPANY	35-14-22	4,300 0	1,233,994 0	48,414 0
BOULWARE NO 2-36	SOHIO PETROLEUM COMPANY	36-14-22	532 0	167,978 0	42,968 0
BOULWARE NO 1-36	SOHIO PETROLEUM COMPANY	36-14-22	234 0		
WICKHAM NO 1-1	HELMERICH & PAYNE, INC	1-14-23	1,561 0	1,281,885 0	112,521 0
WICKHAM NO 2-1	HELMERICH & PAYNE, INC	1-14-23	3,756 0	330,293 0	166,479 0
WICKHAM NO 2-2	COQUINA OIL CORPORATION	2-14-23	3,700 0	2,205,972 0	133,418 0
GRACE NO 1-2	LOUISIANA LAND & EXPLORATION CO	2-14-23	3,471 0	1,267,604 0	188,398 0
WICKHAM NO 1-4	DONALD C SLAWSON	4-14-23	1,142 0	364,451 0	17,838 0
BAILEY NO 2	EL PASO NATURAL GAS COMPANY	8-14-23	666 0	151,316 0	3,721 0
MALES NO 1	EL PASO NATURAL GAS COMPANY	9-14-23	600 0	1,690,007 0	166,375 0
MELBA NO 1-10	GRACE PETROLEUM CORPORATION	10-14-23	1,200 0	1,510,137 0	111,984 0
CARREL NO 1-11	GRACE PETROLEUM CORPORATION	11-14-23	1,285 0	751,760 0	41,394 0
MERRICK "D" NO 1	TXO PRODUCTION CORPORATION	12-14-23	480 0	221,880 0	15,478 0
MOORMAN NO 1-13	WOODS PETROLEUM CORPORATION	13-14-23	2,500 0	551,215 0	30,202 0
SUMMERS NO 1-13	WOODS PETROLEUM CORPORATION	13-14-23	2,000 0	528,424 0	5,781 0
BROWN NO 1-14	GRACE PETROLEUM CORPORATION	14-14-23	41 5	102,769 0	4,194 0
BAILEY NO 1	EL PASO NATURAL GAS COMPANY	17-14-23	2,559 0	789,728 0	20,378 0
LEACH NO 1-22	GRACE PETROLEUM CORPORATION	22-14-23	750 0		
SUMMERS NO 24-1	WOODS PETROLEUM CORPORATION	24-14-23	900 0	74,006 0	0 0
SCOTT NO 1-25	DONALD C SLAWSON	25-14-23	373 0	13,240 0	0 0
TRACY NO 1-29	GRACE PETROLEUM CORPORATION	29-14-24	500 0	33,273 0	0 0
TRACY NO 2-32	GRACE PETROLEUM CORPORATION	32-14-24	611 0	1,333,738 0	0 0
WALKER NO 2-1	CRESCENT DRILLING & EXPLORATION	1-15-19	448 3		
JACKSON NO 1	FILON EXPLORATION CORPORATION	10-15-19			
BAKER NO 1-31	COASTAL OIL & GAS CORPORATION	31-15-19	4,200 0	1,172,471 0	64,803 0
KILHOFFER NO 1	LEEDE OIL & GAS, INC	33-15-19	1,282 0	2,687,338 0	140,664 0

TABLE II (Continued)

LEASE NAME	OPERATOR	S -T -R	I P IN MCF	CUM PROD 7/1/90	PROD 1-7/1/90
HERIFORD NO 1	TXO PRODUCTION CORPORATION	7-15-20	2,820 0	1,521,105 0	76,295 0
KENNEY NO 1	HARPER OIL COMPANY	15-15-20	800 0	506,939 0	44,559 0
WILSON NO 16-1	HARPER OIL COMPANY	16-15-20	1,037 0	779,241 0	106,909 0
HERIFORD NO 1-18	AN-SON CORPORATION	18-15-20	140 0	716,863 0	27,209 0
BROADBENT NO 1	JOHN A TAYLOR	26-15-20	1,301 0	71,411 0	2,851 0
H C QUATTLEBAUM	DIAMOND SHAMROCK CORPORATION	1-15-21	17,000 0	2,285,714 0	21,680 0
H C QUATTLEBAUM NO 2	MAXUS EXPLORATION	1-15-21	2,686 0	2,454,484 0	205,981 0
NETTIE MOORE "A" NO 2	MAXUS EXPLORATION	2-15-21	3,156 0	1,843,345 0	343,441 0
NETTIE MOORE "A" NO 1	DIAMOND SHAMROCK CORPORATION	2-15-21	6,300 0	4,153,036 0	705,785 0
MARVIN QAUTTLEBAUM NO 1-2	MAXUS EXPLORATION	2-15-21	1,640 0	456,152 0	223,602 0
SMITH "A" NO 3-2	WOODS PETROLEUM CORPORATION	3-15-21	1,200 0	234,688 0	15,699 0
SMITH "A" NO 3-1	WOODS PETROLEUM CORPORATION	3-15-21	4,200 0	3,544,121 0	150,805 0
MEYER NO 4-1	WOODS PETROLEUM CORPORATION	4-15-21	4,500 0	15,684,351 0	644,431 0
SWITZER "C" NO 5-1	WOODS PETROLEUM CORPORATION	5-15-21	2,000 0	15,088,383 0	516,105 0
GAMBLE NO 6-1	WOODS PETROLEUM CORPORATION	6-15-21	1,852 0	4,057,039 0	90,308 0
ROUNDS NO 1-8	WOODS PETROLEUM CORPORATION	8-15-21	1,400 0	358,192 0	4,996 0
BUD SWITZER NO 9-1	WOODS PETROLEUM CORPORATION	9-15-21	1,900 0	4,851,400 0	187,592 0
EUGENE BLACKKETTER NO 10-1	WOODS PETROLEUM CORPORATION	10-15-21	2,540 0	4,440,541 0	168,806 0
SHOCKEY NO 11-2	WOODS PETROLEUM CORPORATION	11-15-21	3,200 0	588,718 0	68,460 0
TROY SHOCKEY NO 11-1	WOODS PETROLEUM CORPORATION	11-15-21	1,300 0	2,574,302 0	156,654 0
MARV NO 1	TXO PRODUCTION CORPORATION	12-15-21	1,400 0	260,060 0	80,000 0
PAGE "B" NO 1	TXO PRODUCTION CORPORATION	12-15-21	4,200 0		
PAGE NO 2-13	AN-SON CORPORATION	13-15-21	854 0		
SMITH NO 1-15	ENERGY SERVICES, INC	15-15-21	1,600 0	1,567,924 0	91,053 0
JOE SMITH NO 1	HARPER OIL COMPANY	22-15-21	650 0	210,082 0	8,396 0
CHARLEY SWITZER NO 1-1	WOODS PETROLEUM CORPORATION	1-15-22	300 0	91,683 0	0 0
BROADBENT NO 1	C F BRAUN & COMPANY	4-15-22	200 0	30,925 0	0 0
CAMP NO 1-6	AN-SON CORPORATION	6-15-22	1,290 0	772,219 0	55,997 0
LINK NO 1	DAVIS OIL COMPANY	7-15-22	1,080.0	686,505.0	11,403 0
CHAPMAN NO 1-7	ARROW OIL AND GAS COMPANY	7-15-22	585 0	59,369 0	11,437 0
NAOMI NO 1	HARPER OIL COMPANY	14-15-22	442 0		
YOXSIMER NO 1-15	SANTA FE MINERALS, INC	15-15-22	1,994 0	3,828,552 0	156,450 0
YOXSIMER NO 2-15	SANTA FE MINERALS, INC.	15-15-22	540 0	918,515 0	112,461 0
DEAN YOXSIMER NO 1-16	SUNRISE EXPLORATION, INC	16-15-22	3,550 0	2,435,475 0	152,261 0
MARY SUSAN NO 17-1	ENERGY SERVICES, INC	17-15-22	500 0	324,556 0	12,038 0
DEAN NO 1-19	INEXCO OIL COMPANY	19-15-22	1,100 0	969,494 0	85,114 0
T & S NO 1-19	MERIDIAN OIL PRODUCTION, INC	19-15-22	1,245 0		
H A THOMAS "B" NO 2	DIAMOND SHAMROCK CORPORATION	20-15-22	2,918 0	919,120 0	72,608 0
H A THOMAS "B" NO 1	DIAMOND SHAMROCK CORPORATION	20-15-22	12,300 0	3,644,516 0	461,342 0
BOTTOM NO 1	TXO PRODUCTION CORPORATION	21-15-22	4,110 0	4,315,754 0	326,588 0
EARL "B" NO 1	TXO PRODUCTION CORPORATION	21-15-22	3,000 0	432,309 0	397,390 0
DEAN NO 1	ARCO OIL & GAS COMPANY	21-15-22	1,265 0	1,317,304 0	78,176 0
JACOBS NO 2-22	DIAMOND SHAMROCK CORPORATION	22-15-22	2,968 0	2,962,496 0	184,816 0
FLORENE BECKNER JACOBS NO 1	DIAMOND SHAMROCK CORPORATION	22-15-22	25,000 0	2,876,034 0	100,938 0
RALPH J BECKNER NO 2	SUN OIL COMPANY	23-15-22	4,200 0	2,172,332 0	153,660 0
RALPH J BECKNER NO 1	SUN OIL COMPANY	23-15-22	1,728 0	645,511 0	27,607 0
BOTTOMS "B" NO 1	TXO PRODUCTION CORPORATION	26-15-22	415 0	151,573 0	6,297 0
CLYDE BOTTOM NO 1-27	INEXCO OIL COMPANY	27-15-22	873 0	349,550 0	12,838 0
THOMAS H A NO 2-28	MAXUS EXPLORATION	28-15-22	2,079 0	699,358 0	181,631 0
THOMAS NO 1-28	DIAMOND SHAMROCK CORPORATION	28-15-22	9,600 0	1,018,848 0	38,459 0
EUBANKS NO 1-29	MAXUS EXPLORATION	29-15-22	1,395 0	557,534 0	73,338 0
STRANAHAN NO 1	DIAMOND SHAMROCK CORPORATION	29-15-22	6,600 0	524,837 0	12,722 0
PATTON "B" NO 2	TXO PRODUCTION CORPORATION	30-15-22	1,850 0	2,075,692 0	205,427 0
WICKHAM NO 1-31	INEXCO OIL COMPANY	31-15-22	264 0	471,169 0	21,057 0
MINNIE HAYDEN HAYS NO 1	DIAMOND SHAMROCK CORPORATION	32-15-22	8,000 0	783,681 0	30,715 0
GATES NO 1-33	INEXCO OIL COMPANY	33-15-22	5,594 0	1,184,636 0	35,517 0
GATES NO 2-33	LOUISIANA LAND & EXPLORATION CO	33-15-22	839 0	129,317 0	41,450 0
ESSIE NO 1-34	INEXCO OIL COMPANY	34-15-22	1,300 0	756,477 0	23,551 0
MOONEY NO 1	TEXAS OIL & GAS CORPORATION	35-15-22	880 0	287,007 0	11,065 0
DEAN "F" NO 1	TXO PRODUCTION CORPORATION	36-15-22	1,325 0	446,169 0	20,235 0
WELTY NO 2-1	APACHE CORPORATION	1-15-23	5,506 0	1,592,876 0	325,614 0
ERNEST NO 1	DAVIS OIL COMPANY	1-15-23	1,100 0	4,972,461 0	332,888 0
WELTY NO 3-1	APACHE CORPORATION	1-15-23	15,358 0	2,246,501 0	424,573 0
USA NO 2-2	APACHE CORPORATION	2-15-23	3,326 0	3,809,417 0	744,340 0

TABLE II (Continued)

LEASE NAME	OPERATOR	S T -R	I P IN MCF	CUM PROD 7/1/90	PROD 1-7/1/90
BEULAH NO 1	DAVIS OIL COMPANY	2 15-23	1,452 0	540,719 0	27,064 0
LOVETT NO 1-2	APACHE CORPORATION	2-15-23	7,261 0	1,363,766 0	371,701 0
BEULAH NO 1	TXO PRODUCTION CORPORATION	3 15-23	2,775 0	1,899,536 0	131,929 0
WARD "G" NO 1	TXO PRODUCTION CORPORATION	3-15-23	740 0	148,761 0	0 0
LOVETT NO 1 4	INTERNORTH, INC	4 15-23	1,564 0	393,025 0	17,706 0
PANKEY NO 1-5	ESCO EXPLORATION, INC	5-15-23	2 100 0	724,810 0	49,038 0
LEDDY NO 1 6	ANDERMAN-SMITH OPERATING	6-15-23	484 0	12,808 0	0 0
ANDERHOLT NO 1	TXO PRODUCTION CORPORATION	9-15-23	280 0	123,922 0	6,811 0
KENDALL "B" NO 1	TXO PRODUCTION CORPORATION	10-15-23	900 0	144,776 0	10,894 0
LOVETT NO 1 11	DONALD C SLAWSON	11-15-23	3,000 0	756,029 0	97,086 0
KENDALL NO 11-1	INTERNORTH, INC	11-15-23	1,040 0	69,936 0	0 0
WELTY NO 1 12	SANGUINE, LTD	12-15-23	5,149 0	5,737,550 0	544,275 0
LOVETT "A" NO 1	TXO PRODUCTION CORPORATION	12-15-23	2,250 0	1,234,042 0	78,302 0
UNCLE SAM NO 1	SANGUINE, LTD	12-15-23	1,673 0	219,325 0	200,412 0
SARA NO 2 13	SANTA FE MINERALS, INC	13-15-23	1,300 0	35,936 0	35,936 0
SARA NO 1	SABINE PRODUCTION COMPANY	13-15-23	250 0	253,596 0	8,097 0
MERRICK "B" NO 1	C F BRAUN & COMPANY	14-15-23	5,500 0	401,275 0	0 0
SMITH NO 1-15	SANTA FE - BRAUN	15-15-23	400 0	3,641,385 0	131,047 0
MERRICK NO 1	HARPER OIL COMPANY	23-15-23	1,704 0	6,875,225 0	270,941 0
WICKHAM NO 1-24	INEXCO OIL COMPANY	24-15-23	5,850 0	5,955,997 0	207,755 0
WICKHAM NO 2 24	LOUISIANA LAND & EXPLORATION CO	24-15-23	450 0	221,866 0	28,261 0
WICKHAM NO 1 25	INEXCO OIL COMPANY	25-15-23	5,066 0	4,888,609 0	33,656 0
CARRELL NO 1	HARPER OIL COMPANY	27-15-23	440 0	852,470 0	45,803 0
CARREL NO 2-27	APACHE CORPORATION	27-15-23	1,764 0		
FEDERAL NO 1-32	DONALD C SLAWSON	32-15-23	696 0		
LAURENE NO 1	HARPER OIL COMPANY	33-15-23	1,820 0		
RAYMOND NO 1	HARPER OIL COMPANY	34-15-23	850 0	473,813 0	20,598 0
NANETTE NO 1	HARPER OIL COMPANY	35-15-23	418 0	416,105 0	28,980 0
WICKHAM NO 1-36	INEXCO OIL COMPANY	36-15-23	4,050 0	417,767 0	69,109 0
MARTIN NO 1-1	ANDERMAN-SMITH OPERATING	1-15-24	1,059 0	69,796 0	5,077 0
STAUBER NO 1-2	ANDERMAN-SMITH OPERATING	2-15-24	1,398 0	145,436 0	9,847 0
IRETON NO 1 35	PETROLEUM INVESTMENTS, LTD	35-16-19	242 0		
WALKER NO 36-2	CONTINENTAL RESOURCES CORPORATION	36-16-19	800 0	469,186 0	
WALKER NO 36-3	PETROLEUM INVESTMENTS, LTD	36-16-19	318 0	35,093 0	3,066 0
HARREL NO 10-7	DOME PETROLEUM CORPORATION	7-16-20	1,875 0		
SOUTH UNIT NO 1 8	HOOVER & BRACKEN ENERGIES, INC	8-16-20	930 0	1,114,029 0	23,250 0
MARTIN NO 1 9	BRACKEN EXPLORATION COMPANY	9-16-20	2,500 0		
NOLAN GRAYBILL NO 1-32	DIAMOND SHAMROCK CORPORATION	32-16-20	223 0		
CARLTON NO 26-1	INTERNORTH, INC	26-16-21	1,139 0	954,632 0	15,892 0
CARLSON NO 1	TEXAS OIL & GAS CORPORATION	27-16-21	1,300 0	1,518,928 0	61,479 0
ADAMS-ASHLEY NO 1	FERGUSON OIL & GAS COMPANY, INC	28-16-21	4,620 0	3,674,877 0	79,553 0
GLASEMAN NO 29-1	WOODS PETROLEUM CORPORATION	29-16-21	900 0	2,398,471 0	26,206 0
SWITZER "A" NO 30-1	WOODS PETROLEUM CORPORATION	30-16-21	1,850 0	2,428,599 0	69,685 0
ALBRIGHT NO 1-1	WOODS PETROLEUM CORPORATION	31-16-21	3,600 0	16,016,035 0	633,773 0
SWITZER NO 1	WOODS PETROLEUM CORPORATION	32-16-21	14,722 0	2,801,013 0	78,070 0
G SWITZER NO 2	WOODS PETROLEUM CORPORATION	32-16-21	802 0	2,186,756 0	176,259 0
SMITH NO 1-33	WOODS PETROLEUM CORPORATION	33-16-21	2,900 0	17,058,784 0	563,237 0
CARLTON NO 3-34	CHAMPLIN PETROLEUM COMPANY	34-16-21	961 0	616,071 0	21,845 0
R R CARLTON NO 1	CHAMPLIN PETROLEUM COMPANY	34-16 21	1,200 0	14,011,637 0	412,540 0
LARRY SWITZER NO 1	DIAMOND SHAMROCK CORPORATION	35-16-21	43,000 0	12,609,553 0	300,539 0
BLACKKETTER NO 1	CHAMPLIN PETROLEUM COMPANY	36-16-21	636 0	335,654 0	178 0
TAYLOR FARMS NO 2	SUN OIL COMPANY	25-16-22	9,825 0	1,390,024 0	23,919 0
G SWITZER NO 1 36	SUNRISE EXPLORATION, INC	36-16-22	2,200 0	637,321 0	5 019 0
SWITZER NO 2 36	ANDERMAN-SMITH OPERATING	36-16-22	60 0		
DARLENE NO 1 25	AVANTI ENERGY CORPORATION	25-16 23	2,070 0	772,551 0	0 0
BEALS NO 2 26	DONALD C SLAWSON	26-16 23	2,100 0	1,951,566 0	56,889 0
LEDDY NO 1 26	DONALD C SLAWSON	26-16-23	3,180 0	1,125,105 0	128,366 0
BEALS NO 1 26	DONALD C SLAWSON	26-16-23	5,860 0	3,723,375 0	243,080 0
HOSEA NO 1 27A	WARD PETROLEUM CORPORATION	27 16 23	600 0	250,674 0	29,466 0
LEDDY NO 1	HARPER OIL COMPANY	31-16-23	260 0	184,898 0	6,887 0
HAZEL NO 2 32	ANDERMAN-SMITH OPERATING	32-16 23	2,257 0	294,462 0	11,470 0
HAZEL NO 1 32	ANDERMAN-SMITH OPERATING	32-16-23	40 0	327,019 0	19,544 0
LOVETT NO 2-33	ESCO EXPLORATION, INC	33-16 23	487 0	152,984 0	18,342 0
BLACKKETTER NO 3 34	ESCO EXPLORATION, INC	34-16-23	445 0		
BLACKKETTER NO 1 34	ENERGY SERVICES, INC	34-16-23	1,758 0	2,589,965 0	47,688 0
BLACKKETTER NO 2 34	ESCO EXPLORATION, INC	34 16 23	2,200 0	666,278 0	16,090 0
BEALS NO 1	DAVIS OIL COMPANY	35-16-23	1 600 0	5,319 441 0	151,015 0
BEALS NO 3 35	APACHE CORPORATION	35-16 23	4,554 0	1,132,754 0	
BEALS NO 2 35	APACHE CORPORATION	35 16 23	6,587 0		
HYMAN NO 36 2	WOODS PETROLEUM CORPORATION	36-16-23	5 449 0	94,176 0	68,811 0
HYMAN NO 36 1	WOODS PETROLEUM CORPORATION	36 16 23	5,007 0	7,333,561 0	113,757 0
AVRIETTE NO 1 35	ANDERMAN-SMITH OPERATING	35 16 24	191 0	235,101 0	16,292 0
HARPER STATE NO 1	HARPER OIL COMPANY	36-16 24	1,250 0	287,820 0	10,688 0
Total			1 421 047 8	736,467,111 0	47 259,878 7

APPENDIX B

THIN-SECTION ANALYSIS OF SELECTED SAMPLES

(QRF PERCENTAGES)

TABLE IV

THIN-SECTION ANALYSIS OF SELECTED SAMPLES (QRF PERCENTAGES)

WELL CORE	DEPTH	% QUARTZ	% FELDSPARS	% ROCK FRAGMENTS
L. L. & E. GATES NO. 2-33				
	12172'4"			
	12180'11"	78.9	14.1	7.0
	12184'6"	83.3	8.3	8.4
	12190'0"	73.4	22.8	3.8
	12201'7"			
	12204'1"	71.2	23.1	5.1
	12209'2"	83.7	15.1	1.2
	12212'2"	82.0	16.4	1.6
	12222'0"	76.1	19.8	1.1
	12223'11"	SILTSTONE		
	12393'1"	80	17.1	2.9
	12421'0"	85.3	9.4	5.3
	12434'2"	83.4	13.9	2.7
	12437'7"	78.6	14.7	6.7
	12438'9"	74.7	17.3	8.0
	12453'0"	MICRITE		
	12453'8"	81.6	13.2	5.2
	12478'1"	72.2	22.7	5.1
	12498'11"			
	12512'9"			
L. L. & E. SAVAGE NO. 2-1				
	12383'0"	71.6	18.9	9.5
	12400'0"	71.1	20.0	8.9
	12404'3.5"	88.6	9.4	2.0
	12410'10.5"	73.3	22.7	4.0
	12421'7"	79.3	13.1	7.6
	12434'3"	75.0	19.6	5.4
	12459'1"			
	12493'0"	71.6	26.7	1.7
	12499'5.6"	65.7	27.3	7.0
	12500'3.5"			
INTERNORTH, INC. SMITH "B" 21 NO.1				
	12220'0"			
	12228'3.5"	82.9	14.5	2.6
	12242'11"	78.4	18.9	2.7
	12252'6"	78.2	21.8	TR
	12268'3"	76.7	21.7	1.6
	12282'1"	69.4	22.3	8.3
	12292'8"	72.3	16.9	10.8
	12309'11"			
	12323'8"	69.4	18.1	15.3
	12330'10"	70.9	20.9	8.2
	12349'4"	78.9	16.9	4.2
	12367'7"	78.9	17.1	3.9
	12386'10"	81.5	16.0	2.5
	12415'2"	70.3	23.0	6.7

TABLE IV (Continued)

WELL CORE	DEPTH	% QUARTZ	% FELDSPARS	% ROCK FRAGMENTS
INTERNORTH, INC. SMITH "B" 21 NO.1 (CONT.)	12437'6.5"	68.1	29.0	2.9
	12462'4"	73.3	17.4	9.3
	12493'7"	63.1	17.1	19.8
	12498'2"			
	12517'0"	74.7	16.9	8.4
	12529'3"	74.1	16.0	9.9
INEXCO, INC. TRENT NO. 1-25				
	12541'10"	74.7	16.1	9.2
	12559'10"	74.7	20.0	5.3
	12581'1"	72.7	14.3	13.0
	12582'11"	73.5	16.9	9.6
	12598'3"	79.8	14.3	5.9
	12607'1"	72.2	25.6	2.2
	12609'3"	85.5	7.9	6.6
	12624'4"			
	12654'9"	70.0	28.6	1.4
	12672'0"	78.0	20.0	2.0
TENNECO OIL CO. MERRICK NO. 1-27				
	12696'0"	75.7	14.3	10.0
	12704'2"	83.6	13.4	3.0
	12705'0"	83.4	13.4	3.2
	12723'7"	80.0	15.7	4.3
	12739'11"	77.5	15.5	7.0
	12763'9"	73.8	22.9	3.3
	12772'10"	83.6	13.1	3.3
	12783'4.5"	85.2	11.5	3.3
	12785'8"			
TENNECO OIL CO. LESTER NO. 1-6				
	12740'2.5"			
	12747'5"	72.8	25.7	1.4
	12750'9"	72.9	20.0	7.1
	12756'6"	82.7	16.0	1.2
	12760'4"	76.0	18.7	5.3
	12770'8"			
L L & E. RUTH NO. 1-28				
	13055'4"			
	13072'6"			
	13079'4"			
	13082'5.5"	82.9	14.8	2.3
	13082'9"	83.4	13.7	2.9
	13083'2"	72.1	20.6	7.2
	13096'7"	73.9	18.2	7.9

TABLE IV (Continued)

WELL CORE	DEPTH	% QUARTZ	% FELDSPARS	% ROCK FRAGMENTS
SOUTHPORT EXPL. MERRICK NO. 1-10				
	13898'0"	67.5	28.8	3.7
	13909'0"	72.7	20.4	6.8
	13910'4"	71.4	20.2	8.3
	13918'4"			
	13932'11"	66.7	26.7	6.6
	13937'4"	72.6	22.6	4.8
	13944'3"	64.6	25.6	9.7
	13948'7.5"	71.8	17.9	10.2
	13951'4"			
	13957'3"	55.8	37.7	6.4
	14030'7"			
	14040'7.5"			
	14048'9.5"	76.9	18.4	4.7
	14058'10"			
	14065'8"	81.4	17.1	1.4
	14067'6"			

APPENDIX C

CORE PHOTOGRAPHS

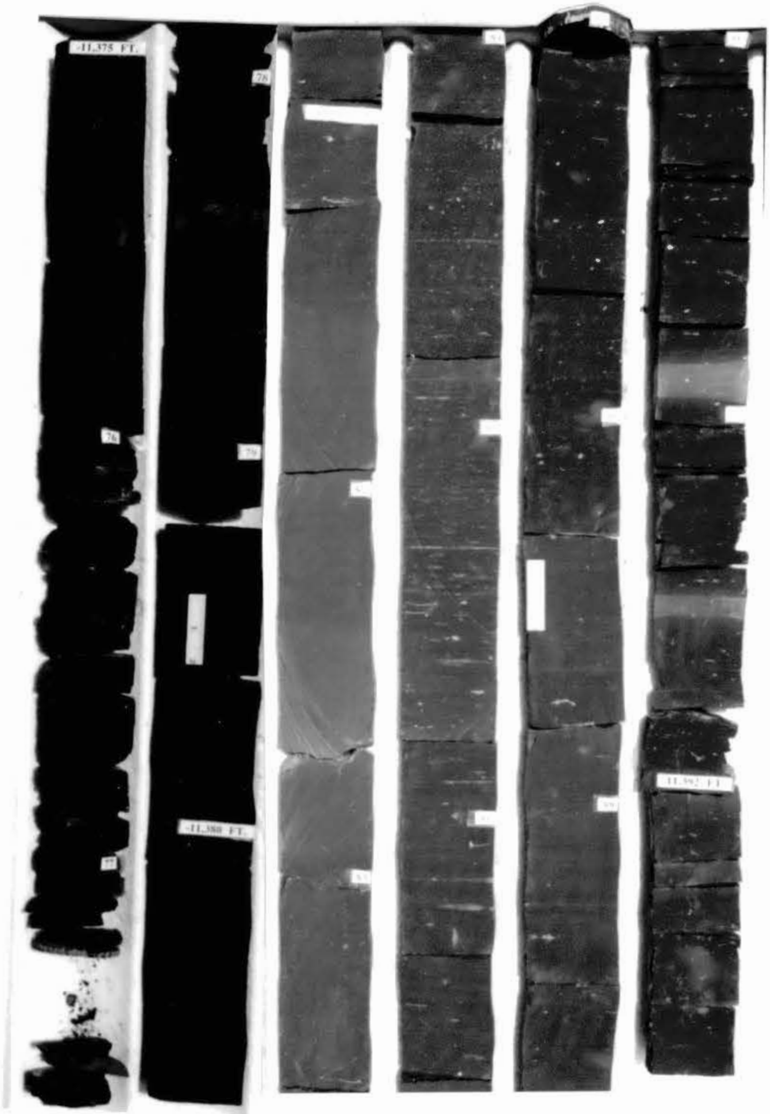


Figure 104. Woods Petroleum Corporation, Switzer "C" No. 1-5, 11,375' to 11,393', Pink Limestone Equivalent.

Figure 104 (Cont.). Woods Petroleum Corporation, Switzer "C" No. 1-5, 11,393' to 11,417', Pink Limestone Equivalent.

Figure 104 (Cont.). Woods Petroleum Corporation, Switzer "C" No. 1-5, 11,417' to 11,455.7', Upper Red Fork.

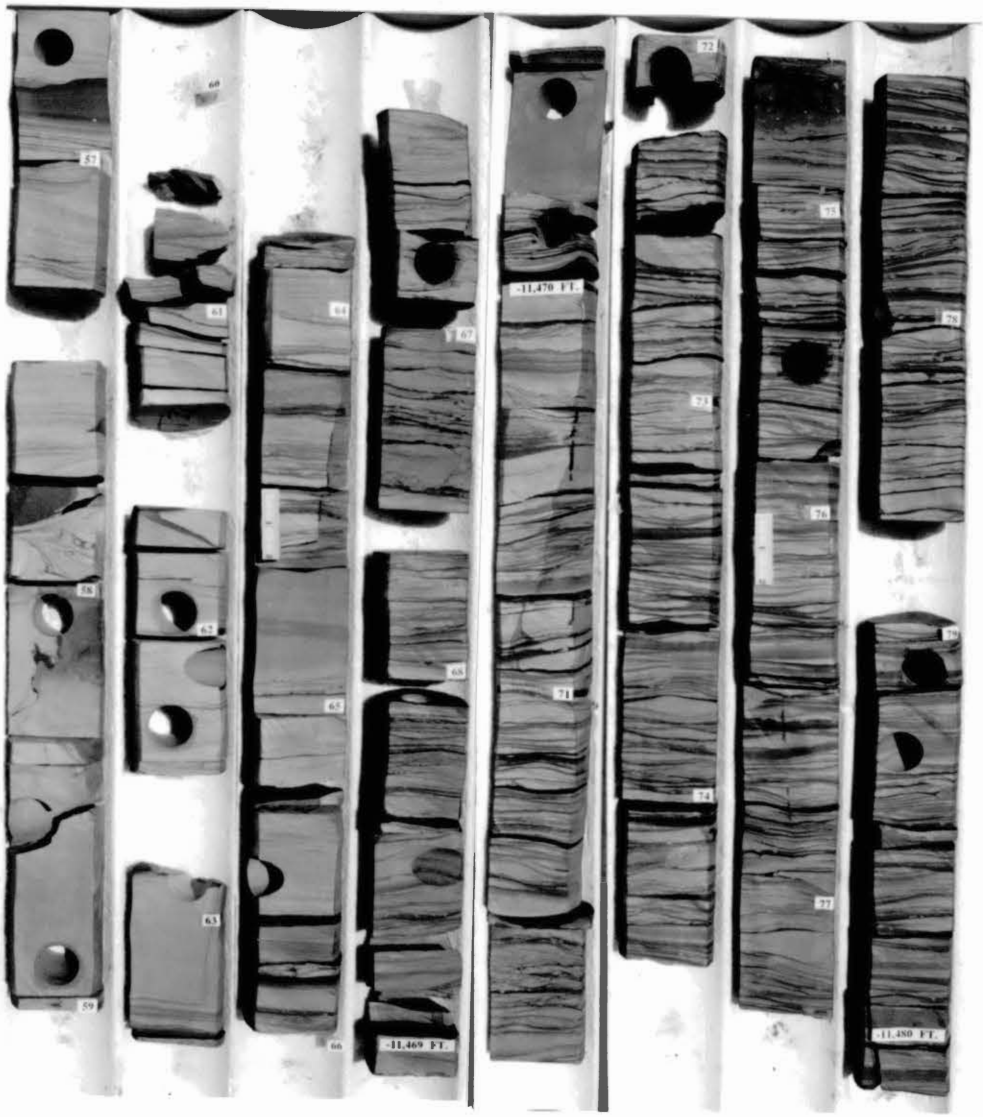


Figure 104 (Cont.). Woods Petroleum Corporation, Switzer "C" No. 1-5, 11,456.5' to 11,480.2', Upper Red Fork.

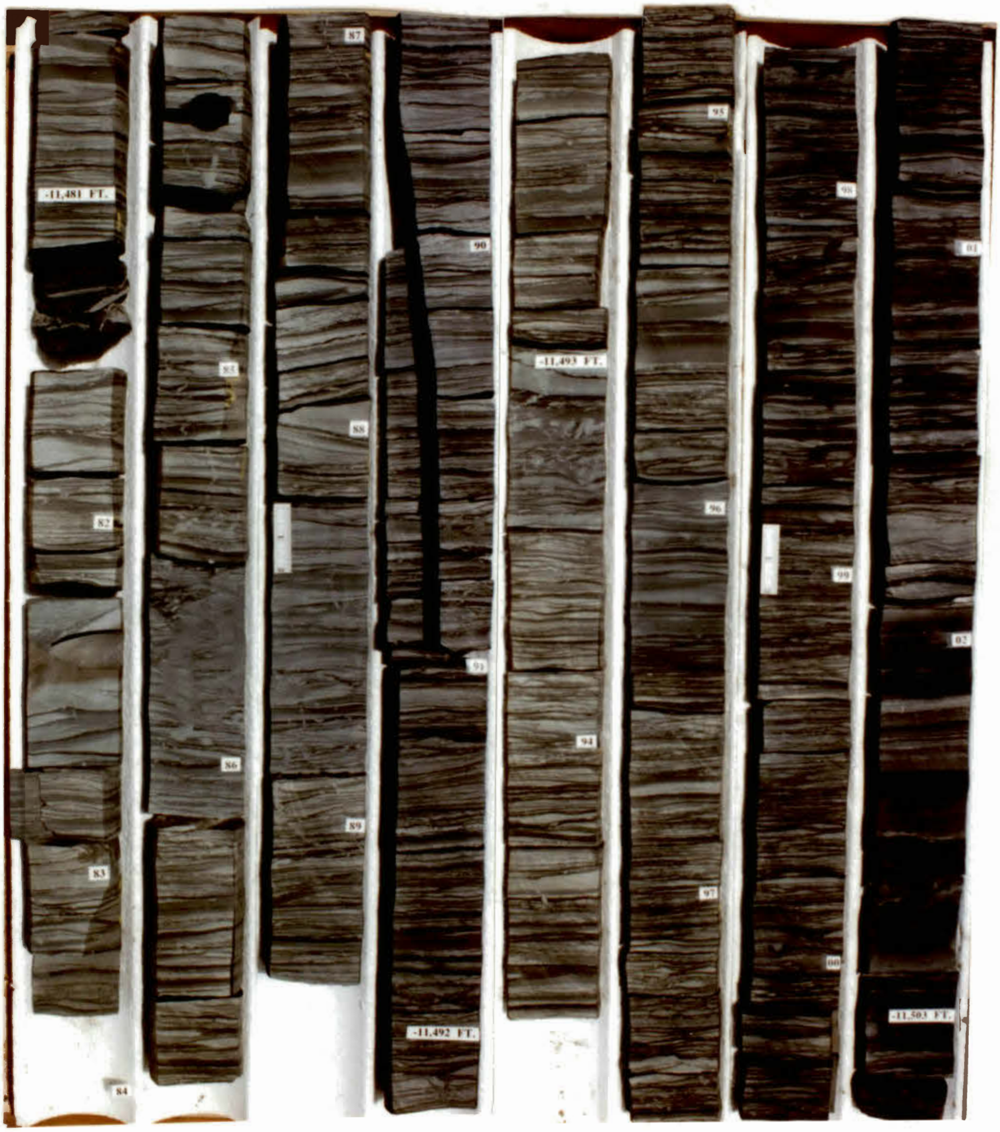


Figure 104 (Cont.). Woods Petroleum Corporation, Switzer "C" No. 1-5, 11,480.4' to 11,503.3', Upper Red Fork.

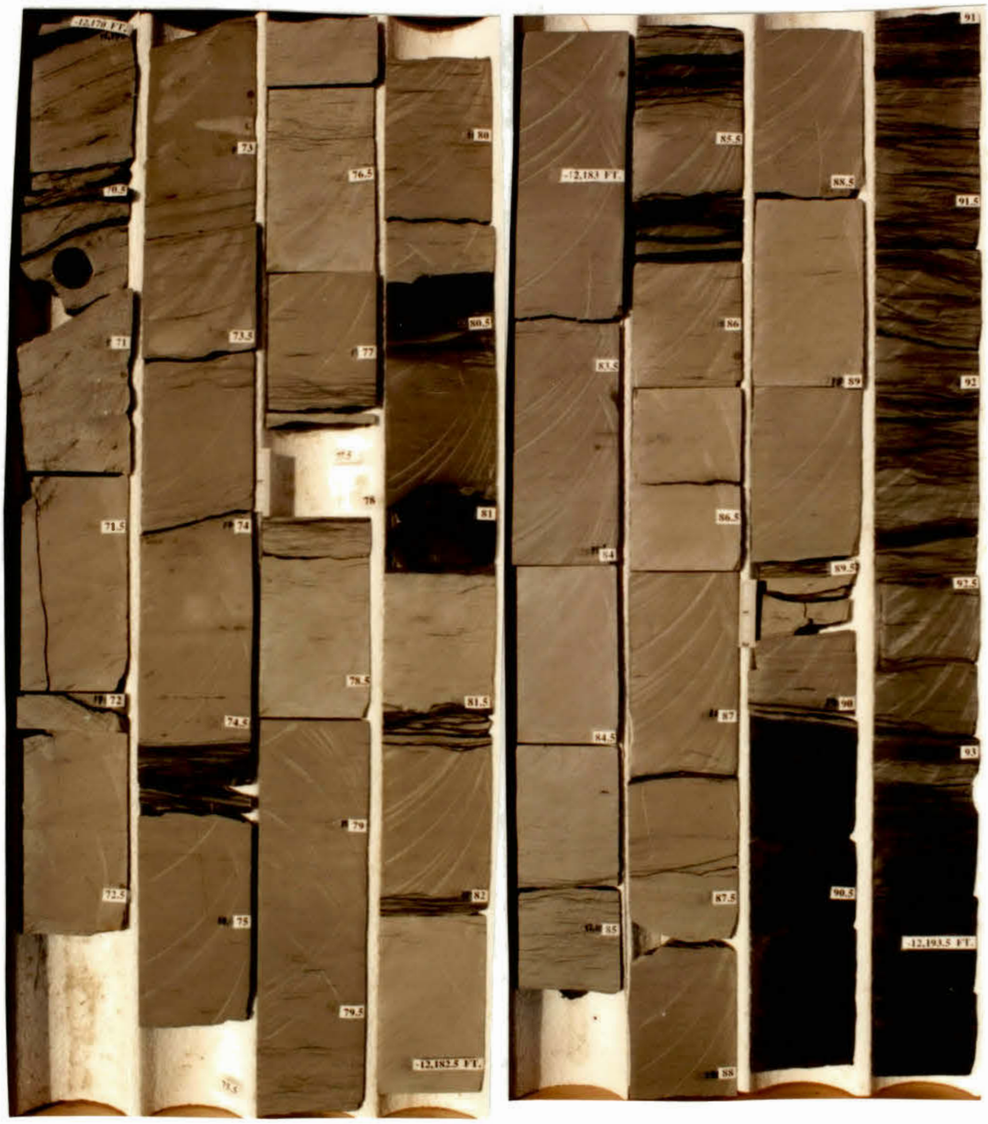


Figure 105. Louisiana Land & Exploration Co., Gates No. 2-33, 12,170' to 12,194', Upper Red Fork.

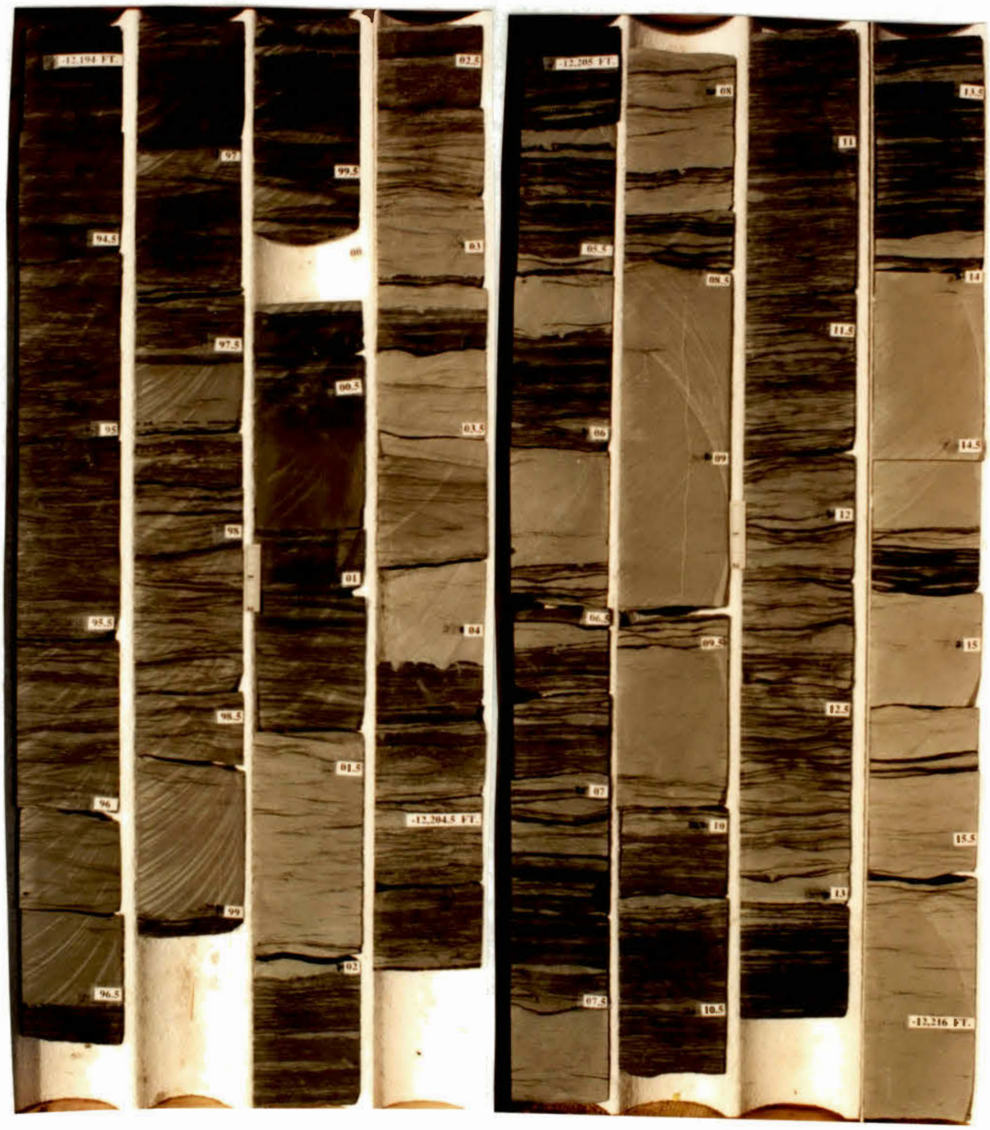


Figure 105 (Cont.). Louisiana Land & Exploration Co., Gates No. 2-33, 12,194' to 12,216.3', Upper Red Fork.

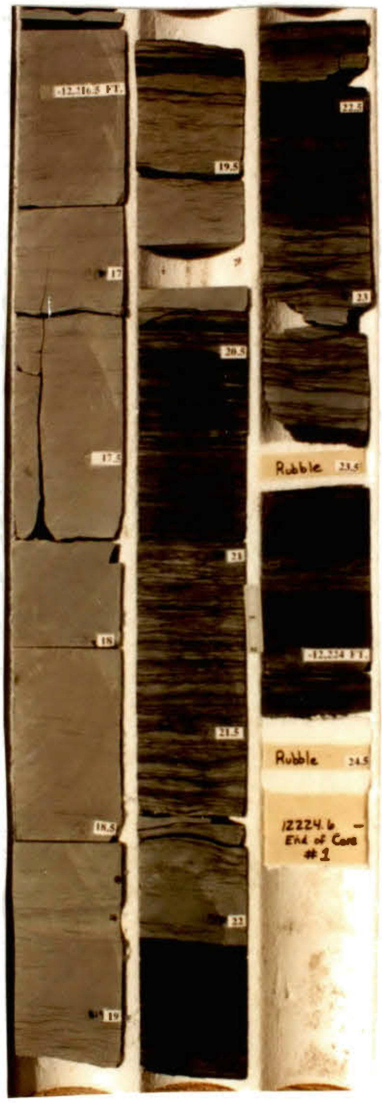


Figure 105 (Cont.). Louisiana Land & Exploration Co., Gates No. 2-33, 12,216.3' to 12,224.6', Upper Red Fork.

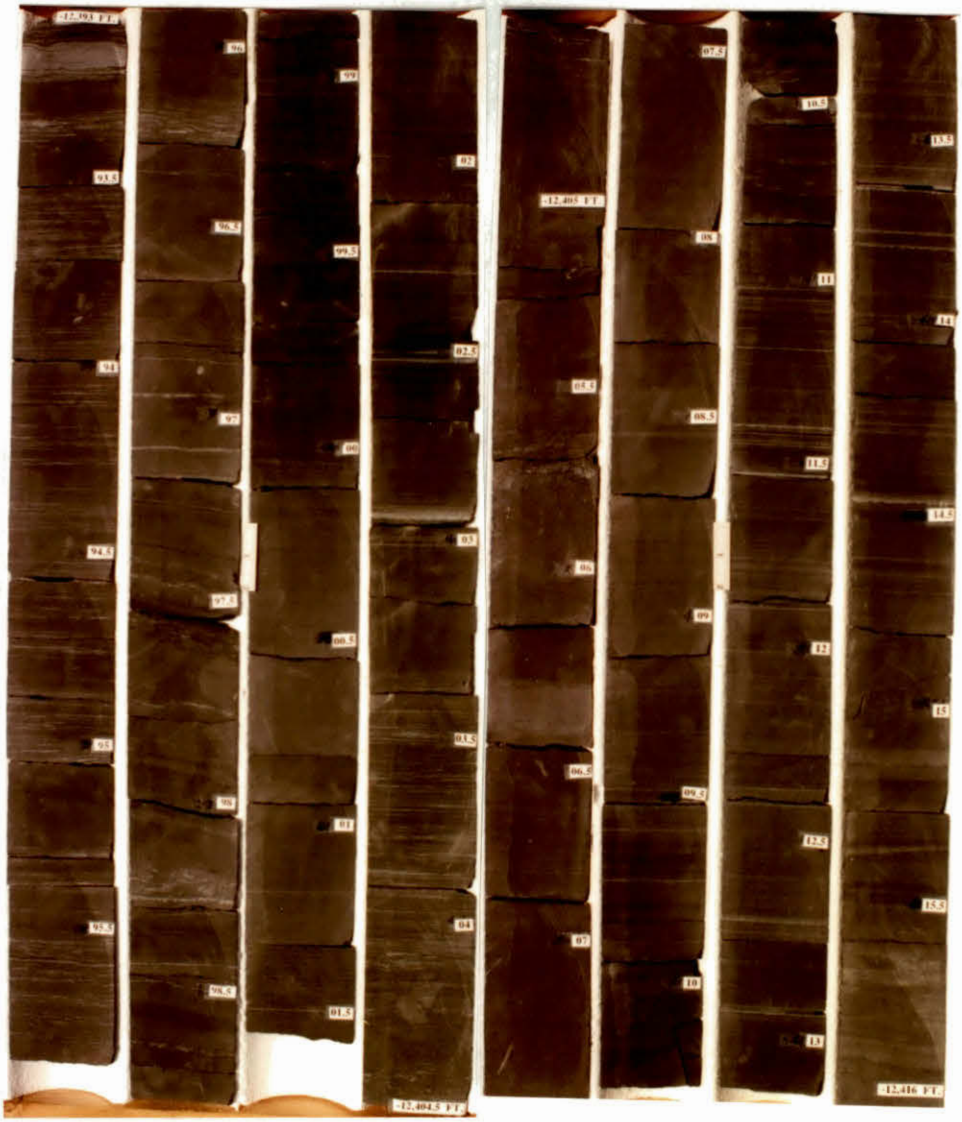


Figure 106. Louisiana Land & Exploration Co.,
Gates No. 2-33,
12,393' to 12,416',
Upper Red Fork (middle).

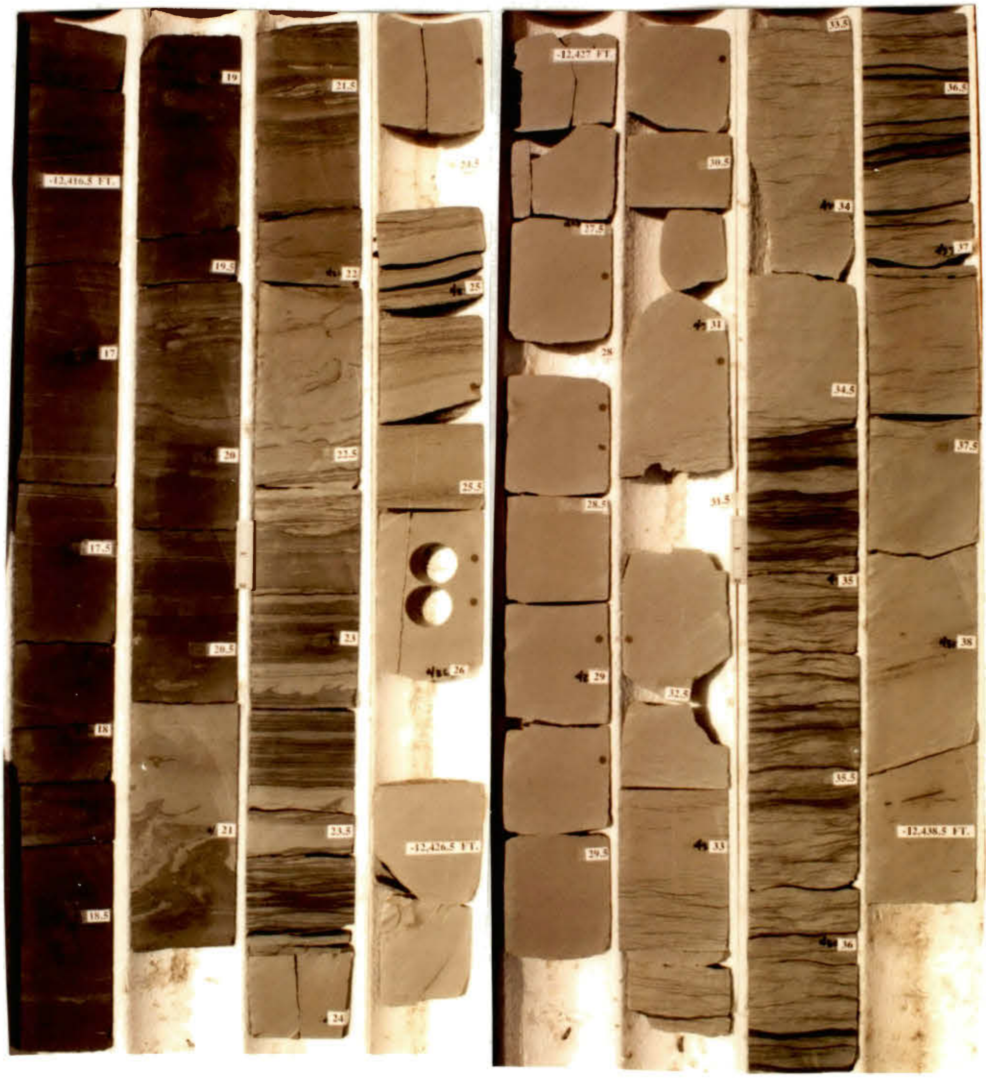


Figure 106 (Cont.). Louisiana Land & Exploration Co., Gates No. 2-33, 12,416' to 12,438.7', Upper Red Fork (middle).

Figure 106 (Cont.). Louisiana Land & Exploration Co.,
Gates No. 2-33,
12,438.7' to 12,463',
Upper Red Fork (middle).

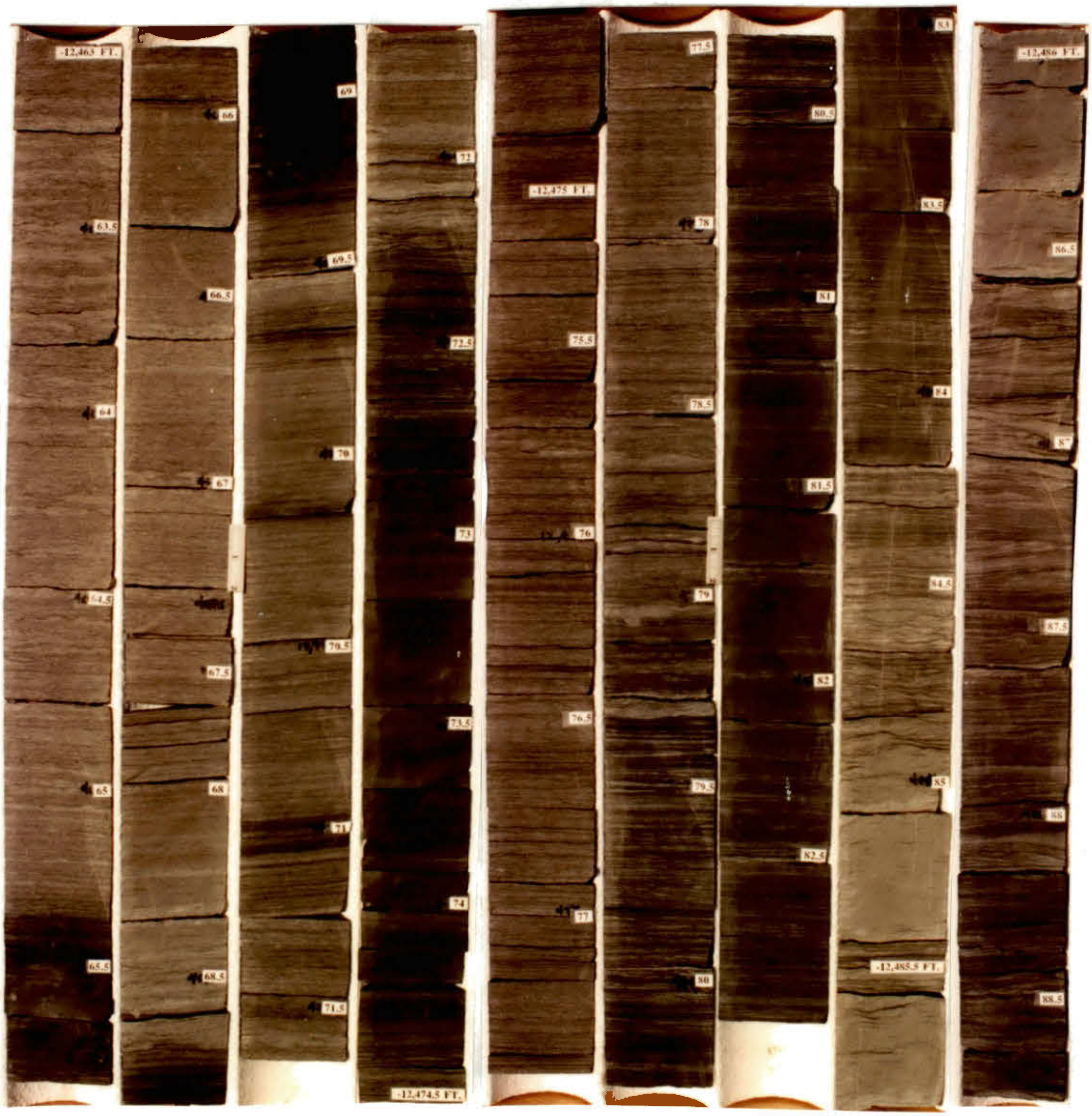


Figure 106 (Cont.). Louisiana Land & Exploration Co., Gates No. 2-33, 12,463' to 12,488.8', Upper Red Fork (middle).

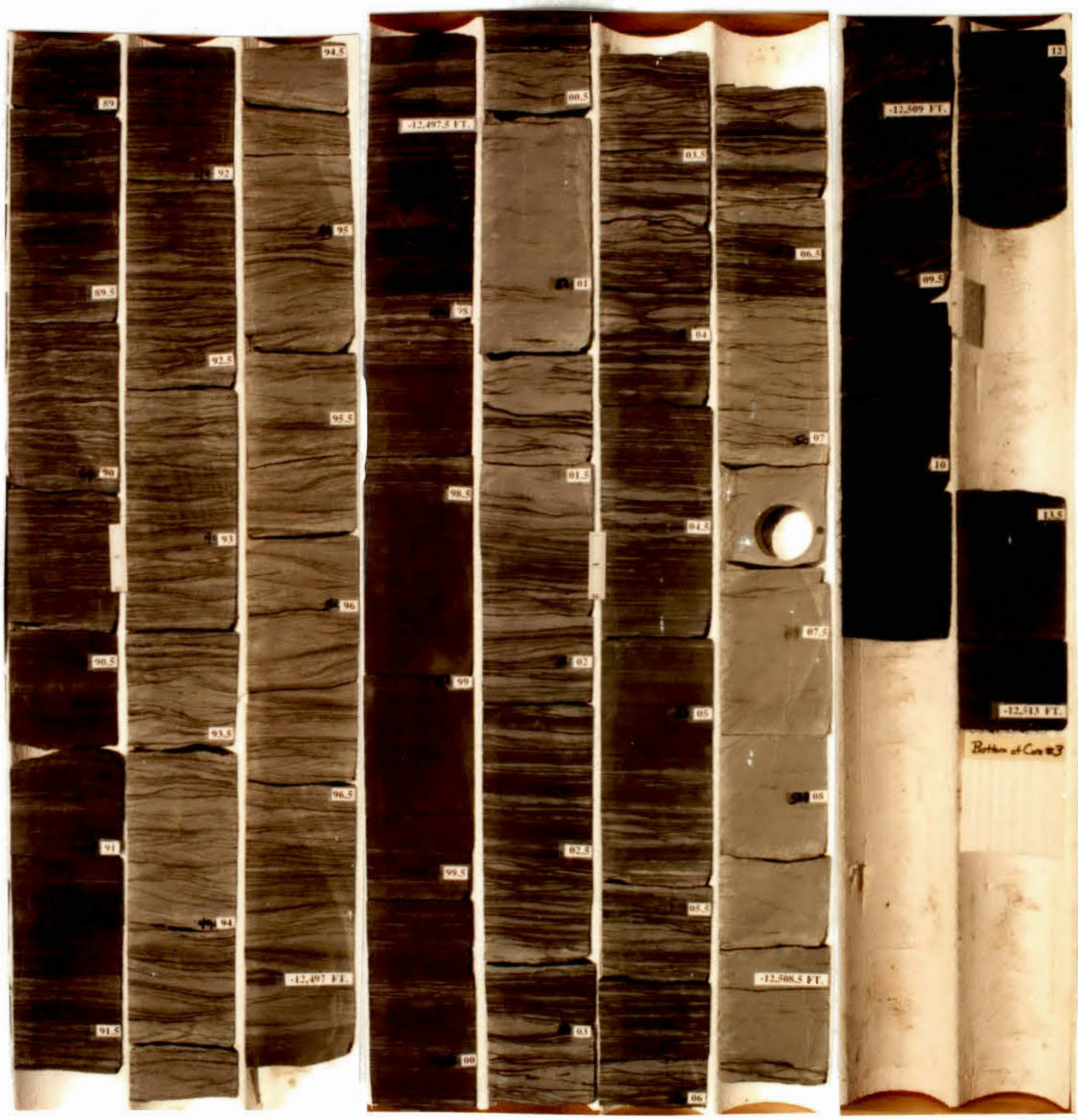


Figure 106 (Cont.). Louisiana Land & Exploration Co., Gates No. 2-33, 12,488.8' to 12,513', Upper Red Fork (middle).

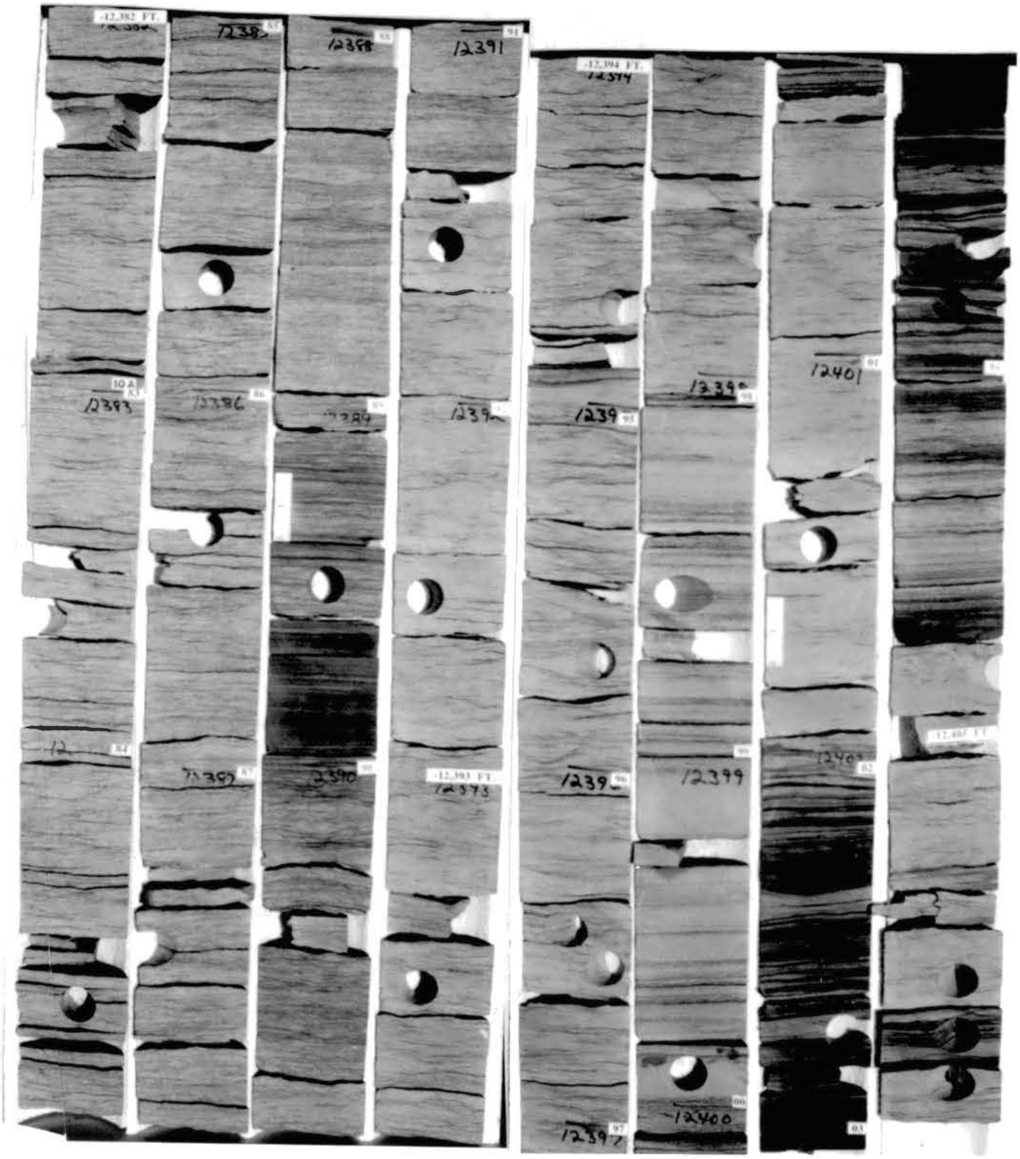


Figure 107. Louisiana Land & Exploration Co.,
Savage No. 2-1,
12,382' to 12,406',
Upper Red Fork.

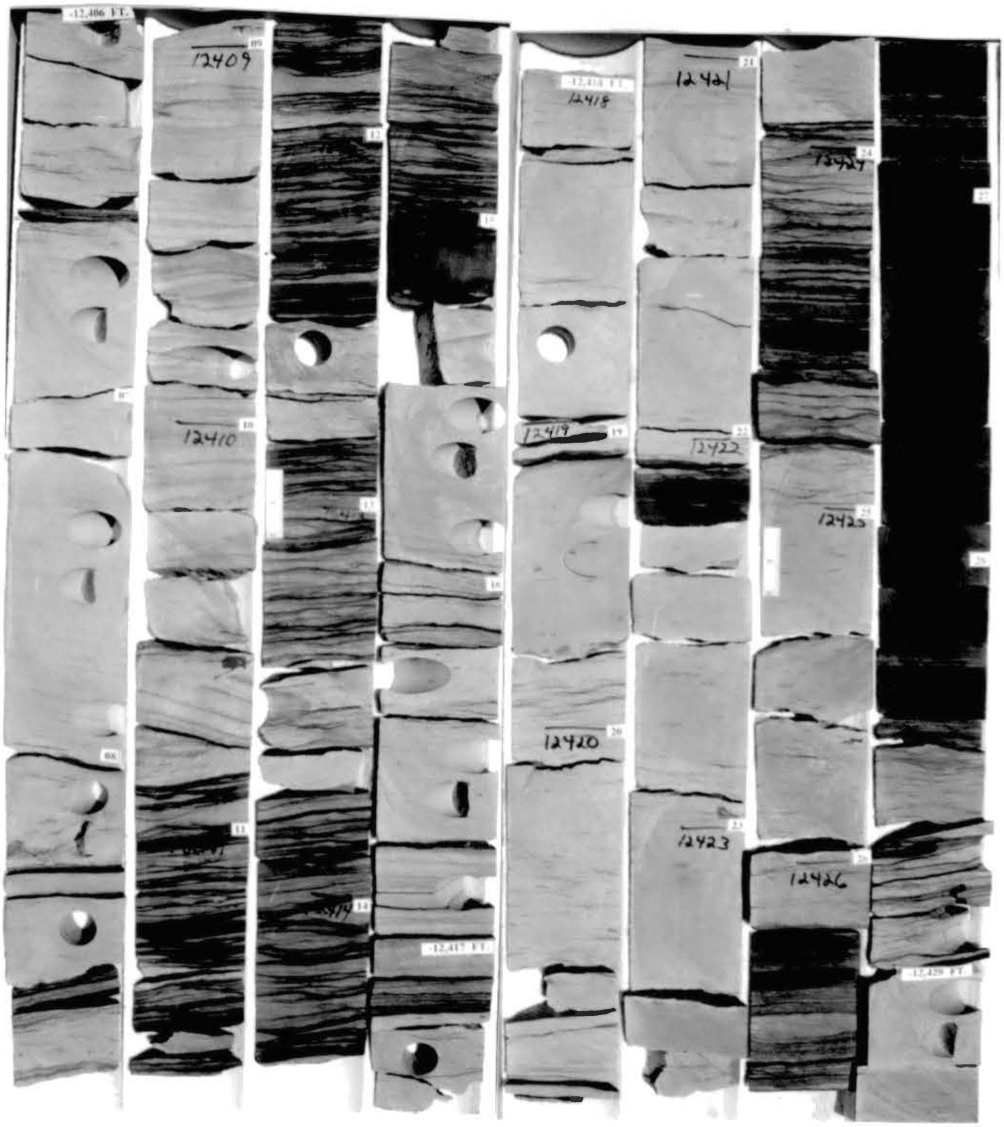


Figure 107 (Cont.). Louisiana Land & Exploration Co., Savage No. 2-1, 12,406' to 12,429.4', Upper Red Fork.

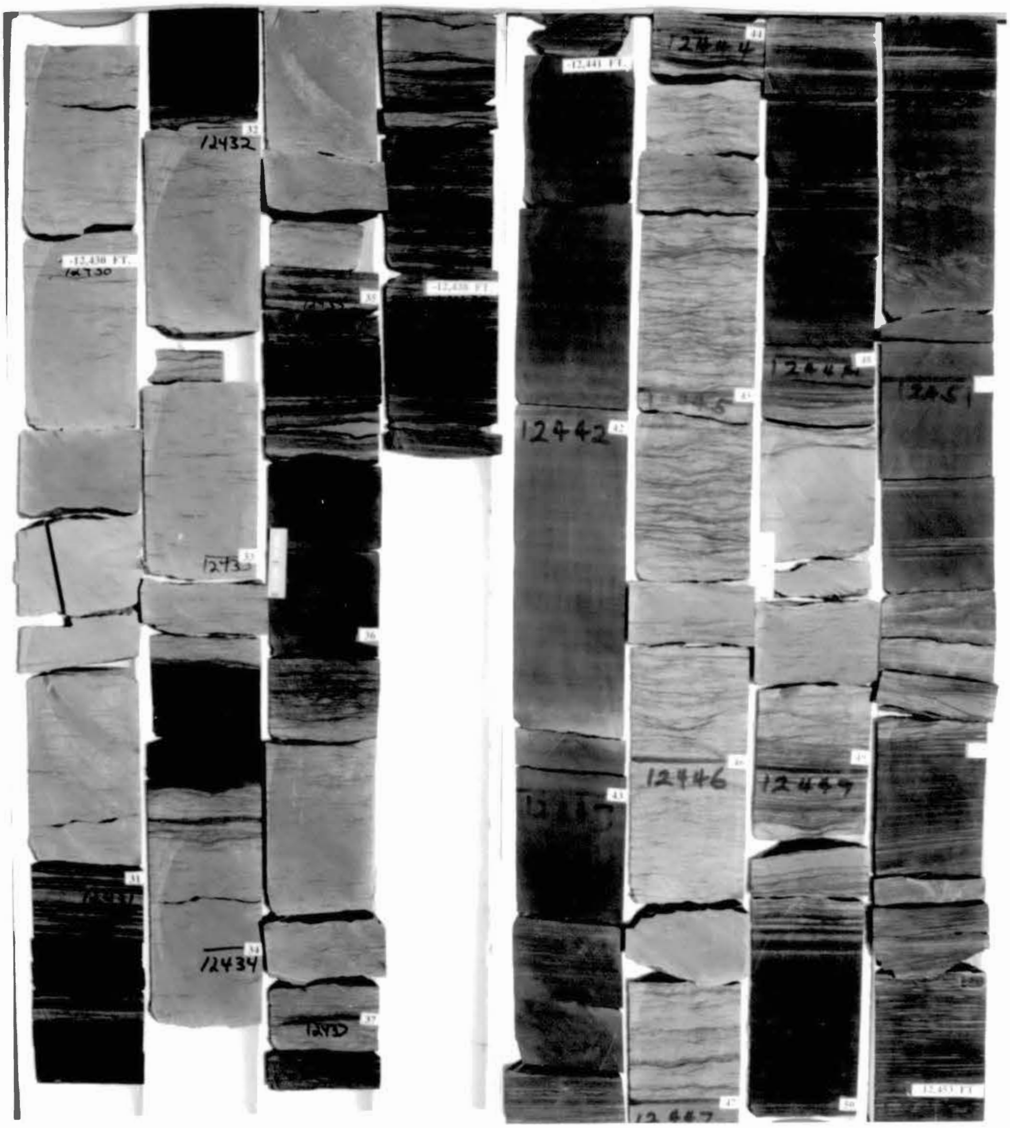


Figure 107 (Cont.). Louisiana Land & Exploration Co.,
Savage No. 2-1,
12,429.4' to 12,453',
Upper Red Fork.

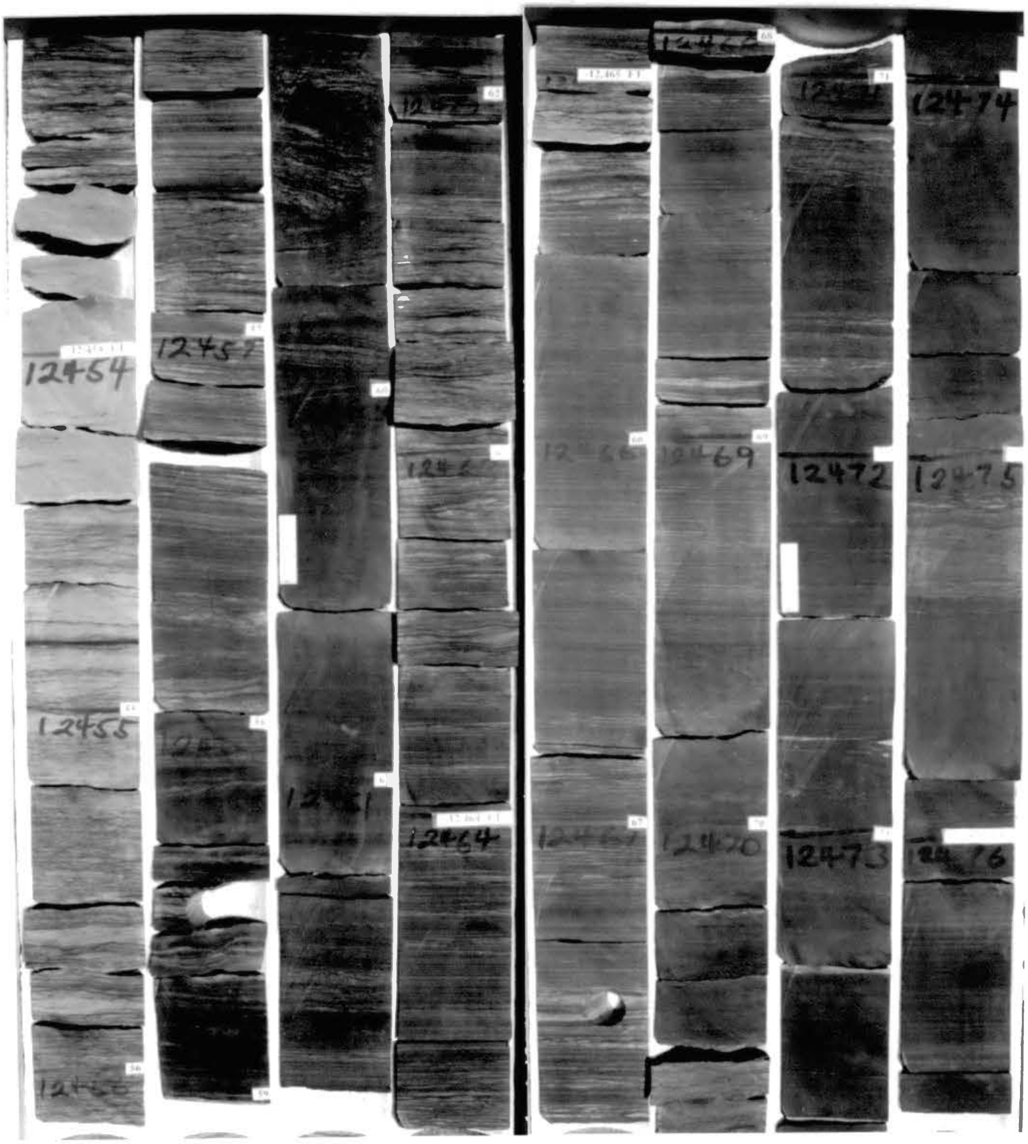


Figure 107 (Cont.). Louisiana Land & Exploration Co.,
Savage No. 2-1,
12,453' to 12,476.8',
Upper Red Fork.

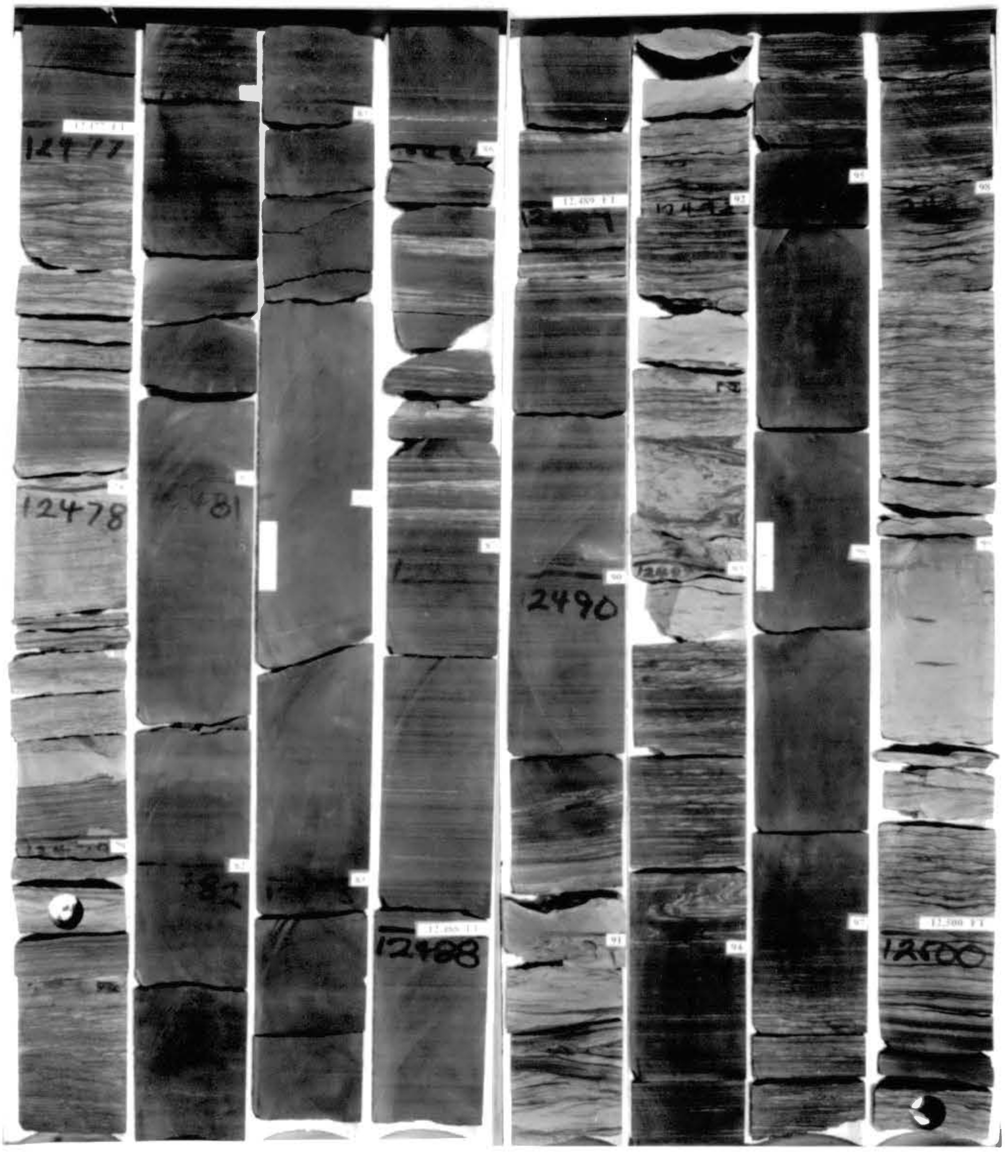


Figure 107 (Cont.). Louisiana Land & Exploration Co., Savage No. 2-1, 12,476.8' to 12,500.5', Upper Red Fork.

Figure 108. Internorth, Inc.,
Smith "B" 21 No. 1,
12,209' to 12,241',
Upper Red Fork.

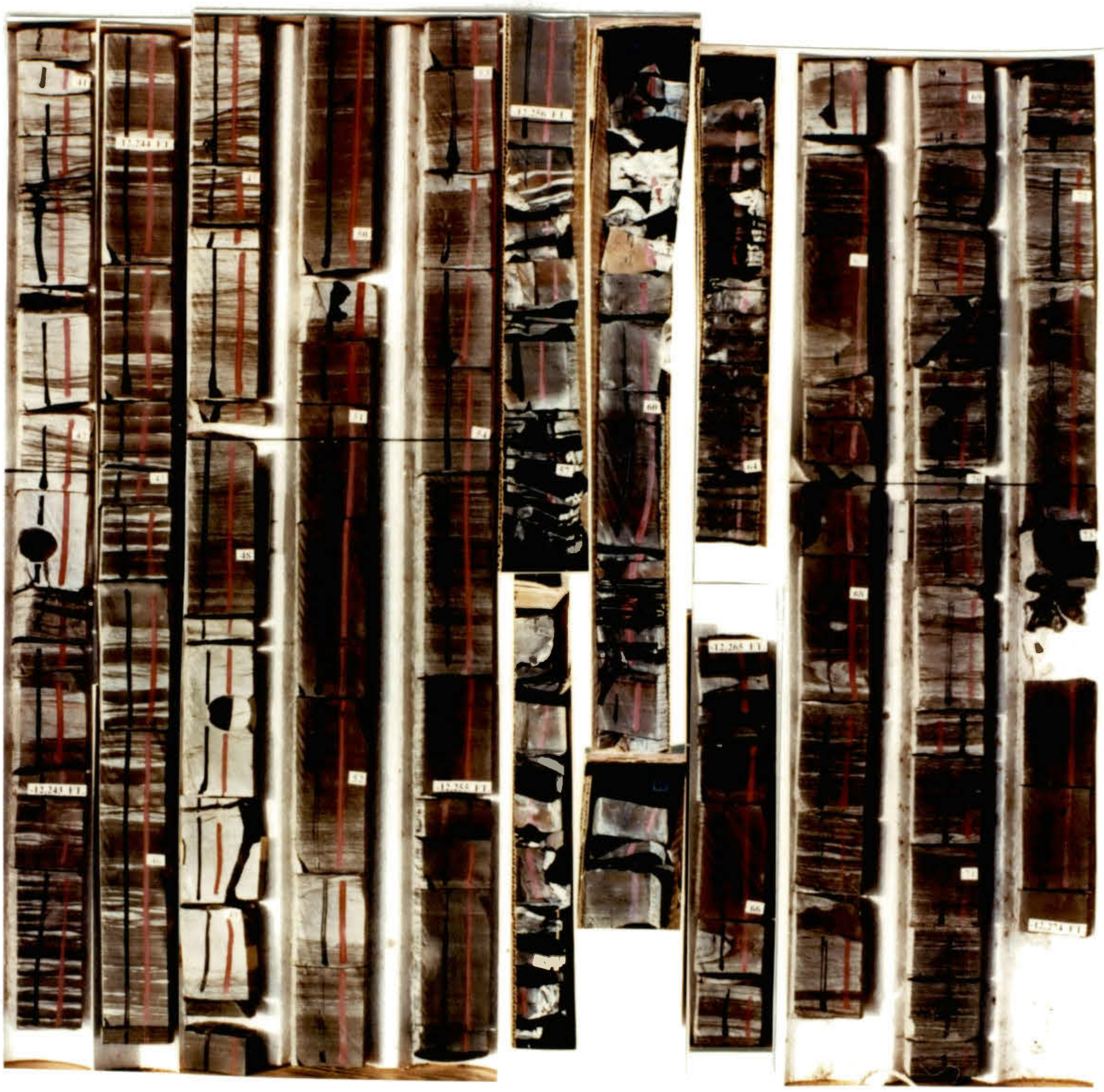


Figure 108 (Cont.). Internorth, Inc.,
Smith "B" 21 No. 1,
12,241' to 12,274',
Upper Red Fork.

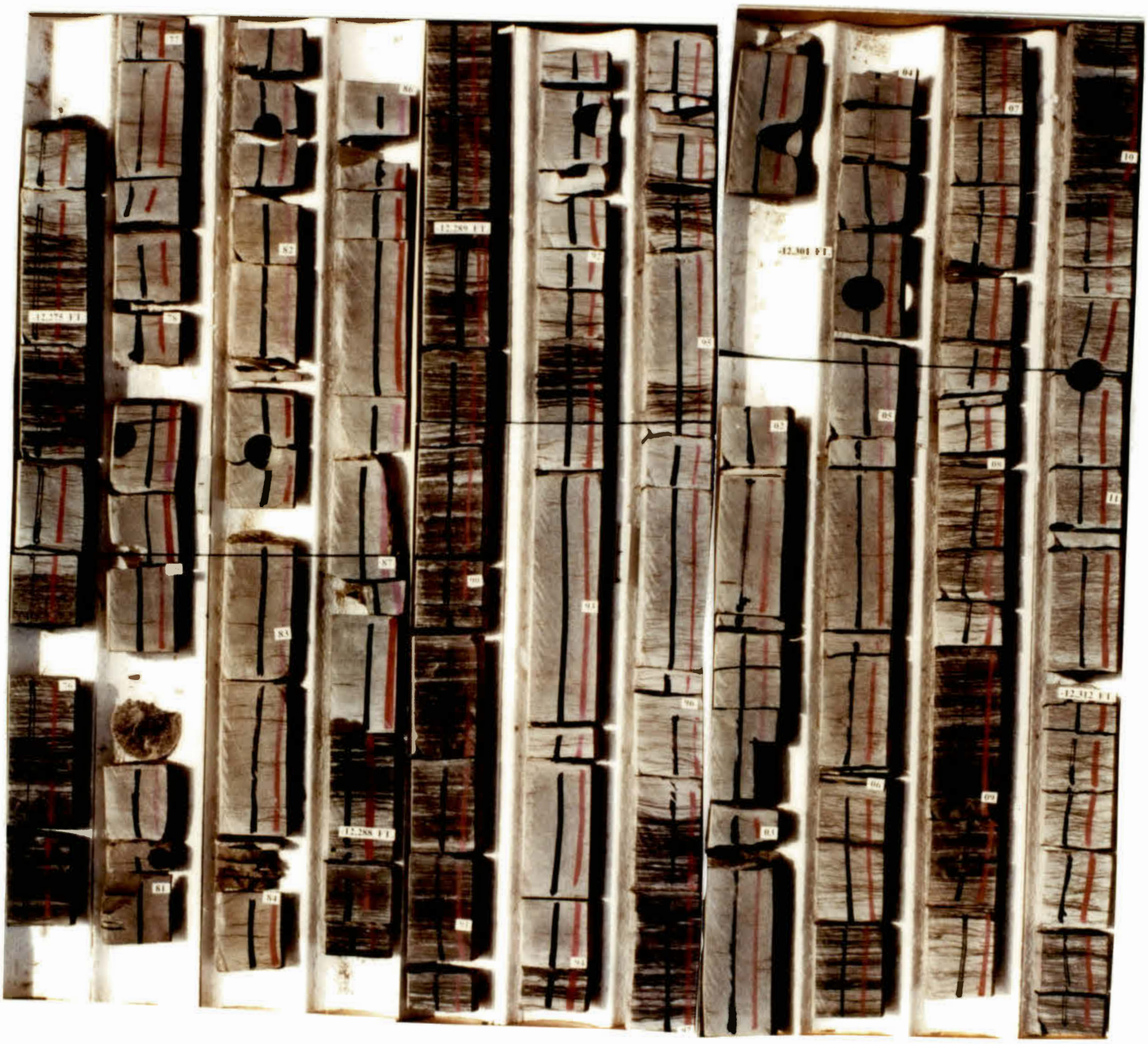


Figure 108 (Cont.). Internorth, Inc., Smith "B" 21 No. 1, 12,274' to 12,313', Upper Red Fork.

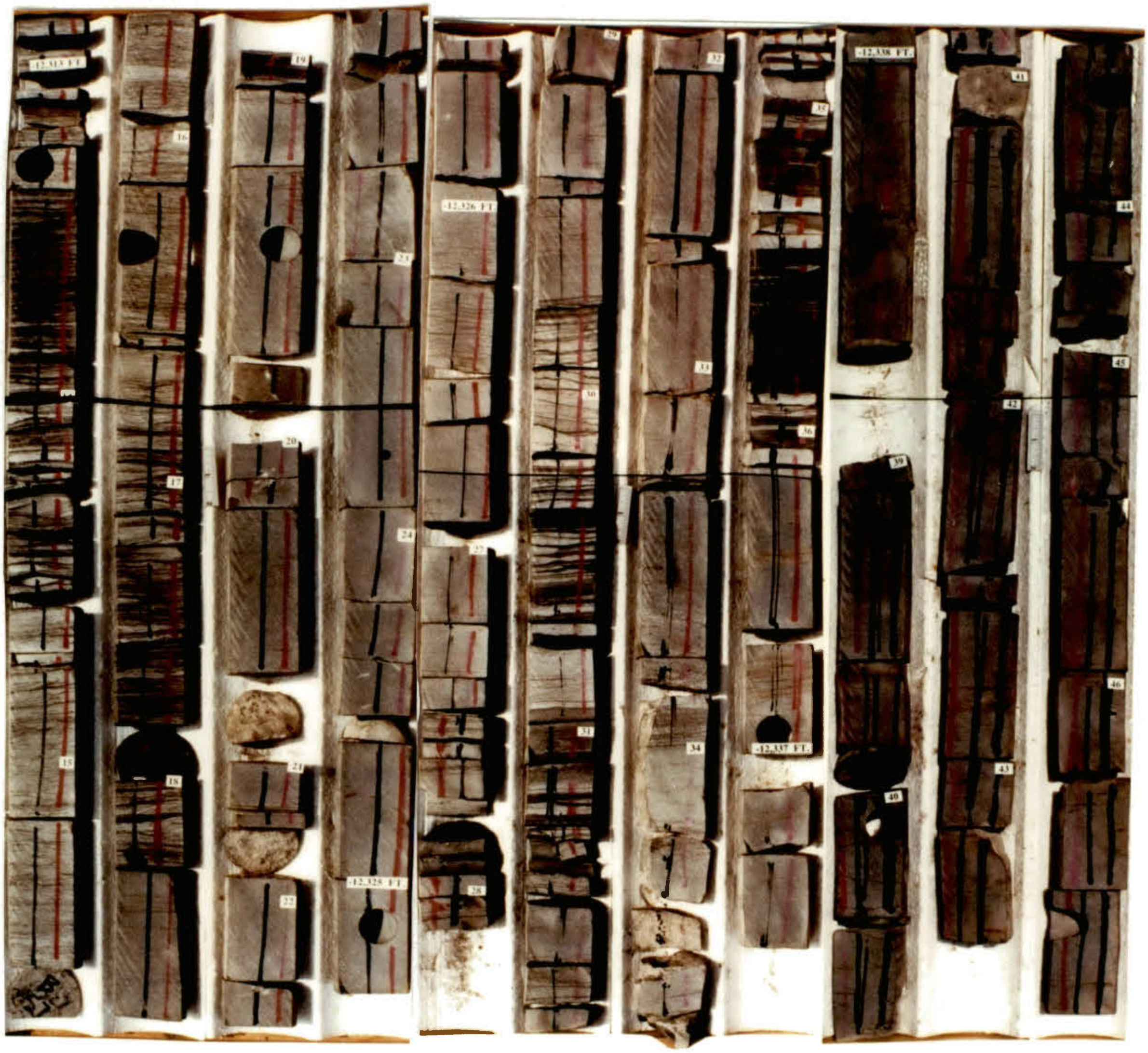


Figure 108 (Cont.). Internorth, Inc., Smith "B" 21 No. 1, 12,313' to 12,346.8', Upper Red Fork.

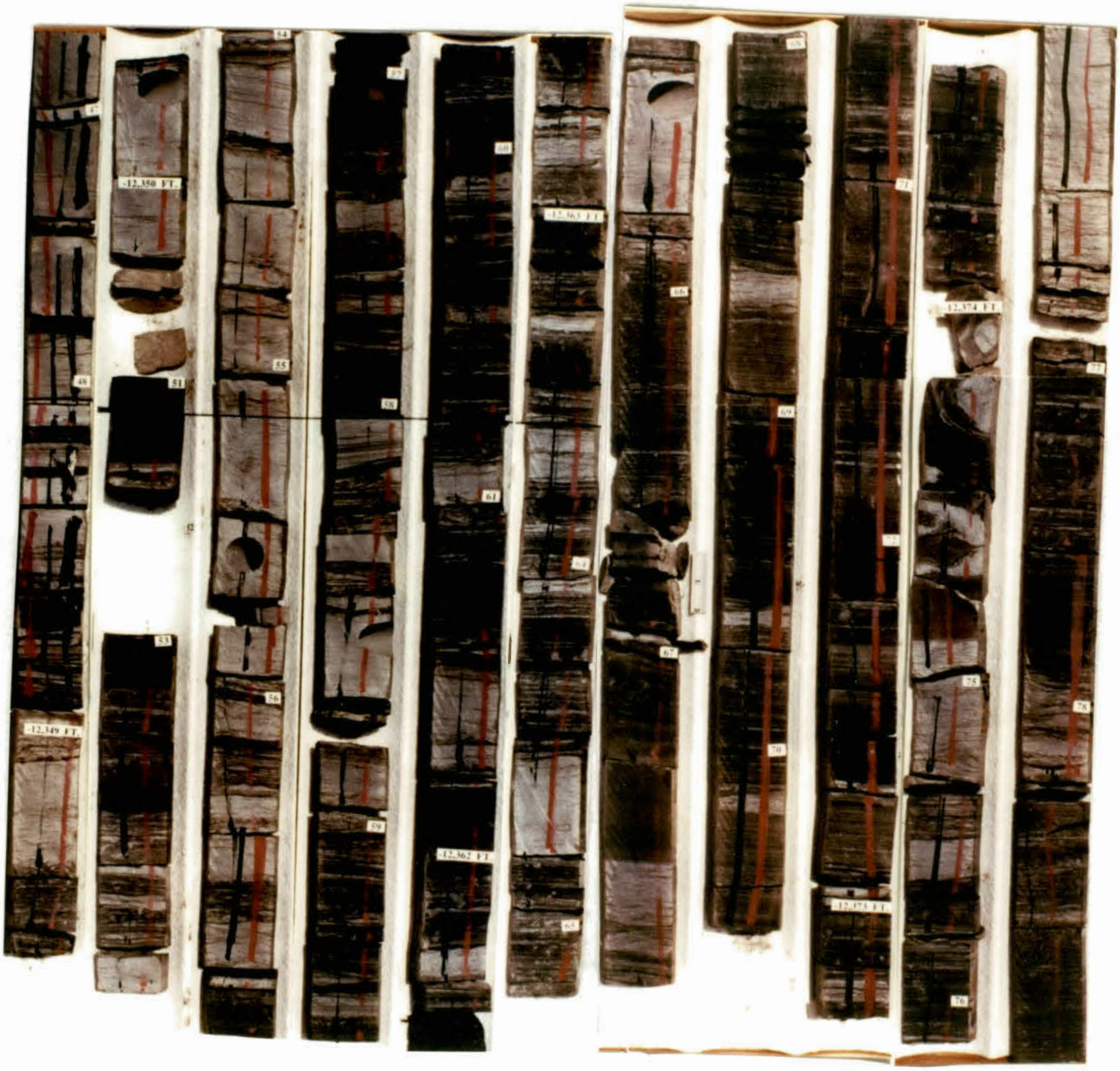


Figure 108 (Cont.). Internorth, Inc., Smith "B" 21 No. 1, 12,346.8' to 12,379', Upper Red Fork.

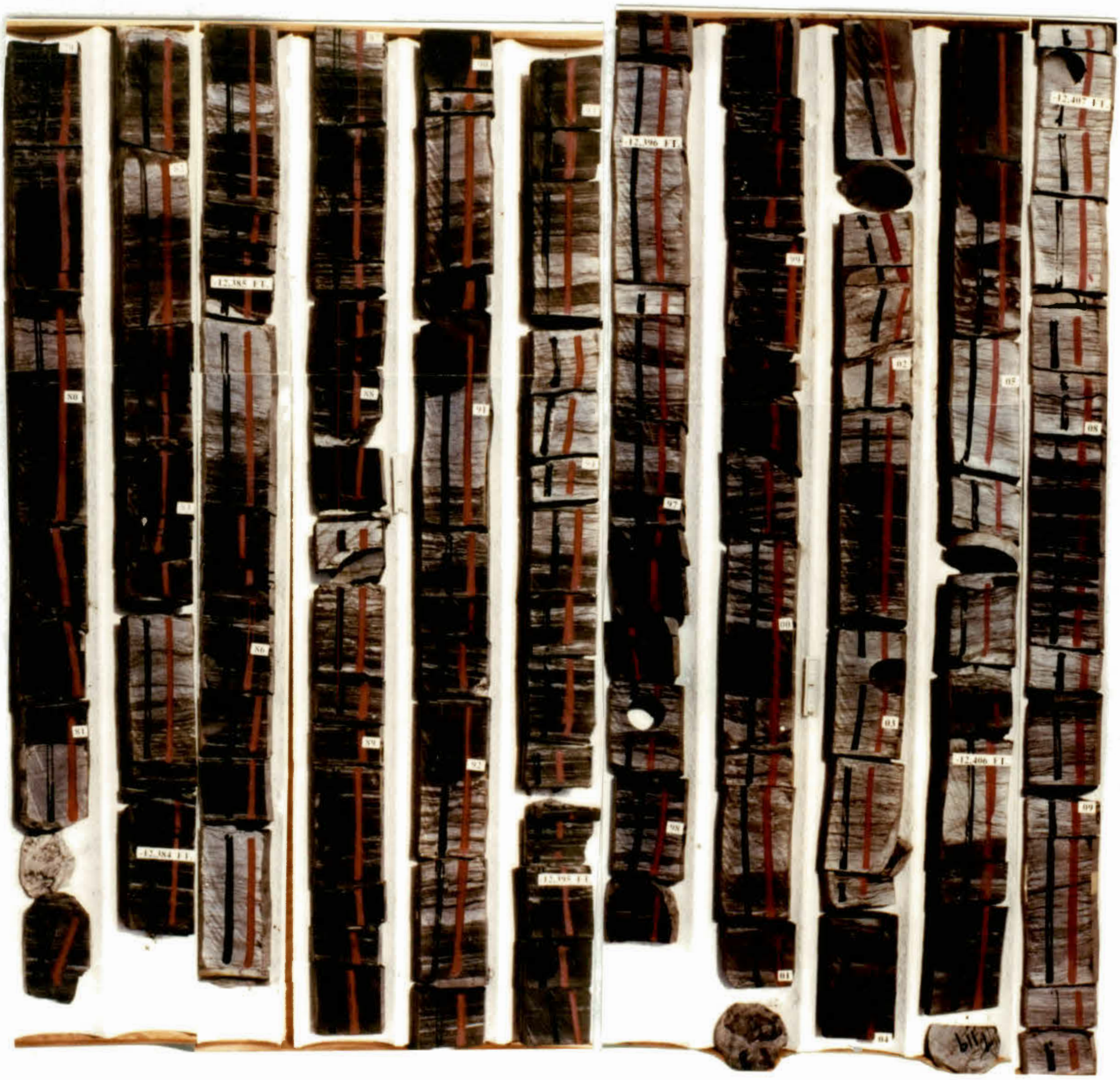


Figure 108 (Cont.). Internorth, Inc.,
Smith "B" 21 No. 1,
12,379' to 12,409.8',
Upper Red Fork.

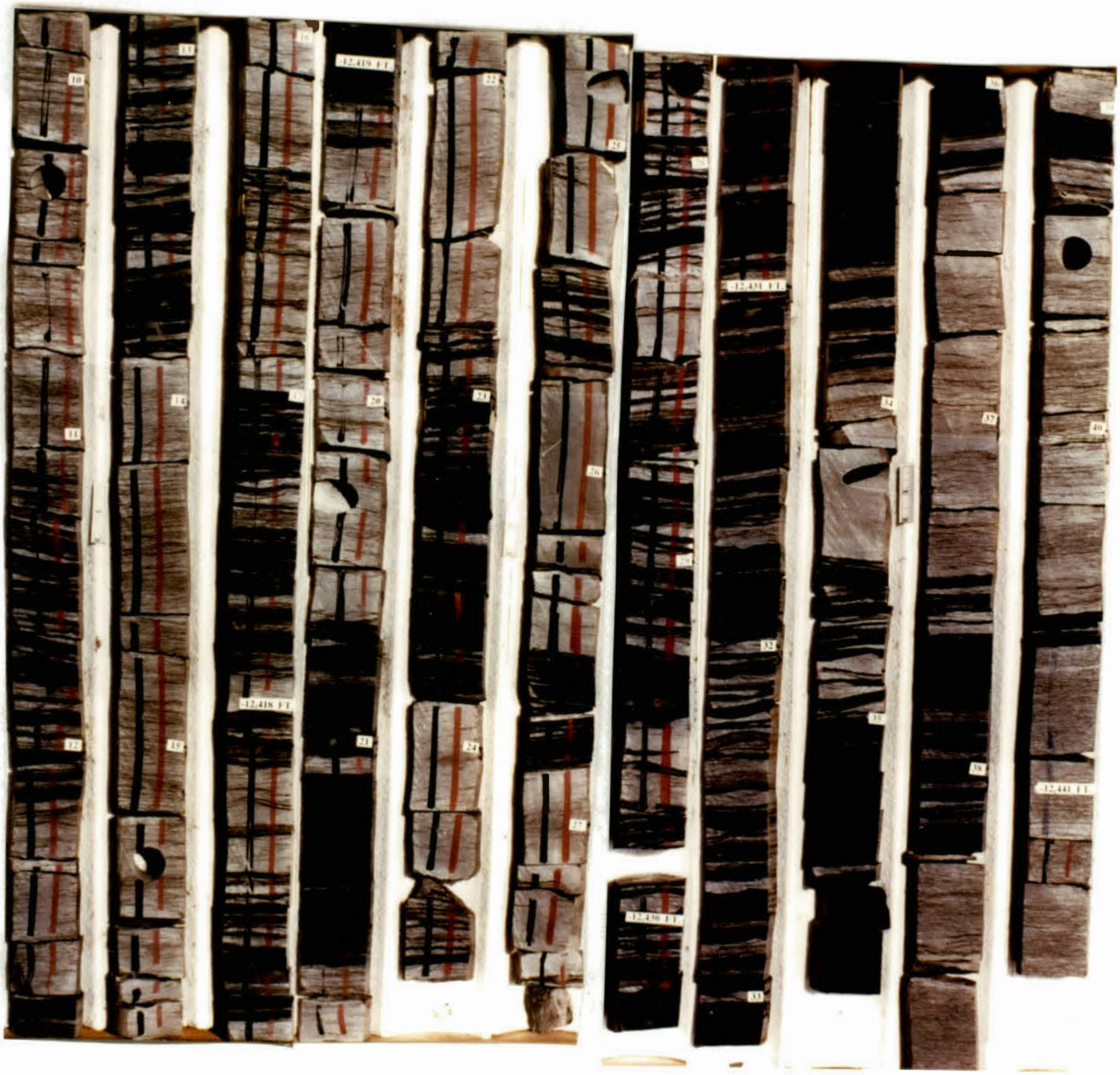


Figure 108 (Cont.). Internorth, Inc.,
Smith "B" 21 No. 1,
12,409.8' to 12,441.5',
Upper Red Fork.

Figure 108 (Cont.). Internorth, Inc.,
Smith "B" 21 No. 1,
12,441.5' to 12,474',
Upper Red Fork.

Figure 108 (Cont.). Internorth, Inc.,
Smith "B" 21 No. 1,
12,474' to 12,506',
Upper Red Fork.

Figure 108 (Cont.). Internorth, Inc., Smith "B" 21 No. 1, 12,506' to 12,532', Upper Red Fork.

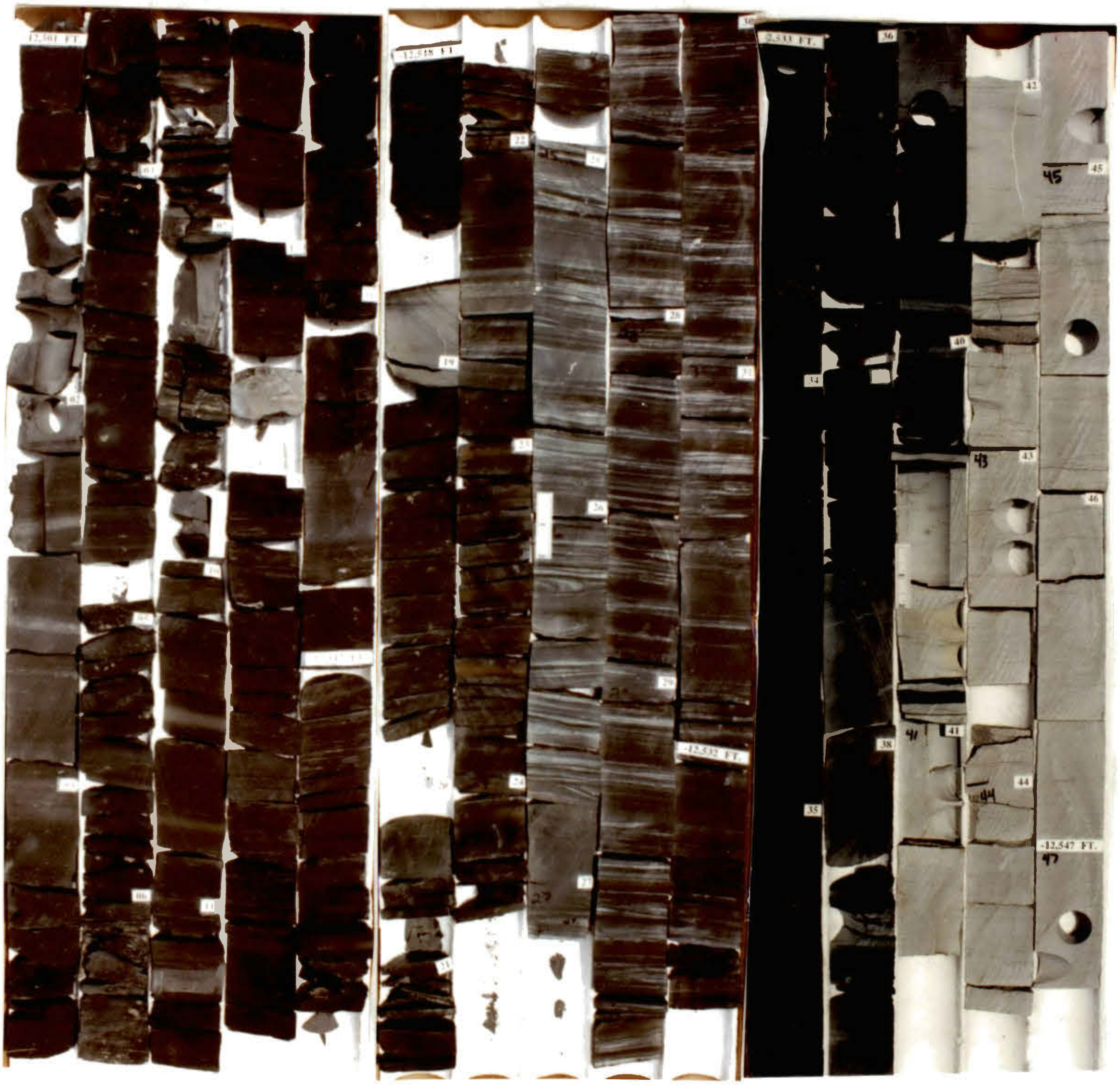


Figure 109. Inexco, Inc.,
Trent No. 1-25,
12,501' to 12,547.5',
Pink Limestone Equivalent
and Upper Red Fork.

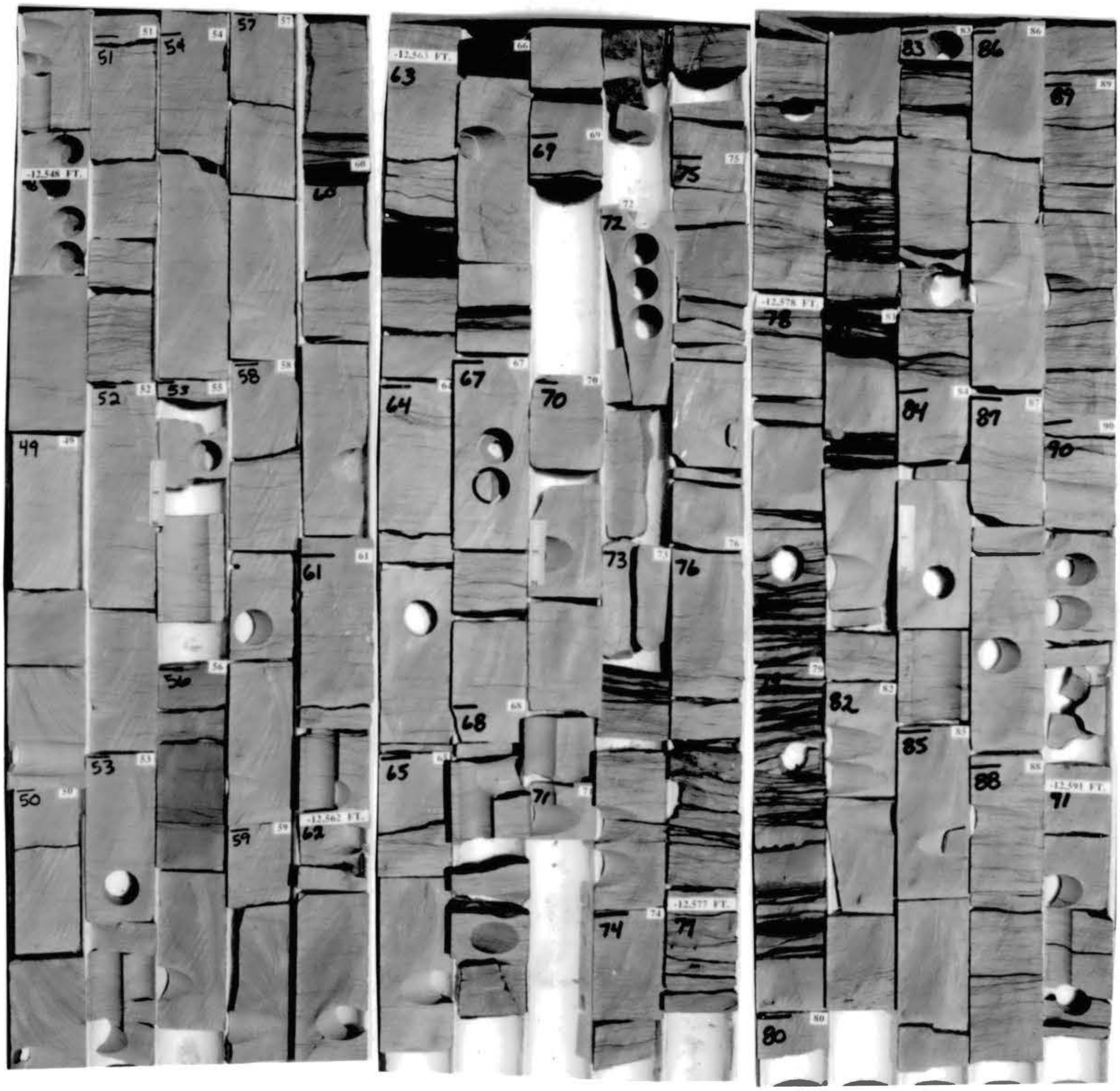


Figure 109 (Cont.). Inexco, Inc.,
Trent No. 1-25,
12,547.5' to 12,591.7',
Upper Red Fork.

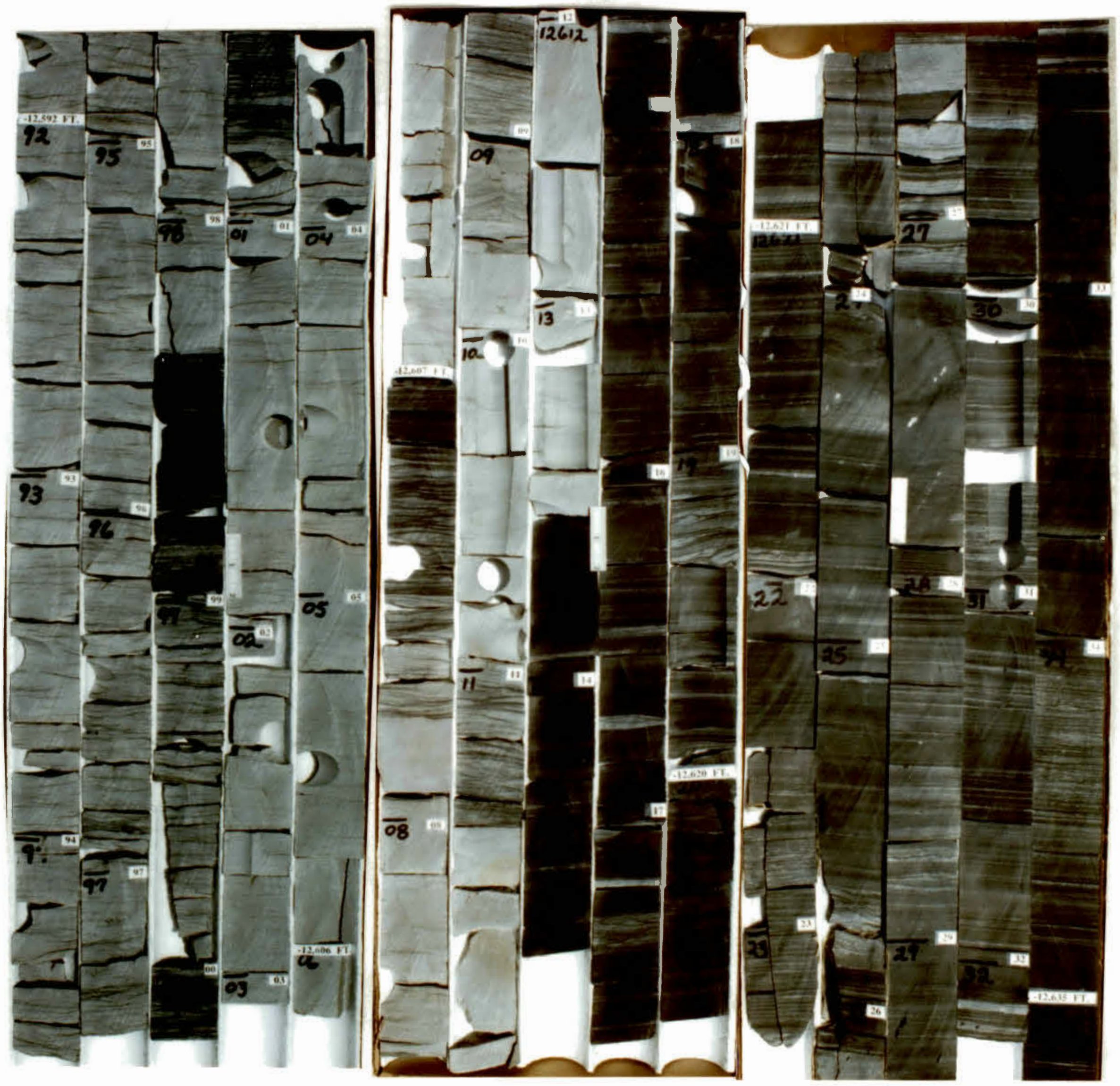


Figure 109 (Cont.). Inexco, Inc., Trent No. 1-25, 12,591.7' to 12,635.3', Upper Red Fork.

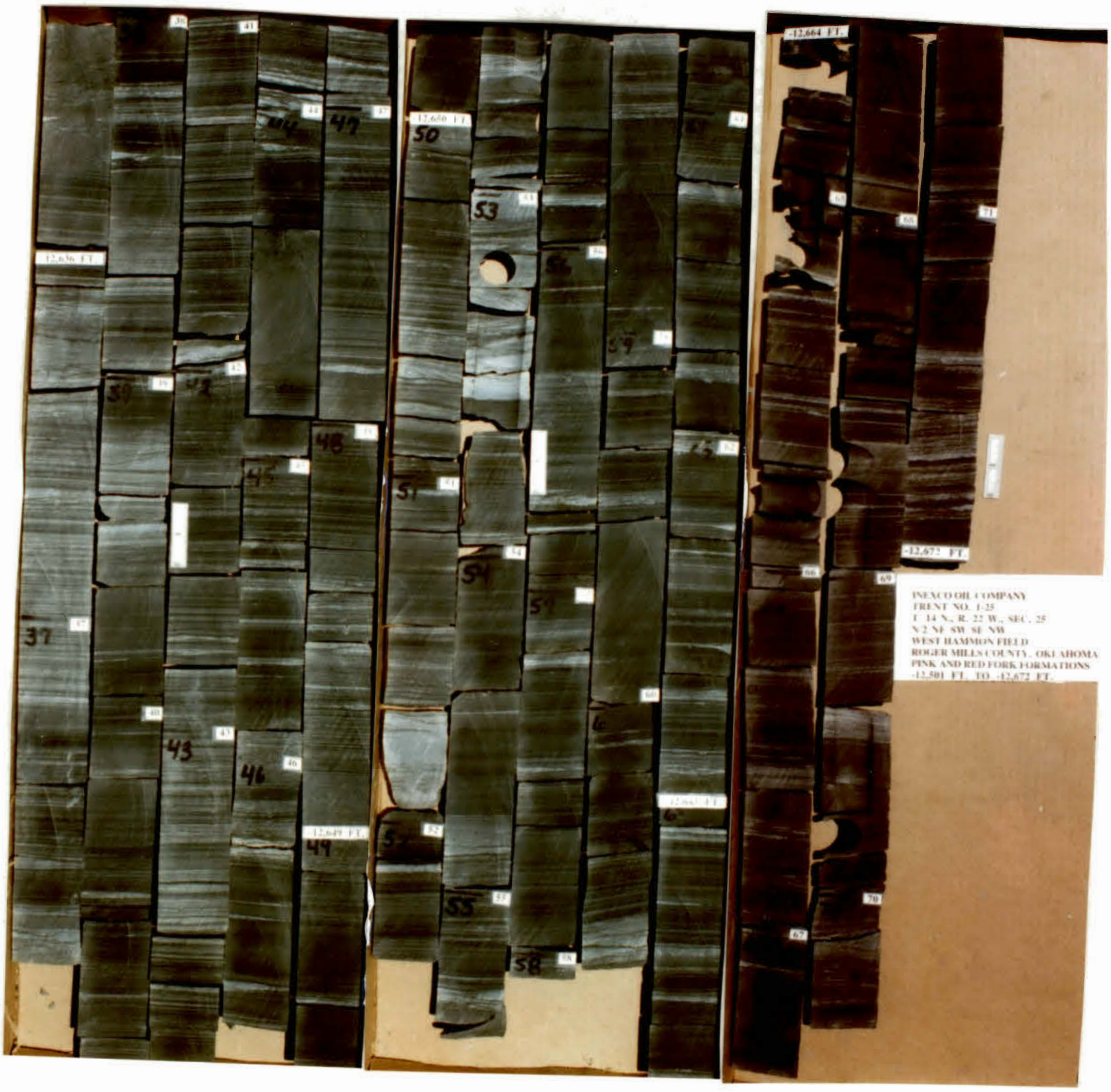


Figure 109 (Cont.). Inexco, Inc., Trent No. 1-25, 12,635.3' to 12,672', Upper Red Fork.

Figure 110. Tenneco Oil Co.,
Merrick No. 1-27,
12,695' to 12,724.5',
Upper Red Fork.

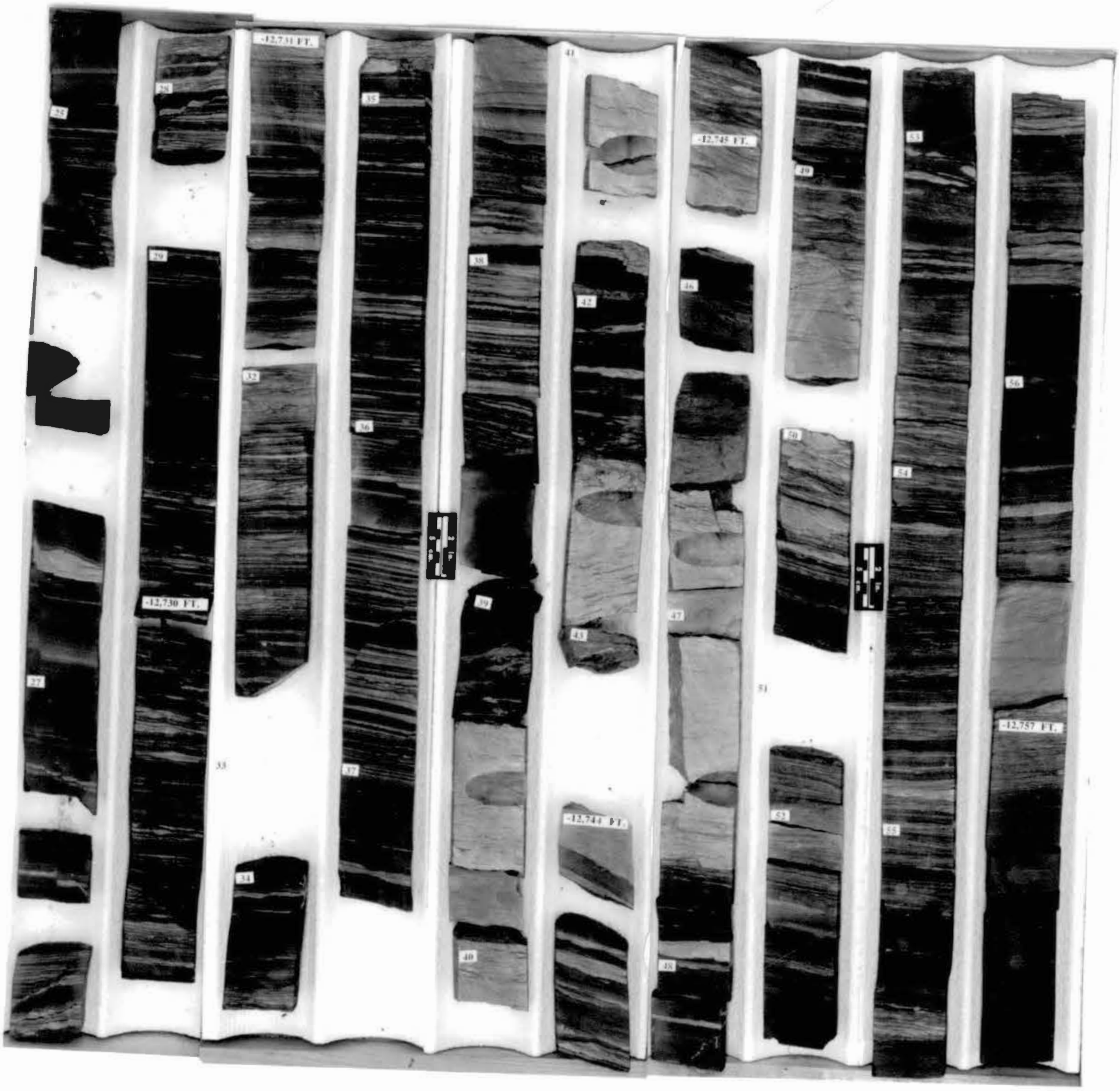


Figure 110 (Cont.). Tenneco Oil Co.,
Merrick No. 1-27,
12,724.5' to 12,758',
Upper Red Fork.

Figure 110 (Cont.). Tenneco Oil Co.,
Merrick No. 1-27,
12,758' to 12,786',
Upper Red Fork.

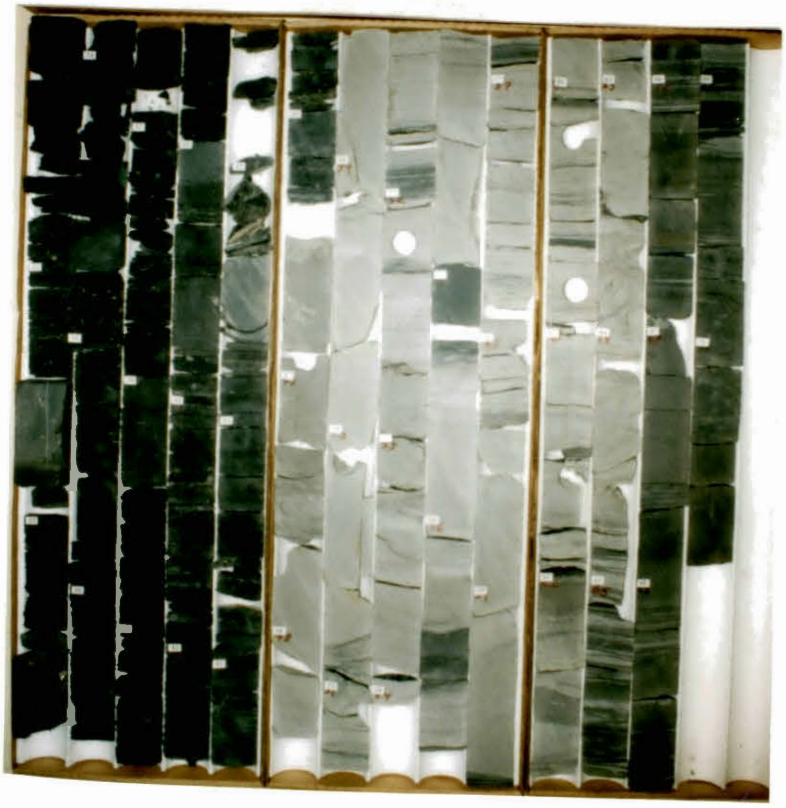


Figure 111. Tenneco Oil Co., Lester No. 1-6, 12,731' to 12,771', Lower Pink Limestone Equivalent and Upper Red Fork.

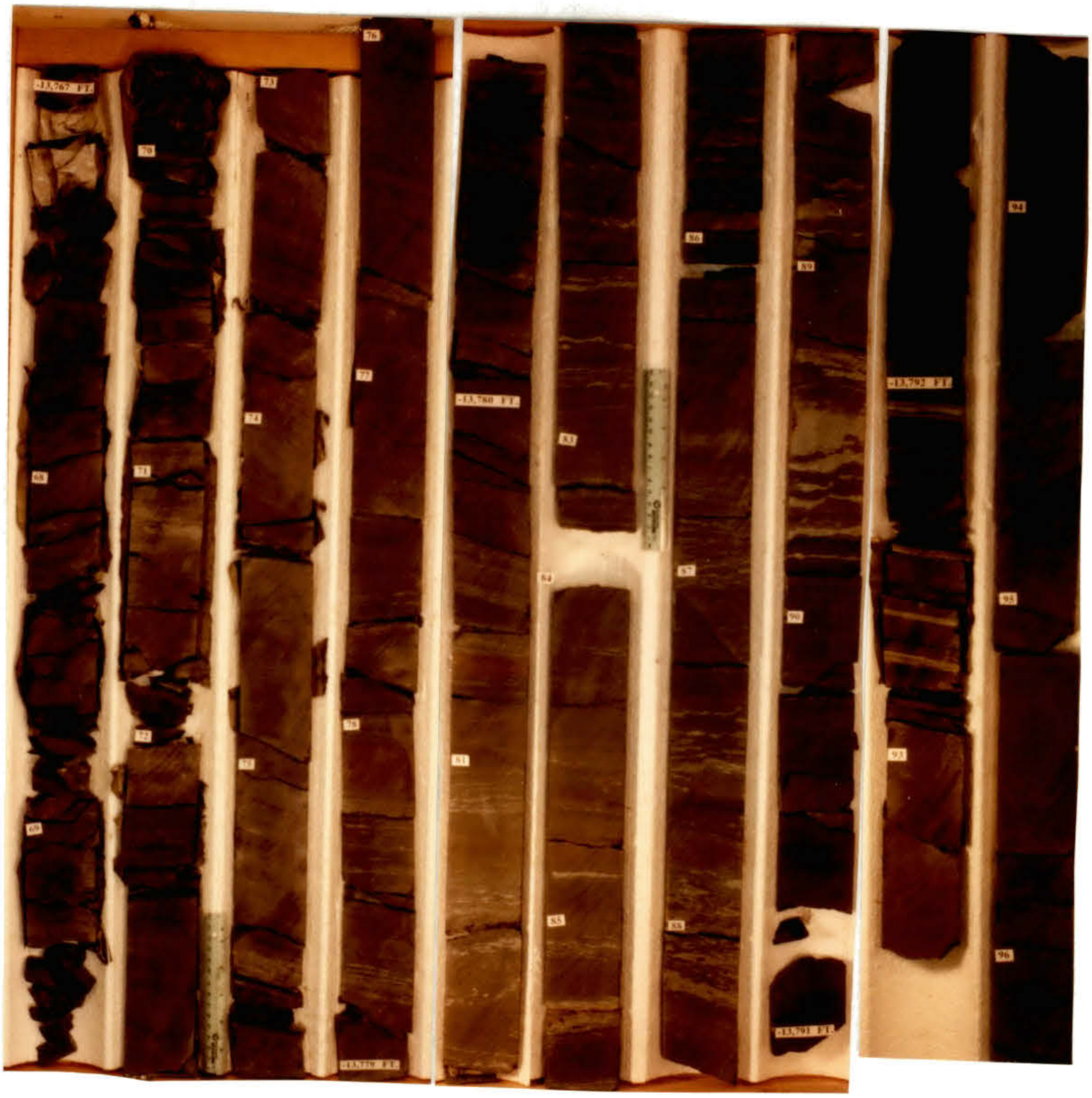


Figure 112. Tenneco Oil Co.,
Griffen No. 1-9,
13,767' to 13,796.3',
Lower Red Fork.

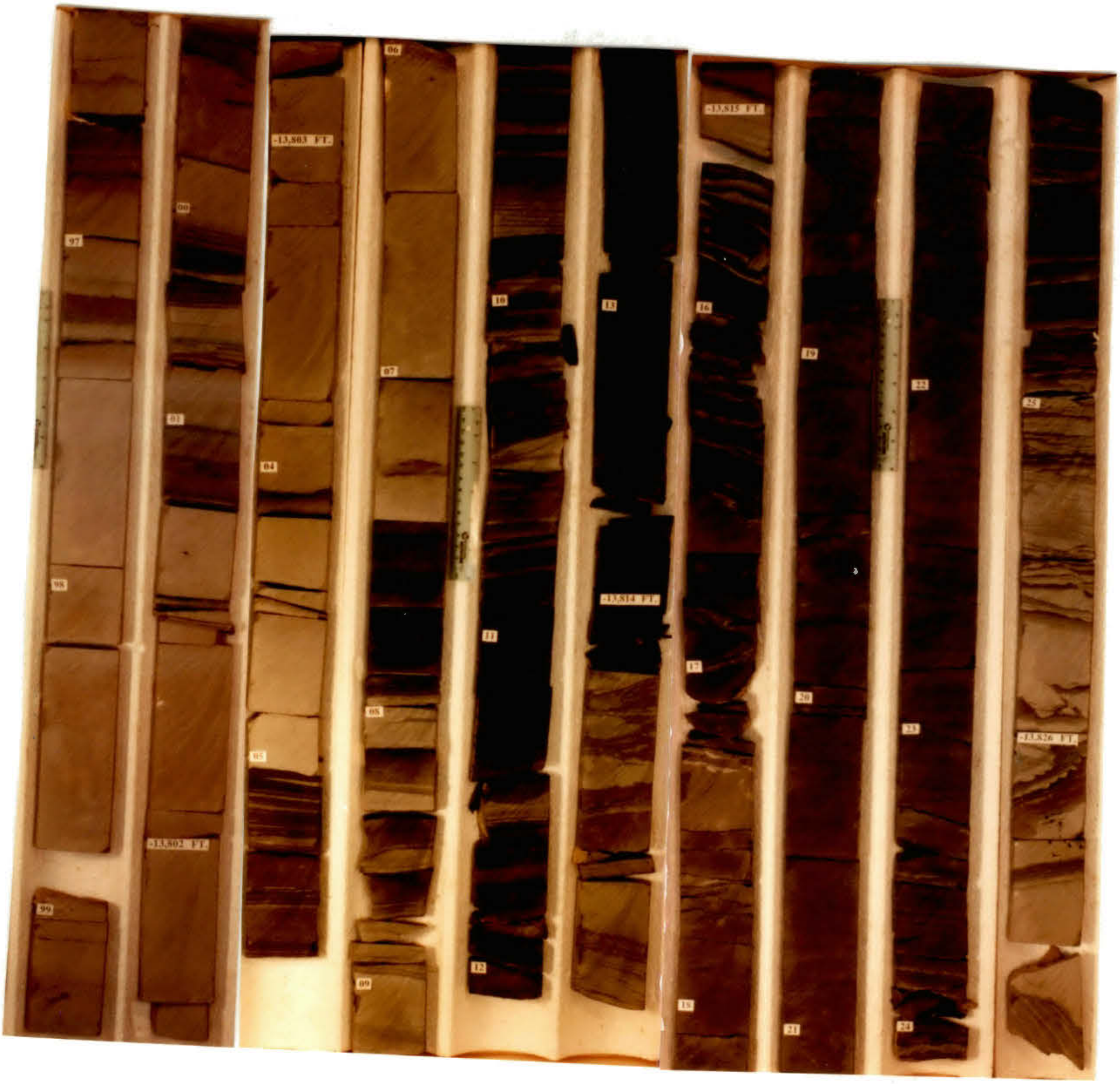


Figure 112 (Cont.). Tenneco Oil Co., Griffen No. 1-9, 13,796.3' to 13,827', Lower Red Fork.

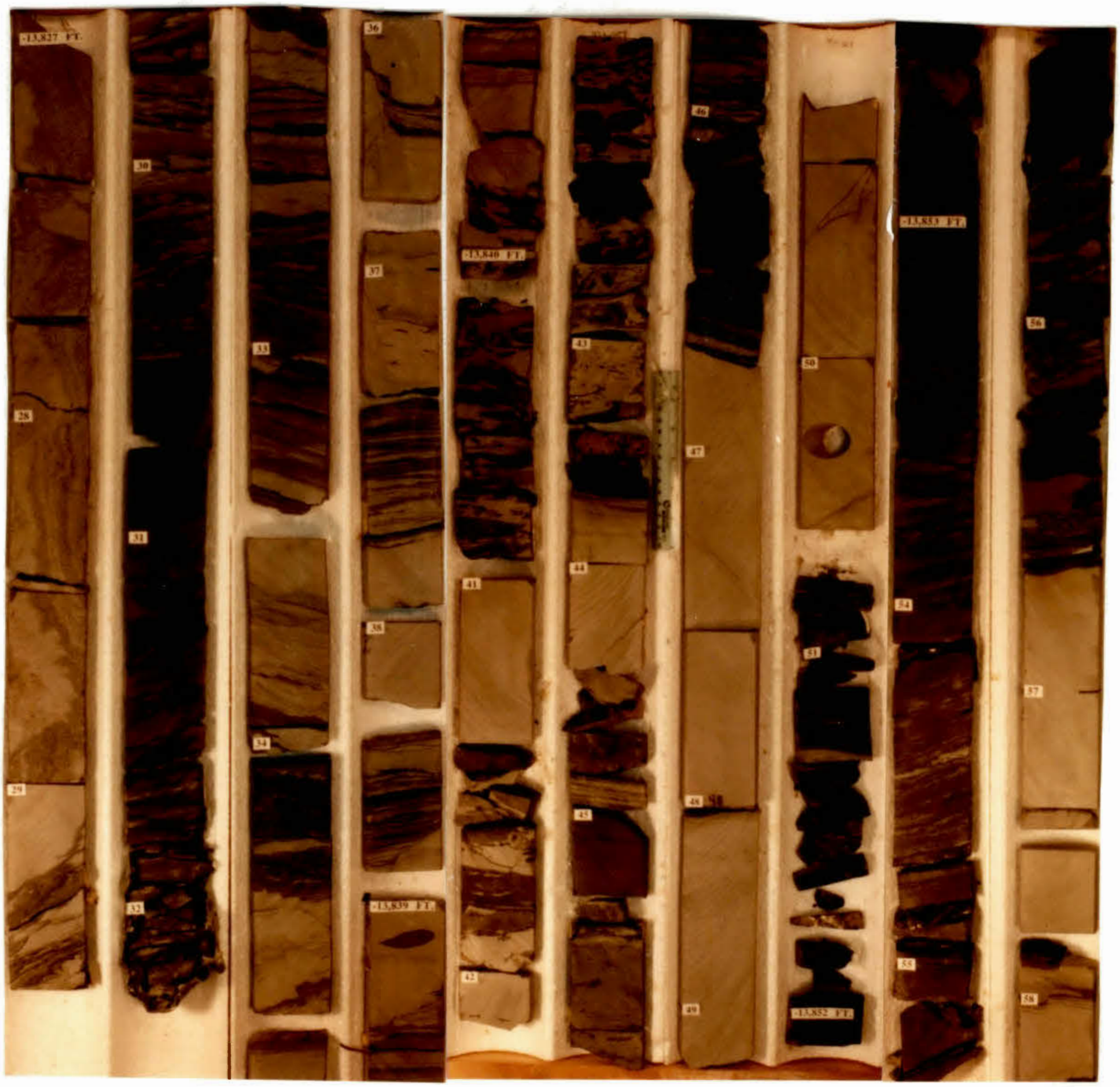


Figure 112 (Cont.). Tenneco Oil Co.,
Griffen No. 1-9,
13,827' to 13,858.3',
Lower Red Fork.

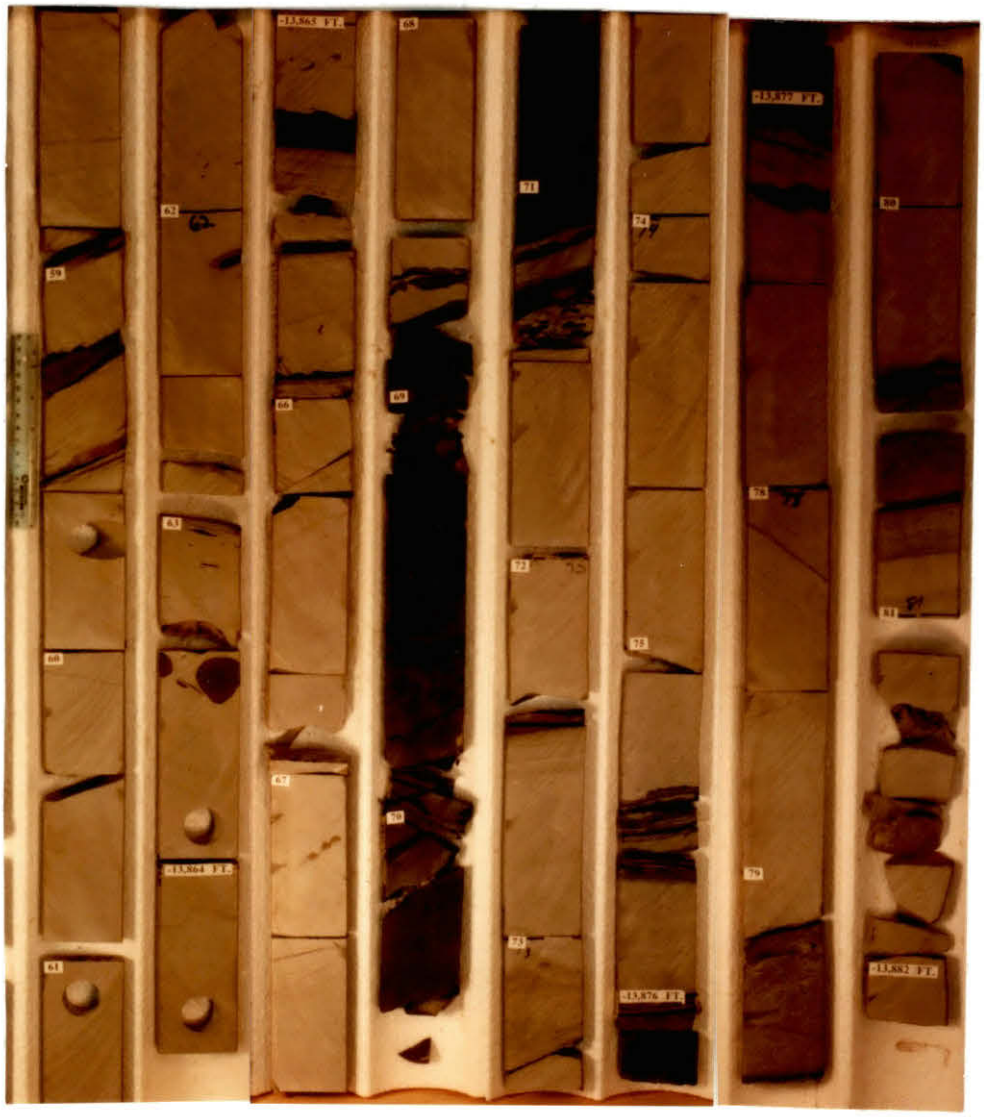


Figure 112 (Cont.). Tenneco Oil Co.,
Griffen No. 1-9,
13,858.3' to 13,882',
Lower Red Fork.

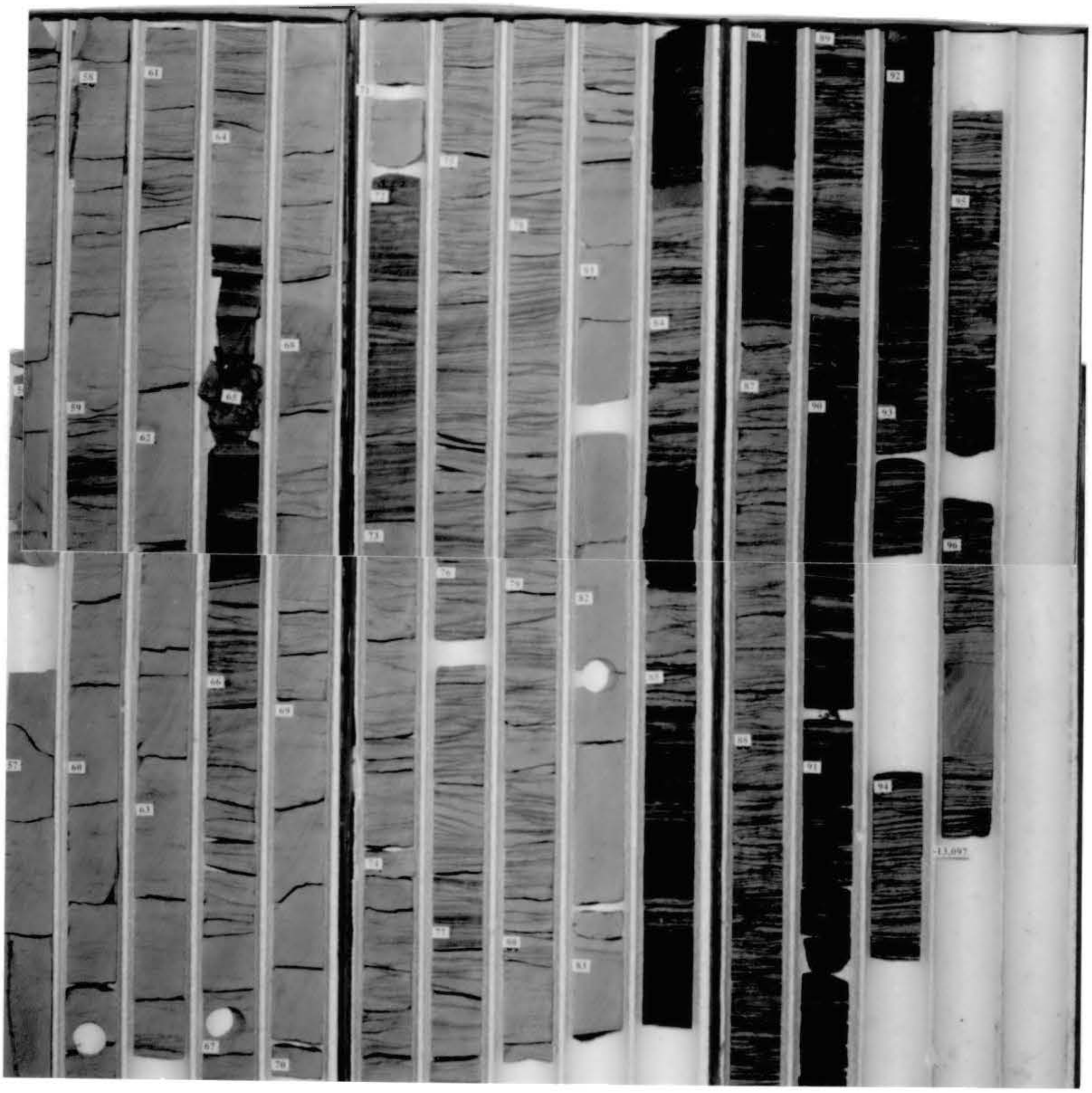


Figure 113. Louisiana Land & Exploration Co.,
Ruth No. 1-28,
13,055' to 13,097',
Upper Red Fork.

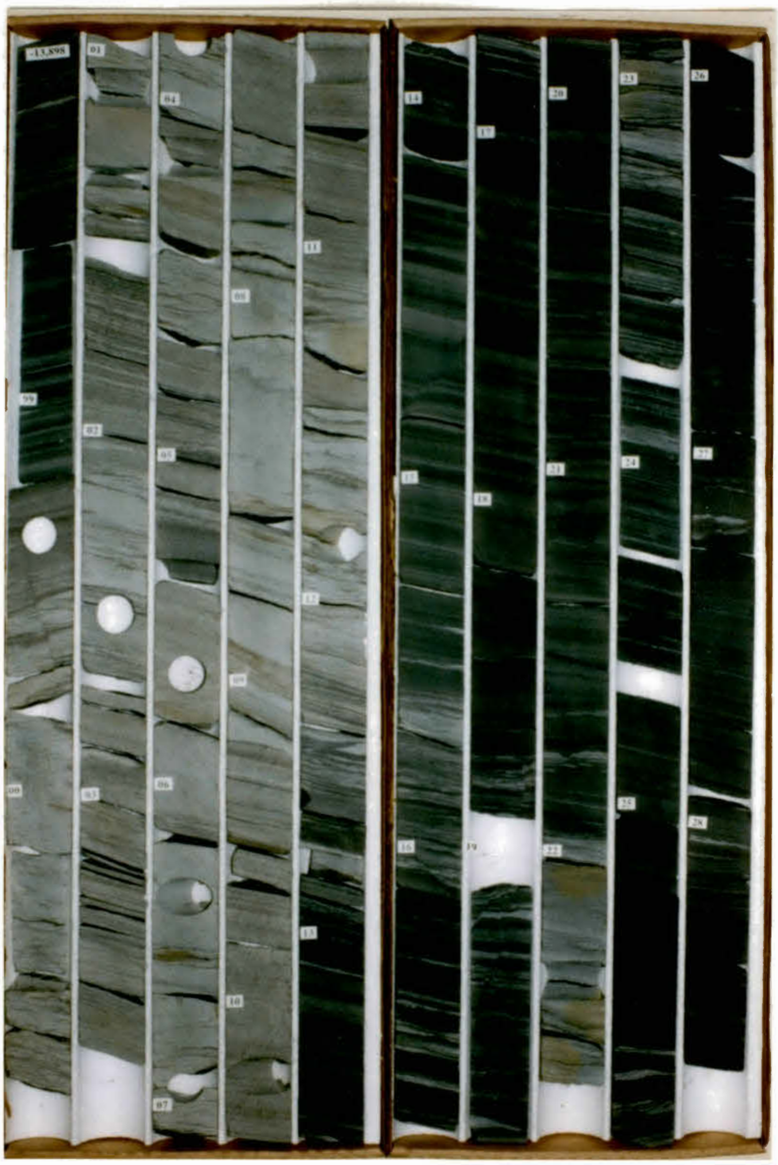


Figure 114. Southport Exploration, Inc., Merrick No. 1-10, 13,898' to 13,929', Upper Red Fork.

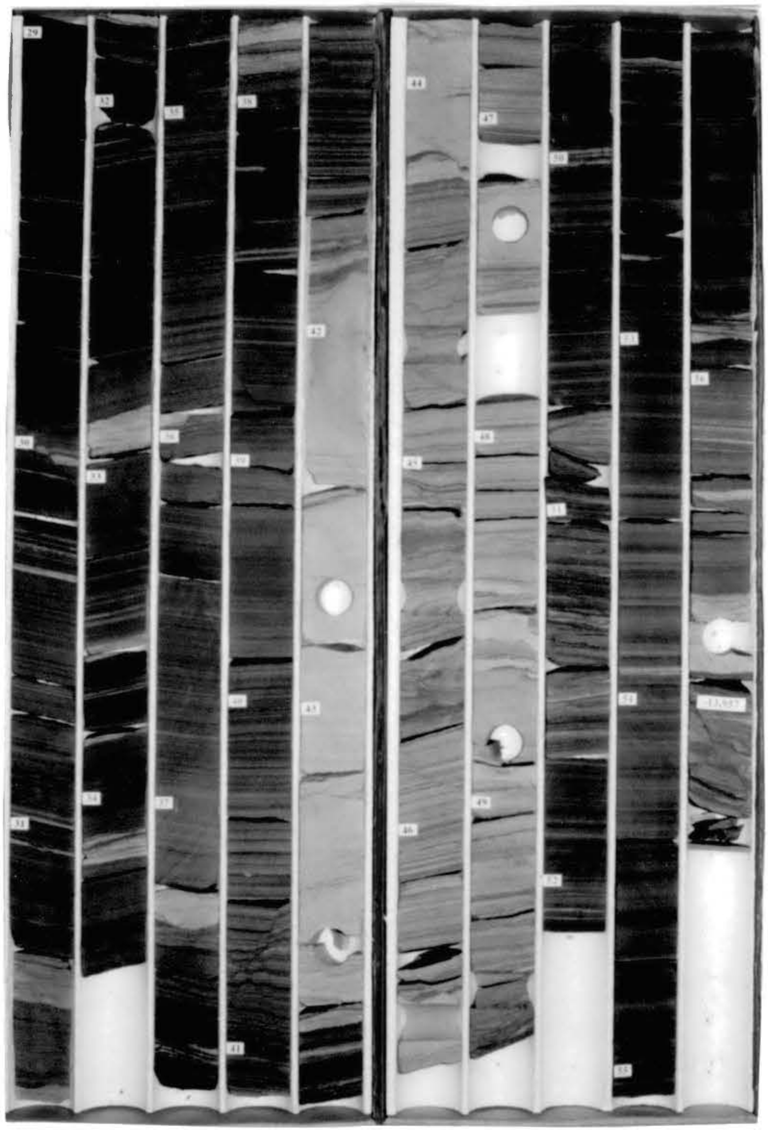


Figure 114 (Cont.). Southport Exploration, Inc., Merrick No. 1-10, 13,929' to 13,957.4', Upper Red Fork.

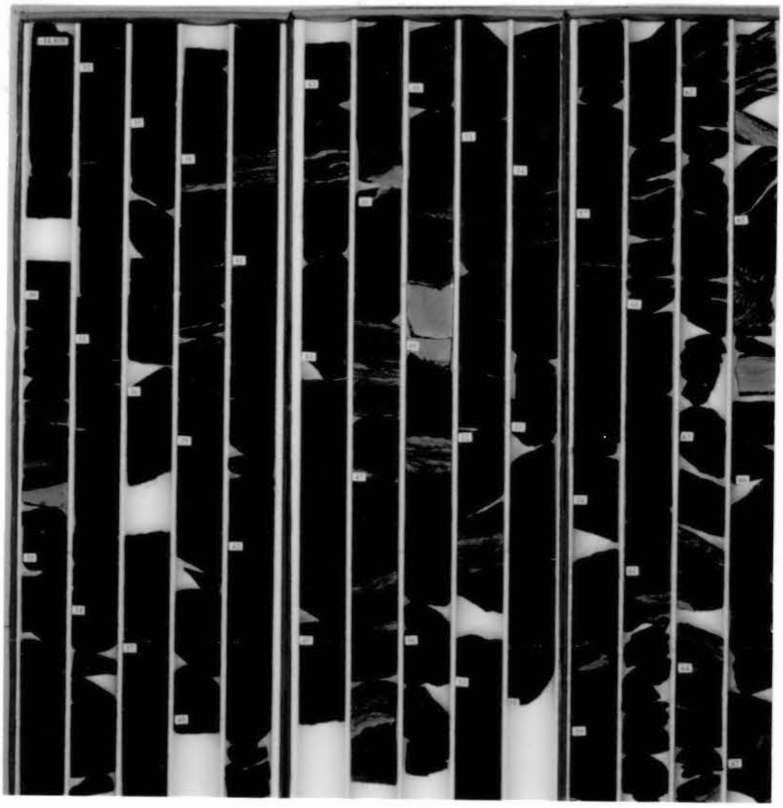


Figure 115. Southport Exploration, Inc.,
Merrick No. 1-10,
14,029' to 14,068',
Red Fork Formation.

APPENDIX D

CORE LOGS

CORE DESCRIPTION LOG

- SANDSTONE
- INTERBEDDED SANDSTONE AND SILTSTONE
- INTERBEDDED SANDSTONE AND SHALE/MUDSTONE
- SANDSTONE WITH CARBONACEOUS AND MICACEOUS LAMINAE (C, M)
- SANDSTONE WITH SILTSTONE LENSES
- SANDSTONE WITH SHALE/ MUDSTONE LENSES
- SILTSTONE
- INTERBEDDED SILTSTONE AND SANDSTONE
- INTERBEDDED SILTSTONE AND SHALE/MUDSTONE
- SILTSTONE WITH SANDSTONE LENSES
- SILTSTONE WITH SHALE LENSES
- SHALE/MUDSTONE
- INTERBEDDED SHALE/ MUDSTONE AND SANDSTONE
- INTERBEDDED SHALE/ MUDSTONE AND SILTSTONE
- SHALE/MUDSTONE WITH SANDSTONE LENSES
- SHALE/MUDSTONE WITH SILTSTONE LENSES

M	MASSIVE
L_H	HORIZONTAL LAMINAE
L_D	DIPPING LAMINAE
R	RIPPLE LAMINAE - COMMONLY ACCENTUATED BY CARBONACEOUS AND MICACEOUS SEDIMENTS
X-B	CROSS-BEDDED
SSD	SOFT SEDIMENT DEFORMATION
B_V	VERTICAL BURROWS
B_H	HORIZONTAL BURROWS
B	INDISTINGUISHABLE BURROWS
WE_D	WATER ESCAPE STRUCTURES - DISH
WE_P	WATER ESCAPE STRUCTURES - PIPE

STRUCTURES DEFINED BY

(GR)	CHANGE IN GRAIN SIZE
(SH)	SHALE CLAST ORIENTATION
(M,C)	MICACEOUS OR CARBONACEOUS SEDIMENT
(S.L)	SHALEY LAMINAE
(COL)	COLOR CHANGE IN SEDIMENTS

OTHER

P	PYRITE		CEMENT *
S	SIDERITE	C_S	SIDERITE CEMENT
G	GLAUCONITE	C_C	CALCITE CEMENT
F_M	MICROFAULTS	C_D	DOLOMITE CEMENT
TS	THIN SECTION OBTAINED		
NA	MISSING OR UNRECOVERED CORE		

* SILICA CEMENT UNLESS OTHERWISE INDICATED

CONTACTS

A	ABRUPT	F	FAULTED
B	BORED	G	GRADATIONAL
D	DEFORMED	S	SCOUR MARK
E	EROSIONAL	O	OTHER

Company: Woods Petroleum Corporation.

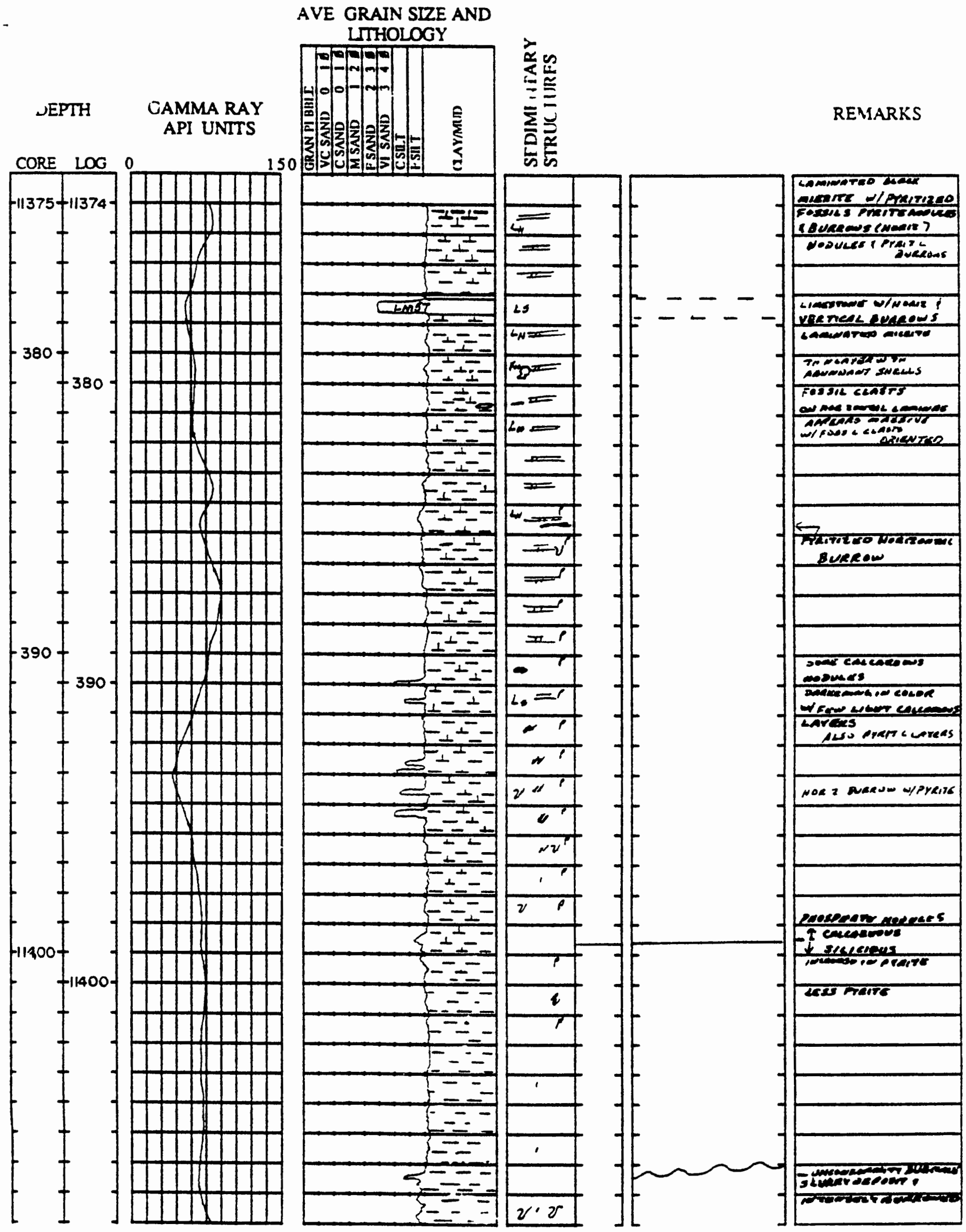
Well: Switzer "C" No. 5-1.

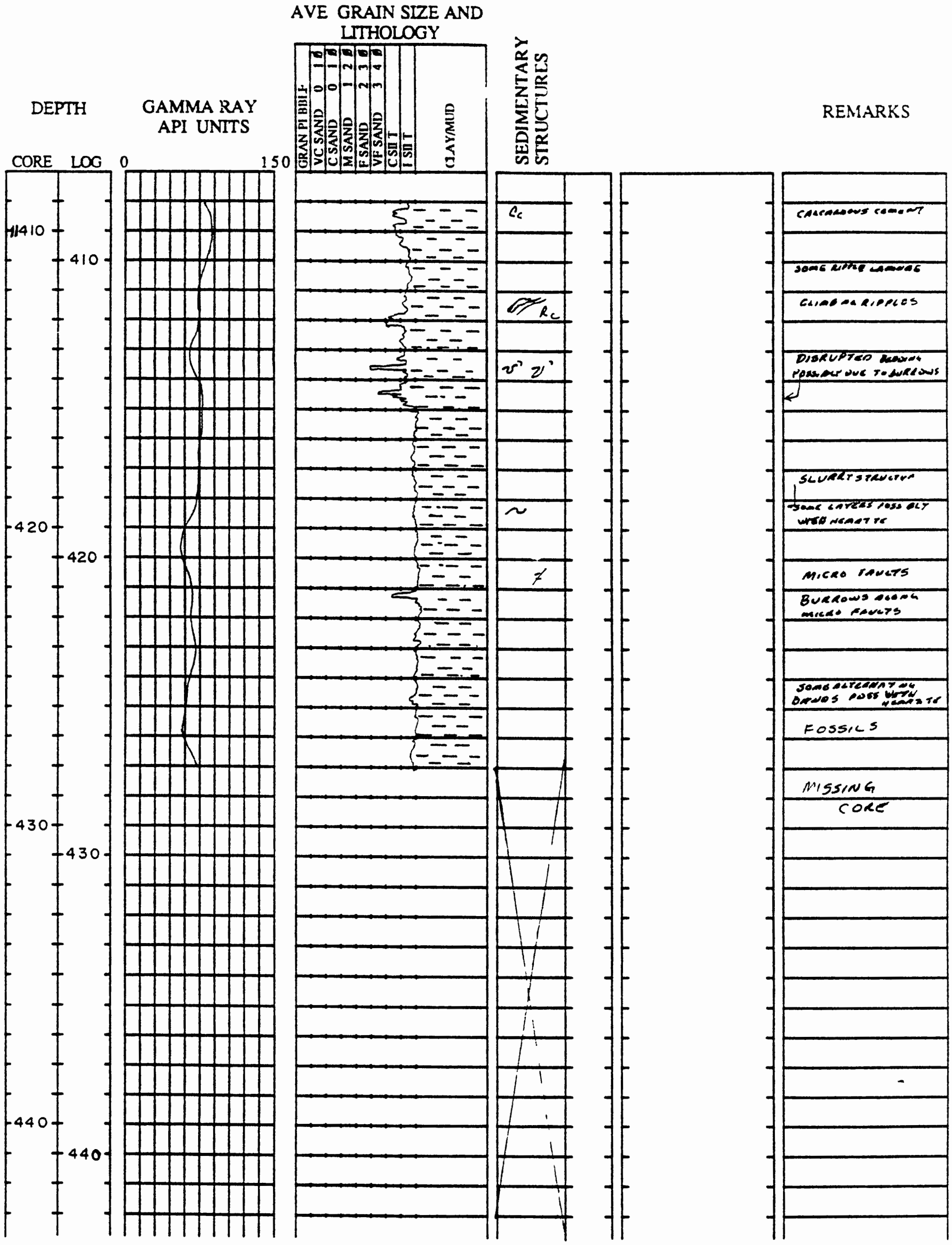
Location: C-NE Sec. 5, T. 15N., R. 21W., Roger Mills County, Oklahoma.

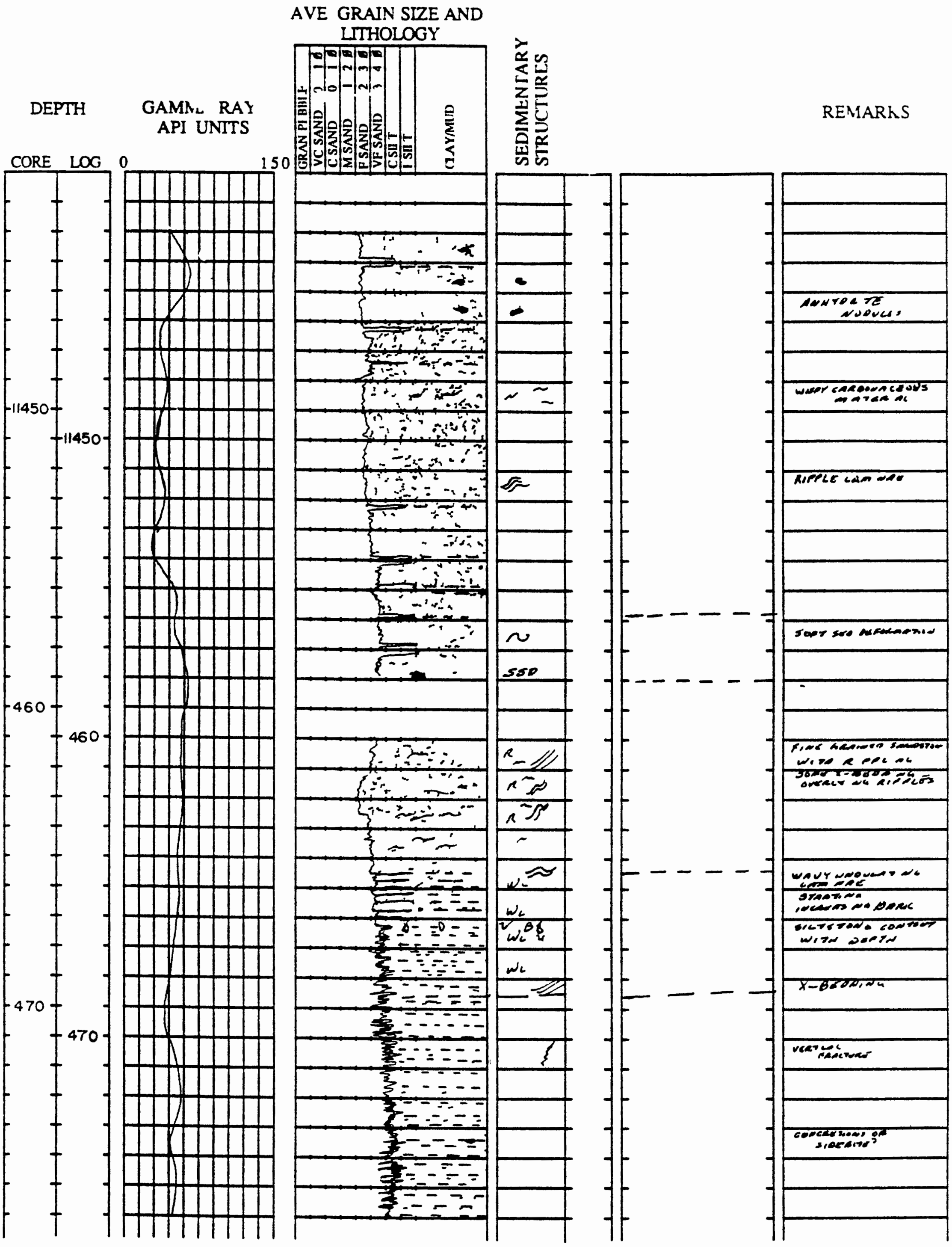
Stratigraphic Interval: Lower Pink Limestone Equivalent and Upper Red Fork Sandstone.

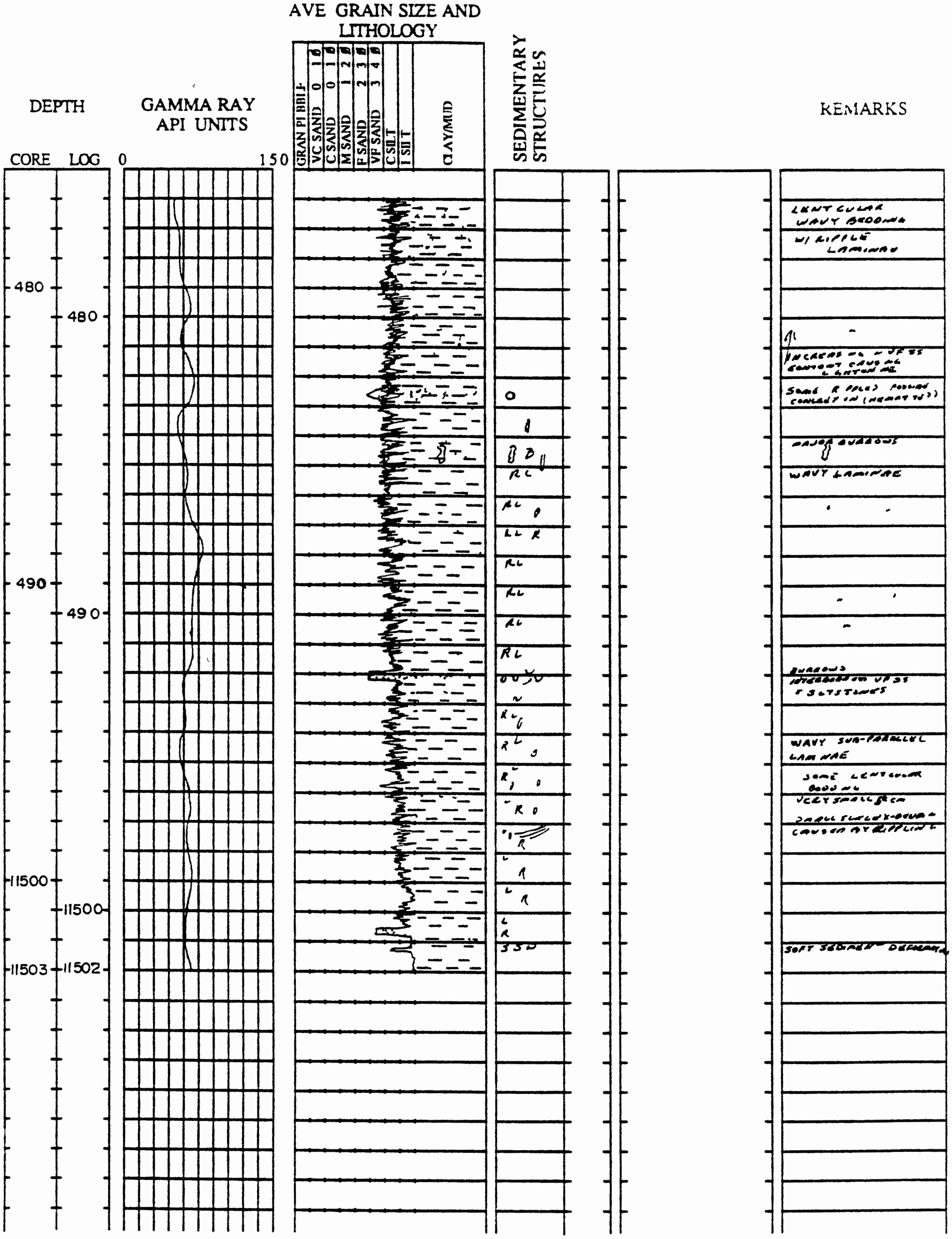
Core depth: 11,375 ft. to 11,503 ft.

Core to log correction: 1 ft.




AVE GRAIN SIZE AND LITHOLOGY
DEPTH
CORE
LOG
GAMMA RAY API UNITS
0
150
GRAN PEBBLE
VC SAND
C SAND
M SAND
F SAND
VF SAND
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
REMARKS
410
420
430
440
CALCAREOUS CEMENT
SOME RIPPLE LAMINAE
CLIMBING RIPPLES
DISRUPTED BEDDING POSSIBLY DUE TO BURROWS
SLURRY STRUCTURE
SOME LAYERS POSSIBLY WITH HEMATITE
MICRO FAULTS
BURROWS ALONG MICRO FAULTS
SOME ALTERNATING BANDS POSS WITH HEMATITE
FOSSILS
MISSING CORE


AVE GRAIN SIZE AND LITHOLOGY
DEPTH
GAMMA RAY API UNITS
CORE
LOG
0
150
GRAN PEBBLE
VC SAND
C SAND
M SAND
F SAND
VF SAND
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
REMARKS
11450
11450
460
460
470
470
SSD
ANHYDRITE NODULES
WISPY CARBONACEOUS MATERIAL
RIPPLE LAMINAE
SOFT SED DEFORMATION
X-BEDDING
VERTICAL FRACTURE
CONCRETIONS OF SIDERITE?



AVE GRAIN SIZE AND LITHOLOGY
GRAN PI BBLE
VC SAND
C SAND
M SAND
F SAND
VF SAND
C SILT
f SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
DEPTH
GAMMA RAY API UNITS
CORE LOG
0
150
REMARKS
480
480
490
490
11500
11500
11503
11502
LENTICULAR WAVY BEDDING
W/ RIPPLE LAMINAE
SOME RIPPLES
MAJOR BURROWS
WAVY LAMINAE
BURROWS
WAVY SUB-PARALLEL LAMINAE
SOME LENTICULAR BEDDING
SOFT SEDIMENT DEFORMATION

Company: Louisiana Land & Exploration.

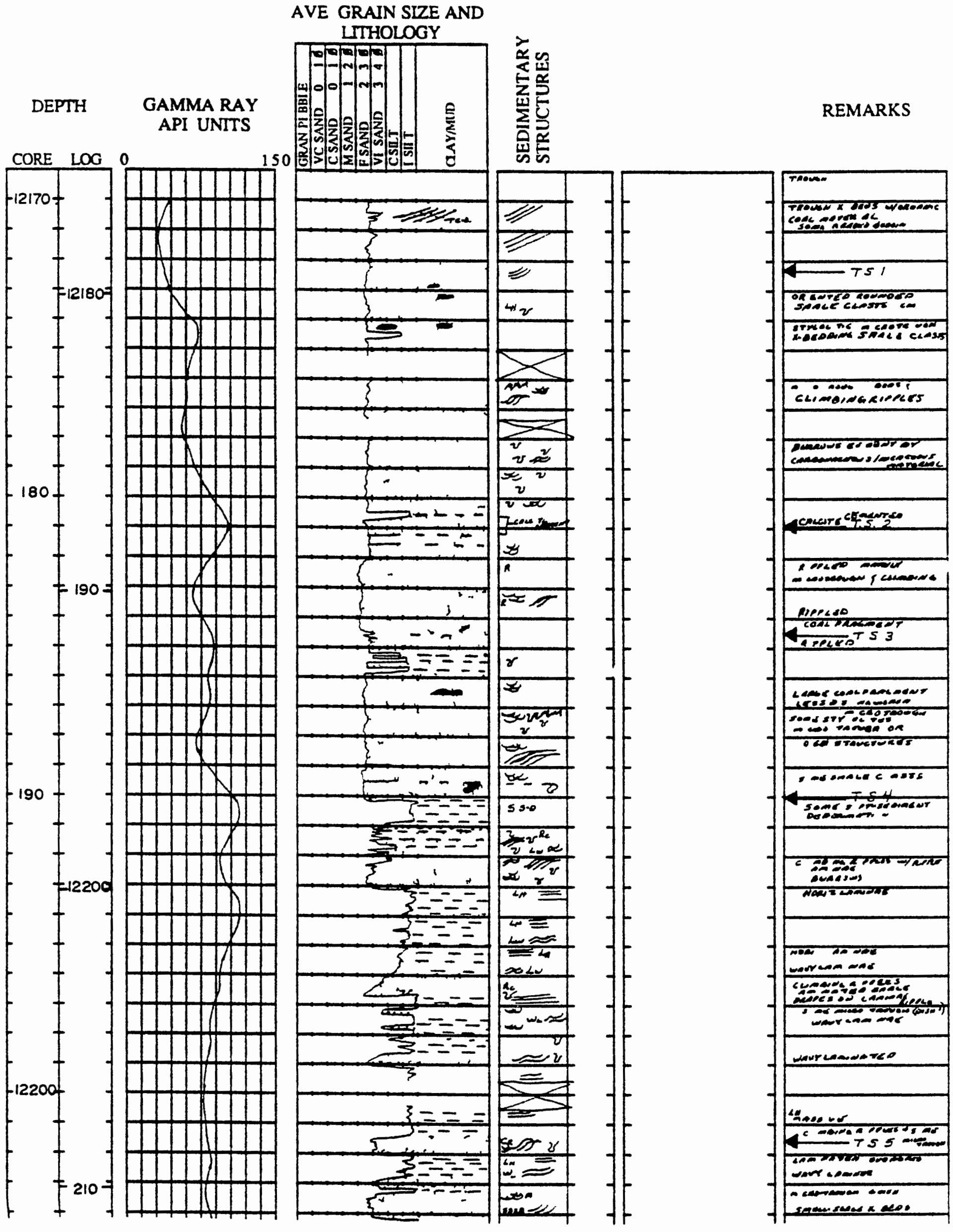
Well: Gates No. 2-33.

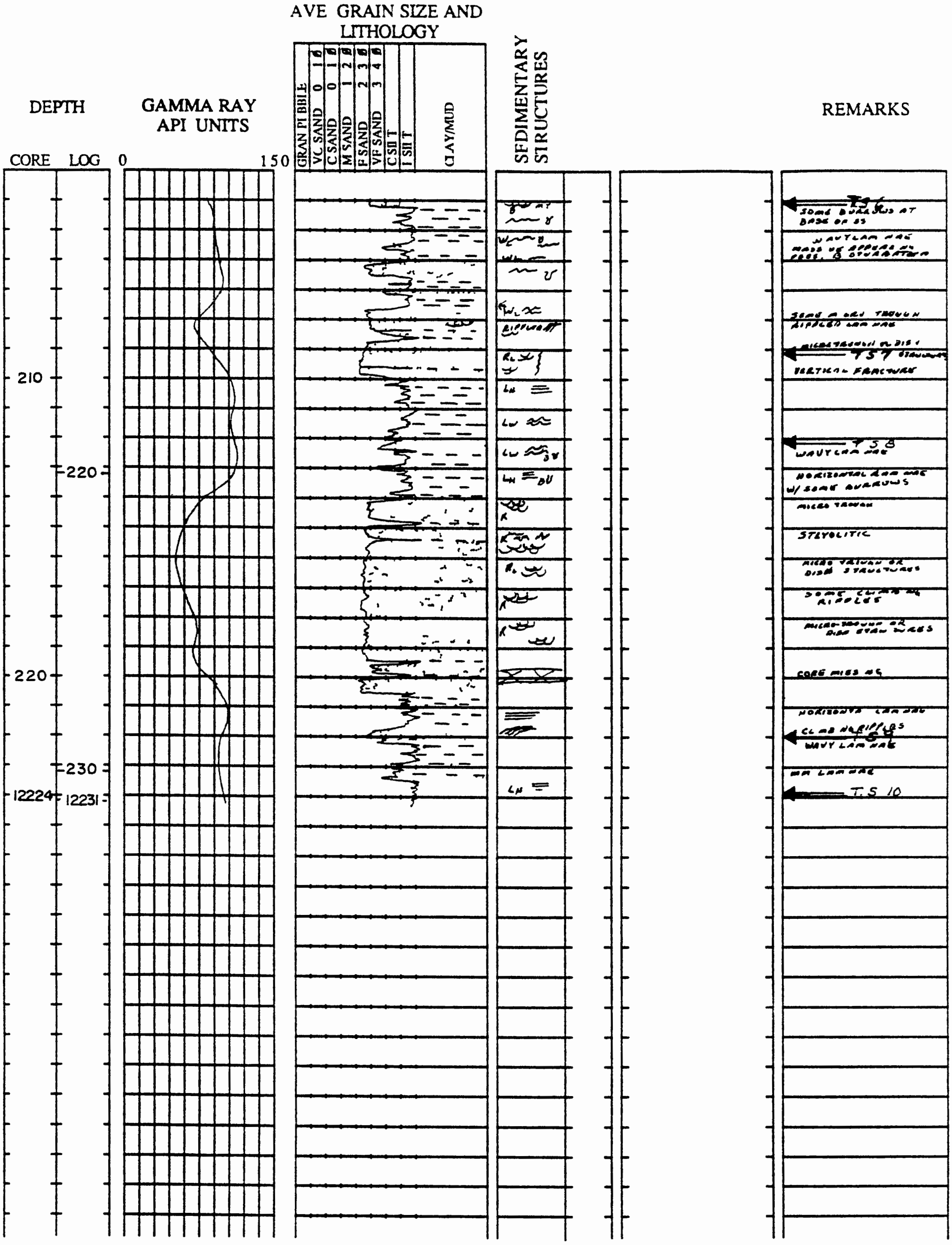
Location: C-SE Sec. 33, T. 15N., R. 22W., Roger Mills County, Oklahoma.

Stratigraphic Interval: Upper Red Fork Sandstone.

Core depth: 12,170 ft. to 12,224 ft.

Core to log correction: 7.2 ft.




AVE GRAIN SIZE AND LITHOLOGY
DEPTH
CORE LOG
GAMMA RAY
API UNITS
0
150
GRAN PEBBLE
VC SAND 0 1
C SAND 0 1
M SAND 1 2
F SAND 2 3
VF SAND 3 4
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
REMARKS
210
220
220
230
12224
12231
VERTICAL FRACTURE
STYLOLITIC
CORE MISSING
T.S 10

Company: Louisiana Land & Exploration.

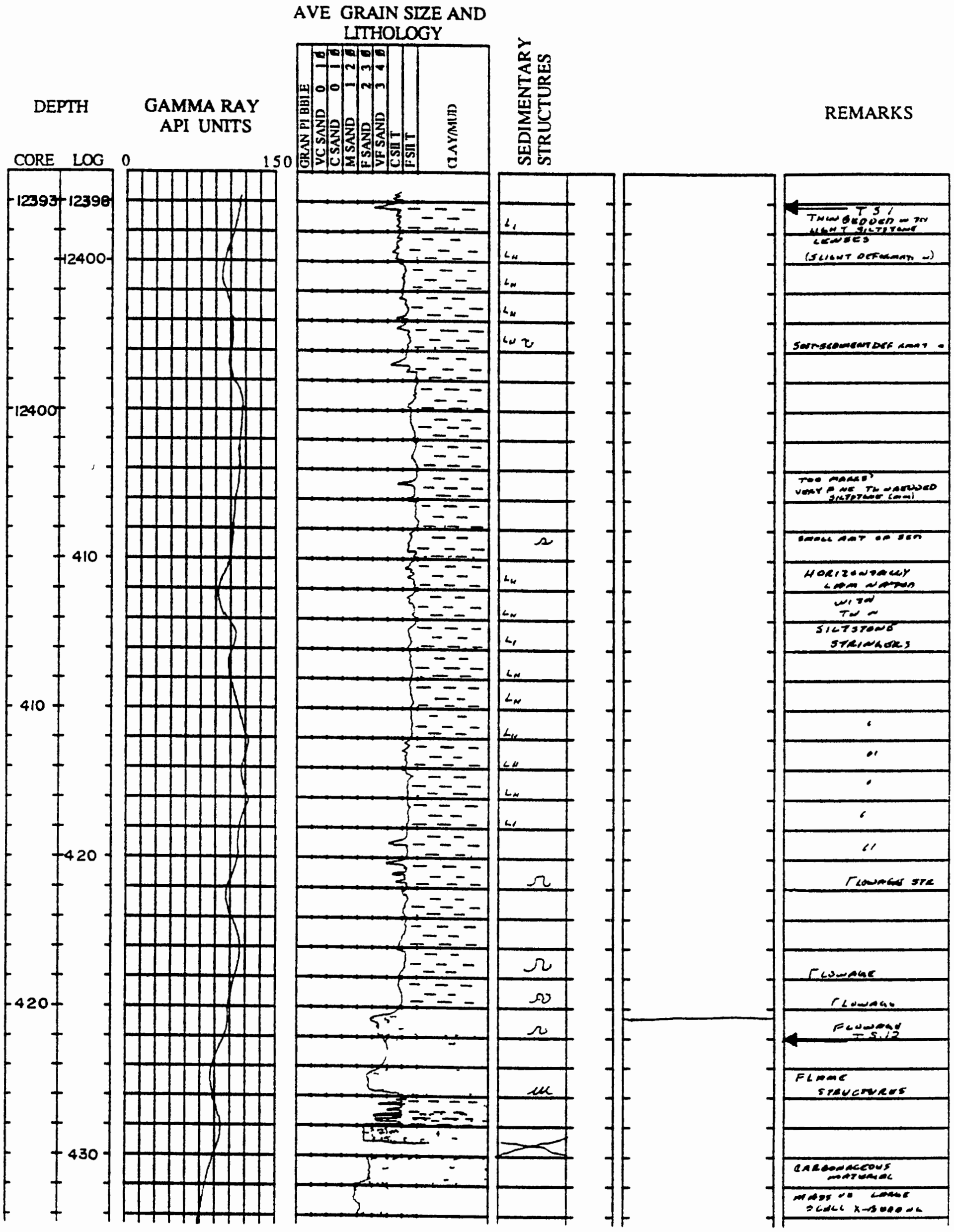
Well: Gates No. 2-33.

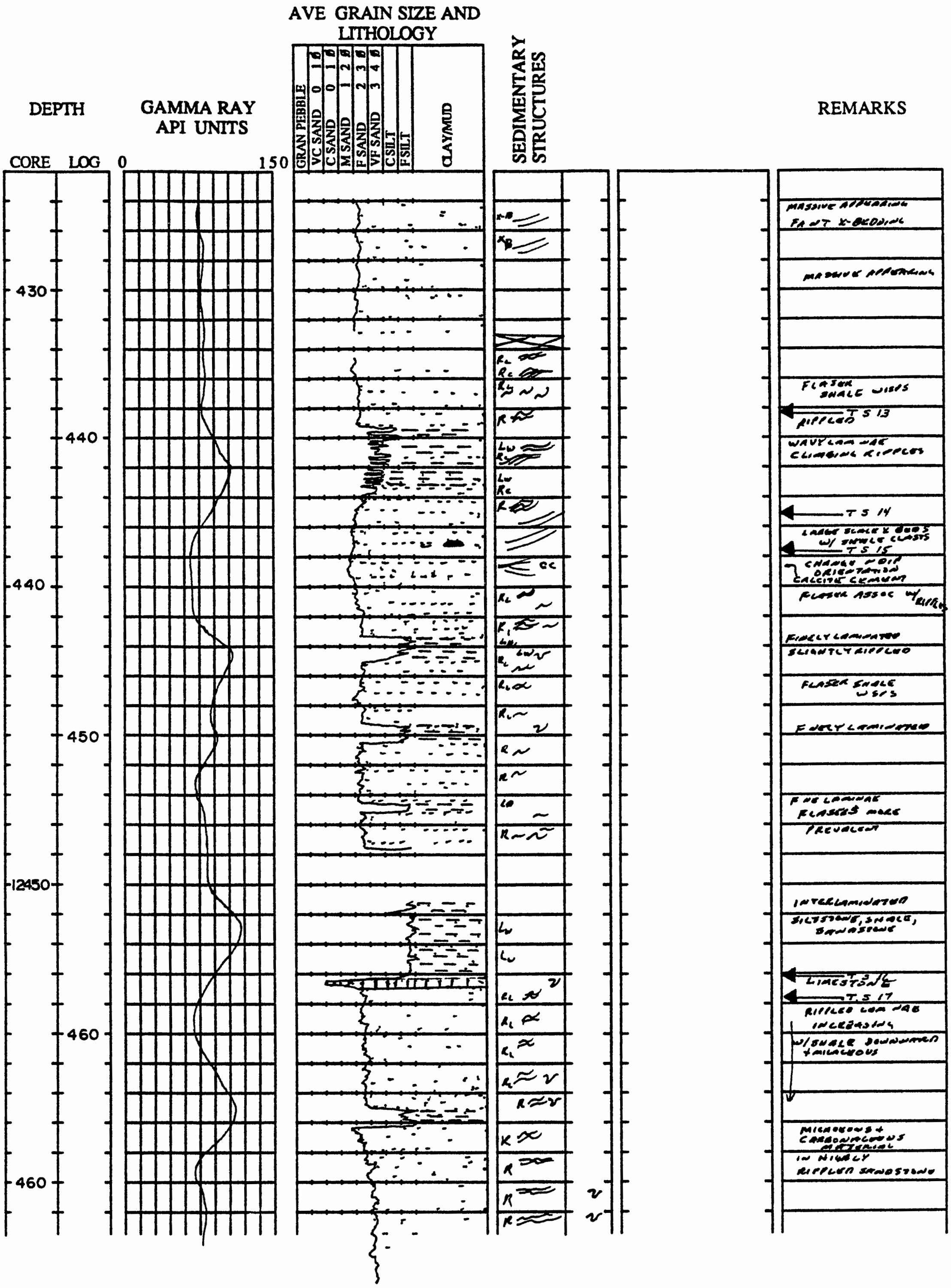
Location: C-SE Sec. 33, T. 15N., R. 22W., Roger Mills County, Oklahoma.

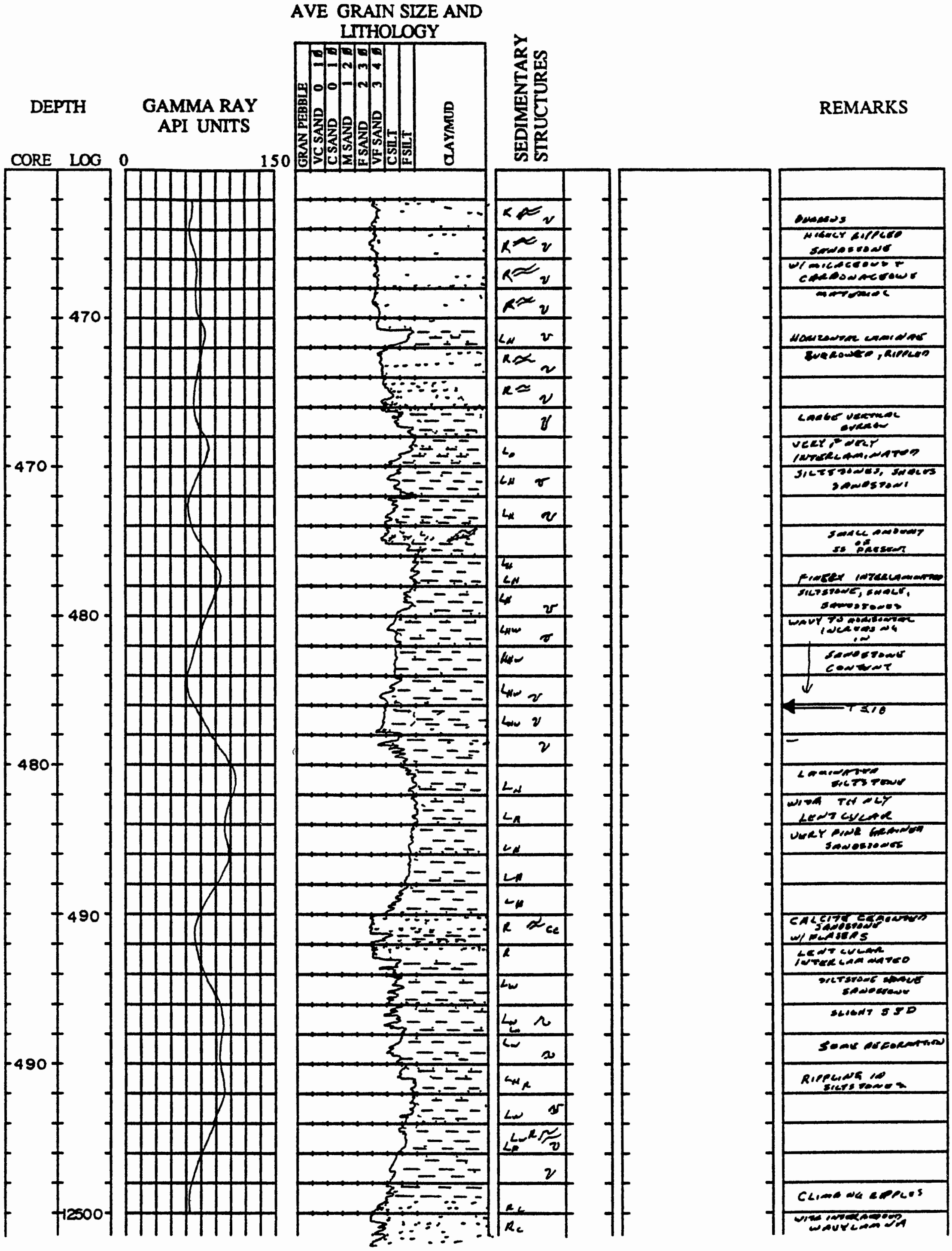
Stratigraphic Interval: (middle) Upper Red Fork Sandstone.

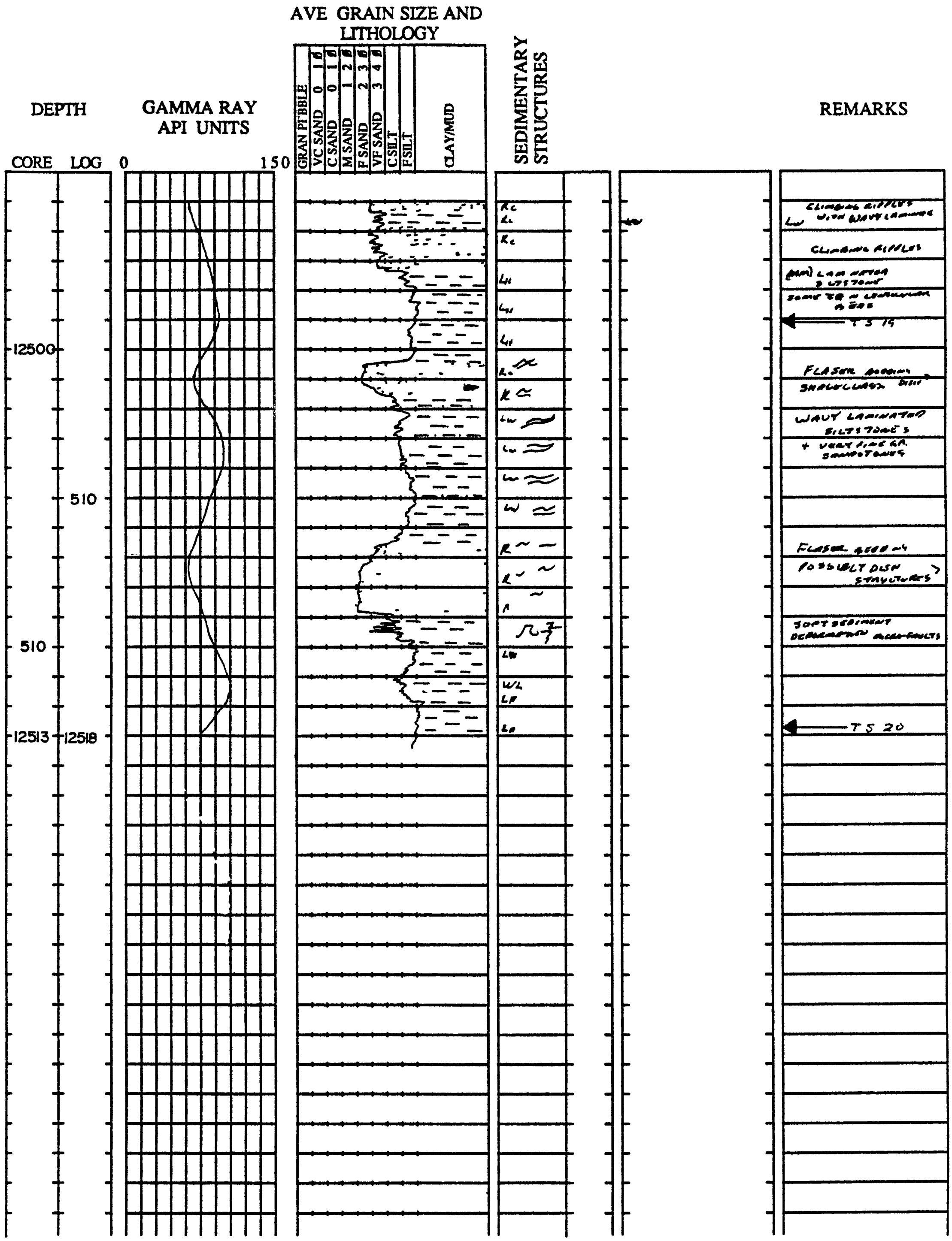
Core depth: 12,393 ft. to 12,513 ft.

Core to log correction: 5 ft.




AVE GRAIN SIZE AND LITHOLOGY
DEPTH
GAMMA RAY API UNITS
CORE
LOG
0
150
GRAN PEBBLE
VC SAND 0 1 Ø
C SAND 0 1 Ø
M SAND 1 2 Ø
F SAND 2 3 Ø
VF SAND 3 4 Ø
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
REMARKS
430
440
440
450
12450
460
460
MASSIVE APPEARING
FAINT X-BEDDING
MASSIVE APPEARING
FLASER SHALE WISPS
T S 13
RIPPLED
WAVY LAMINAE
CLIMBING RIPPLES
T S 14
LARGE SCALE X BEDS W/ SHALE CLASTS
T S 15
FINELY LAMINATED
SLIGHTLY RIPPLED
FLASER SHALE WISPS
FINELY LAMINATED
INTERLAMINATED SILTSTONE, SHALE, SANDSTONE
LIMESTONE
T S 17
MICACEOUS + CARBONACEOUS MATERIAL
IN HIGHLY RIPPLED SANDSTONE


AVE GRAIN SIZE AND LITHOLOGY
GRAN PEBBLE
VC SAND 0 1 ø
C SAND 0 1 ø
M SAND 1 2 ø
F SAND 2 3 ø
VF SAND 3 4 ø
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
DEPTH
CORE
LOG
GAMMA RAY API UNITS
0
150
REMARKS
470
470
480
480
490
490
12500
HIGHLY RIPPLED SANDSTONE
HORIZONTAL LAMINAE
BURROWED, RIPPLED
LARGE VERTICAL BURROW
VERY FINELY INTERLAMINATED SILTSTONES, SHALES SANDSTONE
SMALL AMOUNT OF SS PRESENT
LAMINATED SILTSTONE
WITH THINLY LENTICULAR
VERY FINE GRAINED SANDSTONES
CALCITE CEMENTED SANDSTONE W/ FLASERS
LENTICULAR INTERLAMINATED
SLIGHT SSD
SOME DEFORMATION
RIPPLING IN SILTSTONES
CLIMBING RIPPLES



AVE GRAIN SIZE AND LITHOLOGY
DEPTH
CORE
LOG
GAMMA RAY API UNITS
0
150
GRAN PEBBLE
VC SAND
C SAND
M SAND
F SAND
VF SAND
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
REMARKS
12500
510
510
12513
12518
CLIMBING RIPPLES WITH WAVY LAMINAE
CLIMBING RIPPLES
WAVY LAMINATED SILTSTONES
+ VERY FINE GR. SANDSTONES
TS 19
TS 20

Company: Louisiana Land & Exploration.

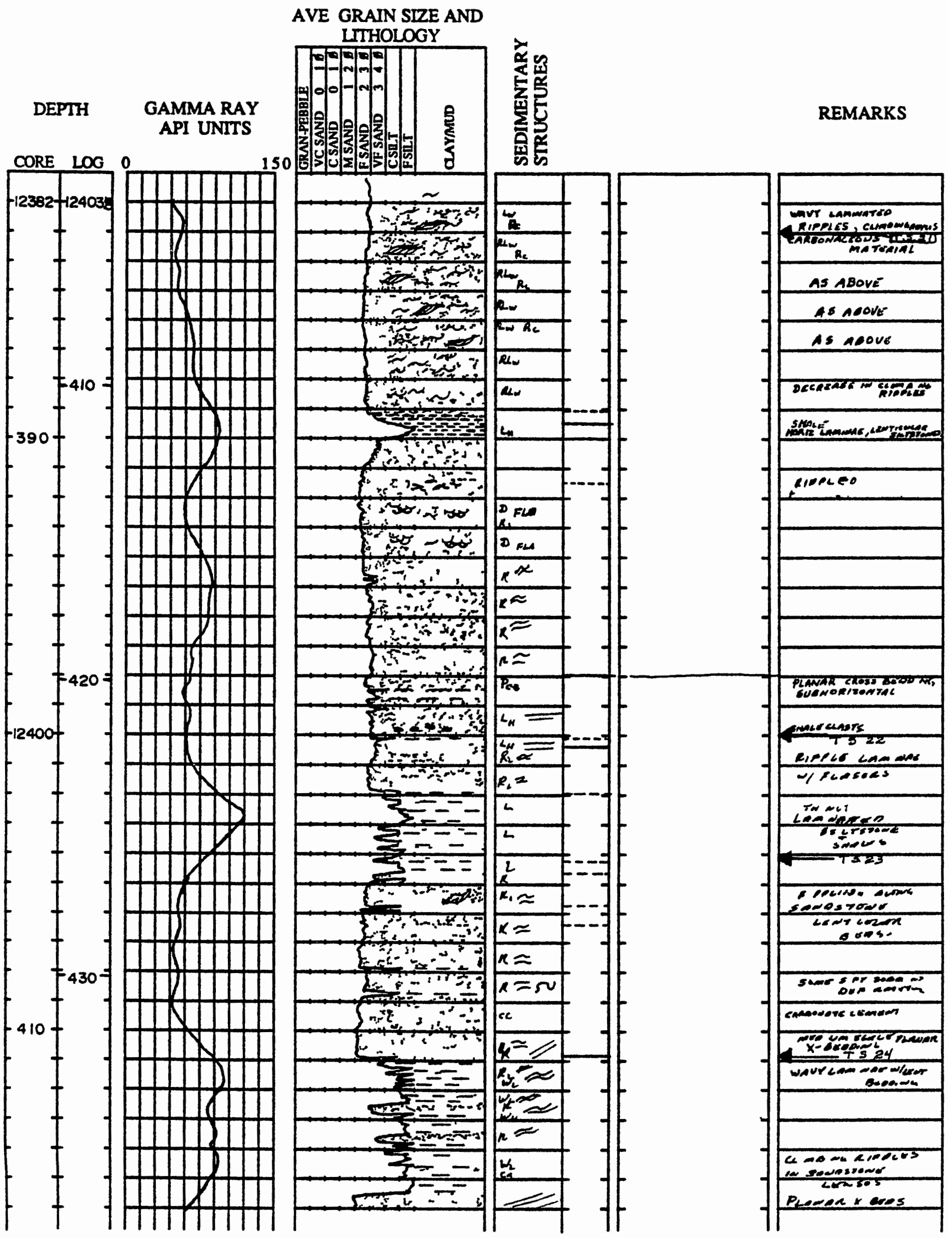
Well: Savage No. 2-1.

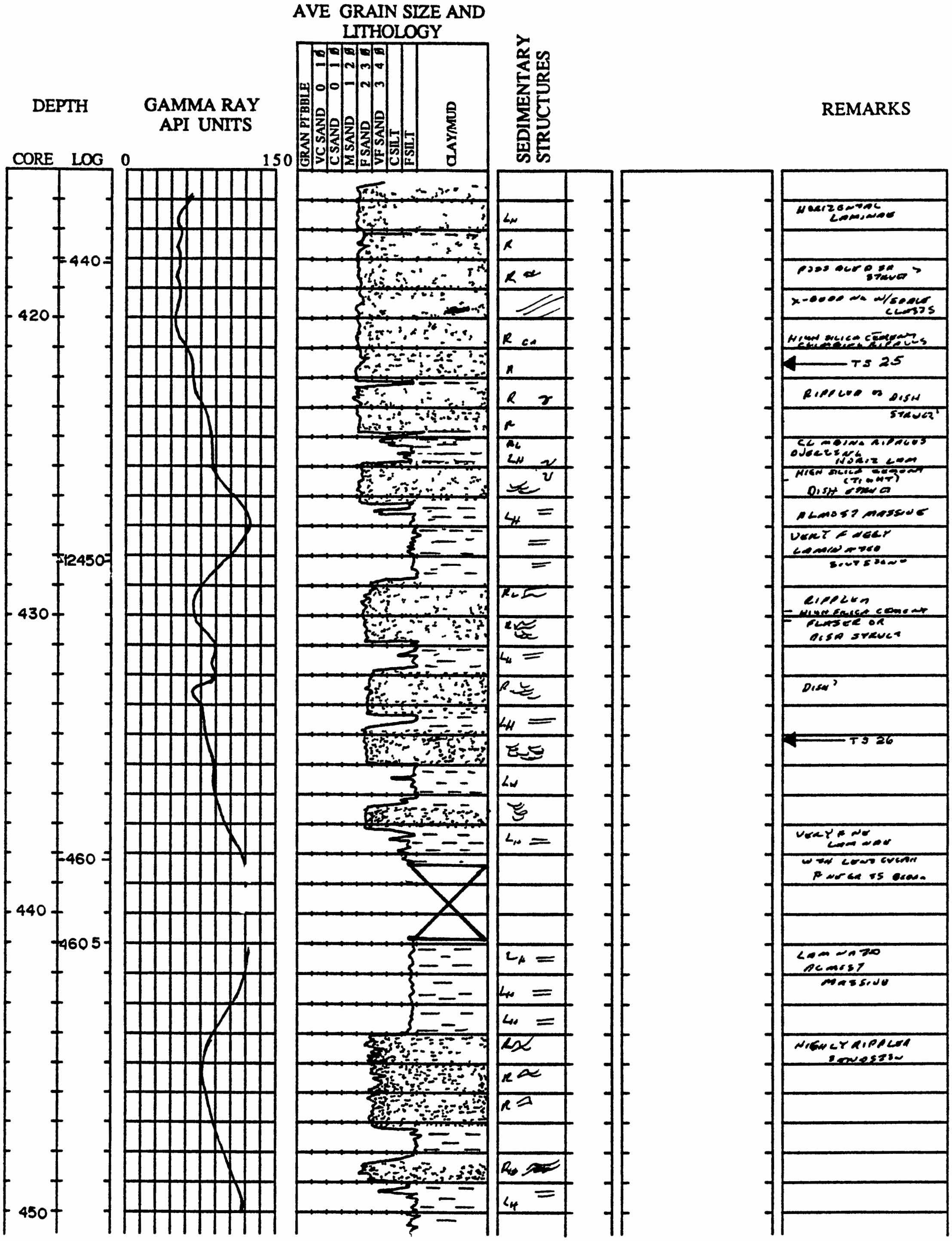
Location: C-SE Sec. 1, T. 14N., R. 22W., Roger Mills County, Oklahoma.

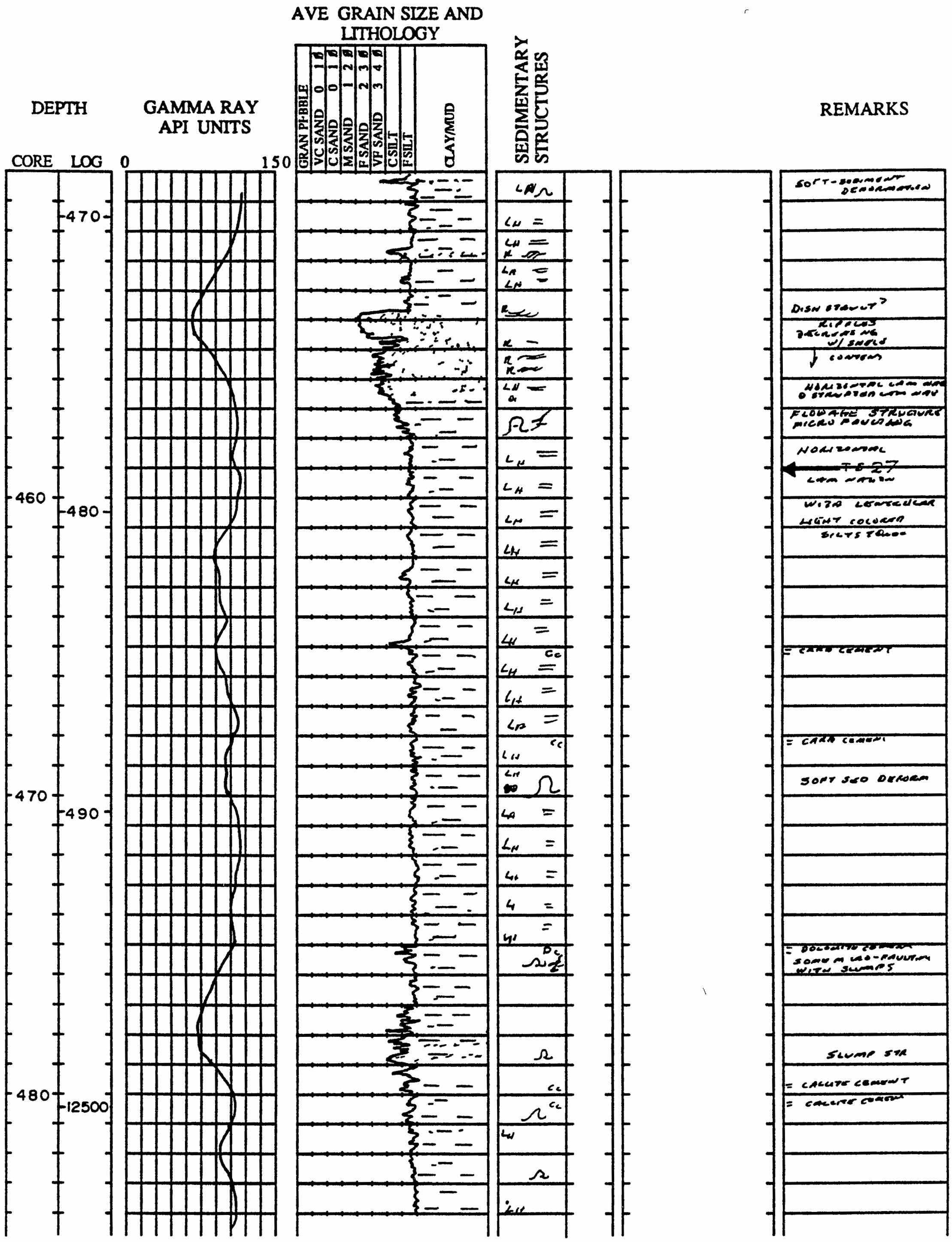
Stratigraphic Interval: Upper Red Fork Sandstone.

Core depth: 12,382 ft. to 12,500 ft.

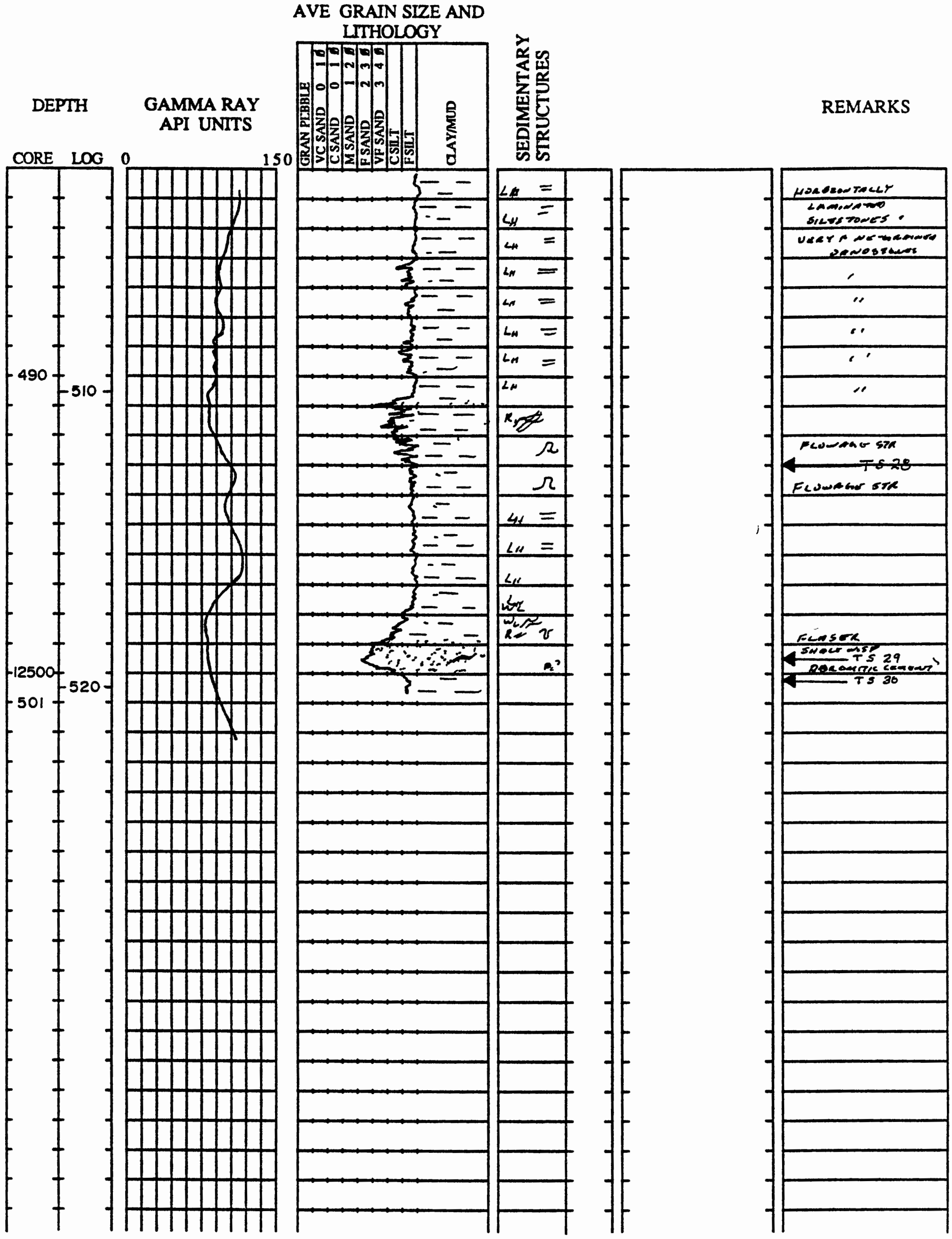
Core to log correction: 21.9 ft.




AVE GRAIN SIZE AND LITHOLOGY
DEPTH
GAMMA RAY API UNITS
SEDIMENTARY STRUCTURES
REMARKS
CORE LOG 0 150
GRAN PBBLE
VC SAND 0 1
C SAND 0 1
M SAND 1 2
F SAND 2 3
VF SAND 3 4
C SILT
F SILT
CLAY/MUD
440
420
12450
430
460
440
4605
450
HORIZONTAL LAMINAE
TS 25
TS 26



AVE GRAIN SIZE AND LITHOLOGY
DEPTH
GAMMA RAY API UNITS
SEDIMENTARY STRUCTURES
REMARKS
CORE
LOG
0
150
GRAN PEBBLE
VC SAND
C SAND
M SAND
F SAND
VF SAND
C SILT
F SILT
CLAY/MUD
470
480
490
12500
460
470
480
FLOWAGE STRUCTURE
MICRO FAULTING
HORIZONTAL
TS 27
WITH LENTICULAR
LIGHT COLORED
SOFT SED DEFORM
SLUMP STR
= CALCITE CEMENT



AVE GRAIN SIZE AND LITHOLOGY
DEPTH
GAMMA RAY API UNITS
CORE LOG 0 150
GRAN PEBBLE
VC SAND 0 1 ø
C SAND 0 1 ø
M SAND 1 2 ø
F SAND 2 3 ø
VF SAND 3 4 ø
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
REMARKS
490
510
12500
520
501
HORIZONTALLY LAMINATED SILTSTONES
FLOWAGE STR
TS 28
FLOWAGE STR
FLASER
TS 29
TS 30

Company: Internorth, Inc.

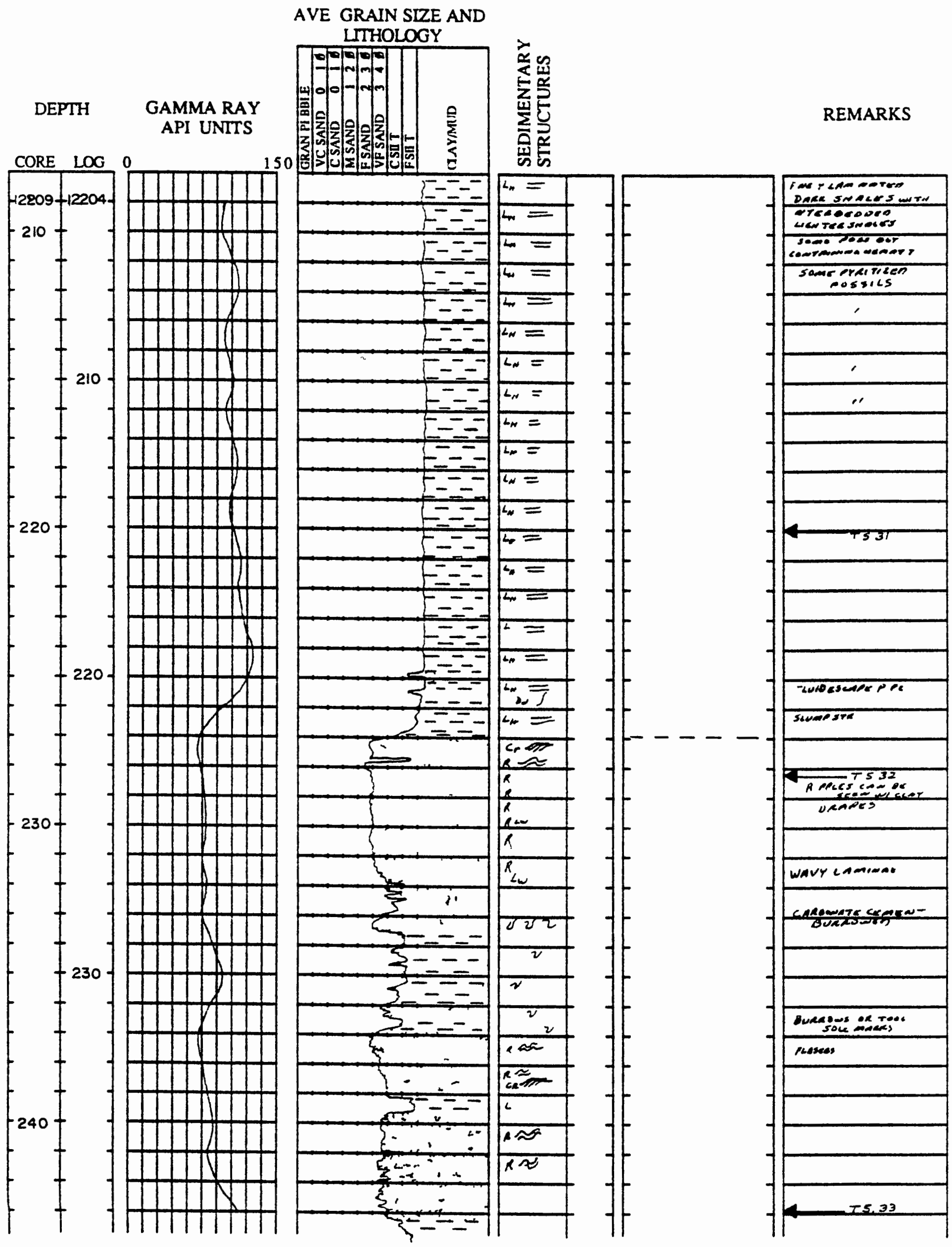
Well: Smith "B" 21 No. 1.

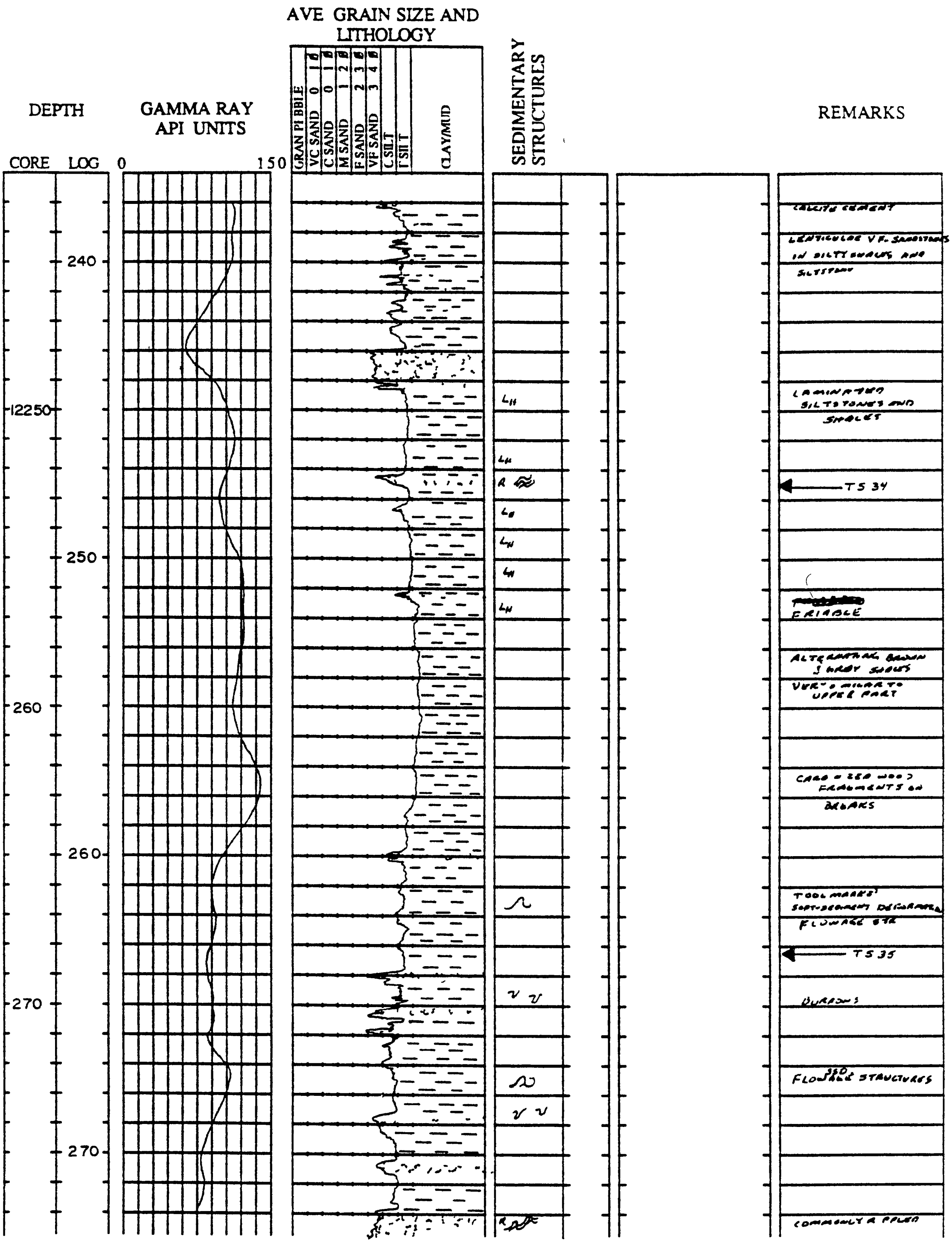
Location: C-SW Sec. 21, T. 14N., R. 20W., Custer County, Oklahoma.

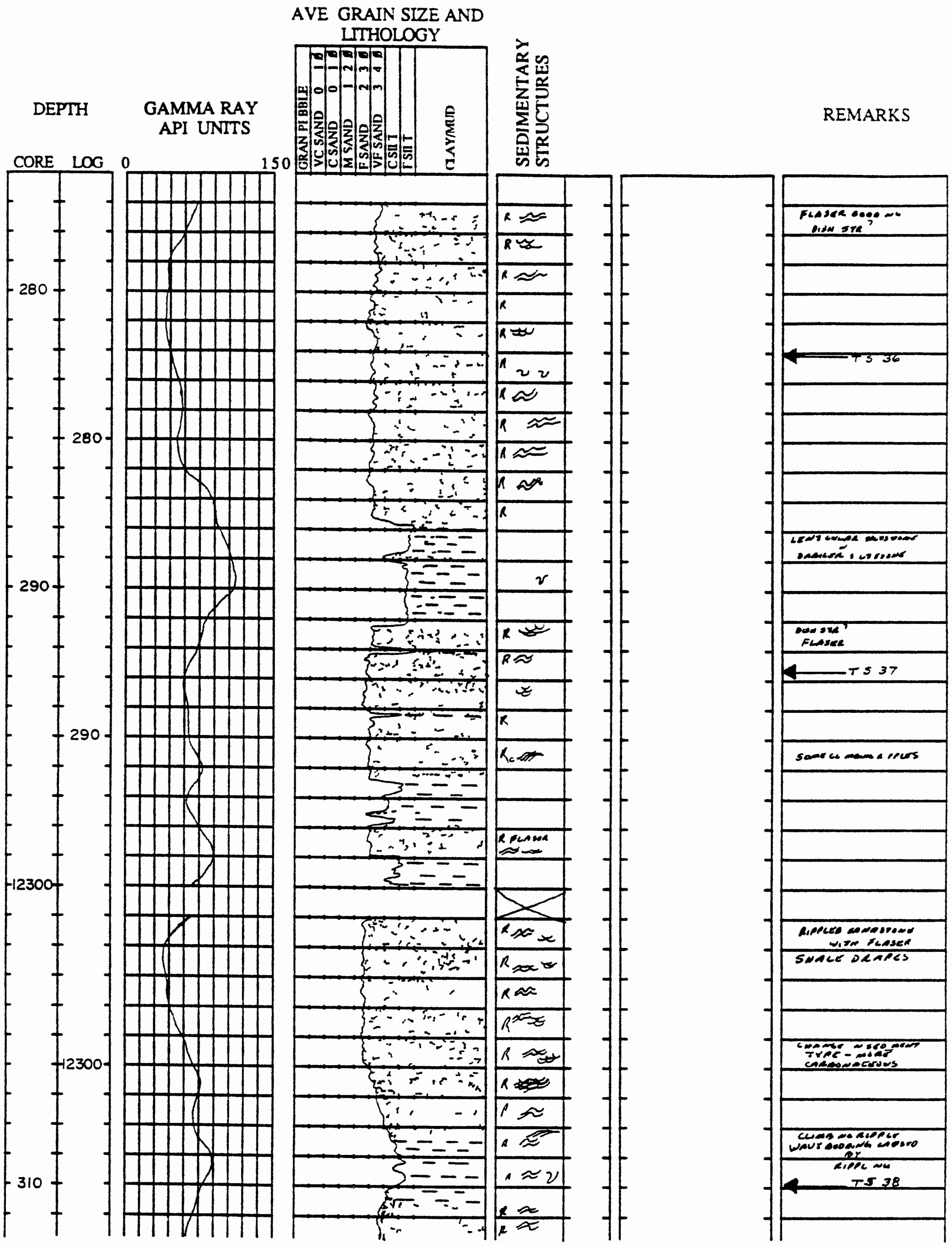
Stratigraphic Interval: Upper Red Fork Sandstone.

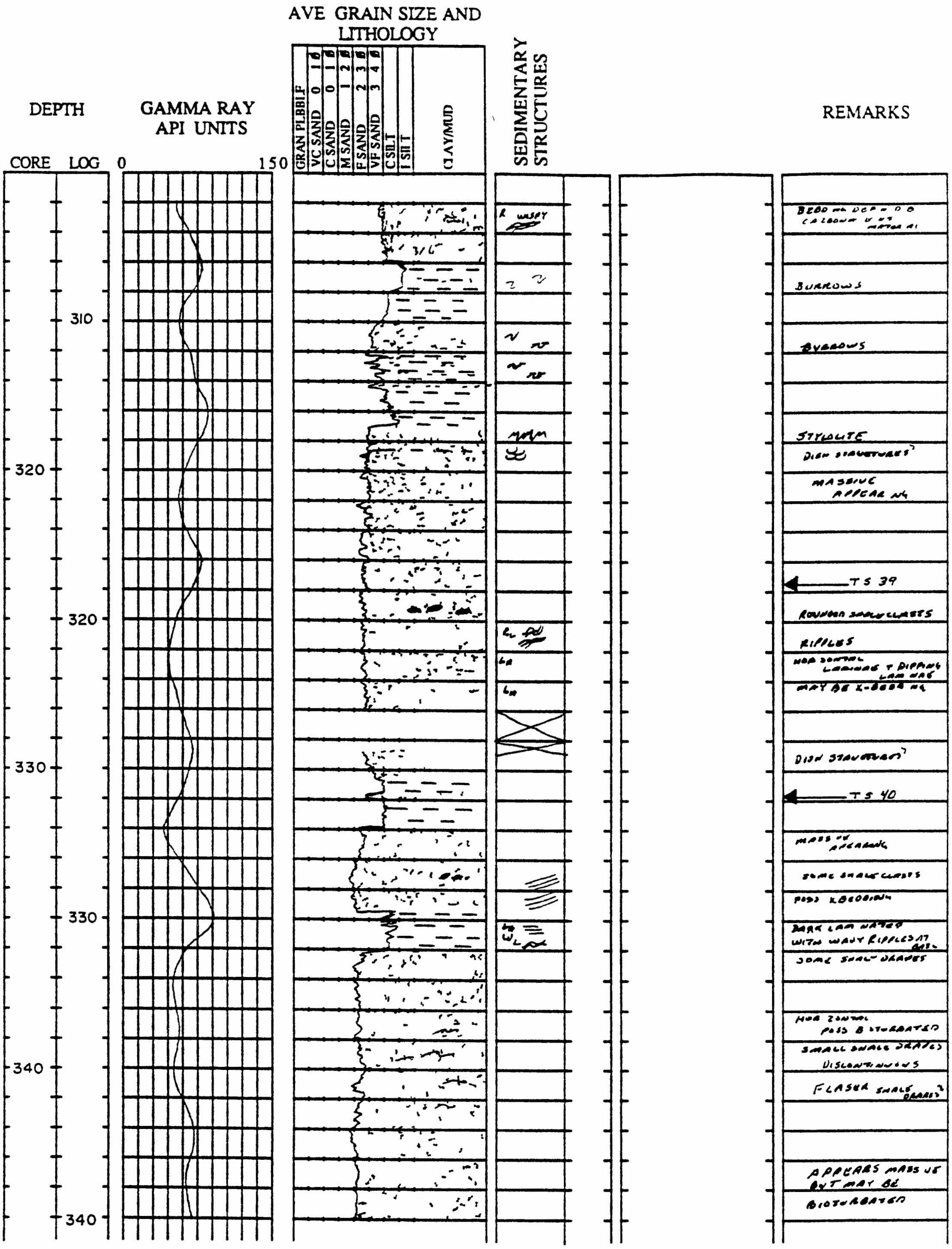
Core depth: 12,209 ft. to 12,532 ft.

Core to log correction: -5 ft.

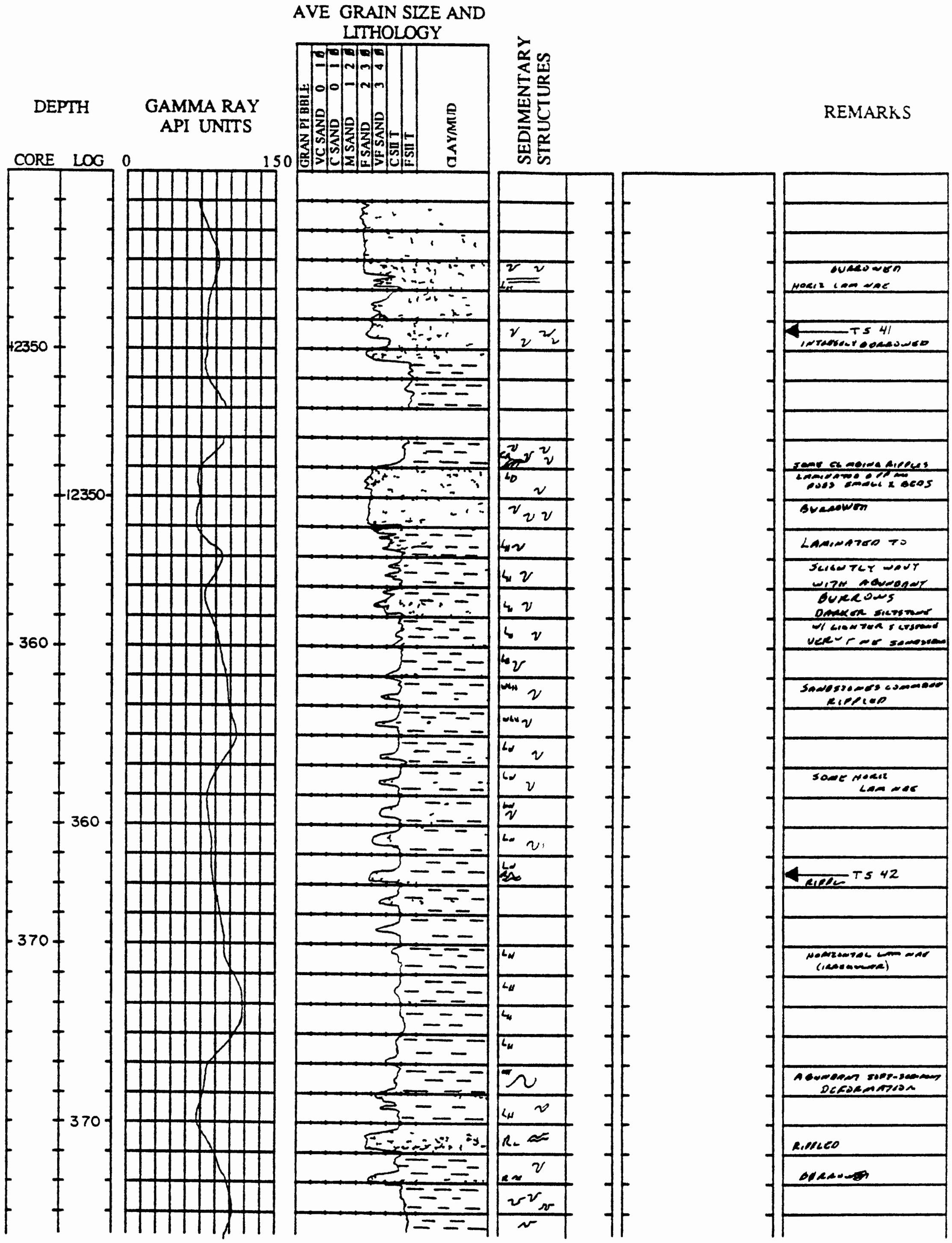


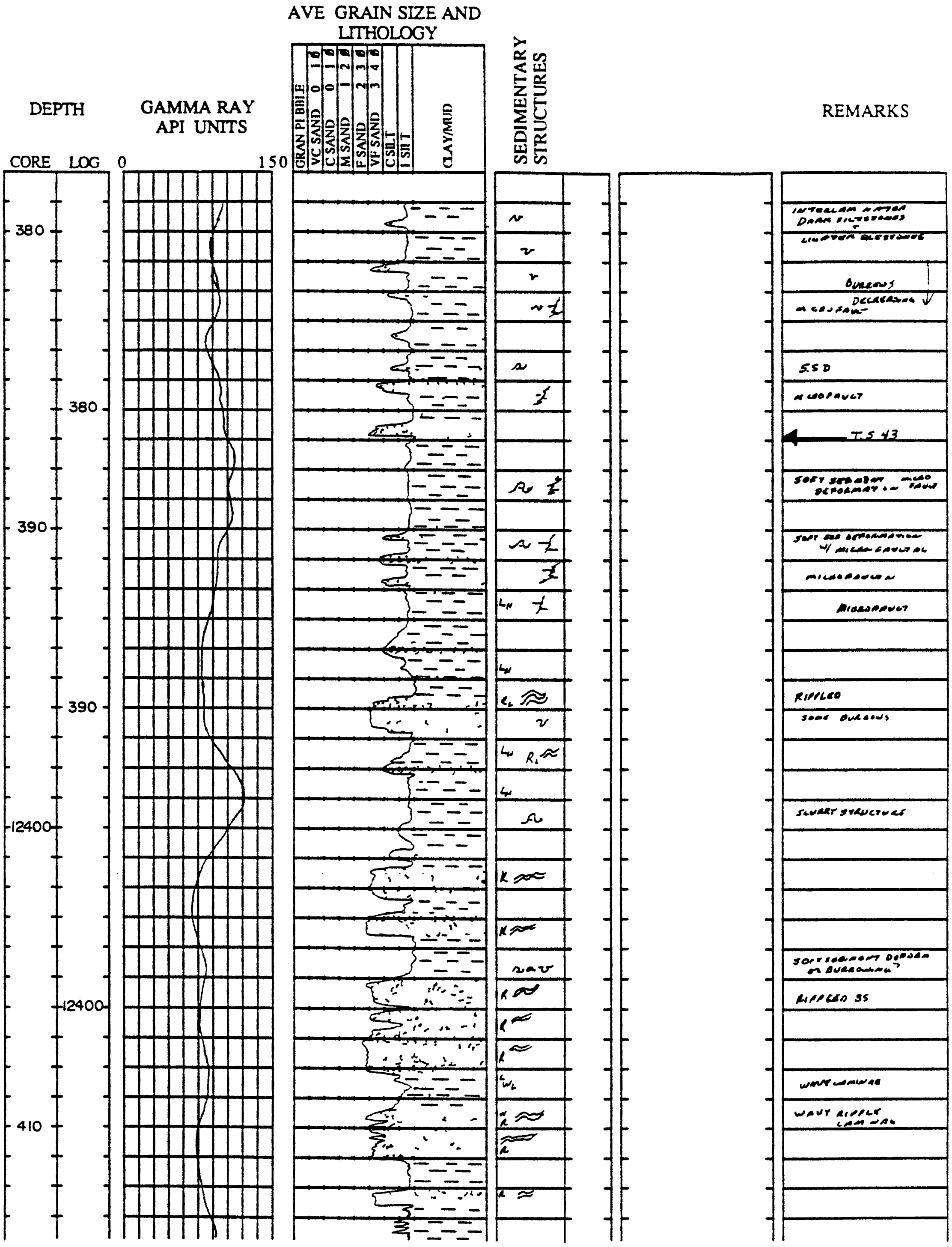

AVE GRAIN SIZE AND LITHOLOGY
DEPTH
GAMMA RAY API UNITS
SEDIMENTARY STRUCTURES
REMARKS
CORE
LOG
0
150
GRAN PEBBLE
VC SAND
C SAND
M SAND
F SAND
VF SAND
C SILT
F SILT
CLAY/MUD
240
12250
250
260
260
270
270
LAMINATED SILTSTONES AND SHALES
TS 34
FRIABLE
TS 35
BURROWS
FLOWAGE STRUCTURES

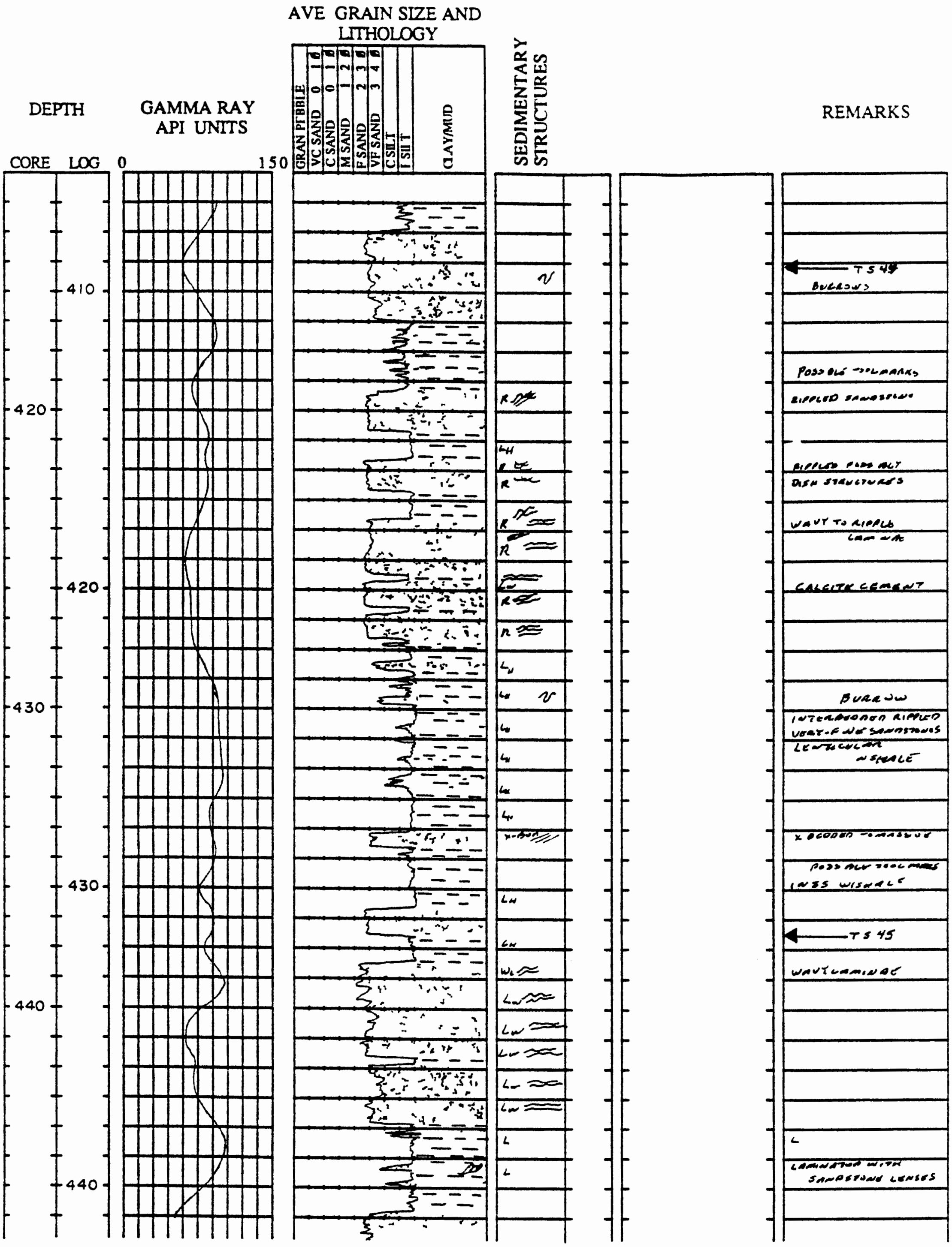

AVE GRAIN SIZE AND LITHOLOGY
DEPTH
GAMMA RAY
API UNITS
CORE
LOG
0
150
GRAN PEBBLE
VC SAND
C SAND
M SAND
F SAND
VF SAND
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
REMARKS
280
280
290
290
12300
12300
310
TS 36
TS 37
SHALE DRAPES
TS 38

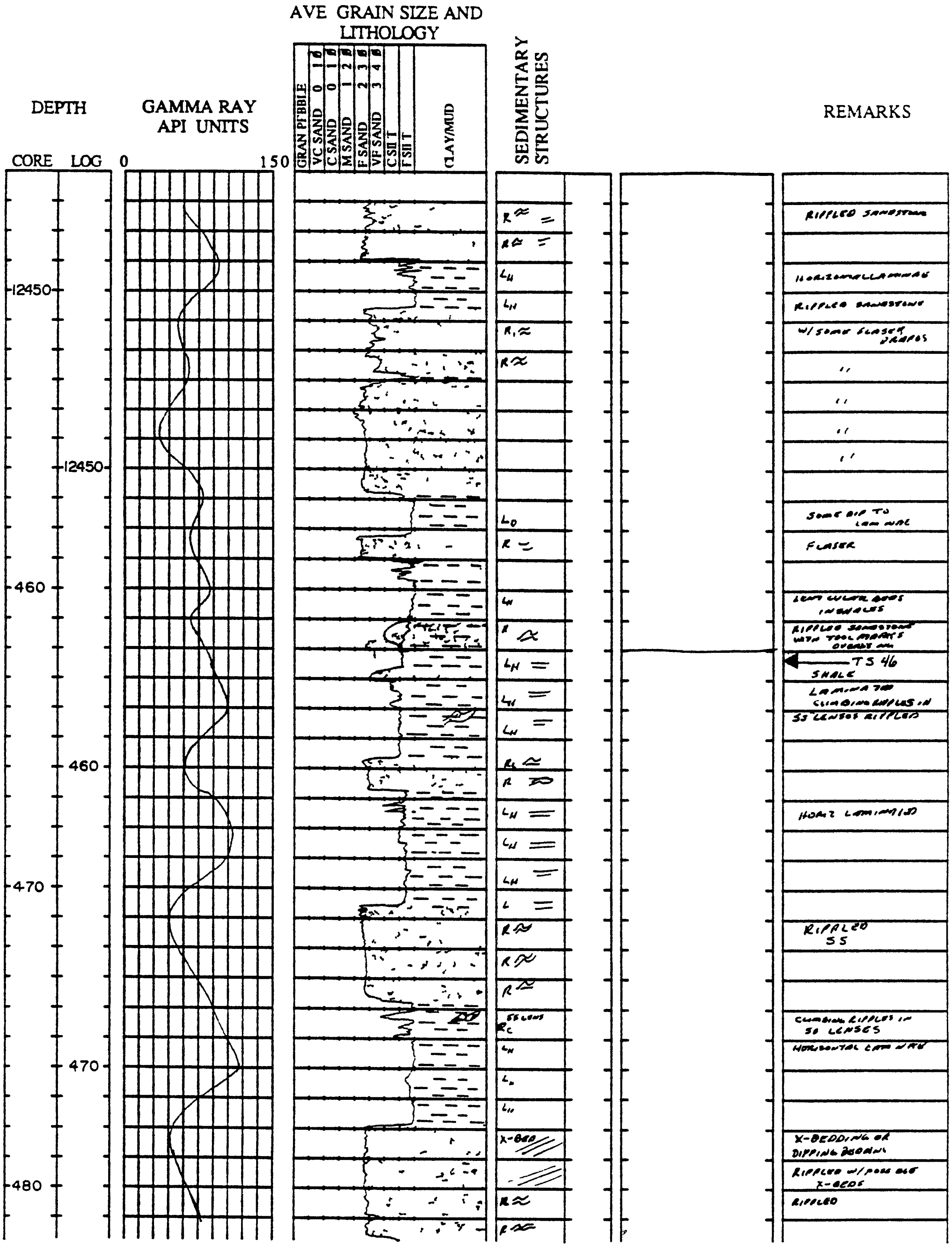


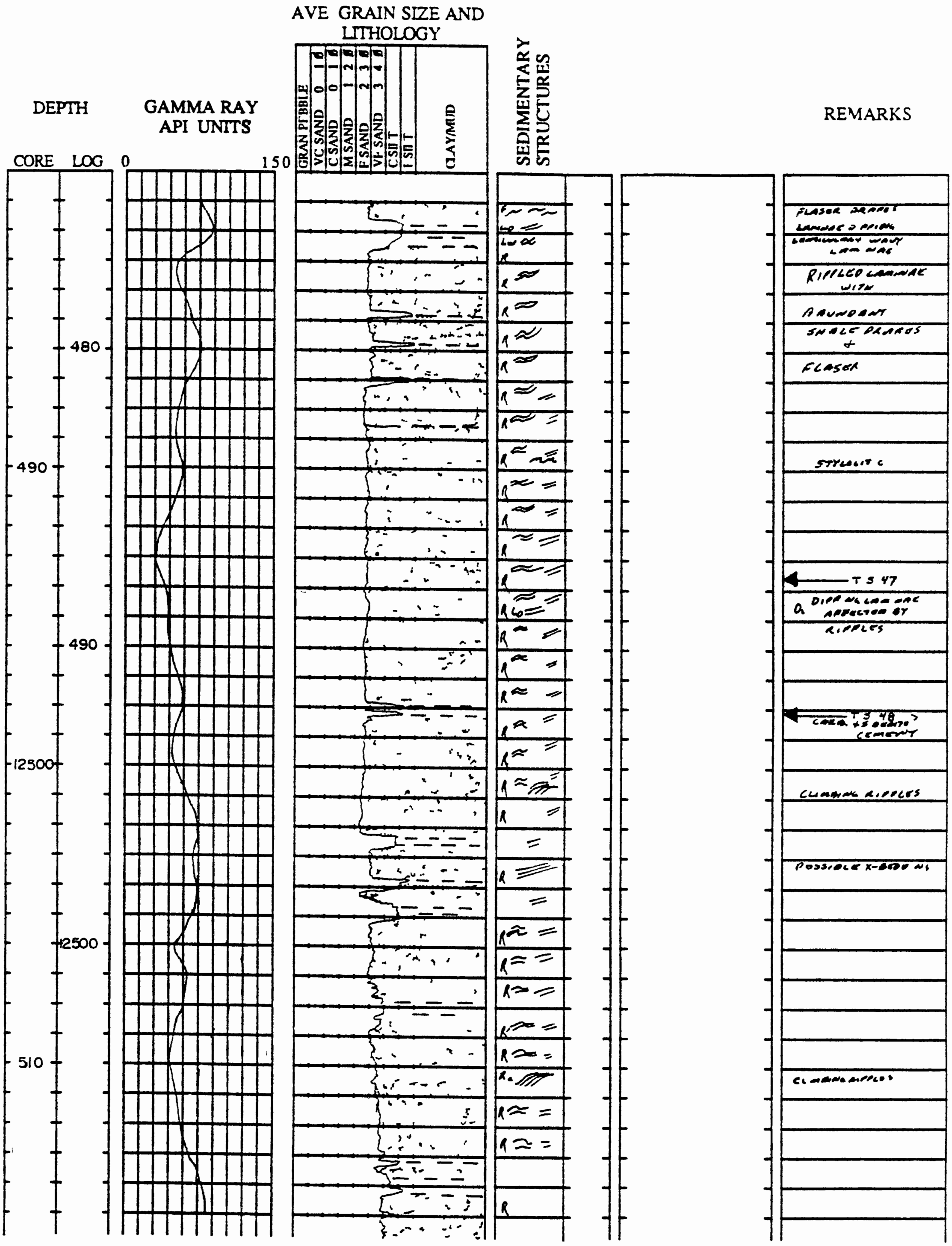
AVE GRAIN SIZE AND LITHOLOGY
GRAN PLBBI F
VC SAND
C SAND
M SAND
F SAND
VF SAND
C SILT
F SILT
CLAY/MUD
DEPTH
CORE
LOG
GAMMA RAY API UNITS
0
150
SEDIMENTARY STRUCTURES
REMARKS
310
320
320
330
330
340
340
BURROWS
STYLOLITE
MASSIVE APPEARING
TS 39
RIPPLES
MAY BE X-BEDDING
TS 40
SOME SHALE CLASTS
FLASER SHALE DRAPES?
APPEARS MASSIVE BUT MAY BE BIOTURBATED

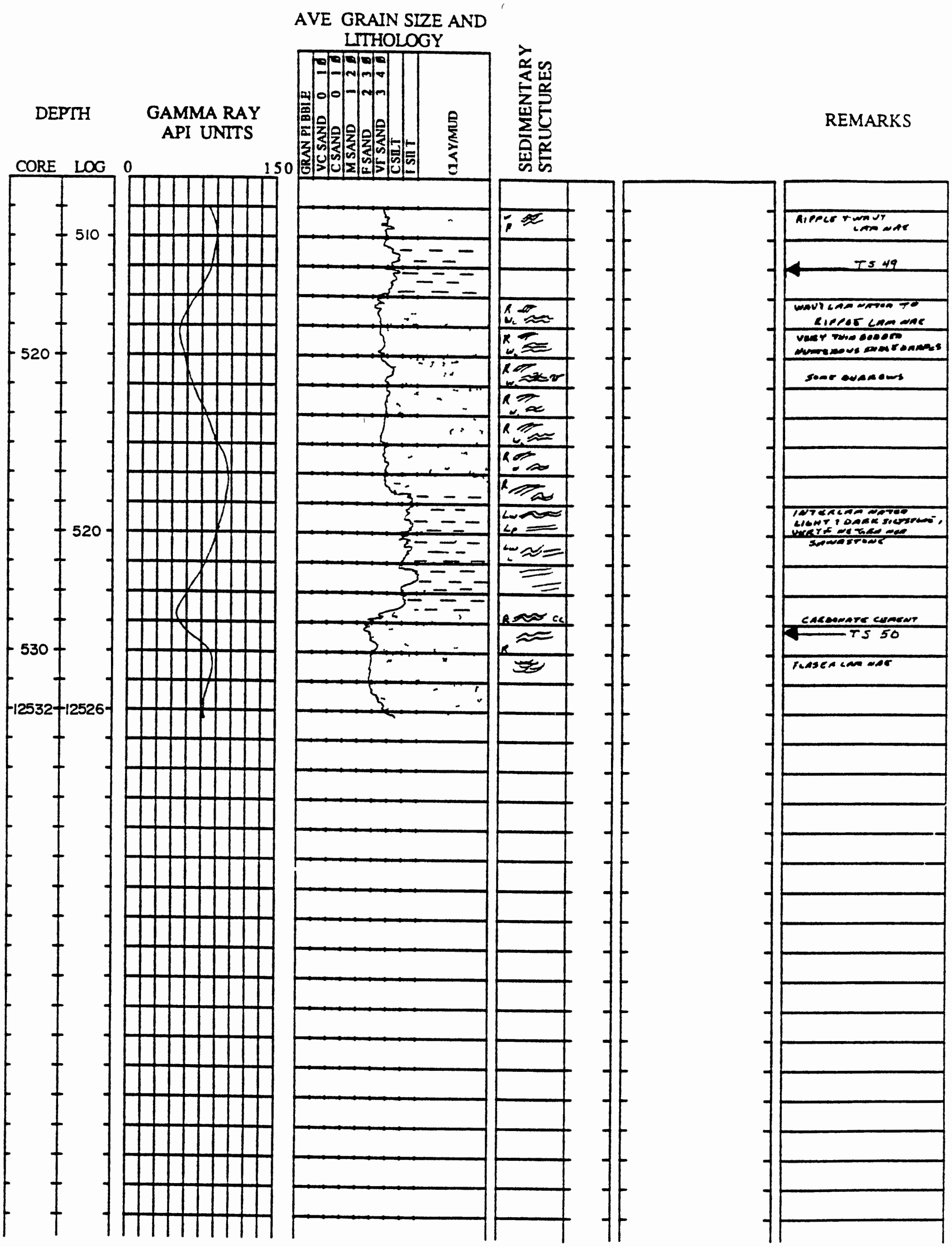

DEPTH
CORE
LOG
GAMMA RAY
API UNITS
0
150
AVE GRAIN SIZE AND LITHOLOGY
GRAN PEBBLE
VC SAND
C SAND
M SAND
F SAND
VF SAND
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
REMARKS
12350
360
370
12350
360
370
BURROWED
HORIZ LAMINAE
TS 41
INTENSELY BURROWED
LAMINATED TO
SLIGHTLY WAVY
WITH ABUNDANT
BURROWS
DARKER SILTSTONE
SANDSTONES COMMONLY
RIPPLED
SOME HORIZ
LAM NAE
TS 42
ABUNDANT SOFT-SEDIMENT
DEFORMATION
RIPPLED


AVE GRAIN SIZE AND LITHOLOGY
GRAN PEBBLE
VC SAND
C SAND
M SAND
F SAND
VF SAND
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
DEPTH
GAMMA RAY API UNITS
REMARKS
CORE
LOG
0
150
380
380
390
390
12400
12400
410
S.S.D
T.S 43
RIPPLED
SLUMP STRUCTURE
WAVY LAMINAE


AVE GRAIN SIZE AND LITHOLOGY
DEPTH
CORE
LOG
GAMMA RAY API UNITS
0
150
GRAN PEBBLE
VC SAND
C SAND
M SAND
F SAND
VF SAND
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
REMARKS
410
420
430
440
TS 45
TS 49
BURROWS
RIPPLED SANDSTONE
DISH STRUCTURES
CALCITE CEMENT
BURROW
WAVY LAMINAE
LAMINATED WITH SANDSTONE LENSES


AVE GRAIN SIZE AND LITHOLOGY
DEPTH
CORE LOG
GAMMA RAY API UNITS
0
150
GRAN PEBBLE
VC SAND
C SAND
M SAND
F SAND
VF SAND
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
REMARKS
12450
12450
460
460
470
470
480
RIPPLED SANDSTONE
HORIZONTAL LAMINAE
RIPPLED SANDSTONE
W/ SOME FLASER DRAPES
SOME DIP TO LAMINAE
FLASER
TS 46
SHALE
HORIZ LAMINATED
RIPPLED SS
CLIMBING RIPPLES IN SS LENSES
HORIZONTAL LAMINAE
X-BEDDING OR DIPPING BEDDING
RIPPLED


AVE GRAIN SIZE AND LITHOLOGY
GRAN PEBBLE
VC SAND
C SAND
M SAND
F SAND
VF SAND
C SILT
F SILT
CLAY/MUD
DEPTH
CORE LOG
GAMMA RAY API UNITS
0
150
SEDIMENTARY STRUCTURES
REMARKS
480
490
490
12500
12500
510
FLASER DRAPES
LENTICULAR WAVY LAMINAE
RIPPLED LAMINAE WITH
ABUNDANT
SHALE DRAPES
FLASER
STYLOLITIC
T S 47
DIPPING LAMINAE AFFECTED BY RIPPLES
T S 48
CLIMBING RIPPLES
POSSIBLE X-BEDDING
CLIMBING RIPPLES


AVE GRAIN SIZE AND LITHOLOGY
GRAN PEBBLE
VC SAND
C SAND
M SAND
F SAND
VF SAND
C SILT
F SILT
CLAY/MUD
DEPTH
CORE
LOG
GAMMA RAY API UNITS
0
150
SEDIMENTARY STRUCTURES
REMARKS
510
520
520
530
12532
12526
TS 49
SOME BURROWS
CARBONATE CEMENT
TS 50

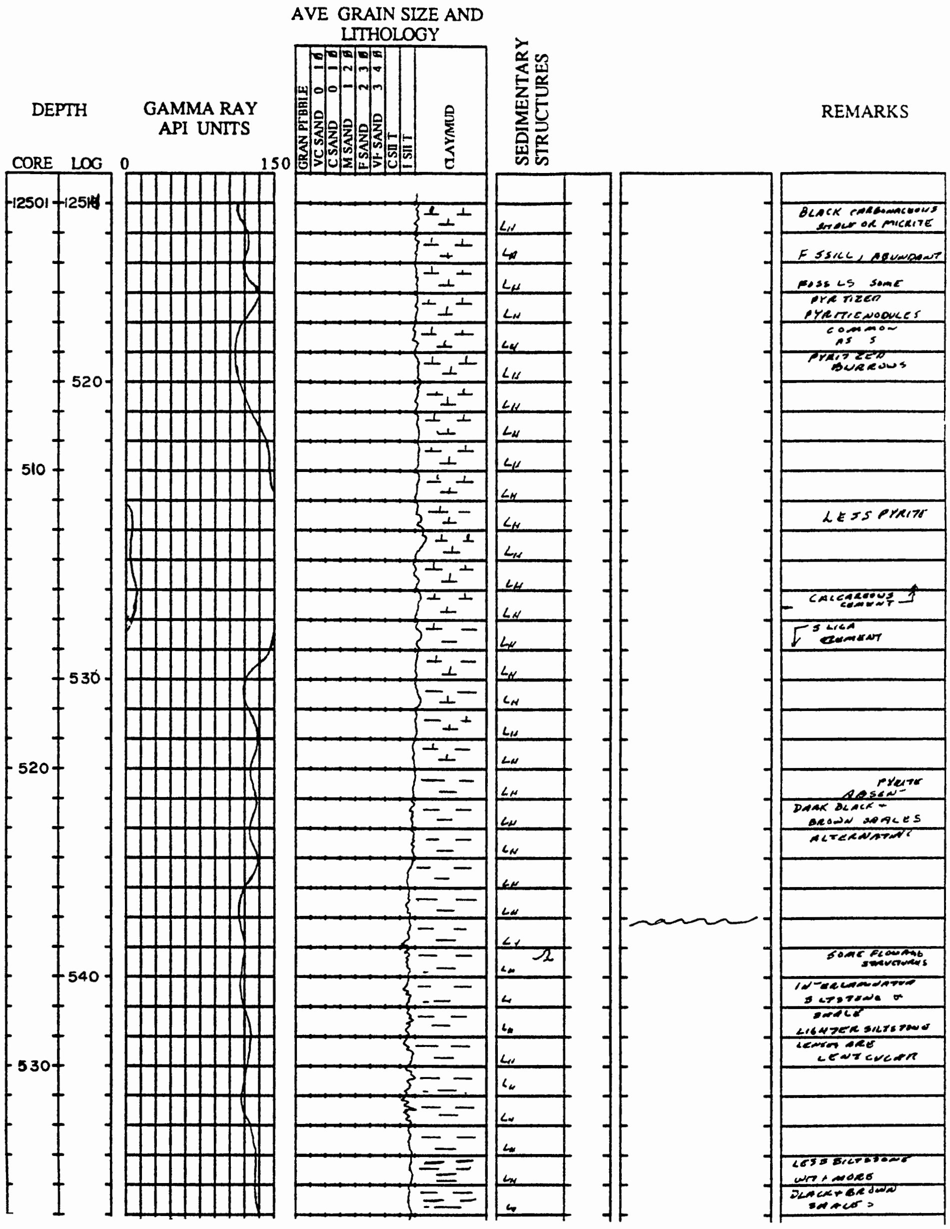
Company: Inexco, Inc.

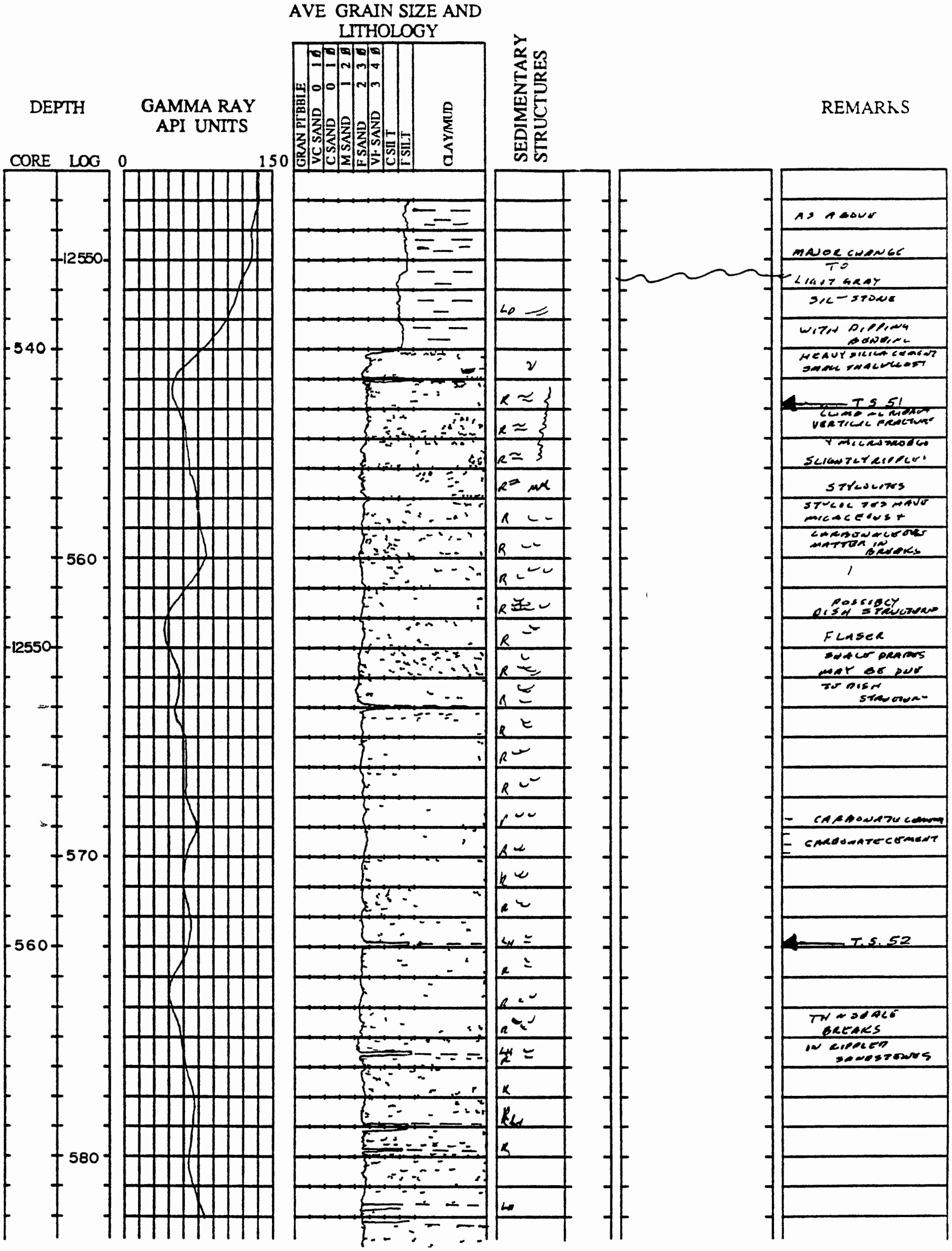
Well: Trent No. 1-25.

Location: C-SW Sec. 25, T. 14N., R. 22W., Custer County, Oklahoma.

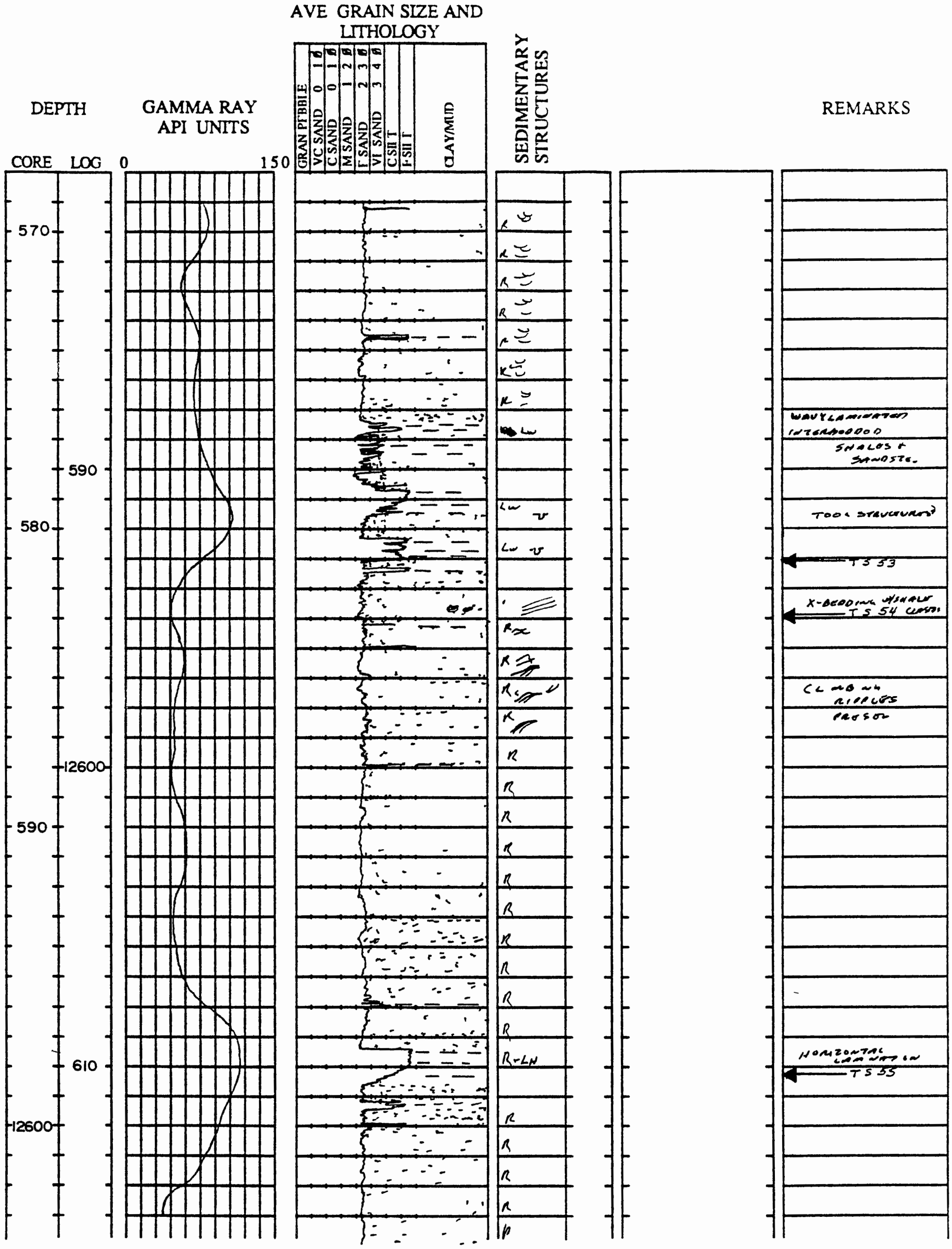
Stratigraphic Interval: Lower Pink Limestone Equivalent and the Upper Red Fork Sandstone.

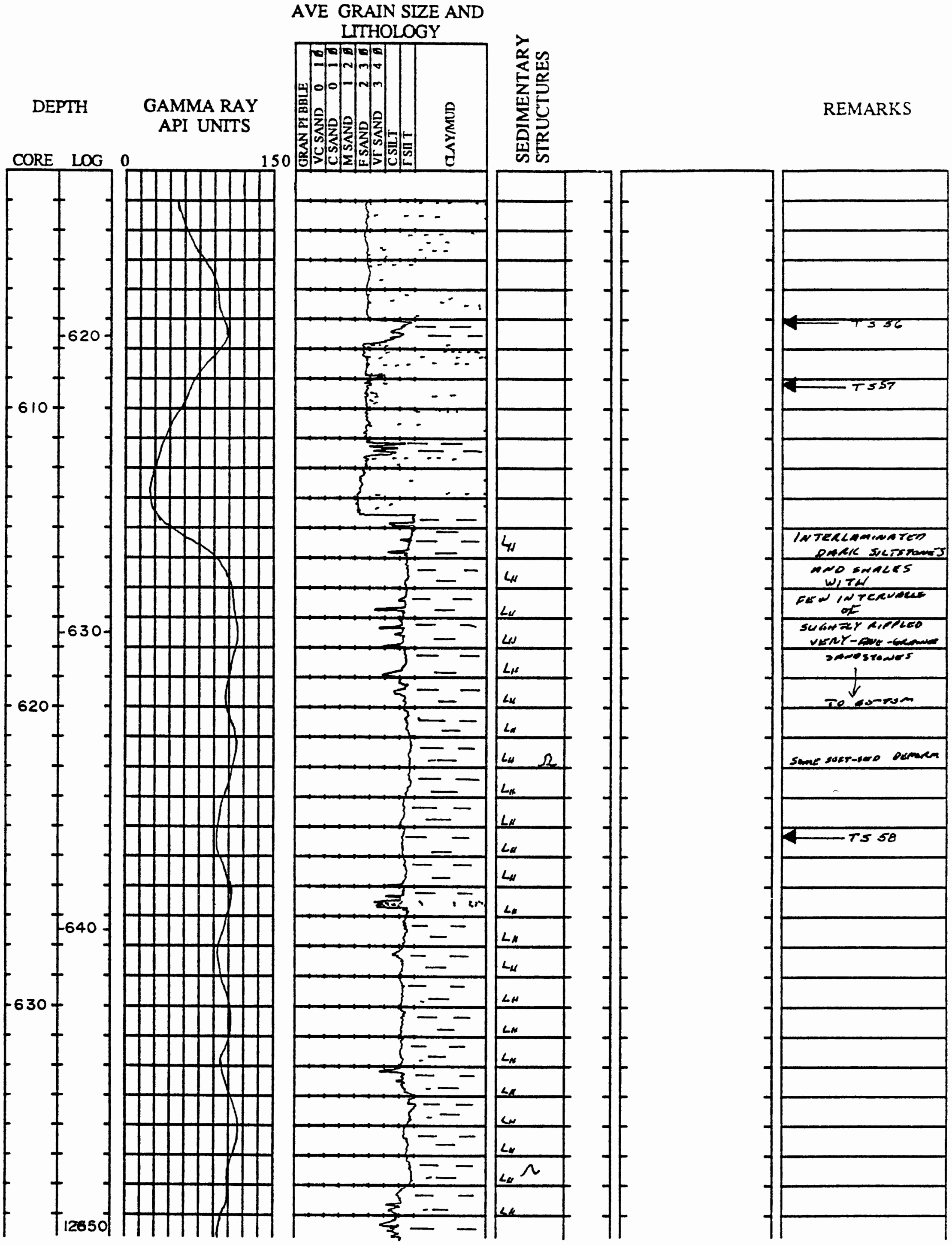
Core depth: 12,501 ft. to 12,672 ft.

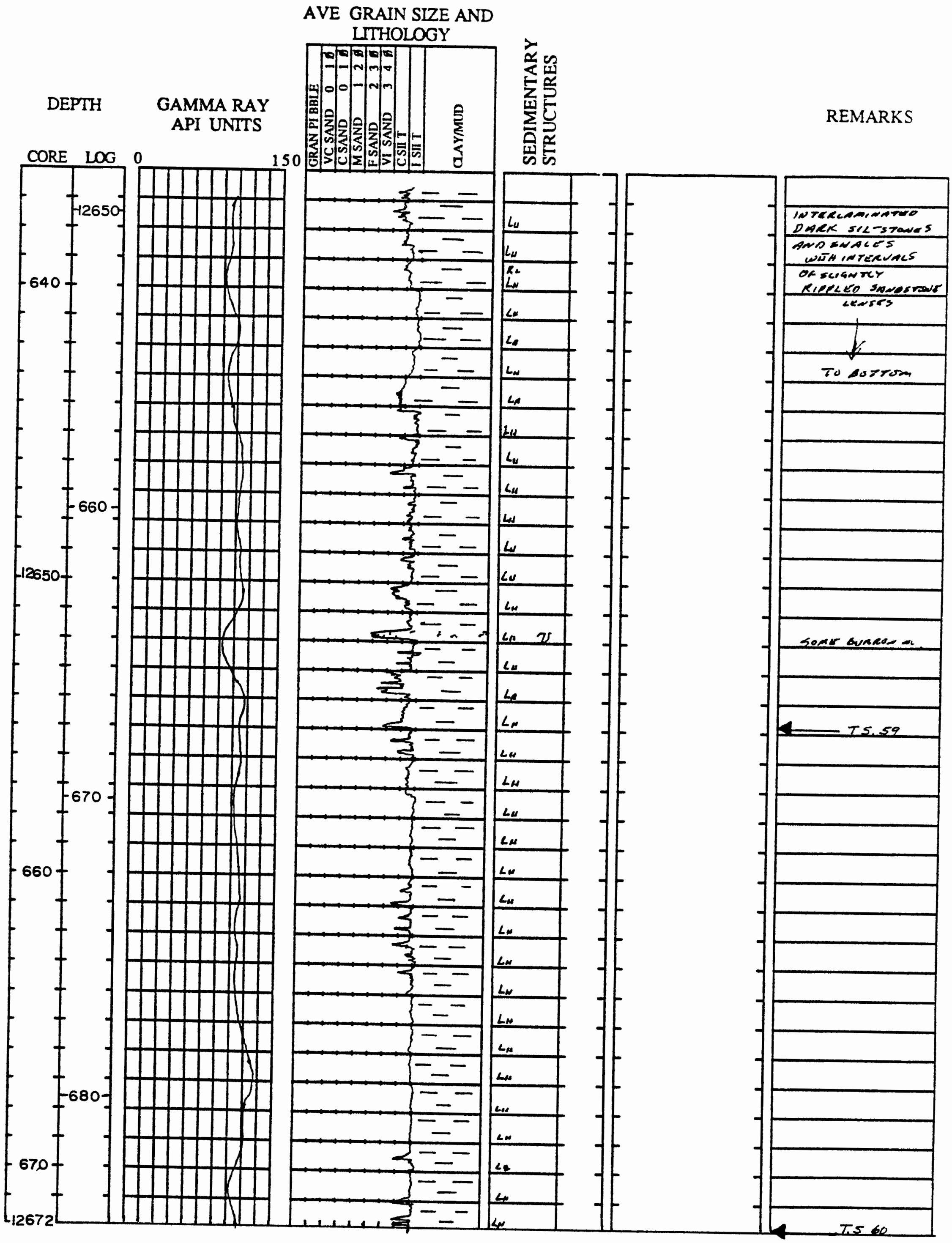




AVE GRAIN SIZE AND LITHOLOGY
GRAN PEBBLE
VC SAND 0 -1 Ø
C SAND 0 1 Ø
M SAND 1 2 Ø
F SAND 2 3 Ø
VF SAND 3 4 Ø
C SILT
F SILT
CLAY/MUD
DEPTH
CORE
LOG
GAMMA RAY API UNITS
0
150
SEDIMENTARY STRUCTURES
REMARKS
12550
540
560
12550
570
560
580
AS ABOVE
MAJOR CHANGE TO LIGHT GRAY SILTSTONE
T S 51
VERTICAL FRACTURE
STYLOLITES
POSSIBLY DISH STRUCTURE
FLASER
CARBONATE CEMENT
T. S. 52
BREAKS
IN RIPPLED SANDSTONES


AVE GRAIN SIZE AND LITHOLOGY
DEPTH
GAMMA RAY API UNITS
CORE LOG
0
150
GRAN PEBBLE
VC SAND
C SAND
M SAND
F SAND
VF SAND
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
REMARKS
570
590
580
12600
590
610
12600
WAVY LAMINATED INTERBEDDED SHALES + SANDSTS.
TS 53
TS 55
HORIZONTAL LAMINATION


AVE GRAIN SIZE AND LITHOLOGY
DEPTH
CORE LOG
GAMMA RAY API UNITS
0
150
GRAN PEBBLE
VC SAND 0 1 Ø
C SAND 0 1 Ø
M SAND 1 2 Ø
F SAND 2 3 Ø
VF SAND 3 4 Ø
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
REMARKS
620
610
630
620
640
630
12650
TS 56
TS 57
INTERLAMINATED DARK SILTSTONES AND SHALES WITH FEW INTERVALS OF SLIGHTLY RIPPLED VERY-FINE-GRAINED SANDSTONES
TO BOTTOM
SOME SOFT-SED DEFORM
TS 58


AVE GRAIN SIZE AND LITHOLOGY
DEPTH
CORE LOG
GAMMA RAY API UNITS
0
150
GRAN PEBBLE
VC SAND
C SAND
M SAND
F SAND
VF SAND
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
REMARKS
12650
640
660
12650
670
660
680
670
12672
INTERLAMINATED DARK SILTSTONES AND SHALES WITH INTERVALS OF SLIGHTLY RIPPLED SANDSTONE LENSES
TO BOTTOM
SOME BURROWS
T.S. 59
T.S. 60

Company: Tenneco Oil Company.

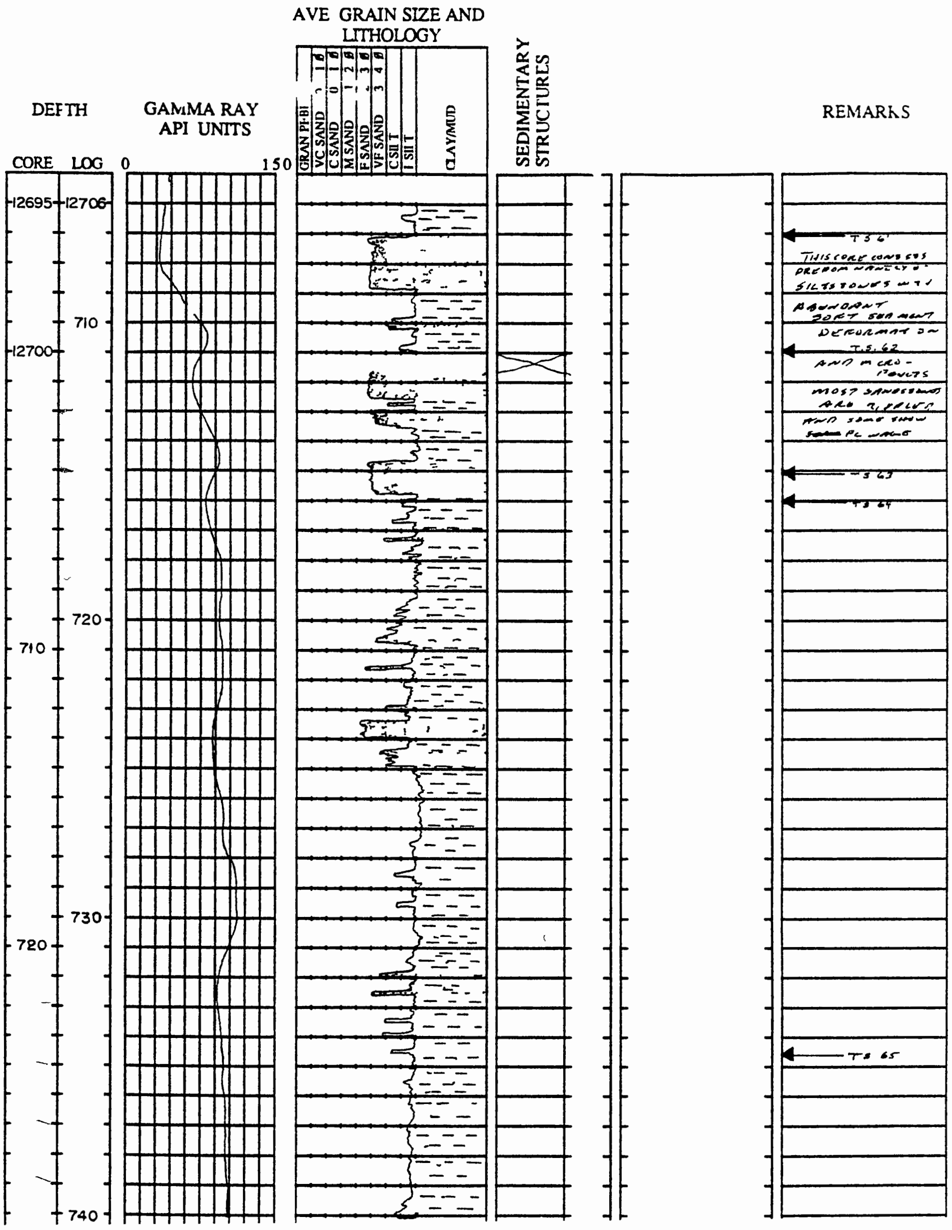
Well: Merrick No. 1-27.

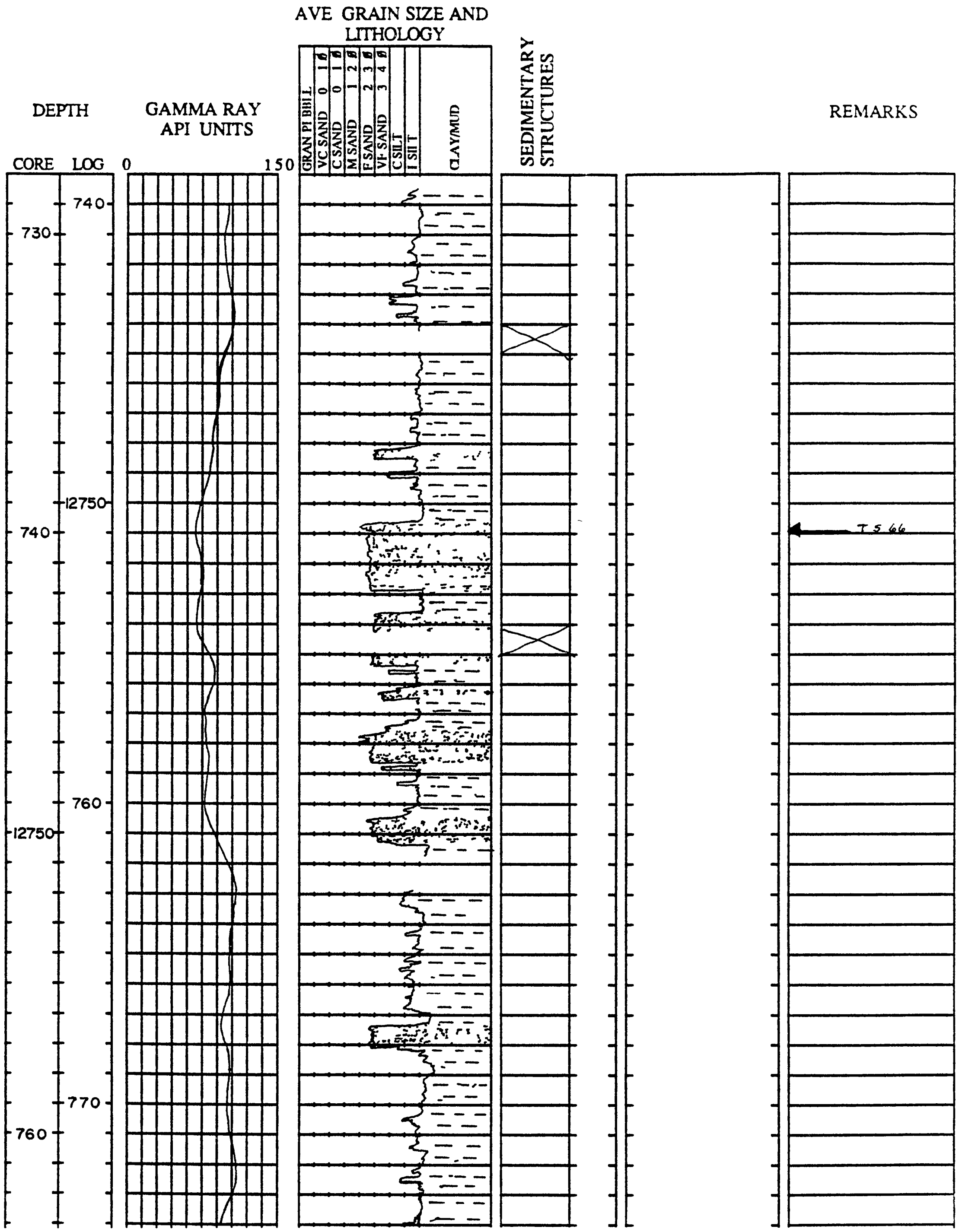
Location: C-SE Sec. 27, T. 14N., R. 22W., Custer County, Oklahoma.

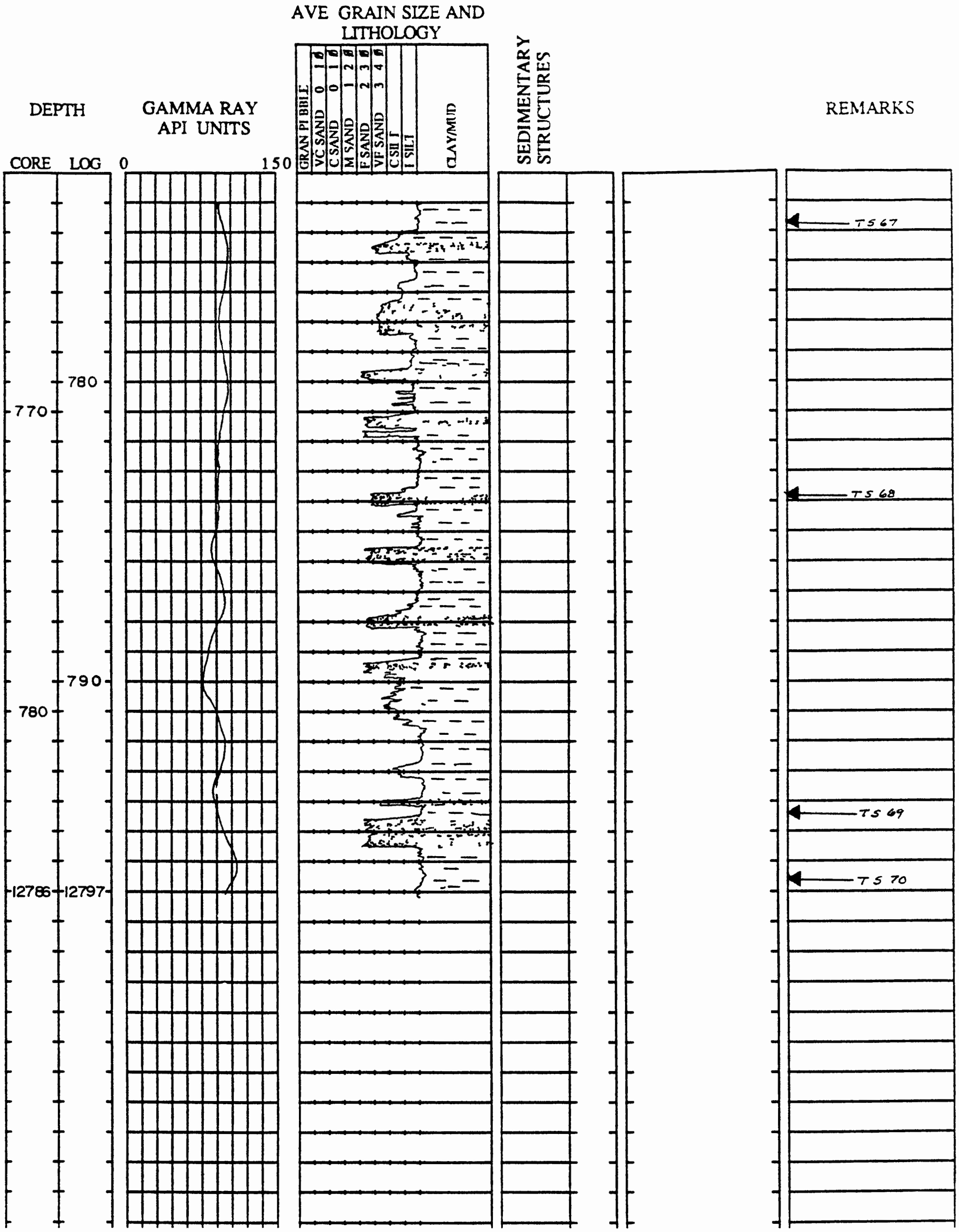
Stratigraphic Interval: Upper Red Fork Sandstone.

Core depth: 12,695 ft. to 12,786 ft.

Core to log correction: 11 ft.




AVE GRAIN SIZE AND LITHOLOGY
GRAN PEBBLE
VC SAND 0 1
C SAND 0 1
M SAND 1 2
F SAND 2 3
VF SAND 3 4
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
DEPTH
GAMMA RAY API UNITS
REMARKS
CORE LOG 0 150
740
730
12750
740
760
12750
770
760
T S 66


AVE GRAIN SIZE AND LITHOLOGY
DEPTH
CORE LOG
GAMMA RAY API UNITS
0 150
GRAN PEBBLE
VC SAND
C SAND
M SAND
F SAND
VF SAND
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
REMARKS
780
770
790
780
12786
12797
TS 67
TS 68
TS 69
TS 70

Company: Tenneco Oil Company.

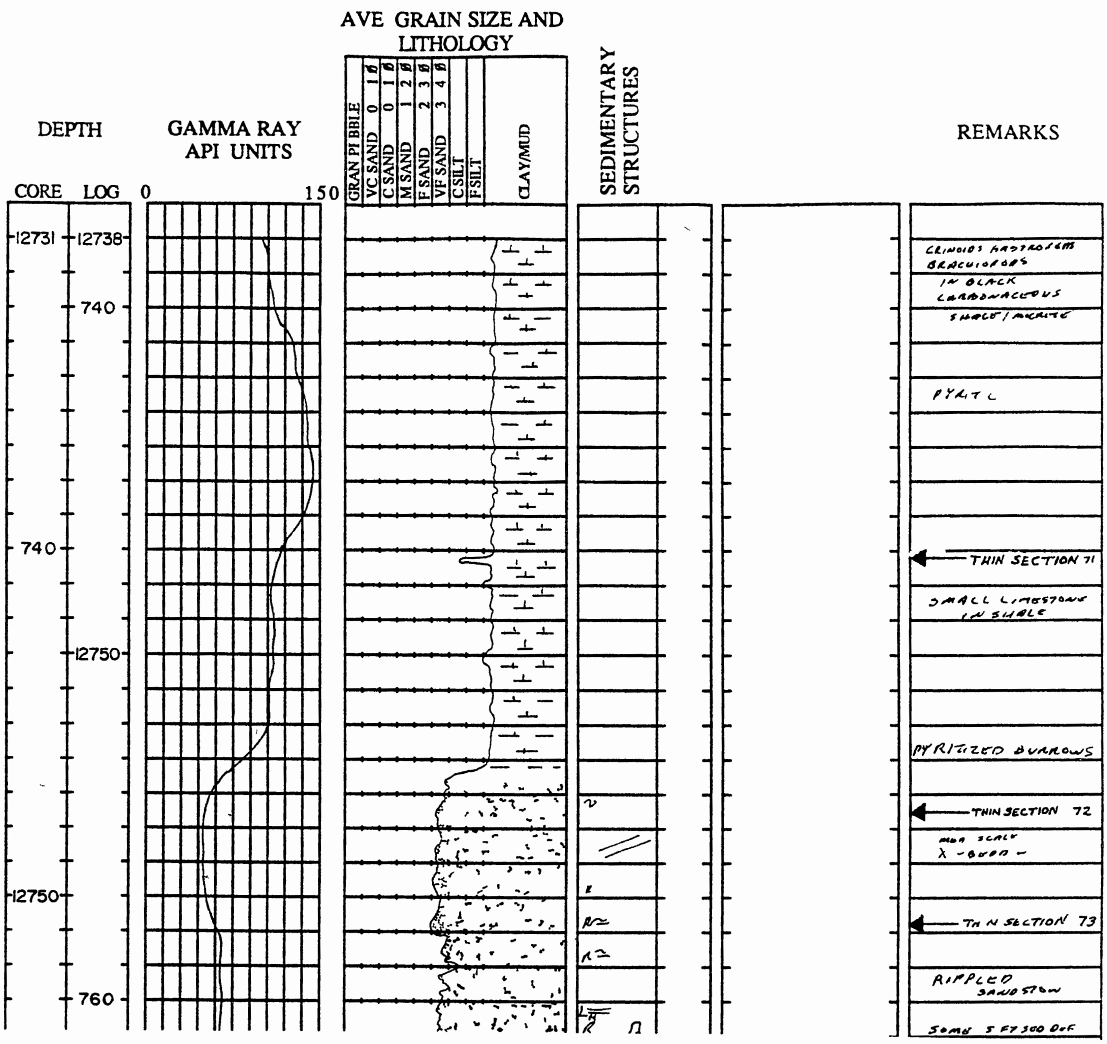
Well: Lester No. 1-6.

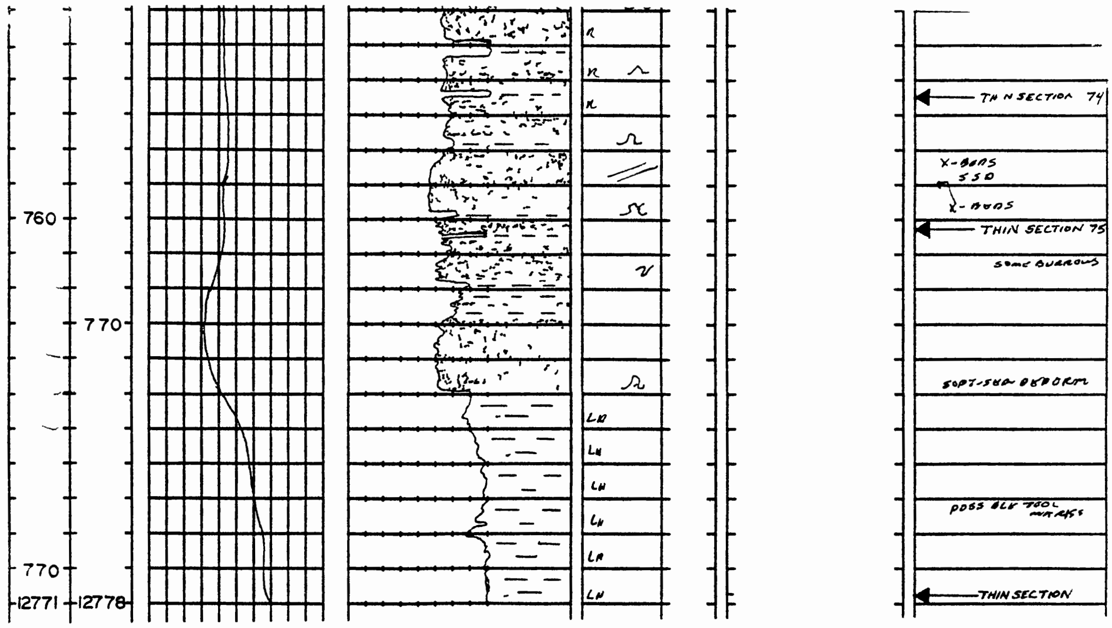
Location: SW-SW-NE-SW Sec. 6, T. 13N., R. 21W., Custer County, Oklahoma.

Stratigraphic Interval: Lower Pink Limestone Equivalent and the Upper Red Fork Sandstone.

Core depth: 12,731 ft. to 12,771 ft.

Core to log correction: 11 ft.




760
770
770
12771
12778
THIN SECTION 74
X-BEDS
SSD
X-BEDS
THIN SECTION 75
SOME BURROWS
THIN SECTION

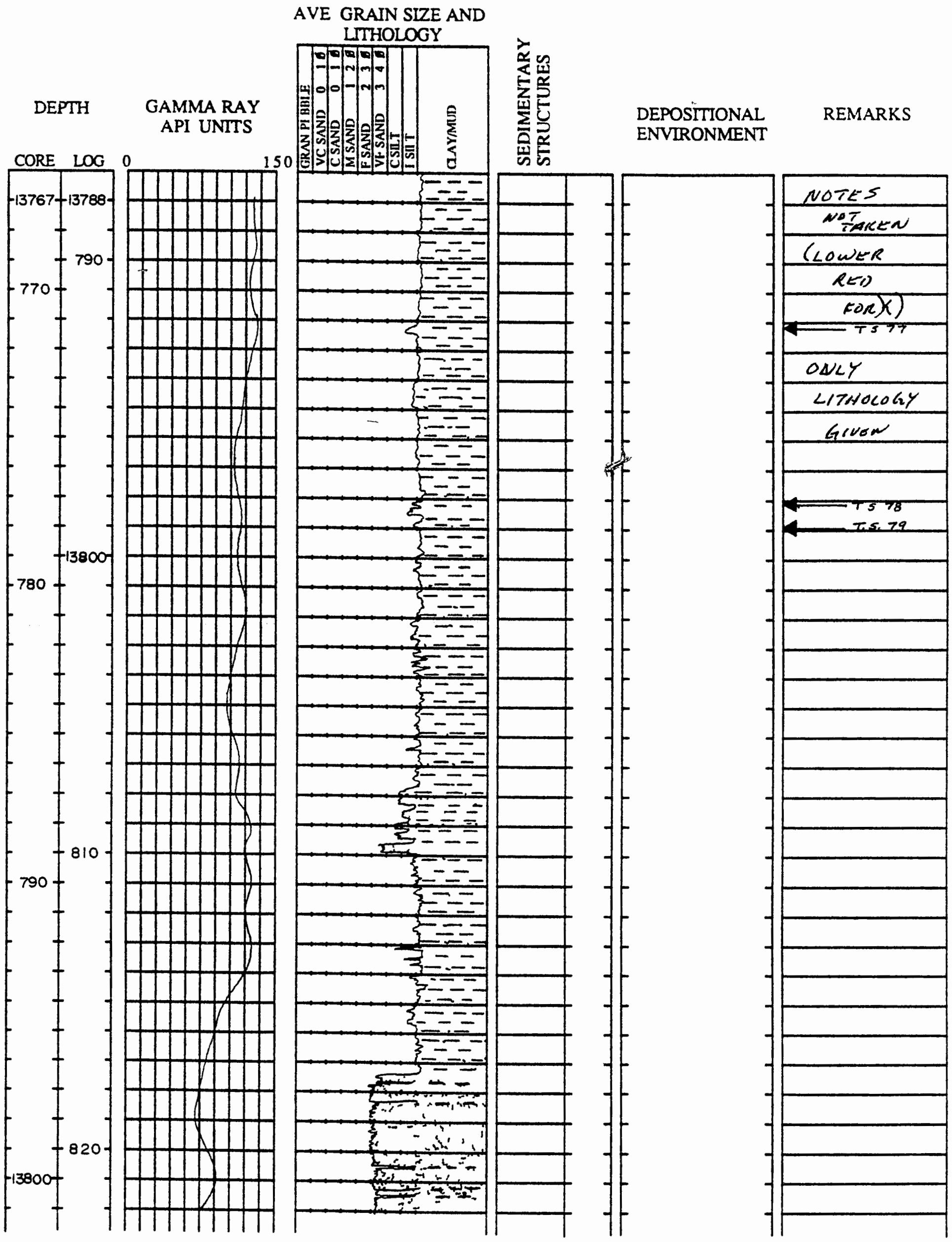
Company: Tenneco Oil Company.

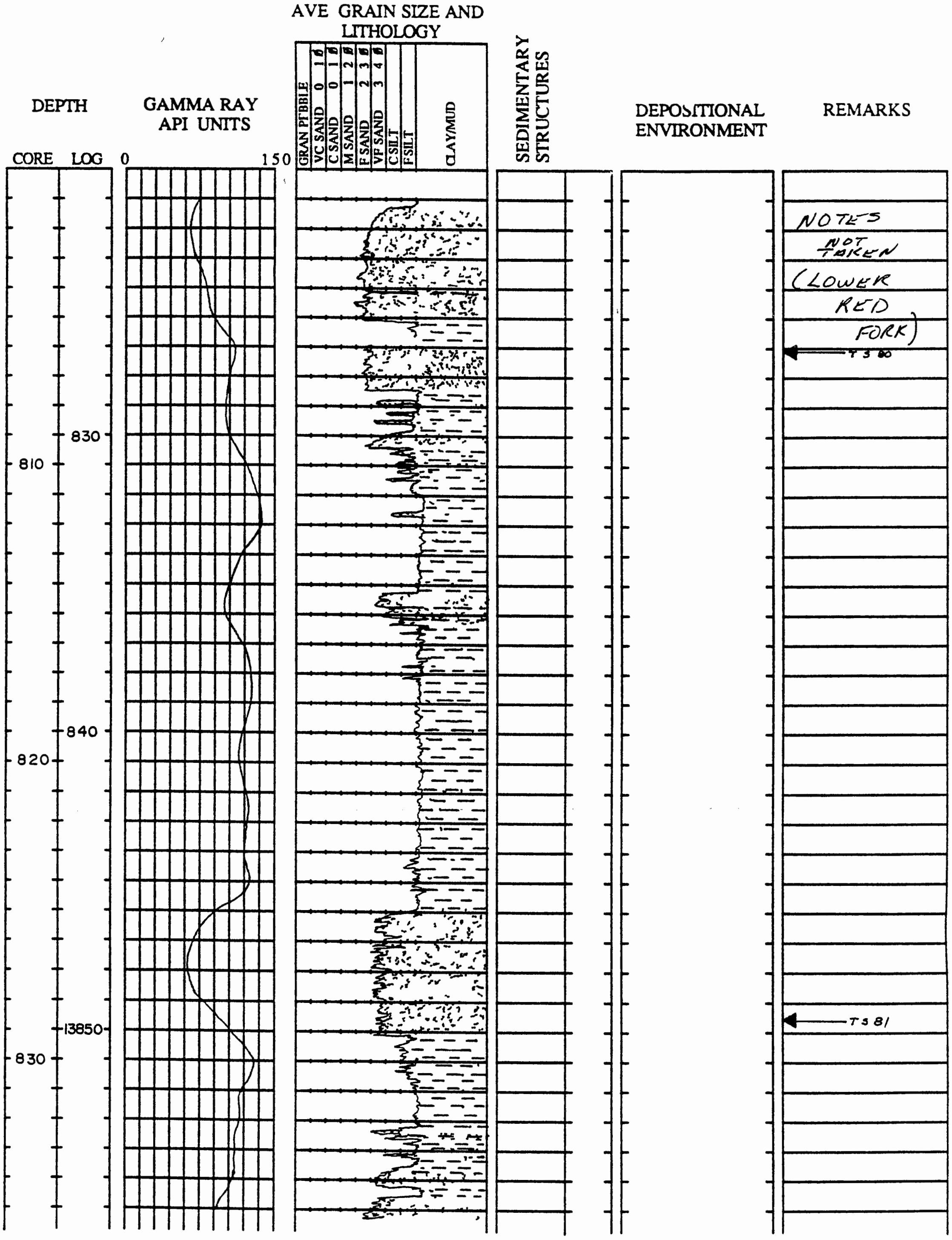
Well: Griffen No. 1-9.

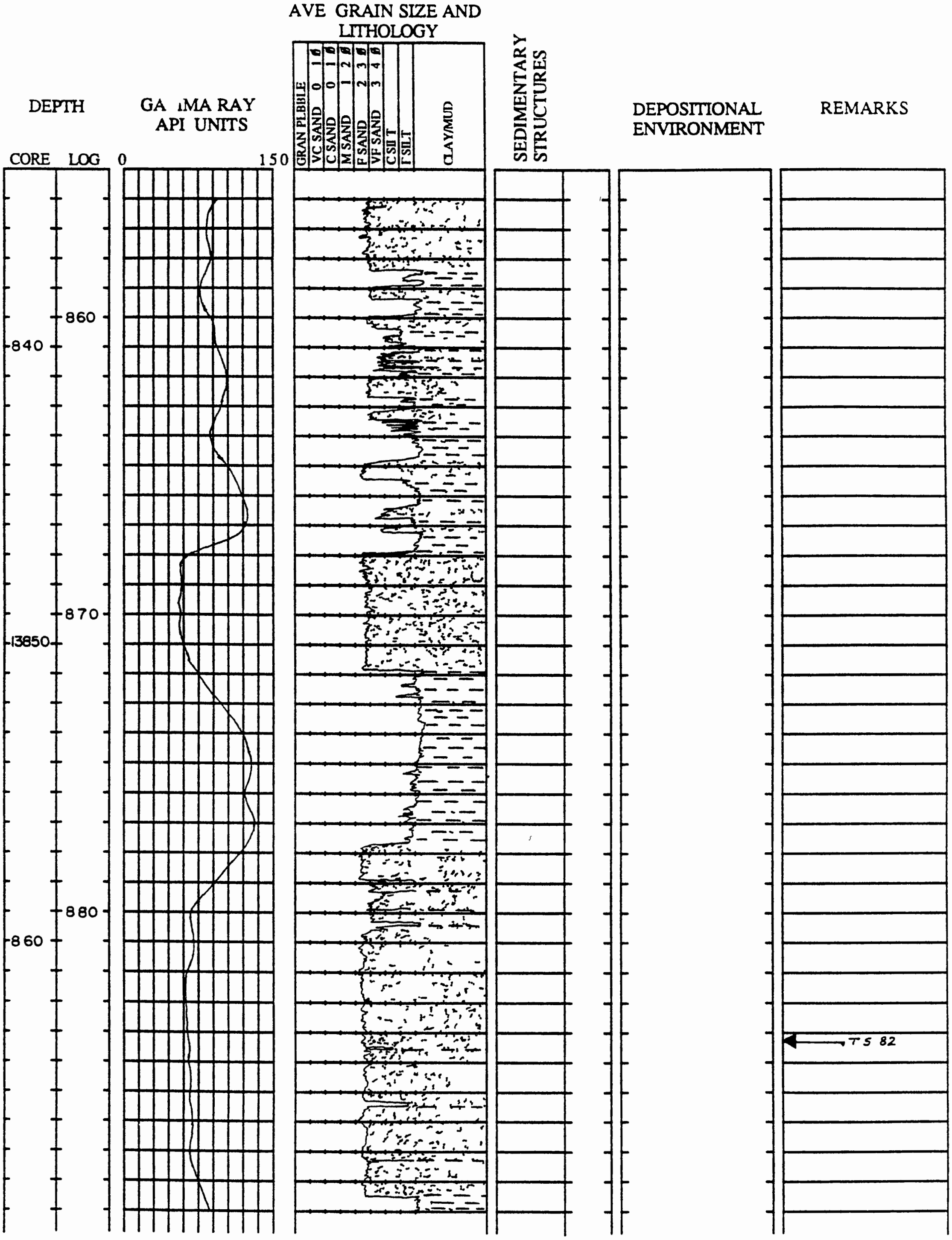
Location: S2-N2-N2-NE Sec. 9, T. 13N., R. 24W., Custer County, Oklahoma.

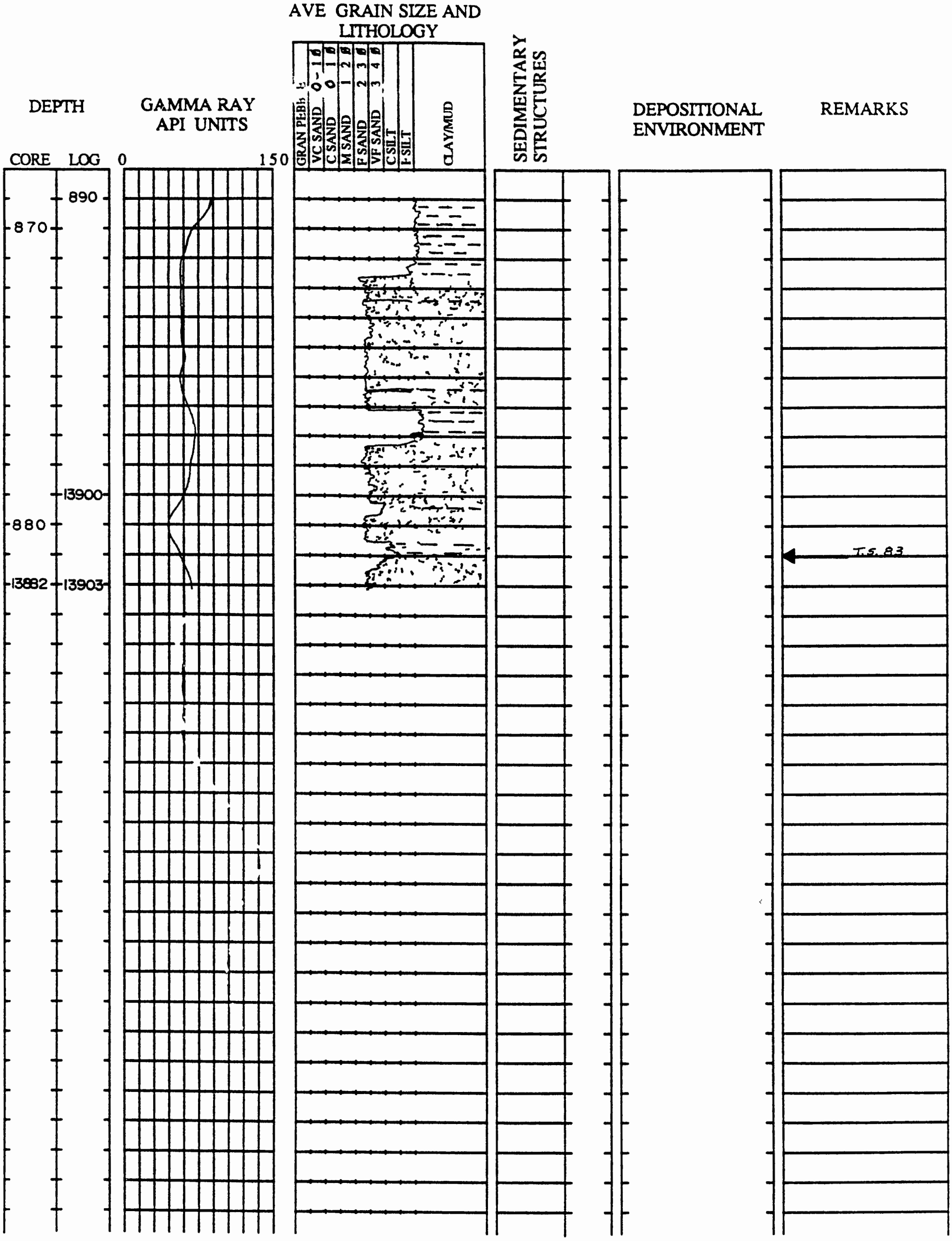
Stratigraphic Interval: Lower Red Fork Sandstone.

Core depth: 13,767 ft. to 13,882 ft.




DEPTH
CORE LOG
GAMMA RAY API UNITS
0 150
AVE GRAIN SIZE AND LITHOLOGY
GRAN PEBBLE
VC SAND 0 1
C SAND 0 1
M SAND 1 2
F SAND 2 3
VF SAND 3 4
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
DEPOSITIONAL ENVIRONMENT
REMARKS
830
810
840
820
13850
830
NOTES NOT TAKEN (LOWER RED FORK)
TS 80
TS 81


AVE GRAIN SIZE AND LITHOLOGY
DEPTH
CORE
LOG
GA ιMA RAY
API UNITS
0
150
GRAN PEBBLE
VC SAND 0 1
C SAND 0 1
M SAND 1 2
F SAND 2 3
VF SAND 3 4
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
DEPOSITIONAL ENVIRONMENT
REMARKS
860
840
870
13850
880
860
TS 82


AVE GRAIN SIZE AND LITHOLOGY
DEPTH
CORE LOG
GAMMA RAY
API UNITS
0
150
GRAN PEBB
VC SAND
C SAND
M SAND
F SAND
VF SAND
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
DEPOSITIONAL ENVIRONMENT
REMARKS
890
870
13900
880
13882
13903
T.S. 83

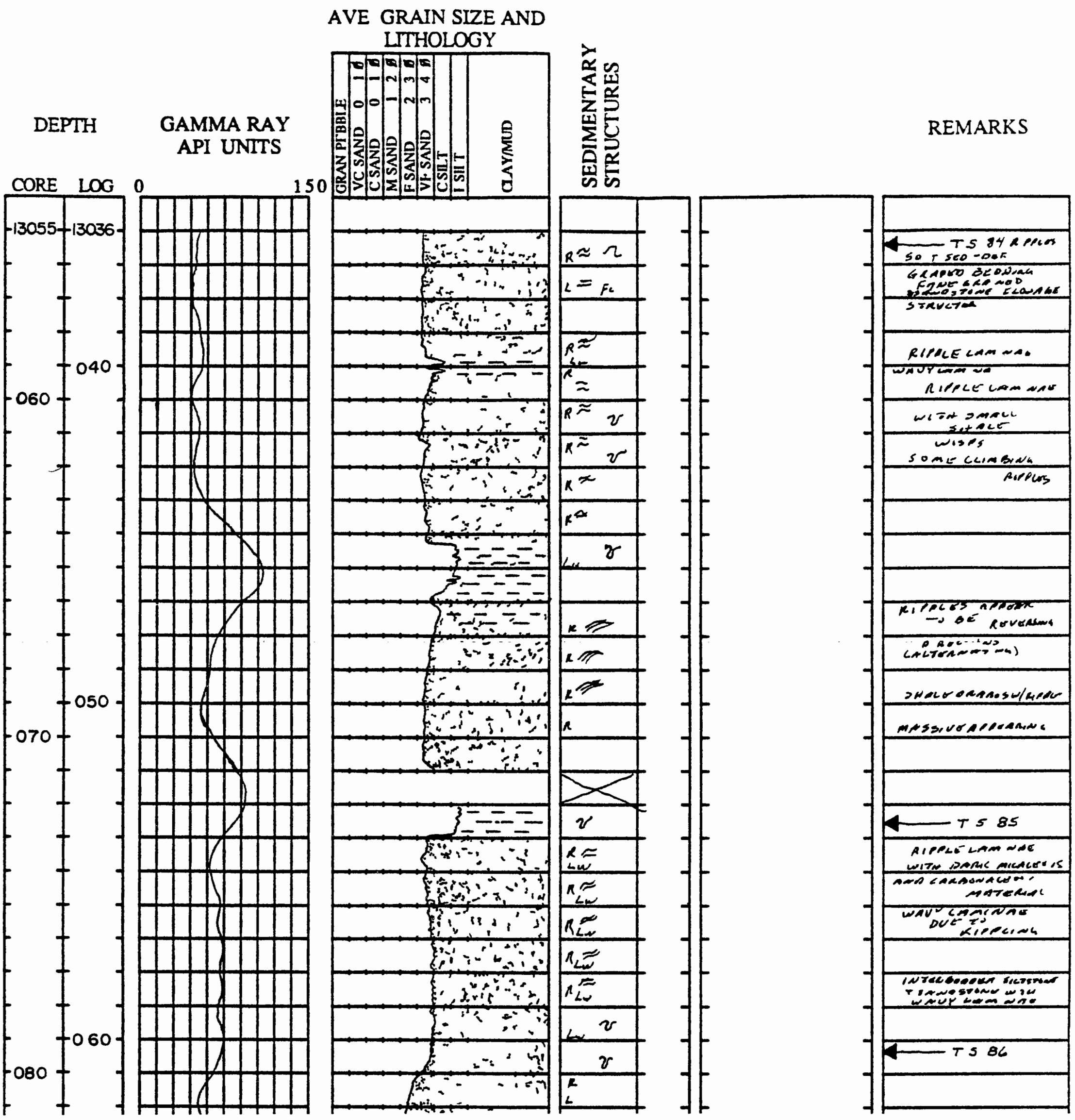
Company: Louisiana Land & Exploration.

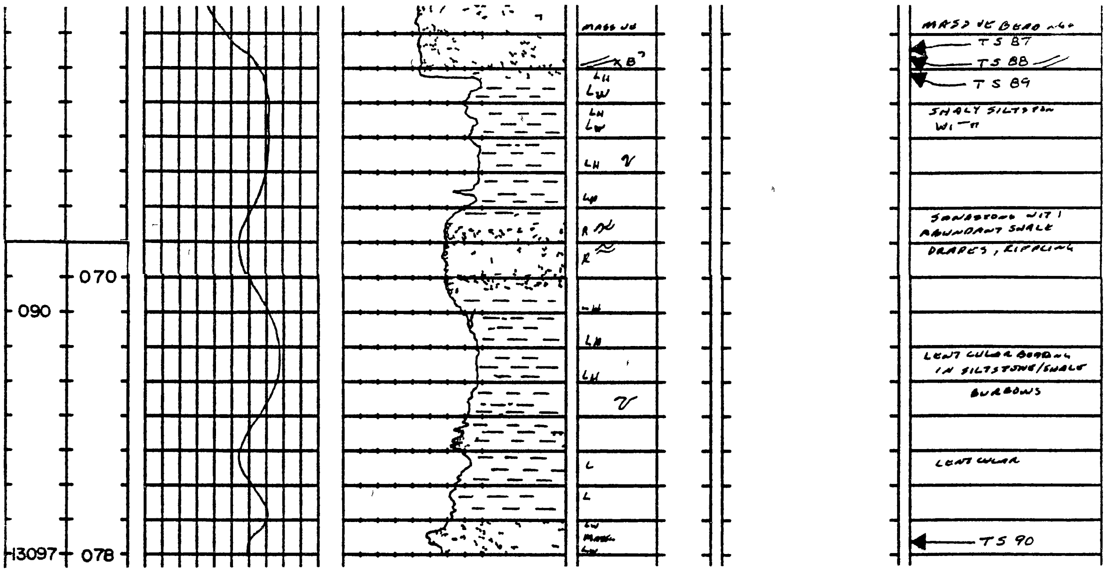
Well: Ruth No. 1-28.

Location: S2-N2-SW Sec. 28, T. 13N., R. 22W., Custer County, Oklahoma.

Stratigraphic Interval: Upper Red Fork Sandstone.

Core depth: 13,055 ft. to 13,097 ft.




070
090
13097
078
TS 87
TS 88
TS 89
TS 90

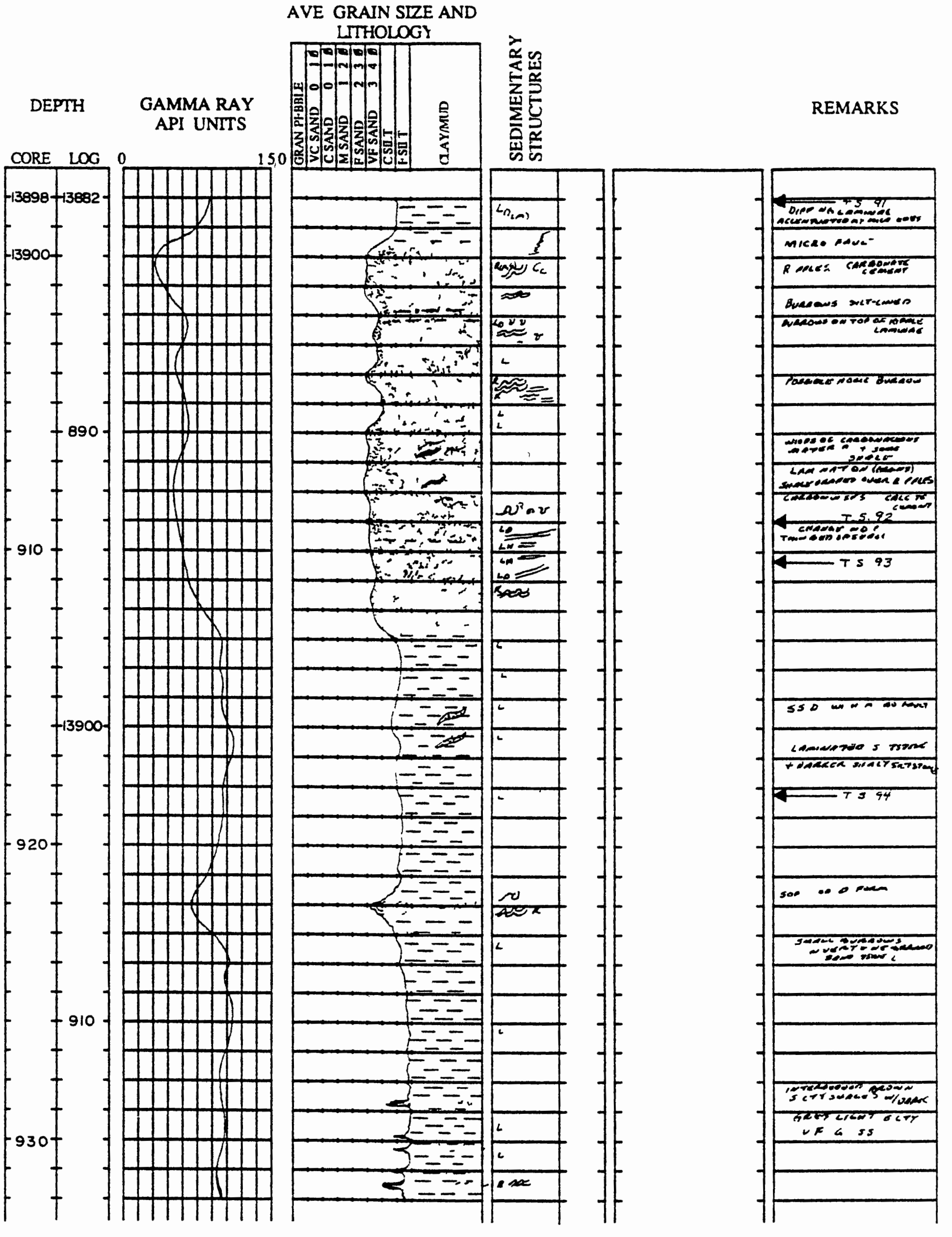
Company: Southport Exploration, Inc.

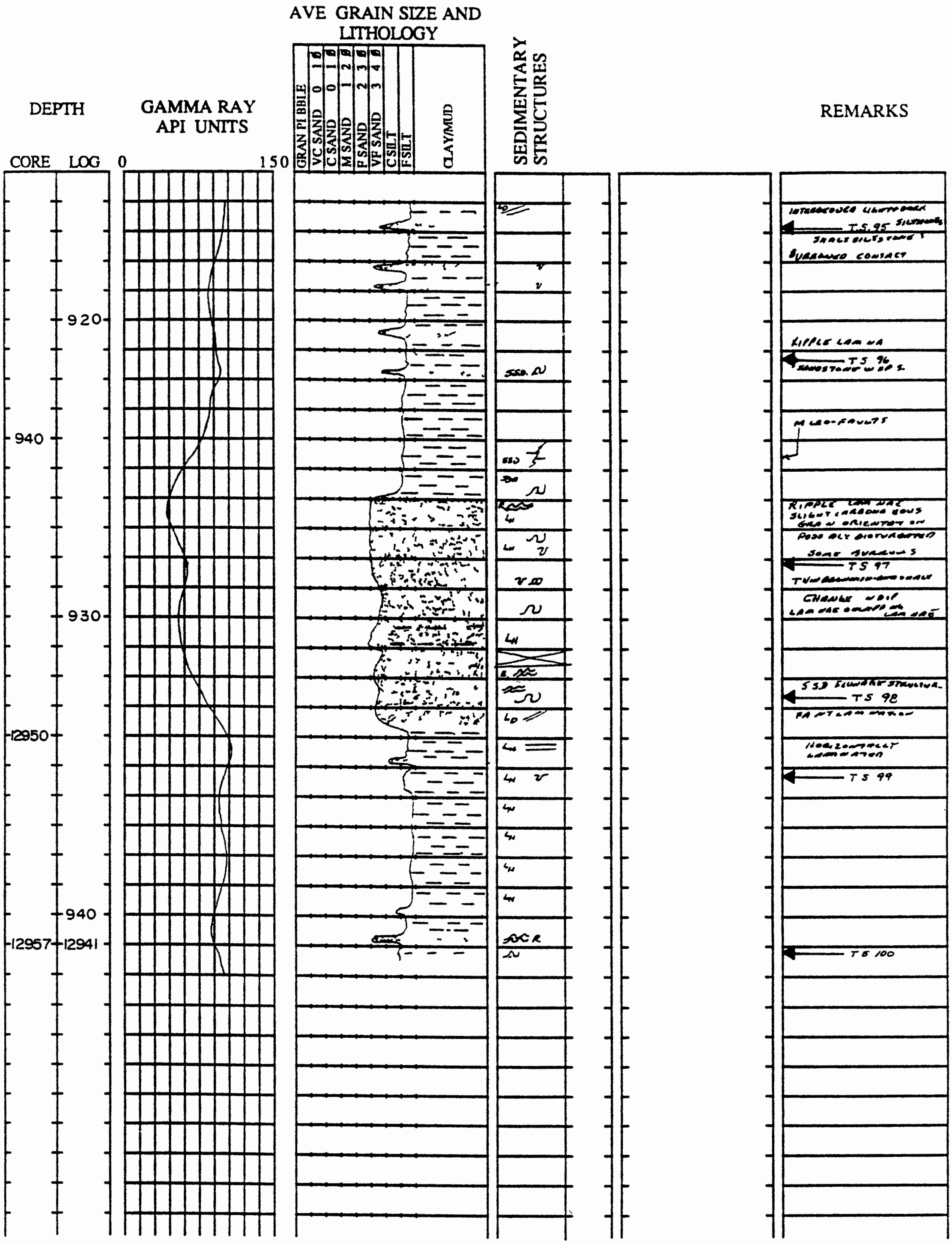
Well: Merrick No. 1-10.

Location: C-NE Sec. 10, T. 12N., R. 22W., Custer County, Oklahoma.

Stratigraphic Interval: Upper Red Fork Sandstone.

Core depth: 13,898 ft. to 13,957 ft.




AVE GRAIN SIZE AND LITHOLOGY
DEPTH
CORE
LOG
GAMMA RAY API UNITS
0
150
GRAN PEBBLE
VC SAND
C SAND
M SAND
F SAND
VF SAND
C SILT
F SILT
CLAY/MUD
SEDIMENTARY STRUCTURES
REMARKS
920
940
930
12950
940
12957
12941
T.S. 95
TS 96
TS 97
TS 98
TS 99
TS 100

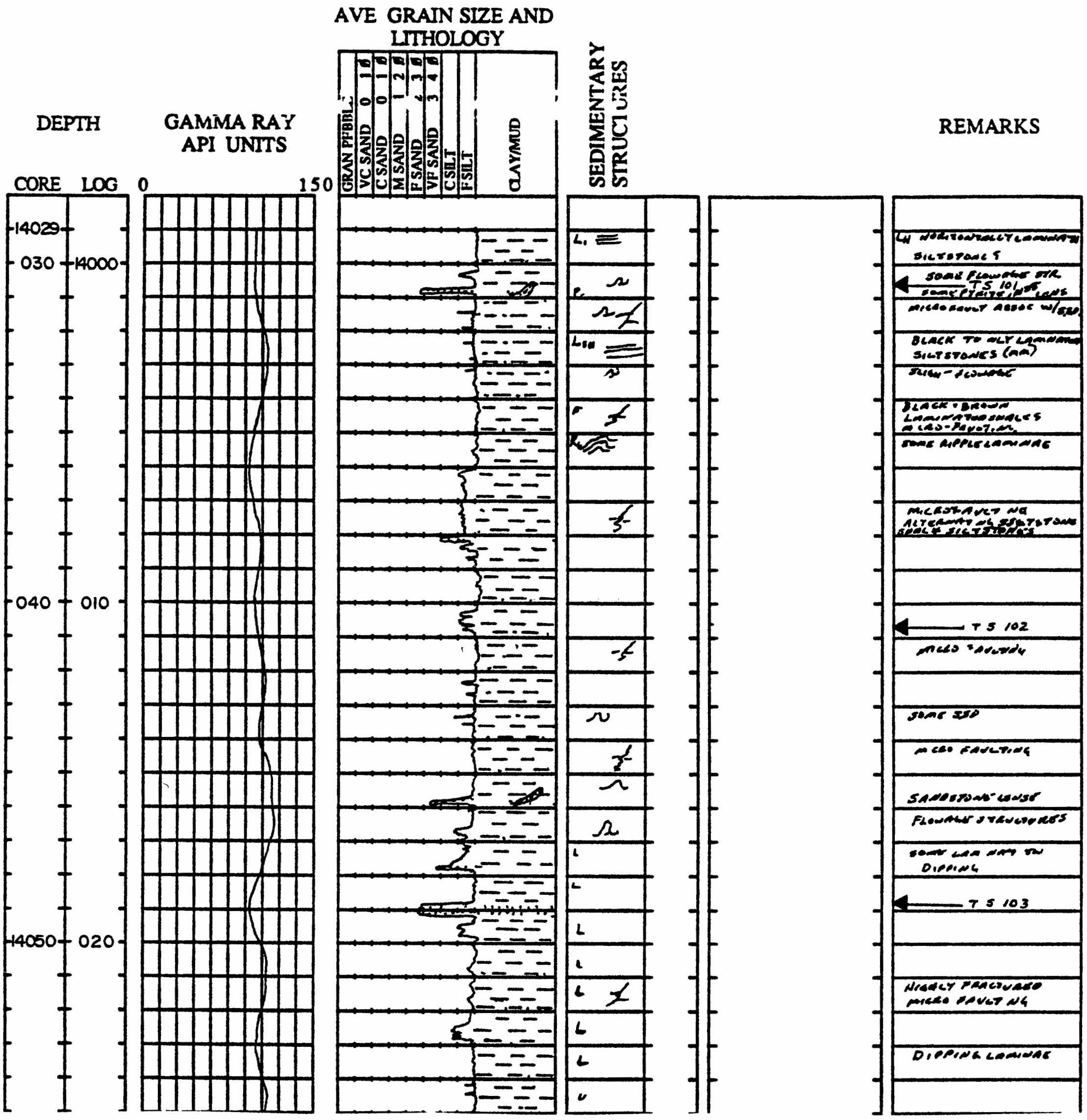
Company: Southport Exploration, Inc.

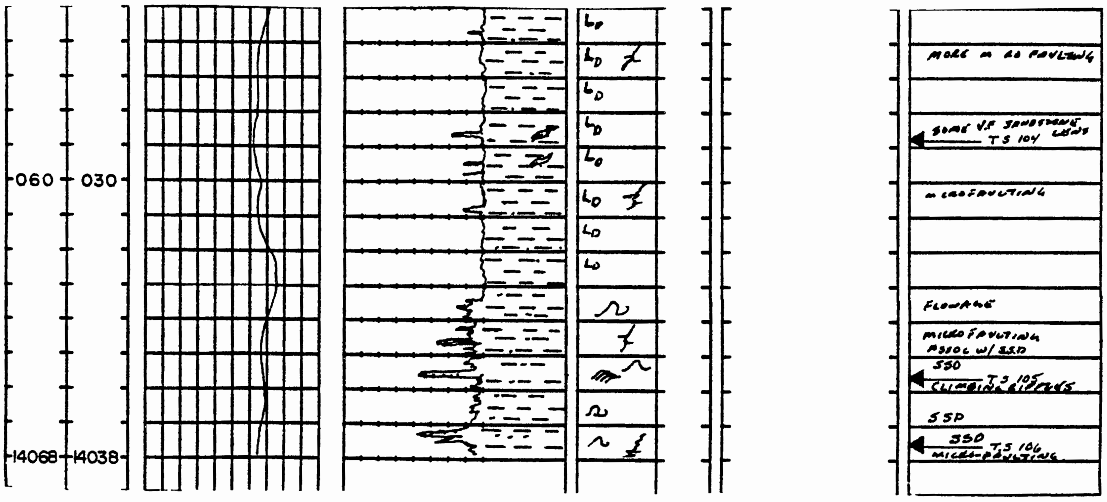
Well: Merrick No. 1-10.

Location: C-NE Sec. 10, T. 12N., R. 22W., Custer County, Oklahoma.

Stratigraphic Interval: Upper Red Fork Sandstone, shales.

Core depth: 14,029 ft. to 14,068 ft.




060
030
14068
14038
TS 104
FLOWAGE
MICROFAULTING
SSD
TS 105
SSP
SSD
TS 106

VITA

Charles J. Anderson, Jr.

Candidate for the Degree of

Master of Science

Thesis: DISTRIBUTION OF SUBMARINE FAN FACIES OF THE UPPER RED FORK INTERVAL IN THE ANADARKO BASIN, WESTERN OKLAHOMA

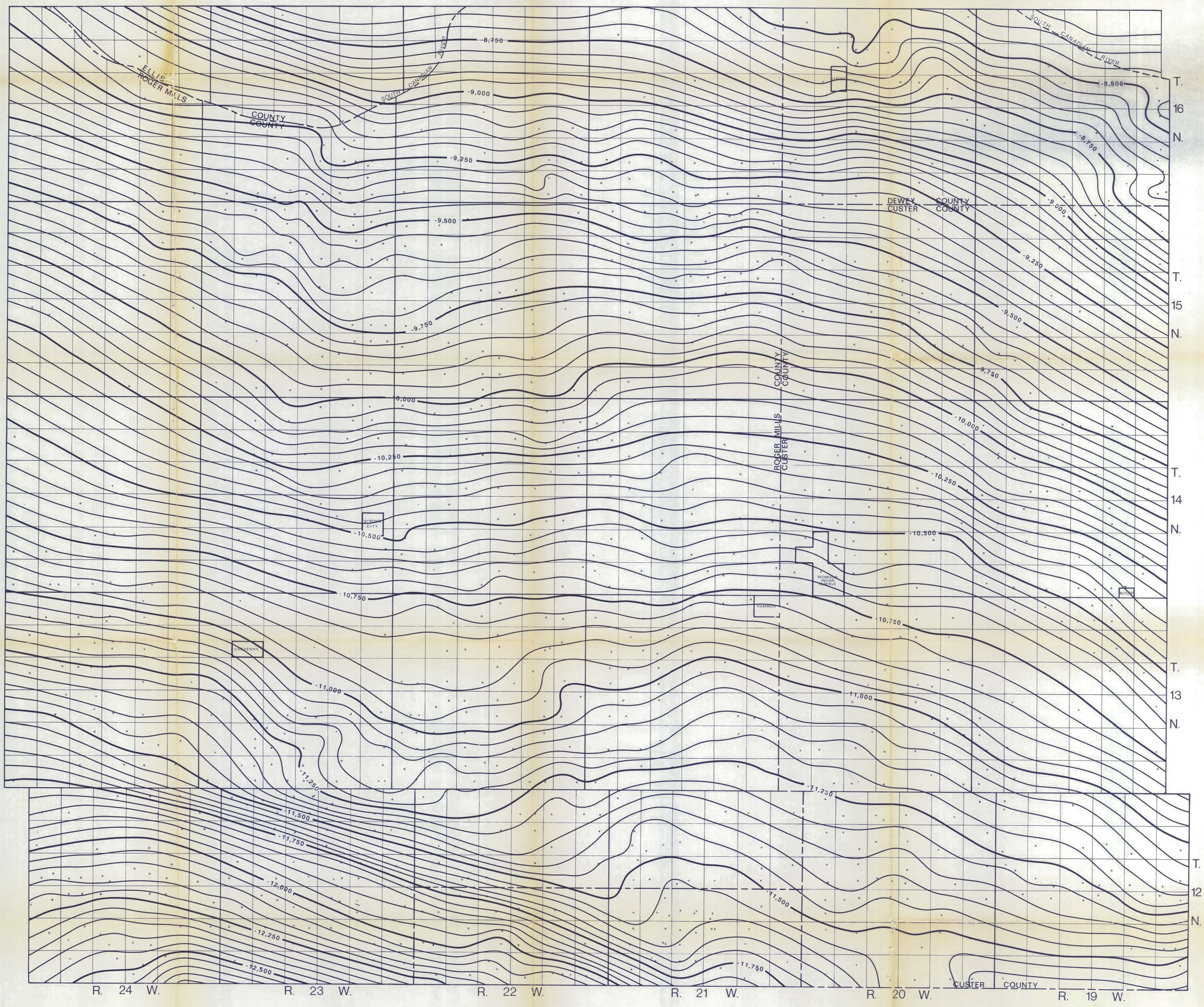
Major Field: Geology

Biographical:

Personal Data: Born in Miami, Oklahoma, December 6, 1961, the son of Peggy and Charles J. Anderson, Sr.

Education: Graduated from Welch High School, Welch, Oklahoma, in May of 1980; received Bachelor of Science in Geology from Oklahoma State University, Stillwater, Oklahoma in December, 1985; completed requirements for the Master of Science degree at Oklahoma State University in May, 1992.

Professional Experience: Teaching Assistant , Department of Geology, Oklahoma State University, June 1987 to May 1989. Summer-hire geologist, UNOCAL, summer of 1989, Casper, Wyoming. Geologist, UNOCAL, Midland, Texas, 1991 to present.



LEGEND

- ABANDONED DRY HOLE
- DRY HOLE (OIL SHOW)
- DRY HOLE (GAS SHOW)
- DRY HOLE (GAS & OIL SHOW)
- OIL WELL
- ABANDONED OIL WELL
- OIL WELL (GAS SHOW)
- GAS WELL
- ABANDONED GAS WELL
- GAS WELL (OIL SHOW)
- OIL & GAS WELL
- ABANDONED OIL & GAS WELL

COUNTY LINE
TOWNSHIP LINE
SECTION LINE

SCALE

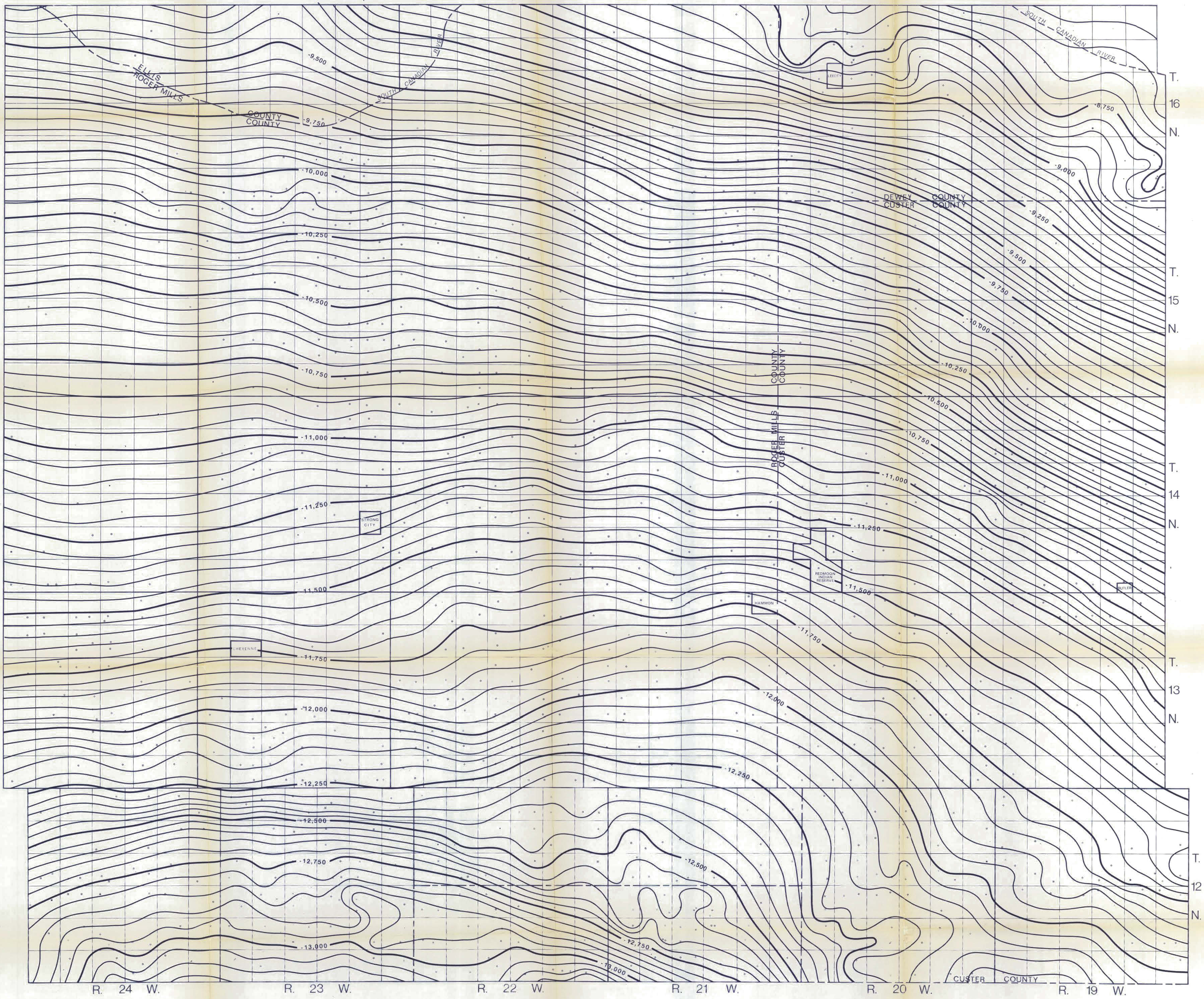
0 1 2

1 INCH = 1 MILE
1:63 360

CONTOUR INTERVAL = 50 FT.

PLATE I

STRUCTURE TOP OF UPPER RED FORK INTERVAL



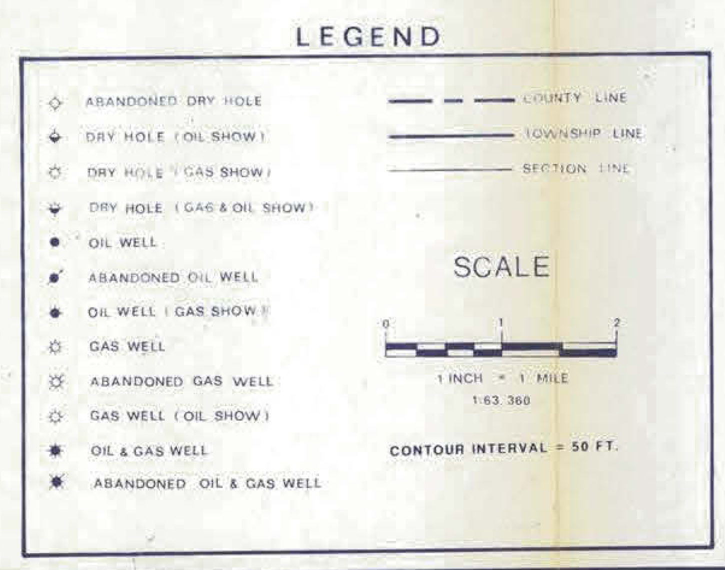
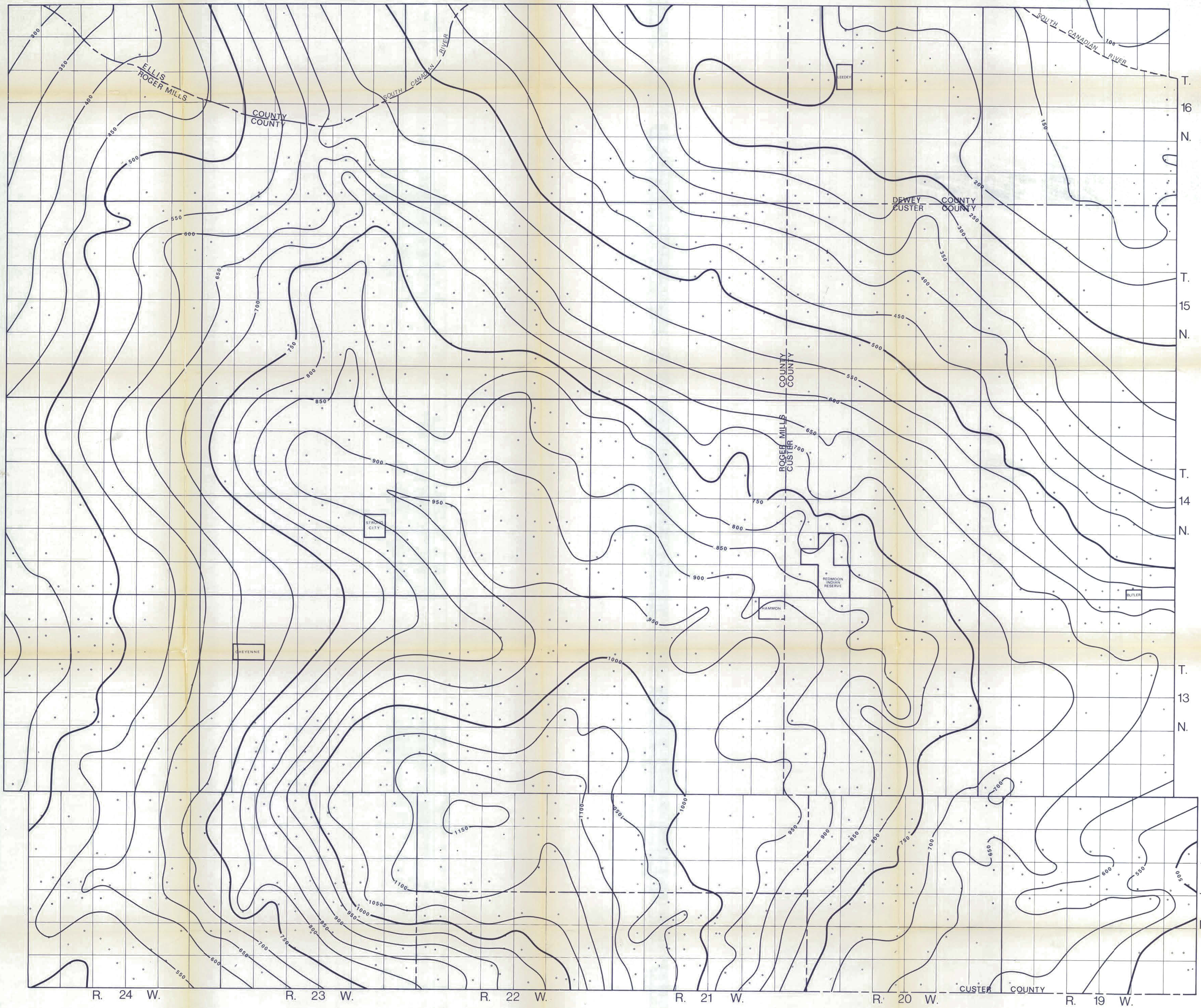


PLATE II

STRUCTURE TOP OF LOWER RED FORK INTERVAL



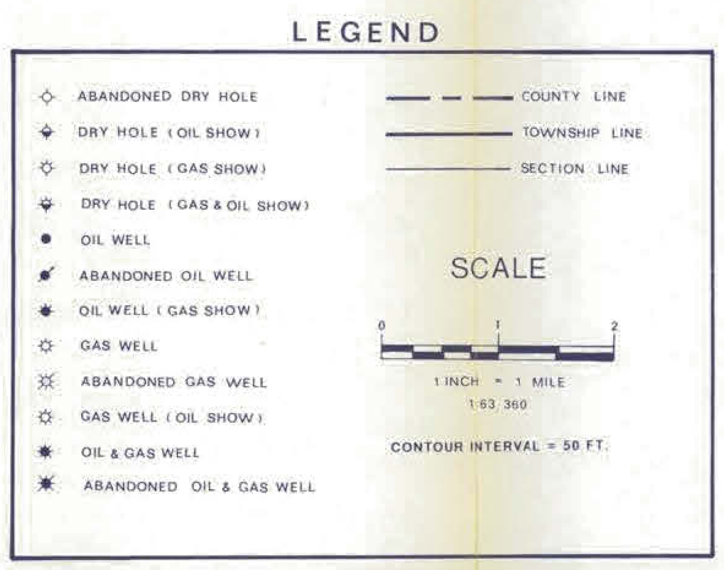


PLATE III

ISOPACH THICKNESS OF UPPER RED FORK INTERVAL

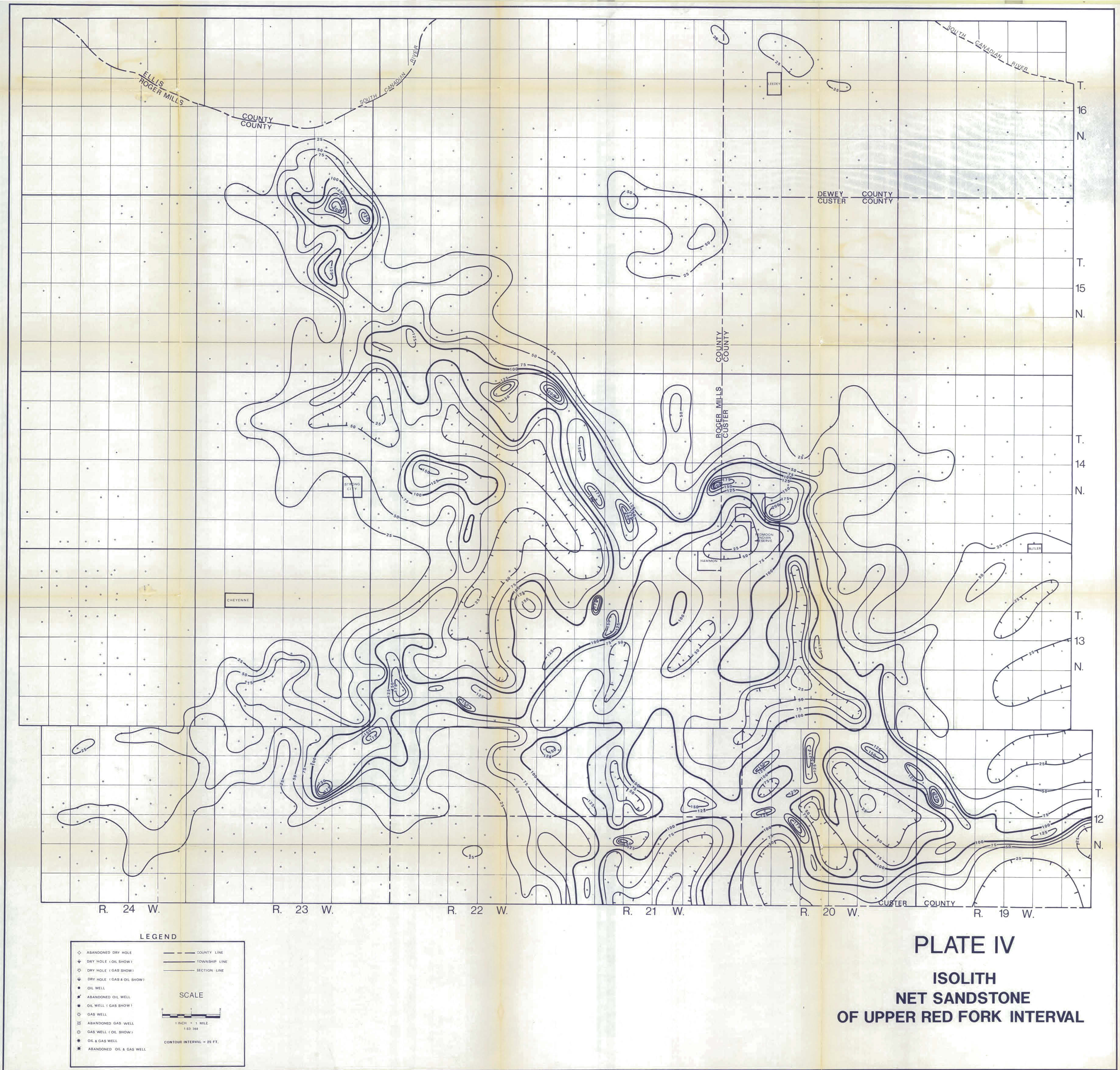


PLATE IV

ISOLITH
NET SANDSTONE
OF UPPER RED FORK INTERVAL