LITHOLOGY, GAS DETECTION, AND ROCK PROPERTIES FROM ACOUSTIC LOGGING SYSTEMS*

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INTRODUCTION

With the advent of large volume frac treatments, interest has increased in obtaining *in situ* rock properties for use in well-treatment design. Also studies have been made relating acoustic properties of formations to lithology.[1] When techniques are being applied for these purposes using well logs, the presence of gas is observed to distort the usual relation between compressive and shear velocity for the particular lithology.

In the application of these techniques, compressive travel time is measured with conventional compensated acoustic-velocity logs. Shear travel time can be calculated from full wave train logs. The relationship between compresive and shear travel time as a function of lithology is shown below.[1]

$$\frac{\Delta ts}{\Delta tc} = \begin{array}{rl} 1.9 = & \text{Limestone} \\ 1.8 = & \text{Dolomite} \\ 1.6 - 1.7 = & \text{Sandstone} \end{array}$$

where:

Δts = Shear Travel Time

Δts = Compressive Travel Time

Physical rock properties such as Poisson's ratio are determined from the ratio of compressive to shear travel time. Young's modulus is determined from this same information with the addition of bulk density.[2] Listed below are the equations for the computation of physical rock properties.[3]

$$\text{Poisson's Ratio} = \sigma = \frac{1/2(\Delta ts/\Delta tc)^2 - 1}{(\Delta ts/\Delta tc)^2 - 1}$$

$$\text{Young's Modulus} = E = \frac{2\rho b(\sigma + 1)}{(\Delta ts)^2}$$

$$\text{Shear Modulus} = \mu = \rho b/(\Delta ts)^2$$

$$\text{Bulk Modulus} = K = \rho b\,[(1/\Delta tc)^2 - 4/3(\Delta ts)]^2$$

These equations are utilized in a computer program. Input is from hand-digitized log data from acoustic logs, full wave train logs, and density logs (when available).[2] Table 1 is a listing of input data and the results of this program with the addition of the shear to compressive travel time ratio (velocity ratio).

FIELD TESTS

The following field examples of rock-property calculations illustrate the distortions in compressive and shear-velocity ratio when gas is present.

Sandstone Example — Sutton County Texas

This example was chosen because production is from sandstone. Shale is the only other important lithology in the producing zones.

This well was drilled with air, and before the hole was loaded with brine a temperature log was run. After the hole was loaded, open hole logs were run. Figure 1 is part of the acoustic velocity log and micro-seismogram log on this well. These logs were then digitized and a rock-prop computer program was run. Table 1 shows the input and output data, and Figure 2 shows the plotted results. Notice that

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TABLE I

SUTTON CO TEX

INPUT

TOP	BOT	TMA	RHOMA	S–C	DELT	RHOB
6279.	6281.	56.	2.64	62.	78.6	0.
6286.	6294.	56.	2.64	42.	68.8	0.
6297.	6299.	56.	2.64	58.	76.3	0.
6304.	6311.	56.	2.64	43.	69.6	0.
6312.	6320.	56.	2.64	39.	69.7	0.
6321.	6325.	56.	2.64	44.	70.0	0.
6327.	6341.	56.	2.64	49.	71.1	0.
6342.	6345.	56.	2.64	47.	71.7	0.
6346.	6348.	56.	2.64	45.	73.1	0.
6349.	6351.	56.	2.64	59.	75.4	0.
6352.	6354.	56.	2.65	50.	74.2	0.
6355.	6358.	56.	2.65	54.	76.8	0.
6360.	6363.	56.	2.65	45.	71.8	0.
6366.	6369.	56.	2.65	45.	69.7	0.
6371.	6373.	56.	2.65	50.	71.6	0.
6374.	6376.	56.	2.65	52.	74.7	0.
6377.	6380.	56.	2.65	56.	76.4	0.
6381.	6383.	56.	2.65	44.	69.7	0.
6385.	6388.	56.	2.65	51.	72.2	0.
6391.	6393.	56.	2.65	40.	68.7	0.
6394.	6397.	56.	2.65	46.	70.1	0.
6397.	6400.	56.	2.64	42.	70.8	0.
6401.	6405.	56.	2.64	44.	70.6	0.
6406.	6411.	56.	2.64	47.	70.9	0.
6417.	6425.	56.	2.64	38.	65.5	0.
6427.	6430.	56.	2.64	42.	64.7	0.
6432.	6435.	56.	2.65	39.	65.2	0.
6436.	6439.	56.	2.65	40.	67.8	0.
6441.	6446.	56.	2.64	39.	66.0	0.
6447.	6450.	56.	2.65	38.	67.0	0.
6452.	6454.	56.	2.65	44.	69.3	0.
6456.	6461.	56.	2.65	37.	66.5	0.
6464.	6467.	56.	2.65	51.	71.5	0.
6469.	6475.	56.	2.65	49.	71.2	0.
6476.	6478.	56.	2.65	49.	71.7	0.
6480.	6483.	56.	2.65	46.	71.0	0.
6485.	6490.	56.	2.65	42.	68.5	0.
6491.	6494.	56.	2.65	46.	69.4	0.
6495.	6502.	56.	2.65	44.	67.8	0.
6503.	6506.	56.	2.65	41.	66.9	0.
6510.	6513.	56.	2.65	41.	66.6	0.
6515.	6520.	56.	2.65	44.	67.3	0.
6524.	6527.	56.	2.65	43.	66.4	0.
6529.	6537.	56.	2.65	42.	67.0	0.
6541.	6549.	56.	2.65	41.	67.8	0.
6550.	6555.	56.	2.65	41.	68.0	0.
6559.	6578.	56.	2.65	41.	67.2	0.
6581.	6582.	56.	2.65	53.	75.8	0.
6585.	6587.	56.	2.65	42.	71.8	0.
6588.	6591.	56.	2.65	45.	70.1	0.
6591.	6594.	56.	2.65	44.	69.5	0.
6595.	6597.	56.	2.65	51.	73.7	0.

OUTPUT

INTERVAL			POIS.	ELASTIC MODULI			POR.	VEL.
TOP	BOTTOM	FT.	RATIO	YOUNGS	SHEAR	BULK	%	RATIO
6279.	6281.	2.	.274	4.10	1.61	3.02	16.9	1.79
6286.	6294.	8.	.188	6.46	2.72	3.45	9.5	1.61
6297.	6299.	2.	.263	4.50	1.78	3.16	15.2	1.76
6304.	6311.	7.	.192	6.25	2.62	3.39	10.2	1.62
6312.	6320.	8.	.153	6.49	2.81	3.12	10.3	1.56
6321.	6325.	4.	.199	6.11	2.55	3.38	10.6	1.63
6327.	6341.	14.	.232	5.63	2.29	3.50	11.4	1.69
6342.	6345.	3.	.214	5.66	2.33	3.30	11.9	1.66
6346.	6348.	2.	.191	5.57	2.34	3.00	13.0	1.62
6349.	6351.	2.	.272	4.55	1.79	3.32	14.6	1.79
6352.	6354.	2.	.224	5.15	2.11	3.11	13.8	1.68
6355.	6358.	3.	.238	4.65	1.88	2.96	15.5	1.71
6360.	6363.	3.	.198	5.79	2.42	3.20	11.7	1.63
6366.	6369.	3.	.209	6.11	2.53	3.50	10.1	1.65
6371.	6373.	2.	.236	5.51	2.23	3.48	11.6	1.70
6374.	6376.	2.	.235	4.99	2.02	3.14	14.0	1.70
6377.	6380.	3.	.252	4.59	1.83	3.08	15.3	1.74
6381.	6383.	2.	.200	6.18	2.58	3.44	10.3	1.63
6385.	6388.	3.	.240	5.37	2.16	3.44	12.2	1.71
6391.	6393.	2.	.169	6.63	2.83	3.34	9.5	1.58
6394.	6397.	3.	.215	5.99	2.47	3.50	10.6	1.66
6397.	6400.	3.	.177	6.11	2.60	3.15	11.2	1.60
6401.	6405.	4.	.196	6.02	2.52	3.30	11.1	1.63
6406.	6411.	5.	.218	5.79	2.38	3.43	11.2	1.67
6417.	6425.	8.	.167	7.39	3.17	3.71	7.1	1.58
6427.	6430.	3.	.210	7.23	2.99	4.16	6.7	1.65
6432.	6435.	3.	.180	7.39	3.13	3.85	7.0	1.60
6436.	6439.	3.	.175	6.78	2.89	3.48	9.0	1.59
6441.	6446.	5.	.175	7.21	3.07	3.70	7.7	1.59
6447.	6450.	3.	.158	7.07	3.05	3.45	8.4	1.57
6452.	6454.	2.	.203	6.25	2.60	3.51	10.0	1.64
6456.	6461.	5.	.150	7.25	3.15	3.46	7.9	1.56
6464.	6467.	3.	.243	5.47	2.20	3.55	11.6	1.72
6469.	6475.	6.	.231	5.62	2.28	3.48	11.4	1.69
6476.	6478.	2.	.228	5.55	2.26	3.41	11.9	1.69
6480.	6483.	3.	.210	5.85	2.42	3.37	11.3	1.65
6485.	6490.	5.	.190	6.53	2.75	3.51	9.4	1.62
6491.	6494.	3.	.218	6.10	2.51	3.61	10.1	1.67
6495.	6502.	7.	.210	6.51	2.69	3.75	8.9	1.65
6503.	6506.	3.	.189	6.91	2.91	3.71	8.2	1.62
6510.	6513.	3.	.191	6.96	2.92	3.76	8.0	1.62
6515.	6520.	5.	.213	6.60	2.72	3.83	8.6	1.66
6524.	6527.	3.	.210	6.85	2.83	3.94	7.9	1.65
6529.	6537.	8.	.198	6.80	2.84	3.75	8.4	1.63
6541.	6549.	8.	.184	6.73	2.84	3.55	9.0	1.61
6550.	6555.	5.	.183	6.68	2.83	3.51	9.3	1.61
6559.	6578.	19.	.188	6.84	2.88	3.65	8.6	1.61
6581.	6582.	1.	.237	4.81	1.95	3.04	15.2	1.70
6585.	6587.	2.	.171	5.95	2.54	3.02	12.2	1.59
6588.	6591.	3.	.207	6.05	2.51	3.44	10.9	1.64
6591.	6594.	3.	.202	6.22	2.59	3.47	10.4	1.64

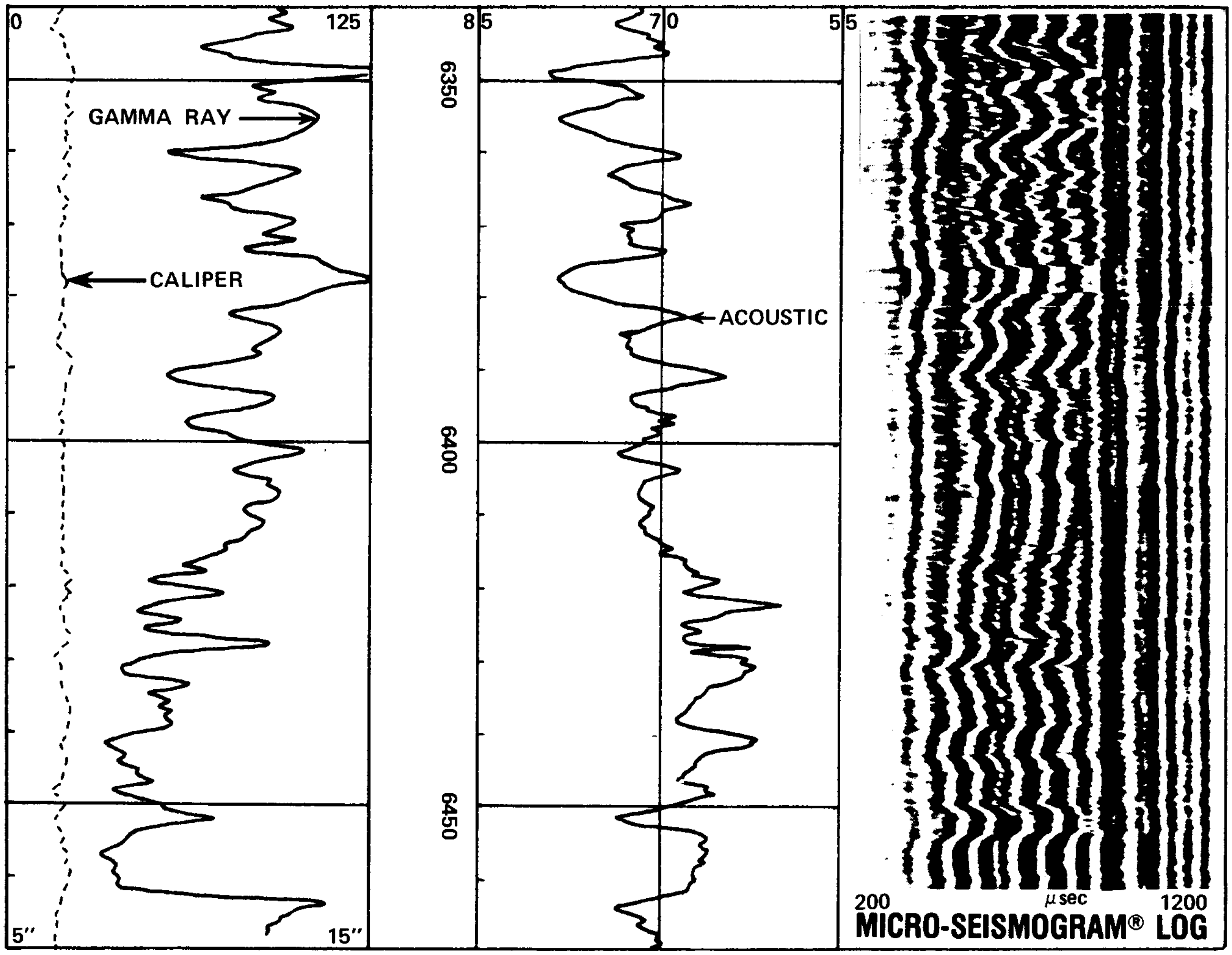


FIGURE 1

the interval from 6500 to 6580 feet has a velocity ratio of 1.6, indicating a sandstone. The shales in this well have a ratio between 1.7 and 1.8. Note the zones from 6390 to 6462 feet. All these zones have velocity ratios of less than 1.6. Also note how these intervals correlate with the temperature log. Anomalous velocity ratios are present in each zone that exhibit gas entry on the temperature log. Other zones that should be sandstone (from gamma log) have ratios from 1.6 to 1.7 as expected.

Laboratory experiments reported in 1968 by Gardner and Harris [4] demonstrate that compressive wave velocity is sensitive to the compressibility of the fluid that saturates a sand. As the compressibility of this fluid increases, as it would with the addition of gas, the compressive wave velocity becomes lower. Shear wave velocity is not sensitive to the saturating fluid.[4]

Therefore, when gas is present and a ratio is made between shear travel time (Δts) and compressive travel time (Δtc), the ratio will be smaller because the Δts remains unchanged and the Δtc becomes larger (compressive velocity becomes lower). These experiments and relationships explain the low velocity ratios mentioned in the previous example. The hypothetical example below illustrates what an increase of two microseconds in Δtc will do to a velocity ratio in a typical sand.

$$\frac{\Delta ts}{\Delta tc} = \frac{112}{70} = \text{Velocity Ratio} = 1.6$$

$$\frac{\Delta ts}{\Delta tc} = \frac{112}{72} = \text{Velocity Ratio} = 1.55$$

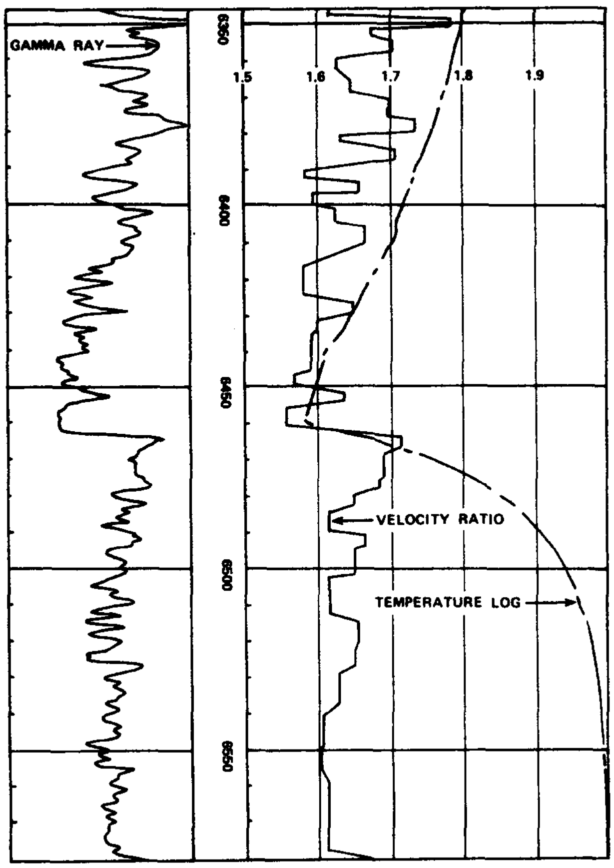
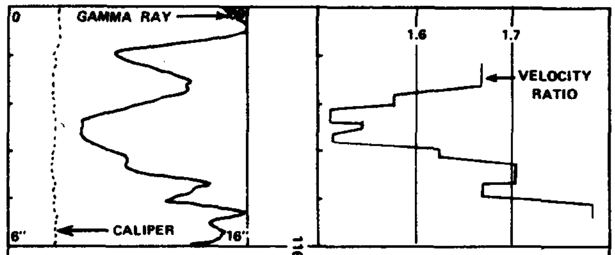


FIGURE 2



TOP	BOT	TMA	RHOMA	S – C	DELT	RHOB
11562.	11567.	53.	2.65	45.	68.0	0.
11569.	11571.	53.	2.65	40.	69.9	0.
11572.	11575.	53.	2.65	38.	74.8	0.
11575.	11576.	53.	2.65	38.	70.3	0.
11577.	11579.	53.	2.65	36.	70.4	0.
11580.	11592.	53.	2.65	39.	63.0	0.
11583.	11587.	53.	2.65	45.	64.5	0.
11587.	11590.	53.	2.65	43.	64.9	0.
11591.	11594.	53.	2.64	56.	72.3	0.

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INTERVAL TOP	INTERVAL BOTTOM	FT.	POIS. RATIO	ELASTIC MODULI YOUNGS	ELASTIC MODULI SHEAR	ELASTIC MODULI BULK	POR. %	VEL. RATIO.
11562.	11567.	5.	.219	6.29	2.58	3.73	11.2	1.67
11569.	11571.	2.	.164	6.31	2.71	3.13	12.5	1.58
11572.	11575.	3.	.112	5.57	2.51	2.39	16.2	1.51
11575.	11576.	1.	.140	6.33	2.78	2.93	13.0	1.55
11577.	11579.	2.	.115	6.43	2.88	2.78	13.0	1.52
11580.	11582.	2.	.195	7.75	3.24	4.23	7.6	1.62
11583.	11587.	4.	.237	6.92	2.80	4.39	9.6	1.70
11587.	11590.	3.	.219	7.00	2.97	4.16	9.0	1.67
11591.	11594.	3.	.270	4.96	1.96	3.59	14.3	1.78
WGTD. AVG.								
11562.	11594.	25.	.197	6.36	2.66	3.59	11.5	1.64

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FIGURE 3

Sandstone Example — Eddy County New Mexico

Another field test, in a Morrow sandstone in Eddy County, New Mexico, again illustrates a smaller than expected velocity ratio. The sand interval in this well is from 11,571 - 11,580 feet. The logs and computer analysis are shown in Figure 3. Note that all the sand interval as indicated by gamma ray has a velocity ratio between 1.51 and 1.55. This zone tested for 4.5 MMCFPD calculated open flow from perforations between 11,571 - 11,580 feet.

Limestone Example — Lea County New Mexico

This example is in the Pennsylvanian limestone. The major lithologies logged are limestone and shale. Figure 4 shows the acoustic and micro-seismogram logs over the zones of interest (perforations marked).Table 2 is a listing and Figure 5 a plot of the computer results. The results of the computations for physical rock properties and velocity ratio indicate an anomaly. None of the velocity ratios obtain a number as high as 1.9 as should be expected for limestone. Several dense zones (9498 to 9514 feet and 9358 to 9384 feet) do have ratios of approximately 1.8. Oscilloscope photographs were taken at 9370, 9516, 9564, and 9566 feet. Every hand calculation of the ratio of shear to compressive travel time compares with the computer results. Note that the perforated intervals have lower velocity ratios than should be expected for limestone. This well produced 317 barrels of oil and 276,600 cu. ft. of gas per day in December 1975, from perforations as shown. The compressibility of the oil with this amount of dissolved gas is probably the reason for these low velocity ratios.[4]

Dolomite Example — Winkler County Texas

This example is in the Ellenburger Formation. The only lithology is dolomite. Figure 6 is the open hole acoustic log and the micro-seismogram log. Figure 7 and Table 3 are the results of the computer

TABLE 2

OUTPUT

TOP	INTERVAL BOTTOM	FT.	POIS. RATIO	ELASTIC MODULI YOUNGS	SHEAR	BULK	POR. %	VEL. RATIO
9268.	9270.	2.	.274	11.27	4.42	8.31	2.9	1.79
9271.	9277.	6.	.284	10.69	4.16	8.27	3.5	1.82
9277.	9280.	3.	.261	11.11	4.41	7.75	3.7	1.76
9281.	9286.	5.	.246	12.27	4.92	8.04	2.6	1.72
9287.	9290.	3.	.263	11.25	4.45	7.92	3.4	1.76
9290.	9304.	14.	.249	12.52	5.01	8.33	2.2	1.73
9305.	9308.	3.	.266	12.09	4.77	8.61	2.3	1.77
9308.	9311.	3.	.265	11.36	4.49	8.07	3.2	1.77
9312.	9315.	3.	.271	11.73	4.61	8.56	2.5	1.79
9316.	9319.	3.	.248	9.25	3.71	6.12	7.2	1.73
9320.	9336.	16.	.267	12.11	4.78	8.65	2.2	1.77
9337.	9342.	5.	.280	11.58	4.53	8.76	2.4	1.81
9346.	9349.	3.	.258	11.60	4.61	8.01	3.1	1.75
9350.	9353.	3.	.274	9.11	3.57	6.73	6.4	1.79
9354.	9357.	3.	.208	8.45	3.50	4.82	9.7	1.65
9358.	9383.	25.	.284	11.89	4.63	9.18	1.6	1.82
9385.	9388.	3.	.273	11.82	4.65	8.67	2.1	1.79
9389.	9396.	7.	.282	11.79	4.60	9.03	1.8	1.82
9400.	9406.	6.	.258	11.57	4.60	7.96	3.0	1.75
9408.	9427.	19.	.243	12.89	5.18	8.37	1.8	1.72
9429.	9432.	3.	.259	11.68	4.64	8.09	2.5	1.75
9433.	9448.	15.	.260	11.70	4.64	8.11	2.7	1.76
9450.	9453.	3.	.280	5.64	2.20	4.26	14.9	1.81
9454.	9482.	28.	.255	12.85	5.12	8.74	1.6	1.74
9484.	9486.	2.	.243	10.72	4.31	6.95	4.8	1.72
9487.	9490.	3.	.262	11.17	4.42	7.82	3.6	1.76
9493.	9496.	3.	.326	5.67	2.14	5.42	12.2	1.97
9497.	9508.	11.	.278	12.16	4.76	9.15	1.9	1.80
9510.	9514.	4.	.279	9.84	3.85	7.43	5.0	1.81
9516.	9525.	9.	.214	10.47	4.31	6.11	6.0	1.66
9529.	9548.	19.	.271	12.38	4.87	8.99	1.6	1.78
9552.	9559.	7.	.286	9.73	3.78	7.59	4.9	1.83
9562.	9565.	3.	.227	7.86	3.20	4.80	10.8	1.68
9567.	9570.	3.	.240	9.94	4.01	6.37	6.1	1.71
9573.	9580.	7.	.252	8.05	3.22	5.40	9.4	1.74
9585.	9592.	7.	.230	12.86	5.23	7.94	2.1	1.69
9594.	9597.	3.	.235	10.92	4.42	6.87	4.6	1.70
9599.	9602.	3.	.239	11.17	4.50	7.14	4.1	1.71
9604.	9608.	4.	.234	10.22	4.14	6.40	5.8	1.70
9612.	9616.	4.	.231	8.99	3.65	5.58	8.1	1.69
9621.	9632.	11.	.168	5.86	2.51	2.94	18.0	1.58
9634.	9636.	2.	.237	11.36	4.59	7.19	3.9	1.70
9640.	9643.	3.	.185	9.90	4.18	5.25	7.5	1.61
9644.	9648.	4.	.239	11.47	4.63	7.32	3.8	1.71
9650.	9654.	4.	.258	5.45	2.16	3.76	16.8	1.75
9657.	9661.	4.	.259	11.41	4.53	7.90	3.3	1.75
9663.	9666.	3.	.212	11.26	4.64	6.52	4.8	1.65
9668.	9681.	13.	.204	13.91	5.77	7.84	1.6	1.64
9683.	9690.	7.	.187	11.25	4.74	5.99	5.4	1.61
9692.	9704.	12.	.287	5.49	2.13	4.30	15.5	1.83
9706.	9712.	6.	.043	8.48	4.06	3.10	12.1	1.45

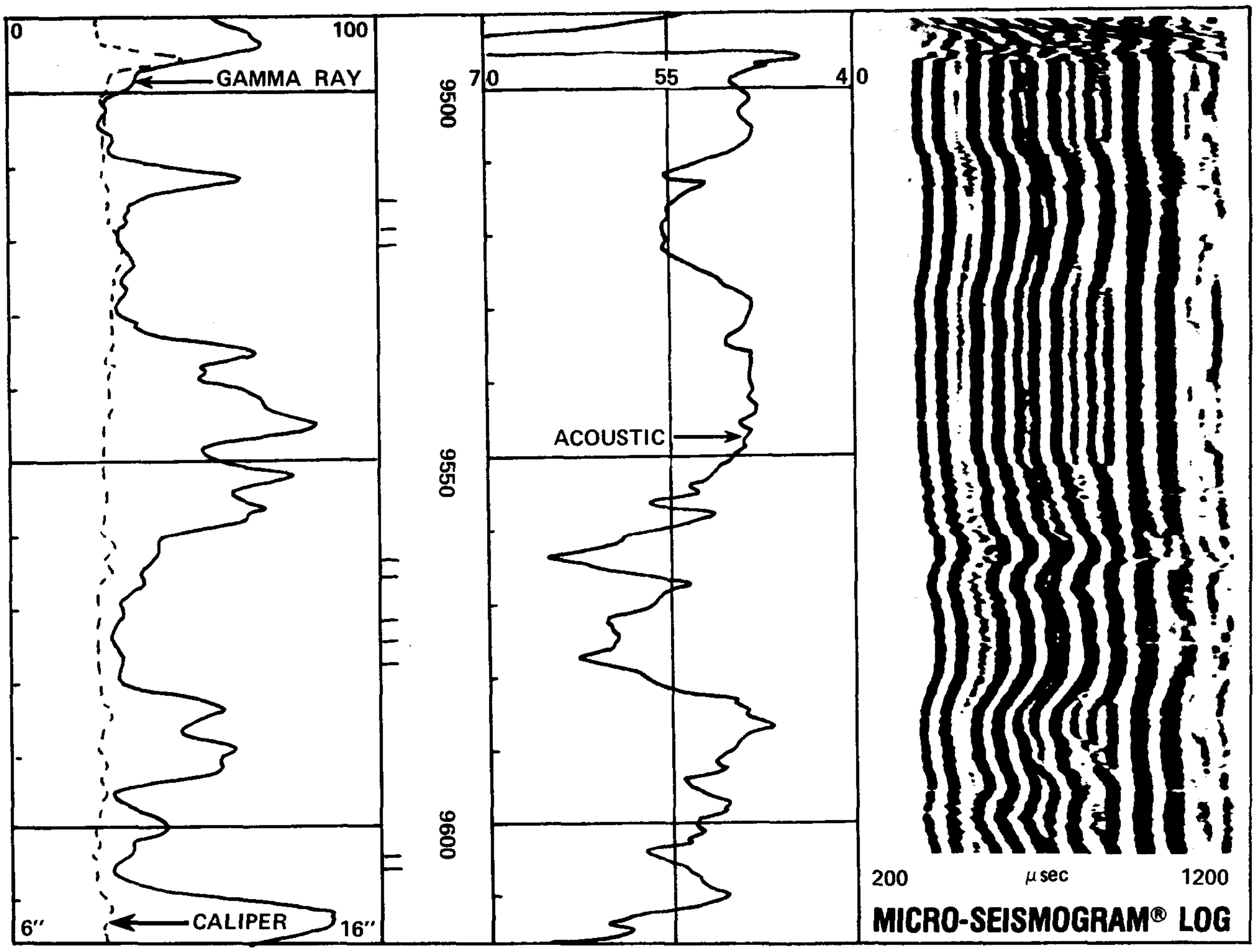

FIGURE 4

analysis. Intervals from 18,395 through 18,415, 18,425, 18,446, 18,513, and 18,560 feet all have velocity ratios which indicate dolomite (1.8). The interval at 18,520 through 18,556 feet is logged by samples as dolomite and tested 1 million cu. ft. of gas. The velocity ratios computed for this zone are in the range of 1.6. No sand is present in this well, so this low velocity ratio is due to the gas.

Dolomite Example — Ector County Texas

This example is in the Permian formation and the lithology is complex. The basic rock type is dolomite, but anhydrite and silica in the form of silt is disseminated throughout the formation. A tabulation of the core data, rock properties from a rock mechanics lab, and rock properties as computed from acoustic and micro-seismogram logs are shown below. Note that Poisson's ratio and lithology compare favorably with velocity ratio. Young's modulus from the log calculations are considerably higher than those from laboratory tests. These differences could be the result of stress relief in the cores as compared to *in situ* measurements with well logs.[4]

DEPTH AND CORE DESCRIPTION	YOUNG'S MODULUS LAB/COMPUTED	POISSON'S RATIO LAB/COMPUTED	VELOCITY RATIO
4050 Dolo. Silty	6.47/7.08	.26/.288	1.83
4074 Dolo. Anhy.	6.78/8.65	.33/.300	1.87
4083 Dolo. Silty	6.37/7.47	.28/.295	1.85
4095 Dolo. Anhy.	6.27/7.66	.30/.288	1.83
4153 Dolo. Anhy.	5.94/9.40	.36/.314	1.92

CONCLUSIONS

1. The ratio of shear to compressive travel time (velocity ratio) can be used to identify lithology but this identification is difficult in mixed

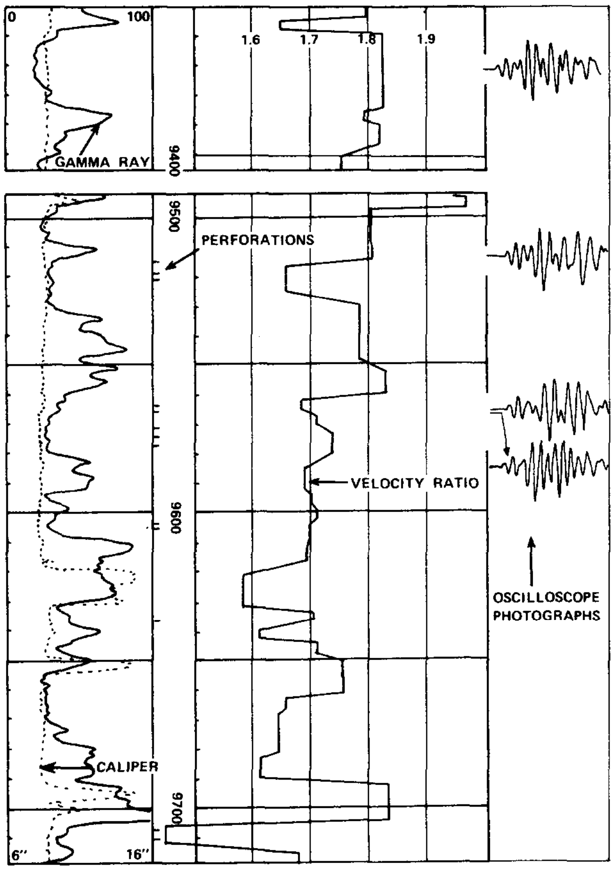

FIGURE 5

lithologies and when gas is present in the rock.

2. Results to date indicate that when the lithology is known, gas can be detected utilizing velocity ratio. The presence of gas makes the velocity ratio smaller than the known ratio for each rock type.
3. Physical rock properties have been measured utilizing well logs and the results have compared favorably with other methods. This information is currently being used in design of well stimulation programs.
4. Additional field tests are needed to establish the technique of gas detection. This approach has been used in cased hole but well completion results are not available. If results prove consistent in other areas, a valuable formation evaluation tool will be added to the tools used in exploration for hydrocarbons.

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ACKNOWLEDGMENTS

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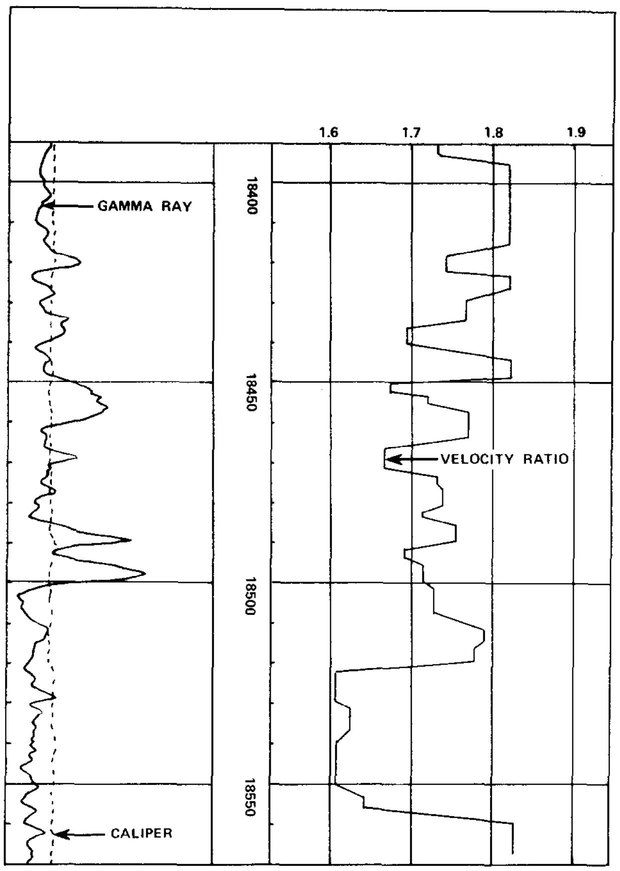

FIGURE 7

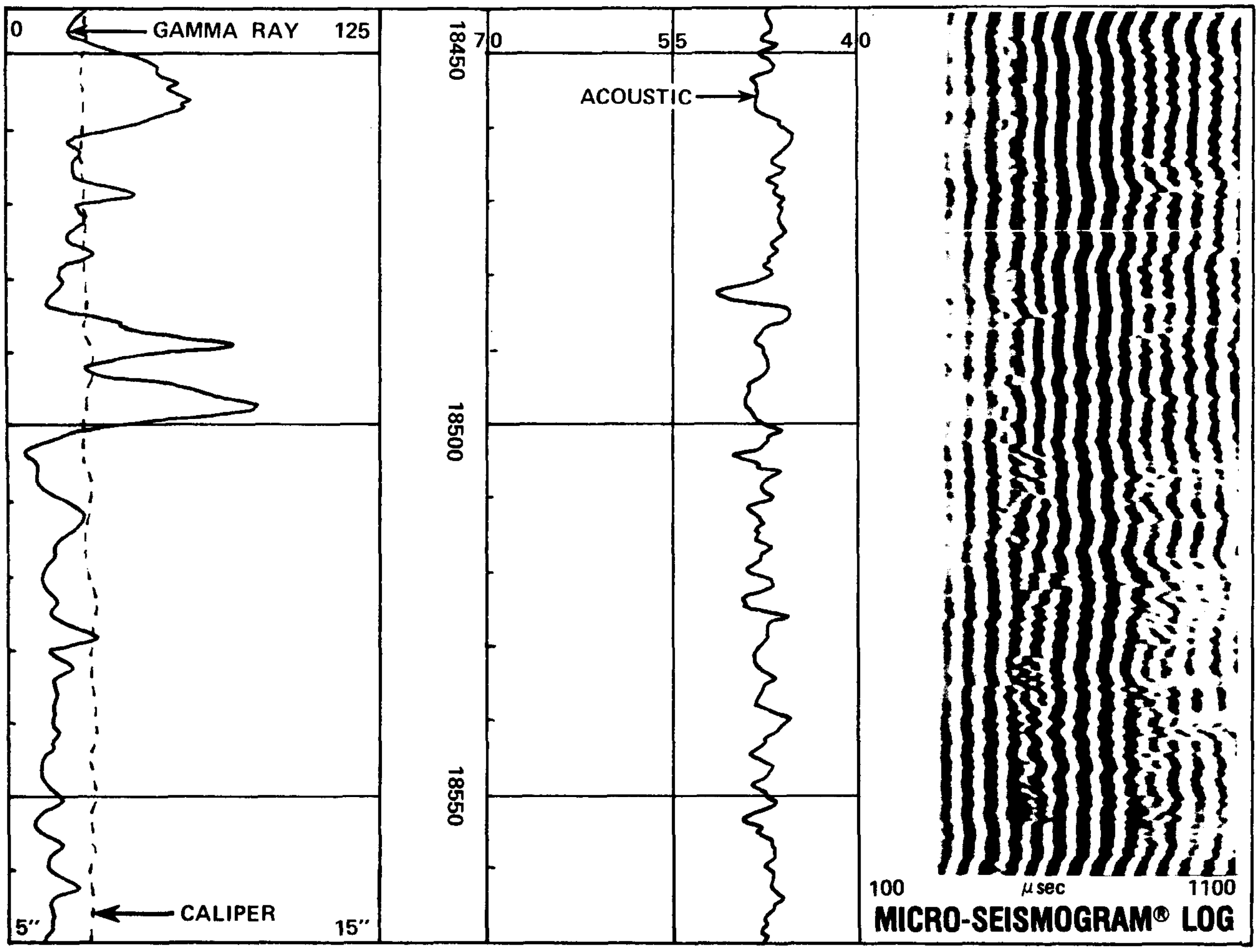

FIGURE 6

express thanks to Terry Walker, Calvin Kessler, and Beth Henderson of Welex. Their efforts in design and application of computer techniques made this paper possible.

TABLE 3

OUTPUT

INTERVAL TOP	INTERVAL BOTTOM	FT.	POIS. RATIO	ELASTIC MODULI YOUNGS	ELASTIC MODULI SHEAR	ELASTIC MODULI BULK	POR. %	VEL. RATIO
18359.	18364.	5.	.261	15.02	5.96	10.46	1.2	1.76
18367.	18373.	6.	.238	15.25	6.16	9.71	1.6	1.71
18378.	18385.	7.	.274	15.14	5.94	11.16	0.8	1.79
18389.	18393.	4.	.250	15.16	6.07	10.09	1.4	1.73
18395.	18397.	2.	.283	15.01	5.85	11.53	0.5	1.82
18400.	18415.	15.	.283	14.15	5.52	10.89	1.4	1.82
18418.	18422.	4.	.254	13.65	5.45	9.24	2.7	1.74
18423.	18426.	3.	.284	14.19	5.53	10.93	1.1	1.82
18429.	18434.	5.	.264	15.81	6.06	10.80	0.7	1.77
18436.	18440.	4.	.232	14.82	6.02	9.21	2.0	1.69
18444.	18448.	4.	.284	13.46	5.24	10.40	1.9	1.82
18450.	18452.	2.	.222	15.09	6.18	9.03	2.1	1.67
18453.	18455.	2.	.244	13.84	5.56	9.02	2.7	1.72
18457.	18463.	6.	.265	14.48	5.72	10.26	1.5	1.77
18466.	18471.	5.	.218	15.88	6.52	9.39	1.4	1.66
18473.	18475.	2.	.249	15.11	6.05	10.03	1.5	1.73
18476.	18480.	4.	.252	14.40	5.75	9.68	2.0	1.74
18482.	18483.	1.	.241	12.76	5.14	8.20	4.2	1.71
18485.	18489.	4.	.259	14.02	5.57	9.70	2.3	1.75
18491.	18493.	2.	.230	14.70	5.98	9.08	2.3	1.69
18495.	18499.	4.	.242	13.66	5.50	8.82	3.2	1.71
18501.	18507.	6.	.248	14.08	5.64	9.30	2.6	1.73
18511.	18514.	3.	.272	13.35	5.25	9.76	2.7	1.79
18516.	18519.	3.	.268	13.83	5.46	9.93	2.3	1.78
18522.	18529.	7.	.183	15.64	6.61	8.23	2.5	1.61
18531.	18536.	5.	.195	15.31	6.41	8.36	2.5	1.62
18539.	18550.	11.	.184	15.71	6.64	8.29	2.3	1.61
18553.	18556.	3.	.205	14.92	6.19	8.42	2.6	1.64
18559.	18567.	8.	.286	13.55	5.27	10.53	1.8	1.83
18574.	18580.	6.	.227	13.54	5.52	8.27	3.6	1.68
18583.	18590.	7.	.214	14.54	5.99	8.47	2.8	1.66
18592.	18597.	5.	.222	15.06	6.16	9.01	2.1	1.67
18602.	18607.	5.	.250	14.22	5.69	9.47	2.2	1.73
18610.	18614.	4.	.201	15.74	6.55	8.77	1.9	1.63
18619.	18635.	16.	.251	14.34	5.73	9.62	2.1	1.74
WGTD. AVG.								
18359.	18635.	180.	.244	14.60	5.88	9.59	2.0	1.72