A Quick Log Analysis PC Program for Field Office Use under the MS-DOS Windows Visual Interface

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ABSTRACT

In the past few years there have been a number of software programs developed to process open hole wireline log data on personal computers. The majority require a thorough knowledge of program documentation to obtain the maximum benefit. When this is combined with the overall reluctance among many users to read documentation, the end result is a less than optimum utilization of processing power. The Microsoft Windows* operating environment for IBM compatible computers was created with the user's needs in the forefront by utilizing the concept of a "visual interface". Programs run under this environment can be executed with a minimum of keystrokes by using a mouse and pull down menus. All options are generally displayed to the user, and a minimum of program knowledge is required to execute an application in this system. To date, though, little use has been made of the Microsoft Windows operating environment in the log analysis software arena. To take advantage of the speed and ease of use, a popular minicomputer-based field log analysis program has been modified to function in the Windows environment. The Quick Log Analysis (QLA)** program is designed to accept the full range of wireline inputs available on the market. The Windows shell allows the user to run the program with a minimum of effort and a minimum of documentation. In addition, the Windows environment allows the user to integrate log graphics, crossplots, reports, and text into a single document. The end result is a user-friendly log analysis program with powerful capabilities.

INTRODUCTION

Since the first electric log was run, oil and gas producers have been striving to take raw wireline data and put it in a form that describes the productivity of their reservoirs. Porosity and resistivity measurements were combined by Archie to describe the reservoir in terms of water saturation. This has evolved to include combining porosity, lithological, resistivity, and electromagnetic propagation inputs to describe the water saturation of the shallow invaded zone and hence the residual hydrocarbons present. Originally these conversions of raw data to reservoir properties were carried out by hand calculations. As technology progressed, the use of computers to perform these conversions became more prevalent. With the advent of the microcomputer, the ability to perform complex conversions of log data to processed output fell within the grasp of most professional log analysts. The processing power available today with the 80286 and 80386 microprocessor based machines is sufficient to handle all but the most complex conversions of log data to processed output. The limitations now appear to be the power of the software performing the conversion.

In designing software for the microcomputer, the programmer has two main tasks at hand. The first is to have the program process raw inputs into polished outputs. This task has been done well in a large variety of microcomputer based log analysis software. Almost any calculation desired can be done with available software, including a wide range of water saturation models and a wide variety of log correction algorithms. The second task is to provide an interface between the program and the user that allows the user to easily perform these complex functions. There has been much less effort put into this aspect than the first task. The "user friendliness" of most available programs became increasingly limited as the complexity of the programs increased. It was this concern that Microsoft sought to address with its Windows operating environment.

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** QLA is a mark of Schlumberger.

THE WINDOWS ENVIRONMENT

The Windows environment for MS-DOS* machines was introduced by the Microsoft Corporation of Bellevue, Washington in November 1985. It introduced the concept of a "visual interface" with software programs. The concept behind this visual interface dated back to the mid - 1970's with work done by the Xerox Palo Alto Research Center. Xerox PARC took a revolutionary approach in designing a user interface - they did real research using actual naive users rather than relying on the instincts of programmers. The visual interface pioneered by PARC was brought into commercial use by Apple Computer, first in their Lisa machine and then on their Macintosh, introduced in January 1984. The Macintosh has been successful in the business and scientific markets primarily because of this visual interface. It is much easier to use than an IBM - PC running MS-DOS. A problem with Macintosh in the petrophysical world is that the great majority of users have MS-DOS hardware and software developed for the Macintosh is not readily transportable to IBM compatible machines. The Windows operating environment for MS-DOS machines brings this visual interface concept to a wider user base and within reach of most petrophysiscists, geologists, and engineers involved in log analysis.

The Windows operating environment allows the user to control the execution of programs by using pull down menus and a pointing device (commonly called a "mouse"). Figure 1 is an example of the MS-DOS executive window for a Windows-based program. By moving the mouse across the table, the arrow on the screen moves as well. The user positions the arrow on the desired option and depresses a button on the mouse twice. This automatically selects the option and executes it. With the exception of renaming files and entering non-default values, a user can execute an entire program without touching the keyboard. In addition, several programs can be running at the same time. The arrows in the upper right hand corner of the screen allow the user to reduce the current program to an icon and go onto another program. For example, if the user is running the Quick Log Analysis program and desires to change their appointment calendar, the Quick Log Analysis program can be reduced to an icon and the "CALENDAR.EXE" program loaded. If the user then desires to work on touching up a report, they can reduce the calendar program to an icon and select the "WRITE.EXE" program. This allows them to run a word processing program while the other two applications are still active. If the system has enough RAM, the user can also load a spreadsheet. The blocks at the top of the screen allow the user to select the drive to use as well. A program can be retrieved from the "A" drive while running a program off the "C" hard drive. In addition, a disk can be formatted on "A" while running a program off the "C" drive. This multitasking ability is one of the key features of Windows.

Another common problem with programs is the selection of an output device. The Windows environment allows the user to choose from a wide variety of printers and plotters. The latest list for Windows 286 version 2.1 includes 128 different output devices (figure 2). Printer manufacturers are continuously adding their printers to this list to accommodate the more than 2 million Windows users. The Windows environment provides the user with a device-independent graphics interface. This means that application programs running under Windows do not directly access the display or printer. This provides a standard interface for all applications.

The change that has taken place in the personal computer industry in recent years has been immense. Many users find themselves with outdated equipment and software the day after they make the purchase. Microsoft has addressed this by writing the Windows program to be easily ported to the Microsoft \ IBM OS\2 Presentation Manager.

The result of all the above features is an ability to have a user friendly environment while still retaining the computational power of the most sophisticated programs for some time to come.

THE QUICK LOG ANALYSIS PROGRAM

One of the earliest computer based log analysis programs was developed by Best, Gardner, and Dumanoir and discussed in a 1978 paper.[1] It was based on the Dual Water Model discussed by Clavier, Coates, and Dumanoir in a 1977 paper.[2] The program used as inputs porosity, resistivity, sonic, and gamma ray tools. The outputs of the program were effective porosity, water saturation, bulk volume water, and apparent grain density. At that time, personal computers were in their infancy. The programs available were initially executed on DEC PDP-11/05 machines, and subsequently PDP-11/34 machines. These machines were installed on field wireline survey units, and the final computation was delivered by the wireline service company engineer at the wellsite. The results of the computation were often used as a tool for pipe setting or completion decisions.

By limiting the use of the program to the field wireline unit, the utility of the program was significantly reduced. Once the unit left location it was difficult to change parameters or do ''what if'' scenarios among ranges of variables. Most clients regarded the program as a ''black box'' and questioned the output. This was somewhat justified in that they had very little control over the input variables. The program was difficult to use as a correlation tool due to the variation in parameter picks among the field engineers. Lastly, if the client was concerned about the privacy of his/her data, this was difficult to obtain as well due to the service company engineer's involvement in the process. The end result was a powerful program being severly underutilized.

With the advent of the microcomputer came the potential to overcome these shortcomings. In mid 1986 the work began on converting the existing FORTRAN code for customer use on their microcomputers. This was at the same time that Microsoft was introducing the Windows program, and the Windows environment appeared to be an excellent vehicle for the program. In early 1988 the first working version was available, with the commercial release of the program in late 1988.

EXAMPLE SCREENS

The first step the user makes is to load Windows. Figure 1 is the first window that appears. To execute the Quick Log Analysis program the user moves the mouse cursor to QLA.EXE and double-clicks the mouse button. This will load the Quick Log Analysis program and display the first window as shown in figure 2. Next the user would load pertinent files by clicking the mouse on ''File'' to display the pull down menu. In the pull down menu the user would select "Load" to display the the Load Files window as shown in figure 3. The Log file is a binary file that was converted from ASCII in a conversion routine, done prior to the execution of the program. The "Style" file sets the format for the log presentation. The style can be customized or standardized for a given field. The "Parameter" file sets the input parameters for the computation such as Rw, shale indicators, and whether or not to correct the resistivity measurements for invasion. After all pertinent files are loaded, the data is ready to be processed and displayed. Figure 4 shows one such log. The log shown in figure 4 is an initial pass through the data with some environmental corrections being made. From this pass the user can determine Rw's and refine some parameters for the final computation. In some cases it may be necessary to use cross plots as an aid in determining parameters. To use the cross plot routine the user selects the "Display" item and from the pull down menu selects "Cross Plot". This transfers the program to the cross plot routine where new cross plots can be built or previous cross plots loaded. Figure 5 shows one such cross plot. After cross plotting the user can refine the parameters by displaying one of the parameter windows. One such window is shown in figure 6. After the parameters are refined the user is ready to process and display the final pass. The final pass is shown in figure 7. Along with the graphical display is a tabular listing that can be built and generated. Figure 8 shows one such tabular report. All 3 of these features, the log display, the cross plot and the report can be combined in a word processing program with text to produce a professional looking document. Figures 9 and 10 give examples of documents generated with Windows programs.

CONCLUSIONS

The integration of a log analysis program and Microsoft Windows is a major step forward in bringing the processing power of the microcomputer to the desks of log analysts. The use of the "visual interface" places the user's needs in the forefront and allows even the most inexperienced computer user to take full advantage of the program's benefits. This combination of user friendliness and computational ability significantly enhances the ability of the geologist or engineer to convert raw data into a more meaningful description of their reservoirs.

REFERENCES

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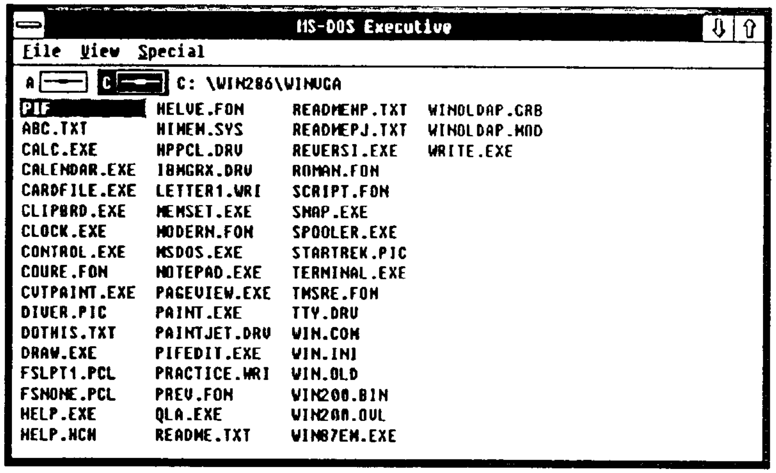


Figure 1

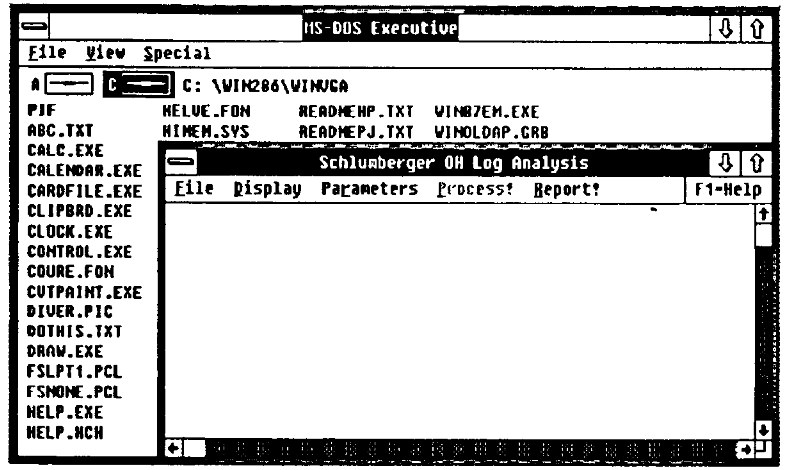


Figure 2

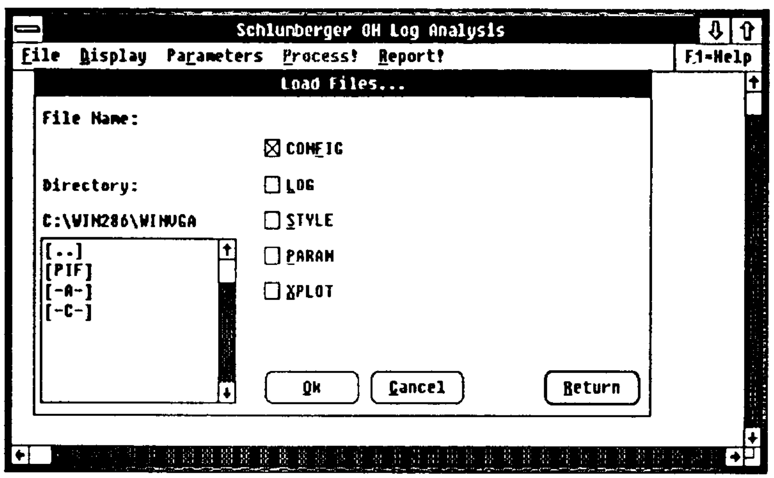


Figure 3

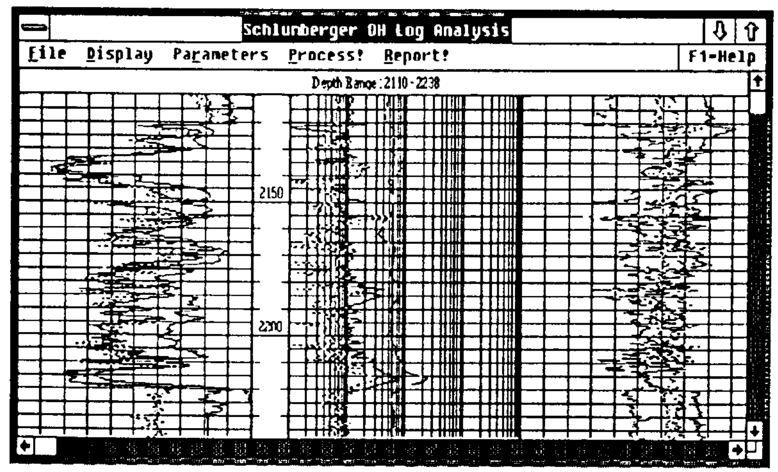


Figure 4

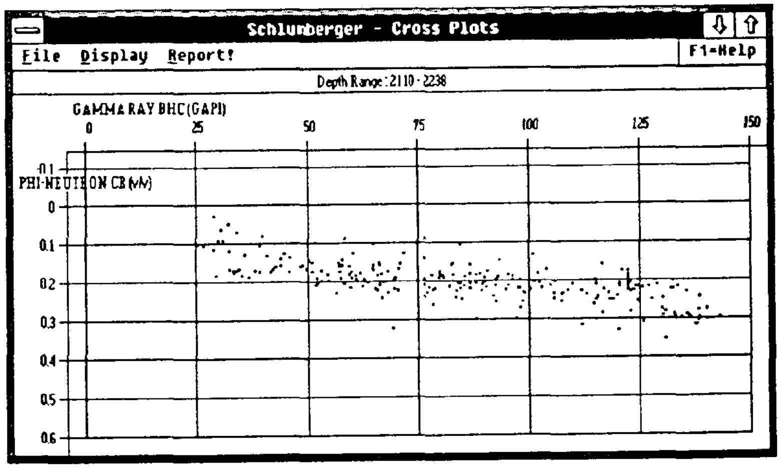


Figure 5

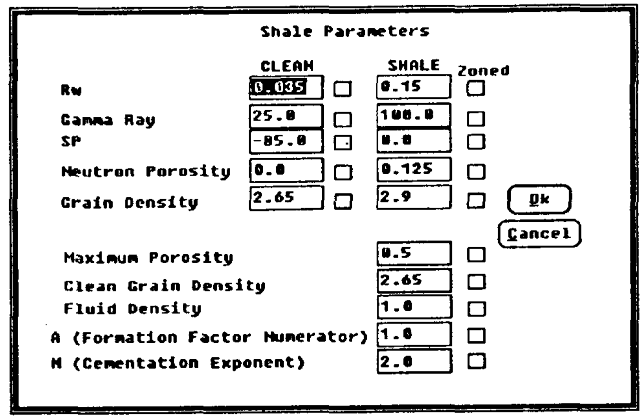


Figure 6

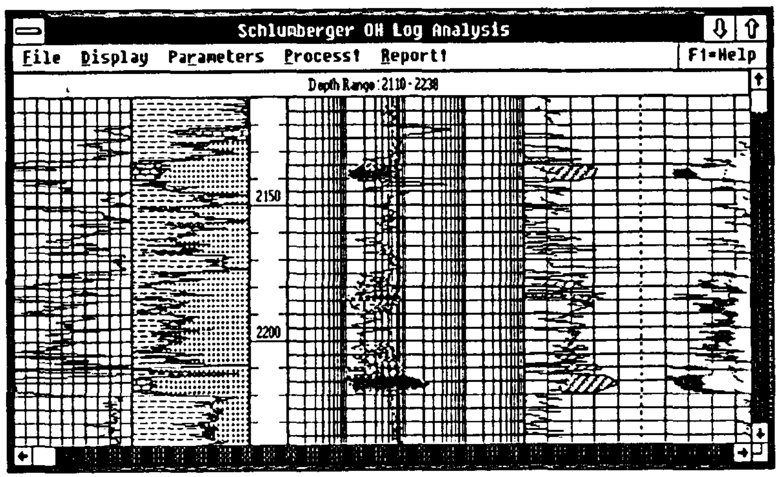


Figure 7

Zone 2 Range 2212.0000 - 2220.0000

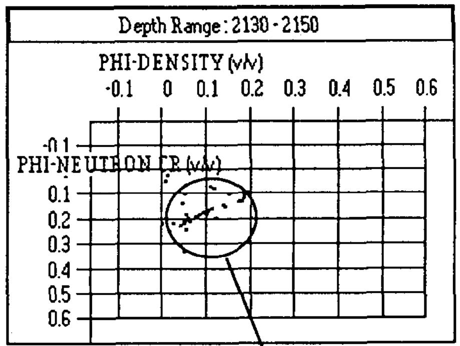
Depth	RT	IPoro	NPoro	EFPoro	GRbhc	BVW	Sxo-EPT	SW	Net
2212.0000	9.63	0.08	0.30	0.00	97	0.00	0.80	1.00	0
2213.0000	10.50	0.18	0.20	0.17	52	0.05	0.57	0.31	1
2214.0000	13.23	0.20	0.18	0.20	29	0.05	0.59	0.26	1
2215.0000	19.61	0.19	0.16	0.18	35	0.04	0.66	0.23	1
2216.0000	24.25	0.18	0.17	0.18	39	0.04	0.68	0.21	1
2217.0000	20.07	0.17	0.17	0.17	33	0.04	0.71	0.24	1
2218.0000	13.87	0.17	0.17	0.17	34	0.05	0.68	0.30	1
2219.0000	10.26	0.14	0.19	0.13	70	0.05	0.59	0.37	1
2220.0000	7.91	0.08	0.24	0.04	120	0.03	0.74	0.93	0
	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	TOT
	14.37	0.15	0.20	0.14	57	0.04	0.67	0.43	7

Figure 8

John,

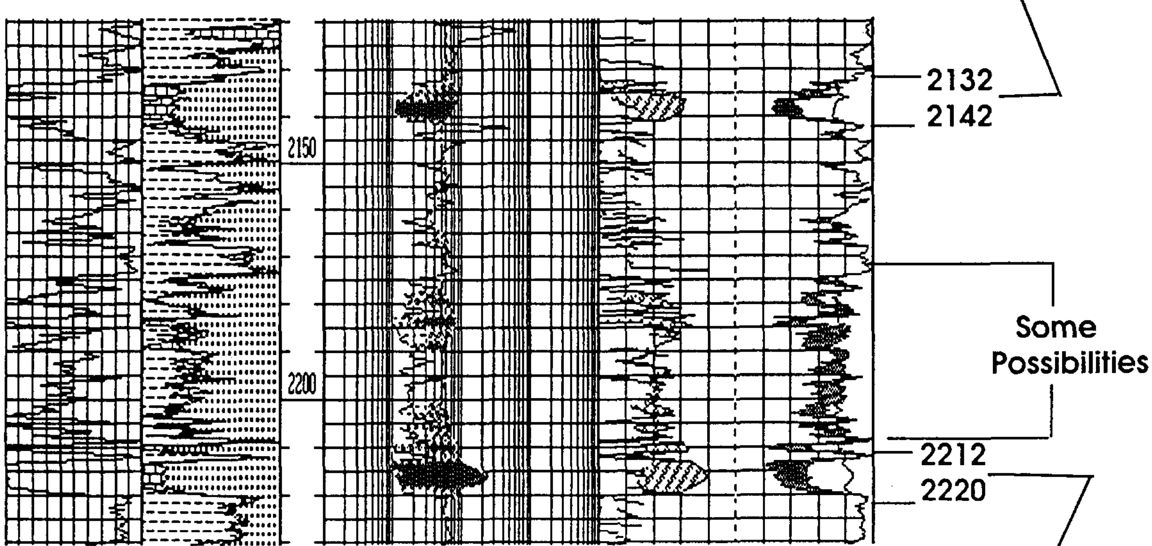
Logging on XYZ well #1 was completed last night. I did a quick analysis of the two main zones at 2132-2142 ft. and 2212-2220 ft. They look very promising. Notice the cross plots from each zone. Both look very clean !! My Net Pay calculations show 5 ft. in zone 1 and 7 ft. in zone 2. (I used RT>6.5, SW<.45 and Phie>.12.)

We're setting up test procedures now and will keep you informed. Good goin' John!!!!



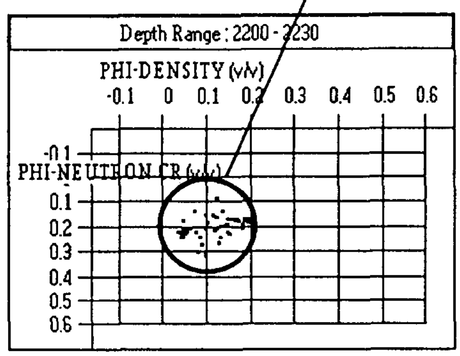
Zone 1 Range 2132.0000 - 2142.0000

Depth	RT	DPoro	NPoro	EFPoro	GRbhc	BVW-F	BVW	Sxo-EPT	SW	Net
2132.0000	6.45	0.05	0.20	0.03	88	0.03	0.03	1.09	0.98	0
2133.0000	7.48	0.11	0.15	0.11	58	0.10	0.06	0.93	0.50	0
2134.0000	7.67	0.06	0.06	0.06	30	0.06	0.06	1.91	1.00	0
2135.0000	8.65	0.15	0.10	0.15	39	0.11	0.06	0.77	0.43	1
2136.0000	9.14	0.11	0.17	0.10	53	0.09	0.05	0.90	0.46	0
2137.0000	8.24	0.19	0.12	0.18	32	0.15	0.07	0.82	0.37	1
2138.0000	7.35	0.19	0.09	0.18	30	0.13	0.07	0.75	0.38	1
2139.0000	6.98	0.19	0.10	0.18	27	0.13	0.07	0.72	0.40	1
2140.0000	6.66	0.17	0.12	0.17	36	0.13	0.07	0.78	0.43	1
2141.0000	5.97	0.12	0.20	0.10	64	0.05	0.05	0.50	0.51	0
2142.0000	4.98	0.01	0.02	0.02	29	0.02	0.02	2.17	1.00	0
	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	TOT
	7.23	0.12	0.12	0.12	44	0.09	0.05	1.03	0.59	5



Zone 2 Range 2212.0000 - 2220.0000

Depth	RT	DPoro	NPoro	EFPoro	GRbhc	BVW-F	BVW	Sxo-EPT	SW	Net
2212.0000	9.63	0.08	0.30	0.00	97	0.00	0.00	0.80	1.00	0
2213.0000	10.50	0.18	0.20	0.17	52	0.10	0.05	0.57	0.31	1
2214.0000	13.23	0.20	0.18	0.20	29	0.11	0.05	0.59	0.26	1
2215.0000	19.61	0.19	0.16	0.18	35	0.12	0.04	0.66	0.23	1
2216.0000	24.25	0.18	0.17	0.18	39	0.12	0.04	0.68	0.21	1
2217.0000	20.07	0.17	0.17	0.17	33	0.12	0.04	0.71	0.24	1
2218.0000	13.87	0.17	0.17	0.17	34	0.11	0.05	0.68	0.30	1
2219.0000	10.26	0.14	0.19	0.13	70	0.08	0.05	0.59	0.37	1
2220.0000	7.91	0.08	0.24	0.04	120	0.03	0.03	0.74	0.93	0
	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	TOT
	14.37	0.15	0.20	0.14	57	0.09	0.04	0.67	0.43	7

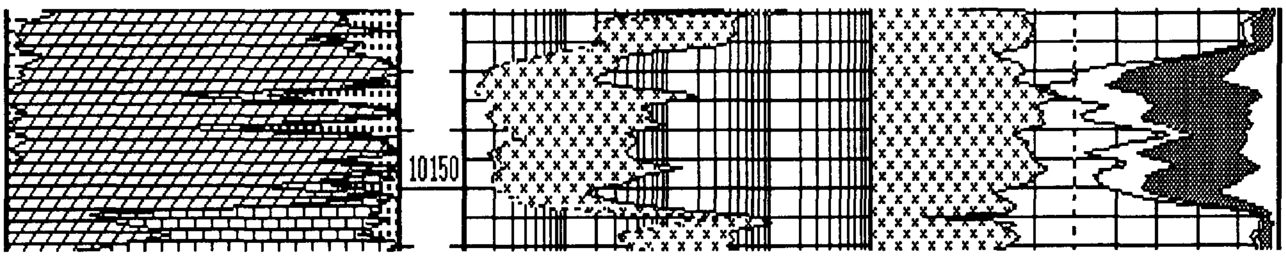


I will get back to you with my analysis on other zones tonight.

Joe

Figure 9

Company CSC Energy		Example 1
Field Left	County Dallas	Texas



Zone 1 Range 10119.0000 - 10155.0000

Depth	NPoro	NPbhc	DPoro	EPoro	RLLD	RT	BVW	PRI	SW	MSI	NET
10119.0000	0.04	0.04	-0.09	0.02	132.0	196.8	0.01	0.01	0.88	0.07	0
10120.0000	0.07	0.07	-0.04	0.03	46.7	79.2	0.01	0.01	0.22	0.12	0
10121.0000	0.09	0.09	-0.04	0.04	30.4	47.1	0.01	0.01	0.24	0.06	0
10122.0000	0.10	0.10	-0.02	0.05	27.5	42.8	0.01	0.01	0.21	0.04	0
10123.0000	0.10	0.11	-0.04	0.05	28.1	45.5	0.01	0.01	0.21	0.03	0
10124.0000	0.09	0.09	-0.02	0.05	26.7	43.7	0.01	0.01	0.21	0.02	0
10125.0000	0.08	0.09	-0.03	0.04	25.4	38.7	0.01	0.01	0.25	0.03	0
10126.0000	0.11	0.11	-0.02	0.06	14.6	24.5	0.01	0.01	0.25	0.02	1
10127.0000	0.16	0.17	0.02	0.09	3.6	4.8	0.03	0.03	0.40	0.08	1
10128.0000	0.21	0.23	0.07	0.14	2.5	3.1	0.05	0.05	0.35	0.08	1
10129.0000	0.27	0.29	0.13	0.20	2.7	3.3	0.05	0.05	0.25	0.05	1
10130.0000	0.30	0.32	0.17	0.24	2.4	2.8	0.06	0.06	0.24	0.03	1
10131.0000	0.30	0.31	0.19	0.25	1.7	2.0	0.07	0.07	0.29	0.03	0
10132.0000	0.31	0.32	0.21	0.26	1.9	2.3	0.07	0.07	0.25	0.02	1
10133.0000	0.32	0.33	0.25	0.30	4.4	5.8	0.04	0.04	0.15	0.00	1
10134.0000	0.28	0.29	0.25	0.27	8.8	17.9	0.02	0.02	0.09	0.00	1
10135.0000	0.27	0.29	0.21	0.25	7.6	11.8	0.03	0.03	0.12	0.00	1
10136.0000	0.26	0.28	0.14	0.21	4.2	5.7	0.04	0.04	0.19	0.02	1
10137.0000	0.30	0.32	0.16	0.23	4.3	7.1	0.04	0.04	0.16	0.04	1
10138.0000	0.29	0.30	0.18	0.24	4.6	6.3	0.04	0.04	0.16	0.02	1
10139.0000	0.23	0.24	0.18	0.21	4.9	9.3	0.03	0.03	0.15	0.00	1
10140.0000	0.20	0.21	0.14	0.17	3.6	5.1	0.04	0.04	0.24	0.00	1
10141.0000	0.21	0.22	0.06	0.13	2.7	4.6	0.04	0.04	0.29	0.05	1
10142.0000	0.27	0.28	0.08	0.18	3.2	4.9	0.04	0.04	0.23	0.03	1
10143.0000	0.27	0.28	0.11	0.20	2.9	4.2	0.05	0.05	0.23	0.01	1
10144.0000	0.30	0.31	0.16	0.24	2.9	4.0	0.05	0.05	0.21	0.03	1
10145.0000	0.25	0.27	0.15	0.21	3.6	4.9	0.04	0.04	0.21	0.04	1
10146.0000	0.25	0.26	0.12	0.19	5.5	8.1	0.03	0.03	0.17	0.00	1
10147.0000	0.27	0.29	0.15	0.22	5.7	10.1	0.03	0.03	0.14	0.00	1
10148.0000	0.27	0.29	0.16	0.23	3.9	4.9	0.04	0.04	0.19	0.00	1
10149.0000	0.26	0.27	0.17	0.22	2.7	3.9	0.05	0.05	0.22	0.00	1
10150.0000	0.25	0.26	0.16	0.21	1.8	2.1	0.07	0.07	0.31	0.00	1
10151.0000	0.24	0.25	0.11	0.18	1.4	1.6	0.07	0.07	0.40	0.00	0
10152.0000	0.21	0.23	0.09	0.16	2.2	2.7	0.05	0.05	0.34	0.00	1
10153.0000	0.16	0.17	0.06	0.11	4.5	6.2	0.03	0.03	0.29	0.01	1
10154.0000	0.05	0.06	0.02	0.04	11.4	21.6	0.01	0.01	0.32	0.00	0
10155.0000	0.03	0.03	-0.00	0.02	55.2	97.0	0.01	0.01	0.74	0.00	0
											TOT
											26

Pay cutoffs used:

Effective porosity	:	> 5%
Bulk volume water	:	< 7%
Water saturation	:	< 50%
Shale index	:	< 10%

Figure 10 — Log analysis