PRELIMINARY GEOLOGIC DESCRIPTION

ARKLA EXPLORATION
T. P. SCOTT NO. 5

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Prepared by

Shirley P. Dutton and Robert J. Finley

Bureau of Economic Geology
W. L. Fisher, Director
The University of Texas at Austin
Austin, Texas 78713-7508

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Robert J. Finley - Principal Investigator

INTRODUCTION

Three intervals of the Travis Peak Formation were cored in the Arkansas Louisiana Gas Company (Arkla) T. P. Scott No. 5 well, Waskom field, Harrison County, Texas. Core was recovered from 5,823.0 to 5,865.3 ft, 6,143.0 to 6,235.9 ft, and 7,413.0 to 7,523.0 ft. The top of the Travis Peak is at 5,841.5 ft (core depth), so 18.5 ft of carbonates from the Sligo Formation were recovered in the upper cored interval.

MACROSCOPIC CORE DESCRIPTION

The Travis Peak cores were described using a hand lens and binocular microscope, and graphic logs of the cores were made at a scale of 1 inch = 5 ft (fig. 1). The following features of the cores were noted on the descriptive logs: depth, rock type, accessories such as pyrite, organic matter, and burrows; sedimentary structures; texture (sorting), induration; grain size; relative amount of carbonate cement; color; and special features such as reservoir bitumen (solid hydrocarbons) and calcareous nodules (fig. 1). Porosity and permeability values reported by NL Erco are noted on the graphic logs, as are the depths from which thin sections have been made. Correction factors between core and log depths are noted for each cored interval (fig. 1). The cores consist of medium to very fine sandstone, mudstone, and limestone. Each of the three cored intervals is described below.

The lowest section of core, from 7,413.0 to 7,523.0 ft, contains thin red mudstones (up to 4 ft thick) interbedded with sandstones up to 29 ft thick (fig. 1). The sandstone from 7,438 to 7,467 ft has a sharp lower contact with planar laminations and high angle crossbeds at the base, and it fines upward to a burrowed, muddy sandstone at the top (fig. 1). This sandstone is interpreted to be a fluvial-channel deposit. The middle to upper part of the sandstone is poorly indurated and in places can be broken into individual sand grains by hand. This zone is quite porous and permeable (porosity as high as 18.9%, permeability as high as 129 md) compared to most Travis Peak sandstones. As will be discussed in the section on Petrographic Description, the detrital sand grains in this interval are coated by thick rims of illite that inhibited the later nucleation of cements, particularly quartz, and thus preserved much of the original depositional porosity. This sandstone is overlain by a red mudstone that contains root traces and has the mottled texture of a soil zone.

The rocks in the lowest section of core are interpreted to have been deposited in a fluvial environment. The crossbedded and planar-laminated sandstones may be longitudinal and transverse-bar deposits and channel fills from a sand-rich, low-sinuosity braided stream system. The tops of many of the sandstones are burrowed, which probably took place after the waning of flood events. The mudstones interbedded with these sandstones are interpreted as overbank floodplain deposits. Floodplain deposits are not commonly preserved in braided systems, which would explain why mudstones are thin and not volumetrically as important as the sandstones in this section of the core.

The middle section of core (6,143.0 to 6,235.9 ft) contains thicker mudstones than does the lowest core. The sandstone at 6,175 to 6,193 ft has a sharp basal contact, and the highest energy sedimentary structures (crossbeds and parallel to slightly inclined laminae) occur in the lower part of the sandstone. The sandstone fines upward, and the upper part is burrowed. Many of the burrows at the top of the sandstone are highlighted by reservoir bitumen. Calcareous nodules are common in the mudstones. Most of the mudstones are gray, not red, and some contain pyrite associated with organic matter.

There is no evidence of marine deposition in the rocks of the middle cored interval, and they probably represent alluvial or delta-plain sediments. Sandstone intervals represent small fluvial channels or crevasse splays deposited in the adjacent floodplain. The red and gray mudstones are interpreted as overbank floodplain deposits. Mudstones are relatively thick in this core, suggesting that the streams carried mixed bedload and suspended load, and overbank floodplain deposits were preserved in the system. The gray color of some of the mudstones is probably caused by a high water table, abundant organic matter, and reducing fluids that moved through overlying sandstones.

The shallowest core (5,823.0 to 5,865.3 ft) records the transition from terrigenous clastic deposition of the Travis Peak Formation to shallow-marine limestone deposition of the Sligo Formation. Sandstones are rare in this interval (fig. 1). The thin sandstones that are present are rippled and burrowed, and they contain reservoir bitumen. Red mudstones persist to depths as shallow as 5,850 ft, which is only 9 ft below the top of the Travis Peak. The red and gray mudstones and thin, interbedded sandstones of this interval are interpreted to be tidal flat deposits that were periodically exposed subaerially. The limestones are classified as packstones, which means they are composed of skeletal fragments and carbonate mud. Oyster fragments are the most common skeletal grains, but pelecypod and gastropod shells were also noted. Thin stringers of terrigenous-clastic mud are common within limestone beds.

PETROGRAPHIC DESCRIPTION

Detailed study of the core is being conducted with a standard petrographic microscope and with a scanning electron microscope (SEM) that includes an energy dispersive X-ray system (EDX).

Grain Size

Analysis of grain size was accomplished by making grain-size point counts of thin sections. Fifty grains per slide were measured along their long dimension, excluding cement overgrowths in order to determine the size of the detrital grains. Mean diameter of sand- and silt-sized grains was calculated for each sample (Table 1); detrital and authigenic clays were not included in the calculation of mean grain diameter.

Most sand grains are fine or very fine, between 0.063 and 0.25 mm, although some of the grains in the 7,450-ft sandstone are medium sand, between 0.25 and 0.5 mm (Table 1). Most silt is coarse silt, between 0.031 and 0.062 mm. Clay particles are smaller than 0.004 mm.

Mineral Composition

Fifteen thin sections have been point counted for a preliminary description of mineral composition (Table 2). The sandstones are mineralogically very mature, and all but one are classified as quartz arenites. (One sample is a subarkose.) Quartz comprises 94.4% to 100% of the essential framework constituents (quartz, feldspar, and rock fragments). Plagioclase feldspar is more abundant than orthoclase, and total feldspar volume varies from 0% to 4.7%. Rock fragments, mainly chert and low-rank metamorphic rock fragments, constitute between 0% and 3.7% of the framework grains.

Authigenic cements constitute between 14.5% and 27.5% of the sandstone volume in these 15 samples (Table 2). Authigenic quartz, illite, chlorite, kaolinite, iron-bearing calcite, dolomite, ankerite, anhydrite, and reservoir bitumen have all been observed in Arkla Scott No. 5 cores.

One of the distinctive features of the Arkla Scott samples is the presence of thick illite cutans around detrital grains in the 7,450-ft sandstone. The upper part of the sandstone (7,442 to 7,453 ft) is porous and poorly indurated, whereas the lower part (7,453 to 7,462 ft) is well indurated. Samples in the upper part contain as much as 14% by volume of clay cutans around detrital grains and volumes of quartz overgrowths as low as 0.5% (Table 2). The deeper part of this sandstone has much thinner clay rims (1% to 3%) and correspondingly more quartz cement (15%: Table 2). The cutans are birefringent and are composed mainly of illite, but EDX analysis of SEM samples indicates that some chlorite occurs in the rims as well. In the upper part of the sandstone, the clays form a coat about 2 μm thick over all the detrital grains (fig. 2); where framework grains have been removed by plucking during thin-section preparation or by dissolution of feldspars during burial diagenesis, the thick illite cutans remain intact and uncrushed (fig. 3). Such extremely thick illite cutans have not been observed in other Travis Peak samples. The presence of these cutans apparently inhibited the nucleation of later cements, particularly quartz. Thus, the poor induration of this unusual Travis Peak sandstone is caused by the presence of thick illite cutans and the corresponding lack of other authigenic cements. The cutans may be the cause of the unusually high SP and low resistivity log responses in this zone.

The depositional setting of this sandstone and the distribution of the cutans within the sandstone suggest that most of the clay entered the sandstone by mechanical infiltration from the soil above. This process is characteristic of the vadose zone; downward percolating rain- or floodwater carries clay-sized material that is deposited tangentially to detrital sand grains when the water evaporates or diffuses into capillaries (Molenaar, 1986). During burial diagenesis, the clays may have been altered, for example to higher crystallinity.

Authigenic illite and chlorite also occur as pore-filling cements in secondary pores that formed by the dissolution of feldspars. Unlike the illite cutans, these cements formed relatively late in the burial history of the Travis Peak. Kaolinite cement was observed in primary pores in the Arkla Scott No. 5 samples. Petrographic evidence is equivocal, but the kaolinite appears to have precipitated at about the same time as the quartz overgrowths.

Quartz cement is the most abundant authigenic mineral in the Arkla Scott No. 5 cores. Quartz overgrowths fill as much as 23% of the sandstone volume (Table 2), and precipitation of authigenic quartz occluded much of the primary porosity. Where volumes of quartz cement are relatively low, perhaps because nucleation was inhibited by early illite cutans, primary porosity has been retained (Table 2). The sandstone at 6,175 to 6,193 ft has porosities as high as 21% and permeabilities as high as 52 md (fig. 1). Primary porosity in a sample from 6,187.3 ft can easily be seen in SEM (figs. 4 and 5); the volume of quartz overgrowths in this sample is only 11%.

Dolomite, ankerite, and iron-bearing calcite occur in the Arkla Scott No. 5 cores. Calcite cement was observed only in the shallowest sample, at 5,843.5 ft, in a sandstone that is interbedded with limestone. Petrographic relationships suggest that the calcite cement precipitated after quartz overgrowths. Dolomite and ankerite are also more abundant in the shallower Travis Peak cores. No dolomite was observed in the deepest section of core (7,413 to 7,523 ft), and ankerite was observed but not counted (and therefore occurs in volumes less than 0.5%) in only a few samples from the lowest core (Table 2). Ankerite cement has a maximum volume of 7.5% in the sample from 6,187.3 (fig. 5), and it could cause completion problems (formation of an iron-hydroxide gel) if it is treated with acid. A decrease in dolomite and ankerite with depth below the top of the Travis Peak has been noted in several other Travis Peak cores (Dutton, 1985).

Minor amounts of late anhydrite cement were observed in several thin sections; it was never hit on a point-count traverse, and therefore must occur in volumes of less than 0.5%. Anhydrite was observed in the core as nodules at 7,428 and 7,435 ft and along a natural fracture at 7,497 ft. Both of these occurrences also suggest that the anhydrite was a late, diagenetic feature that did not precipitate in the depositional environment.

Solid hydrocarbons (also known as reservoir bitumen or "dead oil") occur mainly in the upper two sections of the core (fig. 1). No reservoir bitumen was observed in the lower core during macroscopic examination, but the thin section from 7,466.5 ft contained reservoir bitumen (Table 2). Where it is abundant, reservoir bitumen fills primary porosity; petrographic evidence suggests it entered the sandstones after the precipitation of quartz overgrowths and ankerite. Preliminary studies of the reservoir bitumen suggest it occurs mainly in the upper Travis Peak (Dutton, 1985). It appears to have formed by deasphalting of pooled oil after solution of gas into the oil (Rogers and others, 1974).

Porosity

Porosity observed in thin section in the 15 samples varies from 0% to 6.0% (Table 2). Both primary and secondary pores are present, and primary pores are particularly abundant in samples with thick illite cutans. Secondary pores are formed by the dissolution of framework grains, so they are approximately the same size as detrital grains. However, they commonly contain authigenic clays and fragments of dissolved framework grains, particularly feldspar. Porosity measured by point counting thin sections is lower than porosity measured by porosimeter on adjacent samples because of the presence of abundant microporosity. Microporosity occurs in detrital and authigenic clays (fig. 5); such porosity generally cannot be seen in thin section, but it can be observed by SEM and is measured by a porosimeter.

Table 1. Grain-size distribution in Arkla T. P. Scott No. 5 core

Depth (ft)	Mean (mm)	Sand (%)	Silt (%)	Detrital Clay (%)	Authigenic Clay (%)	Textural Class*
5,843.5	.069	55.4	40.1	0	4.5	Silty sandstone
6,178.2	.115	91.6	1.9	0	6.5	Sandstone
6,187.3	.104	92.6	1.9	0	5.5	Sandstone
6,192.0	.158	97.0	0	0	3.0	Sandstone
6,204.4	.119	89.3	5.7	0	5.0	Sandstone
6,208.4	.163	97.5	0	0	2.5	Sandstone
6,218.4	.142	90.2	1.8	5.0	3.0	Sandstone
7,444.2	.172	86.0	0	1.5	14.5	Sandstone
7,446.4	.274	89.5	0	0	10.5	Sandstone
7,451.0	.192	83.5	0	0	16.5	Sandstone
7,458.2	.167	93.5	0	0	6.5	Sandstone
7,462.1	.209	96.0	0	0	4.0	Sandstone
7,466.2	.158	96.0	0	0	4.0	Sandstone
7,489.5	.150	94.0	0	0	6.0	Sandstone
7,494.6	.165	97.0	0	0	3.0	Sandstone

*Textural class determined only by detrital grains.

Table 2. Petrographic analyses of Arkla T. P. Scott No. 5 core, measured in percent.

	Depth = 5,843.5 ft	6,178.2 ft	6,187.3 ft	6,192.0 ft	6,204.4 ft
Framework Grains					
Quartz	68.0	70.5	71.0	77.0	74.5
Plagioclase	2.5	2.0	3.5	0.5	1.5
Orthoclase	0.5	0.5	0	2.0	1.5
MRF*	0.5	0	0	0.5	0
Chert	0.5	0	0	0	0.5
Clay clasts	1.0	1.0	1.0	0	2.5
Heavy minerals	0	0	0	0	0
Other	0	0	0	0	0
Matrix					
Clay-sized fines	0	0	0	0	0
Cements					
Quartz	14.0	13.5	11.0	16.5	14.0
Dolomite	7.5[1]	0	0.5	0	0
Ankerite	1.0	0.5	7.5	0	0.5
Illite	4.5	4.0	4.5	1.0	0
Chlorite	0	2.5	1.0	2.0	1.0
Solid organic matter	0	3.5	0	0	4.0[2]
Porosity					
Primary porosity	0	1.5	0	0.5	0
Secondary porosity	0	0.5	0	0	0
Porosimeter porosity	1.2	no data	no data	no data	11.7

*Metamorphic rock fragments [1] Iron-rich calcite [2] Kaolinite

Table 2 (continued). Petrographic analyses of Arkla T. P. Scott No. 5 core, measured in percent.

	Depth = 6,208.4 ft	6,218.4 ft	7,444.2 ft	7,446.4 ft	7,451.0 ft
Framework Grains					
Quartz	74.0	69.0	79.0	69.0	73.0
Plagioclase	1.5	2.0	0	0.5	1.5
Orthoclase	1.5	0	0	0	0
MRF*	0	0	0.5	0	0
Chert	0	0	2.5	2.5	1.5
Clay clasts	1.0	6.5	2.0	0.5	1.0
Heavy minerals	0	0	0	0	0
Other	0	0	0	0	0
Matrix					
Clay-sized fines	0	5.0	1.5	0	0
Cements					
Quartz	19.5	6.5	0	14.5	0.5
Dolomite	0	1.0	0	0	0
Ankerite	0	7.0	0	0	0
Illite	1.5	1.0	11.0	8.0	14.0
Chlorite	0.5	2.0	3.5	2.5	2.5
Solid organic matter	0.5[2]	0	0	0	0
Porosity					
Primary porosity	0	0	0	2.0	4.5
Secondary porosity	0	0	0	0.5	1.5
Porosimeter porosity	11.5	12.1	no data	18.9	no data

*Metamorphic rock fragments

[2] Kaolinite

Table 2 (continued). Petrographic analyses of Arkla T. P. Scott No. 5 core, measured in percent.

	Depth = 7,458.0 ft	7,462.1 ft	7,466.5 ft	7,488.5 ft	7,494.6 ft
Framework Grains					
Quartz	72.5	75.5	72.5	77.5	78.0
Plagioclase	1.0	1.0	0	0.5	0.5
Orthoclase	0	0	0	0	0
MRF*	0.5	0	0	0	0.5
Chert	1.0	0.5	0	1.0	0.5
Clay clasts	2.5	0	0	0	0
Heavy minerals	0	0	0	0.5	0
Other	0	0	2.0^2	0	0
Matrix					
Clay-sized fines	0	0	0	0	0
Cements					
Quartz	16.0	14.5	23.0	11.5	15.0
Dolomite	0	0	0	0	0
Ankerite	0	0	0	0	0
Illite	3.0	1.0	1.0	4.0	0.5
Chlorite	3.5	2.5	1.0	1.5	1.0
Solid organic matter	0	0.5^2	0.5	0.5^2	1.5^2
Porosity					
Primary porosity	0	2.5	0	1.5	1.0
Secondary porosity	0	2.0	0	1.5	1.5
Porosimeter porosity	no data	no data	no data	11.9	9.7

*Metamorphic rock fragments ^{2}Kaolinite

REFERENCES

Dutton, S. P., 1985, Petrography and diagenesis of the Travis Peak (Hosston) Formation, East Texas: The University of Texas at Austin, Bureau of Economic Geology, topical report prepared for the Gas Research Institute under contract no. 5082-211-0708.

Molenaar, Niek, 1986, The interrelationship between clay infiltration, quartz cementation and compaction in Lower Givetian terrestrial sandstones, northern Ardennes, Belgium: Journal of Sedimentary Petrology, v. 56, no. 3, p. 359-369.

Rogers, M. A., McAlary, J. D., and Bailey, N. J. L., 1974, Significance of reservoir bitumens to thermal-maturation studies, western Canada Basin: American Association of Petroleum Geologists, v. 58, no. 9, p. 1806-1824.

FIGURE CAPTION

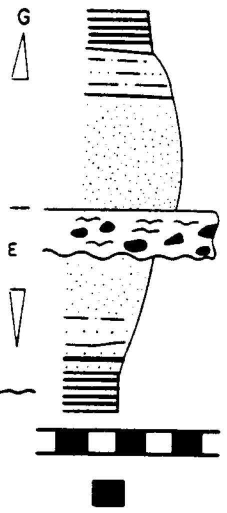
Figure 1. Descriptive log of core of the Travis Peak Formation from the Arkla Scott No. 5 well, Harrison County, Texas. Core depths are 5,823.0 to 5,865.3 ft, 6,143.0 to 6,235.9 ft, and 7,413.0 to 7,523.0 ft.

EXPLANATION OF SYMBOLS

CONTACT

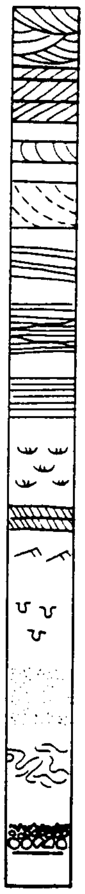
- Gradational G
- Upward fining
- Planar
- Erosive E
- Upward coarsening
- Slightly irregular

ROCK TYPE (%)



- Mudstone
- Siltstone and sandy siltstone (—···—)
- Sandstone
- Mud clast and mud flake (~~) conglomerate
- Interbedded sandstone (····), siltstone (—···—), and
- Mudstone
- Coal
- Porosity

STRUCTURES



- Trough crossbedding
- Planar crossbedding
- Crossbeds with oversteepened foresets
- Indistinct cross-stratification
- Gently inclined lamination = GI
- Gently inclined lamination separated by low-angle discordances
- Horizontal lamination
- Ripple trough lamination
- Planar ripple lamination
- Climbing-ripple lamination
- Heavily bioturbated sandstone
- "Massive" sandstone = M
- Contorted bedding
- Graded bedding

ACCESSORIES

- Vertical and horizontal burrows
- Organic fragments
- Rootlets
- Shells
- Mica flakes
- P Pyrite
- Callianassa burrows

TEXTURE

Sorting	Rounding
vp-s Very poor	a Angular
p-s Poor	s-a Subangular
m-s Moderately well	s-r Subrounded
w-s Well	r Rounded

INDURATION

WI	Well indurated
I	Indurated
IF	Indurated but friable
IS	Indurated but shaly

RELATIVE CALCITE CONTENT

1	Slight effervescence
3	Moderate effervescence
5	Strong effervescence
10	Very strong effervescence

COLOR

Abbreviations from Rock-Color Chart, Geological Society of America

Abbreviations from Geological Society of America Rock-Color Chart Used on Core Descriptions

5R 6/2	Pale red
5R 4/2	Grayish red
5YR 6/1	Light brownish gray
5YR 4/1	Brownish gray
5YR 7/2	Grayish orange pink
5GY 6/1	Greenish gray
N7	Light gray
N6	Medium light gray
N5	Medium gray
N4	Medium dark gray
N3	Dark gray

FIGURE 2.

SEM photograph of illite cutans coating detrital grain. Depth is 7,451.0 ft. Bar length is 100 μm; magnification is 200x.

FIGURE 3.

SEM photograph of thick illite cutan. The framework grain has been removed by dissolution or plucking during thin-section preparation. Depth is 7,451.0 ft. Bar length is 10 μm; magnification is 750x.

FIGURE 4.

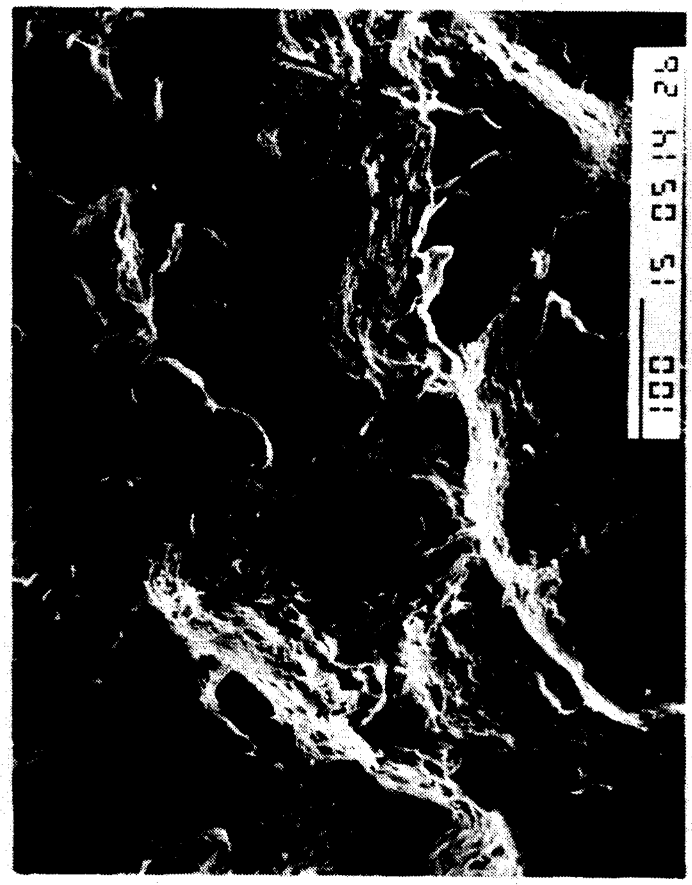
SEM photograph of euhedral quartz overgrowths (Q) and primary porosity. Microporosity within authigenic clays is abundant. Depth is 6,187.3 ft. Bar length is 100 μm; magnification is 350x.

FIGURE 5.

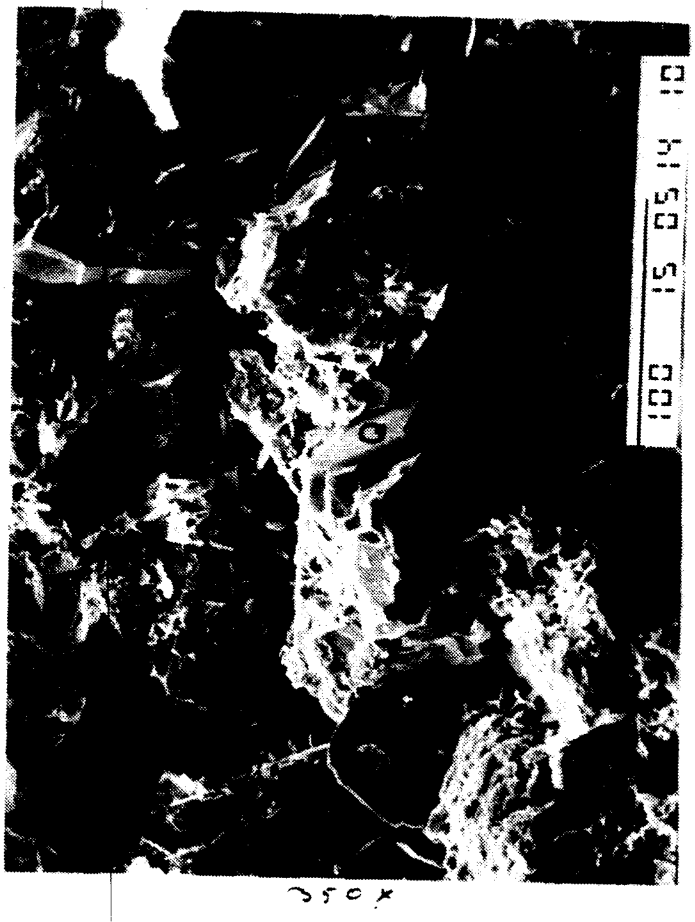
SEM photograph of quartz overgrowths (Q), ankerite (A), and chlorite (C) cement. Depth is 6,187.3 ft. Bar length is 100 μm; magnification is 500x.

750 x

500 x



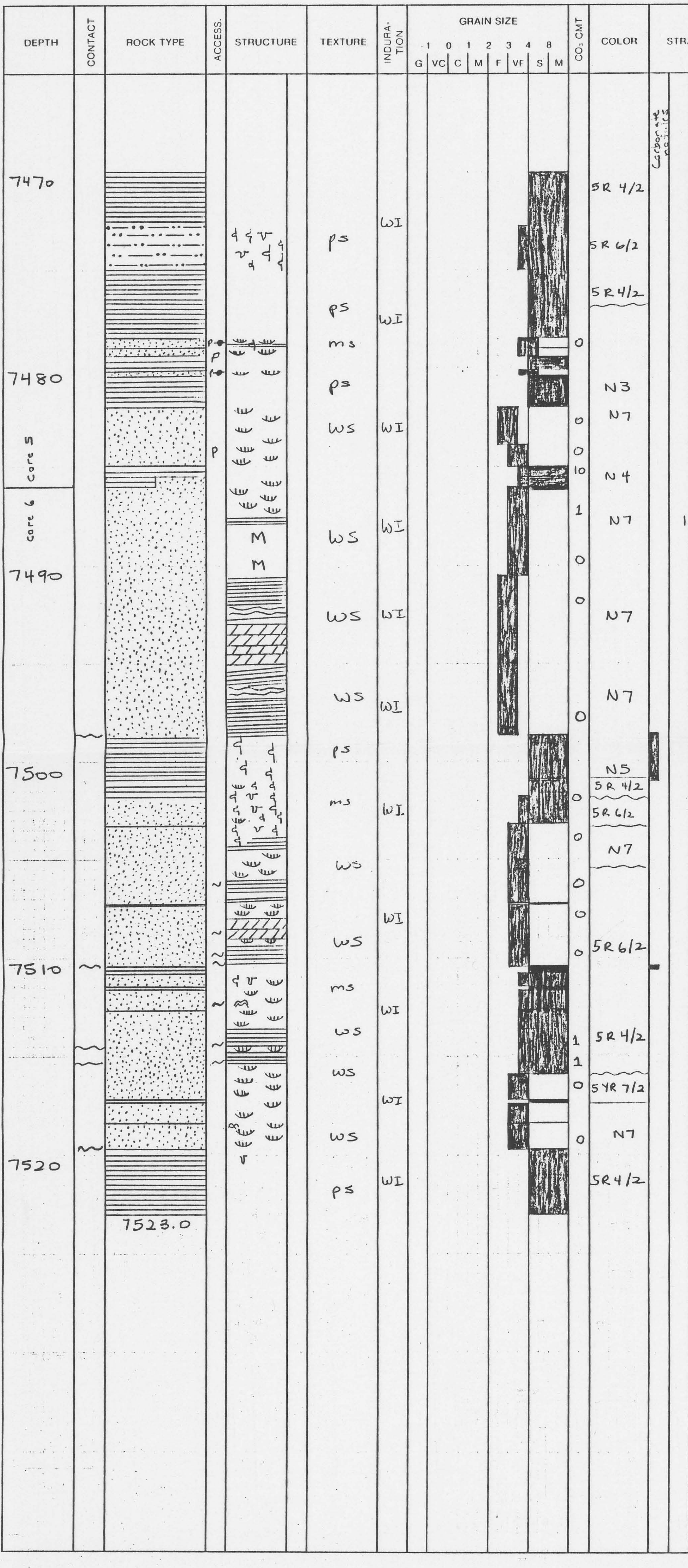
200 x



350 x

WELL ARKLA EXPLORATION T.P. SCOTT No. 5 CORE DEPTH (+)/(-) 1.5 = GR LOG DEPTH @ 7497

FORMATION Travis Peak COUNTY Harrison LOGGED BY S. Dutton DATE 5/86

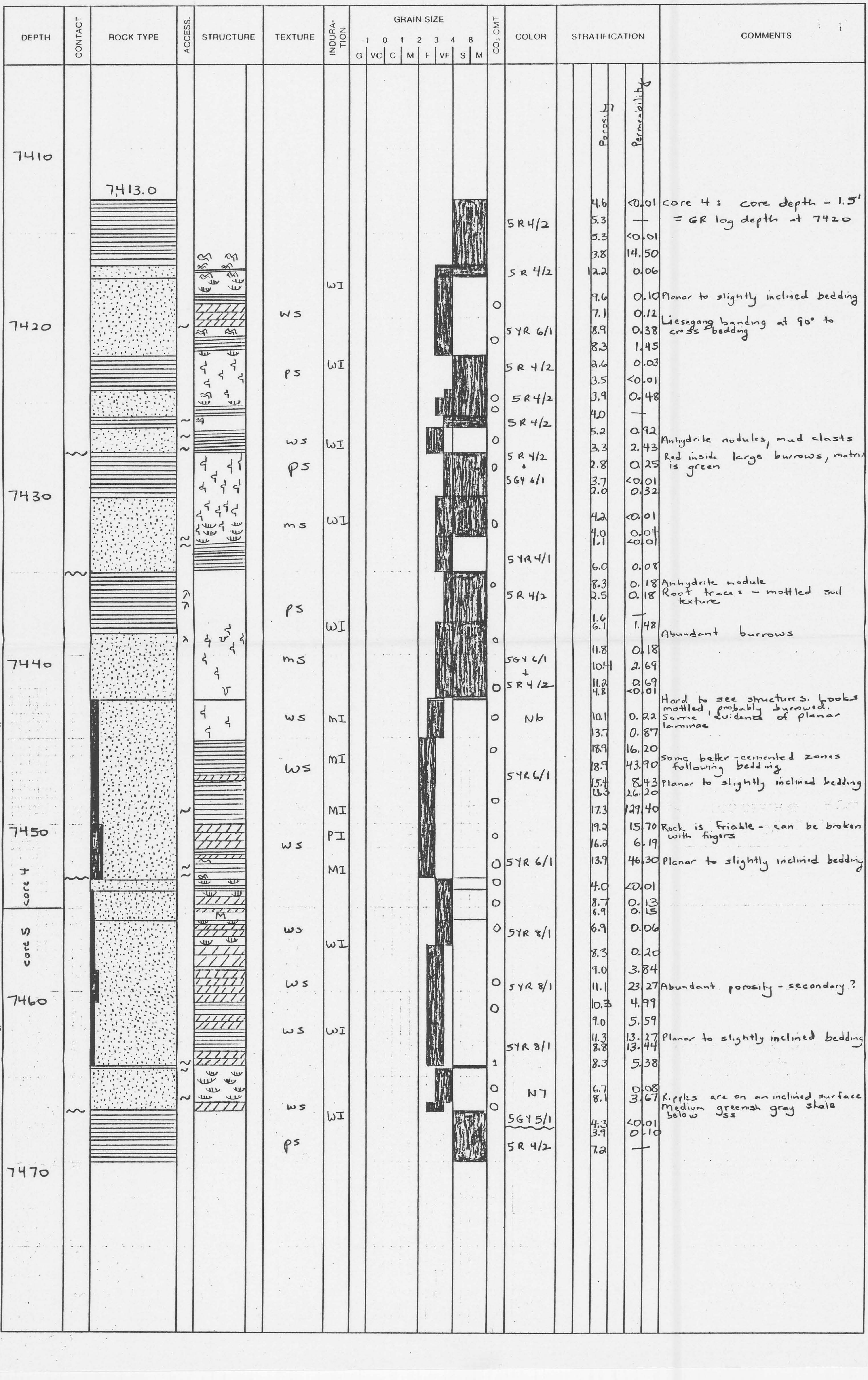


Porosity	Permeability	COMMENTS
1.2	1.22	Core 5: core depth - 1.5 ft =
1.8	—	GR log depth at 7480.5
7.2	0.05	
5.0	0.02	
8.2	<0.01	
2.9	—	
1.2	—	
5.0	—	
3.2	0.15	Planar ss + mud, overlain by ripples
1.9	0.22	Large pyrite nodule
4.9	0.58	
3.1	—	
5.3	0.01	
6.7	58.78	Abundant clay drapes
5.4	0.03	Core rubblized 85.0 to 86.0
6.8	0.32	Abundant mud drapes on ripples
7.7	0.90	
12.3	0.66	
11.9	15.66	
11.9	28.26	
11.0	19.30	Planar to slightly inclined laminae
9.1	9.58	Slightly contorted inclined laminae?
10.0	41.68	Hard to see structures
11.4	68.38	
9.7	10.64	
8.0	5.67	
9.9	5.53	Natural fracture containing
7.3	7.41	ankerite and anhydrite
2.7	0.09	Carbonate nodules in bottom .1'
0.6	1.75	of sand
2.7	<0.01	
1.4	0.08	
2.4	<0.01	
6.4	2.00	
6.7	0.17	
8.4	0.24	
9.3	0.16	
7.3	0.09	
7.8	0.76	
7.9	0.28	Inclined laminae, some
4.5	0.05	contortions
4.0	0.06	
4.0	172.40	
5.8	0.08	Planar to slightly inclined laminae
5.3	0.09	
7.2	101.70	
7.2	0.25	
6.1	0.05	
3.9	0.04	Contorted just below mud layer
3.1	0.04	.1" layer of green clay below sand
3.4	—	
2.4	—	
2.3	—	

Core 6: core depth - 1.5 ft = GR log depth at 7497 ft

WELL ARKLA EXPLORATION T.P. SCOTT NO. 5 CORE DEPTH ~~(+)~~ (-) 1.5 ft = GR LOG DEPTH @ 7420 ft

FORMATION Travis Peak COUNTY Harrison LOGGED BY S. Dutton DATE 5/86



Porosity	Permeability
4.6	<0.01
5.3	—
5.3	<0.01
3.8	14.50
12.2	0.06
9.6	0.10
7.1	0.12
8.9	0.38
8.3	1.45
2.6	0.03
3.5	<0.01
3.9	0.48
4.0	—
5.2	0.92
3.3	2.43
2.8	0.25
3.7	<0.01
2.0	0.32
4.2	<0.01
4.0	0.04
1.1	<0.01
6.0	0.08
8.3	0.18
2.5	0.18
1.6	—
6.1	1.48
11.8	0.18
10.4	2.69
11.2	0.69
4.8	<0.01
10.1	0.22
13.7	0.87
18.9	16.20
18.9	43.90
15.4	8.43
13.3	26.20
17.3	129.40
19.2	15.70
16.2	6.19
13.9	46.30
4.0	<0.01
8.7	0.13
6.9	0.15
6.9	0.06
8.3	0.20
9.0	3.84
11.1	23.27
10.3	4.99
9.0	5.59
11.3	13.27
8.8	13.44
8.3	5.38
6.7	0.08
8.1	3.67
4.3	<0.01
3.9	0.10
7.2	—

core 4 : core depth - 1.5' = GR log depth at 7420

Planar to slightly inclined bedding

Liesegang banding at 90° to cross bedding

Anhydrite nodules, mud clasts

Red inside large burrows, matrix is green

Anhydrite nodule

Root traces - mottled soil texture

Abundant burrows

Hard to see structures. Looks mottled, probably burrowed. Some evidence of planar laminae

Some better-cemented zones following bedding

Planar to slightly inclined bedding

Rock is friable - can be broken with fingers

Planar to slightly inclined bedding

Abundant porosity - secondary ?

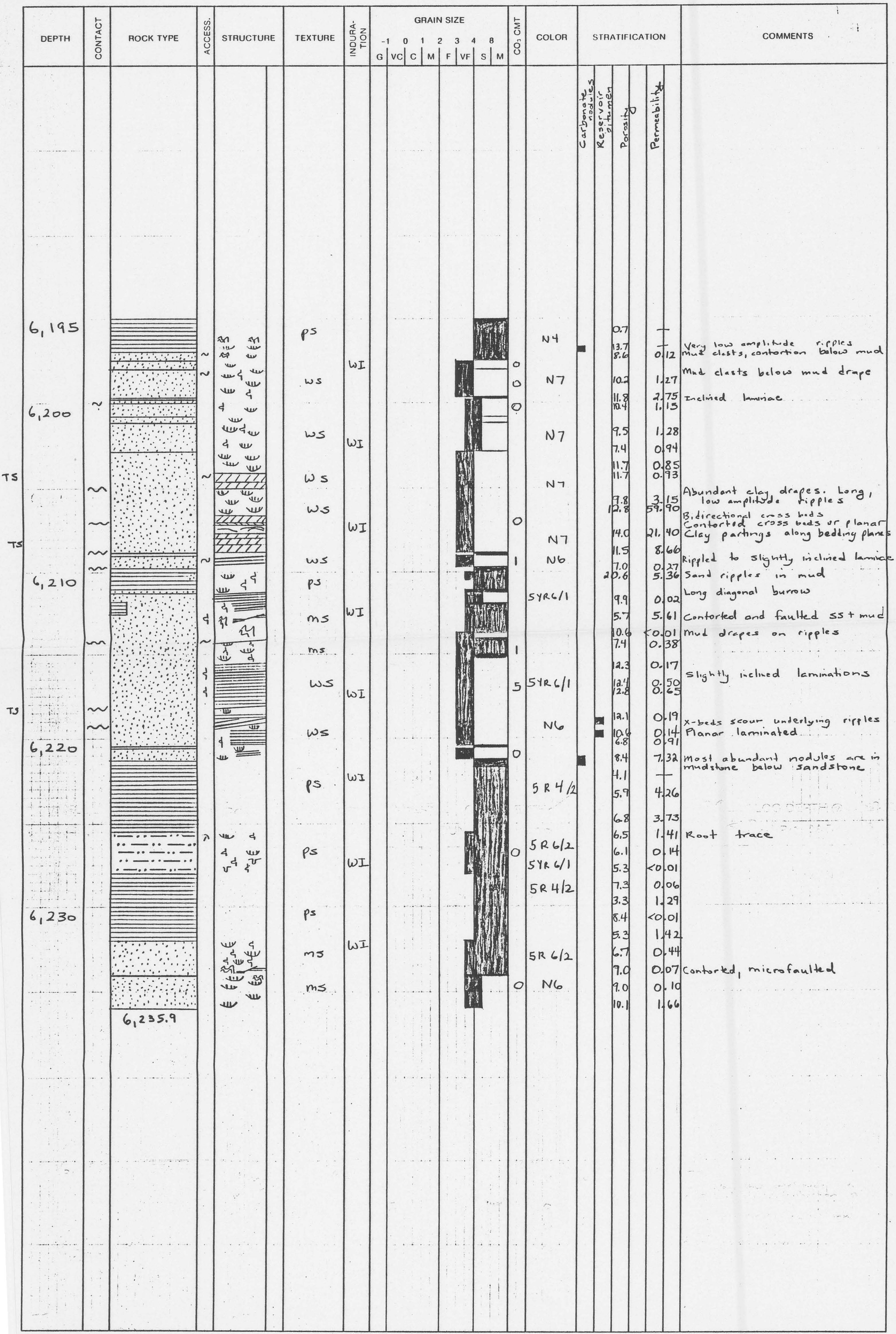
Planar to slightly inclined bedding

Ripples are on an inclined surface

Medium greenish gray shale below ss

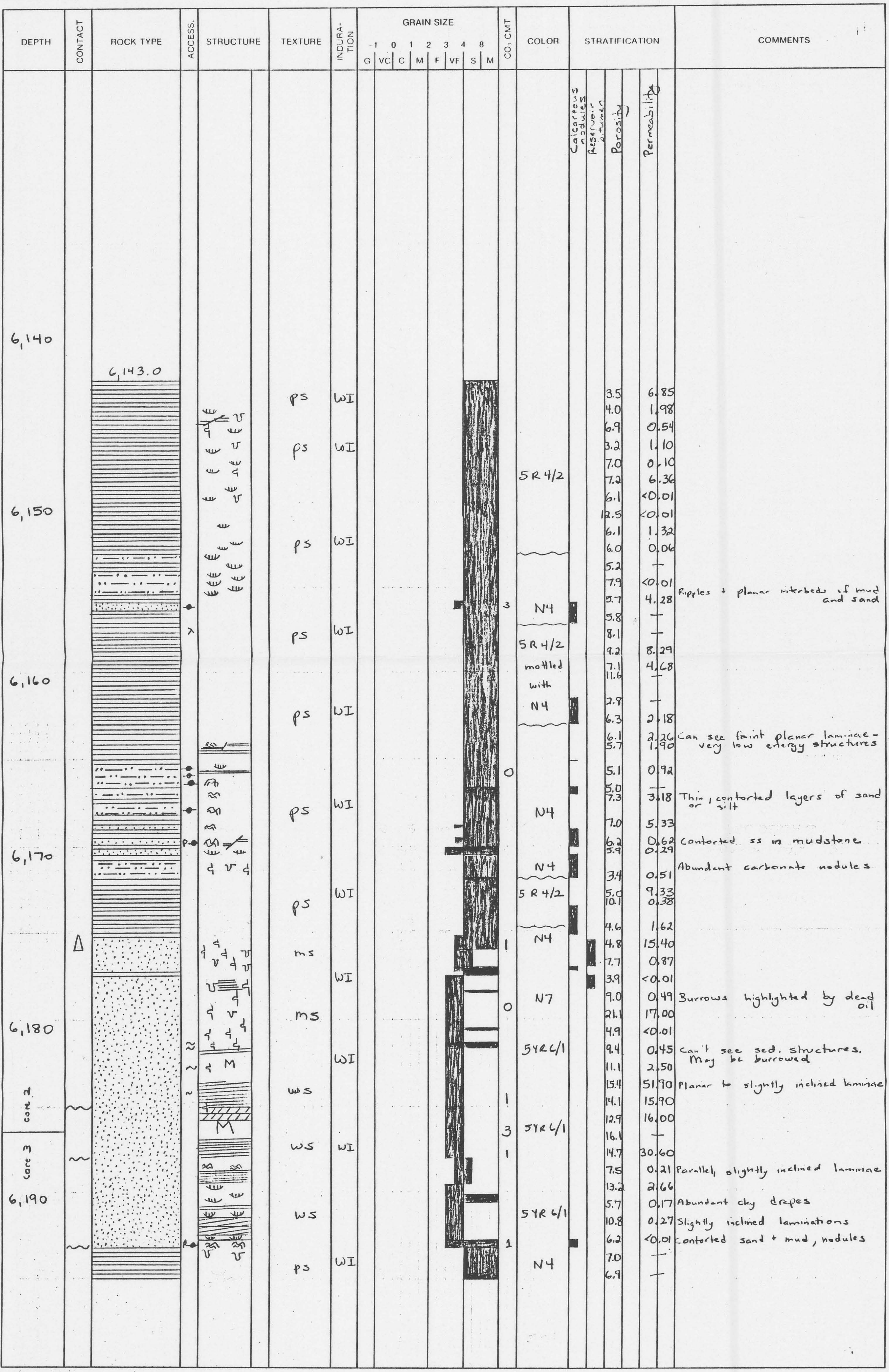
WELL Arkla Exploration T. P. Scott No. 5 CORE DEPTH (+)/(-) 3.5 = GR LOG DEPTH @ 6206 ft

FORMATION Travis Peak COUNTY Harrison LOGGED BY S. Dutton DATE 5/86



Porosity Ø	Permeability k	Comments
0.7	—	
13.7	—	Very low amplitude ripples
8.6	0.12	Mud clasts, contortion below mud
10.2	1.27	Mud clasts below mud drape
11.8	2.75	Inclined laminae
10.4	1.15	
9.5	1.28	
7.4	0.94	
11.7	0.85	
11.7	0.93	
9.8	3.15	Abundant clay drapes. Long, low amplitude ripples
12.8	59.90	
14.0	21.40	Bidirectional cross beds Contorted cross beds or planar Clay partings along bedding planes
11.5	8.66	
7.0	0.27	Rippled to slightly inclined laminae
20.6	5.36	Sand ripples in mud
9.9	0.02	Long diagonal burrow
5.7	5.61	Contorted and faulted ss + mud
10.6	<0.01	Mud drapes on ripples
7.4	0.38	
12.3	0.17	
12.4	0.50	Slightly inclined laminations
12.8	0.65	
12.1	0.19	X-beds scour underlying ripples
10.6	0.14	Planar laminated
6.8	0.91	
8.4	7.32	Most abundant nodules are in mudstone below sandstone
4.1	—	
5.9	4.26	
6.8	3.73	
6.5	1.41	Root trace
6.1	0.14	
5.3	<0.01	
7.3	0.06	
3.3	1.29	
8.4	<0.01	
5.3	1.42	
6.7	0.44	
9.0	0.07	Contorted, microfaulted
9.0	0.10	
10.1	1.66	

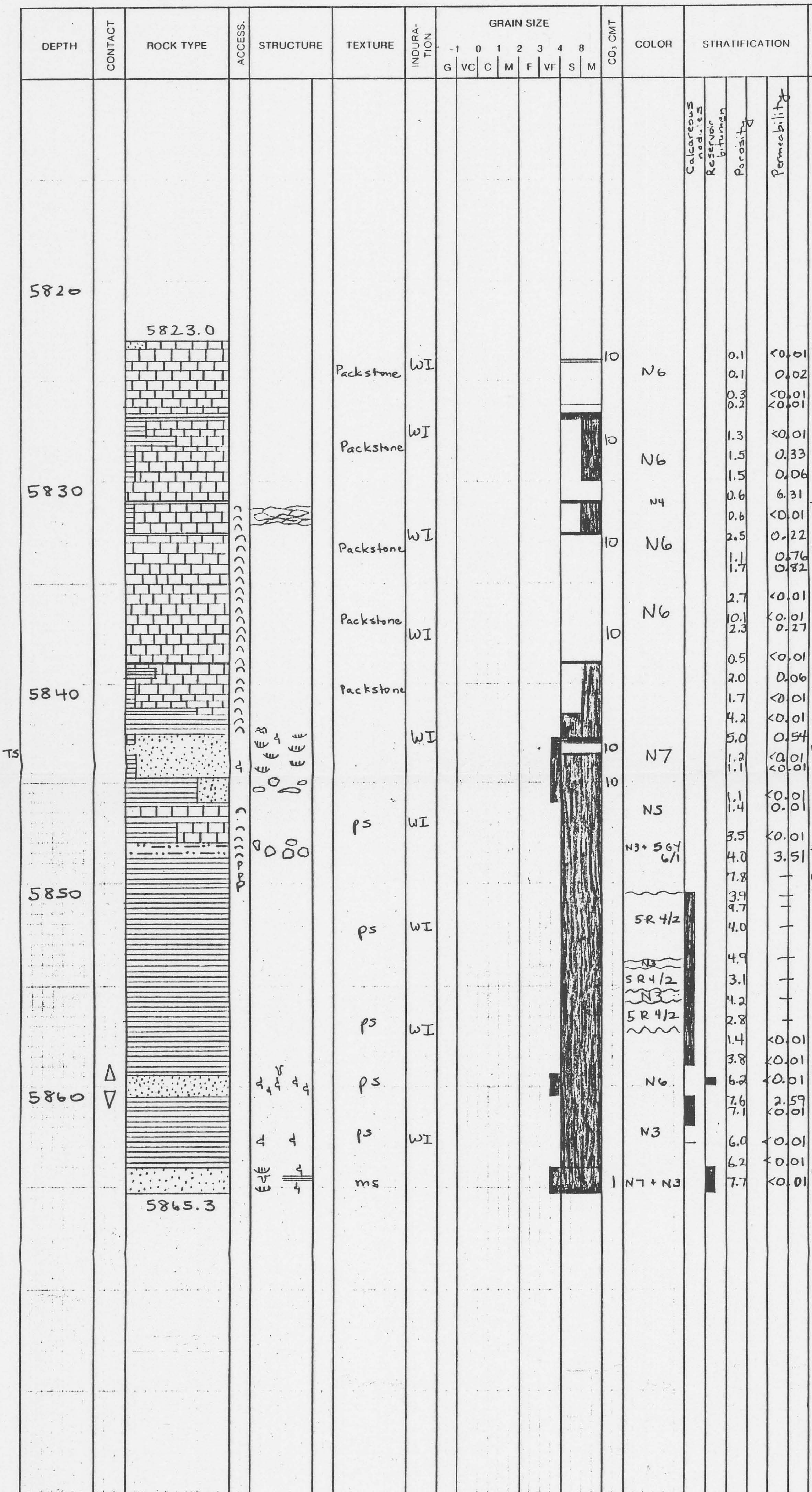
WELL ARKLA EXPLORATION T.P. SCOTT No. 5 CORE DEPTH ~~(+)~~ (-) 3.5 ft = GR LOG DEPTH @ 6172 ft
FORMATION Travis Peak COUNTY Harrison LOGGED BY S. Dutton DATE 5/86



Porosity	Permeability	COMMENTS
3.5	6.85	
4.0	1.98	
6.9	0.54	
3.2	1.10	
7.0	0.10	
7.2	6.36	
6.1	<0.01	
12.5	<0.01	
6.1	1.32	
6.0	0.06	
5.2	—	
7.9	<0.01	
5.7	4.28	Ripples + planar interbeds of mud and sand
5.8	—	
8.1	—	
9.2	8.29	
7.1	4.68	
11.6	—	
2.8	—	
6.3	2.18	
6.1	2.26	Can see faint planar laminae - very low energy structures
5.7	1.90	
5.1	0.92	
5.0	—	
7.3	3.18	Thin, contorted layers of sand or silt
7.0	5.33	
6.2	0.62	Contorted ss in mudstone
5.9	0.29	
		Abundant carbonate nodules
3.4	0.51	
5.0	9.33	
10.1	0.38	
4.6	1.62	
4.8	15.40	
7.7	0.87	
3.9	<0.01	
9.0	0.49	Burrows highlighted by dead oil
21.1	17.00	
4.9	<0.01	
9.4	0.45	Can't see sed. structures. May be burrowed
11.1	2.50	
15.4	51.90	Planar to slightly inclined laminae
14.1	15.90	
12.9	16.00	
16.1	—	
14.7	30.60	
7.5	0.21	Parallel, slightly inclined laminae
13.2	2.66	
5.7	0.17	Abundant clay drapes
10.8	0.27	Slightly inclined laminations
6.2	<0.01	Contorted sand + mud, nodules
7.0	—	
6.9	—	

WELL ARKLA EXPLORATION T. P. SCOTT No. 5 CORE DEPTH (+) (–) 2.5 ft = GR LOG DEPTH @ 5839 ft

FORMATION Travis Peak COUNTY Harrison LOGGED BY S. Dutton DATE 4/86



Porosity	Permeability	COMMENTS
0.1	<0.01	Sand in carbonate mud
0.1	0.02	
0.3	<0.01	
0.2	<0.01	Fossil fragments, esp. oysters, in carbonate mud
1.3	<0.01	
1.5	0.33	
1.5	0.06	
0.6	6.31	
0.6	<0.01	Terrigenous mud stringers between deformed carbonate boudins
2.5	0.22	Calcite-filled fracture
1.1	0.76	
1.7	0.82	
2.7	<0.01	Geopetal structure
10.1	<0.01	
2.3	0.27	
0.5	<0.01	
2.0	0.06	Fossil fragments in carbonate mud Stringers of clastic mud Gastropods, pelecypods, oysters
1.7	<0.01	
4.2	<0.01	
5.0	0.54	Rippled ss separated by mudstone
1.2	<0.01	
1.1	<0.01	
1.1	<0.01	Slumped pieces of clean ss (with fossils) in mudstone
1.4	0.01	
3.5	<0.01	
4.0	3.51	Siltstone slumped in organic-rich mud
7.8	—	Light gray halos around dark, organic-rich mud streaks
3.9	—	
9.7	—	
4.0	—	
4.9	—	
3.1	—	
4.2	—	
2.8	—	
1.4	<0.01	
3.8	<0.01	
6.2	<0.01	Root trace?
7.6	2.59	
7.1	<0.01	
6.0	<0.01	
6.2	<0.01	
7.7	<0.01	Low angle ripples to horizontal laminae