PRELIMINARY GEOLOGIC DESCRIPTION

MOBIL PRODUCING
G. E. CARGILL NO. 14

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Prepared by

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INTRODUCTION

Two intervals of the Travis Peak Formation were cored in the Mobil Producing Cargill No. 14 well, Waskom field, Harrison County, Texas. Core was recovered from 5,903.0 to 5,960.4 ft and from 6,148.0 to 6,297.1 ft. The top of the Travis Peak is at 5,901 ft (log depth), so the core begins close to the top of the formation.

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 Reservoirs, Inc. 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 fine to very fine sandstone, mudstone, and limestone. The two cored intervals are described below.

Sandstones in the lower core are interbedded with thick red and gray mudstones. The sandstones generally have sharp lower contacts and may have concentrations of carbonate nodules or ripped up mud clasts at the base. The most abundant sedimentary structures are planar to slightly inclined laminae and ripples; high-angle crossbedding is not common. The lack of abundant crossbeds suggests that either the current energy was moderate to low or water depth was shallow, or both. Burrowing increases in abundance in the sandstones higher in the cored interval. The thick, lowest sandstone (6,234 to 6,280 ft, core depth) is burrowed only at the top, whereas the middle sandstone (6,188 to 6,205 ft) is moderately burrowed throughout, and the upper sandstone (6,151 to 6,169 ft) is extensively burrowed at the top (fig. 1).

Mudstones in the lower cored interval commonly contain calcareous nodules. Pyrite and wood fragments occur in some of the gray mudstones, particularly at 6,210 ft. Root traces were observed in mottled gray and red mudstone from 6,169 to 6,175 ft (fig. 1).

Rocks of the lower core probably are alluvial or delta-plain deposits; there is no evidence of marine deposition in this interval. Sandstones represent small fluvial channels or crevasse splays deposited in the adjacent floodplain. Mudstones are relatively thick and probably were deposited in floodplain environments, including well-drained and poorly drained swamps. The gray color of some of the mudstones was probably caused by a high water table, abundant organic matter, and reducing fluids that moved through the overlying sandstones.

Sandstones in the upper cored interval are thinner than those in the lower zone; they generally have sharp bases and fine upward. Ripples, planar to slightly inclined laminae, contorted beds, and crossbeds are the most common sedimentary structures. Thin sandstones and the tops of thicker sandstones are commonly burrowed. Thinly interbedded sandstone or siltstone with mudstone is common (for example, 5,930 to 5,937 ft) between the thicker sandstones. Mudstones at 5,957 ft to 5,959 ft contain abundant carbonate. Oyster shell fragments occur in zones near the top and bottom of the core (fig. 1).

The upper core interval is interpreted as having been deposited in a marginal marine position, such as a tidal flat. The thicker, sharp-based sandstones are probably tidal channels that cut interbedded sandstone and mudstone of the mixed tidal flat. The presence of oysters provides additional evidence for a marine to brackish water depositional environment.

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. Most silt is coarse silt, between 0.031 and 0.063 mm, and clay particles are smaller than 0.004 mm. Texturally, the samples are classified as sandstone, silty sandstone, muddy sandstone, sandy mudstone, and sandy claystone (table 1).

Mineral Composition

Twenty-two thin sections have been point counted for a preliminary description of mineral composition (table 2). The sandstones are mineralogically very mature and are classified as quartzarenite or subarkose. Quartz comprises 91% 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 9.0%. Rock fragments, mainly low-rank metamorphic rock fragments, constitute between 0% and 1.5% of the framework grains.

Authigenic cements constitute between 0.5% and 26.5% of the sandstone volume in these five samples (table 2). Authigenic quartz, illite, chlorite, kaolinite, dolomite, ankerite, anhydrite, and reservoir bitumen have all been observed in Mobil Cargill No. 14 thin sections.

Authigenic illite and chlorite occur as pore-filling cements in secondary pores that formed by the dissolution of feldspars (fig. 2). These cements formed relatively late in the burial history of the Travis Peak. Kaolinite cement was observed in primary pores in the Mobil Cargill No. 14 samples. Petrographic evidence is equivocal, but the kaolinite appears to have precipitated at about the same time or somewhat after the quartz overgrowths.

Quartz cement (fig. 3) is the most abundant authigenic mineral in the Mobil Cargill No. 14 cores. Quartz overgrowths fill as much as 18.5% of the sandstone volume (table 2), and precipitation of authigenic quartz occluded much of the primary porosity. However, compared with other parts of the Travis Peak, the volume of quartz overgrowths in the Mobil Cargill No. 14 samples is relatively low, and significant primary porosity has been retained. The sandstone at 5,946 to 5,956 ft has porosity as high as 19% and permeability as high as 332 md (fig. 1). Primary porosity in a sample from 5,953.0 ft can easily be seen in SEM (fig. 4); the volume of quartz overgrowths in this sample is only 12%.

Dolomite and ankerite (fig. 5) both occur in the Mobil Cargill No. 14 cores. Ankerite cement has a maximum volume of 8.5% in the sample from

5,932.2 ft, and it could cause completion problems (formation of an iron-hydroxide gel) if it is treated with acid.

Minor amounts of late anhydrite cement were observed in the sample from 5,948.5 ft. The anhydrite was not intersected on the point-count traverse, and therefore it probably has a total volume of less than 0.5%. The anhydrite cement is a late, diagenetic feature and did not precipitate in the depositional environment.

Reservoir bitumen (solid hydrocarbons) occurs in both the upper and lower cores (fig. 1). Where it is abundant, reservoir bitumen fills primary and secondary porosity. Petrographic evidence suggests it entered the sandstones after precipitation of quartz overgrowths and ankerite. Preliminary studies of the reservoir bitumen show it occurs mainly in the upper Travis Peak (Dutton, 1985). Geochemical data indicate it formed by deasphalting of pooled oil after solution of gas into the oil (Rogers and others, 1974).

Porosity

Porosity observed in thin section varies from 0.5% to 14.5% (table 2). Both primary and secondary pores are present (fig. 5). 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. 2); 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 Mobil Cargill No. 14.

Depth (ft)	Mean (mm)	Sand (%)	Silt (%)	Detrital clay (%)	Authigenic clay (%)	Textural class
5908.0	.075	28.8	17.7	53.5	0	Sandy mudstone
5921.9	.100	85.6	7.4	5.0	2.0	Silty sandstone
5923.8	.157	95.5	0	0.5	4.0	Sandstone
5932.2	.091	41.1	19.4	39.5	0	Sandy claystone
5940.5	.092	67.2	14.8	13.5	4.5	Muddy sandstone
5948.5	.150	95.5	2.0	0	2.5	Sandstone
5949.3	.199	96.0	0	0	4.0	Sandstone
5952.0	.219	99.5	0	0	0.5	Sandstone
6156.0	.160	95.0	0	0	5.0	Sandstone
6162.0	.157	95.5	0	1.0	3.5	Sandstone
6165.1	.124	85.9	3.6	0	10.5	Sandstone
6181.0	.050	12.9	36.6	50.5	0	Sandy mudstone
6192.0	.116	95.5	0	3.5	1.0	Sandstone
6200.8	.099	78.5	15.0	0	6.5	Silty sandstone
6202.5	.176	98.0	0	0	2.0	Sandstone
6217.0	.053	10.3	32.7	57.0	0	Sandy mudstone
6244.0	.179	100.0	0	0	0	Sandstone
6245.0	.121	97.5	2.0	0	0.5	Sandstone
6253.0	.198	100.0	0	0	0	Sandstone
6268.0	.171	99.0	0	0	1.0	Sandstone
6273.3	.099	86.4	9.6	0	4.0	Sandstone
6290.6	.064	29.5	37.5	33.0	0	Sandy mudstone

Table 2. Petrographic analyses of Mobil Cargill No. 14.

	Framework grains								Matrix
Depth (ft)	Quartz	Plagioclase	Orthoclase	MRF	Chert	Clay clasts	Mica	Other	Clay-sized fines
5908.0	35.5	2.0	1.0	0.5	0	0	2.0	0.5[1]	53.5
5921.9	66.0	2.5	0	0	0	5.5	0	0.5[2]	5.0
5923.8	60.0	1.5	1.0	0	0	6.0	0	0	0.5
5932.2	45.5	0.5	0	0	0	0.5	0	0	39.5
5940.5	71.5	1.0	0.5	0	0.5	2.5	0	0	13.5
5948.5	65.5	0	0	0.5	0	1.5	0	0	0
5949.3	67.5	1.0	0	0	0.5	3.0	0	0	0
5952.0	68.5	0	0	0.5	0	2.5	0	0	0
6156.0	75.5	1.0	0	0	0	1.5	0	0	0
6162.0	73.5	2.5	0.5	0	0	2.0	0	0	1.0
6165.1	64.5	1.0	0	0.5	0	0	0	0	0
6181.0	46.0	0	0	0	0	2.0	1.0	0	50.5
6192.0	75.5	1.0	0	0	0	5.0	0	0	3.5
6200.8	69.0	0.5	0.5	0.5	0	1.0	0.5	0	0
6202.5	74.0	0	0	0	0	10.0	0	0	0
6217.0	35.0	0.5	0	0	0	6.5	0	0	57.0
6244.0	72.0	3.5	1.5	0	0	3.5	0.5	0.5[1]	0
6245.0	66.0	4.0	2.5	0	0	1.5	0.5	0	0
6253.0	75.5	2.0	3.0	0.5	0.5	3.0	0	0	0
6268.0	63.0	0	1.0	0	0	9.5	0	0	0
6273.3	68.5	2.5	0	0	0	4.5	0	0	0
6290.6	56.5	0.5	1.0	0	0	0	0	0	33.0

[1] Zircon
[2] Tourmaline

Table 2 (cont.)

Depth (ft)	Cements							Porosity	
	Quartz	Dolomite	Ankerite	Illite	Chlorite	Kaolinite	Reservoir bitumen	Primary	Secondary
5908.0	0	1.5	3.5	0	0	0	0	0	0
5921.9	10.5	1.0	4.0	2.0	0	0	0	2.0	1.0
5923.8	12.0	0.5	4.5	4.0	0	0	0	3.5	6.5
5932.2	0	4.0	8.5	0	0	0	1.5	0	0
5940.5	5.0	0.5	0	0	4.5	0	0	0.5	0
5948.5	14.0	0.5	3.0	1.5	0	1.0	0	7.0	5.5
5949.3	10.0	0	4.5	4.0	0	0	0	2.5	7.0
5952.0	12.0	0	1.5	0.5	0	0	0	3.5	11.0
6156.0	10.5	0	0	5.0	0	0	0	4.0	2.5
6162.0	15.0	0	0	3.5	0	0	0	1.0	1.0
6165.1	16.0	0	0	8.5	2.0	0	0	3.5	4.0
6181.0	0	0.5	0	0	0	0	0	0	0
6192.0	8.5	2.0	3.0	1.0	0	0	0	0	0.5
6200.8	15.0	0	1.0	4.5	2.0	0	0	3.0	2.5
6202.5	11.0	0.5	0.5	0	2.0	0	0	1.5	0.5
6217.0	0	0	1.0	0	0	0	0	0	0
6244.0	11.0	0.5	1.0	0	0	0	0	2.5	3.5
6245.0	16.5	0.5	0	0	0	0.5	0	3.5	4.5
6253.0	7.5	0	3.0	0	0	0	0	1.5	3.5
6268.0	18.5	0	3.0	0	1.0	0	0	0.5	3.5
6273.3	13.5	1.0	5.0	2.5	1.5	0	0	0.5	0
6290.6	0	3.0	6.0	0	0	0	0	0	0

[1] Zircon

[2] Tourmaline

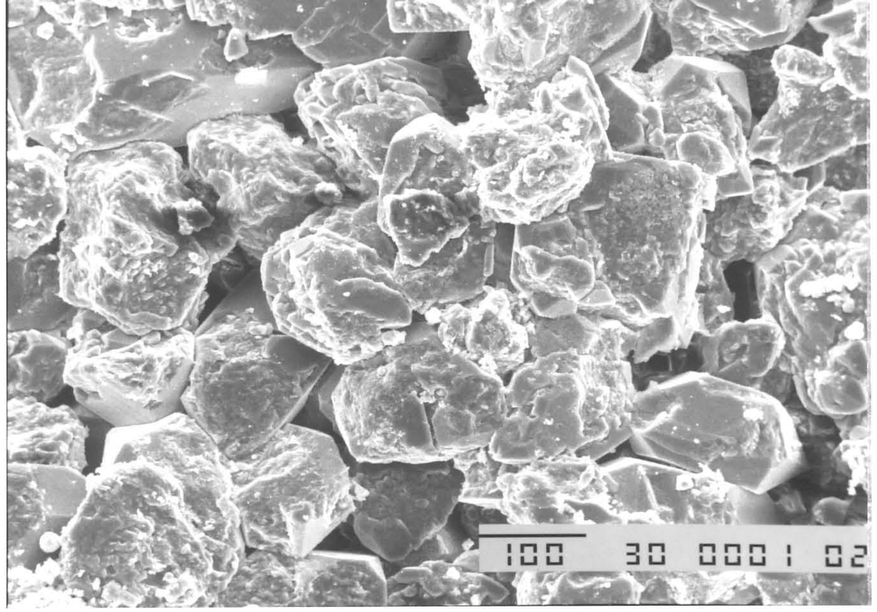
REFERENCES

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.

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 Petroelum Geologists, v. 58, no. 9, p. 1806-1824.

FIGURE CAPTION

Figure 1. Descriptive log of core of the Travis Peak Formation from the Mobil Cargill No. 14 well, Harrison County, Texas. Core depths are 5,903.3 to 5,960.4 ft and 6,148.0 to 6,297.1 ft.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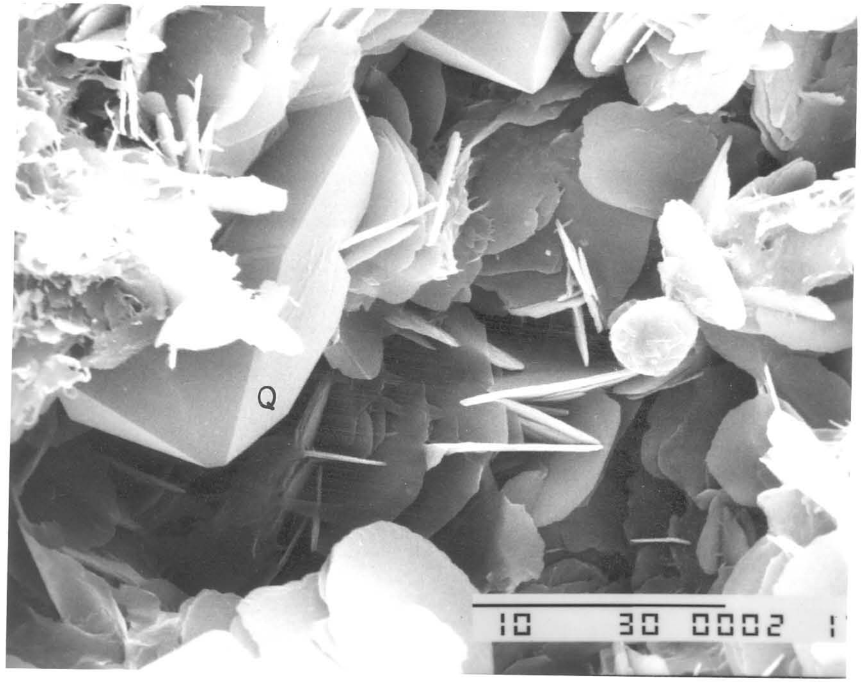
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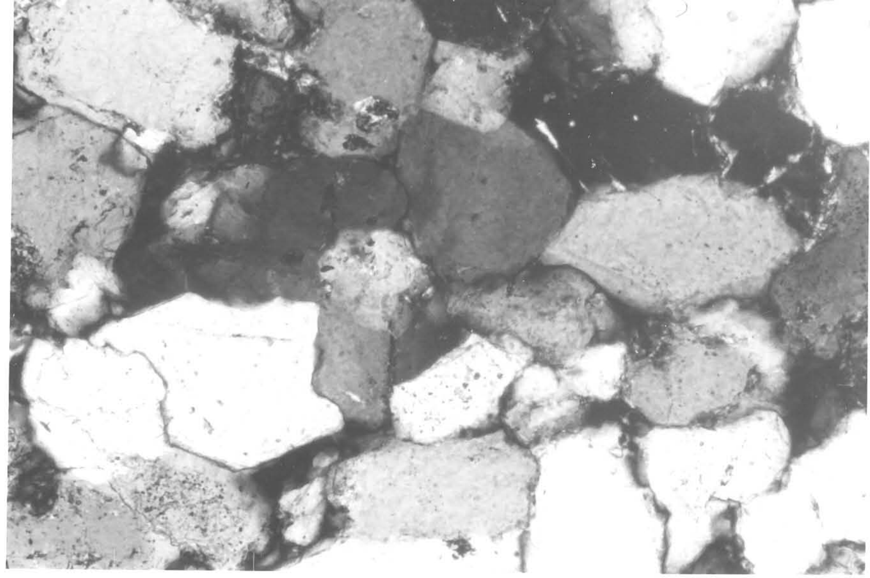

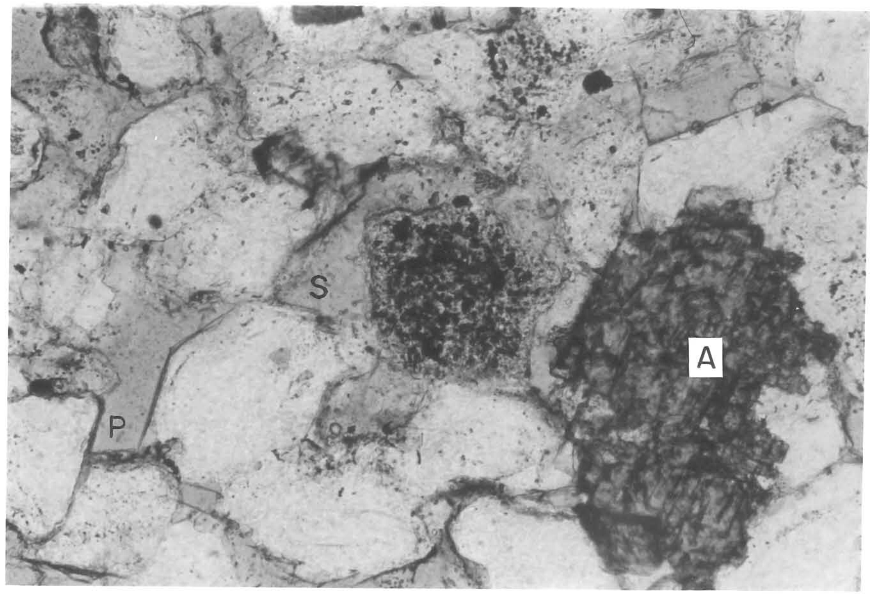
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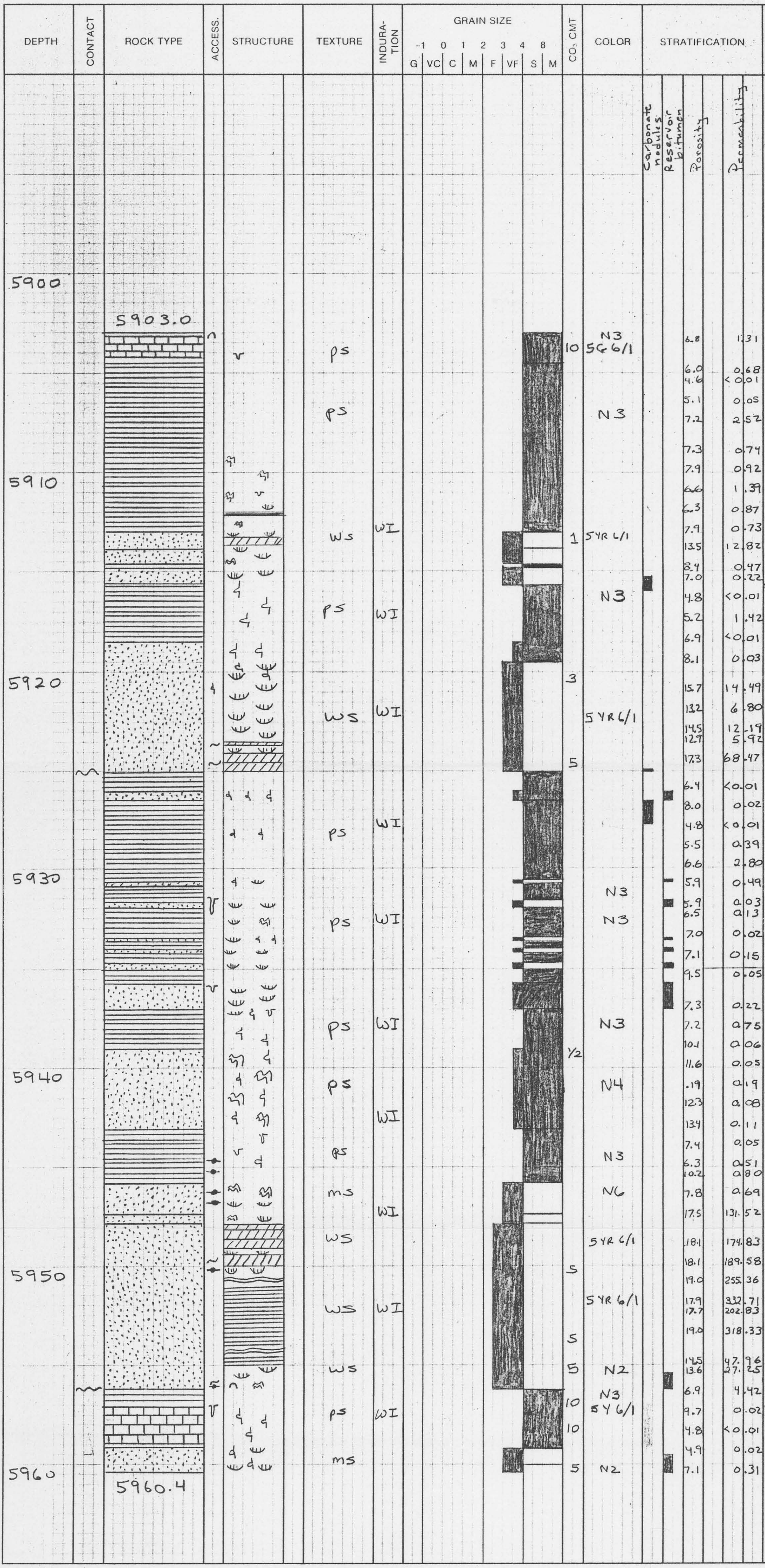
WELL Mobil Producing Cargill No. 14 CORE DEPTH (+) 8 ft = GR LOG DEPTH @ 5933 ft

FORMATION Travis Peak COUNTY Harrison LOGGED BY S. Dutton DATE 8/86



Porosity	Permeability	COMMENTS
6.8	1.31	Oyster shells in mud Terrigenous silt and mud in carbonate
6.0	0.68	
4.6	<0.01	
5.1	0.05	
7.2	2.52	
7.3	0.74	
7.9	0.92	
6.6	1.39	Slumped, rippled layers of silt within mudstone
6.3	0.87	
7.9	0.73	
13.5	12.82	
8.4	0.47	
7.0	0.22	Carb. nodules at base of ss
4.8	<0.01	
5.2	1.42	
6.9	<0.01	
8.1	0.03	
15.7	14.49	
13.2	6.80	
14.5	12.19	
12.9	5.92	
17.3	68.47	Nodules at base of sand
6.4	<0.01	
8.0	0.02	
4.8	<0.01	
5.5	0.39	
6.6	2.80	
5.9	0.49	
5.9	0.03	
6.5	0.13	Thin rippled, slumped siltstones in mudstone
7.0	0.02	
7.1	0.15	
9.5	0.05	Clay drapes on ripple faces
7.3	0.22	Rippled siltstones interbedded with mud
7.2	0.75	
10.1	0.06	
11.6	0.05	Sandstone + siltstone contorted into mudstone
.19	0.19	Pinched off pieces of ss in mudstone
12.3	0.08	
13.4	0.11	Muddy ss to sandy mudstone
7.4	0.05	
6.3	0.51	
10.2	0.80	
7.8	0.69	
17.5	131.52	Tan color, because of oil stain (?)
18.1	174.83	
18.1	189.58	
19.0	255.36	Odd sed. structures. May be slightly contorted ripples or inclined laminae
17.9	332.71	
17.7	202.83	
19.0	318.33	
14.5	47.96	
13.6	27.25	
6.9	4.42	Oyster shells at base of ss
9.7	0.02	Long vertical root trace or filled mud crack
4.8	<0.01	Carbonate with with some terr. silt + mud
4.9	0.02	
7.1	0.31	

WELL Mobil Cargill No. 14 CORE DEPTH (+)(-) 9 ft = GR LOG DEPTH @ 6214 ft

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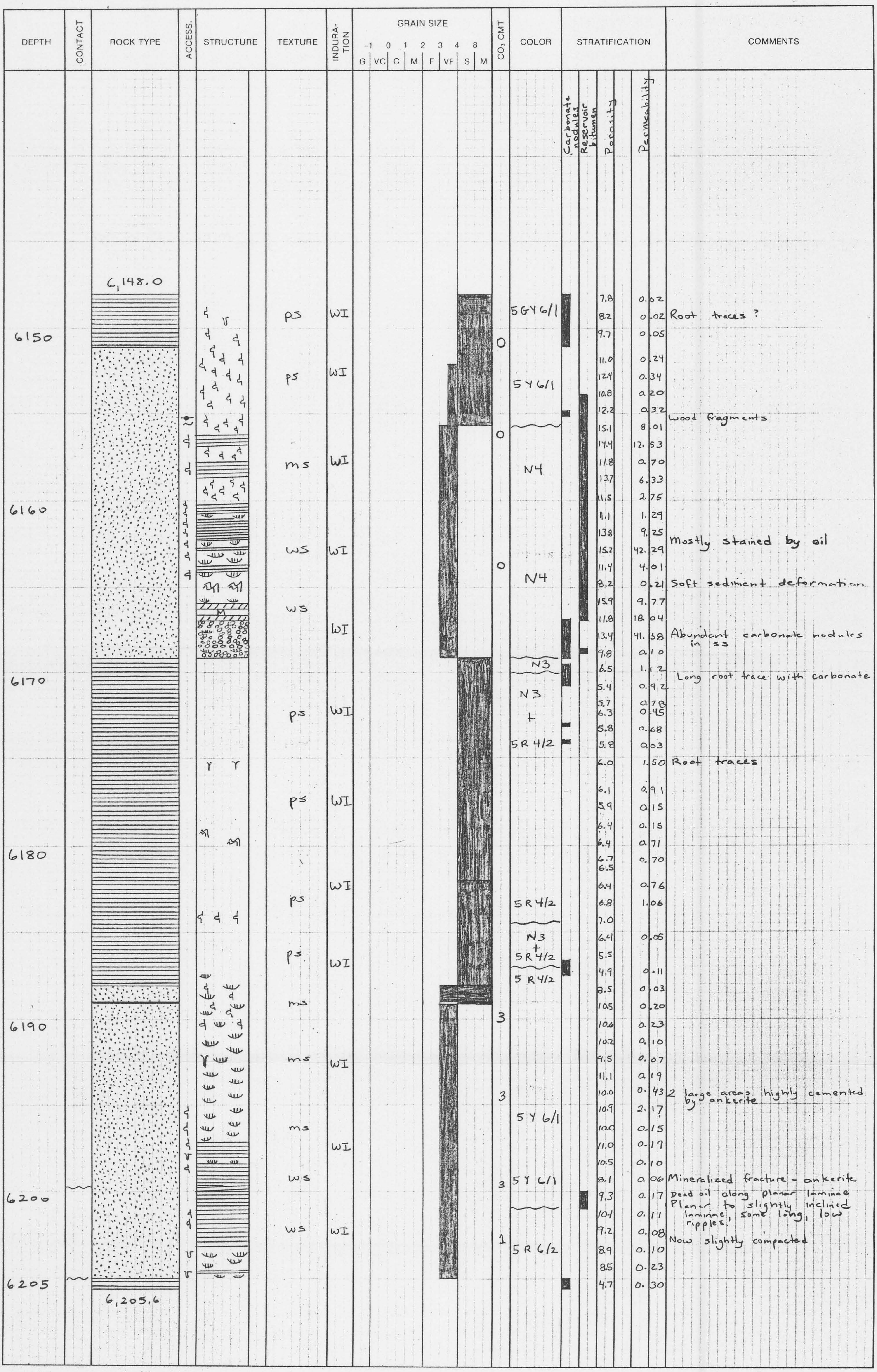
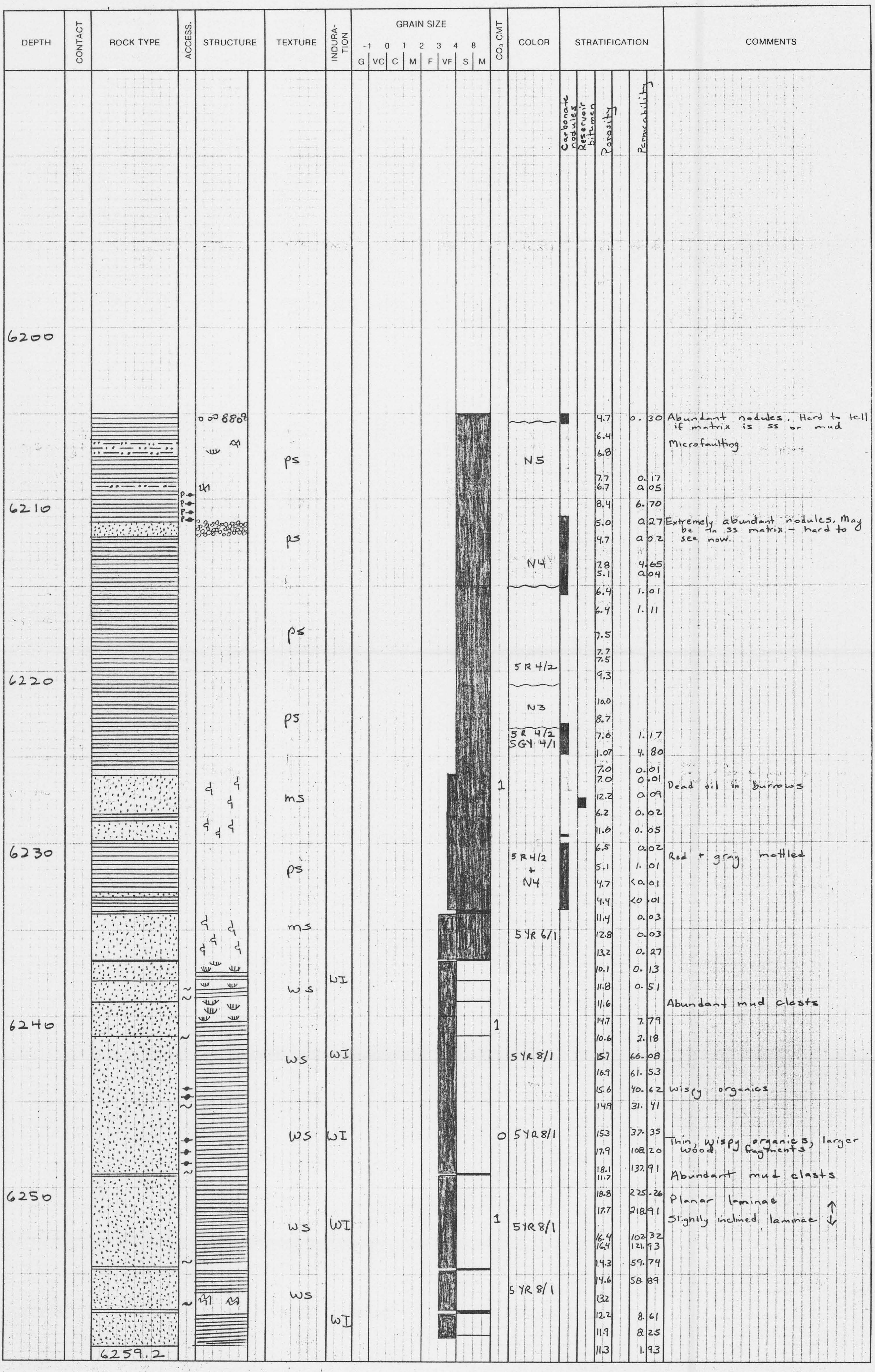


Porosity	Permeability	COMMENTS
7.8	0.02	
8.2	0.02	Root traces ?
9.7	0.05	
11.0	0.24	
12.4	0.34	
10.8	0.20	
12.2	0.32	Wood fragments
15.1	8.01	
14.4	12.53	
11.8	0.70	
13.7	6.33	
11.5	2.75	
11.1	1.29	
13.8	9.25	Mostly stained by oil
15.2	42.29	
11.4	4.01	
8.2	0.21	Soft sediment deformation
15.9	9.77	
11.8	18.04	
13.4	41.58	Abundant carbonate nodules in ss
9.8	0.10	
6.5	1.12	Long root trace with carbonate
5.4	0.92	
5.7	0.78	
6.3	0.45	
5.8	0.68	
5.8	0.03	
6.0	1.50	Root traces
6.1	0.91	
5.9	0.15	
6.4	0.15	
6.4	0.71	
6.7	0.70	
6.5		
6.4	0.76	
6.8	1.06	
7.0		
6.4	0.05	
5.5		
4.9	0.11	
8.5	0.03	
10.5	0.20	
10.6	0.23	
10.2	0.10	
9.5	0.07	
11.1	0.19	
10.0	0.43	2 large areas highly cemented by ankerite
10.9	2.17	
10.0	0.15	
11.0	0.19	
10.5	0.10	
8.1	0.06	Mineralized fracture - ankerite
9.3	0.17	Dead oil along planar laminae Planar to slightly inclined laminae, some long, low ripples.
10.1	0.11	
9.2	0.08	Now slightly compacted
8.9	0.10	
8.5	0.23	
4.7	0.30	

WELL Mobil Producing G.E. Cargill No. 14 CORE DEPTH (+) (-) 12 ft = GR LOG DEPTH @ 6269 ft

FORMATION Travis Peak COUNTY Harrison LOGGED BY S. Dutton DATE 8/86



Porosity	Permeability
4.7	0.30
6.4	
6.8	
7.7	0.17
6.7	0.05
8.4	6.70
5.0	0.27
4.7	0.02
7.8	4.65
5.1	0.04
6.4	1.01
6.4	1.11
7.5	
7.7	
7.5	
9.3	
10.0	
8.7	
7.6	1.17
1.07	4.80
7.0	0.01
7.0	0.01
12.2	0.09
6.2	0.02
11.6	0.05
6.5	0.02
5.1	1.01
4.7	<0.01
4.4	<0.01
11.4	0.03
12.8	0.03
13.2	0.27
10.1	0.13
11.8	0.51
11.6	
14.7	7.79
10.6	2.18
15.7	66.08
16.9	61.53
15.6	40.62
14.9	31.41
15.3	37.35
17.9	108.20
18.1	137.91
11.7	
18.8	225.26
17.7	218.91
16.4	102.32
16.4	121.93
14.3	59.74
14.6	58.89
13.2	
12.2	8.61
11.9	8.25
11.3	1.93

Abundant nodules. Hard to tell if matrix is ss or mud

Microfaulting

Extremely abundant nodules. May be in ss matrix - hard to see now.

Dead oil in burrows

Red + gray mottled

Abundant mud clasts

Wispy organics

Thin, wispy organics, larger wood fragments

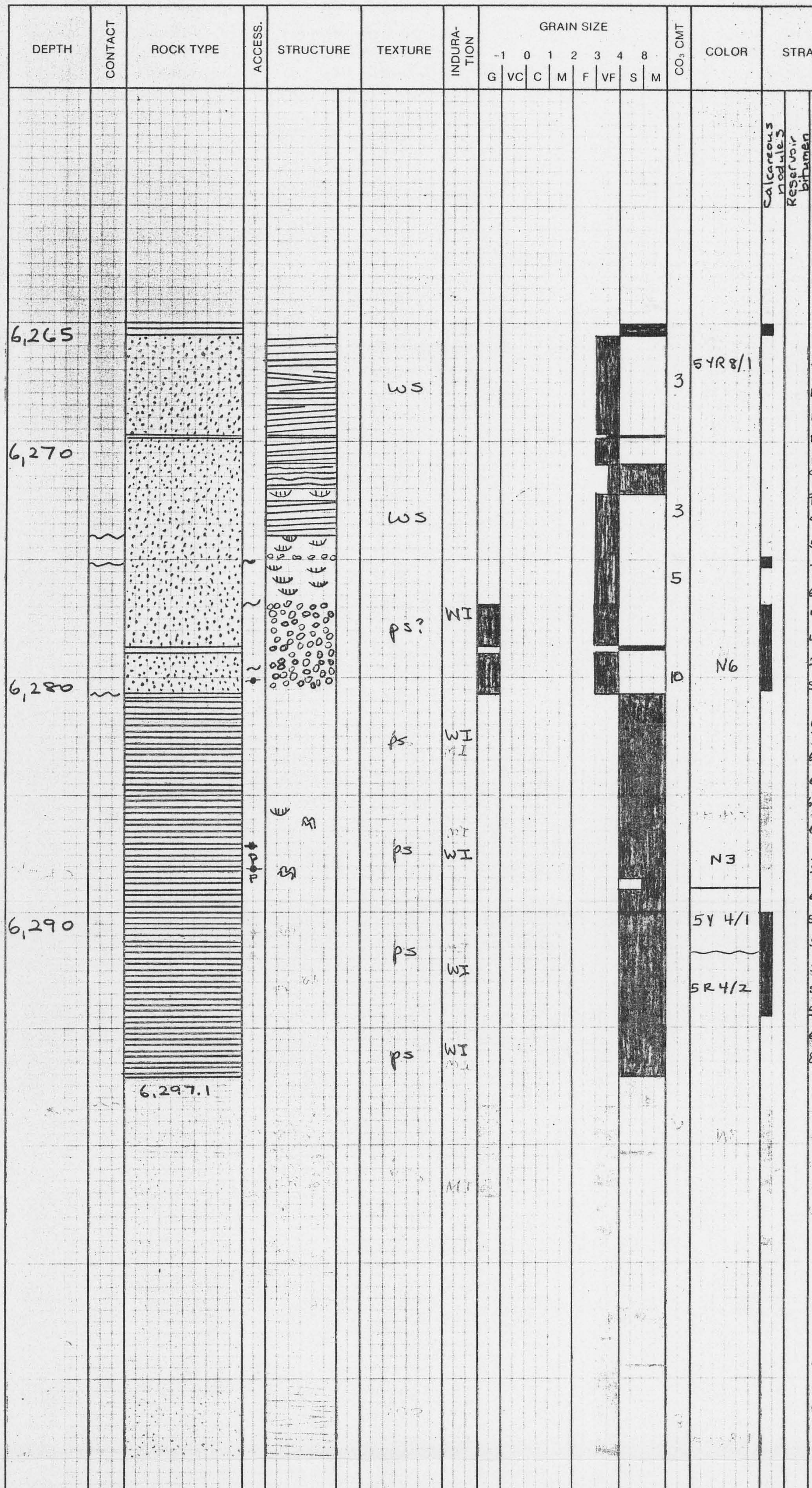
Abundant mud clasts

Planar laminae ↑

Slightly inclined laminae ↓

WELL Mobil Producing Cargill No. 14 CORE DEPTH (+) ~~-~~ 10 ft = GR LOG DEPTH @ 6290 ft+

FORMATION Travis Peak COUNTY Harrison LOGGED BY S. Dutton DATE 8/86



Porosity	Permeability	COMMENTS
11.3	1.93	Red nodules
13.4	4.62	Bidirectional ?? Bidirectional x-bed
14.0	15.26	
13.2	6.01	Parallel to slightly inclined laminae
12.0	3.31	
11.1	1.56	
9.9	0.09	Interbedded mud + ss, mm to cm laminae
9.5	0.14	Inclined bedding
9.6	0.16	
5.3	0.03	
7.7	0.16	Clay drapes on ripple faces
6.7	0.15	Large mud clasts
4.1	0.01	
4.0	0.02	Carbonate nodules in ss matrix. May be diagenetic
2.7	0.01	
5.4	0.38	
6.9		
7.3		
6.2		
6.7	0.82	
6.4		
6.4		Abundant pyrite, organic matter
7.8		
7.9		
6.0	0.40	
5.2	0.08	
5.5	0.91	Carb. nodules increase in abundance ↑
5.7		Occasional green reduction spots
5.7		
5.7		
6.5	3.18	
8.3		

EXPLANATION OF SYMBOLS

CONTACT

Gradational G

Upward fining

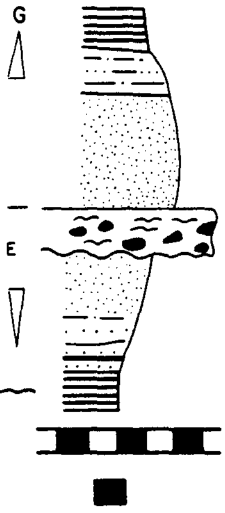
Planar

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

TRAVIS PEAK CORE

Abbreviations from Geological Society of America Rock-Color Chart used on core descriptions.

HUE N

N8	very light gray
N7	light gray
N6	medium light gray
N5	medium gray
N4	medium dark gray
N3	dark gray

HUE YR

5YR 8/1	pinkish gray
5YR 7/2	grayish orange pink
5YR 6/1	light brownish gray
5YR 5/2	pale brown
5YR 4/1	brownish gray
10YR 6/2	pale yellowish brown

HUE Y

5Y 8/1	yellowish gray
5Y 6/1	light olive gray
5Y 5/2	light olive gray
5Y 4/1	olive gray
5Y 3/2	olive gray

HUE G

5G 6/1	greenish gray
5G 4/1	dark greenish gray
5G 2/1	greenish black

HUE R

5R 6/2	pale red
5R 4/2	grayish red
5R 2/2	blackish red
10R 6/2	pale red

HUE GY

5GY 6/1	greenish gray
5GY 4/1	dark greenish gray
5GY 2/1	greenish black

FIGURE 2.

SEM photograph of authigenic chlorite plates and quartz overgrowth (Q). Depth is 6,162.7 ft. Bar length is 10 μm; magnification is 3500X.

FIGURE 3.

Photomicrograph of subarkose from a depth of 6,245.0 ft. Primary pores have been completely occluded by interlocking quartz cement. Long dimension of photo = 2.6 mm; crossed-polarized light.

FIGURE 4.

SEM photograph of euhedral quartz overgrowths and primary porosity. Depth is 5,953.0 ft. Bar length is 100 μm; magnification is 150X.

FIGURE 5.

Photomicrograph of a large mass of ankerite cement (A). Primary (P) and secondary (S) pores are common. Depth is 5,948.5 ft. Long dimension of photo is 2.6 mm; plane-polarized light.