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E-189-21756

SUMMARY

1. A total of 485.6 feet (2470.0 to 2497.0 feet, and 2501.5 to 2960.1 feet) of conventional core from the Anadarko Petroleum Corporation Youngren "J" 1-H well were analyzed in detail.
2. Four principal depositional facies were delineated in the core. These are:

Depositional Facies	% of Cored Strata	Lithologic Characteristics	Porosity Range* (%) (Average*)	Permeability Range* (md) (Average*)	Estimated Reservoir Potential
Paleosol/ Coastal Plain	26%	Mostly brick-red siltstone, argillaceous siltstone and silty claystone. Often dolomitic and/or calcareous. Root mottling common. Caliche nodules and anhydrite nodules also abundant. Thin anhydrite beds. Microporosity and thin, "clean", porous laminations.	0.7-15.1 (6.4)	0.009-4.027 (0.327)	Mostly poor. Grading to fair to good where this facies grades into tidal flat deposits. Fair to good in thin eolian dune deposits.
Tidal Flat	18%	Laminated to ripple cross-stratified siltstone to very fine-grained sandstone. Locally bioturbated. Parts have well preserved intergranular pore space. Carbonate matrix and cement, as well as authigenic clay, present as pore-filling constituents.	1.0-23.9 (12.9)	0.01-180.447 (10.4)	Poor to very good.
Lagoon to Shallow Shelf	20%	Ranging from dolomitic siltstone to silty dolomitic mudstone/wackestone. Bioturbation generally apparent. Fossil fragments, peloids and other carbonate grains common. Patchy silicification noted. Little visible pore space, except for minor amounts of intercrystalline porosity.	0.5-12.9 (6.7)	0.01-2.60 (0.340)	Poor. Locally grading to fair where depositional texture is more grain-rich and/or tidal flat deposits are interfingered.
Carbonate Shoal to Shoal Flank	36%	Limestone to dolomite. Grainstone and packstone depositional textures predominate, locally grading to wackestone. Parts are ooid-dominated, but most of the strata contain a mixture of skeletal debris, peloids, ooids, oncooids and micritic intraclasts. Intergranular and moldic macropores common in limestones. Moldic and intercrystalline macropores predominate in dolomites. Intragranular macropores (within skeletal fragments) present. In addition, locally extensive intragranular microporosity development in micritic grains. Parts of this facies are extensively cemented with calcite, anhydrite and/or dolomite.	2.1-30.8 (12.6)	0.04-88.5 (4.51)	Poor to very good. Diagenesis very important in controlling reservoir potential. Dolomitic portions tend to have better reservoir potential.

* Excludes data from fractured plugs. See text for further discussion.

3. The paleosol/coastal plain facies consists of brick–red, reddish tan and greenish gray dolomitic/calcareous siltstones, argillaceous siltstones and claystones. Most of the measured pore volume is in the form of microporosity within altered matrix material. The average permeability is skewed toward the high end by four measurements from a thin eolian sandstone (between 2792.5 and 2795.5 feet). Excluding these four measurements, average permeability is recalculated to 0.199 md, a value that is considered to be representative of the paleosol/coastal plain strata. Overall, the paleosol/coastal plain facies is judged to have rather **poor** reservoir potential, locally grading to **fair** reservoir potential.
4. The tidal flat facies consists of light olive–gray, tan and reddish tan, very well to well sorted, very fine–grained sandstones and siltstones. The deposits are often dolomitic and/or calcareous. Ripple cross–stratification and laminations are well preserved. Primary intergranular pores predominate. The average porosity of 12.9% and average permeability of 10.4 md are the highest of any of the four facies encountered in this core. The ranges of porosity and permeability values in this facies largely reflect variations in the amount/distribution of carbonate matrix and cements, although anhydrite cement can be locally extensive. Overall, the tidal flat facies is judged to have variable reservoir potential, ranging from **poor** to **very good**.
5. The lagoon to shallow shelf facies consists of dark to medium gray, argillaceous, calcareous/dolomitic siltstones and silty mudstones/wackestones. Locally, these deposits grade to calcareous shale. Some of the mudstones/wackestones are dolomite, while other parts are mostly limestone. The low average porosity (6.7%) and permeability (0.340 md) values indicate that the lagoon to shallow shelf facies has only **poor** to **fair** reservoir potential.
6. The carbonate shoal/shoal flank facies consists of tan to gray grainstones and packstones. These grain–rich deposits vary from limestone to dolomitic limestone to calcareous dolomite. The lithology of this facies appears to vary

throughout the stratigraphic column. Above 2707 feet, the shoal/shoal flank deposits tend to be relatively thick, and the strata are either dolomite or a mixture of limestone and dolomite. Below 2707 feet the shoal/shoal flank units are thinner and nearly all limestones. Most of the grainstones and packstones contain a mixture of carbonate particles including skeletal debris, peloids, oncoids, intraclasts and ooids. Routine core analysis data for the shoal/shoal flank deposits reveal porosity values ranging from 2.1% to 30.8% (average of 12.6%), and permeability values ranging from 0.04 md to 88.5 md (average of 4.51 md). However, closer scrutiny of the data demonstrates important differences in the average values for the limestones and dolomites.

Rock Type	Number of Measurements	Porosity Range (%) (Average)	Permeability Range (md) (Average)
Limestone	112	2.1–30.8 (11.8)	0.04–19.59 (1.954)
Dolomite	55	7.0–21.6 (14.3)	0.12–88.5 (9.722)

Thus, dolomitization acted to enhance the reservoir potential of the shoal/shoal flank grainstones and packstones. In the limestones, the highest porosity and permeability values occur where the grainstone (matrix-free) textures result in well developed networks of intergranular pores. Some of the limestones that have high porosity but low permeability have only poorly interconnected moldic pores. Lower porosity and permeability values occur where calcite cement is extensive and/or where lime mud fills the interstitial areas. In the dolomites, high porosity values typically occur in association with a combination of: 1) intercrystalline pores, 2) relict intergranular pores, and 3) moldic pores. Matrix selective dolomitization has locally enhanced reservoir potential by creating intercrystalline pores that improve pore interconnection. Overall, the grain-rich limestones and dolomites of the carbonate shoal/shoal flank facies are judged to **fair to very good** reservoir potential, with the dolomite portions generally having higher porosity and permeability values.

7. The stratigraphic sequence observed in the core reflects numerous transgressive and regressive cycles. This is recorded by the interfingering of the four depositional facies identified in the core. One of the byproducts of this type of cyclic sedimentation is the "stacking" of potential reservoir facies. For example, there are 8 tidal flat units and 14 carbonate shoal/shoal flank intervals, each separated by low porosity, low permeability paleosol/coastal plain or lagoon/shallow shelf deposits.

**GEOLOGICAL ANALYSIS
OF CONVENTIONAL CORE FROM THE
ANADARKO PETROLEUM CORPORATION
YOUNGREN "J" 1-H WELL
STEVENS COUNTY, KANSAS**

INTRODUCTION

This report, prepared for Anadarko Petroleum Corporation, presents the results and conclusions obtained from geological analysis of 485.6 feet (2470.0 to 2497.0 feet, and 2501.5 to 2960.1 feet) of conventional core from the Anadarko Petroleum Corporation Youngren "J" 1-H well, located in Stevens County, Kansas.

The objectives of this study were to: 1) describe the conventional core and delineate lithologies, textures, sedimentary structures and contact relationships, 2) identify petrographic characteristics and diagenetic alterations that influence pore system properties, and 3) evaluate reservoir potential. In addition, observations and conclusions drawn from analysis of this core were to be compared to similar data obtained on the Anadarko Petroleum Corporation Cornell University "C" 1-H well located in Morton County, Kansas (Reservoirs' Job Number RSH 2982).

In order to meet these objectives, the following analytical program was utilized:

- Following full diameter core analysis measurements (Table 4), the conventional core was slabbed into one-third and two-third sections. Color continuous core photographs are provided in Figure 3.
- The core was described in detail. Rock types, depositional textures, grain size, sedimentary structures and contact relationships were delineated. This description is presented in Figure 2 and in the Core Description Panel at the end of this report.
- Individual core pieces were selected to show representative lithologies. These close core photographs are displayed in Figure 4.

-- One hundred three (103) samples were selected for thin section preparation. The samples were impregnated with blue-dyed epoxy to highlight pore space. The thin sections were then ground to 30 microns and stained with Alizarin Red-S, which aids in differentiating calcite from other carbonate minerals. All of these thin sections were examined, and petrographic observations are incorporated into the core description. The locations of these thin sections are shown on the Core Description Panel.

-- Thirty-two (32) samples were selected for detailed petrographic evaluation. These are:

Depth (ft)	Thin Section	XRD	Figure No.	Stratigraphic Unit
2481.8	X	X	5	Herington
2515.3	X	X	6	Krider
2518.2	X	X	7	Krider
2526.4	X	X	8	Krider
2532.3	X	X	9	Krider
2552.9	X	X	10	Winfield Sandstone
2573.5	X	X	11	Winfield Dolomitic Lime
2578.7	X	X	12	Winfield Dolomitic Lime
2613.2	X	X	13	Towanda Sand
2625.9	X	X	14	Towanda Lime
2637.8	X	X	15	Towanda Lime
2638.2	X	X	16	Towanda Lime
2647.6	X	X	17	Towanda Lime
2682.6	X	X	18	Upper Fort Riley
2704.7	X	X	19	Upper Fort Riley
2740.1	X	X	20	Upper Florence
2743.1	X	X	21	Lower Florence
2768.8	X	X	22	Wreford
2793.5	X	X	23	Council Grove A
2793.9	X	X	24	Council Grove A
2802.6	X	X	25	Council Grove A
2805.2	X	X	26	Council Grove A
2870.3	X	X	27	Council Grove B1
2878.9	X	X	28	Council Grove B1
2896.3	X	X	29	Council Grove B2
2897.6	X	X	30	Council Grove B2
2917.3	X	X	31	Council Grove B3
2918.1	X	X	32	Council Grove B3
2925.5	X	X	33	Council Grove B3
2932.3	X	X	34	Council Grove B4
2951.5	X	X	35	Council Grove B5
2952.3	X	X	36	Council Grove B5

- Point count modal analysis (250 points) was used to determine the relative proportions of framework grains, pore-filling constituents, replacement products and pore types in the sandstone samples. Point count data are presented in Table 2. Thin section photomicrographs are provided in Figures 5 through 36.
- Samples selected for X-ray diffraction (XRD) were ground to 40 microns to ensure homogeneity, and analyzed through standard X-ray diffraction techniques. Bulk mineralogy XRD data are presented in Table 3 and in the figure captions.

Reservoirs' Job Number RSH 3036 was assigned to this study. Any communications regarding this report should refer to this Job Number. Five copies of this report were forwarded to Mr. Todd Montgomery, Anadarko Petroleum Corporation, Houston, Texas. Additional copies of this report may be obtained for reproduction costs. All data, interpretations, and other matters related to this study are considered highly confidential and the sole property of Anadarko Petroleum Corporation, Houston, Texas.


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GEOLOGICAL ANALYSIS

This section of the report presents the results of geological analysis of 485.6 feet (2470.0–2497.0 feet, and 2501.5–2960.1 feet) of conventional core from the Anadarko Petroleum Corporation Youngren "J" 1–H well, located in Stevens County, Kansas. The core recovered strata from 19 stratigraphic units as defined by Anadarko Petroleum Corporation (see Table 1 and Core Description Panel).

Core Description and Interpretation

Four principal depositional facies were delineated in the core. These are :

Depositional Facies	% of Cored Strata	Lithologic Characteristics	Porosity Range* (%) (Average*)	Permeability Range* (md) (Average*)	Estimated Reservoir Potential
Paleosol/ Coastal Plain	26%	Mostly brick-red siltstone, argillaceous siltstone and silty claystone. Often dolomitic and/or calcareous. Root mottling common. Caliche nodules and anhydrite nodules also abundant. Thin anhydrite beds. Microporosity and thin, "clean", porous laminations.	0.7–15.1 (6.4)	0.009–4.027 (0.327)	Mostly poor. Grading to fair to good where this facies grades into tidal flat deposits. Fair to good in thin eolian dune deposits.
Tidal Flat	18%	Laminated to ripple cross-stratified siltstone to very fine-grained sandstone. Locally bioturbated. Parts have well preserved intergranular pore space. Carbonate matrix and cement, as well as authigenic clay, present as pore-filling constituents.	1.0–23.9 (12.9)	0.01–180.447 (10.4)	Poor to very good.
Lagoon to Shallow Shelf	20%	Ranging from dolomitic siltstone to silty dolomitic mudstone/wackestone. Bioturbation generally apparent. Fossil fragments, peloids and other carbonate grains common. Patchy silicification noted. Little visible pore space, except for minor amounts of intercrystalline porosity.	0.5–12.9 (6.7)	0.01–2.60 (0.340)	Poor. Locally grading to fair where depositional texture is more grain-rich and/or tidal flat deposits are interfingered.
Carbonate Shoal to Shoal Flank	36%	Limestone to dolomite. Grainstone and packstone depositional textures predominate, locally grading to wackestone. Parts are ooid-dominated, but most of the strata contain a mixture of skeletal debris, peloids, ooids, oncoids and micritic intraclasts. Intergranular and moldic macropores common in limestones. Moldic and intercrystalline macropores predominate in dolomites. Intragranular macropores (within skeletal fragments) present. In addition, locally extensive intragranular microporosity development in micritic grains. Parts of this facies are extensively cemented with calcite, anhydrite and/or dolomite.	2.1–30.8 (12.6)	0.04–88.5 (4.51)	Poor to very good. Diagenesis very important in controlling reservoir potential. Dolomitic portions tend to have better reservoir potential.

* Excludes data from fractured plugs. See text for further discussion.

Paleosol/Coastal Plain Facies

Description:

The paleosol/coastal plain facies accounts for roughly 26% of the cored strata. Ten individual units were delineated, showing a range in thickness from 5 feet to nearly 30 feet (see Figure 2 and the Core Description Panel). The deposits are dominated by **brick-red, reddish tan and greenish gray, dolomitic/calcareous siltstones, argillaceous siltstones and claystones** (Figure 4,A). A minor amount of very fine-grained, cross-stratified sandstone (eolian deposits near 2794 feet) was also identified. Thin interbeds of anhydrite are present in the paleosol/coastal plain deposits between 2470 and 2475 feet. In addition to quartz and feldspar grains, mica, heavy minerals, iron-stained detrital clay, very finely crystalline dolomite and calcite cements, carbonate matrix, anhydrite cement and iron oxide cement are present in these strata (Figures 25, 26 and 33). Root mottling and desiccation features are common, with caliche nodules and anhydrite nodules noted at numerous horizons. Some of the anhydrite nodules have been partially replaced by chert.

The paleosol/coastal plain deposits are sometimes in gradational contact with tidal flat deposits (for example at 2475.0 feet, 2549.5 feet and 2607.3 feet). In these cases, it can be difficult to establish specific contacts between these two siliciclastic facies, especially where iron-staining is extensive. By comparison, where paleosol/coastal plain deposits overlie carbonate facies (either lagoon/shallow shelf and shoal/shoal flank deposits), sharper contacts can generally be defined.

Primary sedimentary structures are relatively uncommon in the paleosol/coastal plain facies, although faint laminations and ripples can be distinguished at some depths. Root mottling, along with the development of caliche nodules and evaporite (gypsum/anhydrite) nodules probably played significant roles in disrupting bedding features. The very fine-grained (eolian) sandstones at 2794 feet show high-angle, planar cross-stratification and ripple cross-laminations.

Some sections of the paleosol/coastal plain facies are rubble (see Figure 2). Examination of unslabbed core through the paleosol/coastal plain facies revealed

fractures that appear to be artifacts of coring, sample handling and/or full diameter core analysis. Anhydrite-filled fractures were observed in several of the paleosol/coastal plain horizons (for example between 2854.0 and 2862.0 feet). **However, no open natural fractures were identified in the paleosol/coastal plain facies.**

Pore System Properties:

Routine core analysis data (excluding data from samples reported as fractured core pieces) show porosity values in the paleosol/coastal plain facies ranging from 0.7% to 15.1% (average of 6.4%), and permeability values ranging from 0.009 md to 4.027 md (average of 0.327 md). The average porosity and permeability values for this facies are skewed toward the high end by four values from the cross-stratified, very fine-grained sandstone between 2792.5 and 2795.5 feet; in this interval (which is interpreted as a thin eolian deposit), the strata have an average porosity of 7.8%, and an average permeability of 2.68 md. Excluding these four values, the average porosity and permeability for the paleosol/coastal plain facies are reduced to 6.3% and 0.199 md, respectively. These values are probably more representative of the paleosol/coastal plain strata. Examination of thin section samples from the paleosol/coastal plain facies reveals that most of the pore space is in the form of 1) microporosity associated with recrystallized matrix, and 2) patches of intergranular pores that sometimes occur in isolated ripples/laminations of "clean" siltstone (Figures 25, 26 and 33). Detrital clay, carbonate matrix, calcite and dolomite cements, iron oxide cement and patchy anhydrite cement, play important roles in porosity reduction in this facies. In general, the paleosol/coastal plain facies is judged to have rather **poor** reservoir potential; locally, this facies may have **fair** reservoir potential where: 1) somewhat less detrital clay and/or carbonate matrix/cement are present, 2) the deposits grade into "cleaner" tidal flat siltstones/sandstones, and 3) thin eolian deposits are developed.

Interpretation:

The paleosol/coastal plain deposits are interpreted to record sedimentation in a terrestrial (nonmarine) environment. The brick-red (oxidized) color, abundance of root mottling, caliche nodules, anhydrite nodules, and anhydrite interbeds all support this

interpretation. These characteristics are common attributes of ancient soils. The high-angle, cross-stratified eolian sandstone also suggests terrestrial sedimentation. In the idealized depositional model (Diagram 1), these paleosol/coastal plain deposits should thin, and may eventually pinch-out down depositional dip where the deposits grade into areas of intertidal and marine-dominated sedimentation. The interfingering of numerous paleosol/coastal plain horizons with intertidal (tidal flat) and subtidal marine (lagoon/shallow shelf and shoal/shoal flank) deposits probably records cyclic sedimentation in response to repeated sea level fluctuations. The paleosol/coastal plain deposits were very likely widespread during relative low stands in sea level; the tops of these units may have been somewhat reworked during subsequent transgressions. Note that the paleosol facies directly overlies tidal flat, shoal and lagoon/shelf facies. This may suggest that some or most of the regressions occurred rather rapidly, without allowing for gradual facies migration.

Tidal Flat Facies

Description:

The tidal flat facies, which accounts for roughly 18% of the cored interval, consists of **light olive-gray, tan and reddish tan, very well to well sorted, very fine-grained sandstones and siltstones**. The deposits are often dolomitic and/or calcareous. There is a minor amount of laminated and desiccation cracked dolomudstone. Furthermore, several thin interbeds of anhydrite and rather widely distributed anhydrite nodules were observed. Some of the anhydrite has been replaced with chert. Eight individual tidal flat units were identified (Figure 2), showing thicknesses ranging from 2 feet to slightly more than 21 feet. The very fine-grained sandstones and siltstones are typically finely laminated and/or ripple cross-stratified, although burrowing (Figure 4,B) and root mottling may locally disrupt the bedding features. Carbonate grains, such as peloids and small fossil fragments, are scattered throughout the tidal flat facies.

The tidal flat deposits are often in gradational contact with either paleosol/coastal plain or lagoonal strata; the siliciclastic tidal flat accumulations are rarely directly in contact with shoal/shoal flank deposits.

A small portion of the tidal flat facies consists of laminated dolomudstone (between 2555.0 and 2557.0 feet). In these deposits, small fenestral pores and desiccation cracks can be distinguished.

Pore System Properties:

Routine core analysis measurements from the tidal flat facies (excluding data from fractured samples) show porosity values ranging from 1.0% to 23.9% (average of 12.9%), and permeability values ranging from 0.01 md to 180.447 md (average of 10.4 md). Point count data (Table 2) indicate that primary intergranular pores account for most of the total pore volume. Varying amounts of carbonate matrix (both calcite and dolomite), calcite cement, dolomite cement, anhydrite cement, quartz cement and authigenic clay minerals act to reduce porosity in these fine-grained siliciclastic deposits (Table 2 and Figures 5, 10, 13, 20 and 21). In general, the range of porosity and permeability values largely reflects variations in the amount and distribution of carbonate matrix and cements, although detrital clay and anhydrite cement can also be factors. The higher range of porosity values occur where carbonate matrix is uncommon, and where calcite and dolomite cements are relatively sparsely distributed.

Authigenic clays have apparently replaced some macropores with less effective microporosity. SEM (scanning electron microscope) analysis would help to better evaluate the effects of these authigenic clay minerals.

Because these tidal flat deposits tend to be finely laminated and/or ripple cross-stratified, there are often millimeter-scale heterogeneities that reflect subtle variations in the amount of carbonate matrix material. This may make it difficult to evaluate permeability measurements over a given stratigraphic interval, and could account for some of the differences between horizontal (average of 10.4 md) and vertical (average of 6.26 md) permeability (Table 4). Overall, the tidal flat facies is judged to have variable reservoir potential, ranging from **poor** to **very good**.

Interpretation:

The tidal flat deposits are interpreted to record sedimentation in a shallow subtidal to intertidal depositional environment. Where burrows are more abundant, lower intertidal to shallow subtidal sedimentation is inferred. Conversely, where the deposits are finely laminated/ripple cross-stratified (and/or they grade into iron-stained paleosol/coastal plain facies) upper intertidal to perhaps supratidal deposition is more likely. In this overall intertidal to shallow subtidal depositional setting, sedimentation is dominated by tidal fluctuations that result in traction transport processes alternating with suspension deposition. Tidal flat deposits often form strike-elongate sandbodies that roughly parallel the paleocoastline. Tidal range, angle of depositional slope and sea level fluctuations will all influence the final geometry of the tidal flat lithosome. The repeated interfingering of tidal flat deposits with the other facies identified in this core reflects cyclic sedimentation in response to sea level fluctuations. Because tidal flat deposits closely track subtle changes in sea level, they may be widely distributed, forming broad, sheet-like deposits. As with the paleosol/coastal plain deposits, the very fine-grained sandstones and siltstones of the tidal flat facies would be expected to gradationally thin, and may eventually pinch-out, down depositional dip; carbonate-rich, subtidal, marine-dominated (lagoon, shelf, shoal and shoal flank) facies should predominate in the down (depositional) dip areas.

Lagoon to Shallow Shelf Facies

Description:

Roughly 20% of the cored strata are interpreted as lagoon to shallow shelf deposits. These strata, which occur in 12 distinct zones ranging in thickness from 1.6 to 28.1 feet, are dominated by **dark to medium gray, argillaceous, calcareous/dolomitic siltstones and silty mudstones/wackestones** (Figure 4,C). Locally, these deposits grade to calcareous shale. Some of the mudstones/wackestones are dolomite, while others are mostly limestone. Matrix selective dolomitization appears to be rather widespread. The lagoon to shallow shelf deposits are often in gradational contact with shoal, shoal flank and tidal flat facies. In addition, several of the paleosol/coastal plain units are capped by lagoonal/shallow shelf deposits, recording the reestablishment of subtidal sedimentation after a period of subaerial exposure.

Bioturbation is common, and there is generally poor preservation of primary sedimentary structures. In some places, relicts of ripples and/or laminations can be distinguished between the burrows. Fragments of brachiopods, echinoderms, bryozoans, foraminifera, calcareous algae, pelecypods, and corals were observed. Oncoids, intraclasts and peloids are also present. Locally, chert development can be extensive (for example between 2771.1 and 2782.0 feet). This chert occurs both as nodules and as individual silica-replaced fossil fragments.

Pore System Properties:

Routine core analysis data show porosity values ranging from 0.5% to 12.9% (average of 6.7%), and permeability values ranging from 0.01 md to 2.60 md (average of 0.340 md). These measurements exclude values through fractured samples. The higher porosity and permeability values occur where the lagoon/shallow shelf facies grades into shoal/shoal flank deposits and tidal flat deposits. Thin section analysis suggests that throughout most of the lagoon/shallow shelf facies a large portion of the measured pore volume is in the form of 1) poorly interconnected intragranular pores in fossil fragments (such as foraminifera and calcareous algae), and 2) microporosity within the carbonate and siliciclastic matrix. Overall, these deposits are judged to have only **poor** to **fair** reservoir potential, with most of the deposits having permeability well below 0.5 md, and roughly two-thirds of the measurements reported as 0.2 md or less.

Interpretation:

The rather extensive bioturbation, combined with the matrix-rich textures and marine fossils indicate low-energy, subtidal marine sedimentation. These deposits may form in shallow lagoons between the tidal flat and shoal environments, or as shallow shelf deposits seaward of, or peripheral to the carbonate bars.

Carbonate Shoal/Shoal Flank Facies

Description:

The carbonate shoal/shoal flank facies accounts for 36% of the cored strata, the most of any of the four principal facies identified in the study interval. The deposits consist of **tan to gray grainstones and packstones**, that occur in units ranging in thickness

from 2 feet to nearly 35 feet. Fourteen individual shoal/shoal flank units were identified. **These grain-rich deposits vary from limestone to dolomitic limestone to calcareous dolomite** (Figure 4,D-F). One interval (between 2505.0 and 2534.8 feet) is entirely dolomite; other shoal/shoal units (such as between 2762.9 and 2771.1 feet) are mostly limestone, and still other intervals (such as between 2675.8 and 2707.0 feet) contain a mixture of dolomitic limestone and calcareous dolomite. The lithology of this facies appears to vary throughout the stratigraphic column. Above 2707 feet, the shoal/shoal flank deposits tend to be relatively thick, and the strata are either dolomite or a mixture of limestone and dolomite. Below 2707 feet the shoal/shoal flank units are thinner and nearly all limestone.

Most of the grainstones and packstones contain a mixture of carbonate particles, including a wide variety of skeletal debris (echinoderms, bryozoans, brachiopods, foraminifera, calcareous algae and pelecypods), peloids, oncoids, intraclasts and scattered ooids. The interval between 2624 and 2640 feet is dominated by ooids (Figures 14 and 15). In addition to the carbonate allochems, very fine-grained quartz sand and silt are sometimes scattered throughout these limestones and dolomites. Anhydrite can be present as a cement and/or as a replacement phase.

A few natural fractures were observed. Most are filled with calcite, dolomite or anhydrite cement, but some (such as at 2874 and 2882 feet) are partially open.

Most of these grainstones and packstones are rather massive in appearance, although some show faint cross-stratification. Stylolites and compaction seams are relatively common.

Pore System Properties:

Routine core analysis data for the shoal/shoal flank deposits (excluding fractured samples) reveal porosity values ranging from 2.1% to 30.8% (average of 12.6%), and permeability values ranging from 0.04 md to 88.5 md (average of 4.51 md). However, closer scrutiny of the data demonstrates important differences in the average values for the limestones and dolomites.

Rock Type	Number of Measurements	Porosity Range (%) (Average)	Permeability Range (md) (Average)
Limestone	112	2.1–30.8 (11.8)	0.04–19.59 (1.954)
Dolomite	55	7.0–21.6 (14.3)	0.12–88.5 (9.722)

Thus, dolomitization acted to enhance the reservoir potential of the shoal/shoal flank grainstones and packstones.

Calcite cement is the principal pore-filling constituent in the limestone portions of this facies (Figures 14, 15, 22, 27, 29 and 31). Where the strata grade from grainstone to packstone, lime micrite becomes an important pore-filling phase (Figures 12 and 18). Patchy anhydrite cement/replacement also plays a role in porosity reduction. In the dolomite portions of this facies, dolomite cement, anhydrite cement, dolomitized micrite matrix and calcite cement are the main pore-filling constituents (Figures 6, 7, 8, 11 and 17).

In the limestones, the highest porosity and permeability values occur where grainstone (matrix-free) textures result in well developed networks of intergranular pores (Figure 31). These intergranular pores sometimes combine with intraskeletal pores (within bryozoans, foraminifera, calcareous algae and other skeletal constituents), and moldic pores (where grains have been partially to completely leached) to form an enhanced pore system. Microporous micritic grains contribute little to the effective pore network (Figure 27). Some of the limestones that have high porosity but low permeability have only poorly interconnected moldic pores (Figure 15). Lower porosity and permeability values generally occur where calcite cement is extensive and/or where lime mud infills the interstitial areas. In the dolomites, high porosity values typically occur in association with a combination of: 1) intercrystalline pores, 2) relict intergranular pores, and 3) moldic pores (Figures 7, 8 and 9). Matrix selective dolomitization has locally enhanced reservoir potential by creating intercrystalline pores that act to improve pore interconnection (Figures 11 and 17). Overall, the grain-rich limestones and dolomites of the carbonate shoal/shoal flank facies are judged to have **fair to very**

good reservoir potential, with the dolomite portions generally having higher porosity and permeability values.

Interpretation:

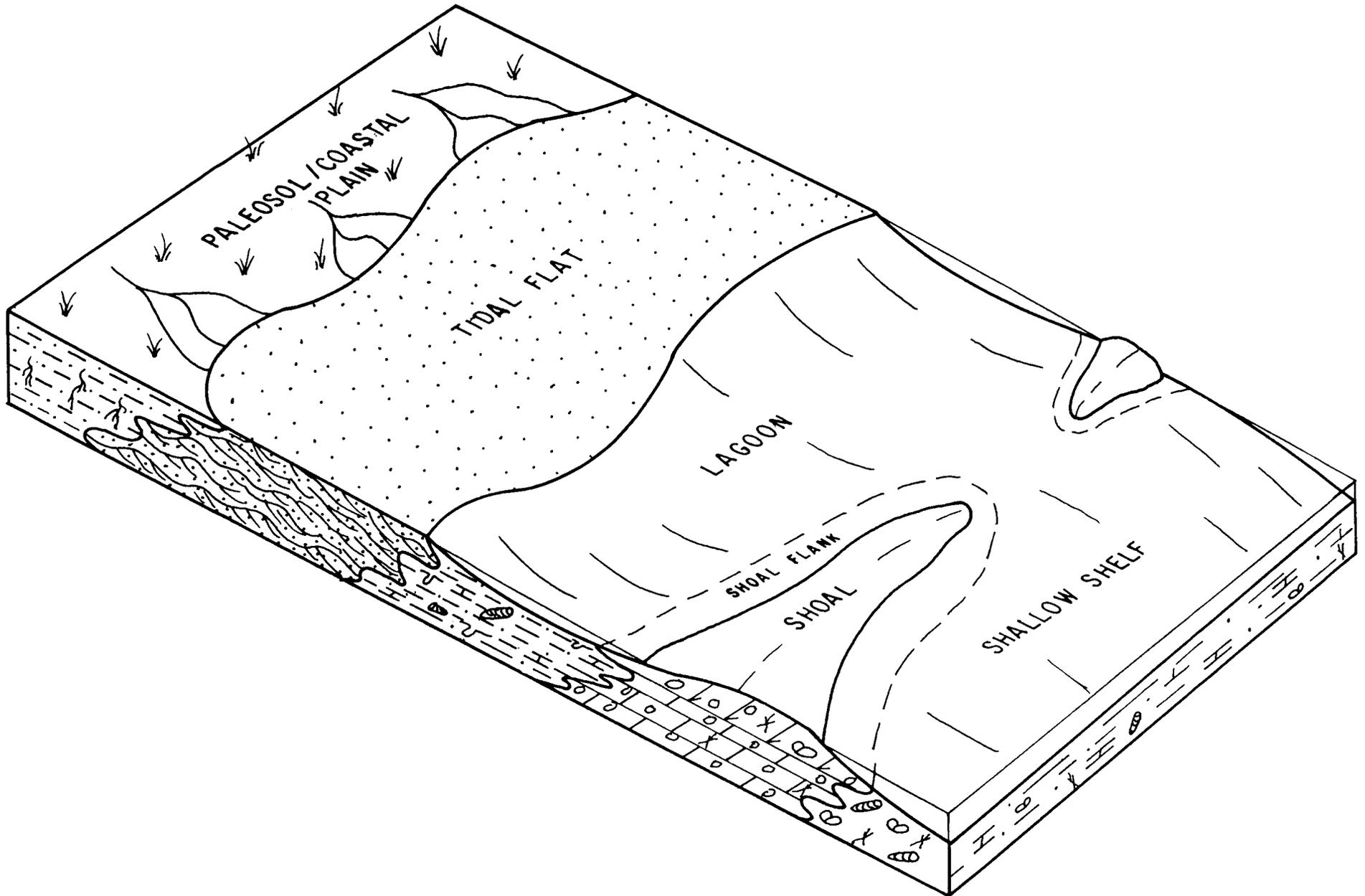
The grain-rich textures and wide assortment of skeletal debris and other carbonate allochems indicate high-energy sedimentation in a shallow marine, carbonate shoal to shoal flank environment. The general paucity of matrix material reflects persistent wind, wave, or tide-driven currents. These deposits probably formed as bars in a shallow subtidal setting. The geometry of the individual bars are difficult to determine without examining facies in a number of closely spaced wells. Sandbody geometry in carbonate shoals depends on tidal range, orientation of impinging currents, underlying paleobathymetry, and sea level fluctuations. In modern deposits, these types of accumulations generally form in water depths of 2 to 20 feet, and many are nearly exposed during low tide.

Depositional Model

An idealized depositional model for these deposits is presented in Diagram 1. Paleosol/coastal plain facies record terrestrial sedimentation, above normal high tide. The tidal flat facies is the product of intertidal and shallow subtidal deposition. Although tidal flat deposits tend to form in belts that parallel the coastline, lateral facies migration in response to progradation and sea level fluctuations may yield broad, sheet-like lithosomes of this reservoir facies. Both the paleosol/coastal plain facies and the tidal flat facies should thin down depositional dip, where subtidal marine (more carbonate-rich?) strata will predominate. The lagoon/shallow shelf facies records low-energy, shallow subtidal sedimentation. These deposits may have formed in backshoal environments (lagoonal settings), as well as seaward of, and peripheral to, offshore carbonate shoals (shallow shelf areas). The faunal assemblage, textures, and frequent gradations into tidal flat deposits indicate somewhat restricted, quiet water lagoon conditions for portions of this facies. Other parts of this facies have a slightly more diverse faunal assemblage and grade directly into shoal flank and shoal deposits, probably indicating shallow shelf sedimentation. The carbonate shoal and shoal flank facies are the product of high to medium energy sedimentation in areas with persistent currents. These deposits formed as carbonate sand bars. It is difficult to determine the sandbody geometry of the individual shoals without examining a series of closely spaced wells. These bars may have formed as either strike-oriented or dip-oriented sandbodies. The development of lagoonal deposits suggests that at least some of these bars formed as strike-oriented barriers, in that they appear to have limited circulation between backshoal lagoon and shelf waters.

The stratigraphic sequence observed in the core reflects numerous progradational and retrogradation cycles. These cycles are probably the product of sea level fluctuations. This is recorded in the repeated interfingering of the four depositional facies identified in the core. One of the byproducts of this type of cyclic sedimentation is the "stacking" of potential reservoir facies. For example, there are eight tidal flat units and fourteen carbonate shoal/shoal flank intervals, each separated by low porosity, low permeability paleosol/coastal plain or lagoon/shallow shelf deposits.

DIAGRAM 1
IDEALIZED DEPOSITIONAL MODEL



Petrography and Diagenesis

This section of the report presents the results of detailed petrographic analysis of 32 samples. In addition, diagenetic alterations that influence porosity and permeability are considered. These samples are broadly subdivided into two categories, Sandstone/Siltstone Samples and Carbonate Samples.

Sandstone/Siltstone Samples:

Ten sandstone/siltstone samples were subjected to detailed petrographic analysis (Table 2). All of the samples are siltstones or very fine-grained sandstones. The coarsest sample has an average grain size in the range of upper very fine sand (0.098 mm). All of the others have average grain sizes in the range of coarse silt to lower very fine sand (0.048–0.080 mm). All ten samples are either very well sorted or well sorted. Several of the samples contain a relative abundance of detrital clay (2802.6, 2805.2 and 2925.5 feet), roughly 20% by point count modal analysis. Most of these argillaceous samples are from the paleosol/coastal plain facies, while the "non clay-rich" samples are from the tidal flat facies. In the "non clay-rich" samples, sorting estimates and the amount of matrix material suggests that these sandstones probably had initial porosities in the range of 38% to 45%. Minus cement porosities are now in the range of 34% to 42%, suggesting that a loss of perhaps 3 to 7 porosity units can be attributed to compaction. This is consistent with **slight to moderate** compaction. **Angular and subangular** grain shapes predominate. This is a common attribute in fine-grained rocks such as these, and the angular shapes are generally not taken as a reliable indicator of energy conditions at the time of deposition, or as a means for evaluating the distance from the source area.

Quartz grains (40.0–54.4%) are the principal framework constituent in all of these samples. Potassium feldspar (0–10.4%) and plagioclase feldspar (1.2–5.2%) are also relatively common. Minor to trace amounts of chert, metamorphic rock fragments, heavy minerals, fossils/carbonate grains, argillaceous rock fragments and mica were also observed. Based on the relative proportions of quartz, feldspar and rock fragments, these sandstones and siltstones can be classified as **subarkoses** and

arkoses. XRD analysis of the sandstone samples show the following mineralogic compositions. Quartz (46–74%), potassium feldspar (0–35%), plagioclase feldspar (4–12%), calcite (0–14%), dolomite (0–14%), anhydrite (0–14%), and clay minerals (2–9%). The quartz and feldspar identified through XRD account for most of the framework grains. In general, petrographic observations indicate more calcite and dolomite than were found through X-ray diffraction. Part of this could be the limitations in distinguishing matrix material from its associated microporosity with the petrographic microscope. In addition, total clay volumes in the argillaceous samples tend to be much higher through thin section petrographic analysis than through X-ray diffraction. Here again, part of this discrepancy is undoubtedly attributed to microporosity within the matrix material, as well as the differences inherent in comparing volume (from point count analysis), with weight percent (from X-ray diffraction).

The principal pore-filling constituents in the sandstone samples are calcite matrix (0–4.4%), dolomite matrix (0–3.6%), calcite cement (0–14.8%), dolomite cement (0–12.8%), anhydrite cement (0–22.8%), authigenic clay (0–3.6%), and detrital clay matrix (0–21.2%). Relatively minor amounts of quartz cement (0–4.8%), feldspar cement (0–0.8%), iron oxide cement (0–3.2%), and pyrite cement (0–1.2%) were also identified. The tidal flat sandstones/siltstones with the least carbonate matrix and carbonate cement have the highest porosities and permeabilities, while the samples that are relatively rich in carbonate matrix and cement have the lowest porosities. Therefore, an important control in porosity distribution in the sandstone/siltstone samples is the amount of carbonate matrix and cement. Locally, anhydrite cement can also be a factor. Authigenic clay may also influence permeability. These clay minerals have replaced macropores with less effective micropores and attenuated pore throat apertures. SEM analysis and X-ray diffraction analysis of the clay fraction could help to better determine the effect that clay minerals have on porosity, permeability and reservoir potential.

Grain replacements are relatively uncommon; only minor to trace amounts of calcite, dolomite, anhydrite, and clay replacements noted.

Point count data indicate that intergranular pores (0–20.8%) and secondary leached grain pores (0–1.6%) are present. In nearly all of the "non clay-rich" (tidal flat) samples, primary intergranular pores account for roughly 90% of the macropore volume. Secondary pores from leached grains are relatively rare. Microporosity occurs in association with authigenic clay and matrix material. Several samples, such as from 2743.1, 2802.6, 2805.2 and 2925.5 feet, have little or no visible pore space; however, routine core analysis measurements for these four samples show measured porosity values ranging from 8.8% to 13.2%. Nearly all of the measured pore volume in these samples is in the form of microporosity. It is significant to note that these four samples all have permeability values below 0.036 md; these permeability values are consistent with pore system dominated by microporosity.

Carbonate Samples:

A total of 22 carbonate samples were analyzed in detail. All of the samples are grainstones or packstones from the shoal/shoal flank facies. Seventeen of these are limestones or dolomitic limestones, and five are dolomites.

Limestones:

Within most of the lime grainstones/packstones, peloids, skeletal fragments, and oncoids are the main allochemical constituents. The skeletal debris includes bryozoans, brachiopods, echinoderms, foraminifera, calcareous algae and pelecypods. Ooids are locally present, and in the samples from the Towanda Lime (Figures 14, 15 and 16), ooids are by far the dominant framework constituent.

The pore structure in the lime grainstones/packstones varies with depositional texture. In the grainstones, intergranular pores are augmented with 1) intragranular pores (mostly intraskeletal pores within foraminifera, bryozoans and calcareous algae), 2) moldic pores from leached and partially leached framework grains, and 3) microporous micritic grains. The ooid grainstones show a somewhat different pore structure, being dominated by moldic pores and subordinate amounts of intergranular pore space. Calcite cement is the primary pore-filling constituent in the grainstones. In the packstones, most of the macropore space is in the form of poorly interconnected

moldic pores and intragranular pores; detrital micrite infills most of the intergranular areas. In addition to the macropores, microporosity occurs in association with micritic framework grains such as oncoids, peloids and micritized skeletal fragments, as well as within partially neomorphosed micrite matrix (Figure 34). In the grainstones with extensive interstitial calcite cement, and in the packstones with an abundance of interstitial detrital micrite, the intragranular pores and moldic pores are generally poorly interconnected, yielding rocks with rather high porosity, but relatively low permeability.

Patchy anhydrite cementation/replacement is apparent in some of these limestones. Partial matrix selective dolomitization has locally enhanced the reservoir potential of packstone strata by creating intercrystalline pores in areas that were previously filled by densely packed micrite.

Dolomites:

Of the five dolomite samples, four appear to be grainstones/packstones. One is somewhat more micritic, having a clearly defined packstone texture. These depositional textures are somewhat difficult to resolve due to dolomitization. Based on the size and shape of the framework grains, peloids, skeletal fragments and oncoids appear to be the main allochemical constituents; that is, prior to dolomitization, these strata closely resembled the lime grainstones and packstones identified throughout most of the shoal/shoal flank facies. The pore systems in the dolomites typically contain a mixture of 1) moldic pores, 2) intercrystalline pores, and 3) varying amounts of relict intergranular pore space. **Intercrystalline pores are an important contributor to permeability.** Some samples have relatively high porosity, but low permeability, such as where scattered, poorly interconnected moldic pores are present. By comparison, where uniformly distributed intercrystalline pores accompany the moldic pores, rather high permeability values are recorded. The sample from 2573.5 feet (Figure 11) shows how dolomitization of micrite matrix can substantially improve reservoir quality. Prior to dolomitization, this sample was probably similar to the packstone/grainstone from 2578.7 feet (Figure 12). However, matrix selective dolomitization has led to rather widespread development of intercrystalline pore space. This increased permeability by roughly an order of magnitude.

COMPARISON BETWEEN THE
ANADARKO PETROLEUM CORP. YOUNGREN "J" 1-H WELL
&
ANADARKO PETROLEUM CORP. CORNELL UNIVERSITY "C" 1-H WELL.

This section of the report provides a comparison of some of the important observations and conclusions obtained from geological analysis of conventional cores from the Anadarko Petroleum Corporation Youngren "J" 1-H well located in Stevens County, Kansas, and the Anadarko Petroleum Corporation Cornell University "C" 1-H well, located in Morton County, Kansas. Both of the cores are from Hugoton Field.

1. A total of 264.5 feet of conventional core (Kridler through Florence) were analyzed from the Anadarko Petroleum Corporation Cornell University "C" 1-H well, while 485.6 feet of conventional core (Herington through Council Grove B5) were analyzed from the Anadarko Petroleum Corporation Youngren "J" 1-H well.

2. The same four principal depositional facies were delineated in both cores. These are: 1) **paleosol/coastal plain**, 2) **tidal flat**, 3) **lagoon to shallow shelf**, and 4) **carbonate shoal to shoal flank**. Subtle differences in the facies terminology used for these two wells reflect refinement of sedimentological concepts based on the larger database. There are differences in the relative proportions of these facies within the two core intervals:

Depositional Facies	% of Cored Strata Cornell University "C" 1-H Well	% of Cored Strata Youngren "J" 1-H Well
Paleosol/ Coastal Plain	28	26
Tidal Flat	29	18
Lagoon to Shallow Shelf	22	20
Carbonate Shoal to Shoal Flank	21	36

The siliciclastic tidal flat facies account for significantly less of the cored strata in the Youngren well, while carbonate shoal to shoal flank deposits are proportional much more abundant. That is, overall, the strata recovered in the Youngren well are more carbonate-rich, containing significantly more carbonate shoal and shoal flank grainstones and packstones.

3. Routine core analysis data show variations in porosity and permeability values by facies between the two cored intervals.

Depositional Facies	Cornell University "C" 1-H Well		Youngren "J" 1-H Well	
	Porosity Range* (%) (Average*)	Permeability Range* (md) (Average*)	Porosity Range* (%) (Average*)	Permeability Range* (md) (Average*)
Paleosol/ Coastal Plain	7.8-21.5 (13.2)	0.010-25.499 (1.169)	0.7-15.1 (6.4)	0.009-4.027 (0.327)
Tidal Flat	7.4-20.2 (13.9)	0.011-34.668 (2.848)	1.0-23.9 (12.9)	0.01-180.447 (10.4)
Lagoon to Shallow Shelf	3.8-19.9 (11.9)	0.002-22.244 (1.132)	0.5-12.9 (6.7)	0.01-2.60 (0.340)
Carbonate Shoal/ Shoal Flank	3.2-26.8 (11.1)	0.005-52.351 (1.601)	2.1-30.8 (12.6)	0.04-88.5 (4.51)

* Excluding data from fractured samples.

It should be noted that the conventional core data from the Cornell University "C" 1-H well were derived from plug analysis, while the core analysis data for the Youngren "J" 1-H well were measured on full diameter core samples. Overall, the porosity and permeability data for the Youngren "J" 1-H well appear to better reflect both the observed pore system properties and the differences among the four facies. That is, the tidal flat and carbonate shoal/shoal flank facies clearly have the best reservoir potential in both wells. The paleosol/coastal plain and lagoon to shallow shelf facies typically have poor reservoir potential.

4. Comparing the deposits over equivalent stratigraphic intervals (from the top of the Herington–Kridler down through the Florence Sand, the deposits in the Youngren "J" 1–H well show 1) thicker, better developed carbonate shoal to shoal flank deposits, and 2) better porosity and permeability development in the principal reservoir facies (the tidal flat and shoal to shoal flank environments). Furthermore, it appears that dolomitization is somewhat more extensive in the area of the Youngren "J" 1–H well. Analysis of the strata in the Youngren "J" 1–H well demonstrates that dolomitization tends to enhance reservoir potential in the shoal/shoal flank facies by creating intercrystalline pores that improve both porosity and permeability.

TABLE 1**STRATIGRAPHIC UNITS****ANADARKO PETROLEUM CORPORATION YOUNGREN "J" 1-H WELL***

Stratigraphic Unit	Core Depth (ft)
Herington	2478-2503
Krider	2503-2538
O'Dell	2538-2547
Winfield Sand	2547-2565
Winfield Dolomitic Lime	2565-2585
Gage	2585-2610
Towanda Sand	2610-2620
Towanda Carbonate	2620-2654
Holmesville	2654-2676
Upper Ft. Riley	2670-2710
Lower Ft. Riley	2710-2732
Upper Florence	2732-2743
Lower Florence	2743-2761
Wreford	2761-2784
Council Grove A	2784-2865
Council Grove B1	2865-2892
Council Grove B2	2892-2915
Council Grove B3	2915-2930
Council Grove B4	2930-2944
Council Grove B5	2944-2963

* Unit tops provided by Anadarko Petroleum Corporation.

TABLE 2

SANDSTONE THIN SECTION POINT COUNT DATA

**ANADARKO PETROLEUM CORPORATION
YOUNGREN "J" 1-H WELL
STEVENS COUNTY, KANSAS**

<u>Depth (ft)</u>	<u>2481.8</u>	<u>2552.9</u>	<u>2613.2</u>	<u>2740.1</u>	<u>2743.1</u>
<u>Stratigraphic Unit</u>	Herington	Winfield	Towanda	Upper Florence	Lower Florence
<u>WWRC#</u>	51416 : 46	52423 : 691	61414 : 472	62416 : 347	62447 : 674
<u>Texture</u>					
Average Grain Size (mm)	LVF Sand (0.065 mm)	LVF Sand (0.077 mm)	C. Silt (0.048 mm)	C. Silt (0.058 mm)	C. Silt (0.056 mm)
Sorting	Very Well	Well	Very Well	Well	Well
<u>Framework Grains</u>					
Quartz	40.0%	50.4%	49.6%	54.0%	54.4%
Plagioclase Feldspar	3.2	4.8	5.2	3.6	2.6
Potassium Feldspar	10.4	7.2	0.8	--	0.8
Chert	0.8	--	1.6	0.8	0.8
Metamorphic Rock Fragment	--	2.4	2.8	1.6	2.4
Heavy Minerals	0.4	0.8	0.4	0.8	1.6
Fossils/Carbonate Grains	8.8	--	--	1.6	1.6
Argillaceous Rock Fragments	--	--	0.4	--	0.4
Mica	--	--	0.8	0.4	0.8
<u>Pore-Filling Constituents</u>					
Matrix Clay	--%	3.6%	--%	0.4%	7.6%
Matrix Calcite	--	--	0.4	2.8	3.2
Matrix Dolomite	13.2	--	0.4	2.4	3.6
Calcite Cement	--	--	2.4	14.8	7.6
Dolomite Cement	3.6	--	10.8	4.8	4.6
Anhydrite Cement	0.4	0.8	2.4	3.6	--
Quartz Cement	0.4	2.0	1.6	0.8	2.4
Authigenic Clay	1.6	2.0	2.0	1.6	3.6
Feldspar Cement	--	0.4	--	--	--
Iron Oxide Cement	--	3.2	--	--	--
Pyrite Cement	--	--	--	1.2	0.4
<u>Grain Replacements</u>					
Calcite	--%	--%	Tr%	--%	0.4
Dolomite	--	--	--	--	--
Anhydrite	--	--	--	--	--
Clay	Tr	Tr	--	--	--
<u>Pore Space</u>					
Intergranular	16.0%	20.8%	17.2%	4.8%	0.8%
Leached Grain	1.2	1.6	1.2	Tr	0.4
<u>Measured Porosity(%)</u>	17.6	26.0	20.7	10.1	9.0
<u>Measured Permeability(md)</u>	10.1	144.	35.7	0.126	0.020

TABLE 2 (CONTINUED)

SANDSTONE THIN SECTION POINT COUNT DATA

**ANADARKO PETROLEUM CORPORATION
YOUNGREN "J" 1-H WELL
STEVENS COUNTY, KANSAS**

<u>Depth (ft)</u>	<u>2793.5</u>	<u>2793.9</u>	<u>2802.6</u>	<u>2805.2</u>	<u>2925.5</u>
<u>Stratigraphic Unit</u>	Coun. Grove A	Coun. Grove A	Coun. Grove A	Coun. Grove A	Coun. Grove B
<u>WWRC#</u>	52427 : 739	52417 : 731	61457 : 634	62457 : 643	62456 : 643
<u>Texture</u>					
Average Grain Size (mm)	LVF Sand (0.080 mm)	UVF Sand (0.098 mm)	C. Silt (0.058 mm)	C. Silt (0.060 mm)	C. Silt (0.058 mm)
Sorting	Well	Well	Very Well	Well	Well
<u>Framework Grains</u>					
Quartz	44.8%	46.0%	46.4%	48.0%	54.0%
Plagioclase Feldspar	4.4	3.2	1.2	2.8	4.0
Potassium Feldspar	2.4	6.0	2.4	2.0	--
Chert	--	0.4	1.2	0.8	--
Metamorphic Rock Fragment	1.2	0.8	0.8	--	0.4
Heavy Minerals	2.4	--	1.2	--	1.2
Fossils/Carbonate Grains	0.8	2.0	1.6	--	--
Argillaceous Rock Fragments	1.6	0.8	--	1.6	--
Mica	0.8	0.8	--	0.8	--
<u>Pore-Filling Constituents</u>					
Matrix Clay	1.2%	0.4%	19.6	21.2%	19.2%
Matrix Calcite	--	--	4.4	--	--
Matrix Dolomite	--	--	--	--	--
Calcite Cement	4.0	4.8	10.8	6.0	2.0
Dolomite Cement	2.4	--	7.2	12.8	12.8
Anhydrite Cement	16.0	22.8	0.4	2.8	2.0
Quartz Cement	3.2	4.8	--	--	--
Authigenic Clay	2.8	1.6	Tr	0.4	--
Feldspar Cement	0.8	--	--	--	--
Iron Oxide Cement	3.2	1.2	2.4	-	1.6
Pyrite Cement	--	--	--	0.4	1.2
<u>Grain Replacements</u>					
Calcite	0.4	--%	0.4	--%	--%
Dolomite	--	--	--	0.4	Tr
Anhydrite	--	--	--	--	--
Clay	Tr	Tr	--	--	--
<u>Pore Space</u>					
Intergranular	6.8%	4.0%	--	--	1.2%
Leached Grain	0.8	0.4	--	--	0.4
<u>Measured Porosity(%)</u>	9.5	8.3	8.8	9.3	13.2
<u>Measured Permeability(md)</u>	4.7	1.68	0.010	0.012	0.035

TABLE 3

MINERALOGICAL ANALYSIS BY X-RAY DIFFRACTION

**ANADARKO PETROLEUM CORPORATION YOUNGREN "J" 1-H WELL
STEVENS COUNTY, KANSAS**

Mineralogy of Whole Rock Sample

Relative Abundance in Percent

Depth (ft)	Unit	Qtz	Ksp	Plag	Cal	Dol	Anh	Clay	Total	Gd	
2481.8	HER	46	35	8	0	9	0	2	100	2.63	
2515.3	KRI	2	1	0	0	92	0	5	100	2.83	
2518.2	KRI	2	0	0	0	95	0	3	100	2.84	
2526.4	KRI	4	0	0	0	93	0	3	100	2.84	
2532.3	KRI	1	0	0	0	92	3	4	100	2.84	
2552.9	WS	74	11	12	0	0	0	3	100	2.64	
2573.5	WDL	5	0	1	11	68	11	4	100	2.82	Ank
2578.7	WDL	1	0	0	94	5	0	0	100	2.72	Ank
2613.2	TS	74	0	7	2	9	5	3	100	2.68	
2625.9	TL	2	0	0	83	1	14	0	100	2.74	Ank
2637.8	TL	2	0	0	96	0	2	0	100	2.71	
2638.2	TL	2	0	0	92	0	6	0	100	2.72	
2647.6	TL	18	0	6	47	23	2	4	100	2.73	Ank
2682.6	UFR	10	0	10	59	19	0	2	100	2.72	Ank
2704.7	UFR	8	1	1	62	8	18	2	100	2.75	Ank
2740.1	UF	74	0	4	14	2	0	6	100	2.66	Ank
2743.1	LF	71	3	8	9	2	0	7	100	2.65	Ank
2768.8	WRE	5	0	0	95	0	0	0	100	2.71	
2793.5	CGA	59	20	7	4	0	6	4	100	2.65	
2793.9	CGA	61	8	6	8	0	14	3	100	2.68	
2802.6	CGA	64	8	7	13	2	0	6	100	2.65	Ank
2805.2	CGA	73	0	8	7	3	0	9	100	2.66	Ank
2870.3	CGB1	3	0	0	74	0	23	0	100	2.76	
2878.9	CGB1	1	0	0	99	0	0	0	100	2.71	
2896.3	CGB2	3	0	0	97	0	0	0	100	2.71	
2897.6	CGB2	12	0	0	88	0	0	0	100	2.70	
2917.3	CGB3	3	0	0	97	0	0	0	100	2.71	
2918.1	CGB3	7	0	0	90	0	3	0	100	2.71	
2925.5	CGB3	74	0	5	0	14	0	7	100	2.68	Ank
2932.3	CGB4	2	0	0	95	0	3	0	100	2.72	
2951.5	CGB5	6	0	0	78	16	0	0	100	2.73	Ank
2952.3	CGB5	1	0	0	98	1	0	0	100	2.71	Ank
	Min	1	0	0	0	0	0	0		2.63	
	Max	74	35	12	99	95	23	9		2.84	
	Avg	24	3	3	47	17	3	2		2.72	

KEY:

HER = Herington
 KRI = Krider
 WS = Winfield Sand
 WDL = Winfield Dol. Lime
 TS = Towanda Sand
 TL = Towanda Lime
 UFR = Upper Ft. Riley
 UF = Upper Florence
 LF = Lower Florence

WRE = Wreford
 CGA = Council Grove A
 CGB1 = Council Grove B1
 CGB2 = Council Grove B2
 CGB3 = Council Grove B3
 CGB4 = Council Grove B4
 CGB5 = Council Grove B5

Qtz = quartz
 Ksp = K-feldspar
 Plag = plagioclase
 Cal = calcite
 Dol = dolomite
 Anh = anhydrite
 Clay = total clay
 Gd = calculated grain density
 Ank = contains ankerite/ferroan dolomite

TABLE 4
FULL DIAMETER CORE ANALYSIS
ANADARKO YOUNGREN 'J' NO. 1-H WELL

Sample #	Depth (ft.)	Porosity (%)	Permeability (md)			Grain Density (g/cc)	Fluids (%)		Dep. Facies
			Kmax	K90	Kvert		Water	Oil	
	2,470.5								
2	2,471.5	6.6	0.20	0.15	0.12	2.78	89.0	0.0	1
3	2,472.5	0.7	0.17	0.17	0.02	2.96	96.5	0.0	1
	2,473.5								
	2,474.5								
5	2,475.5	3.3	8.29	F 7.55	0.52	2.93	93.4	0.0	2
6	2,476.5	1.0	0.11	0.06	0.02	2.93	82.8	0.0	2
7	2,477.5	6.4	5.78	5.37	0.32	2.80	87.6	0.0	2
8	2,478.5	13.7	4.29	2.16	0.73	2.73	27.4	0.0	2
9	2,479.5	13.8	3.10	3.02	0.63	2.75	23.9	0.0	2
10	2,480.5	17.3	13.52	11.83	12.85	2.70	28.8	0.0	2
11	2,481.5	17.1	11.20	10.60	8.24	2.71	28.6	0.0	2
12	2,482.5	15.9	4.94	4.85	1.87	2.69	37.9	0.0	2
13	2,483.5	14.5	4.36	2.91	0.89	2.69	34.0	0.0	2
14	2,484.5	11.7	3.46	3.09	0.19	2.72	49.0	0.0	2
15	2,485.5	15.4	6.28	3.55	0.13	2.67	49.8	0.0	2
16	2,486.5	14.5	16.98	12.08	0.39	2.71	43.5	0.0	2
17	2,487.5	14.2	6.71	5.90	0.31	2.74	31.9	0.0	2
18	2,488.5	11.5	4.60	2.29	0.15	2.73	51.3	0.0	2
19	2,489.5	9.4	2.93	2.60	0.13	2.74	38.9	0.0	2
20	2,490.5	11.1	1.97	1.42	0.23	2.74	38.2	0.0	2
21	2,491.5	9.7	4.56	4.36	0.32	2.77	36.7	0.0	2
22	2,492.5	12.2	0.92	0.65	0.21	2.75	35.5	0.0	2
23	2,493.5	8.9	0.19	0.14	0.09	2.82	74.1	0.0	2
24	2,494.5	5.4	15.58	F 14.84	2.49	2.75	90.8	0.0	3
25	2,495.5	6.3	17.70	F 5.85	0.47	2.83	60.2	0.0	3
26	2,501.8	6.7	32.19	F 0.93	0.06	2.76	62.9	0.0	3
27	2,502.5	9.1	0.05		3	2.83	69.8	0.0	3
28	2,503.5	5.5	0.15	0.12	0.06	2.80	92.7	0.0	3
29	2,504.5	7.0	0.11	0.11	0.08	2.84	52.4	0.0	3
30	2,505.5	11.5	0.33	0.29	0.28	2.84	27.5	0.0	4
31	2,506.5	14.8	2.23	1.83	3.54	2.85	23.5	0.0	4
32	2,507.5	12.9	0.95	0.90	0.90	2.84	24.0	0.0	4
33	2,508.5	14.5	2.48	2.37	1.23	2.84	33.0	0.0	4
34	2,509.5	16.7	7.41	7.26	7.56	2.85	23.3	0.0	4
35	2,510.5	15.1	5.48	5.34	5.88	2.84	24.5	0.0	4
36	2,511.5	10.6	0.19	0.17	0.15	2.85	29.4	0.0	4
37	2,512.5	13.8	5.29	4.80	2.36	2.85	22.3	0.0	4
38	2,513.5	13.5	21.20	7.18	35.74	2.84	24.4	0.0	4
39	2,514.5	16.0	11.47	11.18	8.70	2.84	23.5	0.0	4
40	2,515.5	12.8	2.68	2.30	1.29	2.84	25.6	0.0	4
41	2,516.5	13.3	3.75	3.51	3.30	2.84	23.0	0.0	4

TABLE 4
FULL DIAMETER CORE ANALYSIS
ANADARKO YOUNGREN 'J' NO. 1-H WELL

Sample #	Depth (ft.)	Porosity (%)	Permeability (md)			Grain Density (g/cc)	Fluids (%)		Dep. Facies
			Kmax	K90	Kvert		Water	Oil	
42	2,517.5	14.2	3.10	2.87	0.57	2.84	27.5	0.0	4
43	2,518.5	15.4	29.50	29.00	23.89	2.85	17.0	0.0	4
44	2,519.5	13.4	6.17	3.52	4.12	2.84	20.4	0.0	4
45	2,520.5	11.8	0.55	0.45	0.30	2.85	20.5	0.0	4
46	2,521.5	8.4	1.06	0.44	1.25	2.85	23.8	0.0	4
47	2,522.5	14.0	38.31	12.80	43.56	2.85	17.7	0.0	4
48	2,523.5	11.6	15.23	11.77	6.37	2.85	20.8	0.0	4
49	2,524.5	17.6	88.50	83.80	5.16	2.84	27.5	0.0	4
50	2,525.5	13.5	17.19	15.19	11.49	2.85	19.5	0.0	4
51	2,526.5	17.1	85.58	85.05	15.98	2.84	21.0	0.0	4
52	2,527.5	7.0	17.36	15.44	0.18	2.85	30.1	0.0	4
53	2,528.5	8.3	0.12	0.11	0.08	2.86	31.2	0.0	4
54	2,529.5	14.5	33.34	31.88	22.40	2.85	18.7	0.0	4
55	2,530.5	15.5	24.14	22.76	19.25	2.84	21.2	0.0	4
56	2,531.5	15.3	25.59	24.11	12.44	2.85	15.3	0.0	4
57	2,532.5	15.5	9.86	9.83	4.05	2.82	24.7	0.0	4
58	2,533.5	12.8	5.36	4.82	1.08	2.84	25.4	0.0	4
59	2,534.5	11.7	10.93	9.33	0.29	2.84	26.4	0.0	4
60	2,535.5	12.1	2.28	1.18	0.61	2.84	32.2	0.0	3
61	2,536.5	9.1	0.16	0.12	0.11	2.83	72.2	0.0	3
62	2,537.5	8.7	0.049		²	2.83	65.4	0.0	3
63	2,538.5	10.5	0.26	0.14	0.11	2.81	95.4	0.0	3
64	2,539.5	8.7	0.33	0.19	5.32	2.80	97.7	0.0	3
65	2,540.5	7.5	4.13	2.69	0.28	2.70	97.1	0.0	3
66	2,541.5	6.4	0.15	0.13	0.08	2.69	95.3	0.0	3
67	2,542.5	11.1	0.076	0.073	0.245	2.76	92.0	0.0	1
68	2,543.5	8.3	0.17	0.131	0.08	2.73	96.3	0.0	1
69	2,544.5	9.7	0.077	0.065	0.037	2.75	98.8	0.0	1
70	2,545.5	10.8	0.108	0.105	0.096	2.78	96.8	0.0	1
71	2,546.5	10.8	0.278	0.117	0.026	2.79	95.4	0.0	1
72	2,547.5	11.1	2.418 F	0.111	0.156	2.75	93.4	0.0	1
73	2,548.5	11.9	0.053 ¹	0.046 ¹	0.043	2.75	96.7	0.0	1
74	2,549.5	12.4	0.102	0.082	0.116	2.70	95.0	0.0	2
75	2,550.5	13.0	0.40	0.28	0.15	2.73	61.9	0.0	2
76	2,551.5	22.8	28.38	27.38	24.02	2.67	48.2	0.0	2
77	2,552.5	23.9	180.447	179.413	160.893	2.65	47.4	0.0	2
78	2,553.5	18.8	164.387	161.764	102.63	2.64	66.8	0.0	2
79	2,554.5	12.4	0.44	0.39	0.14	2.82	50.5	0.0	2
80	2,555.5	10.6	0.105	0.08	0.055	2.74	83.8	0.0	2
81	2,556.5	16.5	0.376	0.359	0.216	2.77	67.5	0.0	2
82	2,557.5	18.6	0.41	0.41	0.19	2.77	55.4	0.0	2
83	2,558.5	16.4	1.02	1.01	0.55	2.75	40.1	0.0	2

TABLE 4
FULL DIAMETER CORE ANALYSIS
ANADARKO YOUNGREN 'J' NO. 1-H WELL

Sample #	Depth (ft.)	Porosity (%)	Permeability (md)			Grain Density (g/cc)	Fluids (%)		Dep. Facies
			Kmax	K90	Kvert		Water	Oil	
84	2,559.5	12.8	0.167		³	2.69	78.6	0.0	2
85	2,560.5	20.3	48.15	47.65	13.93	2.66	36.1	0.0	2
86	2,561.5	19.3	17.54	15.86	1.56	2.65	55.2	0.0	2
87	2,562.5	15.7	2.73	2.69	0.41	2.68	54.1	0.0	2
88	2,563.5	14.5	1.59	1.50	0.30	2.68	58.1	0.0	2
89	2,564.5	10.9	1.03	0.49	0.26	2.71	74.8	0.0	2
90	2,565.5	14.5	1.08	1.01	0.38	2.77	45.4	0.0	4
91	2,566.5	13.3	0.42	0.41	0.23	2.83	47.3	0.0	4
92	2,567.5	11.2	0.94	0.90	0.22	2.76	41.3	0.0	4
93	2,568.5	15.8	2.83	2.80	2.53	2.74	35.9	0.0	4
94	2,569.5	13.4	2.42	2.38	1.54	2.75	38.9	0.0	4
95	2,570.5	13.5	1.51	1.45	0.79	2.73	33.2	0.0	4
96	2,571.5	17.1	3.13	3.12	2.75	2.77	33.4	0.0	4
97	2,572.5	19.2	10.60	10.31	7.94	2.84	29.2	0.0	4
98	2,573.5	19.1	8.02	7.36	5.94	2.83	30.5	0.0	4
99	2,574.5	14.5	3.62	0.38	0.39	2.81	55.0	0.0	4
100	2,575.5	12.9	0.20	0.13	0.06	2.81	66.7	0.0	3
101	2,576.5	10.7	1.82	1.64	0.88	2.70	38.1	0.0	4
102	2,577.5	11.9	0.86	0.84	0.52	2.72	34.0	0.0	4
103	2,578.5	12.6	1.13	1.11	1.05	2.71	36.8	0.0	4
104	2,579.5	11.2	12.82	5.10	13.87	2.75	32.7	0.0	4
105	2,580.5	11.5	0.37	0.36	0.21	2.77	30.7	0.0	4
106	2,581.5	12.8	0.27	0.27	0.19	2.78	37.1	0.0	4
107	2,582.5	9.5	1.06	1.01	0.13	2.74	28.8	0.0	4
108	2,583.5	14.4	4.08	3.91	2.28	2.71	29.6	0.0	2
109	2,584.5	10.7	1.52	1.33	0.27	2.69	33.8	0.0	2
110	2,585.5	14.4	16.35	14.96	2.39	2.76	35.1	0.0	2
111	2,586.5	15.2	3.16	3.12	0.60	2.73	32.7	0.0	2
112	2,587.5	12.0	0.19	0.18	0.14	2.74	47.9	0.0	2
113	2,588.5	14.4	0.47	0.44	0.29	2.69	46.4	0.0	2
114	2,589.5	9.1	0.049		³	2.69	76.8	0.0	2
115	2,590.5	5.7	20.98 F	13.34	0.41	2.70	88.8	0.0	3
116	2,591.5	6.5	0.085 ¹	0.07 ¹		2.67	97.8	0.0	1
117	2,592.5	11.4	6.93 F		³	2.74	86.8	0.0	1
118	2,593.5	8.7	0.39		³	2.80	87.2	0.0	1
119	2,594.5	11.4	0.01		³	2.77	85.3	0.0	1
120	2,595.5	12.2	3.48 F		³	2.80	80.4	0.0	1
121	2,596.5	8.0	0.139	0.139	0.006	2.69	95.9	0.0	1
122	2,597.5	12.0	0.302	0.134	4.291	2.75	95.1	0.0	1
123	2,598.5	4.2	0.527	0.413	0.016	2.66	98.1	0.0	1
124	2,599.5	8.1	8.212 F	2.205	0.005	2.68	98.9	0.0	1
125	2,600.5	9.5	2.646 F	2.429	0.673	2.66	93.1	0.0	1

TABLE 4
FULL DIAMETER CORE ANALYSIS
ANADARKO YOUNGREN 'J' NO. 1-H WELL

Sample #	Depth (ft.)	Porosity (%)	Permeability (md)			Grain Density (g/cc)	Fluids (%)		Dep. Facies
			Kmax	K90	Kvert		Water	Oil	
126	2,601.5	10.4	51.267 F	36.543	7.695	2.73	96.6	0.0	1
127	2,602.5	10.1	2.457 F	1.298	0.25	2.68	97.4	0.0	1
128	2,603.5	6.4	0.093	0.055	0.013	2.69	97.1	0.0	1
129	2,604.5	9.7	39.423 F	15.252	12.432	2.71	97.4	0.0	1
130	2,605.5	6.9	0.193	0.104	0.007	2.65	97.7	0.0	1
131	2,606.5	14.5	0.176	0.164	0.123	2.72	73.0	0.0	1
132	2,607.5	14.3	0.348	0.331	0.149	2.72	63.8	0.0	2
133	2,608.5	13.9	0.40	0.39	0.09	2.72	60.7	0.0	2
134	2,609.5	11.6	0.12	0.10	0.10	2.70	69.3	0.0	2
135	2,610.5	10.2	19.03	10.05		2.69	73.8	0.0	2
136	2,611.5	17.0	10.99	10.76	1.83	2.71	34.4	0.0	2
137	2,612.5	20.6	31.46	31.12	28.72	2.70	37.8	0.0	2
138	2,613.5	21.7	42.84	42.55	40.39	2.69	41.3	0.0	2
139	2,614.5	21.7	69.91	60.75	41.03	2.69	39.3	0.0	2
140	2,615.5	21.7	46.45	46.31		2.69	40.0	0.0	2
141	2,616.5	19.8	20.99	20.77	14.66	2.71	37.9	0.0	2
142	2,617.5	16.9	5.50	5.41	3.54	2.75	39.2	0.0	2
143	2,618.5	19.1	10.06	9.98	6.12	2.75	40.4	0.0	2
144	2,619.5	17.0	4.60	4.54	3.03	2.74	55.7	0.0	2
145	2,620.5	16.2	2.33	2.33	1.78	2.75	45.4	0.0	4
146	2,621.5	12.3	0.44	0.43	0.25	2.74	37.0	0.0	4
147	2,622.5	14.4	1.07	1.07	0.90	2.73	39.6	0.0	4
148	2,623.5	16.3	2.82	2.75	2.34	2.73	36.3	0.0	4
149	2,624.5	15.8	2.22	2.01	1.54	2.74	37.6	0.0	4
150	2,625.5	14.3	1.61	1.58	1.57	2.71	33.2	0.0	4
151	2,626.5	14.7	2.48	2.36	1.62	2.71	37.8	0.0	4
152	2,627.5	17.1	4.06	4.01	4.54	2.71	45.0	0.0	4
153	2,628.5	13.5	0.62	0.61	0.52	2.71	39.2	0.0	4
154	2,629.5	13.7	0.60	0.60	0.52	2.71	39.8	0.0	4
155	2,630.5	13.7	0.76	0.76	0.53	2.71	38.7	0.0	4
156	2,631.5	14.9	1.25	1.18	0.46	2.74	40.8	0.0	4
157	2,632.5	18.8	3.66	3.65	3.63	2.78	34.9	0.0	4
158	2,633.5	16.4	3.73	3.70	2.84	2.82	30.0	0.0	4
159	2,634.5	21.6	5.08	5.02	5.75	2.81	29.2	0.0	4
160	2,635.5	19.9	3.83	3.38	2.41	2.80	30.3	0.0	4
161	2,636.5	30.8	2.07	1.99	0.45	2.73	23.1	0.0	4
162	2,637.5	24.6	4.92	4.41	2.87	2.70	26.0	0.0	4
163	2,638.5	18.0	7.48	6.08	1.01	2.71	31.7	0.0	4
164	2,639.5	15.0	3.18	3.11	1.40	2.71	33.9	0.0	4
165	2,640.5	15.5	2.69	2.67	2.37	2.70	32.3	0.0	4
166	2,641.5	15.3	1.91	1.89	1.70	2.70	33.7	0.0	4
167	2,642.5	15.1	1.71	1.71	1.09	2.71	34.7	0.0	4

TABLE 4
FULL DIAMETER CORE ANALYSIS
ANADARKO YOUNGREN 'J' NO. 1-H WELL

Sample #	Depth (ft.)	Porosity (%)	Permeability (md)			Grain Density (g/cc)	Fluids (%)		Dep. Facies
			Kmax	K90	Kvert		Water	Oil	
168	2,643.5	18.1	3.14	3.03	3.56	2.74	33.0	0.0	4
169	2,644.5	16.8	3.97	3.82	3.33	2.73	34.9	0.0	4
170	2,645.5	16.5	1.83	1.81	0.87	2.75	32.8	0.0	4
171	2,646.5	17.3	2.55	2.49	2.18	2.74	31.6	0.0	4
172	2,647.5	18.0	3.48	3.45	3.62	2.74	27.3	0.0	4
173	2,648.5	18.4	2.77	2.70	2.83	2.76	24.4	0.0	4
174	2,649.5	13.4	0.81	0.79	0.47	2.74	29.0	0.0	4
175	2,650.5	14.8	3.79	3.68	1.64	2.75	27.2	0.0	4
176	2,651.5	14.5	1.00	0.98	0.79	2.73	25.5	0.0	4
177	2,652.5	13.1	1.35	1.20	0.94	2.74	27.6	0.0	4
178	2,653.5	10.6	0.46	0.45	0.17	2.75	27.7	0.0	4
179	2,654.5	14.4	0.35	0.35	0.17	2.76	36.2	0.0	2
180	2,655.5	14.1	0.57	0.55	0.41	2.75	34.8	0.0	2
181	2,656.5	8.5	0.13	0.05	0.01	2.76	90.2	0.0	2
182	2,657.5	10.4	0.16	0.16	0.10	2.71	47.8	0.0	2
183	2,658.5	6.9	0.12	0.07	0.04	2.70	85.8	0.0	3
184	2,659.5	6.5	0.61	0.12	0.05	2.70	88.5	0.0	3
185	2,660.5	6.8	0.10	0.07	0.10	2.71	74.2	0.0	2
186	2,661.5	8.7	60.32	F 1.50	0.12	2.71	78.0	0.0	2
187	2,662.5	9.7	0.12	0.09	0.10	2.72	81.2	0.0	2
188	2,663.5	10.1	0.13	0.10	0.14	2.70	87.0	0.0	2
189	2,664.5	10.8	0.10	0.09	0.12	2.71	89.8	0.0	2
190	2,665.5	9.9	0.08	0.07	0.13	2.71	90.6	0.0	2
191	2,666.5	10.2	32.12	F 0.05	0.02	2.70	90.4	0.0	3
192	2,667.5	10.7	0.07	0.06	0.06	2.68	95.5	0.0	2
193	2,668.5	8.1	0.03	0.03	0.03	2.64	94.0	0.0	2
194	2,669.5	9.0	5.88	0.64	0.05	2.69	95.8	0.0	2
195	2,670.5	12.3	5.571	0.12	0.535	2.70	92.6	0.0	2
196	2,671.5	12.7	0.123	0.108	0.051	2.71	89.4	0.0	2
197	2,672.5	13.1			0.09	2.70	88.5	0.0	2
198	2,673.5	14.6	0.80	0.75	0.17	2.69	66.8	0.0	2
199	2,674.5	12.2	0.54	0.53		2.69	94.3	0.0	2
200	2,675.5	13.5	0.31	0.23	0.08	2.78	95.6	0.0	2
201	2,676.5	16.8	1.38	1.22	0.82	2.80	36.1	0.0	4
202	2,677.5	12.8	0.83	0.83	0.18	2.79	40.2	0.0	4
203	2,678.5	10.7	0.96	0.79	0.19	2.72	39.4	0.0	4
204	2,679.5	12.8	1.80	1.71	0.39	2.71	35.1	0.0	4
205	2,680.5	13.1	1.08	1.07	0.68	2.72	36.8	0.0	4
206	2,681.5	13.5	1.01	1.00	0.65	2.72	36.1	0.0	4
207	2,682.5	15.0	0.73	0.72	0.56	2.74	36.8	0.0	4
208	2,683.5	13.8	0.98	0.98	0.84	2.72	39.4	0.0	4
209	2,684.5	14.6	1.31	1.30	1.30	2.73	38.2	0.0	4

TABLE 4
FULL DIAMETER CORE ANALYSIS
ANADARKO YOUNGREN 'J' NO. 1-H WELL

Sample #	Depth (ft.)	Porosity (%)	Permeability (md)			Grain Density (g/cc)	Fluids (%)		Dep. Facies
			Kmax	K90	Kvert		Water	Oil	
210	2,685.5	14.4	1.56	1.55	1.42	2.74	35.8	0.0	4
211	2,686.5	14.9	0.94	0.93	0.87	2.72	33.4	0.0	4
212	2,687.5	13.8	0.82	0.81	0.58	2.72	35.0	0.0	4
213	2,688.5	17.0	2.36	2.32	2.32	2.74	37.5	0.0	4
214	2,689.5	15.5	2.31	2.29	2.15	2.74	43.0	0.0	4
215	2,690.5	15.6	2.47	2.46	2.25	2.74	39.2	0.0	4
216	2,691.5	12.1	1.32	1.31	0.56	2.77	37.9	0.0	4
217	2,692.5	13.5	1.37	1.36	1.01	2.76	38.6	0.0	4
218	2,693.5	16.0	1.67	1.60	0.98	2.77	34.6	0.0	4
219	2,694.5	13.4	0.56	0.53	0.32	2.76	38.1	0.0	4
220	2,695.5	15.6	0.61	0.60	0.55	2.76	34.6	0.0	4
221	2,696.5	11.4	0.45	0.45	0.26	2.74	39.3	0.0	4
222	2,697.5	14.1	1.50	1.40	1.30	2.74	31.7	0.0	4
223	2,698.5	13.5	0.85	0.85	0.61	2.72	32.9	0.0	4
224	2,699.5	12.1	0.60	0.57	0.40	2.76	36.8	0.0	4
225	2,700.5	14.1	1.26	1.21	0.97	2.75	35.0	0.0	4
226	2,701.5	14.3	1.32	1.31	1.04	2.75	33.3	0.0	4
227	2,702.5	13.9	1.09	0.96	0.84	2.72	34.5	0.0	4
228	2,703.5	12.3	0.45	0.39	0.32	2.74	37.6	0.0	4
229	2,704.5	11.4	0.36	0.27	0.25	2.72	39.2	0.0	4
230	2,705.5	13.5	0.53	0.52	0.43	2.74	35.5	0.0	4
231	2,706.5	10.3	0.18	0.16	0.12	2.73	45.9	0.0	4
232	2,707.5	11.9	0.39	0.38	0.30	2.71	37.5	0.0	3
233	2,708.5	10.5	0.19	0.17	0.12	2.72	46.5	0.0	3
234	2,709.5	9.0	0.12	0.12	0.09	2.74	82.5	0.0	3
235	2,710.5	10.7	0.09	0.08	0.11	2.76	87.6	0.0	3
236	2,711.5	11.0	0.44	0.06	0.06	2.75	90.9	0.0	3
237	2,712.5	10.8	0.06	0.06	0.09	2.74	95.6	0.0	3
238	2,713.5	9.7	0.12	0.10	0.10	2.70	98.3	0.0	3
239	2,714.5	7.3	1.75	0.15	0.04	2.72	98.6	0.0	3
240	2,715.5	7.5	0.16	0.08	0.04	2.67	94.8	0.0	3
241	2,716.5	7.2	7.82	F 4.09	0.06	2.68	95.2	0.0	3
242	2,717.5	8.5	0.65	0.58	0.03	2.66	94.4	0.0	3
243	2,718.5	8.3	1.50	0.10	0.04	2.69	66.8	0.0	3
244	2,719.5	7.5	2.60	2.13	0.03	2.66	91.1	0.0	3
245	2,720.5	8.3	0.08	0.04	0.06	2.66	87.1	0.0	3
246	2,721.5	7.7	0.75	0.27	0.06	2.65	91.0	0.0	3
247	2,722.5	7.6	0.51	0.48	0.10	2.66	88.9	0.0	3
248	2,723.5	8.2	0.38	0.07	0.06	2.71	54.7	0.0	3
249	2,724.5	8.2	1.51	0.88	0.05	2.66	89.4	0.0	3
250	2,725.5	6.1	0.05	0.05	0.12	2.65	82.6	0.0	3
251	2,726.5	6.1	0.06	0.06	0.15	2.63	85.7	0.0	3

TABLE 4
FULL DIAMETER CORE ANALYSIS
ANADARKO YOUNGREN 'J' NO. 1-H WELL

Sample #	Depth (ft.)	Porosity (%)	Permeability (md)			Grain Density (g/cc)	Fluids (%)		Dep. Facies
			Kmax	K90	Kvert		Water	Oil	
252	2,727.5	6.2	1.26	0.77	0.06	2.65	84.6	0.0	3
253	2,728.5	6.2	23.16	F 15.30	0.15	2.68	86.5	0.0	3
254	2,729.5	6.8	42.50	F 27.90	1.25	2.69	98.3	0.0	3
255	2,730.5	4.5	0.04	0.03	0.03	2.66	93.8	0.0	3
256	2,731.5	5.9	7.65	F 6.61	0.17	2.68	91.8	0.0	3
257	2,732.5	4.3	0.09	0.06	0.08	2.68	91.4	0.0	3
258	2,733.5	3.6	2.42	2.11	0.03	2.67	98.7	0.0	3
259	2,734.5	5.0	0.71	0.39	0.12	2.70	97.8	0.0	3
260	2,735.5	8.7	0.14	0.13	0.12	2.72	45.1	0.0	4
261	2,736.5	8.1	0.21	0.20	0.23	2.73	30.5	0.0	4
262	2,737.5	5.1	0.08	0.07	0.10	2.69	92.0	0.0	2
263	2,738.5	6.3	0.13	0.06	0.12	2.70	93.6	0.0	2
264	2,739.5	10.3	0.25	0.24	0.13	2.68	55.1	0.0	2
265	2,740.5	10.1	0.34	0.34	0.12	2.68	48.0	0.0	2
266	2,741.5	10.8	0.35	0.33	0.13	2.68	53.4	0.0	2
267	2,742.5	9.0	0.11	0.09	0.09	2.69	94.7	0.0	2
268	2,743.5	8.0	0.11	0.09	0.10	2.67	96.3	0.0	2
269	2,744.5	8.5	0.08	0.08	0.12	2.67	94.3	0.0	2
270	2,745.5	8.4	0.07	0.06	0.05	2.67	99.0	0.0	2
271	2,746.5	8.1	16.40	F 8.69	0.07	2.67	89.5	0.0	2
272	2,747.5	2.1	0.076	0.031	0.024	2.62	95.0	0.0	1
273	2,748.5	3.6	3.902	F 0.126	0.083	2.62	92.0	0.0	1
274	2,749.5	10.2	75.397	F 3		2.77	90.1	0.0	1
275	2,750.5	6.7	49.681	F 35.321	1.005	2.69	95.6	0.0	1
276	2,751.5	6.9	0.037	0.035	15.116	2.70	95.6	0.0	1
277	2,752.5	6.9	8.814	F 7.563	0.096	2.71	93.6	0.0	1
278	2,753.5	1.9	0.024	0.023	0.011	2.62	97.1	0.0	1
279	2,754.5	5.7	0.274	0.041	0.048	2.69	93.6	0.0	1
280	2,755.5	10.3	121.044	F 74.737	43.214	2.72	89.3	0.0	1
281	2,756.5	2.7	0.079	0.037	0.02	2.64	98.6	0.0	1
282	2,758.5	5.0	0.028	0.014	2.331	2.67	94.3	0.0	1
283	2,759.5	4.2	11.332	F 4.272	0.06	2.66	95.9	0.0	1
284	2,760.5	5.1	12.551	F	46.051	2.74	88.0	0.0	1
285	2,761.5	6.8	0.02	0.02	0.01	2.64	92.8	0.0	1
286	2,762.5	16.2	23.848	F 12.841	3.288	2.81	74.9	0.0	1
287	2,763.5	14.9	2.26	0.92	0.41	2.80	56.2	0.0	4
288	2,764.5	9.5	0.14	0.14	0.14	2.73	39.2	0.0	4
289	2,765.5	9.2	0.10	0.10	0.14	2.72	46.1	0.0	4
290	2,766.5	9.1	0.08	0.07	0.09	2.71	48.6	0.0	4
291	2,767.5	6.8	0.19	0.09	0.11	2.70	77.0	0.0	4
292	2,768.5	7.3	0.08	0.07	0.09	2.70	80.6	0.0	4
293	2,769.5	7.3	0.14	0.07	0.10	2.72	80.6	0.0	4

TABLE 4
FULL DIAMETER CORE ANALYSIS
ANADARKO YOUNGREN 'J' NO. 1-H WELL

Sample #	Depth (ft.)	Porosity (%)	Permeability (md)			Grain Density (g/cc)	Fluids (%)		Dep. Facies
			Kmax	K90	Kvert		Water	Oil	
294	2,770.5	8.8	0.14	0.12	0.10	2.70	68.2	0.0	4
295	2,771.5	4.1	0.04	0.03	0.03	2.70	92.9	0.0	3
296	2,772.5	5.4	0.11	0.04	0.10	2.69	89.3	0.0	3
297	2,773.5	9.7	0.26	0.15	0.05	2.67	81.1	0.0	3
298	2,774.5	5.8	0.18	0.16	0.07	2.70	83.7	0.0	3
299	2,775.5	12.2	0.12	0.12	0.09	2.68	80.5	0.0	3
300	2,776.5	6.0	0.01	< 0.01	0.02	2.56	97.6	0.0	3
301	2,777.5	9.8	0.09	0.08	0.08	2.70	78.0	0.0	3
302	2,778.5	7.2	0.09	0.06	0.10	2.70	84.7	0.0	3
303	2,779.5	6.0	0.06	0.05	0.04	2.69	84.8	0.0	3
304	2,780.5	6.1	0.07	0.05	0.06	2.70	88.4	0.0	3
305	2,781.5	5.0	0.05	0.05	0.03	2.69	77.7	0.0	3
306	2,782.5	4.8	0.03	0.03	0.03	2.72	79.5	0.0	3
307	2,783.5	2.0	0.03	0.02	0.02	2.67	96.1	0.0	3
308	2,784.5								1
309	2,785.5	7.3	0.443		³	2.73	98.4	0.0	1
310	2,788.5	2.3	0.046	0.037	0.009	2.57	97.0	0.0	1
311	2,789.5	3.5	0.05	0.045	0.018	2.59	93.6	0.0	1
312	2,790.5	6.6	0.305	0.208	0.146	2.60	55.3	0.0	1
313	2,791.5	8.9	0.649	0.597	0.165	2.60	47.9	0.0	1
314	2,792.5	11.4	4.027	3.831	1.151	2.71	45.2	0.0	1
315	2,793.5	7.2	3.891	3.886	0.349	2.66	44.7	0.0	1
316	2,794.5	6.7	1.606	1.371	0.324	2.70	55.5	0.0	1
317	2,795.5	5.7	1.185	1.184	0.237	2.68	53.6	0.0	1
318	2,796.5	2.3	0.076	0.075	0.012	2.54	84.8	0.0	1
319	2,797.5	7.0	0.196	0.178	0.144	2.62	58.5	0.0	1
320	2,798.5	5.1	0.756	0.684	0.023	2.64	73.9	0.0	1
321	2,799.5	2.5	0.059	0.057	0.036	2.63	76.5	0.0	1
322	2,801.5	2.7	0.029	0.027	0.06	2.57	81.4	0.0	1
323	2,802.5	4.0	0.045	0.043	0.063	2.60	65.5	0.0	1
324	2,803.5	4.8	0.043	0.038	0.07	2.61	76.9	0.0	1
325	2,804.5	3.9	0.056	0.054	0.006	2.64	84.6	0.0	1
326	2,805.5	5.7	0.185	0.077	0.017	2.67	64.2	0.0	1
327	2,807.5	1.3	0.065	0.064	0.031	2.57	94.4	0.0	1
328	2,808.5	7.8	0.04		³	2.73	83.9	0.0	1
329	2,809.5	8.8	0.05		³	2.78	88.8	0.0	1
330	2,810.5	12.7	0.03		³	2.79	90.0	0.0	1
331	2,811.5	12.3	44.48	F 0.68	1.454	2.81	92.9	0.0	1
332	2,812.5	6.1	7.71	F 6.29	0.131	2.76	92.7	0.0	3
333	2,813.5	2.3	0.10	0.03	0.01	2.78	90.3	0.0	3
334	2,814.5	4.5	0.08	0.07	0.07	2.80	88.6	0.0	3
335	2,815.5	10.9	0.12	0.11	0.11	2.81	91.1	0.0	3

TABLE 4
FULL DIAMETER CORE ANALYSIS
ANADARKO YOUNGREN 'J' NO. 1-H WELL

Sample #	Depth (ft.)	Porosity (%)	Permeability (md)			Grain Density (g/cc)	Fluids (%)		Dep. Facies
			Kmax	K90	Kvert		Water	Oil	
336	2,816.5	8.0	0.22	0.08	0.05	2.78	87.7	0.0	3
337	2,817.5	7.9	0.41	0.38	0.05	2.76	88.7	0.0	3
338	2,818.5	8.4	52.15	F 34.94	0.026	2.76	91.3	0.0	3
339	2,819.5	7.5			² 0.259	2.68	85.8	0.0	3
340	2,820.5	3.6	0.45	0.28	< 0.01	2.69	87.9	0.0	3
341	2,821.5	0.8	0.05	0.03	4.00	2.68	96.2	0.0	3
342	2,822.5	1.4	0.77	0.05	0.05	2.70	94.2	0.0	3
343	2,823.5	3.5	39.46	F 9.64	0.013	2.66	92.3	0.0	3
344	2,824.5	6.8	59.82	F 52.45	0.096	2.73	87.0	0.0	3
345	2,825.5	4.5	14.96	F 2.45	0.02	2.69	92.3	0.0	3
346	2,826.5	0.5	0.02	0.02	0.02	2.67	97.8	0.0	3
347	2,827.5	1.1	0.02	0.02	< 0.01	2.69	93.0	0.0	3
348	2,828.5	0.9	2.38	F 0.11	0.02	2.66	95.1	0.0	3
349	2,834.5	5.9	3.78	F 2.91	0.03	2.66	84.9	0.0	3
350	2,835.5	5.1	2.58	F 1.11	0.02	2.65	85.6	0.0	3
351	2,836.5	6.9	2.14	F 1.72	0.12	2.65	84.6	0.0	3
352	2,837.5	5.5	0.09	0.05	0.02	2.59	85.5	0.0	3
353	2,838.5	4.5	0.04	0.03	0.02	2.62	90.4	0.0	3
354	2,839.5	5.9	7.06	F	² 0.009	2.67	86.2	0.0	3
355	2,840.5	5.9	0.013		² 0.014	2.66	85.7	0.0	3
356	2,841.5	7.9	10.16	F 8.94	0.06	2.64	86.7	0.0	3
357	2,842.5	8.7	3.80	F 2.57	0.05	2.65	90.1	0.0	3
358	2,845.5	6.8	85.93	F 38.01	4.01	2.71	86.0	0.0	3
359	2,846.5	5.8			² 0.02	2.68	86.3	0.0	3
360	2,847.5	1.8	0.15	0.14	0.01	2.65	86.8	0.0	3
361	2,848.5	1.7	0.01	0.01	< 0.01	2.68	92.1	0.0	2
362	2,849.5	1.6	0.06	0.02	< 0.01	2.68	92.0	0.0	2
363	2,850.5	9.0			²	2.68	90.3	0.0	1
364	2,851.5	7.8	8.956	F	² 4.013	2.75	94.8	0.0	1
365	2,854.5	2.1	2.156	F 0.614	2.228	2.62	95.2	0.0	1
366	2,855.5	3.0			²	2.62	96.4	0.0	1
367	2,856.5	3.4	1.427	F 0.241	0.29	2.58	91.4	0.0	1
368	2,857.5	2.3	0.087		²	2.57	96.5	0.0	1
369	2,858.5	2.5	0.654	0.368		2.66	94.6	0.0	1
370	2,859.5	6.4	3.68	F 0.85	0.14	2.71	98.2	0.0	1
371	2,860.5	1.2	0.025	0.013	0.025	2.61	94.6	0.0	1
372	2,861.5	1.9	0.025	0.022	0.011	2.64	96.0	0.0	1
373	2,862.5	3.4	0.031	0.028	0.099	2.61	50.3	0.0	1
374	2,863.5	3.3	0.029	0.027	0.021	2.57	71.2	0.0	1
375	2,864.5	3.0	0.059		² 0.027	2.56	91.7	0.0	1
376	2,865.5	1.8	1.268	¹ 0.47	¹ 0.02	2.60	94.9	0.0	1
377	2,866.5	1.4	4.102	F 0.921	0.06	2.61	96.0	0.0	1

TABLE 4
FULL DIAMETER CORE ANALYSIS
ANADARKO YOUNGREN 'J' NO. 1-H WELL

Sample #	Depth (ft.)	Porosity (%)	Permeability (md)			Grain Density (g/cc)	Fluids (%)		Dep. Facies
			Kmax	K90	Kvert		Water	Oil	
378	2,867.5	2.5	8.49	1.70	0.01	2.69	93.4	0.0	4
379	2,868.5	7.5	0.05	0.05	0.04	2.70	73.8	0.0	4
380	2,869.5	8.5	1.77	1.75	0.88	2.71	41.7	0.0	4
381	2,870.5	11.8	11.93	11.29	12.38	2.72	38.0	0.0	4
382	2,871.5	10.8	5.87	5.87	5.38	2.73	39.3	0.0	4
383	2,872.5	2.1	0.04	0.03	0.04	2.71	71.8	0.0	4
384	2,873.5	3.7	4.21	2.64	0.05	2.70	81.1	0.0	4
385	2,874.5	2.9	0.07	0.05	0.02	2.70	85.2	0.0	4
386	2,875.5	14.8	1.47	0.90	0.71	2.67	72.3	0.0	4
387	2,876.5	14.2	0.59	0.57	0.28	2.71	54.7	0.0	4
388	2,877.5	8.7	6.42	5.64	0.47	2.79	45.3	0.0	4
389	2,878.5	8.3	1.29	1.03	0.37	2.72	55.3	0.0	4
390	2,879.5	4.5	3.06	2.73	0.12	2.80	56.2	0.0	4
391	2,880.5	8.6	0.21	0.20	9.70	2.71	55.3	0.0	4
392	2,881.5	9.7	0.67	0.38	0.93	2.72	50.3	0.0	4
393	2,882.5	10.3	0.24	0.18	0.28	2.72	71.0	0.0	4
394	2,883.5	6.7	0.09	0.06	0.10	2.71	77.7	0.0	1
395	2,884.5	4.6	0.06	0.06	0.04	2.72	77.8	0.0	1
396	2,885.5	3.2	0.08	0.05	0.09	2.70	84.9	0.0	1
397	2,886.5	6.0	0.03		³	2.71	90.8	0.0	1
398	2,887.3	7.3	0.04		³	2.73	92.3	0.0	1
399	2,888.5	6.9	0.036		³	2.73	80.1	0.0	1
400	2,889.5	12.8	0.375		³	2.73	86.8	0.0	1
401	2,890.5	6.3	8.424	F 2.849	0.065	2.65	96.9	0.0	1
402	2,892.5	2.4	7.80	F 6.33	0.11	2.79	76.7	0.0	2
403	2,893.5	3.7	1.76	F 1.72	0.04	2.75	79.4	0.0	2
404	2,894.5	11.7	5.14	F 5.03	2.19	2.74	42.1	0.0	4
405	2,895.5	2.6	0.07	0.07	0.08	2.75	75.8	0.0	4
406	2,896.5	6.6	0.05	0.05	0.06	2.69	87.5	0.0	4
407	2,897.5	8.8	0.14	0.13	0.13	2.70	90.5	0.0	4
408	2,898.5	8.3	0.14	0.13	0.11	2.72	87.2	0.0	4
409	2,899.5	7.0	0.30	0.23	0.10	2.70	86.3	0.0	4
410	2,900.5	9.9	0.80	0.54	1.15	2.69	82.4	0.0	4
411	2,901.5	2.6	0.04	0.04	0.02	2.69	86.9	0.0	3
412	2,902.5	2.1	0.24	0.05	0.02	2.66	96.0	0.0	3
413	2,903.5	5.5	20.28	F 0.15	0.02	2.68	94.0	0.0	1
414	2,904.5	10.4	2.223	0.275	0.133	2.74	87.5	0.0	1
415	2,905.5	4.1	0.204	0.064	0.028	2.66	94.3	0.0	1
416	2,906.5	4.5	0.043	0.035	0.016	2.67	93.8	0.0	1
417	2,908.5	9.4	0.587	0.314	0.65	2.63	89.9	0.0	1
418	2,909.5	10.1	0.233	0.135	0.223	2.65	84.7	0.0	1
419	2,910.5	12.1	1.162		² 103.379	2.69	87.6	0.0	1

TABLE 4
FULL DIAMETER CORE ANALYSIS
ANADARKO YOUNGREN 'J' NO. 1-H WELL

Sample #	Depth (ft.)	Porosity (%)	Permeability (md)			Grain Density (g/cc)	Fluids (%)		Dep. Facies
			Kmax	K90	Kvert		Water	Oil	
420	2,911.5	10.6	0.174	0.146	0.151	2.65	91.9	0.0	1
421	2,912.5	3.8	0.024	0.017	0.053	2.61	94.4	0.0	1
422	2,913.5	2.4	0.009	0.007	0.008	2.58	96.9	0.0	1
423	2,914.5	6.7	0.067		² 0.021	2.65	98.8	0.0	1
424	2,915.5	8.2			³	2.72	84.5	0.0	1
425	2,916.5	6.6	0.32	0.31	0.08	2.71	56.3	0.0	4
426	2,917.5	14.6	6.04	5.21	2.88	2.71	36.5	0.0	4
427	2,918.5	7.6	0.38	0.32	0.29	2.76	52.0	0.0	4
428	2,919.5	6.8	0.07	0.07	0.09	2.73	79.3	0.0	4
429	2,920.5	5.6	0.04	0.04	0.04	2.73	88.5	0.0	4
430	2,921.5	15.1	0.378	0.258	0.309	2.76	85.9	0.0	1
431	2,922.5	3.4	0.337	0.025	0.002	2.62	92.7	0.0	1
432	2,923.5	5.0	5.407 F	3.839	0.014	2.67	93.6	0.0	1
433	2,924.5	4.9	14.138 F	9.212	0.358	2.65	95.5	0.0	1
434	2,925.5	6.4	7.302 F	5.991	7.186	2.63	94.8	0.0	1
435	2,926.5	6.6	0.047	0.044	0.038	2.63	96.5	0.0	1
436	2,927.5	10.9	0.078	0.076	0.207	2.69	85.0	0.0	1
437	2,928.5	6.2	0.016	0.015	0.008	2.65	88.7	0.0	1
438	2,929.5	4.9	8.223 F	2.871	0.06	2.61	95.0	0.0	1
439	2,930.5	6.1	0.028	0.025	1.063	2.59	91.4	0.0	1
440	2,931.5	12.0	0.65	0.49	0.33	2.79	78.9	0.0	4
441	2,932.5	6.9	0.22	0.21	0.41	2.74	65.4	0.0	4
442	2,933.5	6.6	0.06	0.06	0.05	2.71	79.9	0.0	4
443	2,934.5	3.1	0.22	0.02	0.01	2.73	91.0	0.0	4
444	2,935.5	4.9	0.31	0.02	0.02	2.74	97.4	0.0	4
445	2,936.5	11.6	0.235	0.08	0.289	2.73	89.2	0.0	1
446	2,940.5	8.6	1.571		³	2.76	93.8	0.0	1
447	2,941.5	11.1				2.76	94.1	0.0	1
448	2,942.5	11.4	54.786 F	43.978	42.35	2.77	93.3	0.0	1
449	2,943.5	7.1	15.537 F	10.618	3.491	2.81	96.8	0.0	1
450	2,944.5	11.4	2.20	1.68	2.82	2.72	54.4	0.0	4
451	2,945.5	14.0	13.18	8.02	3.95	2.72	51.7	0.0	4
452	2,946.5	14.0	19.59	4.38	31.29	2.75	50.7	0.0	4
453	2,947.5	14.0	3.858		² 22.245	2.72	91.3	0.0	4
454	2,948.5	11.5	0.87	0.31	0.42	2.80	82.6	0.0	4
455	2,949.5	10.5	0.27	0.24	0.36	2.89	87.1	0.0	4
456	2,950.5	14.1	0.72	0.67	0.47	2.82	88.6	0.0	4
457	2,951.5	12.1	0.44	0.43	0.17	2.76	89.3	0.0	4
458	2,952.5	13.5	1.63	1.37	0.60	2.77	89.1	0.0	4
459	2,953.5	14.1	1.33	1.31	0.83	2.74	89.9	0.0	4
460	2,954.5	11.5	0.66	0.64	0.40	2.72	86.8	0.0	4
461	2,955.5	3.6	0.50	0.07	0.03	2.70	88.8	0.0	4

TABLE 4
FULL DIAMETER CORE ANALYSIS
ANADARKO YOUNGREN 'J' NO. 1-H WELL

Sample #	Depth (ft.)	Porosity (%)	Permeability (md)			Grain Density (g/cc)	Fluids (%)		Dep. Facies
			Kmax	K90	Kvert		Water	Oil	
462	2,956.5	3.7	0.04	0.04	0.03	2.71	66.5	0.0	4
463	2,957.5	3.3	0.19	0.08	0.24	2.67	92.1	0.0	3
464	2,958.5	2.4	3.57 F	1.52	< 0.01	2.68	94.0	0.0	3
465	2,959.5	5.9	39.01 F	37.27	1.39	2.72	91.0	0.0	3
	Min.	0.5	0.009	0.007	0.002	2.54	15.3	0.0	
	Max.	30.8	180.447	179.413	160.893	2.96	99.0	0.0	
	Avg.	10.0	6.405	4.784	2.98	2.72	66.8	0.0	

¹ - Permeability prior to extraction

² - Permeability from plug sample

³ - Plug Analysis Depositional Facies

1 = Paleosol/Coastal Plain

2 = Tidal Flat

3 = Lagoon/Shallow Shelf

4 = Carbonate Shoal to Shoal Flank

FIGURE 1

CORE TO LOG CORRELATION

ANADARKO PETROLEUM CORPORATION

YOUNGREN 'J' 1-H

STEVENS COUNTY, KANSAS

CORE DEPTH \cong LOG DEPTH

■ - CORED INTERVAL

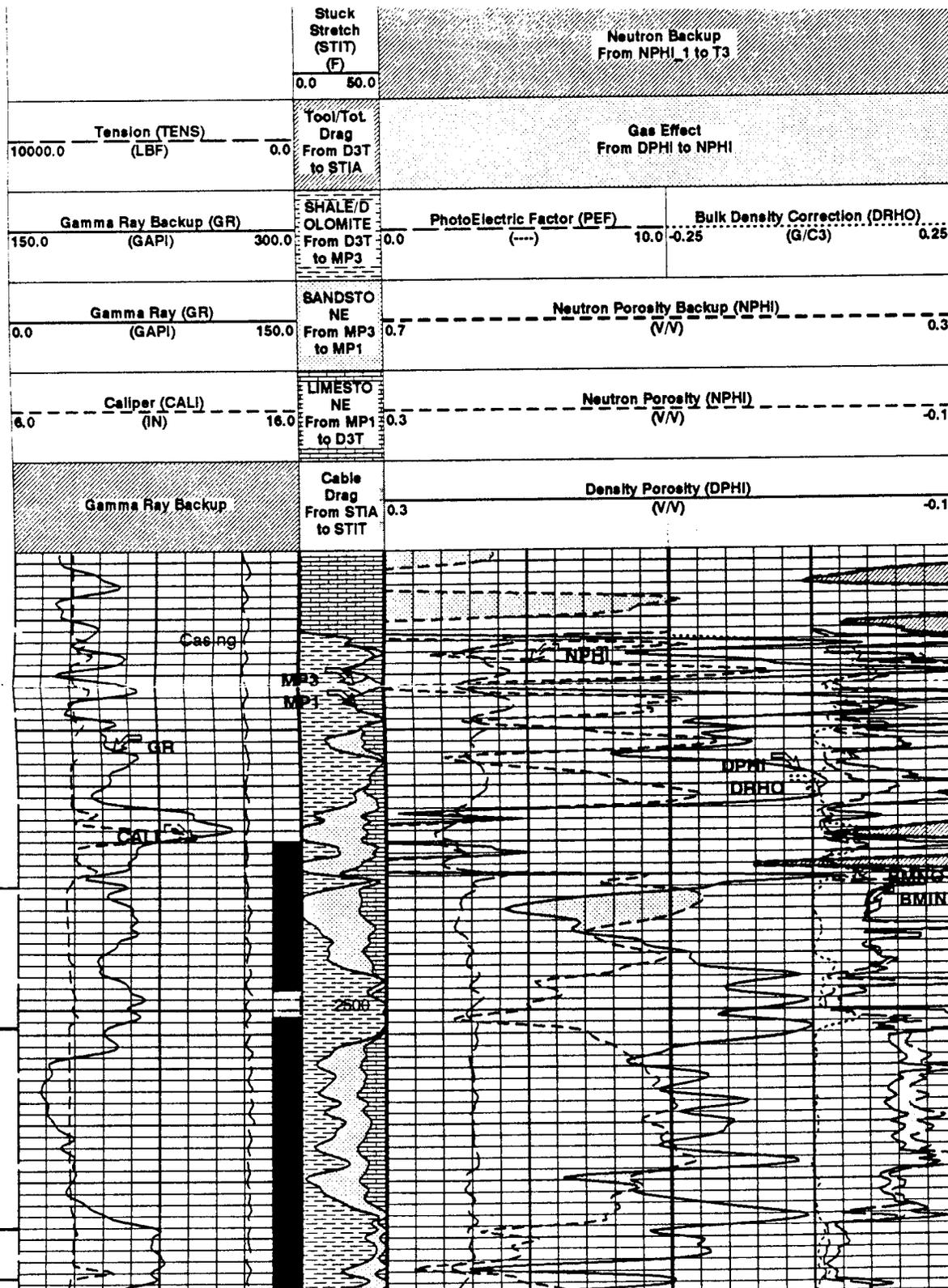


FIGURE 1 CONTINUED
ANADARKO PETROLEUM CORPORATION
YOUNGREN 'J' 1-H

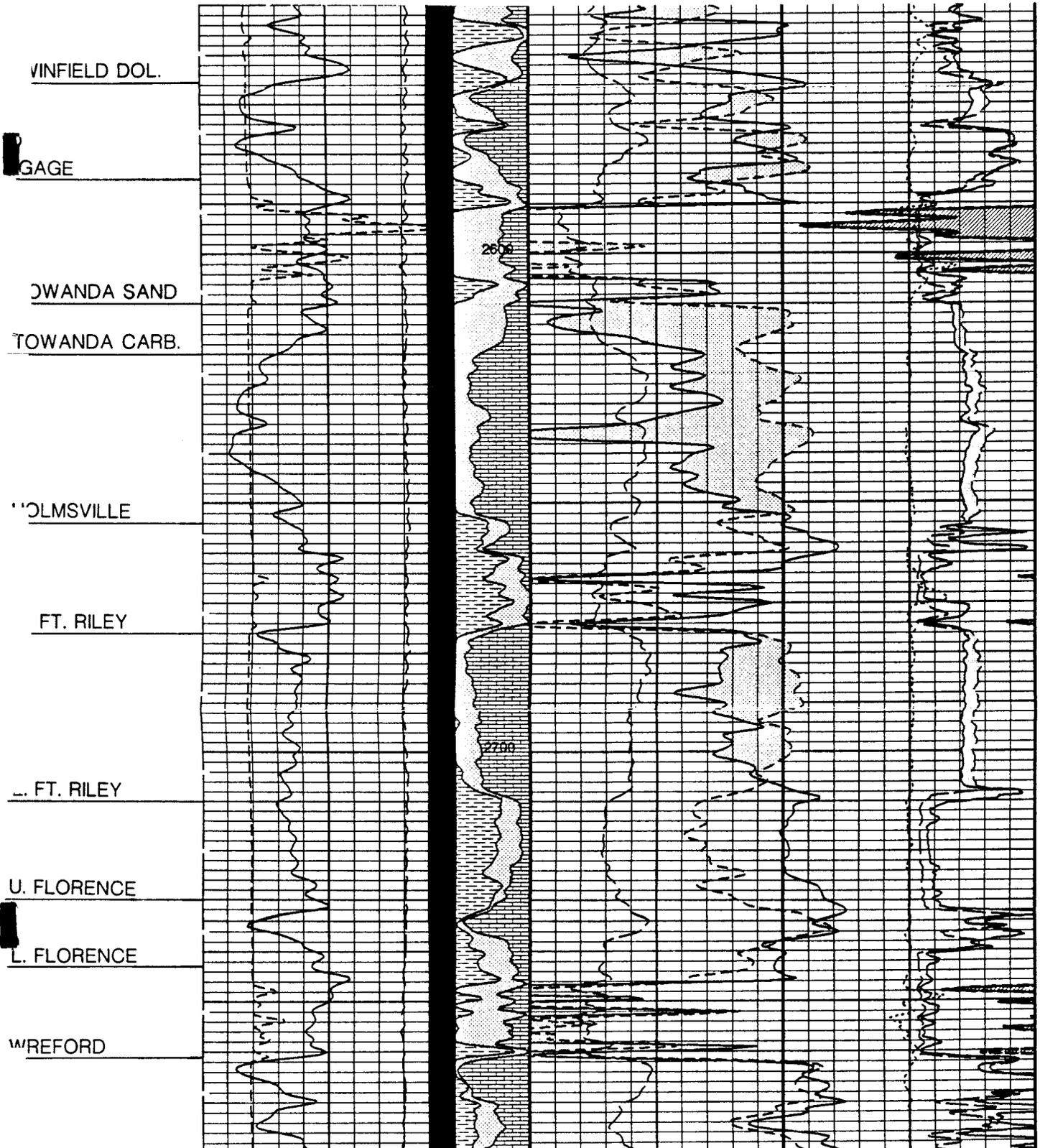
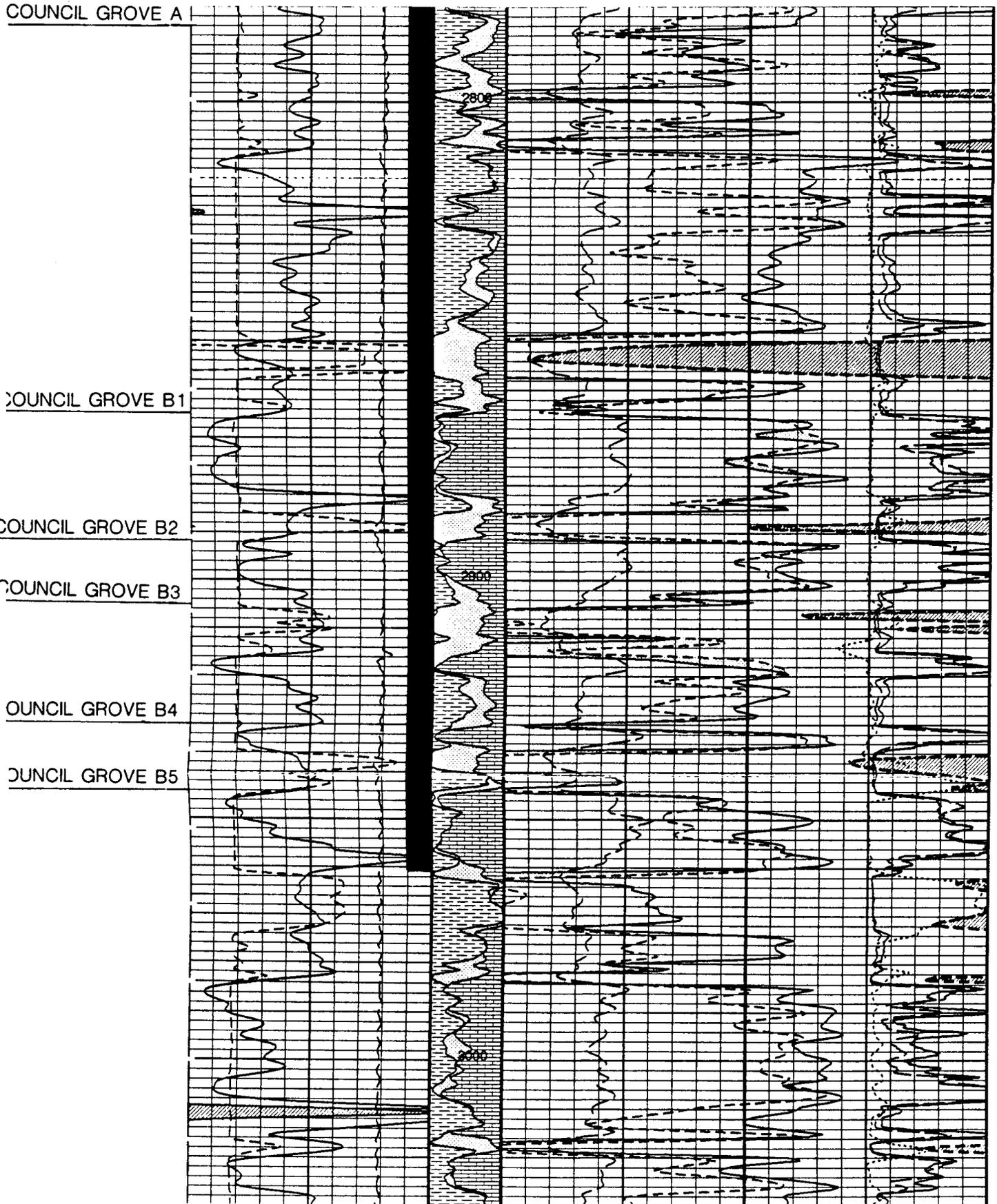


FIGURE 1 CONTINUED
ANADARKO PETROLEUM CORPORATION
YOUNGREN 'J' 1-H



CORE LEGEND

STRUCTURES

	RIPPLE CROSS-STRATIFICATION		MICROFAULT W/ DISPLACEMENT
	RIPPLE FORMS		MUDCRACKS
	CROSS-STRATIFICATION		ROOT CASTS
	LAMINATED		BORED HARDGROUND
	WAVY BEDDING		FRACTURE (SUBSCRIPT: A = ANHYDRITE-FILLED, B = BITUMEN-FILLED, C = CALCITE-FILLED, D = DOLOMITE FILLED, O = OPEN NATURAL, CN = CLOSED NATURAL)
	CONTORTED BEDDING		ANHYDRITE NODULE /VUG
	BIOTURBATED		FINING UPWARD
	BURROW		COARSENING UPWARD
	ANHYDRITE NODULES		SPREITE-FILLED BURROW
	DIFFUSE COMPACTION SEAMS/SHALY LAMINAE		
	STYLOLITE		
	MICROSTYLOLITE		

ACCESSORY CONSTITUENTS

Py - PYRITE	⊙ - CLACITE-FILLED VUGS
CALC. - CALCAREOUS	SSD - SOFT-SEDIMENT-DEFORMATION
SiO ₂ - SILICEOUS	CARB. - CARBONACEOUS DEBRIS
DOL. - DOLOMITE	
ARG. - ARGILLACEOUS	

CONTACTS

—	SHARP
---	GRADATIONAL
~	UNDULATORY/IRREGULAR

SAMPLE LOCATIONS

TS	- THIN SECTION
A-D	- CLOSE CORE PHOTOGRAPH
■	- THIN SECTION, XRD, SCAL SAMPLE

CARBONATE GRAIN VARIETIES

	PELECYPODS
	BRACHIOPODS
	GASTROPODS
	ECHINODERMS
	CALCAREOUS ALGAE (UNDIFFERENTIATED)
	CALCAREOUS RED ALGAE
	BRYOZOANS
	FORAMINIFERA

	CORAL
	OIDS
	ONCOIDS/ALGAL-COATED GRAINS
	PELOIDS
	PELLETS
	INTRACLASTS

LITHOLOGY

	SANDSTONE	⊥	CALCITIC
	SILTSTONE	⌊	DOLOMITIC
	SHALE	---	SILTY
	LIMESTONE	---	SHALY
	DOLOSTONE	SANDY
	ANHYDRITE	+	ANHYDRITIC

FIGURE 2
ANADARKO PETROLEUM CORPORATION
YOUNGREN J 1-H
STEVENS COUNTY, KANSAS

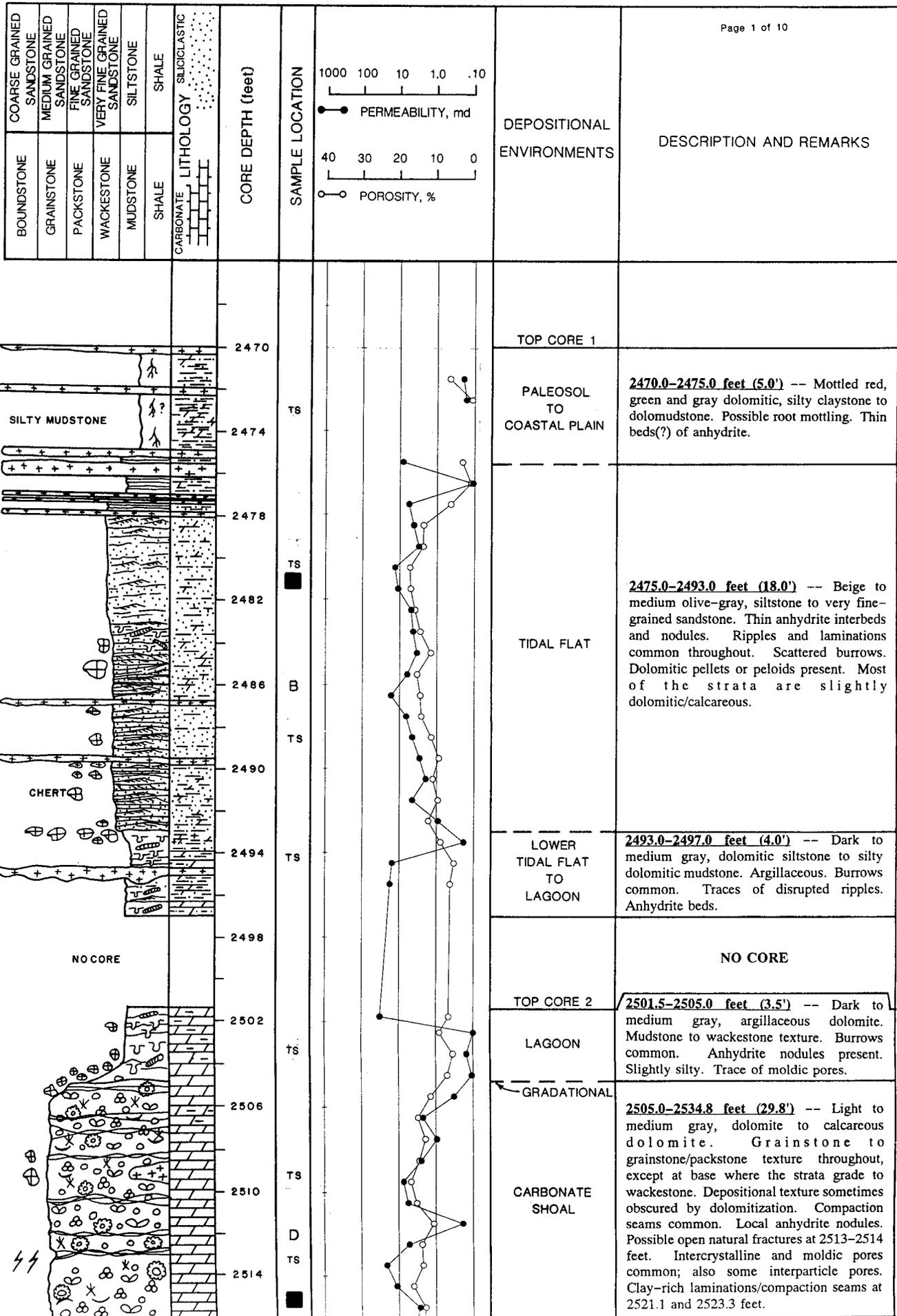


FIGURE 2 CONTINUED
ANADARKO PETROLEUM CORPORATION
YOUNGREN J 1-H

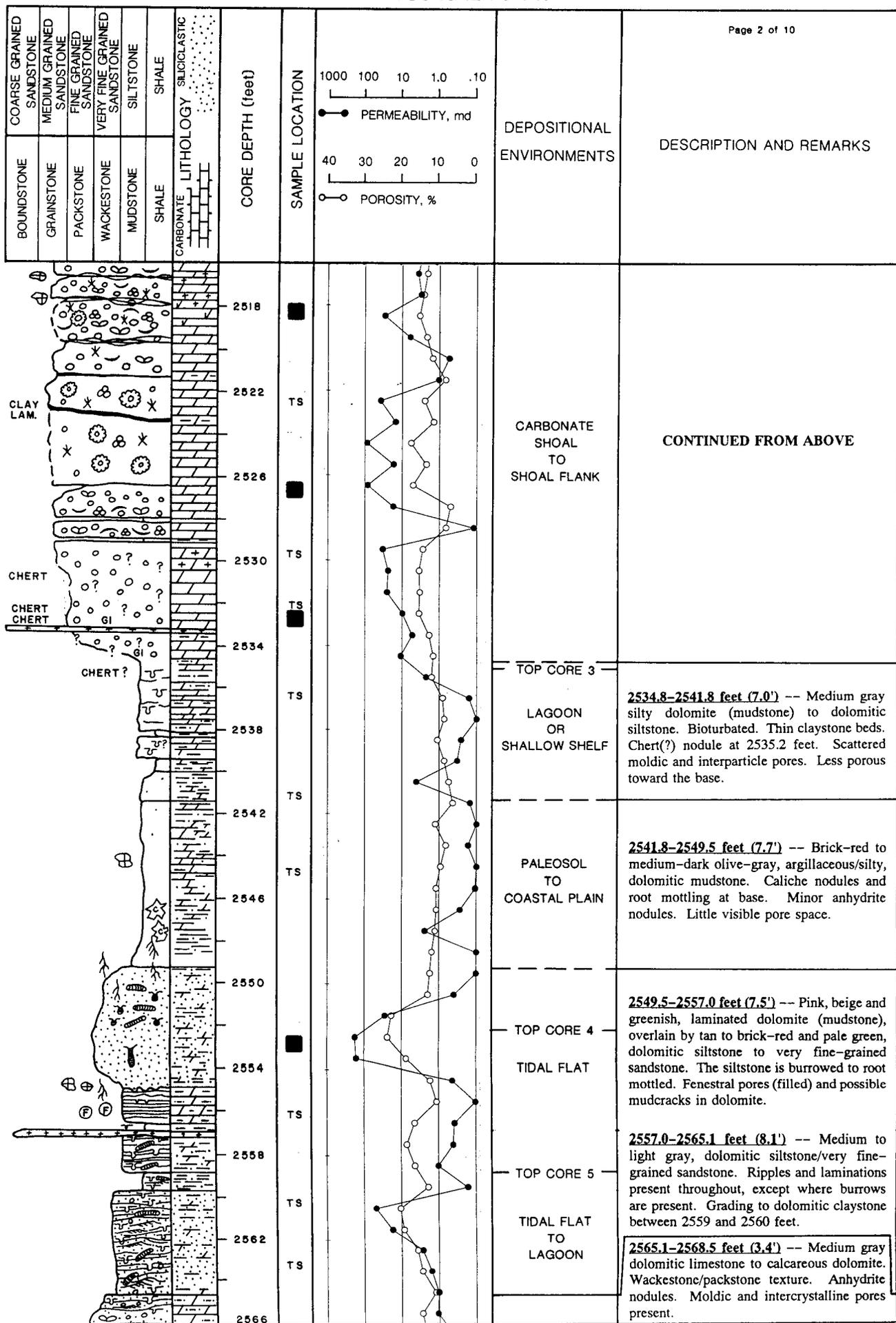
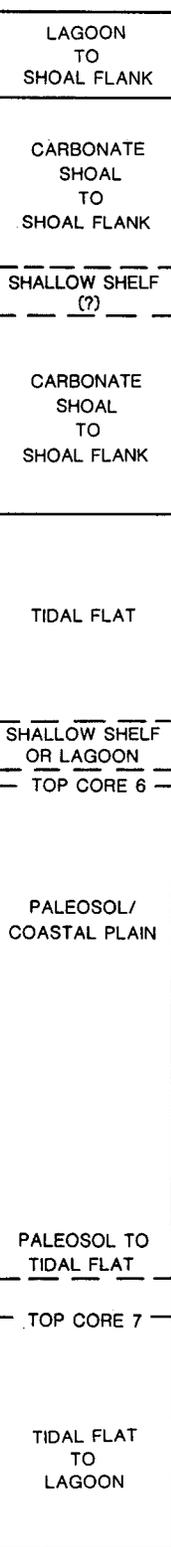
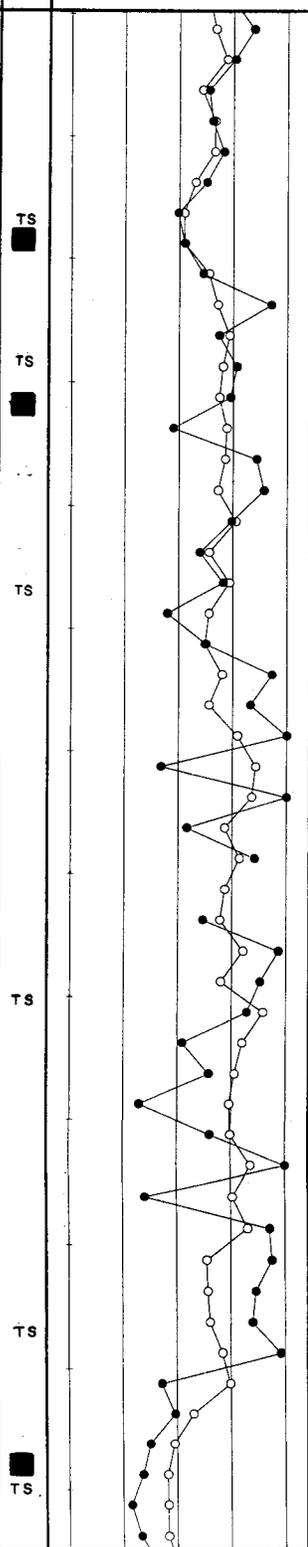
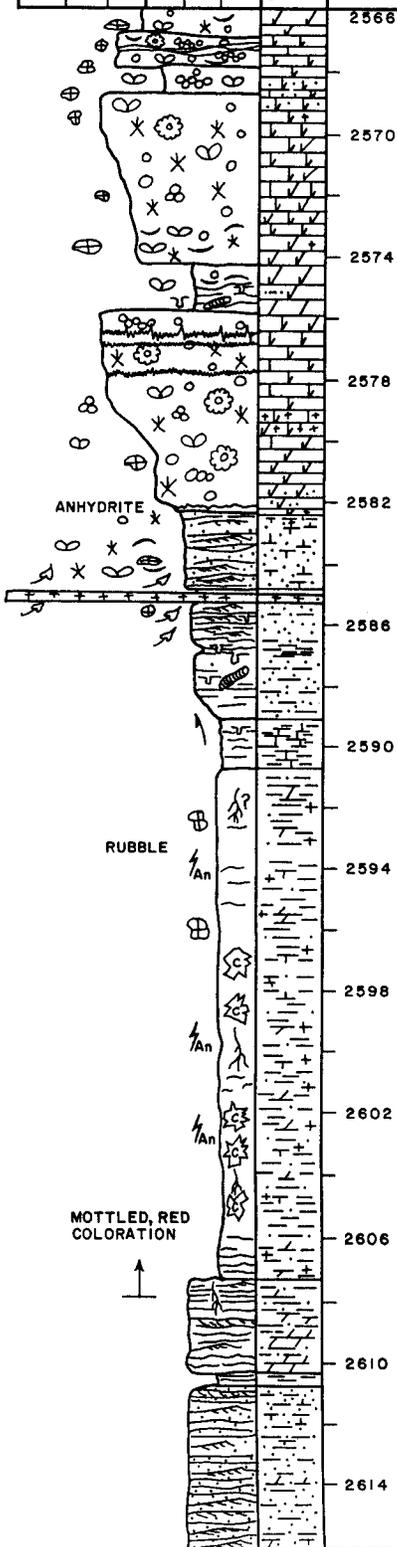
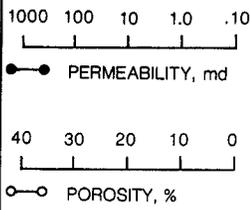
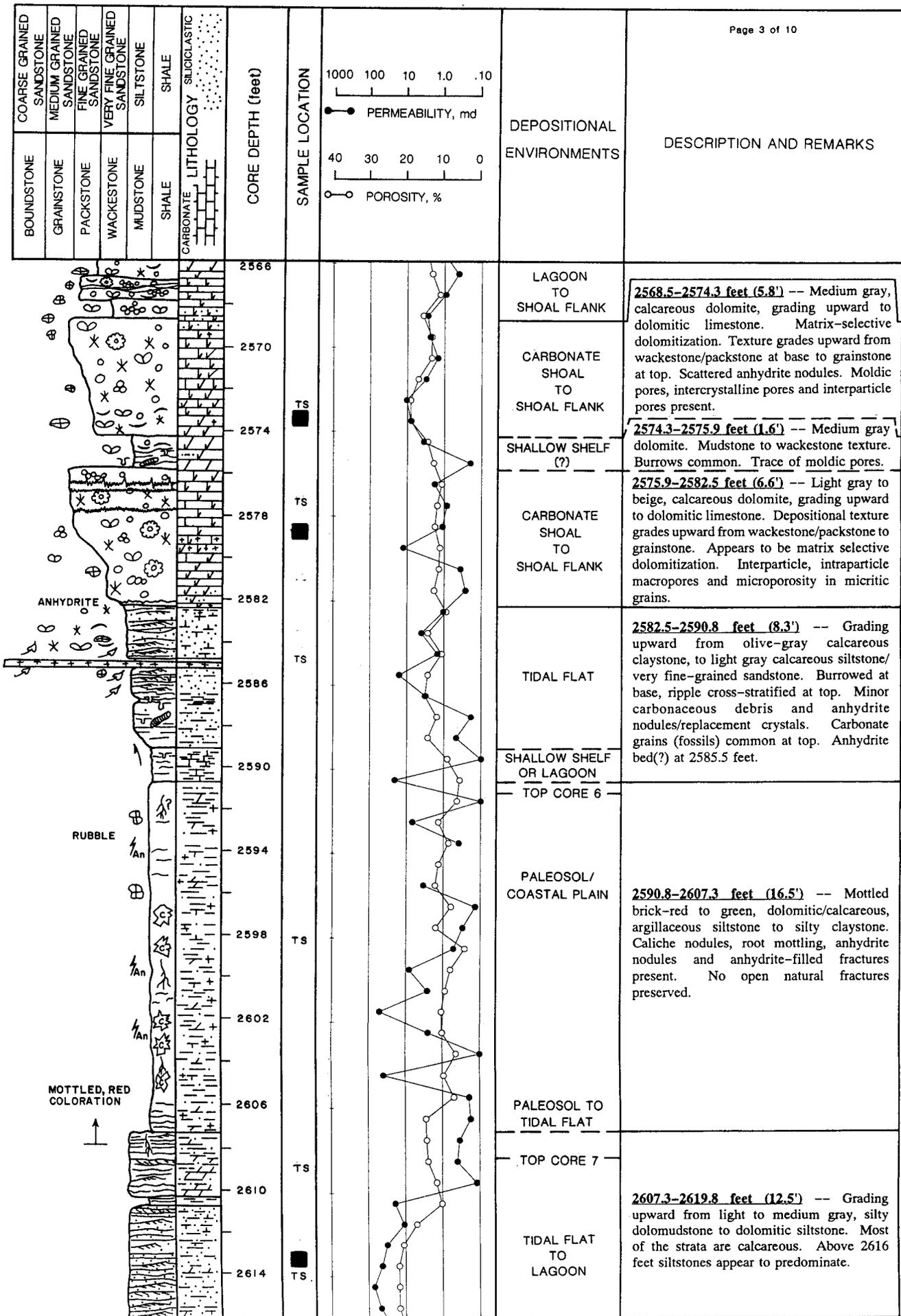


FIGURE 2 CONTINUED
 ANADARKO PETROLEUM CORPORATION
 YOUNGREN J 1-H



2568.5-2574.3 feet (5.8') -- Medium gray, calcareous dolomite, grading upward to dolomitic limestone. Matrix-selective dolomitization. Texture grades upward from wackestone/packstone at base to grainstone at top. Scattered anhydrite nodules. Moldic pores, intercrystalline pores and interparticle pores present.

2574.3-2575.9 feet (1.6') -- Medium gray dolomite. Mudstone to wackestone texture. Burrows common. Trace of moldic pores.

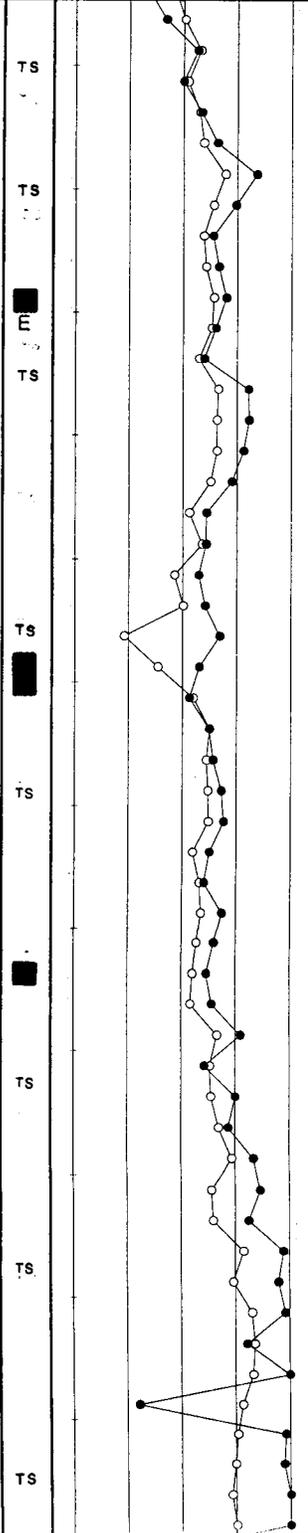
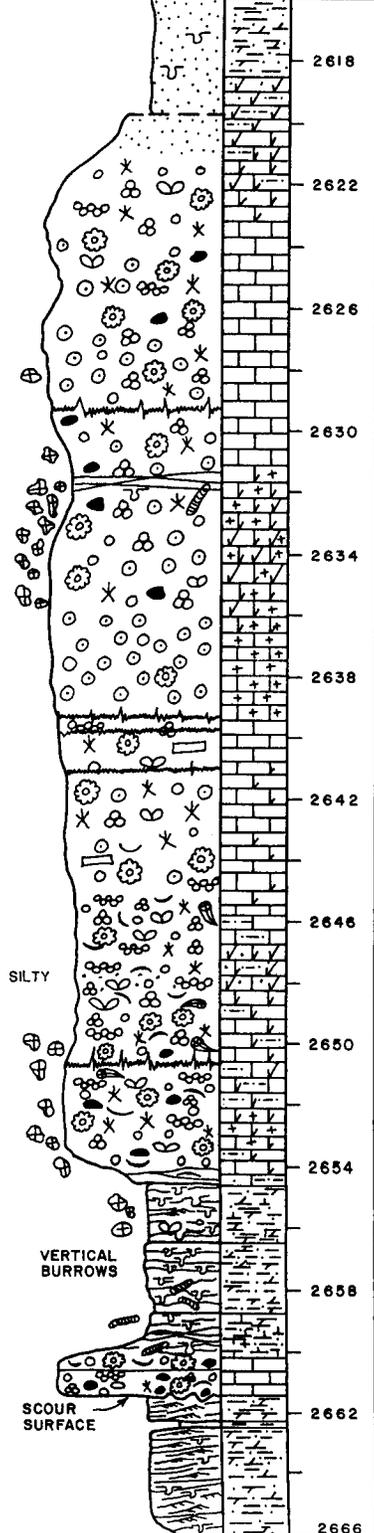
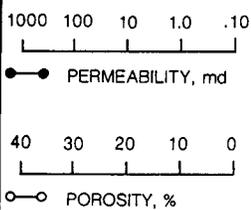
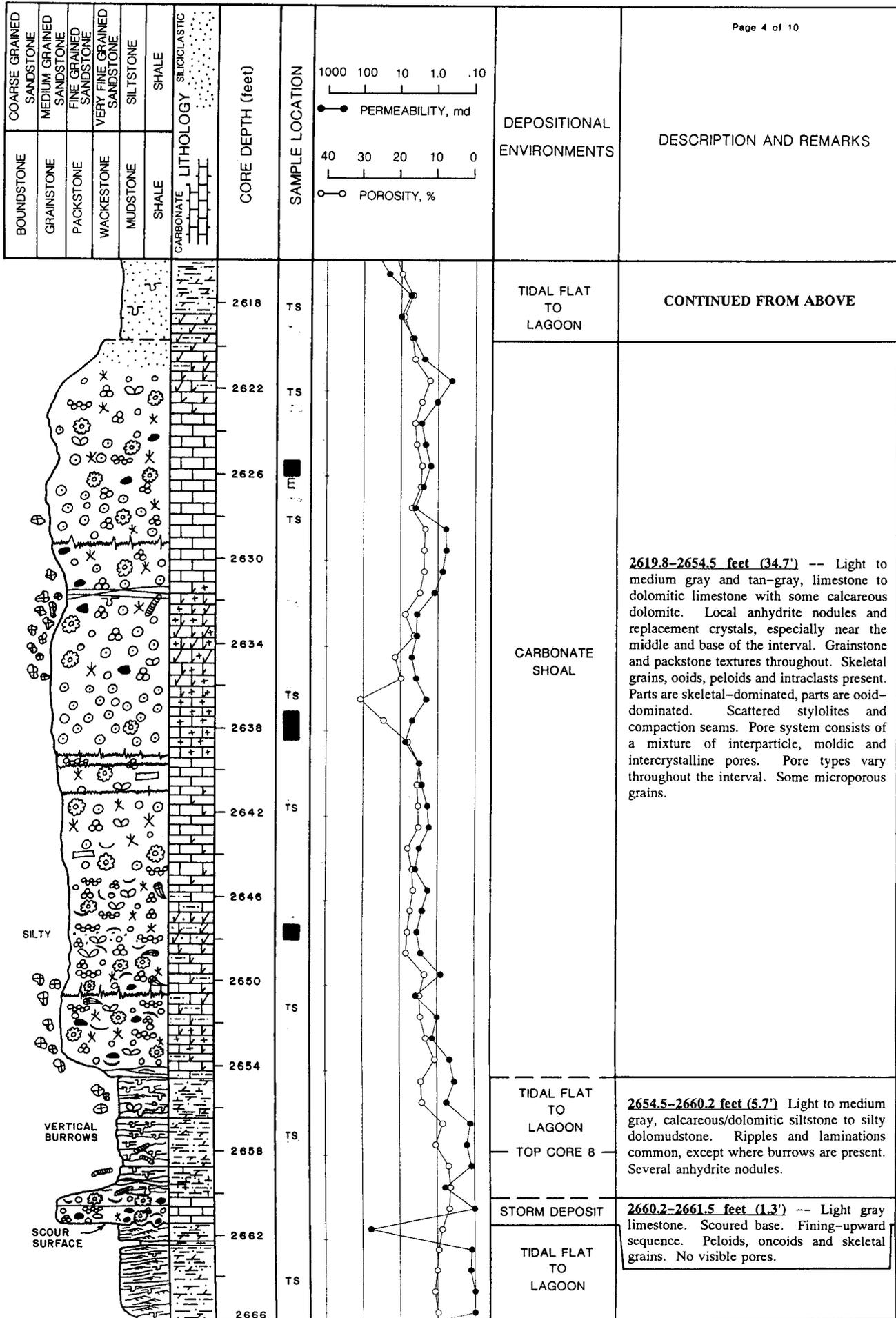
2575.9-2582.5 feet (6.6') -- Light gray to beige, calcareous dolomite, grading upward to dolomitic limestone. Depositional texture grades upward from wackestone/packstone to grainstone. Appears to be matrix selective dolomitization. Interparticle, intraparticle macropores and microporosity in micritic grains.

2582.5-2590.8 feet (8.3') -- Grading upward from olive-gray calcareous claystone, to light gray calcareous siltstone/very fine-grained sandstone. Burrowed at base, ripple cross-stratified at top. Minor carbonaceous debris and anhydrite nodules/replacement crystals. Carbonate grains (fossils) common at top. Anhydrite bed(?) at 2585.5 feet.

2590.8-2607.3 feet (16.5') -- Mottled brick-red to green, dolomitic/calcareous, argillaceous siltstone to silty claystone. Caliche nodules, root mottling, anhydrite nodules and anhydrite-filled fractures present. No open natural fractures preserved.

2607.3-2619.8 feet (12.5') -- Grading upward from light to medium gray, silty dolomudstone to dolomitic siltstone. Most of the strata are calcareous. Above 2616 feet siltstones appear to predominate.

FIGURE 2 CONTINUED
 ANADARKO PETROLEUM CORPORATION
 YOUNGREN J 1-H



TIDAL FLAT TO LAGOON

CARBONATE SHOAL

TIDAL FLAT TO LAGOON

TOP CORE 8

STORM DEPOSIT

TIDAL FLAT TO LAGOON

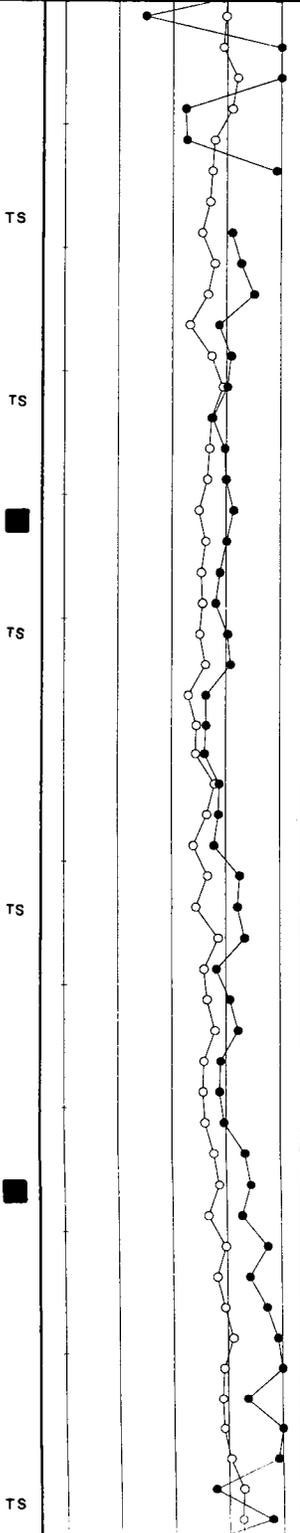
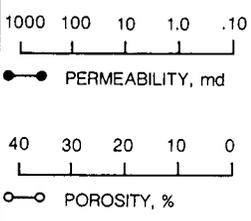
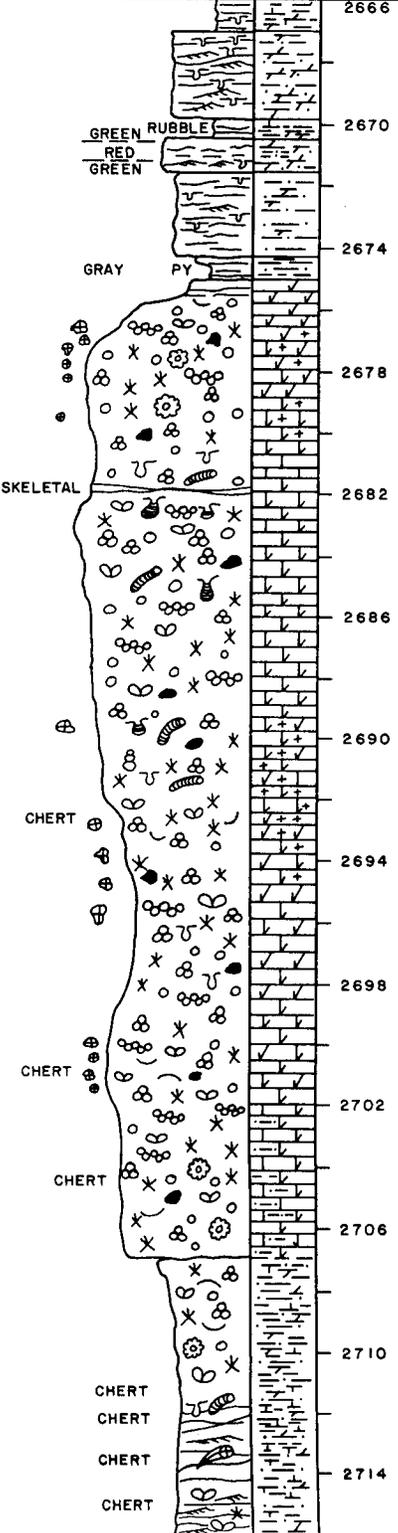
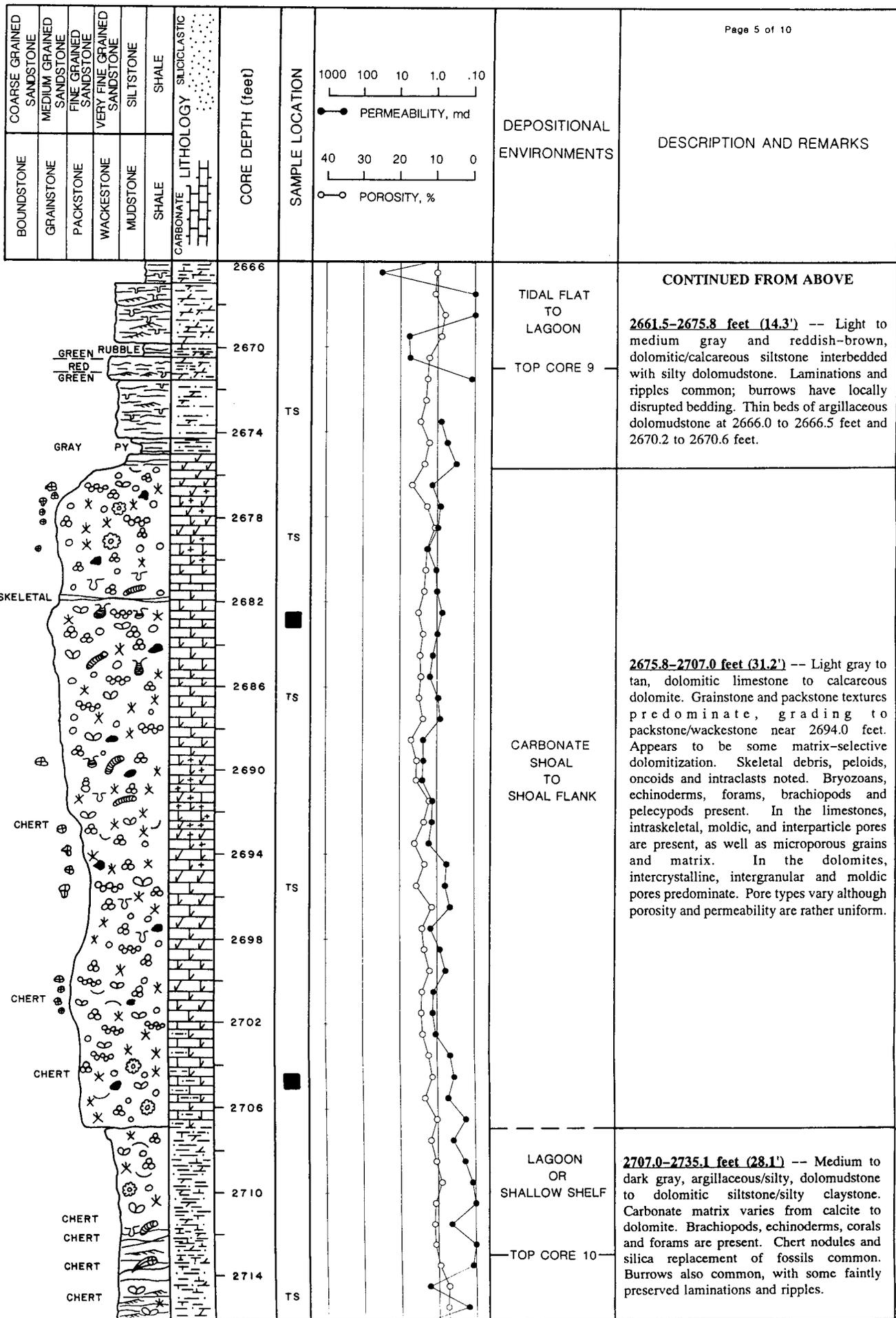
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2619.8-2654.5 feet (34.7') -- Light to medium gray and tan-gray, limestone to dolomitic limestone with some calcareous dolomite. Local anhydrite nodules and replacement crystals, especially near the middle and base of the interval. Grainstone and packstone textures throughout. Skeletal grains, ooids, peloids and intraclasts present. Parts are skeletal-dominated, parts are ooid-dominated. Scattered stylolites and compaction seams. Pore system consists of a mixture of interparticle, moldic and intercrystalline pores. Pore types vary throughout the interval. Some microporous grains.

2654.5-2660.2 feet (5.7') Light to medium gray, calcareous/dolomitic siltstone to silty dolomudstone. Ripples and laminations common, except where burrows are present. Several anhydrite nodules.

2660.2-2661.5 feet (1.3') -- Light gray limestone. Scoured base. Fining-upward sequence. Peloids, oncoids and skeletal grains. No visible pores.

FIGURE 2 CONTINUED
ANADARKO PETROLEUM CORPORATION
YOUNGREN J 1-H



TIDAL FLAT TO LAGOON

TOP CORE 9

CARBONATE SHOAL TO SHOAL FLANK

LAGOON OR SHALLOW SHELF

TOP CORE 10

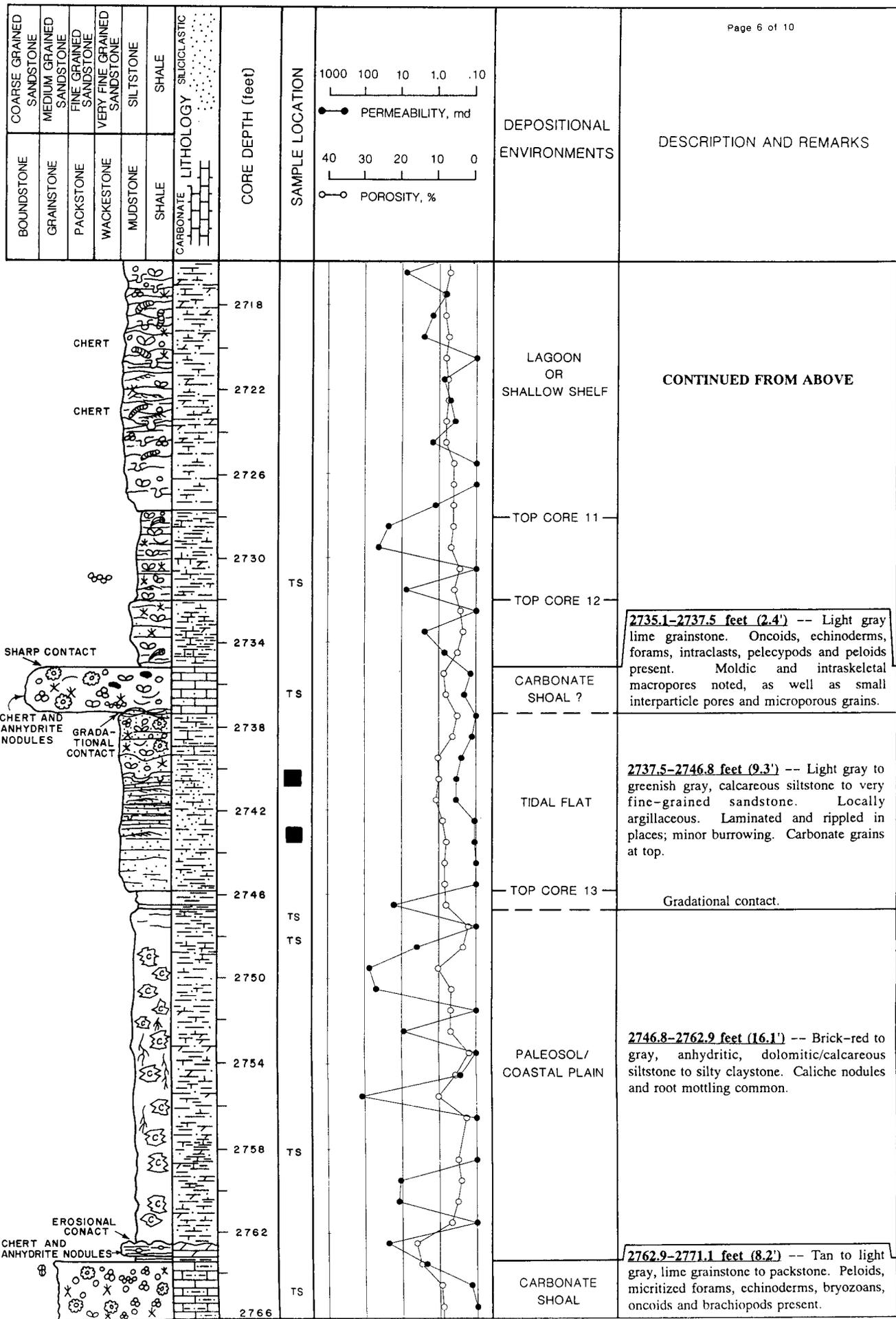
CONTINUED FROM ABOVE

2661.5-2675.8 feet (14.3') -- Light to medium gray and reddish-brown, dolomitic/calcareous siltstone interbedded with silty dolomudstone. Laminations and ripples common; burrows have locally disrupted bedding. Thin beds of argillaceous dolomudstone at 2666.0 to 2666.5 feet and 2670.2 to 2670.6 feet.

2675.8-2707.0 feet (31.2') -- Light gray to tan, dolomitic limestone to calcareous dolomite. Grainstone and packstone textures predominate, grading to packstone/wackestone near 2694.0 feet. Appears to be some matrix-selective dolomitization. Skeletal debris, peloids, oncoids and intraclasts noted. Bryozoans, echinoderms, forams, brachiopods and pelecypods present. In the limestones, intraskeletal, moldic, and interparticle pores are present, as well as microporous grains and matrix. In the dolomites, intercrystalline, intergranular and moldic pores predominate. Pore types vary although porosity and permeability are rather uniform.

2707.0-2735.1 feet (28.1') -- Medium to dark gray, argillaceous/silty, dolomudstone to dolomitic siltstone/silty claystone. Carbonate matrix varies from calcite to dolomite. Brachiopods, echinoderms, corals and forams are present. Chert nodules and silica replacement of fossils common. Burrows also common, with some faintly preserved laminations and ripples.

FIGURE 2 CONTINUED
 ANADARKO PETROLEUM CORPORATION
 YOUNGREN J 1-H



SHARP CONTACT

CHERT AND ANHYDRITE NODULES

GRADATIONAL CONTACT

EROSIONAL CONTACT

CHERT AND ANHYDRITE NODULES

FIGURE 2 CONTINUED
 ANADARKO PETROLEUM CORPORATION
 YOUNGREN J 1-H

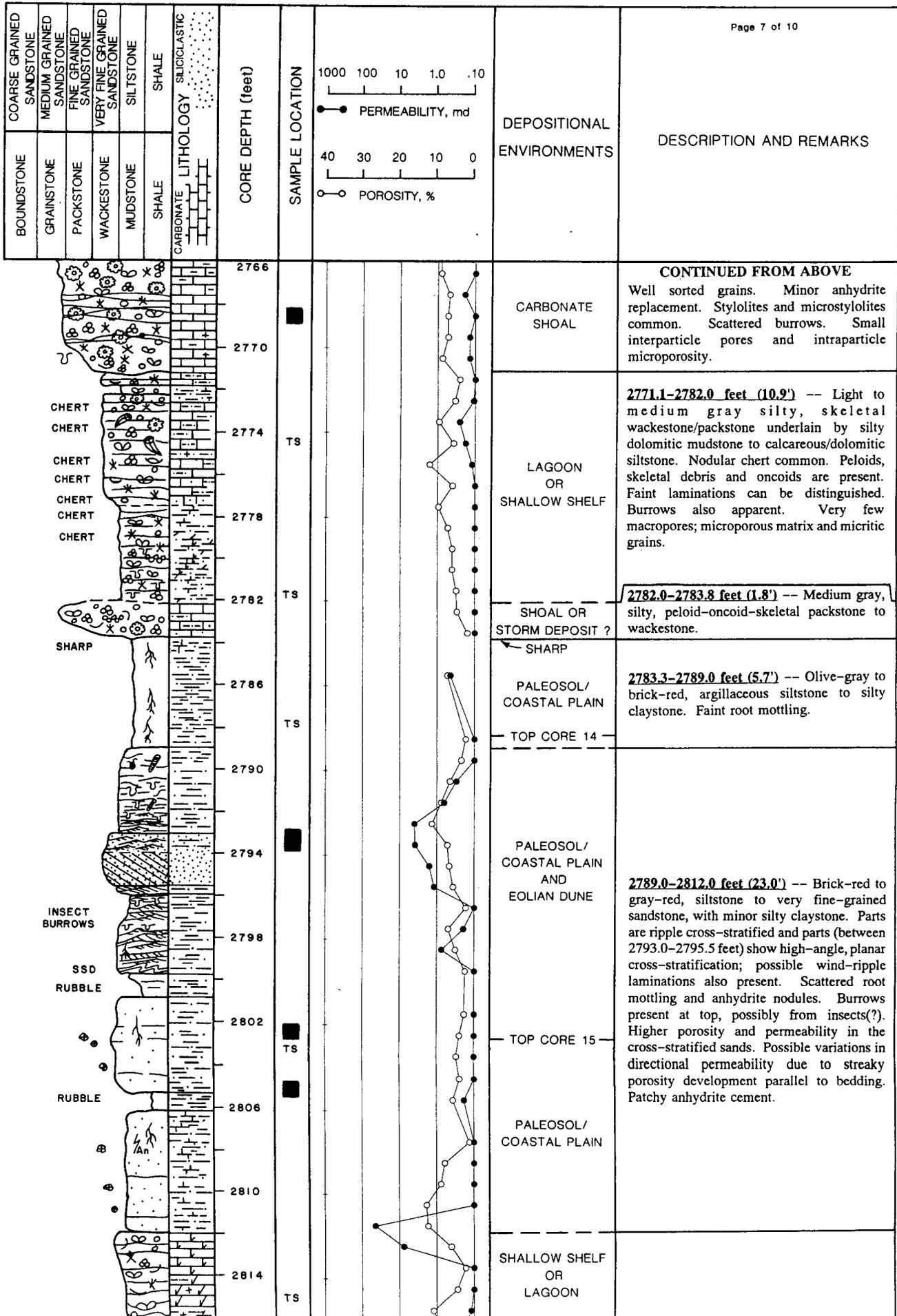


FIGURE 2 CONTINUED
ANADARKO PETROLEUM CORPORATION
YOUNGREN J 1-H

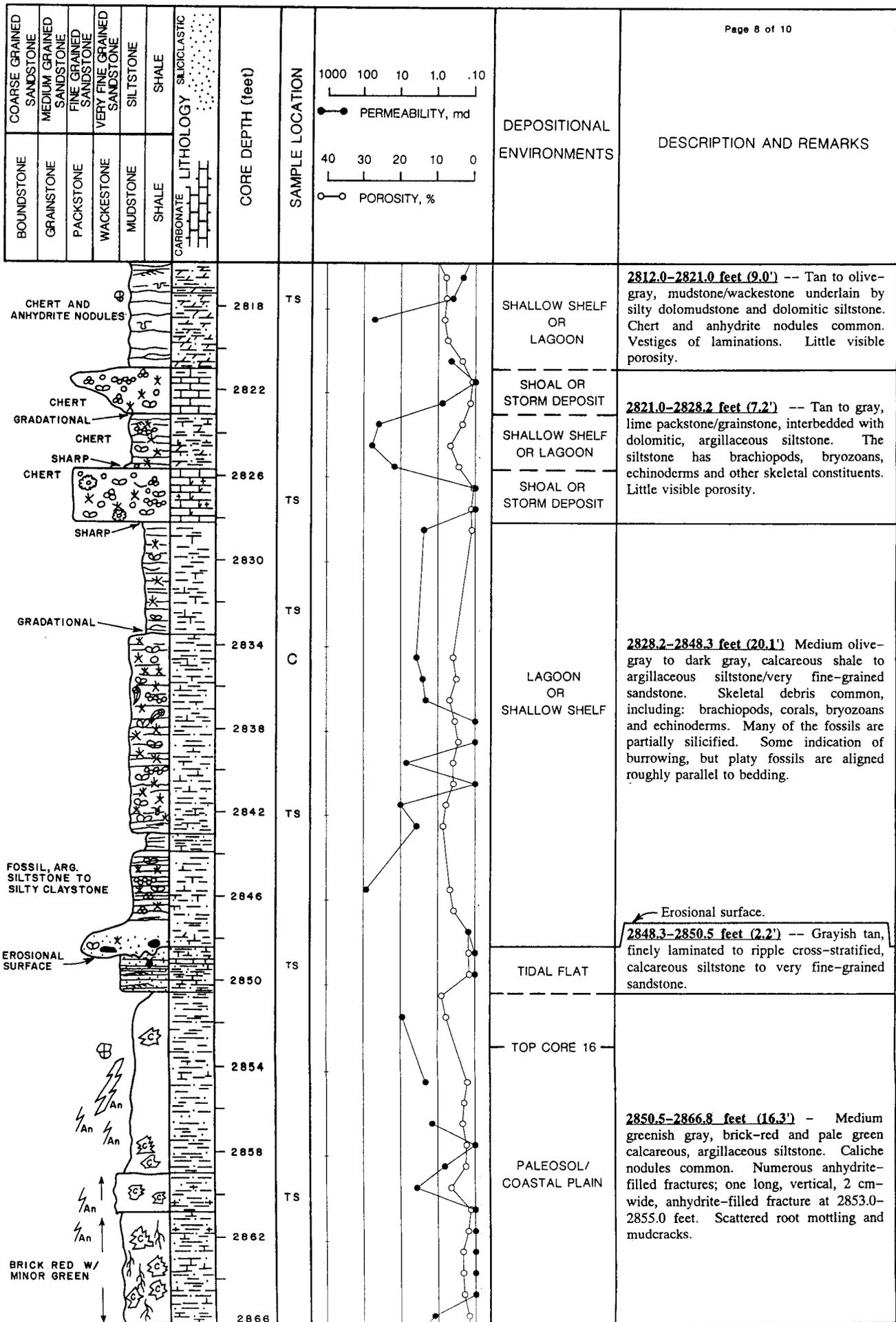


FIGURE 2 CONTINUED
 ANADARKO PETROLEUM CORPORATION
 YOUNGREN J 1-H

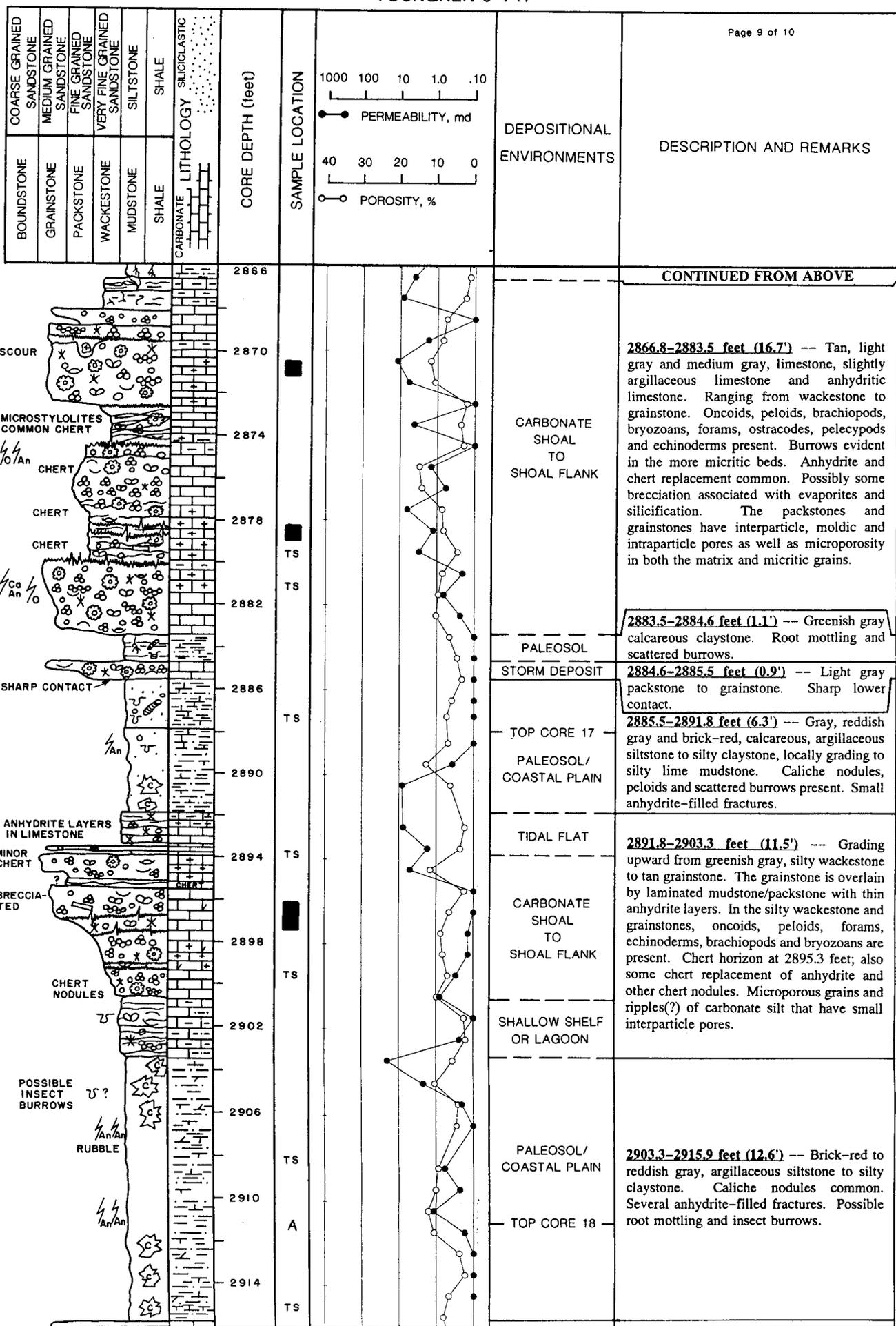


FIGURE 2 CONTINUED
ANADARKO PETROLEUM CORPORATION
YOUNGREN J 1-H

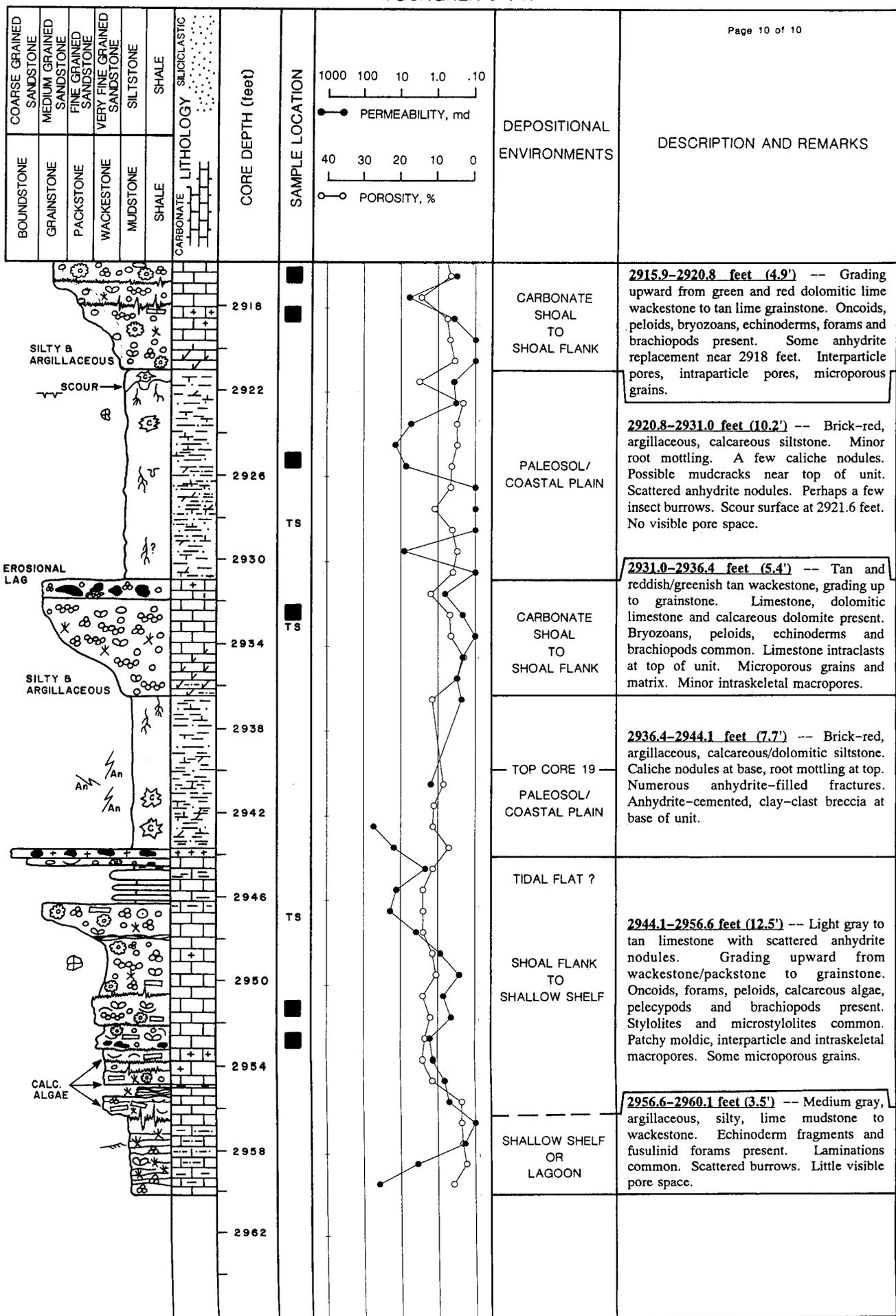


FIGURE 3

CONTINUOUS CORE PHOTOGRAPHS

ANADARKO PETROLEUM CORPORATION YOUNGREN "J" 1-H WELL

WELL FILE

**GEOLOGICAL ANALYSIS
OF CONVENTIONAL CORE FROM THE
ANADARKO PETROLEUM CORPORATION
YOUNGREN "J" 1-H WELL
STEVENS COUNTY, KANSAS**

Prepared
for
Anadarko Petroleum Corporation
Houston, Texas

RSH 3036

CONFIDENTIAL
November, 1994

FIGURE 4

CLOSE CORE PHOTOGRAPHS

ANADARKO PETROLEUM CORPORATION YOUNGREN "J" 1-H WELL

- A. Depth: 2912 feet Dep. Facies: Paleosol/Coastal Plain

The brick-red color and caliche nodules of this argillaceous siltstone are typical of the paleosol/coastal plain facies. Thin anhydrite-filled fractures and anhydrite nodules are also present. Routine core analysis measurements from this facies sometimes yield porosity values in excess of 10%, however, permeability is typically below 0.2 md.

- B. Depth: 2486 feet Dep. Facies: Tidal Flat

This sample displays many of the features identified in the tidal flat facies. The upper one-third of the core piece shows poorly preserved bedding features and scattered burrows, while the lower two-thirds highlights well preserved ripple cross-stratification. Overall, these deposits are interpreted as having accumulated in an intertidal environment; however, the more bioturbated portions were probably deposited in a lower intertidal environment, while the parts with better preserved cross-stratification were deposited in an upper intertidal setting. Average grain size for this facies is in the range of coarse silt.

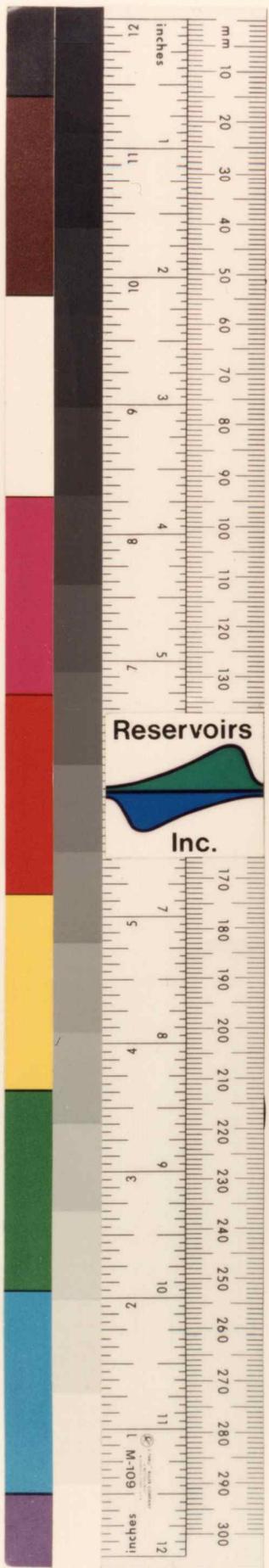


FIGURE 4 (CONTINUED)

CLOSE CORE PHOTOGRAPHS

ANADARKO PETROLEUM CORPORATION YOUNGREN "J" 1-H WELL

- C. Depth: 2835 feet Dep. Facies: Lagoon/Shallow Shelf

Several of the attributes of this facies indicate subtidal marine sedimentation. Specifically, the assemblage of fossil fragments (including echinoderms, bryozoans, brachiopods, foraminifera, calcareous algae and ostracodes) and the bioturbation imply shallow marine deposition. However, it is often difficult to determine if individual units of this facies accumulated in a lagoon or a shallow shelf setting. Porosity and permeability values throughout this facies are typically very low.

- D. Depth: 2512 feet Dep. Facies: Carbonate Shoal/Shoal Flank

This sample comes from a dolomitized grainstone in the carbonate shoal/shoal flank facies. Close examination of the rock reveals an abundance of moldic pores due to the dissolution of skeletal grains and other allochems. A microstylolite/compaction seam (near the center of the core piece) may contribute to a local "tight" streak.

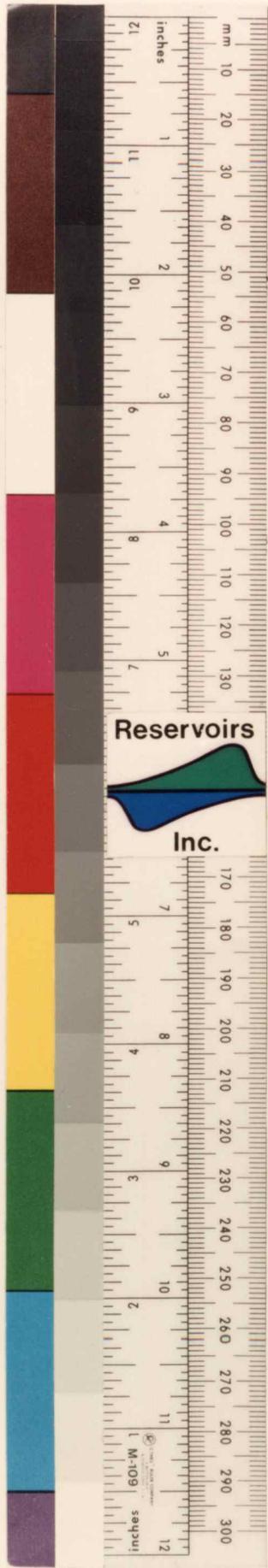


FIGURE 4 (CONTINUED)

CLOSE CORE PHOTOGRAPHS

ANADARKO PETROLEUM CORPORATION YOUNGREN "J" 1-H WELL

- E. Depth: 2626 feet Dep. Facies: Carbonate Shoal/Shoal Flank

This lime grainstone contains an abundance of ooids. Skeletal grains, oncoids, peloids and intraclasts were also identified. The ooids are often leached, yielding relatively high porosity. However, many of the moldic pores are isolated from one another by interstitial calcite cement. This results in low permeability. The lack of carbonate matrix indicates rather high energy conditions at the site of deposition.

- F. Depth: 2634 feet Dep. Facies: Carbonate Shoal/Shoal Flank

This sample is from a partially dolomitized lime grainstone that accumulated in a carbonate shoal environment. Note the patches of authigenic anhydrite (white/bluish nodules). It is unclear if the development of the anhydrite was related to the alteration of calcite to dolomite. Close examination of the sample reveals small moldic pores from leached grains.

