PRELIMINARY GEOLOGIC DESCRIPTION

MARSHALL EXPLORATION
WERNER SAWMILL NO. 5

March, 1986

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

Prepared for

The Gas Research Institute
Contract No. 5082-211-0708
Robert J. Finley - Principal Investigator

INTRODUCTION

Three intervals of the Travis Peak Formation were cored in the Marshall Exploration Werner Sawmill No. 5 well, Belle Bower field, Panola County, Texas. Core was recovered from 6,546.0 to 6.642.7 ft, 6,853.0 to 6,912.3 ft, and 7,049.0 to 7,141.1 ft. The top of the Travis Peak is at 6,478 ft so the core begins about 68 ft below the contact with the Sligo 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 in = 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 dead oil 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 fine to very fine sandstone, mudstone, and minor limestone. Each of the three cored intervals show distinctive characteristics that indicate changing environments during deposition of the upper Travis Peak interval. Each of the cored intervals is described below.

The lowest section of core, from 7,049.0 to 7,141.1 ft, consists predominantly of muddy sandstone beds that are up to 15 ft thick, interbedded with thin red mudstone beds up to 4 ft thick. The sandstones in this section of the

Travis Peak core contain evidence that they were deposited in relatively low-energy environments, with ripple crossbedding (including climbing ripples) and interbedded horizontal laminations of sandstone and mudstone the most common sedimentary structures. Soft-sediment deformation and microfaulting occur where sandstones overlie mudstones. Vertical and horizontal burrows are common in the sandstones, and root traces were identified in one zone (fig. 1). Fluid escape structures occur near the top of this lowest cored interval. Most of the mudstones are red, and disseminated clays impart a light red color to many of the sandstones.

This lowest section of core from the Werner Sawmill No. 5 well is interpreted as having been deposited in a fluvial environment, probably in a low-energy floodplain that was occasionally inundated by overbank deposits. The cores probably do not contain any main channel sandstones. The preservation of abundant floodplain deposits suggests that this was a mixed-load fluvial system.

The middle cored interval (6,853.0 to 6,912.3 ft) contains red mudstones up to 14 ft thick interbedded with fine to very fine grained sandstones. The main sandstone in this interval (6,889.0 to 6,998.5 ft; fig. 1) is interpreted to be 10-ft thick on the basis of the gamma log; only 9.5 ft were recovered in the core. This well-sorted sandstone contains mainly high-energy sedimentary structures - crossbedding and planar to slightly inclined laminations. The base of the sandstone consists of crossbedding in opposite directions. There are three upward-fining zones within the sandstone, each of which contains large-scale crossbedding at the base and small ripple crossbeds at the top. The other sandstones in this cored interval are thinner and contain ripples, soft-sediment deformation features, and abundant burrows (fig. 1). Calcareous nodules occur in some of the sandier intervals in the mudstones.

The middle section of core is also interpreted as having been deposited in a mixed-load fluvial environment. The thick sandstone at 6,889 to 6,898.5 ft probably was deposited in a main channel, and the rest of the core represents floodplain and crevasse-splay deposits. There is evidence from the SP log that the channel sandstone fines upwards, although the top of the sandstone was not recovered.

The upper section of core (6,642.7 to 6,546.0) appears distinctly different than the lower zones (fig. 1). Most of the sandstones and mudstones are gray, although a few red mudstones persist up to a depth of 6,584 ft. The sandstones commonly contain reservoir bitumen, and calcareous nodules are abundant in both sandstones and mudstones. Pyrite and coalified wood fragments are common in intervals of interbedded mudstone and sandstone that have been contorted by soft-sediment deformation. Two well-sorted sandstones occur in this interval, at 6,626.5 to 6,633.5 ft and 6,597 to 6,605 ft (fig. 1). Both sandstones contain several cycles of upward-decreasing scale of sedimentary structures, generally crossbeds or planar laminae to ripples, and some cycles are capped by thin mudstone drapes. Soft-sediment deformation and microfaulting of interbedded sandstone and mudstone are present at the top of both sandstones.

At the top of the upper cored interval are several limestones interbedded with terrigenous mudstones. These mollusk biosparites are evidence that the upper Travis Peak sediments were increasingly influenced by the marine transgression that finally resulted in deposition of the Sligo carbonate section. The sandstones in the upper cored interval also appear to have been deposited in a marine-influenced environment and may represent progradation into a marine embayment. The presence of red mudstones above the 6,600-ft sandstone suggests that continued clastic progradation filled the shallow embayment, and the mudstones were deposited in a subaerially exposed environment such as a tidal flat.

PETROGRAPHIC DESCRIPTION

Detailed study of the core is being conducted with a scanning electron microscope (SEM) and petrographic microscope.

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 .063 and .25 mm. Most silt is coarse silt, between .031 and .062 mm. Clay particles are smaller than .004 mm. The four deepest samples (Table 1) are well-sorted, matrix-free sandstones, but the shallowest sample contains abundant silt and detrital clay and is classified as a sandy mudstone. The presence of detrital clay in the sample from 6,565.6 ft is probably a result of burrowing and clay settling out of suspension on ripple faces.

Mineral Composition

Five thin sections have been point counted for a preliminary description of mineral composition (Table 2). The sandstones are mineralogically mature and are classified as quartz arenites and subarkoses, with quartz comprising

Table 1. **Grain-size distribution in Marshall Werner Sawmill No. 5 core**

Depth (ft)	Mean (mm)	Sand (%)	Silt (%)	Detrital Clay (%)	Authigenic Clay (%)	Textural Class*
6,565.6	.062	34.1	43.4	22.5	0	Sandy mudstone
6,600.7	.169	98.5	0	0	1.5	Sandstone
6,632.7	.111	94.1	1.9	0	4.0	Sandstone
6,893.2	.149	96.5	0	0	3.5	Sandstone
7,068.7	.121	94.6	1.9	0	3.5	Sandstone

*Textural class determined only by detrital grains.

90% to 98% of the essential framework constituents (quartz, feldspar, rock fragments). Plagioclase feldspar is more abundant than orthoclase, and total feldspar volume varies from 2.3% to 7.6%. Rock fragments, mainly chert and low-rank metamorphic rock fragments, constitute between 0% and 4.3% of the framework grains.

Authigenic cements constitute between 11% and 29% of the sandstone volume in these five samples (Table 2). Illite occurs as rims of tangentially-oriented crystals around detrital grains, and illite and chlorite both occur as pore-filling cements in secondary pores that formed by the dissolution of feldspars. Authigenic illite and chlorite have a combined volume of 0% to 4%.

Quartz cement is the most abundant authigenic mineral in the Marshall Werner Sawmill No. 5 cores. Quartz overgrowths fill 3% to 18% of the volume, and precipitation of authigenic quartz occluded much of the primary porosity (fig. 2). The sample from 6,565.6 ft has the lowest amount of quartz cement because of the abundant detrital matrix (Table 2).

Dolomite and ankerite are present in all the samples and have a combined volume of 2% to 12%. Both dolomite and ankerite occur mainly as rhombs, and it is common for the crystals to be dolomite in the center and ankerite around the edges. Ankerite is particularly abundant in the samples from 6,632.7 and 6,893.2 ft (fig. 3) and could cause completion problems (formation of an iron hydroxide gel) if it is treated with acid.

Solid organic matter (also known as reservoir bitumen or "dead oil"), which is common in the sandstones in the upper cored interval, has a volume of 5.5% in the thin section from 6,565.6 ft (Table 2). It fills primary porosity and entered the sandstones after the precipitation quartz overgrowths. Preliminary studies of the reservoir bitumen suggest it occurs mainly in the upper

Table 2. Petrographic analyses of Marshall Werner Sawmill No. 5 core, measured in percent.

	Depth = 6,565.6 ft	6,600.7 ft	6,632.7 ft	6,893.2 ft	7,068.7 ft
Framework Grains					
Quartz	63.5	69.0	67.0	60.5	63.5
Plagioclase	1.5	2.5	2.0	4.0	2.0
Orthoclase	0	0	0	1.0	2.0
MRF*	0	0	0.5	0	2.0
Chert	0	0	0	0.5	1.0
Clay clasts	1.5	1.5	3.5	0	1.0
Heavy minerals	0	0	0	0	0
Other	0.5	0	0	0	0
Matrix					
Clay-sized fines	22.5	0	0	0	0
Cements					
Quartz	3.0	12.5	10.5	11.0	18.0
Dolomite	0.5	0	1.0	3.5	1.5
Ankerite	1.5	1.5	10.5	8.0	5.5
Authigenic clay	0	1.5	4.0	3.5	3.5
Pyrite	0	0.5	1.0	0	0
Solid organic matter	5.5	0	0	0	0
Porosity					
Primary porosity	0	2.0	0	0	0
Secondary porosity	0	9.0	0	8.0	0
Porosimeter porosity	no data	11.7	2.9	7.9	4.8

*Metamorphic rock fragments

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 five samples varies from 0% to 11% (fig. 3). Both primary and secondary pores are present, but secondary pores are much more abundant, particularly in the samples from 6,600.7 and 6,893.2 ft (Table 2). Secondary pores are formed by the dissolution of framework grains, so they are approximately the same size as detrital grains (fig. 4). However, they commonly contain authigenic clays and fragments of dissolved framework grains, particularly feldspar. Primary pores are elongated slits that remain open between quartz overgrowths and other authigenic cements. Finally, microporosity occurs in detrital and authigenic clays; such porosity generally cannot be seen in thin section, but it can be observed by SEM and is measured by a porosimeter.

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 Petroleum Geologists Bulletin: v. 58, no. 9, p. 1806-1824.

FIGURE CAPTION

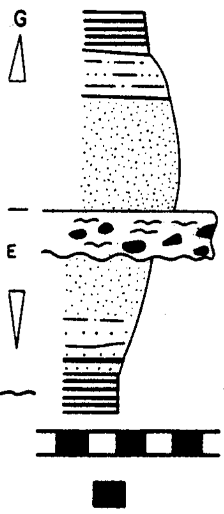
Figure 1. Descriptive log of core of the Travis Peak Formation from the Marshall Werner Sawmill No. 5 well, Panola County, Texas. Core depths are from 6,546.0 to 6,642.7 ft, 6,853.0 to 6,912.3 ft, and 7,049.0 to 7,141 ft.

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
10YR 6/2	Pale yellowish brown
5YR 6/1	Light brownish gray
5Y 6/1	Light olive gray
5G 6/1	Greenish gray
N7	Light gray
N6	Medium light gray
N5	Medium gray
N4	Medium dark gray

F I G U R E 2.

Photomicrograph of abundant quartz cement that occludes primary porosity. Depth is 7,068.7 ft. Long dimension of photo is 0.65 mm; crossed-polarized light.

F I G U R E 3.

Photomicrograph of ankerite cement replacing framework grains and filling pore space. Depth is 6,632.7 ft. Long dimension of photo is 0.65 mm; plane-polarized light.

F I G U R E 4.

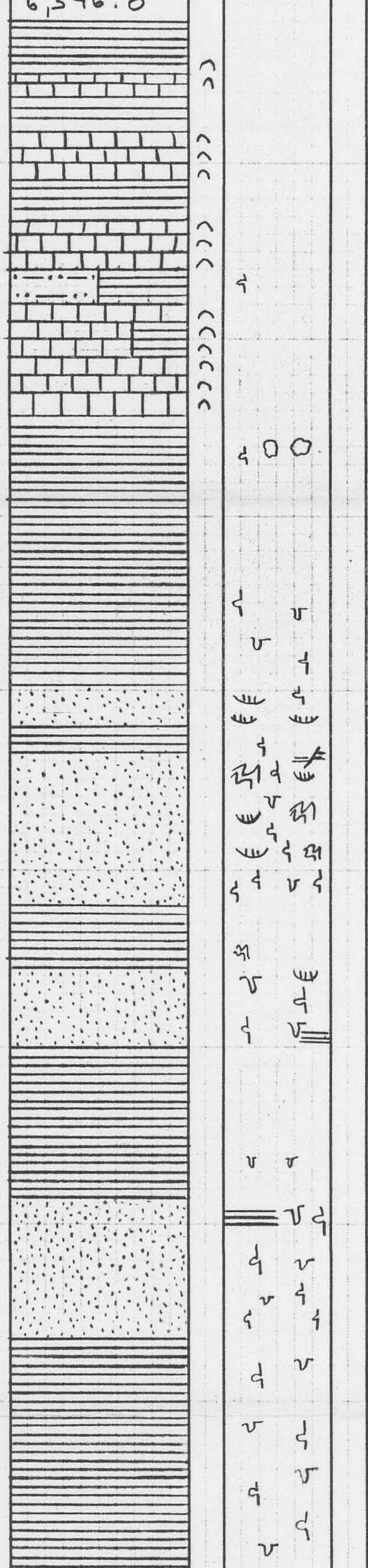
Photomicrograph of euhedral quartz overgrowths and primary and secondary porosity. Depth is 6,600.7 ft. Long dimension of photo is 0.65 mm; plane-polarized light.

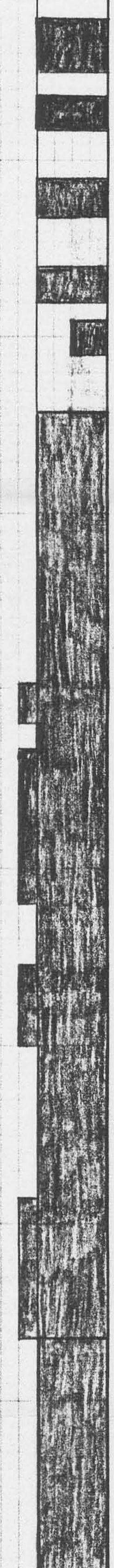
F I G U R E 5.

SEM photograph of euhedral quartz overgrowths and large secondary pore that contains a crystal of barite (B). Bar length is 100 μm; magnification is 150x.

WELL Marshall Exploration Werner Sawmill #5 CORE DEPTH (+)(-) 2.5 ft = GR LOG DEPTH @ 6602 ft
FORMATION Travis Peak COUNTY Panola LOGGED BY S. Dutton DATE 2/86

DEPTH | CONTACT | ROCK TYPE | ACCESS. | STRUCTURE | TEXTURE | INDURATION | GRAIN SIZE (-1 0 1 2 3 4 8; G VC C M F VF S M) | CO_3 CMT | COLOR | STRATIFICATION (Reservoir bitumen, Carbonate nodules, Porosity, Permeability) | COMMENTS

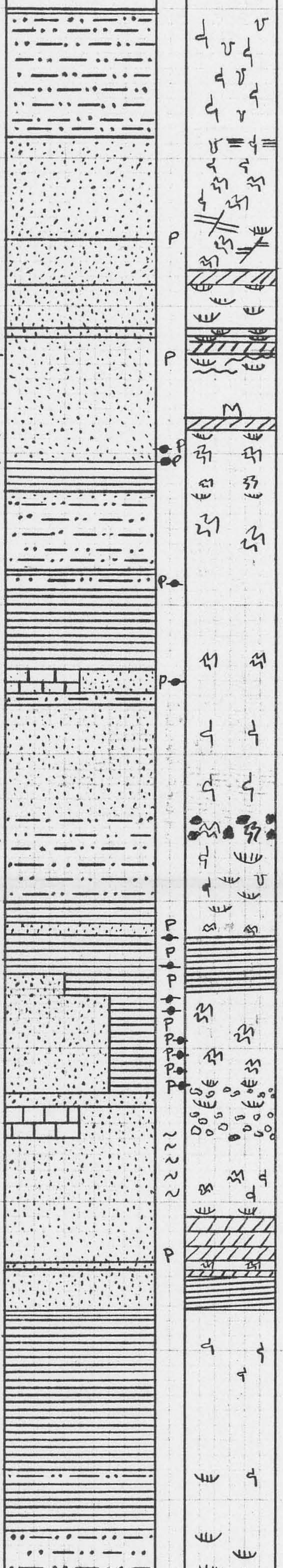


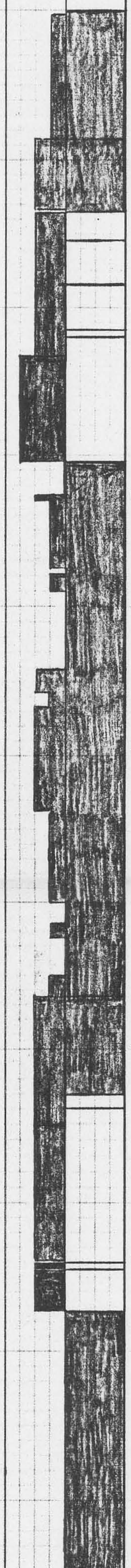


Depth	Texture	CO_3 CMT	Color	Porosity	Permeability	Comments
6,540						
6,546.0						Core 1: Core depth - 2.5 ft = GR log depth at 6602 ft
			N4			
			N6			
			N4			
	Mollusk biosparite		N6	4.2	1.18	
6,550	ps		N4			
			N6			Some silt layers in mud
	Mollusk biosparite			1.4		
				7.6		Interbedded silt + mud
				2.5	0.77	
				2.1	0.16	Gastropod, pelecypod shells + shell hash
	Mollusk biosparite		N6	2.7	0.04	
				2.7		Very large carb. nodules
	ps		N5	7.4		
6,560		1		6.7	2.10	
				4.9		
	ps		N5	6.6	0.04	
				7.3	0.50	
				7.2	2.70	
TS				7.0		
		0		6.9	0.81	
			N7 + N4	7.5		Sediment is rippled, slumped + contorted, faulted. Some burrowing
				8.6		
	ps			5.1	0.43	
6,570				6.3		
	ps		N5	4.8	4.70	
				7.2		
	ms	0	N4 + N7	8.2		Most sed. structures destroyed by burrowing. Some ripples, laminae remain.
				8.6		
				6.8	0.70	
	ps		N5	7.3	8.10	
		10		8.3	1.80	Some red mud mixed in. Root traces?
				9.2		
				10.0	0.11	
6,580	ms		N7	4.7		Most sed. structures destroyed by burrowing
				10.9		
		0		8.2		
	ps		N5	2.4	1.55	
				5.1		
			5 R 6/2	4.8		
				7.7		
	ps		N5	4.8	1.01	
6,590						

WELL Marshall Exploration Werner Sawmill #5 CORE DEPTH (+)(-) 2.5 ft = GR LOG DEPTH @ 6602 ft

FORMATION Travis Peak COUNTY Panola LOGGED BY S. Dutton DATE 2/86



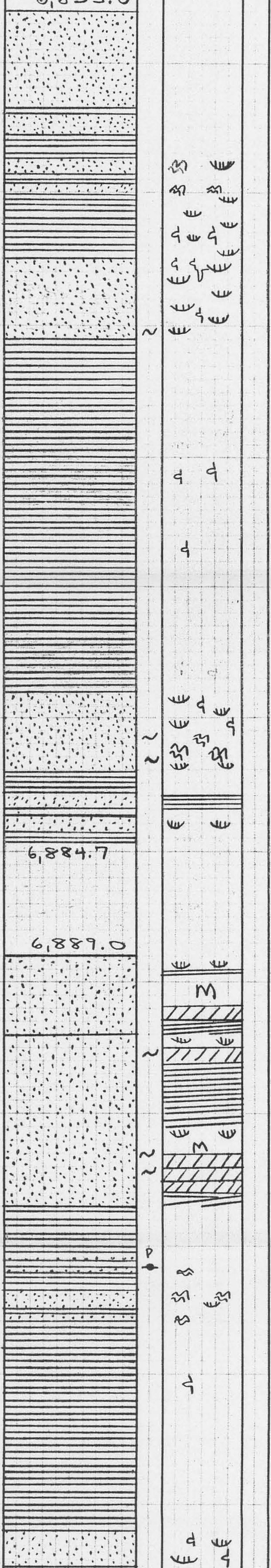


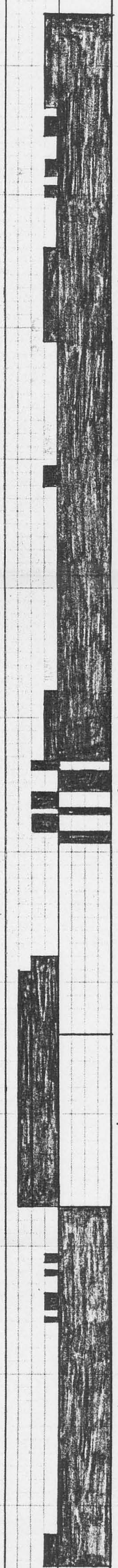
DEPTH	CONTACT	ROCK TYPE	ACCESS.	STRUCTURE	TEXTURE	INDURATION	GRAIN SIZE (-1 0 1 2 3 4 8; G VC C M F VF S M)	CO_3 CMT	COLOR	STRATIFICATION: Reservoir bitumen	Carbonate nodules	Porosity	Permeability	COMMENTS
6,590												7.7	0.41	
					ps				N5			5.9	0.34	
												6.0		
								1				5.7	0.64	
												8.9		
												9.7		
					ms							3.3	1.36	Contorted ss + mud
			P									7.3	0.03	Faulted x-beds
												8.0		
					ws			1				8.5	4.17	
TS 6,600									N6			11.5	23.70	
			P					1				9.6	0.68	Organic- and mud-rich partings
												9.1	0.74	Strange sed. structures – like compressed, contorted ripples
Core 1			P		ws				N5			4.9	0.02	
			P									6.5	0.14	Very large wood fragment
								10				7.4	1.53	Core 2: Core depth – 2 ft = GR log depth at 6630 ft
Core 2					ms				N6			8.7	0.57	
			P									7.7		
												8.6		
6,610					ps				N4			8.5	5.00	Slumped, contorted silt in mud
			P					10				5.8	0.03	Abundant pyrite nodules
												7.0	0.04	
					ms			1	5 Y 8/1			10.4	8.61	
												2.2		
												9.3	0.08	Completely burrowed
												3.0	0.03	Abundant carb. nodules destroy structures
					ps			1	N6			6.0	0.03	Structures contorted by carb. nodules – very abundant
												7.0	1.05	
6,620			P									6.0	6.74	
			P						N5			6.6	8.20	Inclined mud, rare siltstone beds
			P									8.4	0.30	
			P									8.2	0.45	Inclined laminae of ss + mud
			P		ps			3	N7 + N4			8.9		Contorted, interbedded mud + ss
			P									9.4		Abun. pyrite nodules, wood fragments
			P									8.1	0.09	
												7.3	0.04	Carb. nodules in contorted + rippled ss
					ms			3				10.6	0.44	Abundant clay clasts – diff. to see sed. structures
												11.5	4.45	
6,630									N7			8.7	0.34	
			P		ws			5				6.5	0.07	
TS												2.9	0.08	
					ws							7.3	0.03	Planer to slightly inclined laminae
									N4			5.5	2.00	
												3.3		
					ps				5 R 4/2			6.2	4.90	
									5 G 6/1			7.3	0.60	
									5R 4/2			5.5	0.10	
6,640												5.1	0.10	
					ms				5 R 6/2			6.2	0.10	Muddy siltstone
												5.6		
		6,642.7												

WELL Marshall Exploration Werner Sawmill #5 CORE DEPTH ~~(+)~~ (-) 1.5 ft = GR LOG DEPTH @ 6,864 ft

FORMATION Travis Peak COUNTY Panola LOGGED BY S. Dutton DATE 2/86

DEPTH	CONTACT	ROCK TYPE	ACCESS.	STRUCTURE	TEXTURE	INDURATION	GRAIN SIZE (-1 0 1 2 3 4 8; G VC C M F VF S M)	CO_3 CMT	COLOR	STRATIFICATION: Calcareous nodules	Porosity	Permeability	COMMENTS
6,850													Core 3: Core depth - 1.5ft = GR log depth at 6,864 ft
		6,853.0											
					ps						13.9	0.50	
									5R6/2		7.5	0.10	
											9.4	0.10	
					ps						5.1	0.03	
											8.6	0.10	
											4.6	1.60	Reduction spots
											3.6	0.40	
6,860					ps				5R4/2		3.0	0.02	
											4.5	0.02	
	Δ										6.2	0.10	
					ms			0	5R6/2		5.3	0.03	
			~								7.3	0.03	Slightly contorted, soft sediment fault
											5.1	12.40	
											4.9	5.70	
					ps				5R4/2		5.8	5.80	Reduction spots
											4.9	0.10	
											5.8	0.50	
6,870											4.9	0.70	Slightly sandier
											2.4		
											3.3	0.02	
					ps						4.6	0.11	
									5R4/2		6.0	3.41	
											8.6		Reduction spots
					ps						7.4		
									5R4/2		6.0	4.67	
	Δ										5.3	1.93	
											5.1	0.03	
6,880			~		ms						7.2	0.10	
			~						5R 6/2 5G 6/1 5R 4/2 N4		6.9	0.04	Contains red mud clasts
											1.4		
											4.9	2.55	Planar laminated
Core 3											2.7		
		6,884.7											Core 4: Core depth - 1.5 ft = GR log depth at 6,897.0
		6,889.0											Abundant mud drapes
6,890				M							6.5	0.12	
											2.1	0.06	
Core 4											4.5	0.24	
TS			~		ws			1			9.3	1.62	Planar to slightly inclined laminae
											7.9	0.79	
											5.8	0.74	
								3	10YR 6/2		9.3	1.30	
			~	M	ws						8.9	1.75	
			~								10.0	3.64	Mud clasts along x-beds Mineralized fracture
											9.4	3.29	Cross beds in opposed directions
									N4		3.8		
6,900			P								6.1	0.17	contorted pods of ss in mud
											4.7	5.43	
					ps				N4		5.0		Pod of ss within mud
											6.1	7.01	
											4.3	1.51	
											5.0	2.17	
					ps			3			4.7	1.58	
											6.1	4.77	
									5R4/2		5.0	3.43	
											4.4		
6,910											4.5	0.91	
	Δ				ms				5R6/2		4.4		
											4.3		
		6,912.3											

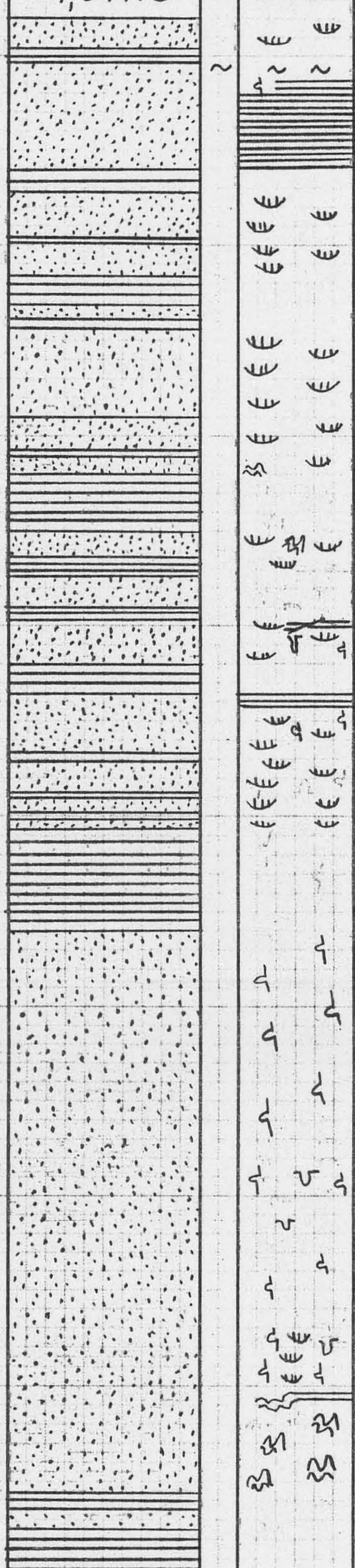


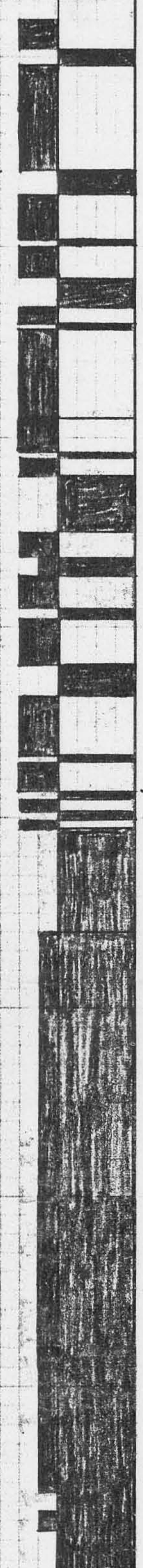


WELL Marcshall Exploration Werner Sawmill #5 CORE DEPTH (-) 3.0 ft = GR LOG DEPTH @ 7,105 ft

FORMATION Travis Peak COUNTY Panola LOGGED BY S. Dutton DATE 2/86

DEPTH	CONTACT	ROCK TYPE	ACCESS.	STRUCTURE	TEXTURE	INDURATION	GRAIN SIZE (-1 0 1 2 3 4 8; G VC C M F VF S M)	CO_3 CMT	COLOR	STRATIFICATION: Calcareous nodules	Porosity	Permeability	COMMENTS
													Core 5: Core depth - 3.0 ft = GR log depth at 7,105 ft
		7,049.0							5R 6/2		6.2	0.41	
									5R 4/2				
7,050			~								7.5	1.61	Abundant mud clasts
									5R 6/2		4.9	0.03	
									5R 4/2 N4		5.7	0.04	
									5R 6/2		6.3	0.02	
					ms								Water escape structures
									N4		5.5	0.03	
					ms			1			7.3		
									N4		7.1	2.90	
									N4		7.6	0.03	
					ms				5YR 6/1				Clay drapes on ripples
											7.9	0.05	
											5.3	0.03	
								3					
7,060											5.1	1.63	
					ps				N4				
									N6		5.3	0.40	
					ms				N4		4.7	6.63	Some mm-scale ss layers
									N6		4.5	0.02	
									N4				
					ms				N6		8.3	1.37	
									N4				Hor. laminae of ss + mud
											4.5	0.03	Abundant mud drapes on ripples
									N6		4.8	0.02	
TS					ws			3		■	4.7	0.03	Zone of calcareous nodules
7,070									N5		4.7	0.03	
					ps						4.3		
											5.4		
											6.4		
					ms					■	6.2	0.03	
											10.5	0.04	
											10.7	0.12	
								0	5R 6/2				
					ms						14.2	0.77	
											11.9	0.92	
											3.4	0.03	Reduced area
7,080											2.3		
									5R 6/2		3.9	0.25	Reduction spots
					ms						7.7	0.06	
											4.8	0.03	
											8.2	0.98	
											8.8	0.24	
					ms			0	5R 6/2		9.4	0.43	Laminated ss + mud, now contorted
									N5 + 5R 4/2		5.7	3.40	
											7.1		
					ps				5R 4/2		4.1	18.59	
7,090													





WELL Marshall Exploration Werner Sawmill #5 CORE DEPTH (+)(-) 3.0 = GR LOG DEPTH @ 7124.0 ft

FORMATION Travis Peak COUNTY Panola LOGGED BY S. Dutton DATE 2/86

DEPTH	CONTACT	ROCK TYPE	ACCESS.	STRUCTURE	TEXTURE	INDURATION	GRAIN SIZE (-1 0 1 2 3 4 8; G VC C M F VF S M)	CO_3 CMT	COLOR	STRATIFICATION	COMMENTS

Stratification columns: Reservoir bitumen | Calcareous nodules | Porosity | Permeability

Depth	Texture	CO3 CMT	Color	Porosity	Permeability	Comments
7,090	ps		5 R 4/2	4.6	2.87	Reduction spots
	ms		5 R 6/2	7.2	0.09	
				6.7	0.39	
			N6	6.2	0.05	
			5 R 6/2	4.6	0.04	
	ms	3		5.9	1.02	Sandy mudstone. Long vertical burrow
			N6	10.4	0.07	Root traces
				5.7		Rippled below, then x-bedded
				7.5		Contorted ss + mud
7,100	ms			9.1	0.03	
				15.6	0.29	
			10 YR 6/2	14.5	0.71	
				10.9	0.09	
		5		14.0	0.09	
				14.1	0.10	
	ms			13.6	0.58	
				6.1	0.55	
			5 R 4/2	9.5	0.09	
				7.7	0.02	
7,110	ms	0	N6	8.0	0.02	Core 6: Core depth -3.0ft = GR log depth at 7124
				5.1	0.12	
	ms		5R 4/2	7.9	0.07	
				12.2	0.06	
				10.8	0.07	
	ps		5R 4/2	3.8		
				8.3	0.06	Muddy sandstone
				5.2	0.28	
	ps			4.2	0.02	
				5.0	0.03	Sandy mudstone
7,120			5 R 4/2	10.5	0.12	
				8.4	0.06	Muddy sandstone
	ms		5R 6/2	8.0	0.07	
	ms	0		8.4	0.07	Low angle ripples Abundant clay drapes
				8.8	0.03	
			N7	7.9	0.03	
	ws		5R 6/2	6.0	0.02	
	ps		5 R 4/2	5.4	0.21	
				6.5	0.20	Low angle ripples to horizontally laminated ss + mud
	ps		5 R 6/2	8.1	0.14	
7,130		0		5.4	0.55	
	ms		N7	7.6	0.08	Abundant clay drapes on ripples. Climbing ripples? Microfaulting
				7.9	0.05	
				7.0	0.16	
	ps		N4	5.4	7.15	Finely laminated ss + mud
				5.9		Laminated ss + mud
	ms	0	N7	6.3	0.03	
	ps		N4	8.7	0.20	Very low angle laminae of ss + mud
				7.5	0.07	Low angle ripples, abundant clay drapes
	ms		N7	7.6	3.86	
7,140		0		7.7	0.11	

core 5

core 6

7,141.1