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W.Va. Geological & Economic Survey

Report of Petrologic Characterization of Jackson 1369

(Columbia Gas Transmission Co. Well #11940)

Submitted by

West Virginia Geological and Economic Survey

to the

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REPORT No. 157
SUBJECT TO REVISION

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Contents

Abstract i

Characterization of overall well 1

Characterization of lithotypes 7

Evaluation of analytical methodology 12

Summary and interpretation 15

Conclusions and recommendations 21

Appendices 23

Key to Abbreviations used in Appendices 24

Appendix A - Strip Logs 26

Appendix B - Means and Correlations - Overall Well 54

Appendix C - Means and Correlations by Lithotype 61

Lenticularly laminated shale 62

Thinly laminated shale 69

Non-banded shale 76

Banded shale 83

Siltstone 85

Appendix D - Raw Data 87

Appendix E - Representative Illustrations 92

Lithotypes 93

Fracture types 103

Appendix F - Univariate and Multivariate Analysis 111

ANOVA and MANOVA 112

Multiple Range Test 126

Komolgorov-Smirnov Test 134

References Cited 137

Summary of Contractural Fulfillment 139

List of Contributors 140

List of Figures

Location Map iii

Stratigraphic Division iv

Strip Logs:

LOI 550°C 27

LOI 1000°C 28

Total Sulfur 29

Bulk density 30

Matrix density 31

Log density 32

Porosity 33

Gamma Ray 34

Quartz (Thin section) 35

14 A° Clay (X-ray) 36

Illite (X-ray) 37

Coquimbite (X-ray) 38

Gypsum (X-ray) 39

Kaolinite (X-ray) 40

Hemihydrate (X-ray) 41

Szomolnokite (X-ray) 42

Quartz (X-ray) 43

Pyrite (X-ray) 44

Calcite (X-ray) 45

Dolomite (X-ray) 46

Orthoclase (X-ray) 47

Plagioclase (X-ray) 48

PRELIMINARY

Siderite (X-ray) 49
Ankerite (X-ray) 50
Anhydrite (X-ray) 51
Grain density 52
Lithotypes 53

Lithotypes
Thinly laminated shale 94
Lenticularly laminated shale 96
Banded shale 98
Non-banded shale 100
Siltstone 102

Fracture types
Coarse hackly fractures 104
Cross fractures 106
Subvertical smooth fractures 108
Horizontal fractures 110

Multivariate Statistics
Eigenvector Generation 115
Eigenvector Scores - Lithotype 116

SUBJECT TO REVISION

ABSTRACT

Fifty samples from WV Jac 1369 (Columbia Gas Transmission Corp. Well #11940) were studied in detail in order to characterize the Devonian shale in terms of its petrology. Mineralogical components from X-ray diffractograms, thin section point counts, petrophysical parameters of density and porosity, log-derived values of bulk density (g/cc) and gamma ray deflection (API units), loss on ignition data between 100°C-550°C and 550°C-1000°C, and total sulfur (LECO method) are graphically displayed on computer-drawn strip logs.

For correlation analyses, all samples exclusive of those which are concretions were considered. Statistical treatment was done on the basis of the entire interval and on subdivision into lithotypes. Major differences between lithotypes are in bulk density, sulfur, grain density and organic matter parameters. Additionally, a preliminary statistical comparison of this well with the previously characterized Linc 1637 (Columbia Gas Transmission Co. Well #20403) was undertaken and revealed significant regional differences in certain mineralogical and physical parameters such as porosity, log density, bulk density, sulfur, and quartz.

A classification system for lithotypes observed in the lower part of the Huron Member based on fabric elements is provided with accompanying representative plates. This classification has proven to be applicable to all Devonian shales we have encountered. A preliminary interpretation of depositional environment is included and integrated into previous models. The lower part of the Huron Member is interpreted as being deposited in less anoxic and perhaps deeper water in Jackson Co. relative to Lincoln County. Specific petrographic frac-

ture types are described from the core and related in conjunction with lithotypes in tentatively explaining the high final open flow of this well. Results of the study are summarized in the brief text and are followed by conclusions and appendices of data.

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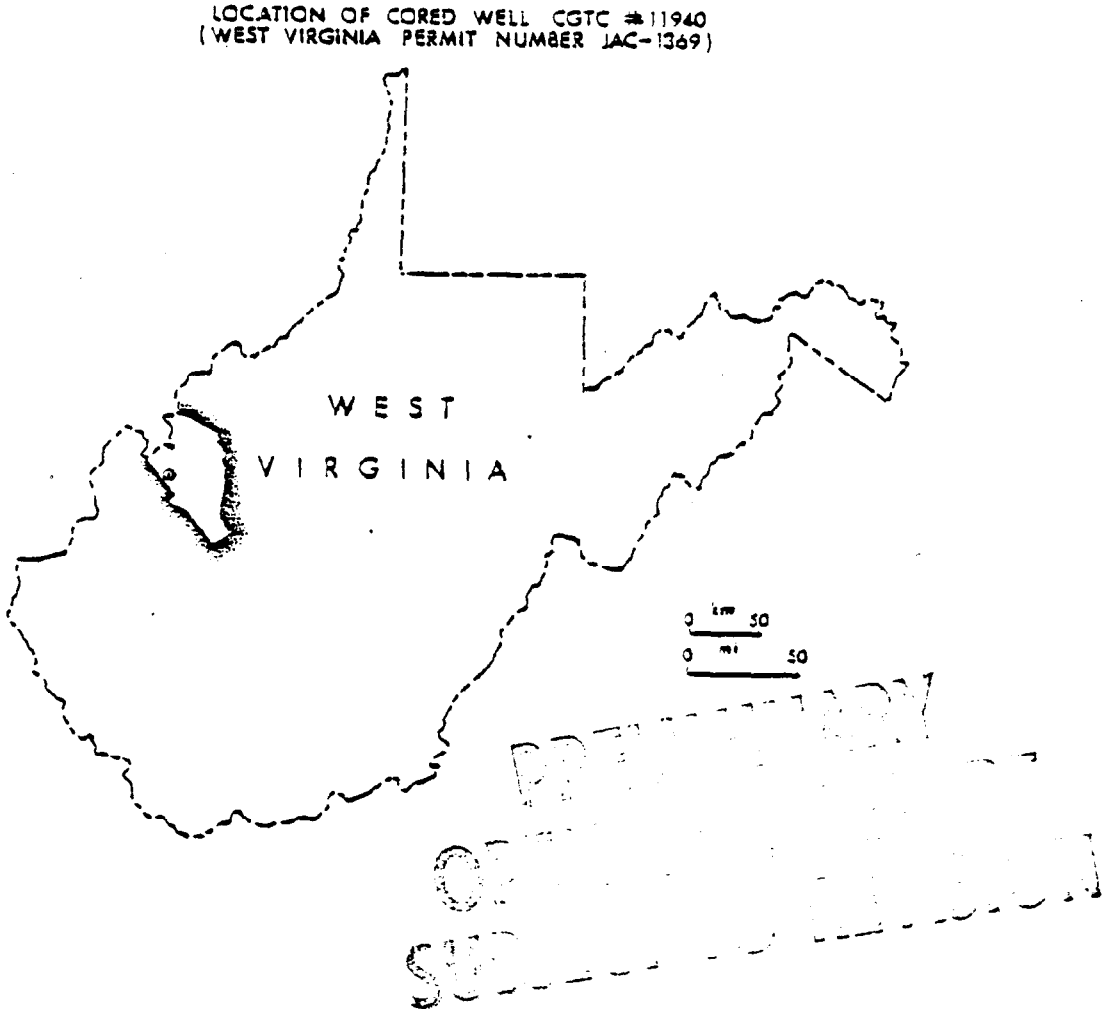

Figure 1: Location of subject well in Jackson County, West Virginia.

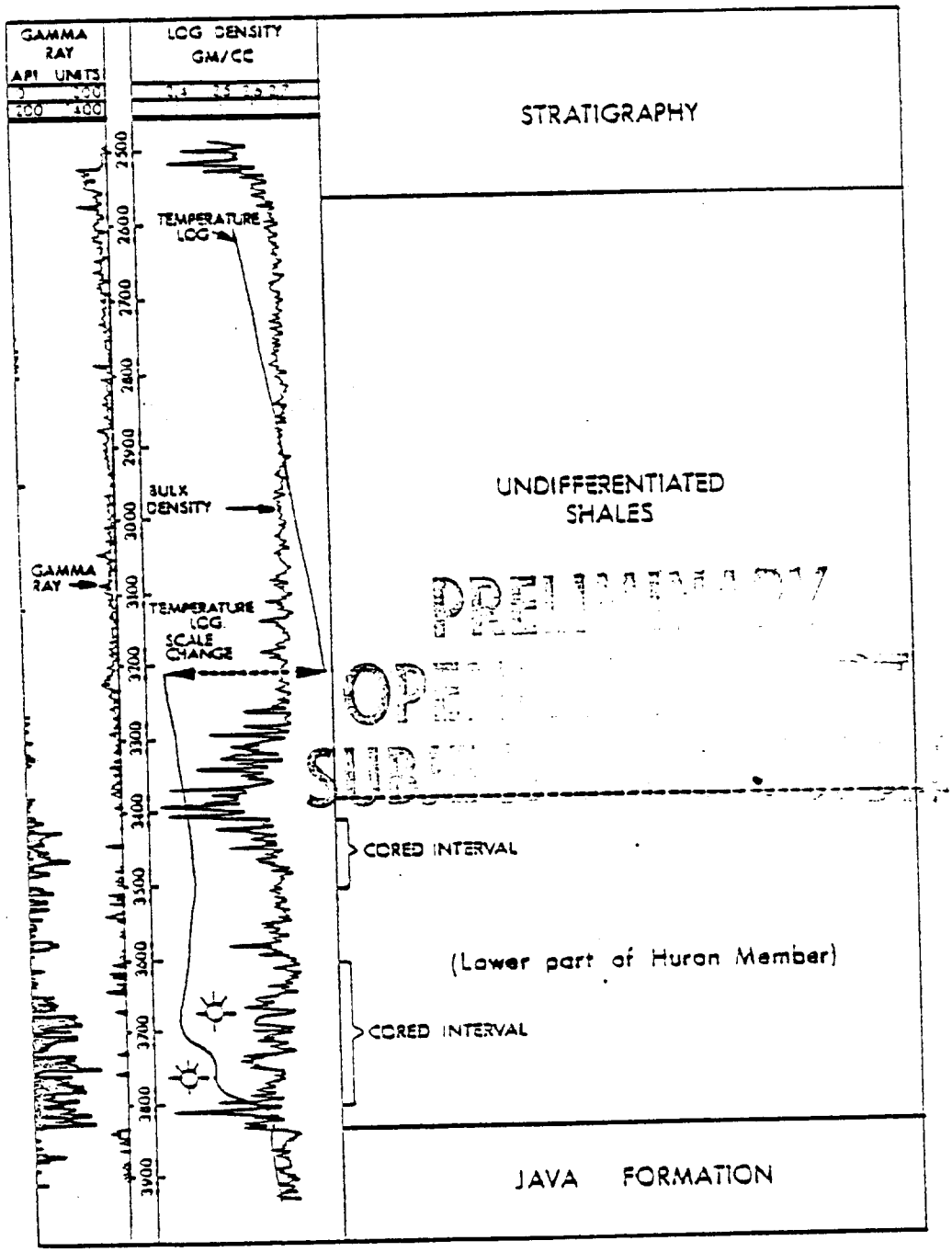

Figure 2: Gamma ray-density-temperature log profile and stratigraphic division of Jac 1369 well, Jackson County, West Virginia.

UGR File # 157
W.Va. Geological & Economic Survey

Characterization of Overall Core Density, Porosity, and Log Parameters

Five types of density were derived for each sample from the subject well:

1) bulk density - measured by immersion of krylon-coated sawed blocks of whole - sample in Kerosene.

2) matrix density - the density of the ground whole - sample as measured by the vacuum-crucible method described by Nuhfer (1978).

3) grain density - the density of the crystalline component of the shales as determined from X-ray mineralogy and established mineral density values tabulated in a number of reference sources. Note that this density excludes organic matter and any amorphous (to X-ray) mineralloids.

4) material balance density - a density computed from the whole rock composition as established by estimates of organic matter from loss on ignition between 100°C and 550°C; from non-pyritic mineralogy as determined by X-ray diffraction and pyritic mineralogy as back-calculated from total sulfur (LECO) analyses. This was used only as a check against matrix density to locate samples with an unacceptable disparity between a directly measured matrix density and a density calculated from composition. Material balance density is not used as a correlation variable.

5) log density - the density taken from the bulk density log at the log depth subjectively selected as corresponding to the sample depth taken from the core.

Porosity was calculated from bulk and matrix density. Precision

of bulk and matrix density is about ±0.01 g/cc. This yields a corresponding porosity precision of about ±0.5%.

Discussion of Statistical Correlations from Overall Core

Bulk Density - Significant negative correlations exist between bulk density and loss on ignition 100-500°C, porosity and gamma ray log response. The correlation with loss on ignition 100-500°C reflects the predictable effect of low density organic matter on bulk density. Concentration of U and Th in organic matter is reflected in the negative correlation (-.59) with gamma ray log response. The correlation with porosity (-.37) likely reflects the lower mean porosity of the higher density (lower organic content) non-banded shales. A very high positive correlation with matrix density (+.93) is explained by the low porosity of all shale lithotypes and documents good precision in measurement of densities in the laboratory.

Matrix Density - Correlations of matrix density mimic those of bulk density because of the low porosity in the shales and are discussed above.

Grain Density - Significant negative correlations exist with thin section derived quartz-feldspar (-.42) and with kaolinite (-.42). These correlations are produced by relatively low grain density argillaceous siltstones that are included in a data matrix of sufficiently low sample number as to be greatly effected by 1 or 2 outlying points. Quartz-feldspar and kaolinite are associated probably due to the diagenetic alteration of feldspar to kaolinite. Grain density shows positive correlations with loss on ignition 100-550°C (+.58), loss on ignition 550-1000°C (+.51), total sulfur (+.52) and pyrite (+.86). The correlations with loss on ignition 550-1000°C; total sulfur, and pyrite reflect the expected increase

in grain density with an increase in pyrite content. Loss on ignition 100-550°C shows a positive correlation (+.51) with pyrite which explains the positive correlation between loss on ignition 100-550°C (organic content) and increasing grain density.

Porosity - A significant negative correlation (-.31) exists with bulk density. In material of constant matrix density, bulk density is theoretically inversely linearly related to porosity. The low correlation coefficient here is attributed to non-constant matrix density and uniformly low porosity values which are individually significantly affected by the error in measurement of even the very precise methodology used by us for porosity determinations. Additionally, the higher bulk density non-banded shales have a lower mean porosity than the lower bulk density finely laminated shales.

Log Density - Weak negative correlations with loss on ignition 100-550°C (-.52), total sulfur (-.43), and pyrite (-.40) are produced by low density organic matter and associated pyrite. Positive correlations with bulk density (+.44) and matrix density (+.58) are surprisingly good considering that the sample depth could not be corrected to the geophysical log depth. The degree of correlation among these parameters is lower than would normally be expected. This is because core samples are point samples which are not strictly comparable to log data acquired as a function of a moving average of instrument response. Considering a gross sample size of two or three feet of borehole, a good approximation of bulk density can be derived from density log values.

Gamma Ray Log Response - Significant negative correlations between this variable and bulk density (-.59), matrix density, (-.56), and log density (-.49) are predictable as a consequence of the well

documented association of higher radioactivity and organic matter in black shales. As with the density log, the moving average response limits direct correspondence with selected point samples.

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Discussion of Statistical Correlations from Overall Core Mineralogic and Loss on Ignition Parameters

Many variables showed significant positive and negative correlations with one another, but the relatively small sample size of the population coupled with the problem of imprecise X-ray data generated from some minerals present in low concentration produced many fortuitous correlations due to one or two outlying points. As such, bivariate scatter plots were used to determine if the trends indicated by the correlation coefficients were indeed characteristic of the lower part of the Huron Member. The following correlations although statistically significant were found to be produced by one to two outlying points and should not be taken as indicative of the lower Huron.

Quartz-feldspar (thin-section) - Ankerite	+.76
Quartz-feldspar (thin-section) - Hemi-hydrate	+.75
Orthoclase - 14 A°clay	-.50
Orthoclase - Coquimbite	+.55
Gypsum - Coquimbite	+.56
Kaolinite - Illite	-.52
Ankerite - Hemi-hydrate	+.95
Plagioclase - Illite	-.49

The following correlations are interpreted from scatter plots as representative of general trends in the lower part of the Huron Member.

Quartz-feldspar (thin-section) - Illite	-.62
Quartz-feldspar (thin-section) - Kaolinite	+.68
Quartz - Illite	-.91

The correlation of thin section quartz-feldspar with illite reflects dilution of one mineral by another. Diagenetically produced kaolinite from feldspar possibly explains the kaolinite association. The strong negative correlation of X-ray quartz and illite is produced by dilution.

Loss on ignition 100-550°C - Pyrite	+.51
Loss on ignition 550-1000°C - Pyrite	+.50
Loss on ignition 100-550°C - Sulfur	+.54
Loss on ignition 550-1000°C - Sulfur	+.60

The association of loss on ignition 100-550°C with pyrite and total sulfur reflects the high pyrite content of organic rich shales within the lower part of the Huron Member. Pyrite and total sulfur correlate with loss on ignition 550-1000°C as expected, but the loss of carbonates on heating probably limits the correlation.

Characterization of Lithotypes in Devonian Shale of Jackson 1369

The lower part of the Huron Member in Jackson 1369 contains many shale lithotypes and is not overwhelmingly dominated by any one type. In this respect, the lower Huron of this well differs from that of the lower Huron described as dominated by a single lithotype in our previous report on Linc 1637 (Nuhfer, Vinopal, Hohn,et.al., 1978). In Jackson 1369, correlation of physical and compositional variables of the stratigraphic unit as a whole tends to mask any significant correlations within a specific lithotype. Correlations by lithotype are listed in Appendix C. A shale classification based on fabric elements was first used in characterizing the Lincoln 1637 well (Nuhfer and Vinopal, 1978; Nuhfer, Vinopal, Hohn and others, 1978) and later modified in Nuhfer and Vinopal (1979). Five types of shale are defined: 1) Non-banded shale is generally devoid of preferred orientation of any visible fabric elements except for the orientation of clay laths due to compaction. Some samples show occasional thin laminae defined by varying silt content, but most appear massive in thin section and radiographs. This lithotype is usually extensively burrowed, commonly contains nodular pyrite and is not associated with gas productivity. 2) Sharply banded shale imparts a coarse linear fabric produced by alternate light and dark bands up to several cm in thickness. Boundaries between bands are sharp. In core sized samples, the bands extend across the core. Pyritized spores, large framboidal aggregates, pyrite-filled "synaeresis cracks" and occasional nodules are present. This shale type is not associated with gas production. 3) Lenticularly

laminated shale exhibits a linear fabric produced by alternate light and dark laminae up to a centimeter in thickness. However, the boundaries between laminae are often undulatory. Bioturbation is common at laminae boundaries. In core sized samples, the laminae are more discontinuous and thicker compared to the thinly laminated shale type. This shale type may be associated with gas production depending on its organic content and lateral continuity of porous pyrite bodies. 4) Thinly laminated shale consists of uniformly thin, discontinuous laminae caused by wispy concentrations of silt, pyritic matter and organic matter. Most laminae are less than 2 mm in thickness. Laminae boundaries are even, sharp and rarely undulatory. Pyrite occurs mainly as very fine particles and framboids. Traction features and burrows are rare. This shale type is associated with gas production, gas shows, and is present in the productive lower portion of the Huron Member in Jackson County, 5). Combinations of the above types, where two or more of the above types occur within a small (hand specimen-sized) portion of the vertical profile. Additionally, two non-shale lithotypes are present in minor amounts in the lower part of the Huron Member in Jackson Co., crossbedded argillaceous siltstones and concretions.

Thinly laminated shale - Within the cored portion of the lower part of the Huron Member, thinly laminated shales comprise approximately one third of the samples collected. Thinly laminated shale is analytically distinguishable from non-banded and sharply banded shales by its higher LOI organic content. Mean organic content (5.8%) is slightly higher than that of lenticularly laminated shale (4.7%). Mean total sulfur and pyrite content is not significantly different from that of the lenticularly laminated shales, but is

higher than that of the non-banded shales. Mean matrix density and bulk density is lower than that of non-banded shale reflecting the higher organic content. However, the mean grain density is not significantly different from those of the other lithotypes indicating that mineralogic differences are not great. Mean porosity (1.3%) is not different from that of the lenticularly laminated shales (1.5%) and non-banded shales (1.0%). Log parameters of bulk density and gamma ray response do not differentiate finely laminated core samples from the other lithotypes in this well. Many of the correlations shown in Appendix C with magnitudes .50-.65 are not real, produced by the small sample size and the fact that many of the data values for minor components are zero. An example of this effect is shown by the correlation between coquimbite and illite (-.59); many of the samples have a coquimbite value of zero and only a few points induce the correlation. Truly significant correlations generally appear between sample depth, LOI (organic content) and density parameters. Loss on ignition 100-550°C shows predictable negative correlations with bulk density (-.81) with sample depth probably reflecting the correlation between LOI 100-550°C and sample depth (+.65). The thinly laminated shales in the lower portion of the core contain more organic matter.

<u>Lenticularly laminated shales</u> - Within the cored interval, lenticularly laminated shales comprise about one third of the samples collected and appear to be relatively more abundant in the lower portions of the core. The means of LOI organic content and sulfur fall between those of the thinly laminated and non-banded shale types. Several of the lenticularly laminated shales have an organic content equal to that of the finely-laminated shales. Most significant correlations involve LOI organic content, sample depth,

and density parameters. Density log values show no correlation with sample derived bulk density. Thin section quartz (-.64) and 14 A° clay (-.55) show negative correlations with sample depth which reflect dilution by an increasing illite content (+.68) with sample depth. LOI organic content has a moderate positive correlation (+.72) with grain density, which reflects the association between LOI organic content and high density pyrite (+.73). The negative correlation (-.59) between bulk density and porosity is not real and is due to variable matrix density. The correlations of bulk density with dolomite (+.71), gamma ray response with orthoclase (-.55) and coquimbite with pyrite (-.78), calcite (+.96), dolomite (+.81), grain density (-.80) and hemihydrate (-.82) are not representative and represent correlations induced by a few data points.

<u>Non-banded shale</u> - Non-banded shales comprise approximately one fourth of the samples collected and appear to be relatively more abundant in the upper and basal portions of the core. This lithotype has the lowest mean sulfur, pyrite, porosity and LOI organic content values. Correspondingly, mean bulk density and matrix density are higher than other shale lithotypes due to the lower organic content. Log characteristics (bulk density, gamma ray response) do not significantly differ from those of other lithotypes. Log density shows no correlation with sample derived bulk density, possibly because of a small data base. Pyrite shows a strong correlation (+.85) with total sulfur which is much higher than that of the other lithotypes and possibly indicates the presence of non-crystalline iron sulfudes in the other lithotypes. The strong negative correlation (-.90) between quartz and illite, the two major mineral components, reflects dilution of one mineral by another.

The correlations of illite with dolomite (-.83) and bulk density with coquimbite (+.76), and matrix density with coquimbite (+.66) represent the biasing effect of one or two points on an overall trend of no correlation. Porosity shows a moderate correlation (+.61) with matrix density which is in agreement with the association of porosity and pyrite in Devonian shales described by Nuhfer and Vinopal, (1978).

Siltstones - Crossbedded siltstones with low mean porosity (1.48%) make up a minor portion of the core. The combination of appreciable argillaceous matrix and carbonate cement limits porosity.

Sharply banded shale - Sharply banded shales are present in small amounts, but the population size is inadequate for statistical treatment.

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Evaluation of Analytical Methodology

Bulk density - Precision of bulk density is better than 0.005 g/cc. It is reported to two decimal places, both being valid and reliable.

Matrix density - Precision of matrix density is better than 0.01 g/cc. Several methods of matrix determination were examined, but the vacuum crucible method devised by Nuhfer was as reproducible as any ASTM mehtod examined and was much faster. Rock powders dried at room temperature were utilized. It was proven by examination of sample on individual thermograms that ground shales dried at high temperatures (80-100°C), even at atmospheric pressure, lose hydrocarbon material, a factor which will result in erroneously high porosity being calculated from density measurements. Comparison with material balance density shows only a few variations which might be caused by erroneous data.

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Porosity - Precision is better than 0.5%; calculated from bulk and matrix density. The low range of porosity values abailable generally prevents linear correlations from being established with any other variables.

Loss on Ignition - Measured on a high precision (±0.001 g) balance on samples at least 2 g in weight. Precision appears to be ±5% per determination, with variations being caused by sample inhomogeneity and non-uniform heating of the muffle furnace. Organic matter is approximated by LOI between 100° & 550°C, a second LOI from 550-1000°C reflects loss of CO_2 from carbonates, some S from sulfides, and some tightly bound waters in clay minerals.

X-ray diffraction mineralogy - Precision estimated as ±10% per determination on mineralogy >10% in total concentration; ±50% on minerals present in concentration between 5%-10% and as much as ±100% on low concentration materials. At this time, uncertainty with respect to stoichiometric composition, amounts of any amorphous mineralloids and further lack of information with respect to effects of matrix differences (arising from compositional changes between thinly laminated lithotypes at one end, and non-banded lithotypes at the other) prevent one from making complete estimates of the accuracy of determination of each mineral. Comparisons of X-ray diffraction data with preliminary geochemical data and of X-ray diffraction-based material balance density with matrix density are still in progress.

Total Sulfur - Precision is apparently ±15% per determination from analyses of ground sample.

Thin Section Point Counts - As discussed in Nuhfer, Vinopal and Hohn (1978), point counting of shales appears imprecise relative to estimating amounts of mineralogic and organic components in Devonian Shales. The percent of silt, assumed to be proportional to the amount of thin section quartz-feldspar, is useful in making sedimentologic interpretations and was determined for each sample. Additionally, thin section petrography was used extensively in fabric analysis of shale lithotypes and in examining crystal textures in filled fractures. Reproducability depends on consistence of microscopist. It is advisable to have only one microscopist do all of the point counts for a single well in order to yield the best between-sample comparisons.

Sample Selection - Samples must be selected and carefully prepared so that truly equivalent rock material is compared on all

tests. This was accomplished by vertical slabbing of material from the thin-section blank for petrophysical, mineralogical, and geochemical analyses. The necessity of adhering to a scheme to produce equivalent samples cannot be overemphasized. It is imperative that only a skilled, conscientious technician be entrusted with responsibility for initial subsampling. Samples which yielded apparently anomalous results were run in replicate. Where replications reconfirmed the anomalous values, the data were retained. The chance, however, still exists in these cases that an abrupt lateral variation caused inconsistent materials to be compared, producing anomalous values.

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Summary and Interpretation

The 50 samples taken from the 297' core of Jac 1369 have been classified into six lithotypes based on fabric elements as seen in radiographs and negative prints (5x) of thin sections. Non-shale lithotypes; siltstones and concretions, are of minor abundance in the core. The four shale types are:

1) Thinly laminated
2) Lenticularly laminated
3) Sharply banded
4) Non-banded

The numerical order from 1 (thinly laminated) through 4 (non-banded) is a generally valid progressive order which reflects compositon with respect to decreasing organic matter and decreasing pyritic matter. This order also reflects a trend from highly ordered fabric in the finely laminated lithotype towards a more random fabric in the non-banded type. A cross section through the Cottageville Field in Jackson Co. (Patchen, 1977) shows that major gas pays are associated with the higher radioactive upper and basal portions of the lower Huron interval which contain relatively more organic rich finely laminated and lenticularly laminated shale than bounding stratigraphic zones. Because the lateral continuity is greatest in the thinly laminated lithotype, this fabric may favor lateral conduction of gas.

The subject well (Jac 1369) had a very high final open flow of 1007 MCF/day and is located at the southwestern margin of a linear trend of high natural open flow wells (Nuckols, 1978). This linear trend has been interpreted by Sundheimer (1978) as associated with

underlying basement faulting associated with the Rome Trough. Fractures seen in the partial core of 1369 appear to be a factor in establishing high productivity. However, blanket application of the term "fracture porosity" without considering the degree of permeability enhancement and porosity induced by specific petrographic fracture types creates an oversimplified model of the shale as a reservoir.

Current theories of the role of fractures in shale gas production ascribe large volumes of free gas to megascopic and microscopic fracture systems in the shale (Science Applications Inc., 1977). Characterization of WV 1637 (Lincoln Co.) (Nuhfer, Vinopal, Hohn, et. al., 1978) failed to find any such extensive system of microfractures in the productive lower Huron and Rhinestreet intervals in that well. A large number of samples were examined by X-radiography and optical and scanning electron microscopy in both wells. No microfracture system was observed in the highly productive WV 1369 well described in this report. Additionally, the mean porosity of the lower portion of the Huron Member and the finely laminated lithotypes in the lower Huron is significantly lower in the Jac 1369 well than in the Linc 1637 well. If any microfracture system capable of contributing significantly to rock porosity was present in the highly productive Jac 1369, it should be reflected in higher porosity values. Permeability tests by Core Laboratories did not show permeability values for selected samples from Jac 1369 to be significantly different from shale wells characterized by lower productivity.

In contrast to any postulated system of microfractures, we feel that gas moves out of the matrix to the wellbore and to any connecting permeability enhancing fractures by diffusion through the finely

laminated and lenticularly laminated shale. Productivity in these lithotypes is favored by richer organic content, which enhances sorption capacity, and lateral continuity of fabric which favors lateral outgassing of the rock. Free gas in megascopic fractures connected to the wellbore has been commonly invoked to explain the initial years of high gas production from some shale wells. No worker, however, has proven the existence of a fracture system of sufficient volume to account for such long term production. Schettler (1977, 1978) postulates such fractures may be depleted in shorter periods of time (perhaps in hours) and that gas diffusion from the shale matrix contributes almost exclusively to total gas production. The Jac 1369 well had an initial test of 4700 MCF but quickly blew down to a final open flow of 1007 MCF. This observation probably represents the rapid depletion of free gas from the megascopic fractures. Volume of fracture pore space should be estimated from measurements made on large numbers of actual core samples, and not carelessly invoked without further supporting data to explain long-term "free gas" production.

In the subject core, several petrographic fracture types were noted and are tentatively classified in terms of possible permeability and porosity enhancing characteristics. Where the temperature log indicated gas influx from the lower part of the Huron Member, fractures were noted in core samples that had prominent coarse hackles creating a rough surface. Slight movement along the uneven fracture surface created numerous "voids" and "vugs" that are only partially mineralized. This type of fracture was observed in samples from 3720 to 3739 feet. Other examples may have been present further down the core, but the core had been badly picked over and disarranged prior to sampling by us. These fractures are interpreted

as contributing significantly to permeability. Relatively smooth sub-vertical fractures that were infilled by carbonates were observed in this same depth interval. These fractures probably do represent an increase in permeability over that of the shale matrix, but appear to have low to moderate intercrystalline porosity. Between two such parallel smooth fractures spaced 3 cm apart, partially open cross fractures were occasionally observed. These crossfractures are not propped open by partial mineralization, but retain some porosity and a high degree of permeability as a consequence of surface roughness and movement. Near the bottom of the core at 3789 feet, horizontal mineral filled fractures were noted. These fractures are tightly cemented by large dolomite crystals that have few intercrystalline boundaries and contacts. As such, the porosity of these fractures is quite low. Permeability may still be higher than that of the shale matrix because of a greater ease of diffusion along the interfaces of the coarse crystals. Additional investigations on the nature of fracture mineralization and surface features of fractures observed in Devonian shale cores and outcrops is currently in progress.

Environments of Deposition

A general depositional model for the Devonian shales developed from vertical profile analysis of the most complete stratigraphic sequence available in a core (Lincoln - 1637) is presented in Nuhfer and Vinopal (1979). The lower part of the Huron Member in that well is interpreted as a nearshore shallow-marine shelf environment. In Linc 1637, dominance of the thinly laminated lithotype, the lack of traction features and the lack of borrowing suggest a quiet anoxic environment. The lower part of the Huron Member in Jac 1369 shows a different frequency of lithotypes than that noted in the Linc 1637 core. More non-banded and lenticularly laminated shale is present in Jac 1369. Additionally, the mean quartz content of the lower Huron is lower in Jackson County. This difference in quartz content is also present in the thinly laminated lithotype. The greater relative abundance of lenticularly laminated shales and non-banded shales coupled with the lower total quartz content is interpreted as indicating an environment further from the source area in less anoxic and perhaps deeper waters for the lower Huron in Jackson County. In a deeper-water shelf environment, conditions that produce stratification and restriction of circulation, would be more frequently disrupted by the effect of impinging regional basin currents. Perhaps eustatic, climatic, or tectonic changes affected basinal circulation allowing stratification to exist for moderate periods of time resulting in bundles of finely laminated shale in the upper and lower portions of the lower part of the Huron Member in Jackson County. The destruction of stratified waters on the shelf would increase bottom circulation permitting

inhabitation by burrowing organisms and producing non-banded and lenticularly laminated shales. The lower portion of Huron Member correlates with turbidite sands to the east. Some of the sediment in the non-banded and sharply banded shales in Jac 1369 may be the distal pulses of fine silt and clay carried in by waning turbidity currents. The distance from the postulated eastern turbidite sand accumulation to Jackson County is approximately 75 miles, which is not an unreasonable distance for turbidites to move fine grained material.

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Conclusions and Recommendations

1) Within a specific stratigraphic unit, many varied shale lithotypes can be present with widely differing organic matter contents and fabric elements. Characterization of a stratigraphic interval should be presented in terms of specific rock lithotypes.

2) Comparison of depth unconnected core samples with geophysical logs indicates that point samples of different lithotypes cannot commonly be correlated to significantly different log response. As such, cable tool or air rotary samples selected for analysis from a stratigraphic unit must be carefully evaluated before interpreted as indicating significant interwell differences. Future well cores should be logged with a surface scintillometer in order to make comparison between log data and sample data more objective.

3) Different petrographic fracture types exist, which influence permeability and porosity to varying extents. In tentative order of permeability enhancing characteristics they are: 1) coarse, hackly, partially mineralized, vertical fractures, 2) partially mineralized cross fractures between two vertical fractures, 3) tightly mineralized sub-vertical to vertical fractures, 4) tightly mineralized horizontal fractures. Further research on the physical properties and origin of specific petrographic fracture types is in progress to order to integrate them into a reservoir model.

4) The highly productive Jac 1369 well is interpreted in terms of a favorable lithotype combined with a specific petrographic fracture type (coarse, hackly, partially mineralized fractures) that enhances permeability. An additional core should be taken in

the high producing zone of the Cottageville Field to determine the extent of favorable fracture types in organic rich shales below the lower Huron.

5) Statistical relationships between analyzed variables are summarized in the discussion and in the appendices. However, in general, organic content and pyritic matter are the primary factors which cause variability in the shales. Refer to Nuhfer, Vinopal, Hohn, et. al., (1978) for additional conclusions and recommendations from the characterization of Linc 1637.

6) The lower part of the Huron Member in Jackson Co. shows significant differences when compared to the same unit in Lincoln County. Specifically less quartz, pyrite and organic matter is present in the lower portion of the Huron Member in Jackson County. Mean porosity is lower. Mean bulk density and log density are higher due to the overall lower organic content. These differences reflect the greater diversity (more non-banded and lenticularly laminated shales) of lithotypes present in Jackson County. The difference in lithotype abundance is due to different depositional environments with the lower portion of Huron Member interpreted as being deposited in less anoxic and perhaps deeper water in Jackson County.

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APPENDICES

Key to Abbreviations in Appendices

SAMPLE - sample number, corrected depth in feet

LOSIG 100 - weight % loss on ignition, 100-550°C

LOSIG 500 - weight % loss on ignition, 550-1000°C

SULFUR - total weight % sulfur from LECO method

STRAT - this is simply a numerical designation (3) representing the lower Huron interval defined in the well.

BULKDEN - bulk density (g/cc) measured on core sample

MATRXDEN - matrix density (g/cc) measured on core sample

LOGDEN - bulk density (g/cc) from density log

POROSITY - percent porosity of samples from matrix and bulk density measurements

GAMMA - API units from gamma ray log

QUARTZ - percent quartz-feldspar (silt) measured in thin section

EXP - relative amount of 14°A clay mineral by X-ray diffraction

ILL -	"	"	"	illite	"	"
COQ -	"	"	"	coquimbite	"	"
KAO -	"	"	"	kaolinite	"	"
HEM -	"	"	"	hemi-hydrate	"	"
ANH -	"	"	"	anhydrite	"	"
SZM -	"	"	"	szomolnokite	"	"
QTZ -	"	"	"	quartz	"	"
PYR -	"	"	"	pyrite	"	"
CAL -	"	"	"	calcite	"	"
DOL -	"	"	"	dolomite	"	"
ORT -	"	"	"	orthoclase	"	"
PLA -	"	"	"	plagioclase	"	"

SID - relative amount of 14°A siderite by X-ray diffraction

ANK - " " " ankerite " "

GRDEN - computed grain density (g/cc) of sample using compositional percentages

PRELIMINARY
OPEN FILE REPORT
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APPENDIX A

STRIP LOGS OF PARAMETERS

PRELIMINARY
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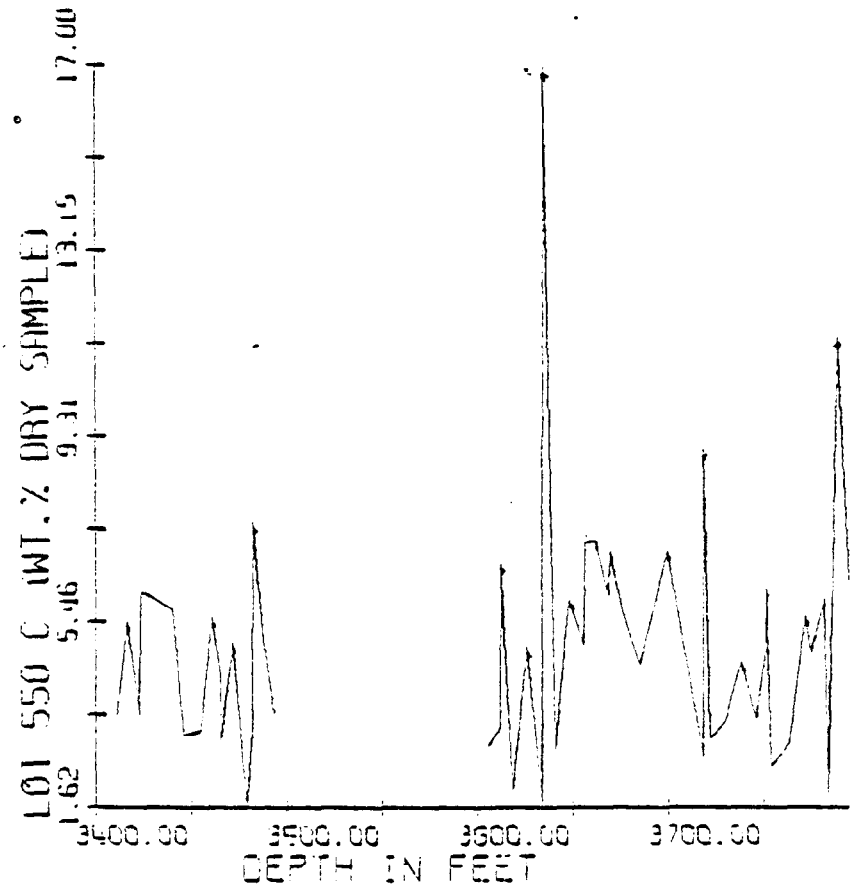
SUBJECT TO REVISION



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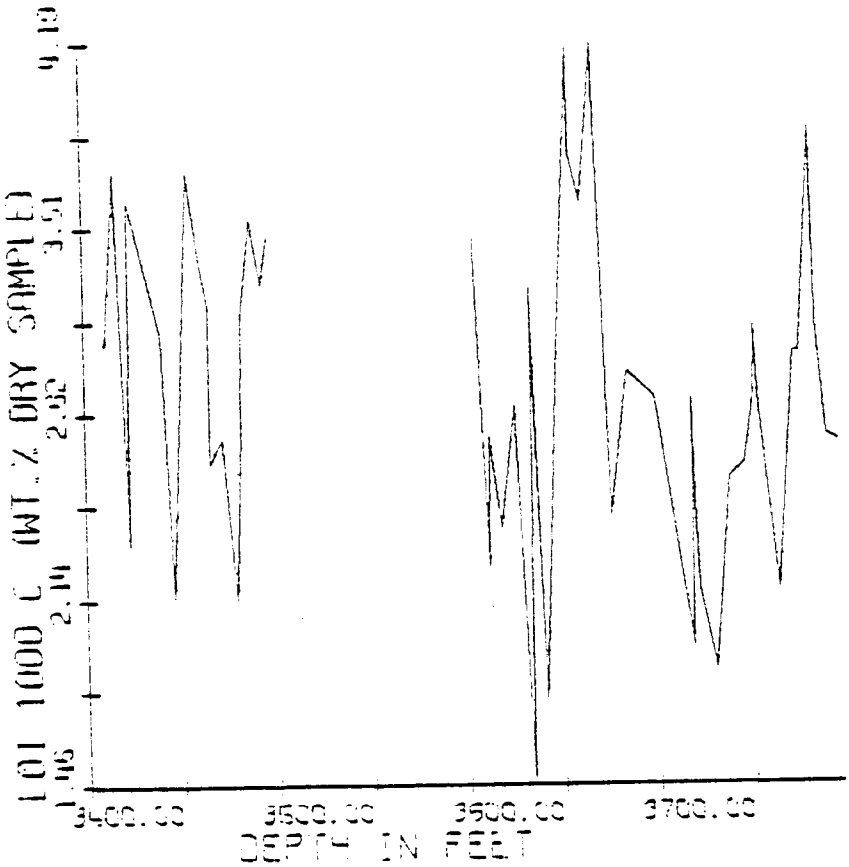

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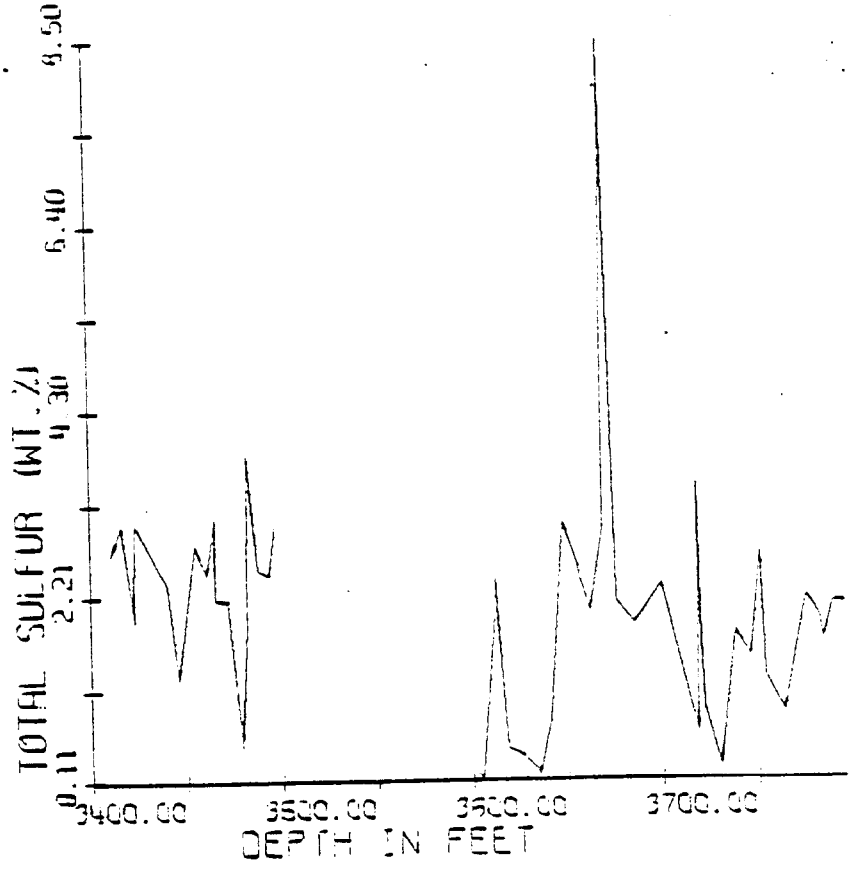

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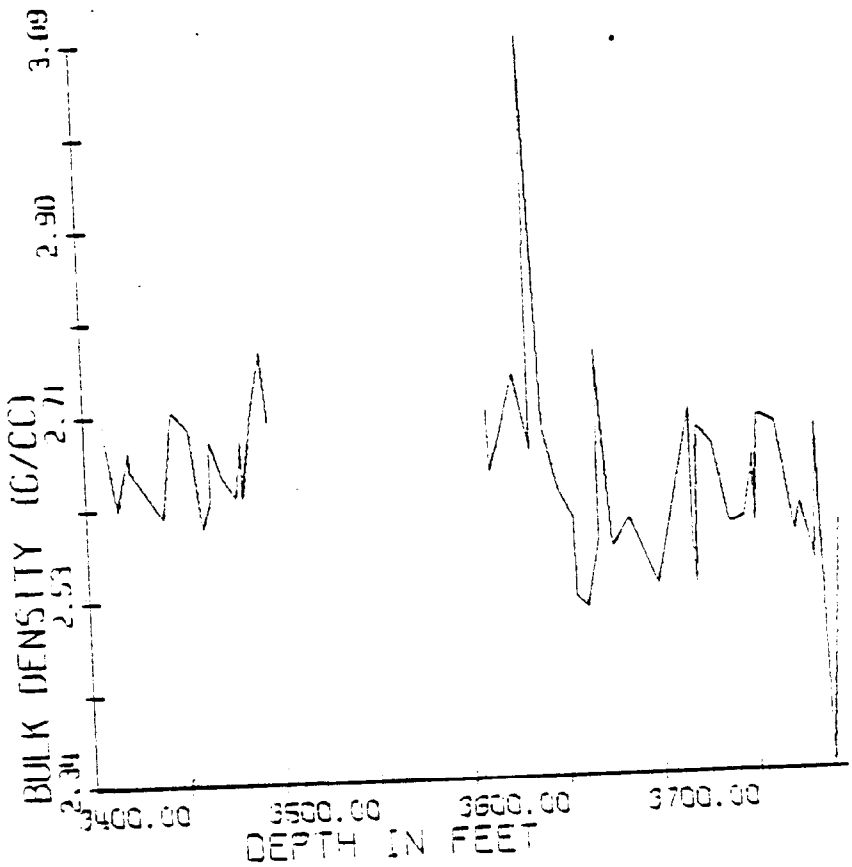

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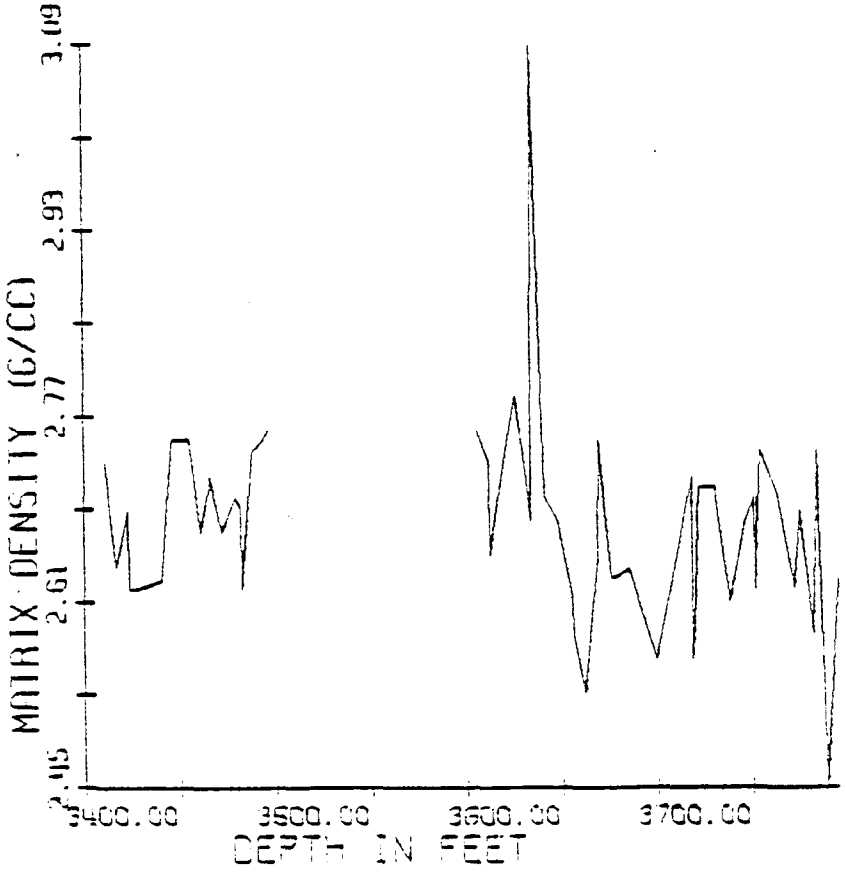

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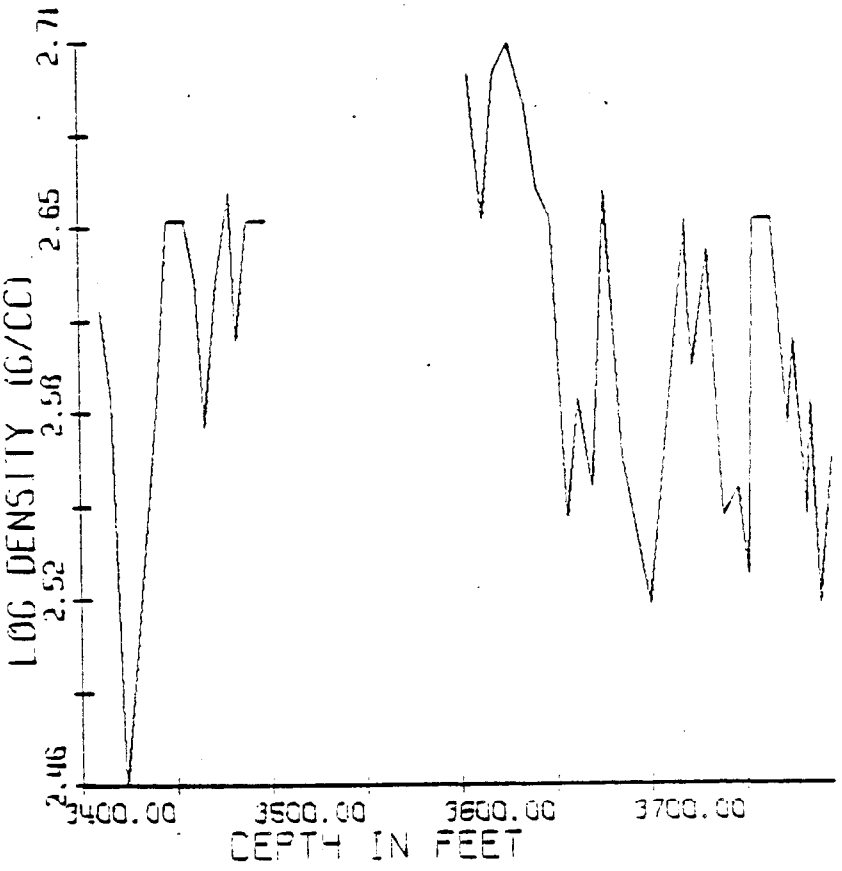

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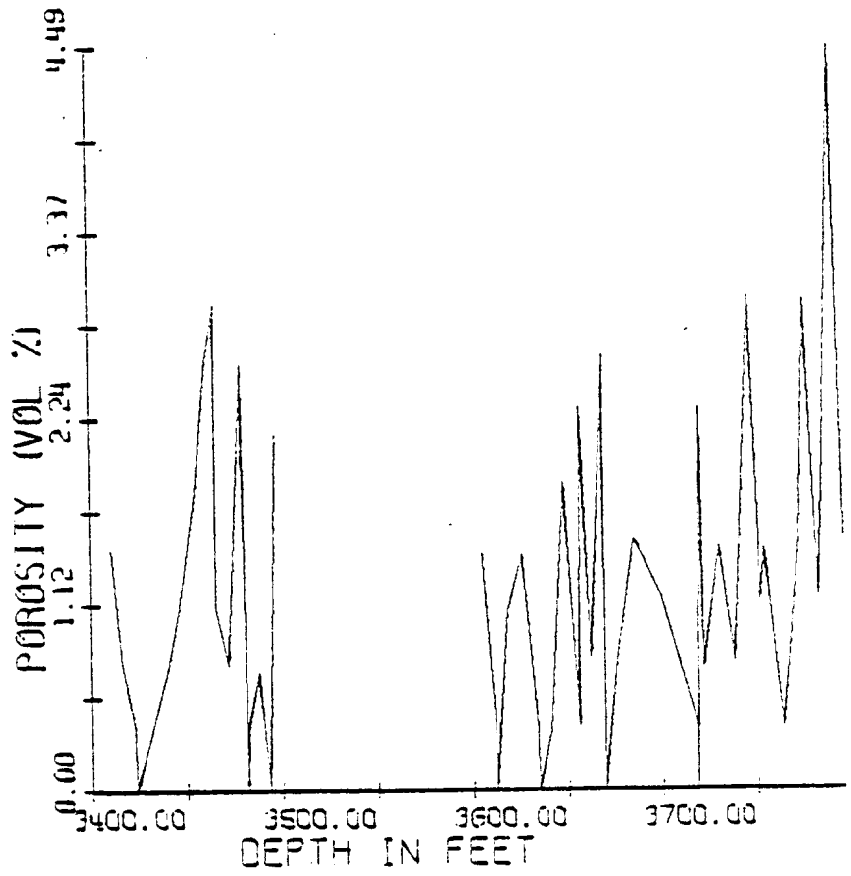

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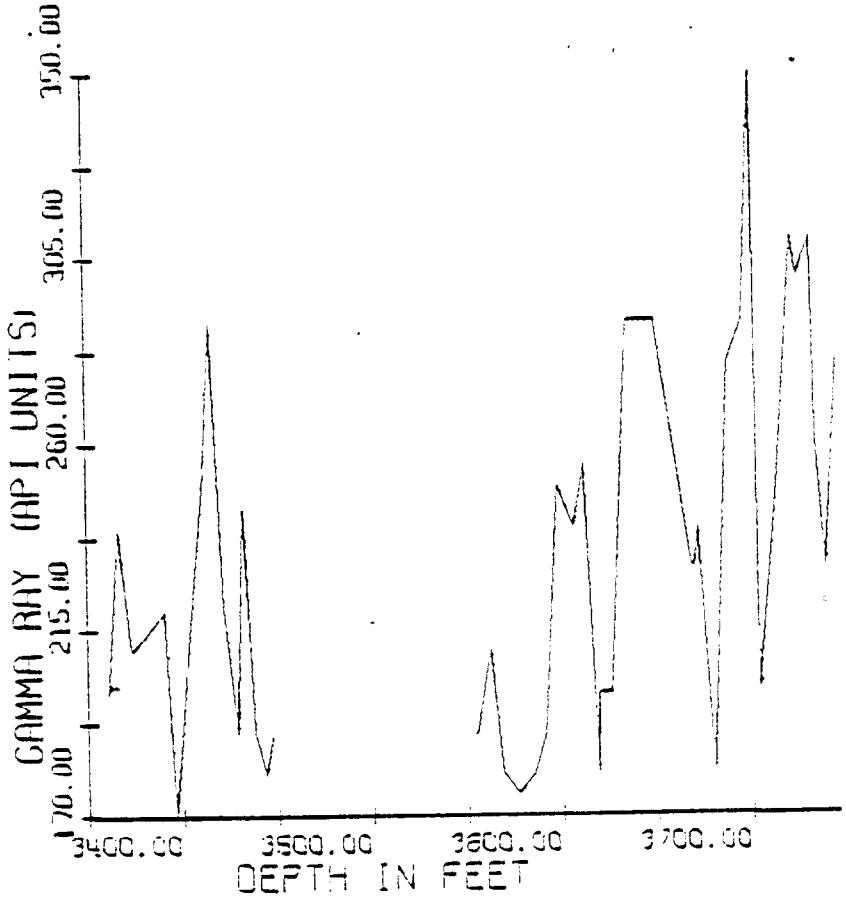

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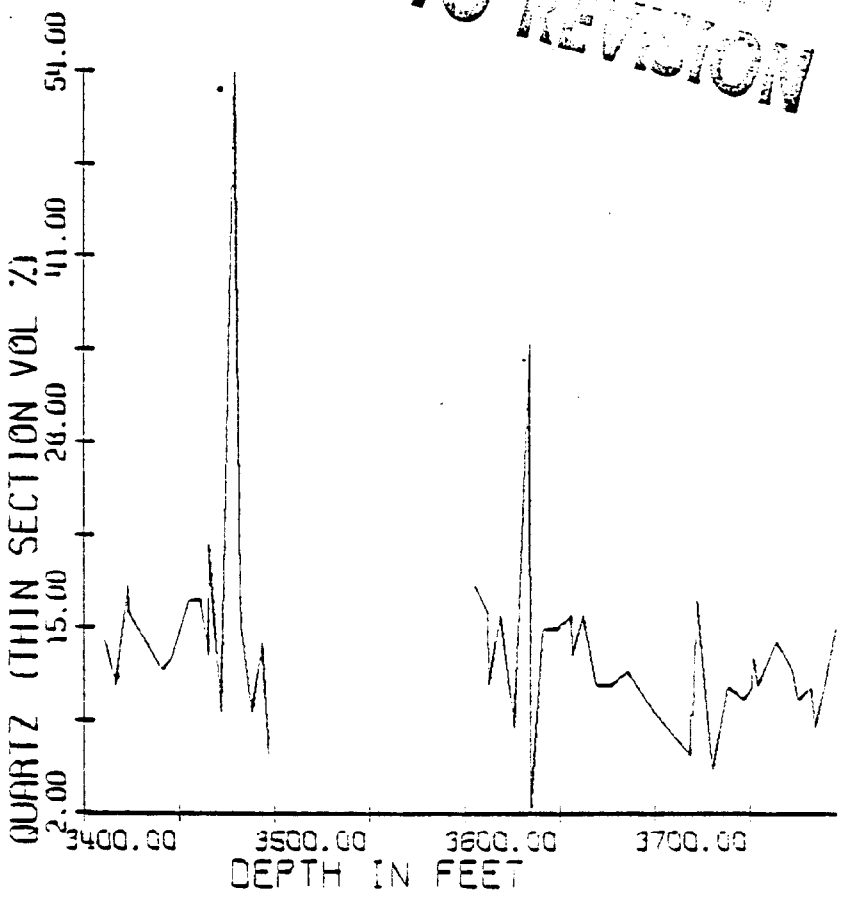

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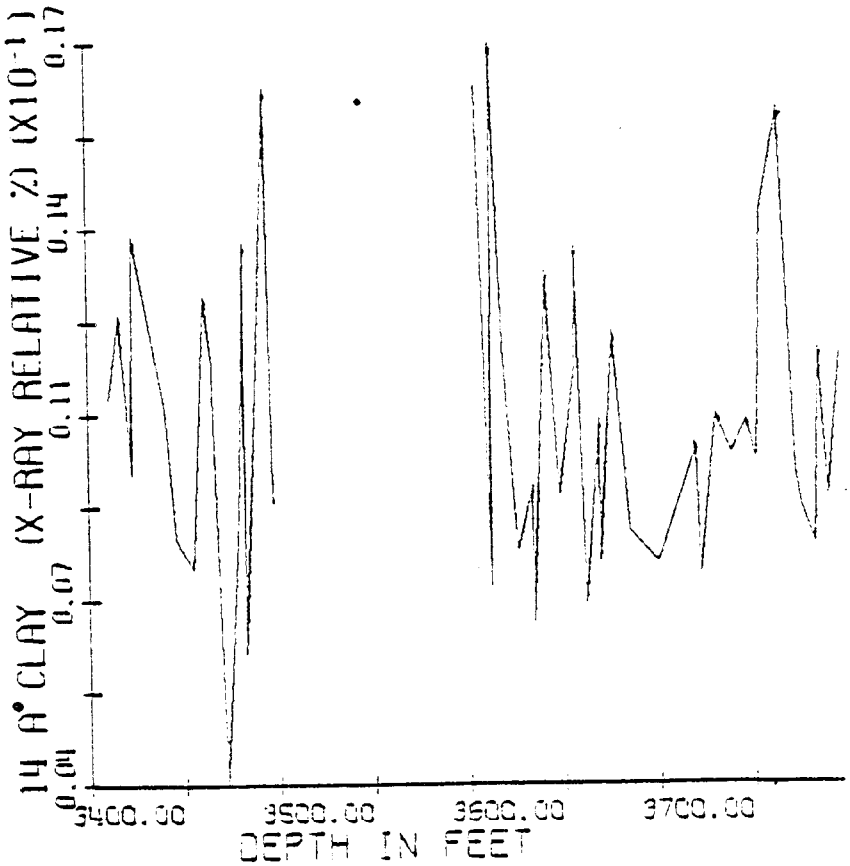

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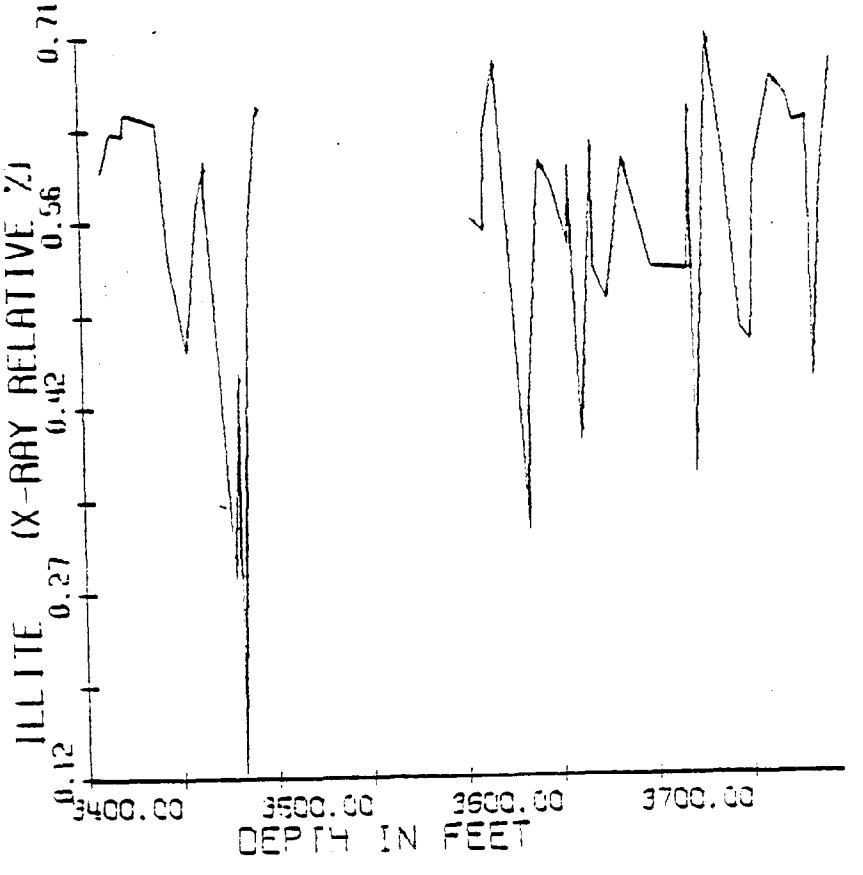

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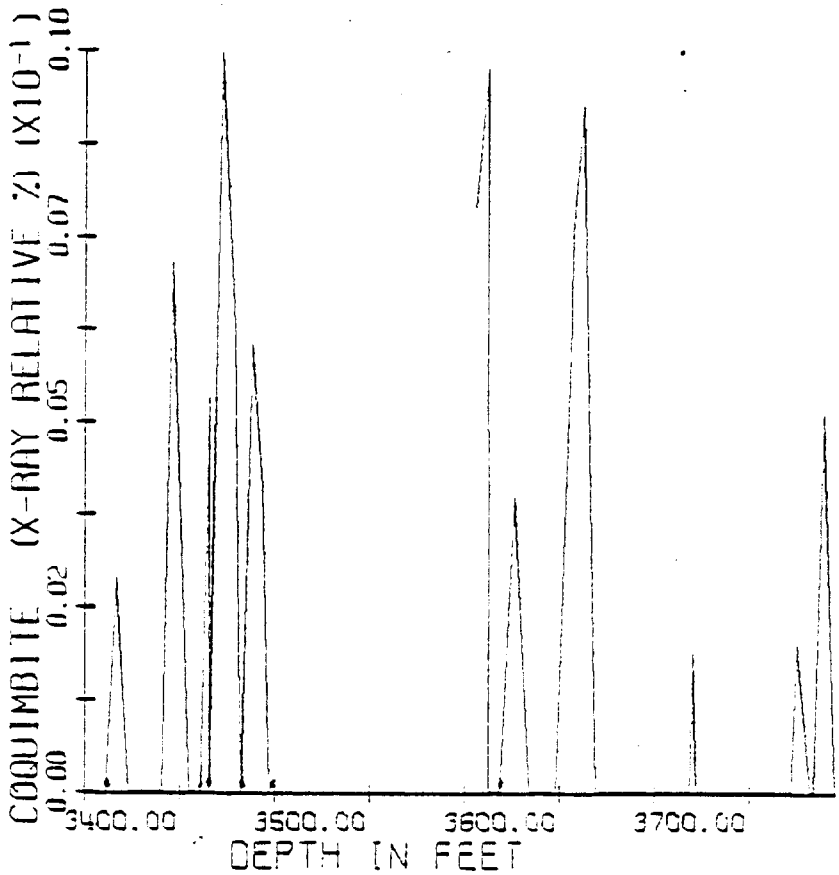

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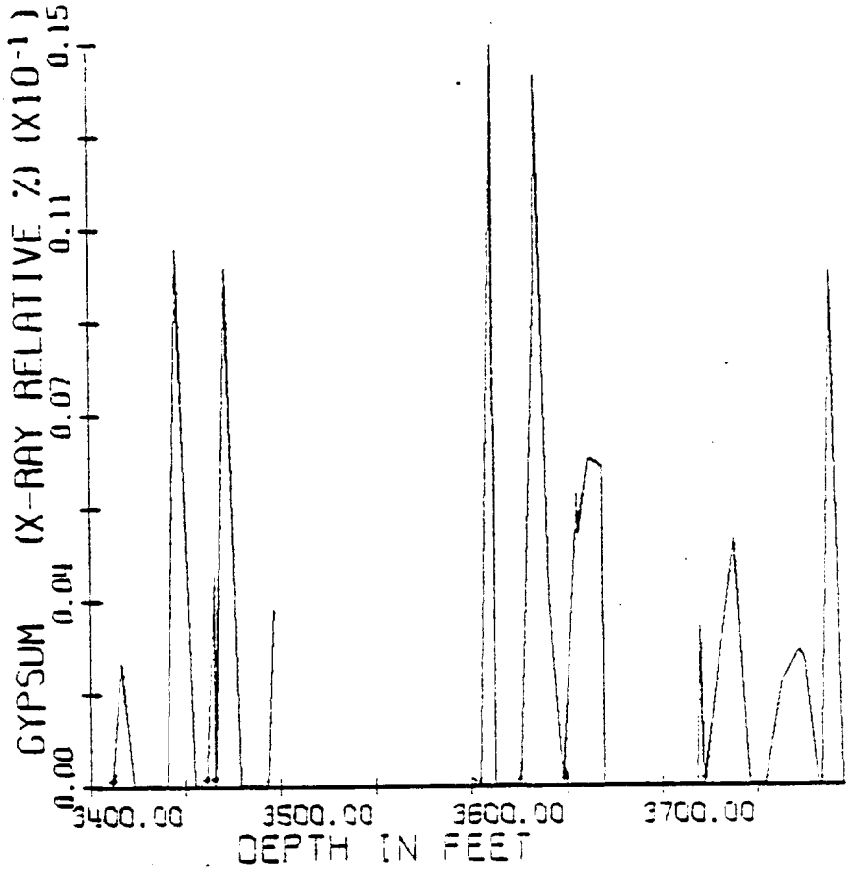

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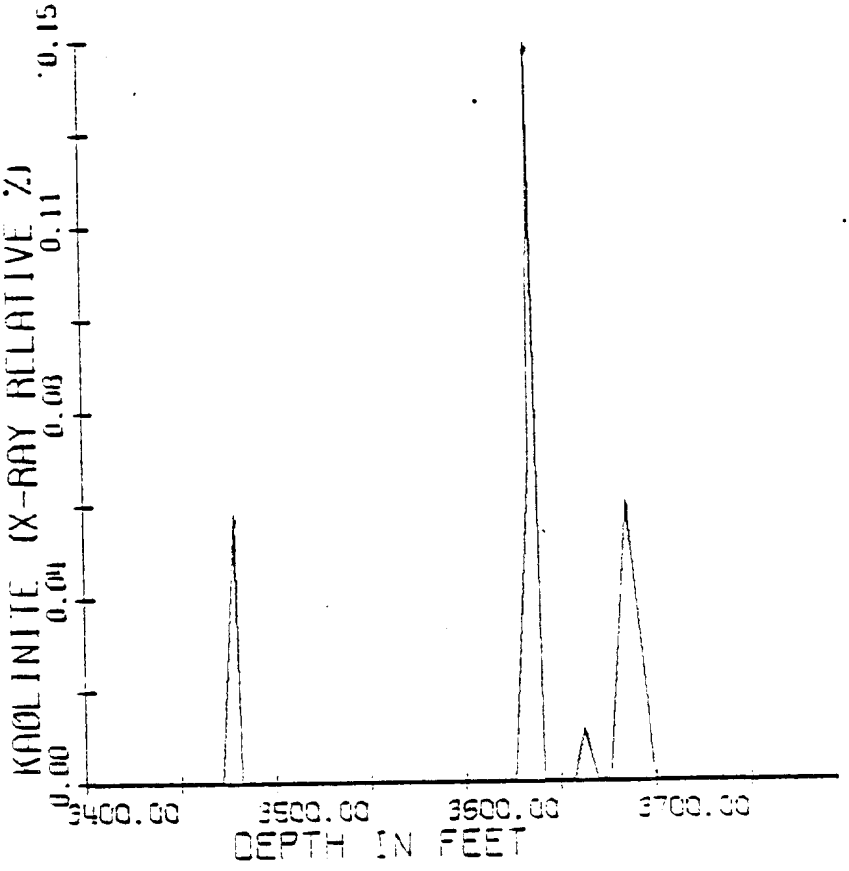

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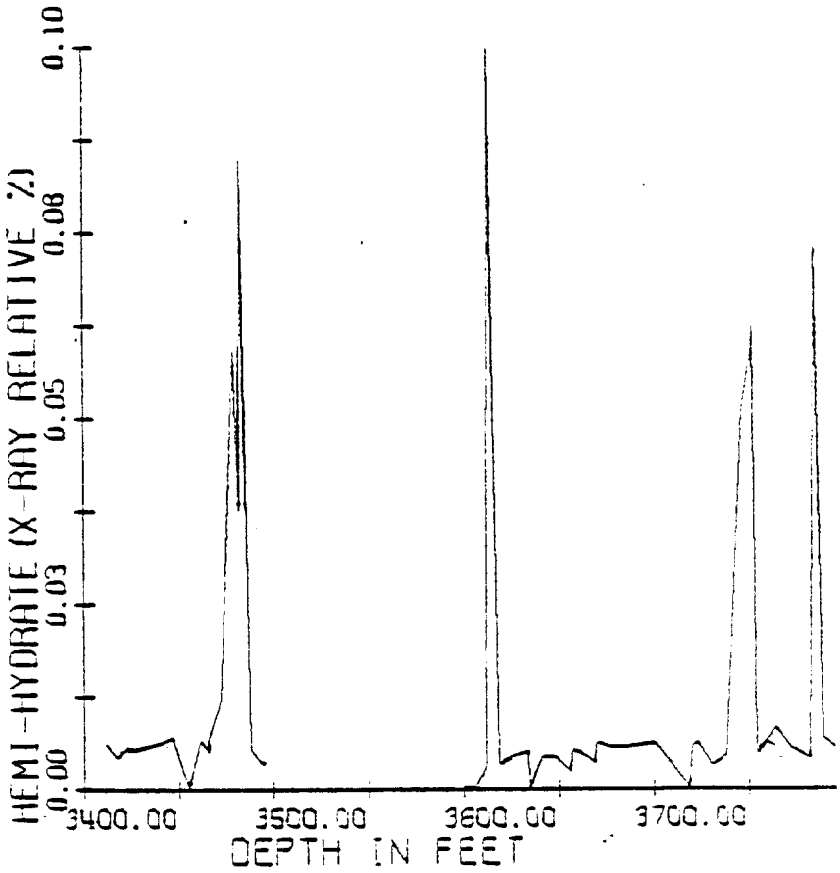

PRELIMINARY
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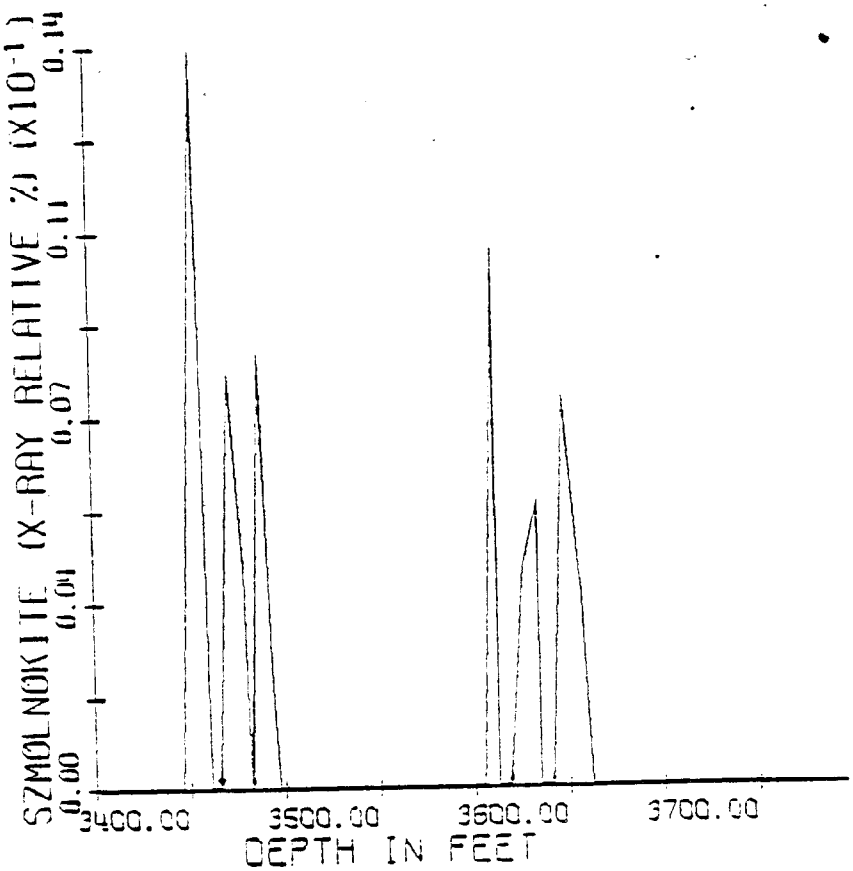
SUBJECT TO CHANGE



PRELIMINARY
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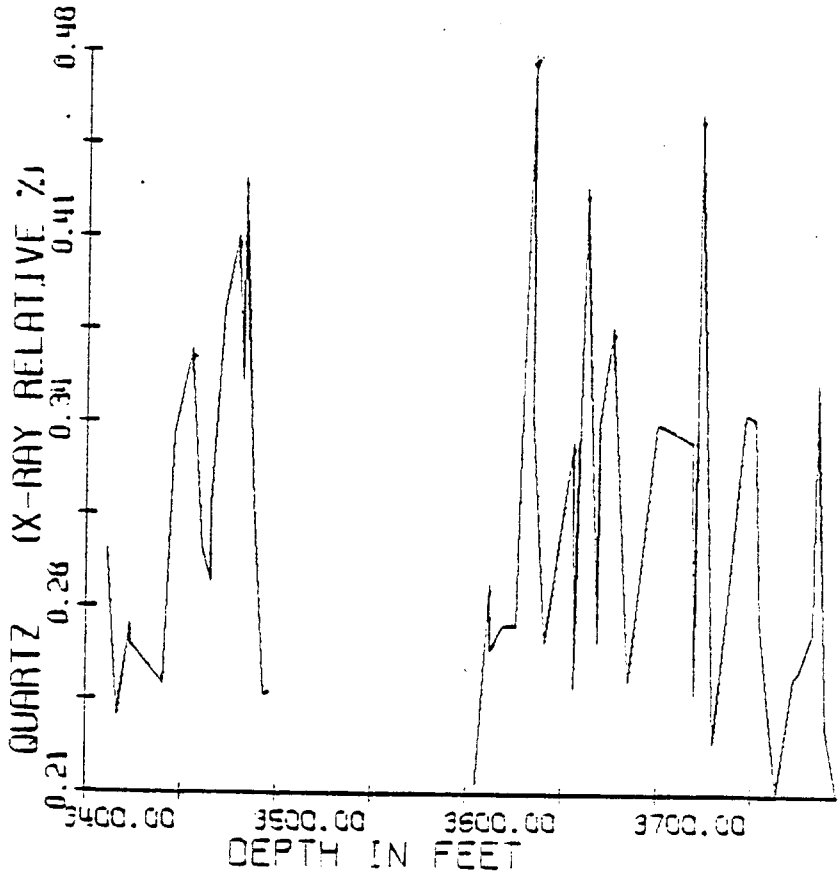
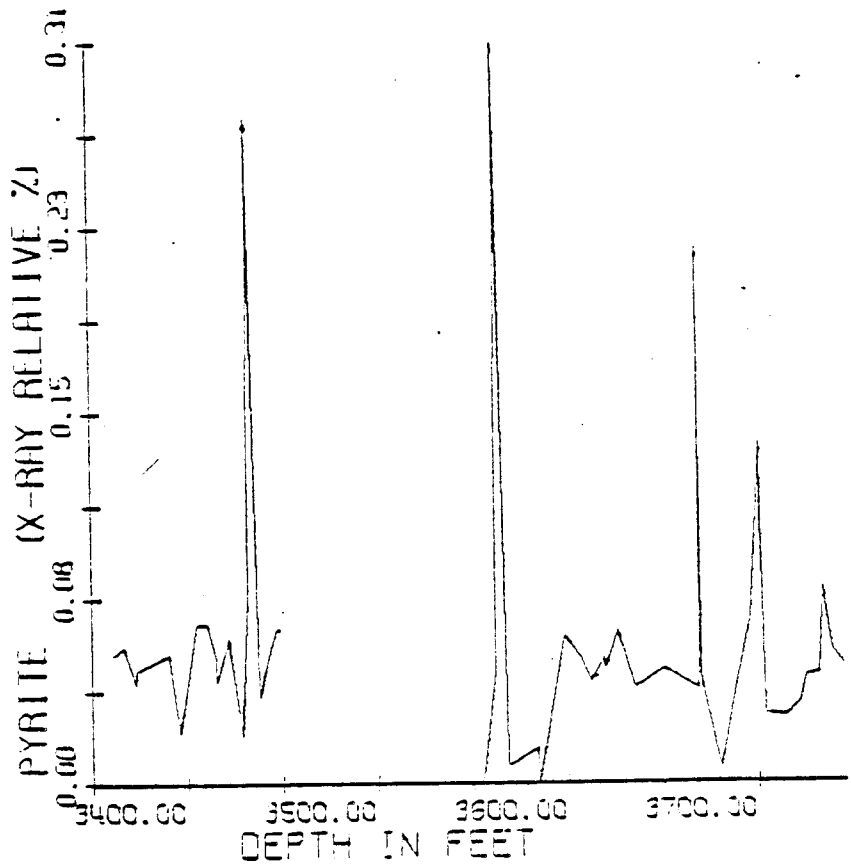
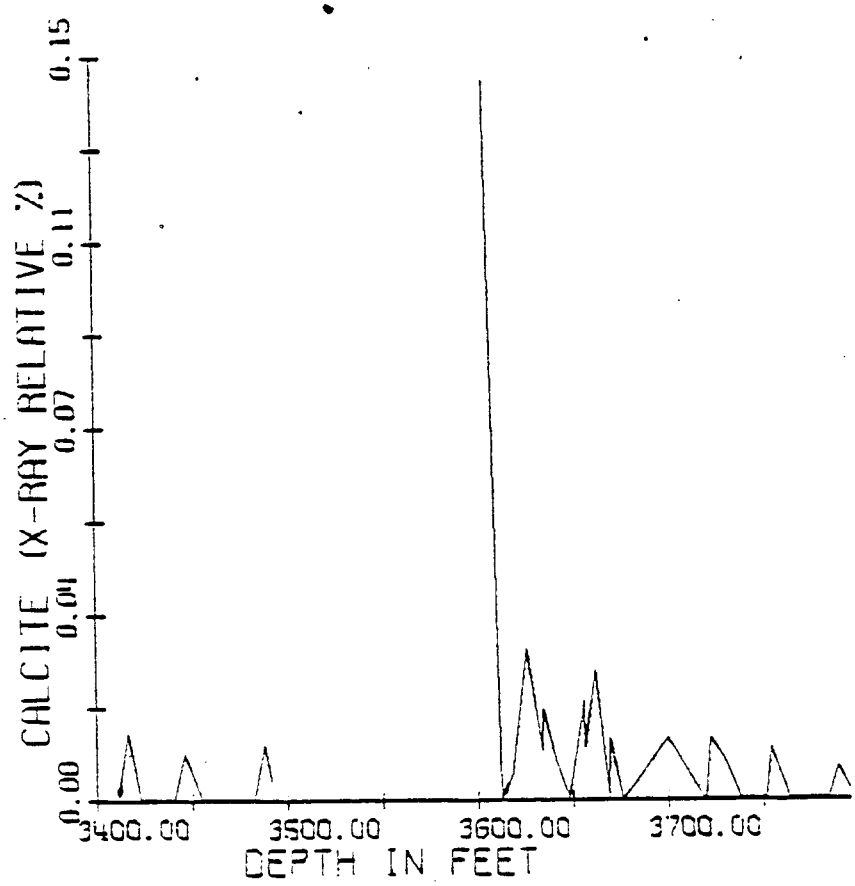
SUBJECT TO REVISION




PYRITE (X-RAY RELATIVE %)
0.00
0.08
0.15
0.23
0.31
3400.00
3500.00
3600.00
3700.00
DEPTH IN FEET

PRELIMINARY
OPEN-FILE REPORT
SUBJECT TO REVISION



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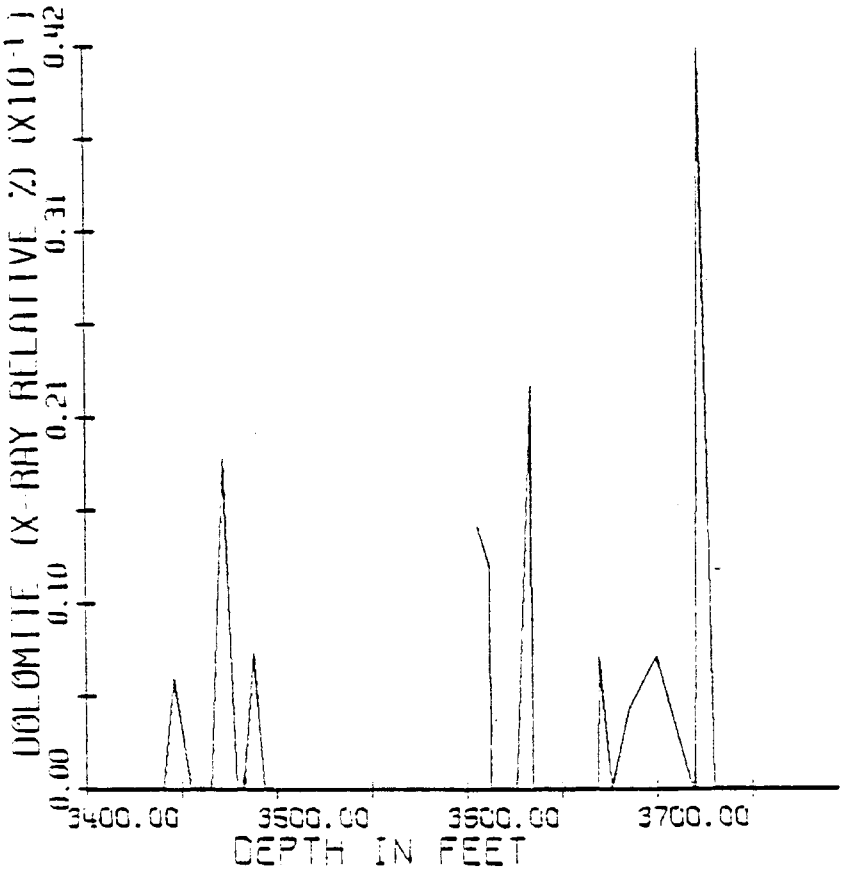

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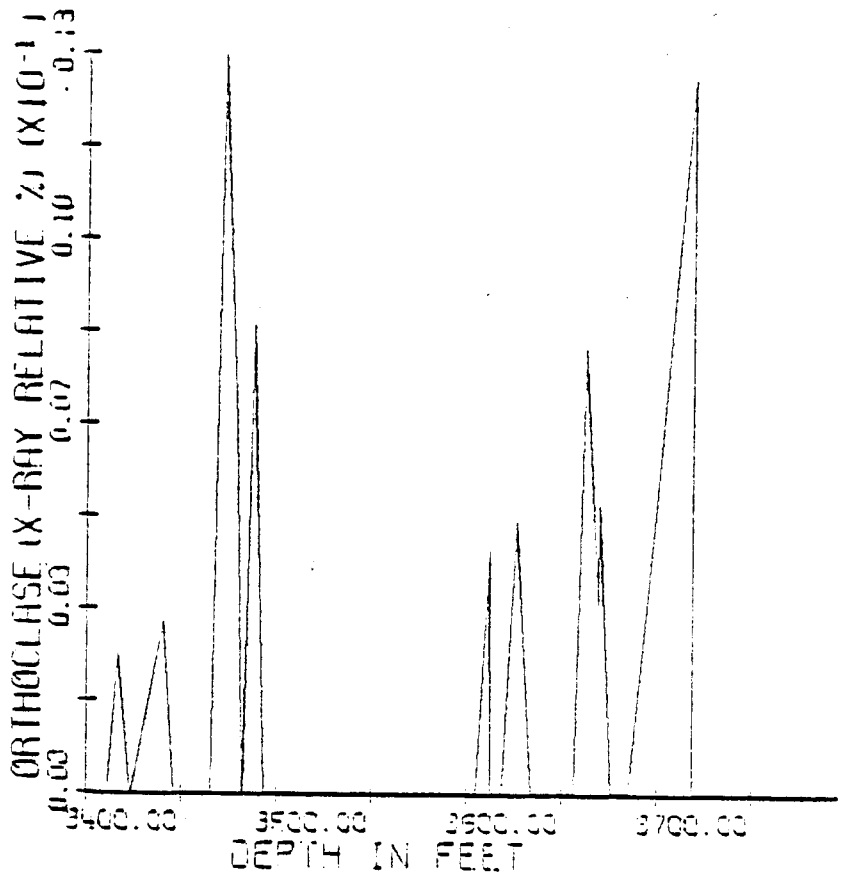

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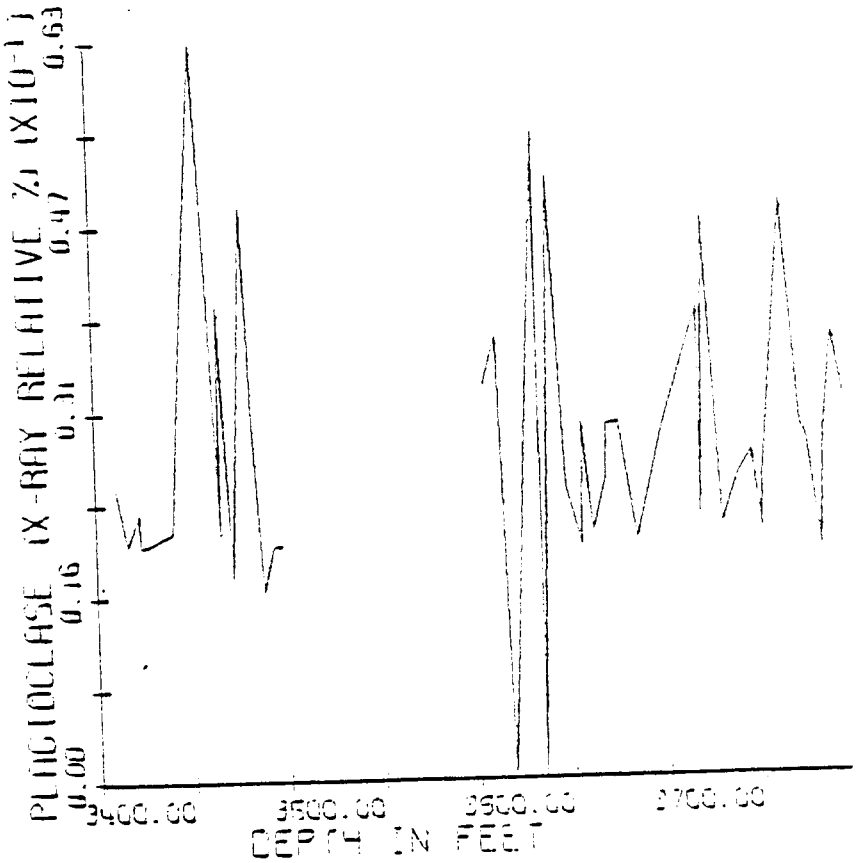

PRELIMINARY
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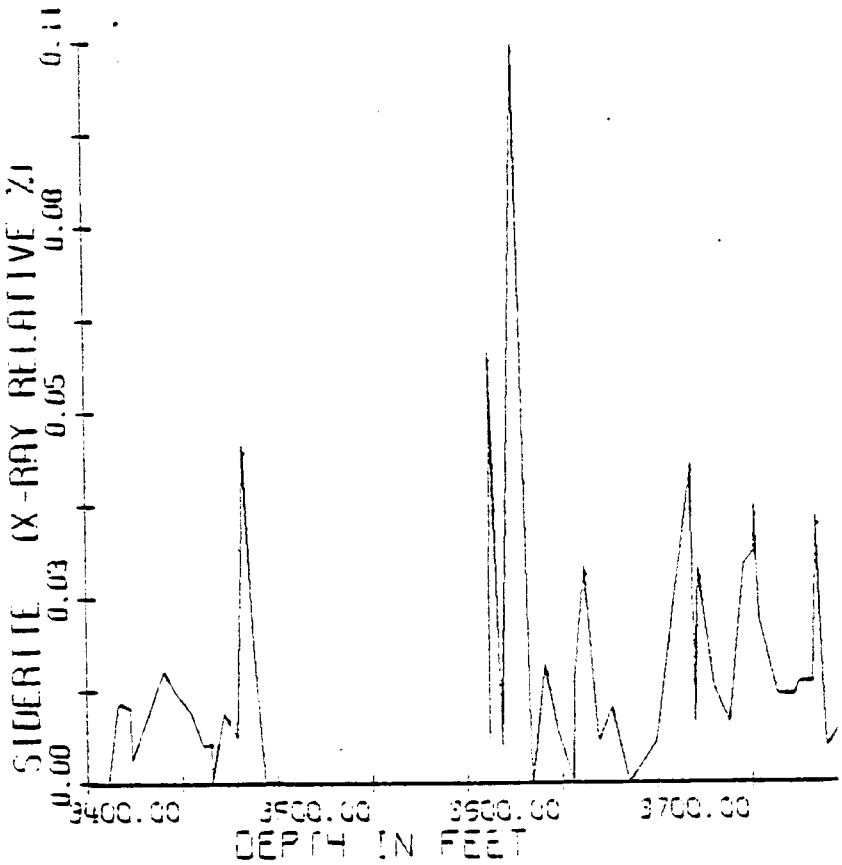
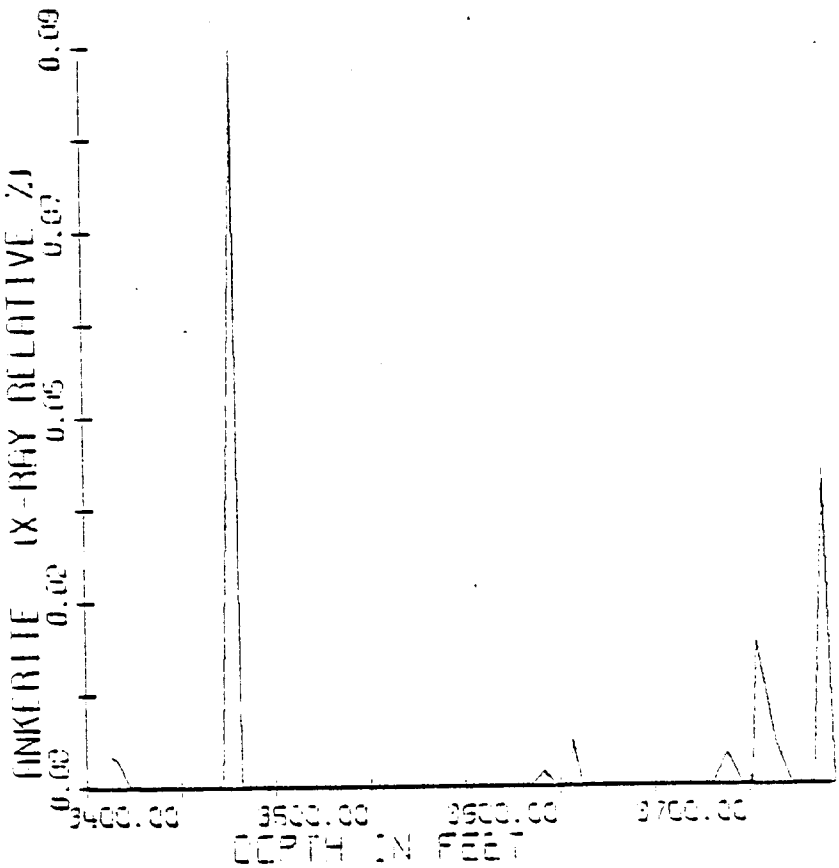


PRELIMINARY
OPEN-FILE DATA
SUBJECT TO REVISION



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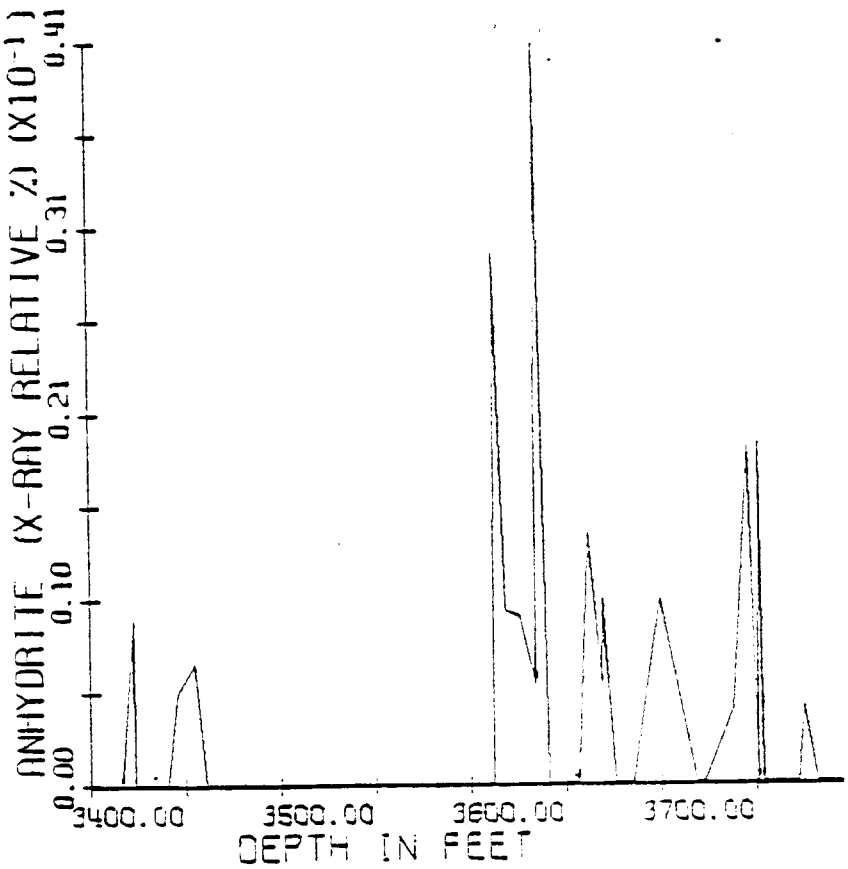

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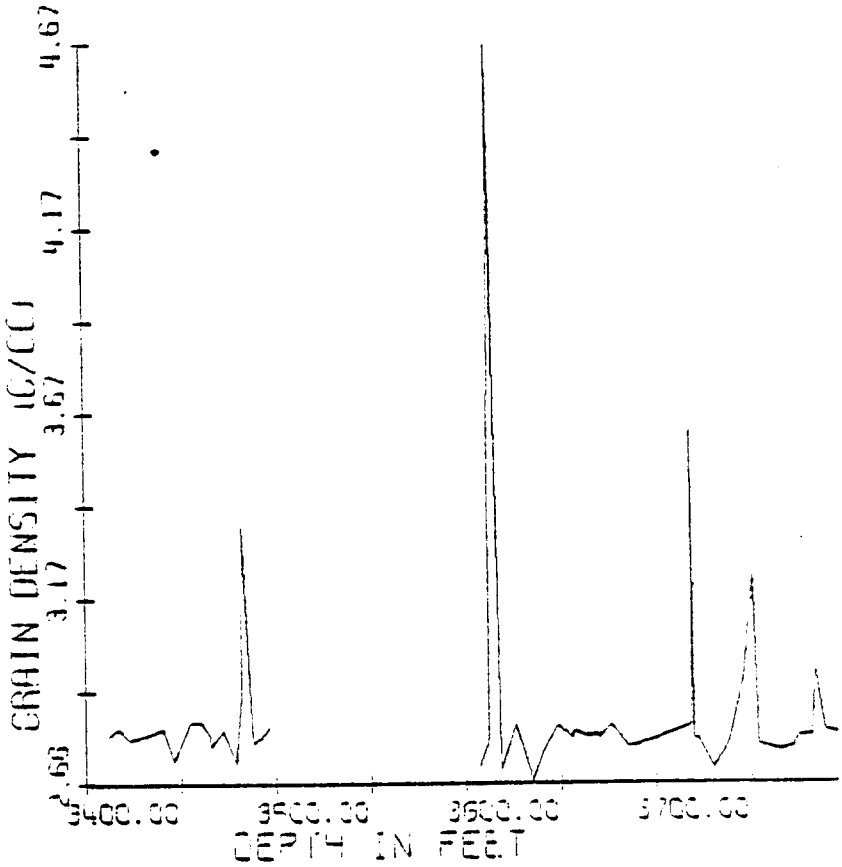

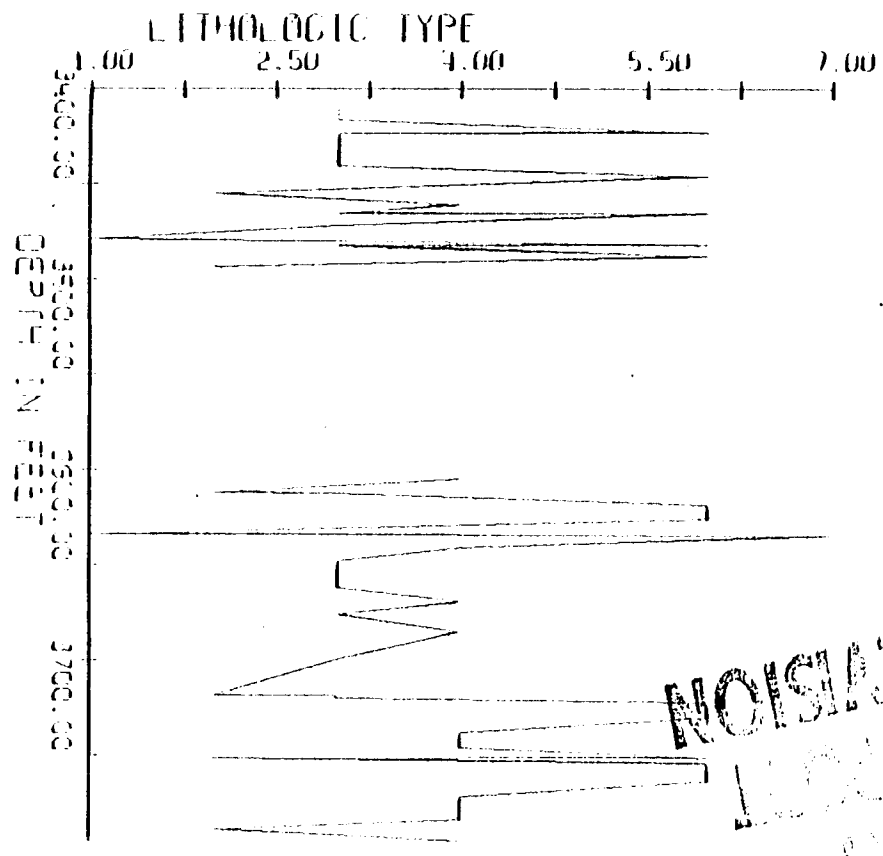

Code

1 - Siltstone
2 - Banded Shale
3 - Thinly Laminated Shale
4 - Lenticularly Laminated Shale
6 - Non-Banded Shale

SUBJECT TO REVISION
OFFICIAL REPORT
PRELIMINARY

APPENDIX B

MEANS AND CORRELATION MATRIX - OVERALL WELL

PRELIMINARY
CONFIDENTIAL REPORT
SUBJECT TO REVISION

S T A T I S T I C A L A N A L Y S I S S Y S T E M 12:56 FRIDAY, JANUARY 12, 1979 5

VARIABLE	N	MEAN	STD DEV	SUM	MINIMUM	MAXIMUM
SAMPLE	40	3603.67750000	125.93470731	144147.10000000	3411.20000000	3795.00000000
LOSIG100	40	4.54750000	1.61784718	181.90000000	1.60000000	7.20000000
LOSIG500	40	2.95500000	0.68535972	118.20000000	1.50000000	4.20000000
SULFUR	40	2.06025000	1.36897021	82.41000000	0.11000000	8.50000000
BULKDEN	40	2.64575000	0.06990424	105.83000000	2.51000000	2.78000000
MATRXDEN	40	2.67800000	0.06357713	107.12000000	2.53000000	2.79000000
LOGDEN	40	2.60975000	0.05907351	104.39000000	2.46000000	2.71000000
POROSITY	40	1.25150000	0.83284976	50.06000000	0	2.97000000
GAMMA	40	228.00000000	42.78449276	9120.00000000	170.00000000	310.00000000
QUARTZ	40	0.14525000	0.08063808	5.81000000	0.05000000	0.54000000
EXP	40	0.01048355	0.00252682	0.41934205	0.00436185	0.01612921
ILL	40	0.57191661	0.10068549	22.87666438	0.28053076	0.70828526
COO	40	0.00224530	0.00332954	0.08981217	0	0.00991331
GYP	40	0.00253309	0.00369773	0.10132370	0	0.01473198
KAO	40	0.00477539	0.01606836	0.19101572	0	0.06592467
HEM	40	0.00644151	0.00888500	0.25766026	0	0.05969376
ANH	40	0.00242880	0.00399917	0.09715196	0	0.01411315
SZM	40	0.00184354	0.00352256	0.07374173	0	0.01443111
QTZ	40	0.29610955	0.06804697	11.84438212	0.20695710	0.48011621
PYR	40	0.04123579	0.01744224	1.64943150	0	0.06643531
CAL	40	0.00940916	0.02400968	0.37636627	0	0.14968493
DOL	40	0.00361133	0.00833473	0.14445305	0	0.04178846
ORT	40	0.00161863	0.00308370	0.06474516	0	0.01319109
PLA	40	0.02960970	0.01235544	1.18438816	0	0.06294421
SID	40	0.01245268	0.01758347	0.49810708	0	0.10947058
ANK	40	0.00328537	0.01440795	0.13141480	0	0.09009763

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VARIABLE	N	MEAN	STD DEV	SUM	MINIMUM	MAXIMUM
GRDEN	40	2.78971352	0.03884434	111.58854067	2.69251824	2.84576393

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 40

	SAMPLE	LOSIG100	LOSIG500	SULFUR	BULKDEN	MATRXDEN	LOGDEN	POROSITY	GAMMA	QUARTZ	EXP	ILL	COQ
SAMPLE	1.00000 0.0000	0.21516 0.1824	-0.12143 0.4554	-0.15680 0.3339	-0.35499 0.0246	-0.33369 0.0354	0.00965 0.9529	0.06805 0.6765	0.36133 0.0220	-0.21878 0.1750	-0.02289 0.8885	0.12851 0.4294	-0.22083 0.1709
LOSIG100	0.21516 0.1824	1.00000 0.0000	0.57270 0.0001	0.54351 0.0003	-0.61621 0.0001	-0.66165 0.0001	-0.51928 0.0006	0.09650 0.5536	0.40592 0.0094	-0.47170 0.0021	-0.16748 0.3016	0.19789 0.2209	0.03134 0.8478
LOSIG500	-0.12143 0.4554	0.57270 0.0001	1.00000 0.0000	0.60040 0.0001	-0.19088 0.2381	-0.20337 0.2082	-0.36191 0.0217	0.15595 0.3366	0.18529 0.2523	-0.31621 0.0468	0.08836 0.5877	0.18613 0.2502	0.12546 0.4405
SULFUR	-0.15680 0.3339	0.54351 0.0003	0.60040 0.0001	1.00000 0.0000	0.03072 0.8508	-0.04754 0.7708	-0.43343 0.0052	-0.07695 0.6369	0.13572 0.4037	-0.27015 0.0918	-0.15919 0.3265	0.11075 0.4963	-0.10554 0.5169
BULKDEN	-0.35499 0.0246	-0.61621 0.0001	-0.19088 0.2381	0.03072 0.8508	1.00000 0.0000	0.92114 0.0001	0.43500 0.0050	-0.37389 0.0175	-0.59018 0.0001	0.04864 0.7657	0.15696 0.3334	-0.02979 0.8552	0.02668 0.8702
MATRXDEN	-0.33369 0.0354	-0.66165 0.0001	-0.20337 0.2082	-0.04754 0.7708	0.92114 0.0001	1.00000 0.0000	0.58086 0.0001	-0.01399 0.9317	-0.55767 0.0002	0.06562 0.6875	0.11496 0.4800	-0.03793 0.8163	0.02466 0.8799
LOGDEN	0.00965 0.9529	-0.51928 0.0006	-0.36191 0.0217	-0.43343 0.0052	0.43500 0.0050	0.58086 0.0001	1.00000 0.0000	0.12180 0.4540	-0.49224 0.0013	0.15208 0.3489	0.09652 0.5536	-0.23810 0.1390	0.19406 0.2302
POROSITY	0.06805 0.6765	0.09650 0.5536	0.15595 0.3366	-0.07695 0.6369	-0.37389 0.0175	-0.01399 0.9317	0.12180 0.4540	1.00000 0.0000	0.23438 0.1455	0.04558 0.7800	-0.08106 0.6190	0.07566 0.6426	-0.01069 0.9478
GAMMA	0.36133 0.0220	0.40592 0.0094	0.18529 0.2523	0.13572 0.4037	-0.59018 0.0001	-0.55767 0.0002	-0.49224 0.0013	0.23438 0.1455	1.00000 0.0000	-0.14478 0.3728	-0.16553 0.3074	0.18870 0.2436	-0.16337 0.3136
QUARTZ	-0.21878 0.1750	-0.47170 0.0021	-0.31621 0.0468	-0.27015 0.0918	0.04864 0.7657	0.06562 0.6875	0.15208 0.3489	0.04558 0.7800	-0.14478 0.3728	1.00000 0.0000	-0.00166 0.9919	-0.61984 0.0001	0.12634 0.4372
EXP	-0.02289 0.8885	-0.16748 0.3016	0.08836 0.5877	-0.15919 0.3265	0.15696 0.3334	0.11496 0.4800	0.09652 0.5536	-0.08106 0.6190	-0.16553 0.3074	-0.00166 0.9919	1.00000 0.0000	0.45926 0.0029	-0.14154 0.3836
ILL	0.12851 0.4294	0.19789 0.2209	0.18613 0.2502	0.11075 0.4963	-0.02979 0.8552	-0.03793 0.8163	-0.23810 0.1390	0.07566 0.6426	0.18870 0.2436	-0.61984 0.0001	0.45926 0.0029	1.00000 0.0000	-0.34596 0.0288
COQ	-0.22083 0.1709	0.03134 0.8478	0.12546 0.4405	-0.10554 0.5169	0.02668 0.8702	0.02466 0.8799	0.19406 0.2302	-0.01069 0.9478	-0.16337 0.3136	0.12634 0.4372	-0.14154 0.3836	-0.34596 0.0288	1.00000 0.0000
GYP	0.00082 0.9960	-0.07712 0.6362	-0.19488 0.2282	-0.10252 0.5290	-0.05256 0.7474	-0.08005 0.6234	0.11008 0.4989	-0.09922 0.5425	-0.13903 0.3922	0.01797 0.9123	-0.33752 0.0332	-0.22918 0.1549	0.55878 0.0002
KAO	0.00502 0.9755	-0.31620 0.0468	-0.31221 0.0498	-0.25606 0.1107	-0.07833 0.6309	-0.06196 0.7041	0.15059 0.3537	0.05243 0.7480	0.05182 0.7508	0.67840 0.0001	-0.19133 0.2369	-0.52251 0.0005	0.00903 0.9559

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CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 40

	SAMPLE	LOSIG100	LOSIG500	SULFUR	BULKDEN	MATRXDEN	LOGDEN	POROSITY	GAMMA	QUARTZ	EXP	ILL	COD
HEM	-0.18054 0.2649	-0.24686 0.1246	-0.26912 0.0931	-0.15328 0.3450	-0.06039 0.7113	0.01742 0.9150	0.09170 0.5736	0.22243 0.1679	-0.09930 0.5421	0.75860 0.0001	-0.16785 0.3005	-0.48440 0.0015	0.18987 0.2406
ANH	0.07160 0.6606	0.12432 0.4441	0.02897 0.8592	0.13279 0.4140	0.00014 0.9603	-0.04476 0.7819	-0.09218 0.5716	-0.12915 0.4269	-0.12671 0.4359	-0.02896 0.8592	-0.38874 0.0132	-0.24773 0.1233	-0.00808 0.9605
SZM	-0.22484 0.1631	-0.13205 0.4167	0.04050 0.8040	0.01047 0.9489	0.23527 0.1439	0.24715 0.1242	0.31223 0.0498	-0.04718 0.7725	-0.20552 0.2033	0.19925 0.2177	-0.32337 0.0418	-0.40160 0.0102	0.38468 0.0143
QTZ	-0.11936 0.4632	-0.13960 0.3903	-0.19989 0.2162	0.00453 0.9779	-0.02499 0.8784	-0.05559 0.7333	0.10980 0.5000	-0.17197 0.2887	-0.11957 0.4624	0.47906 0.0018	-0.53231 0.0004	-0.91391 0.0001	0.18300 0.2583
PYR	-0.26826 0.0942	0.51387 0.0007	0.50114 0.0010	0.62448 0.0001	-0.30634 0.0545	-0.30198 0.0582	-0.39550 0.0115	0.10710 0.5107	0.31542 0.0474	-0.25891 0.1067	-0.14778 0.3628	0.09129 0.5753	-0.08151 0.6171
CAL	0.04432 0.7860	-0.11838 0.4669	0.19346 0.3135	-0.23543 0.1436	0.19586 0.2258	0.20781 0.1982	0.28483 0.0749	-0.04150 0.7993	-0.20672 0.2006	0.02576 0.8746	0.27922 0.0810	-0.12061 0.4585	0.36988 0.0192
DOL	0.07273 0.6556	-0.24152 0.1333	-0.28256 0.0773	-0.15649 0.3349	0.23894 0.1376	0.17097 0.2915	0.15585 0.3369	-0.26903 0.0932	-0.11961 0.4623	0.15411 0.3424	-0.30654 0.0544	-0.56189 0.0062	0.17537 0.2791
ORT	-0.18602 0.2505	0.23971 0.1363	0.11124 0.4944	0.16549 0.3075	-0.00329 0.9839	-0.05555 0.7335	0.06141 0.7066	-0.13773 0.3967	-0.15061 0.3536	0.05527 0.7348	-0.50876 0.0008	-0.45475 0.0032	0.54676 0.0003
PLA	0.04549 0.7805	-0.35555 0.0244	-0.37642 0.0167	-0.18702 0.2479	0.15002 0.3555	0.20447 0.2057	0.25104 0.1182	0.04398 0.7876	-0.04857 0.7660	0.48142 0.0017	-0.00679 0.9668	-0.48669 0.0015	-0.10710 0.5107
SID	0.15386 0.3432	0.09672 0.5527	-0.05350 0.7430	-0.26430 0.0994	0.14277 0.3795	0.18004 0.2663	0.25957 0.1058	0.00390 0.9810	-0.15452 0.3411	-0.19335 0.2319	-0.38175 0.2617	-0.16614 0.3056	0.14251 0.3804
ANK	-0.11681 0.4729	-0.32858 0.0384	-0.20627 0.2016	-0.20170 0.2120	-0.02513 0.8777	0.06982 0.6686	0.14883 0.3594	0.25954 0.1058	-0.15277 0.3467	0.76300 0.0001	-0.02011 0.9020	-0.43234 0.0053	0.16811 0.2998
GRDEN	-0.17858 0.2702	0.58931 0.0001	0.51248 0.0007	0.51635 0.0006	-0.22715 0.1587	-0.19992 0.2162	-0.29013 0.0694	0.12788 0.4317	0.25484 0.1125	-0.41335 0.0080	-0.19971 0.2166	0.09424 0.5630	-0.07647 0.6391

	GYP	KAO	HEM	ANH	SZM	QTZ	PYR	CAL	DOL	ORT	PLA	SID	ANK
SAMPLE	0.00082 0.9960	0.00502 0.9755	-0.18054 0.2649	0.07160 0.6606	-0.22484 0.1631	-0.11936 0.4632	-0.26826 0.0942	0.04432 0.7860	0.07273 0.6556	-0.18602 0.2505	0.04549 0.7805	0.15386 0.3432	-0.11681 0.4729
LOSIG100	-0.07712 0.6362	-0.31620 0.0468	-0.24686 0.1246	0.12432 0.4441	-0.13205 0.4167	-0.13960 0.3903	0.51387 0.0007	-0.11838 0.4669	-0.24152 0.1333	0.23971 0.1363	-0.35555 0.0244	0.09672 0.5527	-0.32858 0.0384
LOSIG500	-0.19488 0.2282	-0.31221 0.0498	-0.26912 0.0931	0.02897 0.8592	0.04050 0.8040	-0.19989 0.2162	0.50114 0.0010	0.19346 0.3135	-0.28256 0.0773	0.11124 0.4944	-0.37642 0.0167	-0.05350 0.7430	-0.20627 0.2016
SULFUR	-0.10252 0.5290	-0.25606 0.1107	-0.15328 0.3450	0.13279 0.4140	0.01047 0.9489	0.00453 0.9779	0.62448 0.0001	-0.23543 0.1436	-0.15649 0.3349	0.16549 0.3075	-0.18702 0.2479	-0.26430 0.0994	-0.20170 0.2120

UGR File # 157
W.Va. Geological & Economic-Survey

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 40

	GYP	KAO	HEM	ANH	SZM	QTZ	PYR	CAL	DOL	ORT	PLA	SID	ANK
BULKDEN	-0.05256 0.7474	-0.07833 0.6309	-0.06039 0.7113	0.00814 0.9603	0.23527 0.1439	-0.02499 0.8784	-0.30634 0.0545	0.19566 0.2258	0.21894 0.1376	-0.00329 0.9819	0.15002 0.3555	0.14277 0.3795	-0.02513 0.8777
MATRXDEN	-0.08005 0.6234	-0.06196 0.7041	0.01742 0.9150	-0.04476 0.7839	0.24715 0.1242	-0.05559 0.7333	-0.30198 0.0582	0.20781 0.1982	0.17097 0.2915	-0.05555 0.7335	0.20447 0.2057	0.18004 0.2663	0.06982 0.6686
LOGDEN	0.11008 0.4989	0.15059 0.3537	0.09170 0.5736	-0.09218 0.5716	0.31223 0.0498	0.10980 0.5000	-0.39550 0.0115	0.28403 0.0749	0.15585 0.3369	0.06141 0.7066	0.25104 0.1182	0.25957 0.1058	0.14883 0.3594
POROSITY	-0.09922 0.5425	0.05243 0.7480	0.22231 0.1679	-0.12918 0.4269	-0.04718 0.7725	-0.17197 0.2887	0.10710 0.5107	-0.04150 0.7993	-0.26903 0.0932	-0.13773 0.3967	0.04398 0.7876	0.00390 0.9810	0.25954 0.1058
GAMMA	-0.13903 0.3922	-0.05182 0.7508	-0.09930 0.5421	-0.12671 0.4359	-0.20552 0.2033	-0.11957 0.4624	0.31542 0.0474	-0.20672 0.2006	-0.11961 0.4623	-0.15061 0.3536	-0.04857 0.7660	-0.15452 0.3411	-0.15277 0.3467
QUARTZ	0.01797 0.9123	0.67848 0.0001	0.75860 0.0001	-0.02896 0.8592	0.19925 0.2177	0.47906 0.0018	-0.25891 0.1067	0.02576 0.8746	0.15411 0.3424	0.05527 0.7348	0.48142 0.0017	-0.19335 0.2319	0.76300 0.0001
EXP	-0.33752 0.0332	-0.19133 0.2369	-0.16785 0.3005	-0.38874 0.0132	-0.32337 0.0418	-0.53231 0.0004	-0.14778 0.3628	0.27922 0.0810	-0.30654 0.0544	-0.50876 0.0008	-0.00679 0.9668	-0.18175 0.2617	-0.02011 0.9020
ILL	-0.22918 0.1549	-0.52251 0.0005	-0.48440 0.0015	-0.24773 0.1233	-0.40160 0.0102	-0.91391 0.0001	0.09179 0.5753	-0.12061 0.4585	-0.56169 0.0002	-0.45475 0.0032	-0.48669 0.0015	-0.16614 0.3056	-0.43234 0.0053
COQ	0.55878 0.0002	0.00903 0.9559	0.18987 0.2406	-0.00808 0.9605	0.38468 0.0143	0.18300 0.2583	-0.08151 0.6171	0.36088 0.0192	0.17537 0.2791	0.54676 0.0003	-0.10710 0.5107	0.14251 0.3804	0.16811 0.2998
GYP	1.00000 0.0000	0.10896 0.5033	-0.07578 0.6421	0.05410 0.7402	0.29698 0.0627	0.24516 0.1273	-0.01276 0.9377	-0.04530 0.7813	0.25736 0.1089	0.26021 0.1049	0.10610 0.5147	-0.10221 0.5303	-0.12524 0.4411
KAO	0.10896 0.5033	1.00000 0.0000	0.51128 0.0007	0.02489 0.8788	0.11907 0.4643	0.40657 0.0092	-0.28094 0.0791	-0.03923 0.8101	0.20500 0.2045	0.07722 0.6358	0.27118 0.0905	-0.14995 0.3557	0.48902 0.0014
HEM	-0.07578 0.6421	0.51128 0.0007	1.00000 0.0000	-0.11403 0.4836	0.06818 0.6759	0.32016 0.0440	-0.15859 0.3284	-0.16097 0.3211	-0.01803 0.9121	0.34584 0.0288	0.24191 0.1326	-0.04635 0.7764	0.95186 0.0001
ANH	0.05410 0.7402	0.02489 0.8788	-0.11403 0.4836	1.00000 0.0000	-0.01442 0.9296	0.31615 0.0469	-0.20942 0.1947	0.04942 0.7620	-0.02498 0.8784	0.26442 0.0992	-0.06320 0.6984	0.31180 0.0502	-0.13458 0.4077
SZM	0.29698 0.0627	0.11907 0.4643	0.06818 0.6759	-0.01442 0.9296	1.00000 0.0000	0.33142 0.0367	0.17795 0.2720	-0.05637 0.7297	0.18432 0.2549	0.36321 0.0212	0.27784 0.0826	0.07086 0.6639	0.08690 0.5939
QTZ	0.24516 0.1273	0.40657 0.0092	0.32016 0.0440	0.31615 0.0469	0.33142 0.0367	1.00000 0.0000	0.03705 0.8204	-0.11514 0.4793	0.54772 0.0003	0.37668 0.0166	0.36097 0.0221	0.02984 0.8550	0.23579 0.1430
PYR	-0.01276 0.9377	-0.28094 0.0791	-0.15859 0.3284	-0.20942 0.1947	0.17795 0.2720	0.03705 0.8204	1.00000 0.0000	-0.45399 0.0033	-0.19996 0.2161	0.06109 0.7081	-0.09226 0.5713	-0.32026 0.0439	-0.22070 0.1712
CAL	-0.04530 0.7813	-0.03923 0.8101	-0.16097 0.3211	0.04942 0.7620	-0.05637 0.7297	-0.11514 0.4793	-0.45399 0.0033	1.00000 0.0000	0.27047 0.0914	0.02011 0.9020	0.02032 0.9010	0.14873 0.3597	-0.06939 0.6705

UGR File # 157
W.Va. Geological & Economic Survey

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 40

	GYP	KAO	HEM	ANB	SZM	QTZ	PYR	CAL	DOL	ORT	PLA	SID	ANK
DOL	0.25736 0.1089	0.20500 0.2045	-0.01803 0.9121	-0.02498 0.8784	0.18432 0.2549	0.54772 0.0003	-0.19996 0.2161	0.27047 0.0914	1.00000 0.0000	0.21205 0.1890	0.28748 0.0721	0.04394 0.7878	-0.10133 0.5338
ORT	0.26021 0.1049	0.07722 0.6358	0.34584 0.0288	0.26442 0.0992	0.36321 0.0212	0.37668 0.0166	0.06109 0.7081	0.02011 0.9020	0.21205 0.1890	1.00000 0.0000	-0.16714 0.3026	0.25077 0.1186	0.22650 0.1599
PLA	0.10610 0.5147	0.27148 0.0905	0.24191 0.1326	-0.06320 0.6984	0.27784 0.0826	0.36097 0.0221	-0.09226 0.5713	0.02032 0.9010	0.28748 0.0721	-0.16714 0.3026	1.00000 0.0000	0.01621 0.9209	0.26293 0.1012
SID	-0.10221 0.5303	-0.14995 0.3557	-0.04635 0.7764	0.31180 0.0502	0.07086 0.6639	0.07984 0.6550	-0.32026 0.0439	0.14873 0.3597	0.04394 0.7878	0.25077 0.1186	0.01621 0.9209	1.00000 0.0000	-0.03630 0.8240
ANK	-0.12524 0.4413	0.40902 0.0014	0.95186 0.0001	-0.13458 0.4077	0.08690 0.5939	0.23579 0.1410	-0.22070 0.1712	-0.06939 0.6705	-0.10133 0.5338	0.22650 0.1599	0.26293 0.1012	-0.03630 0.8240	1.00000 0.0000
GRDEN	-0.14749 0.3638	-0.41708 0.0074	-0.21649 0.1797	-0.06484 0.6910	0.18244 0.2599	-0.03425 0.8338	0.85934 0.0001	-0.38565 0.0140	-0.23073 0.1520	0.14617 0.3681	-0.12408 0.4456	0.19659 0.2240	-0.26321 0.1008

	GRDEN
SAMPLE	-0.17858 0.2702
LOSIG100	0.58931 0.0001
LOSIG500	0.51248 0.0007
SULFUR	0.51635 0.0006
BULKDEN	-0.22715 0.1587
MATRXDEN	-0.19992 0.2162
LOGDEN	-0.29013 0.0694
POROSITY	0.12788 0.4317
GAMMA	0.25484 0.1125
QUARTZ	-0.41335 0.0080

UGR File # 157
W.Va. Geological & [redacted] Survey

OPEN FILE REPORT
SUBJECT TO REVISION

UGR File # 157
W.Va. Geological & [redacted]ic Survey
60

S T A T I S T I C A L A N A L Y S I S S Y S T E M 12:56 FRIDAY, JANUARY 12, 1979 10

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 40

	GRDEN
EXP	-0.19971 0.2166
ILL	0.09424 0.5630
COQ	-0.07647 0.6391
GYP	-0.14749 0.3638
KAO	-0.41708 0.0074
HEM	-0.21649 0.1797
ANH	-0.06484 0.6910
SZM	0.18244 0.2599
QTZ	-0.03425 0.8338
PYR	0.85934 0.0001
CAL	-0.38565 0.0140
DOL	-0.23073 0.1520
ORT	0.14617 0.3681
PLA	-0.12408 0.4456
SID	0.19659 0.2240
ANK	-0.26321 0.1008
GRDEN	1.00000 0.0000

SUBJECT TO REVISION

APPENDIX C

MEANS AND CORRELATION MATRICES BY LITHOTYPE

PRELIMINARY
OPEN FILE REPORT
SUBJECT TO
REVISION

Lenticularly Laminated Shale

PRELIMINARY
OPEN FILE REPORT
WEST VIRGINIA GEOLOGICAL SURVEY

VARIABLE	N	MEAN	STD DEV	SUM	MINIMUM	MAXIMUM
SAMPLE	11	3690.21818182	99.33750367	40592.40000000	3461.00000000	3795.00000000
LOSIG100	11	5.10909091	1.33750106	56.20000000	2.80000000	7.00000000
LOSIG500	11	3.19090909	0.70349775	35.10000000	1.80000000	4.20000000
SULFUR	11	2.41909091	2.15814019	26.61000000	0.11000000	8.50000000
BULKDEN	11	2.62545455	0.06919012	28.88000000	2.55000000	2.77000000
MATRXDEN	11	2.66363636	0.05696889	29.30000000	2.58000000	2.76000000
LOGDEN	11	2.59454545	0.04967165	28.54000000	2.55000000	2.70000000
POROSITY	11	1.50454545	0.94309452	16.55000000	0	2.97000000
GAMMA	11	252.72727273	52.55300355	2780.00000000	180.00000000	310.00000000
QUARTZ	11	0.13000000	0.02756810	1.43000000	0.10000000	0.18000000
KAP	11	0.01066353	0.00245217	0.11729880	0.00806901	0.01606754
ILL	11	0.61227638	0.04592967	6.73504023	0.52237284	0.68648362
CHO	11	0.00088018	0.00233664	0.00968200	0	0.00769147
GYP	11	0.00183073	0.00233298	0.02013808	0	0.00633097
KAO	11	0.00528738	0.01753627	0.05816122	0	0.05816122
HEM	11	0.00465312	0.00183959	0.05118432	0	0.00684705
ANH	11	0.00222605	0.00347079	0.02448657	0	0.01038322
SZN	11	0	0	0	0	0
QTZ	11	0.26227515	0.03829909	2.88502664	0.20714352	0.34398397
PYR	11	0.04037229	0.01647451	0.44409524	0	0.06538676
CAL	11	0.01605948	0.04451258	0.17665424	0	0.14968493
DOL	11	0.00245403	0.00484711	0.02699433	0	0.01497757
OOT	11	0.00078150	0.00178785	0.00859649	0	0.00522896
PLA	11	0.03044269	0.00907785	0.33486960	0.01933126	0.05113655
SID	11	0.00927581	0.00521783	0.10203389	0	0.01772269
ANK	11	0.00052167	0.00125291	0.00573835	0	0.00392451

UGR File # 157
W.Va. Geological & Economic Survey

VARIABLE	N	MEAN	STD DEV	SUM	MINIMUM	MAXIMUM
GRDEN	11	2.78592139	0.03692639	30.64513534	2.69251824	2.83677150

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 11

	SAMPLE	LOSIG100	LOSIG500	SULFUR	BULKDEN	MATRXDEN	LOGDEN	POROSITY	GAMMA	QUARTZ	EXP	ILL	COO
SAMPLE	1.00000 0.0000	0.24812 0.4619	-0.12810 0.7074	-0.01989 0.9537	-0.35911 0.2781	-0.49378 0.1727	-0.55554 0.0760	-0.13513 0.6920	0.56704 0.0689	-0.64173 0.0333	-0.54830 0.0807	0.68494 0.0200	-0.20968 0.5361
LOSIG100	0.24812 0.4619	1.00000 0.0000	0.58144 0.0606	0.70691 0.0150	-0.25237 0.4541	-0.32464 0.3300	-0.76533 0.0061	0.08654 0.8003	0.25854 0.4427	-0.45291 0.1618	-0.63512 0.0358	0.10745 0.7532	-0.56336 0.0711
LOSIG500	-0.12810 0.7074	0.58144 0.0606	1.00000 0.0000	0.49128 0.1249	0.01345 0.9687	0.08325 0.8077	-0.29346 0.3811	0.24379 0.4700	-0.17508 0.6066	-0.22172 0.5123	-0.23712 0.4826	-0.34158 0.3039	0.12151 0.7219
SULFUR	-0.01989 0.9537	0.70691 0.0150	0.49128 0.1249	1.00000 0.0000	0.43031 0.1865	0.28568 0.3944	-0.46853 0.1461	-0.30894 0.3553	-0.20383 0.5477	-0.41230 0.2076	-0.54089 0.0858	-0.49425 0.1223	-0.36163 0.2745
BULKDEN	-0.35911 0.2781	-0.25237 0.4541	0.01345 0.9687	0.43031 0.1865	1.00000 0.0000	0.91285 0.0001	0.48671 0.1290	-0.53419 0.0905	-0.68104 0.0210	0.29883 0.3720	0.31496 0.3455	-0.77469 0.0051	0.43077 0.1860
MATRXDEN	-0.49378 0.1727	-0.32464 0.3300	0.08325 0.8077	0.28568 0.3944	0.91285 0.0001	1.00000 0.0000	0.66501 0.0256	-0.14887 0.6622	-0.70841 0.0147	0.40114 0.2214	0.46191 0.1526	-0.73892 0.0094	0.59621 0.0529
LOGDEN	-0.55554 0.0760	-0.76533 0.0061	-0.29346 0.3811	-0.46853 0.1461	0.48671 0.1290	0.66501 0.0256	1.00000 0.0000	0.08939 0.7938	-0.45726 0.1573	0.77409 0.0052	0.85219 0.0009	-0.33296 0.3171	0.72534 0.0115
POROSITY	-0.13513 0.6920	0.08654 0.8003	0.24379 0.4700	-0.30894 0.3553	-0.53419 0.0905	-0.14887 0.6622	0.08939 0.7938	1.00000 0.0000	0.20230 0.5508	0.01577 0.9633	0.07868 0.8181	0.31560 0.3444	0.11333 0.7401
GAMMA	0.56704 0.0689	0.25854 0.4427	-0.17508 0.6066	-0.20383 0.5477	-0.68104 0.0210	-0.70841 0.0147	-0.45726 0.1573	0.20230 0.5508	1.00000 0.0000	-0.37963 0.2495	-0.53146 0.0925	0.60624 0.0480	-0.31627 0.3434
QUARTZ	-0.64173 0.0333	-0.45291 0.1618	-0.22172 0.5123	-0.41230 0.2076	0.29883 0.3720	0.40114 0.2214	0.77409 0.0052	0.01577 0.9633	-0.37963 0.2495	1.00000 0.0000	0.90416 0.0001	-0.22550 0.5050	0.50431 0.1137
EXP	-0.54830 0.0807	-0.63512 0.0358	-0.23712 0.4826	-0.54089 0.0858	0.31496 0.3455	0.46191 0.1526	0.85219 0.0009	0.07868 0.8181	-0.53146 0.0925	0.90416 0.0001	1.00000 0.0000	-0.18308 0.5900	0.66683 0.0250
ILL	0.68494 0.0200	0.10745 0.7532	-0.34158 0.3039	-0.49425 0.1223	-0.77469 0.0051	-0.73892 0.0094	-0.33296 0.3171	0.31560 0.3444	0.60624 0.0480	-0.22550 0.5050	-0.18308 0.5900	1.00000 0.0000	-0.31289 0.3488
COO	-0.20968 0.5361	-0.56336 0.0711	0.12151 0.7219	-0.36163 0.2745	0.43077 0.1860	0.59621 0.0529	0.72534 0.0115	0.11333 0.7401	-0.31627 0.3434	0.50431 0.1137	0.66683 0.0250	-0.31289 0.3488	1.00000 0.0000
GYP	0.15203 0.6554	-0.15511 0.6488	-0.16083 0.6366	-0.15096 0.6577	-0.23797 0.4410	-0.19970 0.5561	-0.16806 0.6213	0.14392 0.6729	-0.23264 0.4912	-0.39349 0.2312	-0.05557 0.8711	0.23438 0.4879	-0.23309 0.4903

SUBJECT TO REVISION

UGR File # 157
W.Va. Geological & Economic Survey

S T A T I S T I C A L A N A L Y S I S S Y S T E M 0132 WEDNESDAY, JANUARY 17, 1979

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 11

	SAMPLE	LOSIG100	LOSIG500	SULFUR	BULKDEN	MATRXDEN	LOGDEN	POROSITY	GAMMA	QUARTZ	EXP	ILL	COD
KAO	-0.01742 0.9595	-0.12624 0.7115	-0.09000 0.7924	-0.08285 0.8087	-0.12202 0.7208	-0.13761 0.6866	-0.16389 0.6301	0.00543 0.9873	0.23523 0.4863	-0.12031 0.7246	-0.28377 0.3977	-0.01084 0.9748	-0.12493 0.7144
HEM	-0.01496 0.9652	0.55508 0.0763	-0.15069 0.6583	0.50217 0.1155	-0.18434 0.5874	-0.27759 0.4085	-0.50720 0.1113	-0.03351 0.9221	0.37951 0.2497	-0.30946 0.3544	-0.59272 0.0546	0.04650 0.8920	-0.82071 0.0020
ANH	0.07031 0.8372	0.45167 0.1631	0.43197 0.1846	0.83300 0.0014	0.43051 0.1862	0.35849 0.2790	-0.38042 0.2378	-0.18776 0.5804	-0.34035 0.3058	-0.55759 0.0747	-0.44908 0.1650	-0.47349 0.1413	-0.15827 0.6421
SZR	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000
QTZ	-0.28763 0.3911	0.43350 0.1829	0.30421 0.3631	0.77477 0.0051	0.29006 0.3869	0.13637 0.6893	-0.35365 0.2860	-0.31486 0.3456	-0.16548 0.6268	-0.38367 0.2441	-0.48270 0.1326	-0.60479 0.0487	-0.47876 0.1363
PYR	-0.07134 0.8349	0.72939 0.0109	0.23329 0.4900	0.44977 0.1651	-0.44317 0.1722	-0.41537 0.2039	-0.60263 0.0497	0.32516 0.3292	0.24927 0.4598	-0.34905 0.2927	-0.53293 0.0914	0.14168 0.6778	-0.78663 0.0041
CAL	-0.29909 0.3716	-0.54560 0.0826	0.14001 0.6814	-0.29617 0.3765	0.52897 0.0943	0.61606 0.0436	0.70990 0.0144	-0.08544 0.8078	-0.44100 0.1746	0.60131 0.0504	0.72014 0.0124	-0.41539 0.2039	0.95742 0.0001
DOL	-0.30267 0.3656	-0.32578 0.3202	0.28946 0.3879	0.08430 0.8053	0.71297 0.0138	0.71998 0.0125	0.50221 0.1154	-0.26435 0.4321	-0.45921 0.1554	0.41411 0.2054	0.43738 0.1785	-0.64292 0.0329	0.80734 0.0027
ORT	-0.10163 0.7662	0.53895 0.0671	0.60655 0.0479	0.87217 0.0005	0.48726 0.1285	0.39829 0.2250	-0.33440 0.3140	-0.23981 0.4775	-0.55411 0.0769	-0.34883 0.2931	-0.32160 0.3348	-0.52475 0.0975	-0.18112 0.5941
PLA	-0.52571 0.0967	-0.45000 0.1649	-0.53494 0.0900	-0.15373 0.6518	0.44982 0.1651	0.48732 0.1284	0.69277 0.0181	-0.14913 0.6617	-0.50054 0.1169	0.63290 0.0366	0.63199 0.0370	-0.22198 0.5118	0.08485 0.8041
STD	0.37109 0.2612	-0.23846 0.4801	-0.37414 0.2570	-0.26149 0.4373	-0.07484 0.8269	-0.11812 0.7294	0.17559 0.6056	-0.11081 0.7457	0.14048 0.6803	-0.15391 0.6514	0.00603 0.9860	0.35134 0.2494	-0.05268 0.8778
ANK	0.07877 0.8179	-0.36915 0.2639	-0.54932 0.0801	-0.19779 0.5599	-0.02545 0.9408	-0.20250 0.5504	-0.09013 0.7921	-0.41812 0.2006	-0.01024 0.9762	-0.12221 0.7204	0.04325 0.8995	0.00528 0.9877	-0.17252 0.6120
GROPH	0.01382 0.9678	0.71826 0.0128	0.18801 0.5798	0.41272 0.2071	-0.47185 0.1428	-0.45097 0.1639	-0.59442 0.0518	0.31576 0.3442	0.29016 0.3867	-0.38081 0.2479	-0.54158 0.0853	0.22105 0.5136	-0.79665 0.0033

	GYP	KAO	HEM	ANH	SZR	QTZ	PYR	CAL	DOL	ORT	PLA	STD	ANK
SAMPLE	0.15203 0.6554	-0.01742 0.9595	-0.01496 0.9652	0.07031 0.8372	0.00000 1.0000	-0.28763 0.3911	-0.07134 0.8349	-0.29909 0.3716	-0.30267 0.3656	-0.10163 0.7662	-0.52571 0.0967	0.37109 0.2612	0.07877 0.8179
LOSIG100	-0.15511 0.6488	-0.12624 0.7115	0.55508 0.0763	0.45167 0.1631	0.00000 1.0000	0.43350 0.1829	0.72939 0.0109	-0.54560 0.0826	-0.32578 0.3202	0.53895 0.0671	-0.45000 0.1649	-0.23846 0.4801	-0.36915 0.2639
LOSIG500	-0.16083 0.6360	-0.09000 0.7924	-0.15069 0.6583	0.43197 0.1846	0.00000 1.0000	0.30421 0.3631	0.23329 0.4900	0.14001 0.6814	0.28946 0.3879	0.60655 0.0479	-0.53494 0.0900	-0.37414 0.2570	-0.54932 0.0801

UGR File # 157
W.Va. Geological & Economic Survey

SUBJECT TO REVISION

S T A T I S T I C A L A N A L Y S I S S Y S T E M 8:32 WEDNESDAY, JANUARY 17, 1979

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 11

	GYP	KAO	HEM	ANH	SZM	QTZ	PYR	CAL	DOL	ORT	PLA	SID	ANK
SULFUR	-0.15096 0.6577	-0.08285 0.8087	0.50217 0.1155	0.83380 0.0014	0.00000 1.0000	0.77477 0.0051	0.44977 0.1651	-0.29617 0.3765	0.08430 0.8053	0.87217 0.0005	-0.15373 0.6518	-0.26149 0.4373	-0.19779 0.5599
BULKDEN	-0.23797 0.4310	-0.12202 0.7208	-0.18434 0.5874	0.43051 0.1862	0.00000 1.0000	0.29006 0.3869	-0.44317 0.1722	0.52897 0.0943	0.71297 0.0138	0.48726 0.1285	0.44982 0.1651	-0.07484 0.8269	-0.02545 0.9408
MATRXDEN	-0.19970 0.5561	-0.13761 0.6866	-0.27759 0.4085	0.35849 0.2790	0.00000 1.0000	0.13637 0.6893	-0.41537 0.2039	0.61606 0.0436	0.71998 0.0125	0.39829 0.2250	0.48732 0.1284	-0.11812 0.7294	-0.20250 0.5504
LOGDEN	-0.16806 0.6213	-0.16389 0.6301	-0.50720 0.1113	-0.38842 0.2378	0.00000 1.0000	-0.35365 0.2860	-0.60261 0.0497	0.70990 0.0144	0.50221 0.1154	-0.33440 0.3148	0.69277 0.0181	0.17559 0.6056	-0.09013 0.7921
POROSITY	0.14192 0.6729	0.00543 0.9873	-0.03351 0.9221	-0.18776 0.5404	0.00000 1.0000	-0.31486 0.3456	0.32516 0.3292	-0.08544 0.8028	-0.26435 0.4321	-0.23981 0.4775	-0.14913 0.6617	-0.11081 0.7457	-0.41812 0.2006
GAMMA	-0.23264 0.4912	0.21521 0.5863	0.37951 0.2497	-0.34035 0.3058	0.00000 1.0000	-0.16548 0.6268	0.24927 0.4598	-0.44100 0.1746	-0.45921 0.1554	-0.55411 0.0769	-0.50054 0.1169	0.14048 0.6803	-0.01024 0.9762
QUARTZ	-0.39349 0.2312	-0.12031 0.7246	-0.30946 0.3544	-0.55759 0.0747	0.00000 1.0000	-0.38367 0.2441	-0.34905 0.2927	0.60131 0.0504	0.41411 0.2054	-0.34883 0.2931	0.63290 0.0366	-0.15391 0.6514	-0.12221 0.7204
FKP	-0.05557 0.8711	-0.28377 0.3977	-0.59272 0.0546	-0.44988 0.1650	0.00000 1.0000	-0.48270 0.1326	-0.53293 0.0914	0.72014 0.0124	0.43738 0.1765	-0.32160 0.3348	0.63199 0.0370	0.00603 0.9860	0.04325 0.8995
ILL	0.23438 0.4879	-0.01084 0.9748	0.04650 0.8920	-0.47349 0.1413	0.00000 1.0000	-0.60479 0.0487	0.14168 0.6778	-0.41539 0.2039	-0.64292 0.0329	-0.52475 0.0975	-0.22198 0.5118	0.35134 0.2894	0.00528 0.9877
COO	-0.23109 0.4903	-0.12493 0.7144	-0.82071 0.0020	-0.15827 0.6421	0.00000 1.0000	-0.47870 0.1363	-0.78663 0.0041	0.95742 0.0001	0.80734 0.0027	-0.18112 0.5941	0.08485 0.8041	-0.05268 0.8778	-0.17252 0.6120
GYP	1.00000 0.0000	-0.26026 0.4396	-0.12804 0.7075	0.26698 0.4274	0.00000 1.0000	0.06221 0.8558	0.05323 0.8765	-0.28377 0.3978	-0.43702 0.1789	0.13382 0.6949	0.05805 0.8654	0.29129 0.3848	0.52636 0.0962
KAO	-0.26026 0.4396	1.00000 0.0000	0.20351 0.5484	-0.21272 0.5300	0.00000 1.0000	-0.12413 0.7161	-0.01725 0.9599	-0.08493 0.8039	0.13875 0.6941	-0.14498 0.6706	-0.37725 0.2527	-0.58960 0.0563	-0.13809 0.6855
HEM	-0.12804 0.7075	0.20351 0.5484	1.00000 0.0000	0.20141 0.5526	0.00000 1.0000	0.56596 0.0695	0.78801 0.0040	-0.81724 0.0021	-0.57836 0.0623	0.14745 0.6653	0.04019 0.9066	-0.13266 0.6974	0.01041 0.9758
ANH	0.26698 0.4274	-0.21272 0.5300	0.20141 0.5526	1.00000 0.0000	0.00000 1.0000	0.68055 0.0212	0.26093 0.4384	-0.16970 0.6179	0.10786 0.7523	0.86263 0.0006	-0.19568 0.5642	-0.13927 0.6830	0.09150 0.7890
SZM	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000
QTZ	0.06221 0.8558	-0.12413 0.7161	0.56596 0.0695	0.68055 0.0212	0.00000 1.0000	1.00000 0.0000	0.51145 0.1078	-0.41789 0.2009	-0.13322 0.6962	0.62655 0.0391	0.02436 0.9433	-0.06411 0.8514	0.17875 0.5990
PYR	0.05323 0.8765	-0.01725 0.9599	0.78801 0.0040	0.26093 0.4384	0.00000 1.0000	0.51145 0.1078	1.00000 0.0000	-0.82257 0.0019	-0.69686 0.0172	0.25877 0.4424	-0.12579 0.7125	-0.14996 0.6599	-0.11766 0.7305

SUBJECT TO REVISION

UGR File # 157
W.Va. Geological & Economic Survey

S T A T I S T I C A L A N A L Y S I S S Y S T E M 8:32 WEDNESDAY, JANUARY 17, 1979

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 11

	GYP	KAO	HEM	ANH	SZR	QTZ	PYR	CAL	DOL	ORT	PLA	SID	ANK
CAL	-0.28177 0.3978	-0.06491 0.8039	-0.81724 0.0021	-0.16970 0.6179	0.00000 1.0000	-0.41789 0.2009	-0.82257 0.0019	1.00000 0.0000	0.89193 0.0002	-0.09053 0.7912	0.13160 0.6997	-0.15673 0.6454	-0.13997 0.6815
DOL	-0.43702 0.1789	0.13875 0.6841	-0.57836 0.0623	0.10786 0.7523	0.00000 1.0000	-0.13322 0.6962	-0.69686 0.0172	0.89193 0.0002	1.00000 0.0000	0.21122 0.5330	-0.01634 0.9620	-0.39470 0.2296	-0.23188 0.4927
ORT	0.13382 0.6949	-0.14498 0.6706	0.14745 0.6653	0.86263 0.0006	0.00000 1.0000	0.62655 0.0391	0.25872 0.4424	-0.09053 0.7912	0.21122 0.5330	1.00000 0.0000	-0.11674 0.7325	-0.27816 0.4075	-0.20020 0.5550
PLA	0.05805 0.8654	-0.17725 0.2527	0.04019 0.9066	-0.19568 0.5642	0.00000 1.0000	0.02436 0.9433	-0.12579 0.7125	0.13160 0.6997	-0.01634 0.9620	-0.11674 0.7325	1.00000 0.0000	0.35166 0.2889	0.15148 0.6566
SID	0.29129 0.3848	-0.58960 0.0563	-0.13266 0.6974	-0.13927 0.6830	0.00000 1.0000	-0.06411 0.8514	-0.14996 0.6599	-0.15673 0.6454	-0.39470 0.2296	-0.27816 0.4075	0.35166 0.2889	1.00000 0.0000	0.20856 0.5383
ANK	0.52636 0.0962	-0.13809 0.6855	0.01041 0.9758	0.09150 0.7890	0.00000 1.0000	0.17875 0.5990	-0.11766 0.7305	-0.13997 0.6815	-0.23188 0.4927	-0.20020 0.5550	0.15148 0.6566	0.20856 0.5383	1.00000 0.0000
GRDEN	0.08716 0.7982	-0.12369 0.7171	0.76555 0.0060	0.23906 0.4790	0.00000 1.0000	0.48725 0.1285	0.98616 0.0001	-0.85187 0.0009	-0.76629 0.0059	0.21433 0.5268	-0.09072 0.7908	0.01030 0.9760	-0.09895 0.7722

	GRDEN
SAMPLE	0.01382 0.9678
LOSIG100	0.71826 0.0128
LOSIG500	0.18801 0.5798
SOLFOR	0.41272 0.2071
BOLKDEN	-0.47185 0.1428
NATRADEN	-0.45097 0.1639
LOGDEN	-0.59442 0.0538
POROSITY	0.31576 0.3442
GAMMA	0.29016 0.3867

UNOFFICIAL DOCUMENT
SUBJECT TO REVISION

UGR File # 157
W.Va. Geological & Economic Survey

S T A T I S T I C A L A N A L Y S I S S Y S T E M 22
8:32 WEDNESDAY, JANUARY 17, 1979

CORRELATION COEFFICIENTS / PROB > |R| UNDER H0:RHO=0 / N = 11

	GRDEN
QUARTZ	-0.38081 0.2479
EXP	-0.54158 0.0853
ILL	0.22105 0.5136
COQ	-0.79665 0.0033
GYP	0.08746 0.7982
KAO	-0.12369 0.7171
HEM	0.76555 0.0060
ANH	0.23906 0.4790
SZK	0.00000 1.0000
QTZ	0.48725 0.1285
PYR	0.98616 0.0001
CAL	-0.85187 0.0009
DOL	-0.76629 0.0059
ORT	0.21433 0.5268
PLA	-0.09072 0.7908
SID	0.01030 0.9760
ANK	-0.09895 0.7722

SUBJECT TO REVISION
OPEN FILE REPORT
PRELIMINARY

Thinly Laminated Shale

SUBJECT TO REVISION

STATISTICAL ANALYSIS SYSTEM

8:32 WEDNESDAY, JANUARY 17, 1979

10

VARIABLE	N	MEAN	STD DEV	SUM	MINIMUM	MAXIMUM
SAMPLE	13	3565.15384615	124.92868376	46347.00000000	3411.20000000	3720.20000000
LOSIG100	13	5.78461538	1.13566879	75.20000000	3.50000000	7.20000000
LOSIG500	13	3.21538462	0.53672798	41.80000000	2.40000000	4.20000000
SULFUR	13	2.51923077	0.42281717	32.75000000	1.96000000	3.10000000
BULKDEN	13	2.59615385	0.05881305	33.75000000	2.51000000	2.69000000
MATRXDEN	13	2.62923077	0.05780161	34.18000000	2.53000000	2.73000000
LOGDEN	13	2.58538462	0.05531958	33.61000000	2.46000000	2.66000000
POROSITY	13	1.25538462	0.87020702	16.32000000	0	2.95000000
GAMMA	13	237.30769231	29.19870036	3085.00000000	200.00000000	290.00000000
QUARTZ	13	0.12615385	0.02693772	1.64000000	0.09000000	0.16000000
EXP	13	0.01035181	0.00258003	0.13457353	0.00436185	0.01357718
ILL	13	0.56770184	0.08320847	7.38012390	0.38665892	0.65141005
COQ	13	0.00331070	0.00383618	0.04303910	0	0.00991331
GYP	13	0.00287470	0.00332676	0.03737113	0	0.01031304
KAO	13	0.00084296	0.00303933	0.01095845	0	0.01095845
HEM	13	0.00573014	0.00232597	0.07449181	0.00221950	0.01245159
ANH	13	0.00188434	0.00466220	0.02449637	0	0.01411315
SZM	13	0.00181851	0.00304905	0.02364062	0	0.00807455
QTZ	13	0.30682362	0.06365916	3.98870703	0.23512810	0.43075671
PYR	13	0.05280586	0.00652350	0.68647614	0.04206218	0.06282867
CAL	13	0.00642918	0.00929542	0.08357929	0	0.02664481
DOL	13	0.00202165	0.00543964	0.02628147	0	0.01874654
ORT	13	0.00245514	0.00410244	0.03191676	0	0.01319109
PLA	13	0.02396620	0.00492114	0.31156054	0.01742823	0.03141445
STD	13	0.00999171	0.00848722	0.12989224	0	0.03224109
ANF	13	0.00099166	0.00194989	0.01289162	0	0.00561850

PRELIMINARY
OPEN-FILE REPORT
SUBJECT TO REVISION

STATISTICAL ANALYSIS SYSTEM 8:32 WEDNESDAY, JANUARY 17, 1979

VARIABLE	N	MEAN	STD DEV	SUM	MINIMUM	MAXIMUM
GRDEN	13	2.81215138	0.01556825	36.55796790	2.79239377	2.83443613

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 13

	SAMPLE	LOSIG100	LOSIG500	SULFUR	BULKDEN	MATRXDEN	LOGDEN	POROSITY	GAMMA	QUARTZ	EXP	ILL	COO
SAMPLE	1.00000 0.0000	0.65253 0.0156	-0.15691 0.6087	-0.55480 0.0491	-0.80912 0.0008	-0.63109 0.0207	0.14212 0.6433	0.21885 0.4725	0.29254 0.3321	-0.10775 0.7261	-0.15889 0.6041	-0.35891 0.2285	0.09799 0.7501
LOSIG100	0.65253 0.0156	1.00000 0.0000	0.00999 0.9742	-0.43962 0.1328	-0.83190 0.0004	-0.88376 0.0001	-0.25457 0.4013	-0.00505 0.9869	0.24995 0.4102	-0.13012 0.6718	-0.07201 0.8151	-0.17441 0.5688	0.10328 0.7371
LOSIG500	-0.15691 0.6087	0.00999 0.9742	1.00000 0.0000	0.39003 0.1877	0.00995 0.9741	-0.21448 0.4817	-0.57838 0.0384	-0.24284 0.4240	0.17302 0.5719	0.67303 0.0117	0.40513 0.1697	0.08370 0.7857	0.36398 0.2215
SULFUR	-0.55480 0.0491	-0.43962 0.1328	0.39003 0.1877	1.00000 0.0000	0.63223 0.0204	0.56736 0.0431	-0.28768 0.3405	0.10152 0.7414	0.18544 0.5441	0.41969 0.1534	0.46847 0.1064	0.53874 0.0575	-0.28531 0.3447
BULKDEN	-0.80912 0.0008	-0.83190 0.0004	0.00995 0.9741	0.63223 0.0204	1.00000 0.0000	0.86193 0.0002	0.05300 0.8635	-0.20456 0.5026	-0.38262 0.1969	0.21606 0.4783	0.07987 0.7953	0.31973 0.2469	-0.25310 0.4041
MATRXDEN	-0.63109 0.0207	-0.88376 0.0001	-0.21448 0.4817	0.56736 0.0431	0.86193 0.0002	1.00000 0.0000	0.37930 0.2012	0.24578 0.4183	-0.22846 0.4528	0.03541 0.9086	0.07158 0.8162	0.34261 0.2518	-0.23262 0.4444
LOGDEN	0.14212 0.6433	-0.25457 0.4013	-0.57838 0.0384	-0.28768 0.3405	0.05300 0.8635	0.37930 0.2012	1.00000 0.0000	0.28878 0.3386	-0.24565 0.4185	-0.29251 0.3321	-0.36249 0.2235	-0.23675 0.4361	0.01886 0.9512
POROSITY	0.21885 0.4725	-0.00505 0.9869	-0.24284 0.4240	0.10152 0.7414	-0.20456 0.5026	0.24578 0.4183	0.28878 0.3386	1.00000 0.0000	0.44961 0.1232	-0.20736 0.4966	0.06511 0.8326	0.29622 0.3257	0.06653 0.8290
GAMMA	0.29254 0.3321	0.24995 0.4102	0.17302 0.5719	0.18544 0.5441	-0.38262 0.1969	-0.22846 0.4528	-0.24565 0.4185	0.44961 0.1232	1.00000 0.0000	-0.06194 0.8407	-0.20678 0.4979	-0.12151 0.6925	0.22308 0.4638
QUARTZ	-0.10775 0.7261	-0.13012 0.6718	0.67303 0.0117	0.41969 0.1534	0.21606 0.4783	0.03541 0.9086	-0.29251 0.3321	-0.20736 0.4966	-0.06194 0.8407	1.00000 0.0000	0.35313 0.2366	-0.01578 0.9592	0.08023 0.7944
EXP	-0.15889 0.6041	-0.07201 0.8151	0.40513 0.1697	0.46847 0.1064	0.07987 0.7953	0.07158 0.8162	-0.36249 0.2235	0.06511 0.8326	-0.20678 0.4979	0.35313 0.2366	1.00000 0.0000	0.68038 0.0105	-0.39654 0.1798
ILL	-0.35891 0.2285	-0.17441 0.5688	0.08370 0.7857	0.53874 0.0575	0.31973 0.2469	0.34261 0.2518	-0.23675 0.4361	0.29622 0.3257	-0.12151 0.6925	-0.01578 0.9592	0.68038 0.0105	1.00000 0.0000	-0.56253 0.0454
COO	0.09799 0.7501	0.10328 0.7371	0.36398 0.2215	-0.28531 0.3447	-0.25310 0.4041	-0.23262 0.4444	0.01886 0.9512	0.06653 0.8290	0.22308 0.4638	0.08023 0.7944	-0.39654 0.1798	-0.56253 0.0454	1.00000 0.0000
GYP	0.07241 0.8141	0.02859 0.9261	0.21750 0.4751	-0.33588 0.2619	-0.15812 0.6059	-0.14813 0.6291	0.09176 0.7606	0.03511 0.9093	0.14372 0.6395	-0.07146 0.8165	-0.50562 0.0779	-0.53027 0.0623	0.96212 0.0001

UGR File # 157
W.Va. Geological & [redacted] Survey

OPEN FILE
SUBJECT TO REVISION

STATISTICAL ANALYSIS SYSTEM 8:32 WEDNESDAY, JANUARY 17, 1979

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 13

	SAMPLE	LOSIG100	LOSIG500	SULFUR	POLKDEN	MATRXDEN	LOGDEN	POROSITY	GAMMA	QUARTZ	EXP	ILL	CHO
KAO	0.23292 0.4410	0.37447 0.2075	0.21541 0.4799	-0.35476 0.2343	-0.44014 0.1323	-0.51582 0.0712	0.02507 0.9352	-0.16069 0.6000	0.18206 0.5518	0.37752 0.2035	-0.34411 0.2496	-0.65374 0.0154	0.46245 0.1116
HEM	-0.25981 0.3913	-0.09474 0.7581	-0.57154 0.0413	-0.37299 0.2094	0.20114 0.5099	0.19449 0.5243	0.24524 0.4193	-0.05190 0.8663	-0.24207 0.4256	-0.60553 0.0283	-0.64400 0.0175	-0.29083 0.3350	0.23319 0.4432
ANH	0.39514 0.1814	0.51301 0.0730	0.07171 0.8159	-0.38091 0.1991	-0.57829 0.0384	-0.65536 0.0150	-0.19831 0.5160	-0.15312 0.6175	0.48777 0.0909	0.06787 0.8256	-0.45312 0.1200	-0.64997 0.0162	0.22809 0.4536
SZM	0.13190 0.6675	-0.03152 0.9186	0.02336 0.9396	0.03431 0.9114	0.18599 0.5429	0.20796 0.4954	0.28039 0.3515	0.04376 0.8871	-0.02062 0.9467	0.03898 0.8994	-0.42977 0.1427	-0.25024 0.4096	0.40551 0.1692
QTZ	0.34293 0.2514	0.05110 0.8681	-0.16277 0.5952	-0.40418 0.0936	-0.20699 0.4974	-0.21542 0.4388	0.24341 0.4229	-0.12772 0.2744	0.07211 0.8149	0.06866 0.8236	-0.64080 0.0183	-0.96802 0.0001	0.41464 0.1589
PYR	-0.24223 0.4253	-0.44736 0.1253	-0.27472 0.3637	0.22090 0.4683	0.40355 0.0941	0.59451 0.0321	0.55707 0.0480	-0.09040 0.7690	-0.36037 0.2264	-0.17462 0.5683	-0.02205 0.9430	-0.01155 0.9701	-0.14077 0.6464
CAL	0.35803 0.2297	0.37739 0.2036	0.64907 0.0164	-0.20522 0.5012	-0.53420 0.0600	-0.66109 0.0139	-0.27809 0.3576	-0.27899 0.3560	0.38559 0.1932	0.31425 0.2957	-0.09988 0.7454	-0.49818 0.0832	0.49937 0.0823
DOL	-0.09001 0.7700	-0.04959 0.8722	-0.34360 0.2504	-0.30245 0.3152	0.13310 0.6647	0.06431 0.8347	0.09519 0.7571	-0.17812 0.5604	0.03808 0.9017	-0.54037 0.0566	-0.76889 0.0021	-0.47638 0.0998	0.39467 0.1820
ORT	-0.08177 0.7906	0.13674 0.6560	-0.17193 0.5143	-0.44043 0.1120	-0.07637 0.8042	-0.20600 0.4995	0.11344 0.7121	-0.31653 0.2920	0.09865 0.7485	-0.34298 0.2513	-0.85644 0.0002	-0.70151 0.0075	0.55996 0.0466
PLA	0.65029 0.0161	0.44881 0.1240	-0.44259 0.1299	-0.37271 0.2098	-0.57765 0.0387	-0.29685 0.3247	0.15211 0.6198	0.45610 0.1172	0.02874 0.9258	-0.39232 0.1849	0.71435 0.4819	0.15969 0.6023	-0.38660 0.1919
SID	0.20619 0.4991	0.56711 0.0433	0.03955 0.8979	-0.47080 0.1044	-0.58192 0.0369	-0.56604 0.0437	0.17228 0.5736	-0.05083 0.8690	0.10590 0.7306	0.02355 0.9391	-0.27696 0.3596	-0.48801 0.0907	0.43534 0.1371
ANK	-0.20196 0.5082	-0.08568 0.7808	0.34730 0.2450	0.18629 0.5423	0.02762 0.9315	0.12486 0.6844	-0.03311 0.9145	0.25706 0.3965	-0.18804 0.5384	0.04205 0.8915	0.42754 0.1450	0.29213 0.3328	0.09758 0.7511
GADER	-0.17330 0.5623	-0.09038 0.7690	-0.26360 0.3842	0.07409 0.8099	0.18658 0.5316	0.29751 0.3235	0.58328 0.0364	-0.07779 0.8006	-0.30641 0.3086	-0.17354 0.5707	-0.03126 0.9193	-0.05323 0.8629	-0.12066 0.6946

	GZP	KAO	HEM	ANH	SZM	QTZ	PYR	CAL	DOL	ORT	PLA	SID	ANK
SAMPLE	0.07241 0.6141	0.23292 0.4410	-0.25981 0.3913	0.39514 0.1814	0.13190 0.6675	0.34293 0.2514	-0.24223 0.4253	0.35803 0.2297	-0.09001 0.7700	-0.08177 0.7906	0.65029 0.0161	0.20619 0.4991	-0.20196 0.5082
LOSIG100	0.02859 0.9261	0.37447 0.2075	-0.09474 0.7581	0.51301 0.0730	-0.03152 0.9186	0.05110 0.8681	-0.44736 0.1253	0.37739 0.2036	-0.04959 0.8722	0.13674 0.6560	0.44881 0.1240	0.56711 0.0433	-0.08568 0.7808
LOSIG500	0.21750 0.4753	0.21541 0.4799	-0.57154 0.0413	0.07171 0.8159	0.02336 0.9396	-0.16277 0.5952	-0.27472 0.3637	0.64907 0.0164	-0.34360 0.2504	-0.17193 0.5143	-0.44259 0.1299	0.03955 0.8979	0.34730 0.2450

UGR File # 157
W.Va. Geological & Economic Survey

SUBJECT TO REVISION
OFFICIAL RECORD
PRELIMINARY

S T A T I S T I C A L A N A L Y S I S S Y S T E M 0132 WEDNESDAY, JANUARY 17, 1979

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 13

	GYP	KAO	DEN	APH	SZN	QTZ	PYR	CAL	DOL	ORT	PLA	SID	ANK
SOLEDIC	-0.33588 0.2619	-0.35476 0.2341	-0.37293 0.2094	-0.38091 0.1991	0.03331 0.9114	-0.48418 0.0936	0.22090 0.4683	-0.20522 0.5012	-0.10245 0.3157	-0.44041 0.1320	-0.37271 0.2098	-0.47080 0.1044	0.18629 0.5423
BOLEDEN	-0.15842 0.6059	-0.44014 0.1323	0.20114 0.5099	-0.57829 0.0384	0.14599 0.5429	-0.20699 0.4974	0.48355 0.0941	-0.53420 0.0600	0.13310 0.6647	-0.07637 0.8042	-0.57765 0.0387	-0.58192 0.0369	0.02262 0.9415
RATKXDEN	-0.14813 0.6291	-0.51582 0.0712	0.19149 0.5243	-0.05536 0.8150	0.20796 0.4954	-0.23542 0.4388	0.59451 0.0321	-0.66109 0.0139	0.06431 0.8343	-0.20600 0.4995	-0.29685 0.3247	-0.56604 0.0437	0.12486 0.6844
LOGDEN	0.09376 0.7606	0.02507 0.9352	0.24524 0.1193	-0.19831 0.5160	0.28039 0.3535	0.24341 0.4229	0.55707 0.0480	-0.27809 0.3576	0.09519 0.7571	0.11344 0.7121	0.15211 0.6198	0.17228 0.5736	-0.03311 0.9145
POROSITY	0.01511 0.9093	-0.16069 0.6000	-0.05190 0.8663	-0.15312 0.6175	0.04176 0.8871	-0.32772 0.2744	-0.09040 0.7690	-0.27899 0.3560	-0.17812 0.5604	-0.31653 0.2920	0.45610 0.1172	-0.05083 0.8690	0.25706 0.3965
GAMMA	0.14372 0.6395	0.18206 0.5516	-0.24207 0.1256	0.48777 0.0909	-0.02462 0.9167	0.07211 0.8149	-0.36037 0.2264	0.38559 0.1932	0.03808 0.9017	0.09865 0.7485	0.02874 0.9258	0.10590 0.7306	-0.18804 0.5184
QUARTZ	-0.07146 0.8165	0.17752 0.2035	-0.60551 0.0281	0.06787 0.8256	0.03898 0.8994	0.06866 0.8236	-0.17462 0.5683	0.31425 0.2957	-0.54037 0.0566	-0.34298 0.2513	-0.39232 0.1849	0.02355 0.9391	0.04205 0.8915
EXP	-0.50562 0.0774	-0.34411 0.2196	-0.64400 0.0175	-0.45312 0.1200	-0.42977 0.1427	-0.64080 0.0183	-0.02205 0.9430	-0.09980 0.7454	-0.76809 0.0021	-0.85644 0.0002	0.21435 0.4819	-0.27696 0.3596	0.42754 0.1450
ILL	-0.53027 0.0623	-0.65174 0.0154	-0.29083 0.3350	-0.64997 0.0162	-0.25024 0.4096	-0.96802 0.0001	-0.01155 0.9701	-0.49818 0.0832	-0.47638 0.0998	-0.70151 0.0075	0.15969 0.6023	-0.48801 0.0907	0.29213 0.3320
CHO	0.96212 0.0001	0.46245 0.1116	0.23319 0.4432	0.22809 0.4536	0.40551 0.1692	0.41464 0.1589	-0.14077 0.6464	0.49937 0.0823	0.39467 0.1820	0.55996 0.0466	-0.38660 0.1919	0.43534 0.1371	0.09758 0.7511
GYP	1.00000 0.0000	0.32521 0.2781	0.33587 0.2056	0.11267 0.7140	0.47955 0.0973	0.40270 0.1725	-0.07391 0.8104	0.36290 0.2230	0.54239 0.0555	0.62255 0.0231	-0.40952 0.1646	0.30314 0.3140	-0.01461 0.9622
KAO	0.32521 0.2781	1.00000 0.0000	-0.12625 0.6811	0.78811 0.0014	-0.17920 0.5580	0.58495 0.0357	-0.49484 0.0856	0.65344 0.0154	-0.11167 0.7165	0.40389 0.1711	-0.19608 0.5209	0.78767 0.0014	-0.15281 0.6182
DEN	0.33587 0.2056	-0.12625 0.6811	1.00000 0.0000	-0.05360 0.8619	0.32574 0.2774	0.24591 0.4180	0.26727 0.3774	-0.43132 0.1411	0.86250 0.0001	0.72569 0.0050	-0.10701 0.7279	0.07628 0.8044	-0.07587 0.8054
APH	0.11267 0.7140	0.78811 0.0014	-0.05360 0.8619	1.00000 0.0000	-0.26114 0.3888	0.59945 0.0304	-0.57266 0.0408	0.67229 0.0118	0.09435 0.7592	0.46459 0.1097	0.06403 0.8354	0.57637 0.0392	-0.22268 0.4646
SZN	0.47955 0.0973	-0.17920 0.5580	0.32574 0.2774	-0.26114 0.3888	1.00000 0.0000	0.19046 0.5331	0.51110 0.0743	-0.09029 0.7693	0.52041 0.0683	0.32292 0.2819	-0.22307 0.4638	-0.10829 0.7247	-0.01177 0.9696
QTZ	0.40270 0.1725	0.58495 0.0357	0.24591 0.4180	0.59945 0.0304	0.19046 0.5331	1.00000 0.0000	0.03622 0.9065	0.38965 0.1881	0.42592 0.1467	0.59660 0.0314	-0.15165 0.6209	0.33177 0.2681	-0.41340 0.1603
PYR	-0.07391 0.8104	-0.49484 0.0856	0.26727 0.3774	-0.57266 0.0408	0.51110 0.0743	0.03622 0.9065	1.00000 0.0000	-0.44220 0.1303	0.25503 0.4004	0.01939 0.9499	-0.11702 0.7034	-0.23613 0.4374	0.09862 0.7486

UGR File # 157
W.Va. Geological & Economic Survey

SUBJECT TO REVISION
OPEN FILE REPORT
PRELIMINARY

STATISTICAL ANALYSIS SYSTEM 8:32 WEDNESDAY, JANUARY 17, 1979

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 13

	GYP	KAO	OPA	ANH	SZP	OTZ	PYR	CAL	DOL	ORT	PLA	SID	ANK
CAL	0.36290 0.2230	0.65311 0.0154	-0.43132 0.1411	0.67229 0.0110	-0.09029 0.7693	0.38965 0.1881	-0.44220 0.1303	1.00000 0.0000	-0.12171 0.6920	0.23441 0.4407	-0.15644 0.6098	0.45112 0.1218	0.08766 0.7758
DOL	0.54239 0.0555	-0.11167 0.7155	0.86250 0.0001	0.09435 0.7592	0.52041 0.0683	0.42592 0.1467	0.25503 0.4004	-0.12171 0.6920	1.00000 0.0000	0.82962 0.0005	-0.23933 0.4310	-0.03546 0.9084	-0.20476 0.5022
ORT	0.62255 0.0231	0.40389 0.1711	0.72569 0.0050	0.46459 0.1097	0.32292 0.2819	0.59660 0.0314	0.01939 0.9499	0.23441 0.4407	0.82962 0.0005	1.00000 0.0000	-0.40273 0.1724	0.45497 0.1183	-0.24782 0.4143
PLA	-0.40952 0.1646	-0.19608 0.5209	-0.10701 0.7279	0.06403 0.8354	-0.22307 0.4638	-0.15165 0.6209	-0.11702 0.7034	-0.15644 0.6098	-0.23933 0.4310	-0.40273 0.1724	1.00000 0.0000	-0.03803 0.9018	0.23527 0.4391
SID	0.30414 0.3140	0.78767 0.0014	0.07628 0.8044	0.57637 0.0392	-0.10829 0.7247	0.33177 0.2681	-0.23613 0.4374	0.45112 0.1218	-0.03546 0.9084	0.45497 0.1183	-0.03803 0.9018	1.00000 0.0000	-0.01654 0.9572
ANK	-0.01461 0.9672	-0.15281 0.6182	-0.07587 0.8054	-0.22268 0.4646	-0.01177 0.9696	-0.41340 0.1603	0.09862 0.7486	0.08766 0.7758	-0.20476 0.5022	-0.24782 0.4143	0.23527 0.4391	-0.01654 0.9572	1.00000 0.0000
GRDEN	-0.13324 0.6643	-0.17148 0.5754	0.22224 0.4655	-0.31566 0.2934	0.34903 0.2425	-0.00357 0.9908	0.84077 0.0003	-0.28786 0.3402	0.09721 0.7521	0.11413 0.7104	-0.04352 0.8877	0.25630 0.3980	0.14718 0.6309

	GRDEN
SAMPLE	-0.17236 0.5623
LOSIG100	-0.09038 0.7690
LOSIG500	-0.26160 0.3842
SOLEDG	0.07409 0.8099
HOLEDEN	0.18658 0.5416
MATRXDEN	0.29751 0.3235
LOGDEN	0.58328 0.0364
POROSITY	-0.07779 0.8006
GAMMA	-0.30641 0.3086

UGR File # 157.
W.Va. Geological & Economic Survey

S T A T I S T I C A L A N A L Y S E S S Y S T E M 8:32 WEDNESDAY, JANUARY 17, 1979

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 13

	GPDEP
QUARTZ	-0.14353 0.5707
EXP	-0.03126 0.9193
ILL	-0.05323 0.8629
COO	-0.12066 0.6946
GYP	-0.13324 0.6643
KAO	-0.17148 0.5354
HEM	0.22224 0.4655
ANH	-0.31566 0.2934
SZA	0.44904 0.2425
QTZ	-0.00357 0.9908
PYR	0.84077 0.0003
CAL	-0.26786 0.3402
HAL	0.09721 0.7521
ORT	0.11413 0.7104
PLA	-0.04352 0.8877
SID	0.25630 0.3988
ANK	0.14734 0.6309

UGR File # 157
W.Va. Geological & Economic Survey

Non-Banded Shale

PRELIMINARY
OPEN FILE
SUBJECT TO REVISION

STATISTICAL ANALYSIS SYSTEM

8132 WEDNESDAY, JANUARY 17, 1979

VARIABLE	N	MEAN	STD DEV	SUM	MINIMUM	MAXIMUM
SAMPLE	10	3603.69000000	136.92607454	36036.90000000	3423.10000000	3763.50000000
LOSIG100	10	3.36000000	1.00465583	33.60000000	1.90000000	5.10000000
LOSIG500	10	2.49000000	0.47246399	24.90000000	1.90000000	3.50000000
SOLFOR	10	1.20600000	0.78017377	12.06000000	0.25000000	2.50000000
BULKDEN	10	2.70000000	0.02357023	27.00000000	2.67000000	2.75000000
MATRDEN	10	2.72700000	0.02907844	27.27000000	2.69000000	2.79000000
LOGDEN	10	2.62900000	0.07093816	26.29000000	2.46000000	2.71000000
POROSITY	10	0.98700000	0.42000132	9.87000000	0.37000000	1.48000000
GAMMA	10	208.50000000	39.44405321	2085.00000000	170.00000000	290.00000000
QUARTZ	10	0.13200000	0.04984420	1.32000000	0.05000000	0.21000000
EXP	10	0.01080941	0.00250581	0.10809407	0.00788339	0.01566459
ILL	10	0.58524792	0.10304139	5.85247924	0.35860100	0.70828526
COQ	10	0.00170975	0.00285310	0.01709749	0	0.00714147
GYP	10	0.00153467	0.00337735	0.01534674	0	0.01074979
KAO	10	0	0	0	0	0
HEM.	10	0.00564366	0.00174612	0.05643656	0.00314906	0.00839464
ANH	10	0.00356228	0.00436309	0.03562282	0	0.00959297
SZP	10	0.00127857	0.00287351	0.01278567	0	0.00850519
QTZ	10	0.29343537	0.07030430	2.93435374	0.20695710	0.45825344
PYR	10	0.02517783	0.01377745	0.25177831	0.00530797	0.04200360
CAL	10	0.00879391	0.00918730	0.08793913	0	0.03093436
DOL	10	0.00558998	0.01305755	0.05589978	0	0.04178846
ORT	10	0.00132110	0.00290531	0.01321102	0	0.00835980
PLA	10	0.02934736	0.01508508	0.29347362	0	0.04868214
SID	10	0.02427947	0.03125705	0.24279471	0	0.10947058
AGK	10	0.00226871	0.00559332	0.02268707	0	0.01749521

UGR File # 157
W.Va. Geological & Economic Survey

S T A T I S T I C A L A N A L Y S I S S Y S T E M

8:32 WEDNESDAY, JANUARY 17, 1979

VARIABLE	N	MEAN	STD DEV	SUM	MINIMUM	MAXIMUM
GRDEN	10	2.76788959	0.01922571	27.67889587	2.70918556	2.83508205

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 10

	SAMPLE	LOSIG100	LOSIG500	SULFUR	BULKDEN	MATRXDEN	LOGDEN	POROSITY	GAMMA	QUARTZ	EXP	ILL	COO
SAMPLE	1.00000 0.0000	-0.26889 0.4525	-0.23532 0.5128	-0.67980 0.0306	-0.20932 0.5617	-0.07538 0.8360	0.44485 0.1977	0.24427 0.4964	0.02042 0.9554	-0.37273 0.2888	0.45270 0.1889	0.06698 0.8541	-0.49108 0.1495
LOSIG100	-0.26889 0.4525	1.00000 0.0000	0.57491 0.0821	0.24657 0.4922	0.60999 0.0611	0.49368 0.1470	0.06330 0.8621	-0.01741 0.9619	-0.24562 0.4940	-0.50856 0.1334	-0.36199 0.3040	-0.25871 0.4705	0.58406 0.0762
LOSIG500	-0.23532 0.5128	0.57491 0.0821	1.00000 0.0000	0.52257 0.1212	0.59065 0.0675	0.51518 0.1275	0.22842 0.5256	0.06031 0.8686	-0.07840 0.8295	-0.17835 0.6220	0.07220 0.8429	-0.18677 0.6054	0.40170 0.2499
SULFUR	-0.67980 0.0306	0.24657 0.4922	0.52257 0.1212	1.00000 0.0000	0.02356 0.9485	-0.15438 0.6702	-0.54094 0.1064	-0.43640 0.2072	0.38161 0.2765	0.40510 0.2455	0.01828 0.9600	-0.14662 0.6861	0.24669 0.4920
BULKDEN	-0.20932 0.5617	0.60999 0.0611	0.59065 0.0675	0.02356 0.9485	1.00000 0.0000	0.92405 0.0001	0.51833 0.1248	0.25815 0.4714	-0.38041 0.2673	-0.33101 0.3502	-0.31633 0.3732	-0.42650 0.2190	0.76302 0.0102
MATRXDEN	-0.07538 0.8360	0.49368 0.1470	0.51518 0.1275	-0.15438 0.6702	0.92405 0.0001	1.00000 0.0000	0.64476 0.0441	0.60782 0.0623	-0.47904 0.1613	-0.47070 0.1698	-0.31684 0.3724	-0.32388 0.3613	0.66085 0.0375
LOGDEN	0.44485 0.1977	0.06330 0.8621	0.22842 0.5256	-0.54094 0.1064	0.51833 0.1248	0.64476 0.0441	1.00000 0.0000	0.55555 0.0955	-0.42549 0.2202	-0.54615 0.1024	0.16864 0.6414	0.03774 0.9176	0.32871 0.3537
POROSITY	0.24427 0.4964	-0.01741 0.9619	0.06031 0.8686	-0.43640 0.2072	0.25815 0.4714	0.60782 0.0623	0.55555 0.0955	1.00000 0.0000	-0.40540 0.2451	-0.50549 0.1361	-0.14456 0.6903	0.06473 0.8590	0.09026 0.8042
GAMMA	0.02042 0.9554	-0.24562 0.4940	-0.07840 0.8295	0.38161 0.2765	-0.38041 0.2673	-0.47904 0.1613	-0.42549 0.2202	-0.40540 0.2451	1.00000 0.0000	0.69400 0.0260	0.27559 0.4409	-0.13919 0.7014	-0.51248 0.1299
QUARTZ	-0.37273 0.2888	-0.50856 0.1334	-0.17835 0.6220	0.40510 0.2455	-0.33101 0.3502	-0.47070 0.1698	-0.54615 0.1024	-0.50549 0.1361	0.69400 0.0260	1.00000 0.0000	-0.01872 0.9591	-0.18038 0.6180	-0.36908 0.2939
EXP	0.45270 0.1889	-0.36199 0.3040	0.07220 0.8429	0.01828 0.9600	-0.31633 0.3732	-0.31684 0.3724	0.16864 0.6414	-0.14456 0.6903	0.27559 0.4409	-0.01872 0.9591	1.00000 0.0000	0.62220 0.0547	-0.40243 0.2489
ILL	0.06698 0.8541	-0.25871 0.4705	-0.18677 0.6054	-0.14662 0.6861	-0.42650 0.2190	-0.32388 0.3613	0.03774 0.9176	0.06473 0.8590	-0.13919 0.7014	-0.18038 0.6180	0.62220 0.0547	1.00000 0.0000	-0.30957 0.3841
COO	-0.49108 0.1495	0.58406 0.0762	0.40170 0.2499	0.24669 0.4920	0.76302 0.0102	0.66085 0.0375	0.32871 0.3537	0.09026 0.8042	-0.51248 0.1299	-0.36908 0.2939	-0.40243 0.2489	-0.30957 0.3841	1.00000 0.0000
GYP	-0.25095 0.4843	-0.10467 0.7735	-0.41712 0.2065	-0.09624 0.7914	0.18595 0.6468	0.16767 0.6434	0.13784 0.7041	0.08251 0.8201	-0.33243 0.3480	-0.13882 0.7021	-0.20598 0.5681	-0.02216 0.9516	0.58266 0.0771

NOT TO BE REPRODUCED
SUBJECT TO REVISION

UGR File # 157
W.Va. Geological & Economic Survey

S T A T I S T I C A L A N A L Y S I S S Y S T E M 8:32 WEDNESDAY, JANUARY 17, 1979

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 10

	SAMPLE	LOSIG100	LOSIG500	SULFUR	BULKDEN	MATRXDEN	LOGDEN	POROSITY	GAMMA	QUARTZ	EXP	ILL	COQ
KAO	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000
HEM	-0.21021 0.5599	-0.04019 0.9122	-0.15568 0.6676	0.39181 0.2628	0.04040 0.9118	-0.21328 0.5541	-0.34081 0.3352	-0.62321 0.0542	0.63441 0.0486	0.54258 0.1051	0.09042 0.8038	-0.33001 0.3517	0.10901 0.7644
ANH	-0.35673 0.3116	0.03587 0.9216	-0.11530 0.7511	-0.30814 0.3864	0.24163 0.4976	0.22664 0.5289	-0.00467 0.9898	0.06020 0.8668	-0.53877 0.1081	0.02804 0.9387	-0.40058 0.2513	0.18464 0.6096	0.12730 0.7260
SZM	-0.25090 0.4844	0.83978 0.0024	0.84668 0.0020	0.37023 0.2923	0.61017 0.0508	0.50563 0.1360	0.28635 0.4225	-0.02666 0.9417	-0.29482 0.4083	-0.44979 0.1921	-0.14437 0.6907	-0.20188 0.5159	0.62261 0.0545
QTZ	-0.17609 0.6265	-0.01683 0.9632	0.03616 0.9206	0.22836 0.5257	0.12666 0.7273	0.05985 0.8696	-0.15759 0.6637	-0.10744 0.7677	0.18789 0.6032	0.37203 0.2898	-0.62830 0.0517	-0.89893 0.0004	0.19341 0.5924
PYR	-0.41121 0.2378	0.08409 0.8174	0.27440 0.4429	0.84744 0.0020	-0.14123 0.6971	-0.35704 0.3112	-0.71313 0.0206	-0.60857 0.0619	0.67751 0.0314	0.62111 0.0553	0.01345 0.9706	-0.37347 0.2878	-0.07803 0.8303
CAL	0.17233 0.6340	0.57382 0.0828	0.39425 0.2596	-0.37219 0.2896	0.80226 0.0052	0.86311 0.0013	0.55908 0.0929	0.51459 0.1280	-0.51409 0.1285	-0.56211 0.0908	-0.47168 0.1687	-0.48731 0.1531	0.46387 0.1769
DOL	0.18934 0.6003	-0.02622 0.9427	-0.12049 0.7402	-0.01506 0.9671	-0.03898 0.8931	-0.13576 0.7084	-0.10982 0.7626	-0.23663 0.5104	0.20046 0.5787	0.21295 0.5547	-0.46141 0.1795	-0.82767 0.0031	-0.01198 0.9738
ORT	-0.23990 0.5044	0.85658 0.0016	0.84446 0.0021	0.33385 0.3458	0.66486 0.0359	0.54490 0.1034	0.30649 0.3891	0.00006 0.9999	-0.30752 0.3874	-0.46295 0.1779	-0.16498 0.6488	-0.21280 0.5550	0.62499 0.0533
PLA	0.19071 0.5977	-0.03941 0.9139	-0.28433 0.4259	0.08504 0.8153	0.00408 0.9911	-0.09676 0.7903	-0.20431 0.5713	-0.25294 0.4808	0.61264 0.0597	0.27300 0.4454	0.02891 0.9364	-0.47446 0.1659	-0.05258 0.8853
SID	0.18746 0.6040	0.60225 0.0654	0.32842 0.3542	-0.38409 0.2732	0.75567 0.0115	0.75962 0.0108	0.40710 0.2430	0.34658 0.3266	-0.34066 0.3354	-0.44659 0.1957	-0.38260 0.2751	-0.40589 0.2445	0.30111 0.3979
ANK	0.50188 0.1394	-0.33446 0.3449	0.16473 0.6493	-0.01459 0.9681	-0.04176 0.9045	0.05961 0.8701	0.13342 0.7133	0.23989 0.5044	0.03362 0.9265	-0.13684 0.7062	0.64006 0.0462	0.14291 0.6937	-0.27007 0.4505
GRDEN	-0.11445 0.7529	0.60553 0.0636	0.52944 0.1155	0.29471 0.4085	0.54138 0.1060	0.38138 0.2769	-0.19968 0.5802	-0.16424 0.6503	0.22090 0.5397	0.07177 0.8438	-0.28910 0.4178	-0.60377 0.0645	0.14160 0.6964

	GYP	KAO	HEM	ANH	SZM	QTZ	PYR	CAL	DOL	ORT	PLA	SID	ANK
SAMPLE	-0.25095 0.4843	0.00000 1.0000	-0.21021 0.5599	-0.35673 0.3116	-0.25090 0.4844	-0.17609 0.6265	-0.41121 0.2378	0.17233 0.6340	0.18934 0.6003	-0.23990 0.5044	0.19071 0.5977	0.18746 0.6040	0.50188 0.1394
LOSIG100	-0.10467 0.7745	0.00000 1.0000	-0.04019 0.9122	0.03587 0.9216	0.83978 0.0024	-0.01683 0.9632	0.08409 0.8174	0.57382 0.0828	-0.02622 0.9427	0.85658 0.0016	-0.03941 0.9139	0.60225 0.0654	-0.33446 0.3449
LOSIG500	-0.43712 0.2065	0.00000 1.0000	-0.15568 0.6676	-0.11530 0.7511	0.84668 0.0020	0.03616 0.9206	0.27440 0.4429	0.39425 0.2596	-0.12049 0.7402	0.84446 0.0021	-0.28433 0.4259	0.32842 0.3542	0.16473 0.6493

NORTHERN OHIO GEOLOGICAL SOCIETY

UGR File # 157
W.Va. Geological & Economic Survey

S T A T I S T I C A L A N A L Y S I S S Y S T E M 0132 WEDNESDAY, JANUARY 17, 1979

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 10

	GYP	KAO	HEM	ANH	SZH	OTZ	PYR	CAL	DOL	ORT	PLA	SID	ANK
SULFUR	-0.09624 0.7914	0.00000 1.0000	0.39181 0.2628	-0.30814 0.3864	0.37021 0.2923	0.22836 0.5257	0.84744 0.0020	-0.37219 0.2896	-0.01506 0.9671	0.33385 0.3458	0.08504 0.8153	-0.38409 0.2732	-0.01459 0.9681
BULKDEN	0.16595 0.6468	0.00000 1.0000	0.04040 0.9118	0.24363 0.4976	0.63017 0.0508	0.12666 0.7273	-0.14123 0.6971	0.80226 0.0052	-0.04898 0.8931	0.66406 0.0359	0.00408 0.9911	0.75567 0.0115	-0.04376 0.9045
MATRXDEN	0.16767 0.6414	0.00000 1.0000	-0.21328 0.5541	0.22664 0.5269	0.50563 0.1360	0.05985 0.8696	-0.35704 0.3112	0.86311 0.0013	-0.11576 0.7084	0.54490 0.1034	-0.09676 0.7903	0.75962 0.0108	0.05961 0.8701
LOGDEN	0.13784 0.7041	0.00000 1.0000	-0.34081 0.3352	-0.00467 0.9898	0.28635 0.1225	-0.15759 0.6637	-0.71313 0.0206	0.55908 0.0929	-0.10982 0.7626	0.30649 0.3891	-0.20431 0.5713	0.40710 0.2430	0.13342 0.7133
POROSITY	0.08251 0.8207	0.00000 1.0000	-0.62371 0.0542	0.06020 0.8688	-0.02666 0.9417	-0.10744 0.7677	-0.60857 0.0619	0.51459 0.1280	-0.23663 0.5104	0.00006 0.9999	-0.25294 0.4808	0.34658 0.3266	0.23989 0.5044
GAMMA	-0.33243 0.3480	0.00000 1.0000	0.63441 0.0488	-0.53877 0.1081	-0.29482 0.4083	0.18789 0.6032	0.67751 0.0314	-0.51409 0.1285	0.20046 0.5787	-0.30752 0.3874	0.61264 0.0597	-0.34066 0.3154	0.03362 0.9265
QUARTZ	-0.13882 0.7021	0.00000 1.0000	0.54258 0.1051	0.02804 0.9387	-0.43979 0.1921	0.37203 0.2898	0.62111 0.0553	-0.56211 0.0908	0.21295 0.5547	-0.46295 0.1779	0.27300 0.4454	-0.44659 0.1957	-0.13684 0.7062
EXP	-0.20598 0.5681	0.00000 1.0000	0.09042 0.8038	-0.40058 0.2513	-0.14337 0.6907	-0.62830 0.0517	0.01345 0.9706	-0.47168 0.1687	-0.46141 0.1795	-0.16498 0.6488	0.02891 0.9360	-0.38268 0.2751	0.64006 0.0462
ILL	-0.02216 0.9516	0.00000 1.0000	-0.33001 0.3517	0.18464 0.6096	-0.20188 0.5759	-0.09893 0.8004	-0.37337 0.2878	-0.48731 0.1531	-0.02767 0.9031	-0.21280 0.5550	-0.47446 0.1659	-0.40589 0.2445	0.14291 0.6937
CHL	0.58266 0.0771	0.00000 1.0000	0.10901 0.7644	0.12730 0.7260	0.62261 0.0545	0.19341 0.5924	-0.07803 0.8303	0.46387 0.1769	-0.01198 0.9738	0.62499 0.0533	-0.05258 0.8853	0.30111 0.3979	-0.27007 0.4505
GYP	1.00000 0.0000	0.00000 1.0000	0.31673 0.3726	0.05949 0.8703	-0.22465 0.5326	0.06816 0.8516	-0.23068 0.5214	-0.05303 0.8843	-0.04544 0.9008	-0.22958 0.5234	0.25673 0.4740	-0.17141 0.6359	-0.14096 0.6977
KAO	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000
HEM	0.31673 0.3726	0.00000 1.0000	1.00000 0.0000	-0.33803 0.3394	-0.18127 0.6162	0.25486 0.4773	0.63049 0.0507	-0.33391 0.3457	0.23017 0.5223	-0.18865 0.6017	0.02531 0.9031	-0.17606 0.6250	-0.04813 0.8949
ANH	0.05949 0.8703	0.00000 1.0000	-0.33803 0.3394	1.00000 0.0000	-0.05192 0.8869	-0.20886 0.5625	-0.41527 0.2327	0.25689 0.4737	-0.32276 0.3630	-0.01814 0.9603	-0.54624 0.1023	0.33275 0.3475	-0.36796 0.2955
SZH	-0.22465 0.5326	0.00000 1.0000	-0.18127 0.6162	-0.05192 0.8869	1.00000 0.0000	0.03365 0.9265	0.07961 0.8270	0.49656 0.1463	-0.01497 0.9673	0.99787 0.0001	-0.30549 0.3907	0.41006 0.2392	-0.20053 0.5786
OTZ	0.06816 0.8516	0.00000 1.0000	0.25486 0.4773	-0.20886 0.5625	0.03365 0.9265	1.00000 0.0000	0.40491 0.2456	[illegible] 0.5013	0.88723 0.0006	0.02424 0.9470	0.32539 0.3589	0.03055 0.9332	-0.24096 0.5024
PYR	-0.23068 0.5214	0.00000 1.0000	0.63049 0.0507	-0.41527 0.2327	0.07961 0.8270	0.40491 0.2456	1.00000 0.0000	-0.40435 0.2465	0.28978 0.4167	0.05222 0.8861	0.45247 0.1892	-0.31160 0.3808	0.06833 0.8512

UGR File # 157
W.Va. Geological & Economic Survey

CORRELATION COEFFICIENTS / PROB > |R| UNDER H0:RHO=0 / N = 10

	GYP	KAO	HEM	ANH	SZR	QTZ	PYR	CAL	DOL	ORT	PLA	SID	ANK
CAL	-0.05303 0.8843	0.00000 1.0000	-0.33191 0.3457	0.25689 0.4737	0.49656 0.1441	0.18885 0.6013	-0.40435 0.2465	1.00000 0.0000	0.16888 0.6409	0.54207 0.1055	-0.08297 0.8197	0.92933 0.0001	-0.03285 0.9282
DOL	-0.04544 0.9008	0.00000 1.0000	0.23017 0.5223	-0.32276 0.3630	-0.01497 0.9673	0.88723 0.0006	0.28978 0.4167	0.16888 0.6409	1.00000 0.0000	-0.02510 0.9451	0.39708 0.2559	0.05959 0.8701	-0.19294 0.5933
ORT	-0.22958 0.5234	0.00000 1.0000	-0.18865 0.6017	-0.01814 0.9603	0.99787 0.0001	0.02424 0.9470	0.05222 0.8861	0.54207 0.1055	-0.02510 0.9451	1.00000 0.0000	-0.29958 0.4004	0.46575 0.1749	-0.20493 0.5701
PLA	0.25673 0.4740	0.00000 1.0000	0.82531 0.0033	-0.54624 0.1023	-0.30549 0.3907	0.32539 0.3589	0.45247 0.1892	-0.08297 0.8197	0.39708 0.2559	-0.29958 0.4004	1.00000 0.0000	0.04205 0.9082	0.15331 0.6724
SID	-0.17141 0.6359	0.00000 1.0000	-0.17686 0.6250	0.33275 0.3475	0.41006 0.2392	0.03055 0.9332	-0.31160 0.3808	0.92933 0.0001	0.05959 0.8701	0.46575 0.1749	0.04205 0.9082	1.00000 0.0000	-0.04184 0.9086
ANK	-0.14096 0.6977	0.00000 1.0000	-0.04813 0.8949	-0.36796 0.2955	-0.20053 0.5786	-0.24096 0.5024	0.06833 0.8512	-0.03285 0.9282	-0.19294 0.5933	-0.20493 0.5701	0.15331 0.6724	-0.04184 0.9086	1.00000 0.0000
GRDEN	-0.42123 0.2254	0.00000 1.0000	0.27866 0.4356	0.00282 0.9938	0.43371 0.2105	0.28261 0.4288	0.40580 0.1546	0.51807 0.1251	0.23890 0.5062	0.46381 0.1769	0.34027 0.3360	0.67286 0.0330	0.04631 0.8989

	GRDEN
SAMPLE	-0.11445 0.7529
LOSIG100	0.60553 0.0636
LOSIG500	0.52944 0.1155
SULFUR	0.29471 0.4085
BULKDEN	0.54138 0.1060
MATRXDEN	0.08138 0.7769
LOGDEN	-0.19968 0.5802
POROSITY	-0.16424 0.6503
GAMMA	0.22090 0.5397

SUBJECT TO LITIGATION

UGR File #157
W.Va. Geological & Economic Survey

S T A T I S T I C A L A N A L Y S I S S Y S T E M

CORRELATION COEFFICIENTS / PROB > |R| UNDER H0:RHO=0 / N = 10

	GRDEN
QUARTZ	0.07177 0.8438
EXP	-0.28910 0.4178
ILL	-0.60377 0.0645
COQ	0.14160 0.6964
GYP	-0.42123 0.2254
KAO	0.00000 1.0000
HEM	0.27868 0.4356
AQH	0.00282 0.9938
SZH	0.43371 0.2105
QTZ	0.28261 0.4288
PYR	0.48580 0.1546
CAL	0.51802 0.1251
DOL	0.23890 0.5062
QRT	0.46381 0.1769
PLA	0.34027 0.3360
SID	0.67286 0.0330
ANK	0.04631 0.8989

NOT FOR PUBLICATION
OR
SUBJECT TO
PRELIMINARY

Banded Shale

CONFIDENTIAL
SUBJECT TO REVISION

UGR File # 157
W.Va. Geological & Economic Survey

STATISTICAL ANALYSIS SYSTEM

8:32 WEDNESDAY, JANUARY 17, 1979

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARIANCE	C.V.
SAMPLE	4	3514.42500000	67.84552921	3455.00000000	3612.10000000	33.92276460	14057.700000	4603.0158333	1.930
LOSIG100	4	3.40000000	0.18257419	3.20000000	3.60000000	0.09128709	13.600000	0.0333333	5.370
LOSIG500	4	3.20000000	0.62182527	2.30000000	3.70000000	0.31091264	12.800000	0.3866667	19.432
SULFUR	4	2.56750000	0.44033131	2.01000000	3.01000000	0.22016566	10.270000	0.1938917	17.150
BULKDEN	4	2.72500000	0.03785939	2.70000000	2.78000000	0.01892969	10.900000	0.0014333	1.389
MATRXDEN	4	2.74750000	0.01258306	2.73000000	2.76000000	0.00629153	10.990000	0.0001583	0.458
LOGDEN	4	2.65000000	0.00000000	2.65000000	2.65000000	0.00000000	10.600000	0.0000000	0.000
POROSITY	4	1.09000000	1.06548893	0.00000000	2.17000000	0.53274447	4.360000	1.1352667	97.751
GAMMA	4	200.00000000	18.25741858	180.00000000	220.00000000	9.12870929	800.000000	333.3333333	9.129
QUARTZ	4	0.13250000	0.04991660	0.06000000	0.17000000	0.02495830	0.530000	0.0024917	37.673
EXP	4	0.01025971	0.00395951	0.00774421	0.01612921	0.00197975	0.041039	0.0000157	38.593
TEL	4	0.57819027	0.09129972	0.46010681	0.65566187	0.04564986	2.312761	0.0083356	15.791
COO	4	0.00344967	0.00459438	0.00000000	0.00970328	0.00229719	0.013799	0.0000211	133.183
GYP	4	0.00459361	0.00697361	0.00000000	0.01473198	0.00348681	0.018374	0.0000486	151.811
KAO	4	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.000000	0.0000000	.
HEM	4	0.00264496	0.00179258	0.00000000	0.00396769	0.00089629	0.010580	0.0000032	67.773
AMH	4	0.00172713	0.00345426	0.00000000	0.00690851	0.00172713	0.006909	0.0000119	200.000
SZP	4	0.00683261	0.00676364	0.00000000	0.01443111	0.00338182	0.027330	0.0000457	98.991
QTZ	4	0.28533937	0.05984629	0.24269338	0.37084194	0.02992314	1.143357	0.0035816	20.937
PYR	4	0.05828267	0.00922010	0.04646524	0.06643531	0.00461005	0.233131	0.0000850	15.820
CAL	4	0.00460646	0.00533101	0.00000000	0.00964945	0.00266551	0.018426	0.0000284	115.729
DOL	4	0.00313143	0.00626286	0.00000000	0.01252573	0.00313143	0.012526	0.0000392	200.000
ORT	4	0.00109782	0.00219563	0.00000000	0.00439126	0.00109782	0.004391	0.0000048	200.000
PLA	4	0.03516382	0.02026527	0.02007423	0.06294421	0.01013264	0.140655	0.0004107	57.631
SID	4	0.00418045	0.00508288	0.00000000	0.01031057	0.00254144	0.016722	0.0000258	121.587
ANK	4	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.000000	0.0000000	.
GRDEN	4	2.81932280	0.02503472	2.78885464	2.84576393	0.01251736	11.277291	0.0006267	0.888

NOT TO BE REPRODUCED

Siltstone

SUBJECT TO REVISION

S T A T I S T I C A L A N A L Y S I S S Y S T E M 5
8:32 WEDNESDAY, JANUARY 17, 1979

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARIANCE	C.V.
SAMPLE	2	3556.55000000	109.67226176	3479.00000000	3634.10000000	77.55000000	7113.1000000	12028.005000	3.084
LOSIG100	2	1.65000000	0.07071068	1.60000000	1.70000000	0.05000000	3.3000000	0.005000	4.285
LOSIG500	2	1.80000000	0.42426407	1.50000000	2.10000000	0.30000000	3.6000000	0.180000	23.570
SULFUR	2	0.36000000	0.21213203	0.21000000	0.51000000	0.15000000	0.7200000	0.045000	58.926
BULKDEN	2	2.65000000	0.02828427	2.63000000	2.67000000	0.02000000	5.3000000	0.000800	1.067
MATRXDEN	2	2.69000000	0.01414214	2.68000000	2.70000000	0.01000000	5.3800000	0.000200	0.526
LOGDEN	2	2.67500000	0.02121320	2.66000000	2.69000000	0.01500000	5.3500000	0.000450	0.793
POROSITY	2	1.48000000	1.56977705	0.37000000	2.59000000	1.11000000	2.9600000	2.464200	106.066
GAMMA	2	185.00000000	7.07106781	180.00000000	190.00000000	5.00000000	370.0000000	50.000000	3.822
QUARTZ	2	0.44500000	0.13435029	0.35000000	0.54000000	0.09500000	0.8900000	0.018050	30.191
EXP	2	0.00916840	0.00038726	0.00889456	0.00944223	0.00027384	0.0183368	0.000000	4.224
ILL	2	0.29812997	0.02488904	0.28053076	0.31572917	0.01759921	0.5962599	0.000619	8.348
CHO	2	0.00309745	0.00438045	0.00000000	0.00619489	0.00309745	0.0061949	0.000019	141.421
GYP	2	0.00504665	0.00713704	0.00000000	0.01009329	0.00504665	0.0100933	0.000051	141.421
KAO	2	0.06094803	0.00703804	0.05597139	0.06592467	0.00497664	0.1218961	0.000050	11.548
HEM	2	0.03248386	0.03848060	0.00527397	0.05969376	0.02720989	0.0649677	0.001481	118.461
ANH	2	0.00281885	0.00398645	0.00000000	0.00563770	0.00281885	0.0056377	0.000016	141.421
SZP	2	0.00499249	0.00091245	0.00434729	0.00563770	0.00064520	0.0099850	0.000001	18.277
QTZ	2	0.44646862	0.04758487	0.41282103	0.48011621	0.03364759	0.8929372	0.002264	10.658
PYR	2	0.01697556	0.00321321	0.01470348	0.01924764	0.00227208	0.0339511	0.000010	18.928
CAL	2	0.00488388	0.00690685	0.00000000	0.00976776	0.00488388	0.0097678	0.000048	141.421
DOL	2	0.01137587	0.01608791	0.00000000	0.02275174	0.01137587	0.0227517	0.000259	141.421
ORT	2	0.00331481	0.00468785	0.00000000	0.00662962	0.00331481	0.0066296	0.000022	141.421
PLA	2	0.05191455	0.00425327	0.04890704	0.05492207	0.00300752	0.1038291	0.000018	8.193
STD	2	0.00333220	0.00471244	0.00000000	0.00666440	0.00333220	0.0066644	0.000022	141.421
ANK	2	0.04504881	0.06370864	0.00000000	0.09009763	0.04504881	0.0900976	0.004059	141.421
GRDEN	2	2.71462517	0.01802631	2.70187864	2.72737169	0.01274652	5.4292503	0.000325	0.664

SUBJECT TO REVISION OF RECORDS
RECEIVED

SUBJECT TO REVISION

APPENDIX D

RAW DATA FOR ALL SAMPLES

LITYPE=1

OBS	SAMPLE	LOSIG100	LOSIG500	SULFUR	BULKDEN	MATRXDEN	LOGDEN	POROSITY	GAMMA	QUARTZ	NTYPE	EXP	ILL	COO	GYP	KAO	HEM
1	3479.0	1.6	2.1	0.51	2.63	2.70	2.66	2.59	190	0.54	S	0.00889456	0.280511	0.00619489	0.0000000	0.0559714	0.0596938
2	3634.1	1.7	1.5	0.21	2.67	2.68	2.69	0.37	180	0.35	P	0.00944223	0.315729	0.00000000	0.0100931	0.0659247	0.0052740

OBS	ANH	SZM	QTZ	PYR	CAL	DOL	ORT	PLA	STD	ANK	GRDEN
1	0.0000000	0.00434729	0.412821	0.0192476	0.00000000	0.0000000	0.00662962	0.0489070	0.0066644	0.0900976	2.72737
2	0.0056377	0.00563770	0.480116	0.0147035	0.00976776	0.0227517	0.00000000	0.0549221	0.0000000	0.0000000	2.70188

LITYPE=2

OBS	SAMPLE	LOSIG100	LOSIG500	SULFUR	BULKDEN	MATRXDEN	LOGDEN	POROSITY	GAMMA	QUARTZ	NTYPE	EXP	ILL	COO	GYP
3	3455.0	1.2	1.7	2.81	2.70	2.75	2.65	1.82	220	0.17	P	0.0080215	0.460107	0.00000000	0.0000000
4	3493.6	3.5	3.3	2.44	2.78	2.75	2.65	0.00	180	0.14	S	0.0161292	0.655662	0.00409541	0.0000000
5	3497.0	3.6	3.5	3.01	2.70	2.76	2.65	2.17	190	0.06	S	0.0091439	0.644522	0.00000000	0.0016425
6	3612.1	3.3	2.3	2.01	2.72	2.73	2.65	0.37	210	0.16	P	0.0077442	0.552471	0.00970328	0.0147320
7	3718.6	2.6	2.0	0.63	2.71	2.72	2.65	0.37	230	0.06	A	0.0099407	0.520817	0.00000000	0.0000000
8	3751.3	6.2	3.1	2.68	2.59	2.62	2.53	1.14	350	0.13	A	0.0100240	0.470045	0.00000000	0.0000000

OBS	KAO	HEM	ANH	SZM	QTZ	PYR	CAL	DOL	ORT	PLA	STD	ANK	GRDEN
3	0	0.0000000	0.0069085	0.0144311	0.370842	0.066435	0.00000000	0.0000000	0.0000000	0.0629442	0.0103106	0	2.84576
4	0	0.0034072	0.0000000	0.0024170	0.242693	0.055522	0.00000000	0.0000000	0.0000000	0.0200742	0.0000000	0	2.81028
5	0	0.0039677	0.0000000	0.0000000	0.245111	0.064708	0.00877640	0.0000000	0.0000000	0.0200986	0.0000000	0	2.83240
6	0	0.0032049	0.0000000	0.0104824	0.284681	0.046465	0.00964945	0.0125257	0.0043913	0.0375382	0.0064112	0	2.78885
7	0	0.0000000	0.0000000	0.0000000	0.336373	0.038325	0.00000000	0.0000000	0.0128181	0.0398455	0.0473824	0	2.83493
8	0	0.0629169	0.0191346	0.0000000	0.342069	0.109149	0.00000000	0.0000000	0.0000000	0.0255429	0.0412135	0	3.19328

UGR File # 157
W.Va. Geological & Economic Survey

LITYPE=3

OBS	SAMPLE	LOSIGIO	LOSIGSO	SULFUR	BULKDEN	MATRXDEN	LOGDEN	POROSITY	GAMMA	QUARTZ	NTYPE	EXP	ILL	COO	GYP	KAO	HEM
9	3411.2	1.5	3.1	2.70	2.69	2.73	2.62	1.46	200	0.14	S	0.0109400	0.603333	0.00000000	0.0000000	0.0000000	0.0063302
10	3416.6	5.5	3.7	3.04	2.62	2.64	2.59	0.76	240	0.11	S	0.0122955	0.634138	0.00292751	0.0024618	0.0000000	0.0043247
11	3423.3	6.1	3.6	3.05	2.66	2.62	2.46	0.00	210	0.16	S	0.0135772	0.648793	0.00000000	0.0000000	0.0000000	0.0052951
12	3440.3	5.7	3.1	2.32	2.61	2.63	2.59	0.76	220	0.12	S	0.0106574	0.640486	0.00000000	0.0000000	0.0000000	0.0064635
13	3465.5	4.3	3.2	3.10	2.63	2.71	2.58	2.95	290	0.13	S	0.0113522	0.611707	0.00526396	0.0041558	0.0000000	0.0049523
14	3472.0	5.1	2.7	2.15	2.65	2.67	2.63	0.75	220	0.09	P	0.0043619	0.447898	0.00991331	0.0103130	0.0000000	0.0124516
15	3648.0	6.0	3.0	3.03	2.63	2.68	2.65	1.87	250	0.15	S	0.0092264	0.580699	0.00000000	0.0000000	0.0000000	0.0042599
16	3656.1	5.0	4.2	2.51	2.60	2.61	2.55	0.38	240	0.16	S	0.0113639	0.541221	0.00630999	0.0057964	0.0000000	0.0022195
17	3656.3	7.2	3.8	2.42	2.52	2.58	2.55	2.32	240	0.13	S	0.0134136	0.605300	0.00749133	0.0049942	0.0000000	0.0053584
18	3662.0	7.2	3.6	2.02	2.51	2.53	2.59	0.79	255	0.16	P	0.0073970	0.3866659	0.00921506	0.0064754	0.0109594	0.0047528
19	3676.0	5.7	2.4	2.11	2.57	2.63	2.66	0.79	200	0.11	S	0.0119674	0.498107	0.00000000	0.0000000	0.0000000	0.0057117
20	3699.5	7.0	2.9	2.33	2.53	2.56	2.52	1.17	290	0.09	P	0.0080690	0.522373	0.00000000	0.0000000	0.0000000	0.0063868
21	3720.2	6.9	2.5	1.96	2.53	2.59	2.62	2.32	230	0.09	S	0.0099521	0.651410	0.00191793	0.0031745	0.0000000	0.0059853

OBS	ANH	SZN	QTZ	PYR	CAL	DOL	ORT	PLA	STD	ANK	GRDEN
9	0.0000000	0.00000000	0.296476	0.0539419	0.0000000	0.0000000	0.0000000	0.0248989	0.0000000	0.00407948	2.80620
10	0.0000000	0.00000000	0.235128	0.0570718	0.0138584	0.0000000	0.0024618	0.0200933	0.0120454	0.00319364	2.82777
11	0.0000000	0.00000000	0.261217	0.0477265	0.0000000	0.0000000	0.0000000	0.0200301	0.0033591	0.00000000	2.79714
12	0.0000000	0.00000000	0.246727	0.0542840	0.0000000	0.0000000	0.0030652	0.0213895	0.0169277	0.00000000	2.82823
13	0.0000000	0.00000000	0.284481	0.0513056	0.0000000	0.0000000	0.0000000	0.0209173	0.0058652	0.00000000	2.80258
14	0.0000000	0.00807455	0.386298	0.0608197	0.0000000	0.0187465	0.0131911	0.0174282	0.0105049	0.00000000	2.82321
15	0.0000000	0.00750086	0.297214	0.0611574	0.0000000	0.0000000	0.0000000	0.0245509	0.0073110	0.00000000	2.83299
16	0.0000000	0.00396209	0.337488	0.0518637	0.0201846	0.0000000	0.0000000	0.0195903	0.0000000	0.00000000	2.79405
17	0.0000000	0.00402312	0.245491	0.0522354	0.0102680	0.0000000	0.0000000	0.0303122	0.0154946	0.00561850	2.81715
18	0.0141132	0.00000000	0.430757	0.0420622	0.0266448	0.0000000	0.0079698	0.0207546	0.0322411	0.00000000	2.80327
19	0.0000000	0.00000000	0.379808	0.0628287	0.0000000	0.0000000	0.0000000	0.0301515	0.0113457	0.00000000	2.83444
20	0.0103832	0.00000000	0.343984	0.0472802	0.0126235	0.0075349	0.0052290	0.0300292	0.0061074	0.00000000	2.79775
21	0.0000000	0.00000000	0.243559	0.0438969	0.0000000	0.0000000	0.0000000	0.0314145	0.0086902	0.00000000	2.79239

UGR File # 157
N.Va. Geological & Economic Survey

LITYPE=4

OBS	SAMPLE	LOSIG100	LOSIG500	SULFUR	BULKDEN	MATRXDEN	LOGDEN	POROSITY	GAMMA	QUARTZ	NTYPE	FXP	ILL	COQ	GYP
22	3461.0	5.6	3.4	2.46	2.60	2.67	2.63	2.62	250	0.17	S	0.0126406	0.572609	0.00000000	0.00000000
23	3605.0	2.9	3.5	0.11	2.72	2.76	2.70	1.45	190	0.18	S	0.0160675	0.562392	0.00769147	0.00000000
24	3641.1	2.8	1.8	0.81	2.69	2.70	2.66	0.37	190	0.15	S	0.0129690	0.608971	0.00000000	0.00369746
25	3669.1	6.0	4.2	2.97	2.58	2.65	2.56	2.64	180	0.11	S	0.0105054	0.623917	0.00000000	0.00633097
26	3669.3	7.0	4.0	0.50	2.77	2.75	2.56	0.00	200	0.11	P	0.0080690	0.522373	0.00000000	0.00000000
27	3685.0	4.6	1.0	1.88	2.60	2.64	2.57	1.52	290	0.12	S	0.0085654	0.610775	0.00000000	0.00000000
28	3737.9	4.6	2.6	1.80	2.59	2.61	2.55	0.77	280	0.11	S	0.0099366	0.614578	0.00000000	0.00488042
29	3745.8	3.4	2.6	1.49	2.60	2.68	2.56	2.99	290	0.10	A	0.0104435	0.473665	0.00000000	0.00000000
30	3772.0	5.6	3.0	1.06	2.58	2.62	2.58	1.53	310	0.12	S	0.0695905	0.655895	0.00000000	0.00269989
31	3775.0	4.8	3.0	2.18	2.61	2.69	2.61	2.97	300	0.10	S	0.0089773	0.636335	0.00199054	0.00252135
32	3782.0	6.0	3.9	1.95	2.55	2.58	2.55	1.16	310	0.11	S	0.0083900	0.640713	0.00000000	0.00000000
33	3784.0	1.9	3.1	1.69	2.69	2.74	2.59	1.82	260	0.08	A	0.0116579	0.434552	0.00000000	0.00000000
34	3795.0	6.3	2.1	2.09	2.59	2.61	2.57	1.52	280	0.15	S	0.0115874	0.686484	0.00000000	0.00000000

OBS	KAO	HEM	ANH	BZM	QTZ	PYR	CAL	DOL	ORT	PLA	SID	ANK	GRDEN
22	0.0000000	0.0068470	0.0000000	0	0.296586	0.0653868	0.000000	0.0000000	0.00000000	0.0404302	0.0055008	0.00000000	2.83677
23	0.0000000	0.0000000	0.0000000	0	0.208946	0.0000000	0.149665	0.0149776	0.00000000	0.0332604	0.0069805	0.00000000	2.69252
24	0.0000000	0.0044997	0.0000000	0	0.262199	0.0292225	0.007768	0.0000000	0.00000000	0.0511365	0.0177227	0.00181385	2.76763
25	0.0000000	0.0034012	0.0054554	0	0.262799	0.0522749	0.000000	0.0000000	0.00336754	0.0254586	0.0064899	0.00000000	2.80957
26	0.0000000	0.0063868	0.0103832	0	0.343984	0.0472802	0.012623	0.0075349	0.00522896	0.0300292	0.0061074	0.00000000	2.79175
27	0.0581612	0.0057819	0.0000000	0	0.247941	0.0395154	0.004661	0.0044818	0.00000000	0.0201169	0.0000000	0.00000000	2.77215
28	0.0000000	0.0047851	0.0042688	0	0.284167	0.0393373	0.000000	0.0000000	0.00000000	0.0252683	0.0080460	0.00392451	2.78271
29	0.0000000	0.0516564	0.0188562	0	0.347670	0.0691907	0.000000	0.0000000	0.00000000	0.0275147	0.0325298	0.00000000	2.96083
30	0.0000000	0.0052845	0.0000000	0	0.250645	0.0335660	0.000000	0.0000000	0.00000000	0.0294354	0.0128831	0.00000000	2.77467
31	0.0000000	0.0049100	0.0043792	0	0.253127	0.0442443	0.000000	0.0000000	0.00000000	0.0285974	0.0149184	0.00000000	2.80151
32	0.0000000	0.0039287	0.0000000	0	0.267489	0.0453640	0.000000	0.0000000	0.00000000	0.0193313	0.0147838	0.00000000	2.80523
33	0.0000000	0.0738923	0.0000000	0	0.359176	0.0805509	0.000000	0.0000000	0.00000000	0.0292228	0.0395791	0.00000000	2.97997
34	0.0000000	0.0053592	0.0000000	0	0.207144	0.0479029	0.001917	0.0000000	0.00000000	0.0318055	0.0078011	0.00000000	2.80462

UGR File # 157
W.Va. Geological & Economic Survey

LITYPE=6

OBS	SAMPLE	LOSIG100	LOSIG500	SULFUR	BULKDEN	MATRXDEN	LOGDEN	POROSITY	GAMMA	QUARTZ	NTYPE	EXP	ILL	COQ	GYP
35	3423.1	3.5	2.3	1.94	2.68	2.69	2.46	0.37	210	0.18	S	0.0095547	0.630401	0.00000000	0.0000000
36	3446.0	3.1	2.1	1.28	2.72	2.75	2.65	1.09	170	0.13	P	0.0084510	0.532994	0.00714147	0.0107498
37	3465.6	3.0	2.6	2.17	2.69	2.72	2.58	1.10	290	0.21	S	0.0109665	0.586016	0.00000000	0.0000000
38	3482.1	3.2	2.8	1.80	2.69	2.69	2.61	0.00	245	0.17	A	0.0135148	0.445098	0.00000000	0.0000000
39	3488.0	5.1	3.5	2.50	2.72	2.74	2.65	0.73	190	0.09	P	0.0109710	0.556028	0.00596090	0.0000000
40	3618.7	1.9	2.4	0.47	2.66	2.72	2.70	1.10	180	0.16	S	0.0117008	0.688580	0.00000000	0.0000000
41	3626.0	5.0	2.9	0.38	2.75	2.79	2.71	1.43	175	0.08	P	0.0083027	0.516034	0.00399512	0.0000000
42	3722.0	3.0	2.2	0.92	2.69	2.71	2.60	0.74	240	0.17	S	0.0078034	0.358601	0.00000000	0.0000000
43	3730.0	3.5	1.9	0.25	2.67	2.71	2.64	1.48	180	0.05	S	0.0106159	0.708285	0.00000000	0.0025067
44	3751.1	4.9	2.9	2.61	2.66	2.70	2.53	1.48	350	0.11	A	0.0098416	0.463495	0.00000000	0.0000000
45	3754.0	2.5	2.8	1.27	2.70	2.74	2.65	1.46	200	0.11	S	0.0139835	0.601511	0.00000000	0.0000000
46	3763.5	3.0	2.2	0.88	2.69	2.70	2.65	0.37	250	0.14	S	0.0156646	0.673230	0.00000000	0.0020902

OBS	KAO	HEM	ANH	SZH	QTZ	PYR	CAL	DOL	ORT	PLA	SID	ANK	GRDEN
35	0	0.0060640	0.00935011	0.00000000	0.269503	0.041111	0.0000000	0.0000000	0.00000000	0.0230365	0.010980	0.0000000	2.79251
36	0	0.0072542	0.00533731	0.00000000	0.339692	0.020491	0.0094538	0.0063025	0.00000000	0.0384136	0.013719	0.0000000	2.73532
37	0	0.0071624	0.00000000	0.00000000	0.313265	0.042004	0.0000000	0.0000000	0.00000000	0.0405870	0.000000	0.0000000	2.77596
38	0	0.0379255	0.00000000	0.00000000	0.358571	0.077518	0.0000000	0.0000000	0.00000000	0.0363336	0.039158	0.0000000	2.91980
39	0	0.0051249	0.00000000	0.00950519	0.312803	0.035600	0.0115227	0.0078088	0.00835986	0.0161380	0.020378	0.0000000	2.76580
40	0	0.0033119	0.00959297	0.00000000	0.268999	0.006733	0.0055567	0.0000000	0.00000000	0.0000000	0.005526	0.0000000	2.70919
41	0	0.0047620	0.00927439	0.00428049	0.269247	0.011096	0.0309344	0.0000000	0.00485122	0.0277518	0.109471	0.0000000	2.83508
42	0	0.0066279	0.00000000	0.00000000	0.458253	0.035165	0.0125477	0.0417885	0.00000000	0.0472935	0.031840	0.0000000	2.79581
43	0	0.0031491	0.00206804	0.00000000	0.225281	0.005308	0.0073885	0.0000000	0.00000000	0.0213071	0.014090	0.0000000	2.71370
44	0	0.0602848	0.00000000	0.00000000	0.145256	0.139852	0.0000000	0.0000000	0.00000000	0.0208368	0.034185	0.0000000	3.23476
45	0	0.0045054	0.00000000	0.00000000	0.270354	0.027377	0.0105352	0.0000000	0.00000000	0.0302639	0.023895	0.0174952	2.77543
46	0	0.0083946	0.00000000	0.00000000	0.206957	0.026894	0.0000000	0.0000000	0.00000000	0.0486821	0.012896	0.0651919	2.76011

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APPENDIX E

REPRESENTATIVE ILLUSTRATIONS

LITHOTYPES

1. Thinly Laminated Shale Type (A) Radiograph positive print - depth 3699.5 (1x); (B) negative-print image of thin section - depth 3411.2 (5x). Greater continuity of laminae shown in radiograph is possibly explained by greater thickness of sample slab (2 mm for radiograph, 20 μm for thin section). Darker laminae in radiographs reflect increasing concentrations of pyritic matter. These appear as lightest tones on direct negative print image of thin sections. Wispy silt streaks appear as dark laminae in B. Burrows and traction features are generally lacking in finely laminated shale type. This lithotype comprises about 25% of the samples interval. We believe the lateral continuity provided by this fabric permits better migration of gas through available pore space in the pyritic-organic laminae, the silty lenses and laminae, and perhaps through the illite-quartz matrix itself. The higher organic content of these shales may also permit greater amounts of adsorbed gas to exist within this lithotype. Most samples of thinly laminated shale were not in the gas producing zone indicated by the temperature log, but many pieces of core were removed prior to sampling by us. Organic rich shale types (thinly laminated and lenticularly laminated) with moderate to high lateral fabric continuity coupled with a favorable petrographic fracture type is tentatively concluded to explain the extremely high production of Jac 1369.

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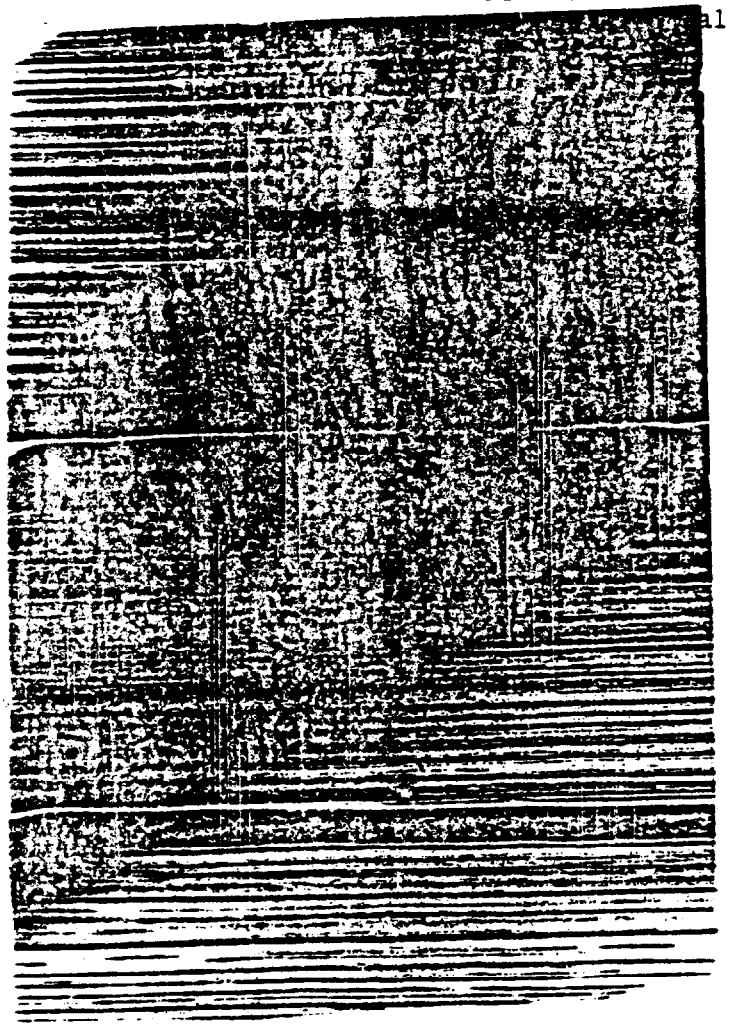
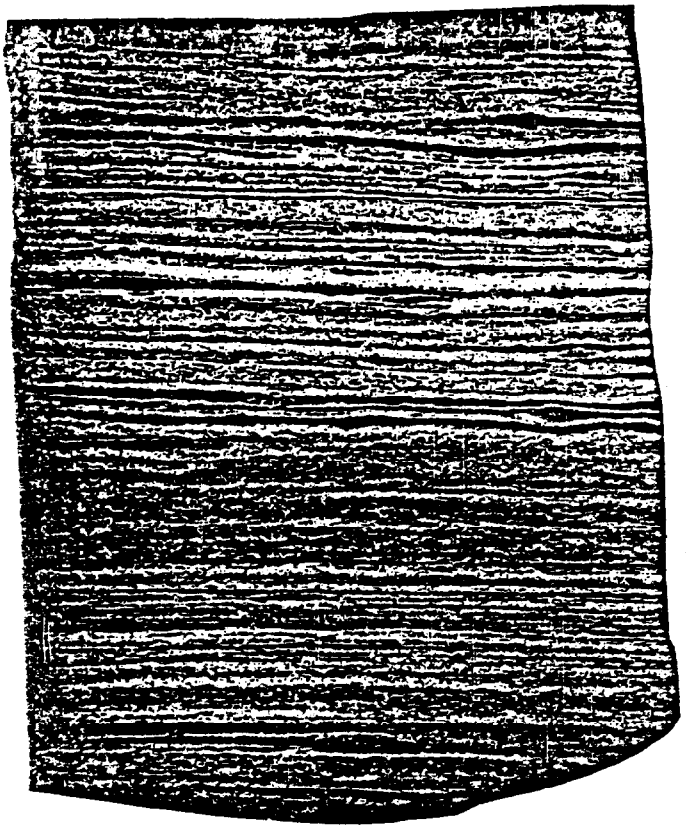
94





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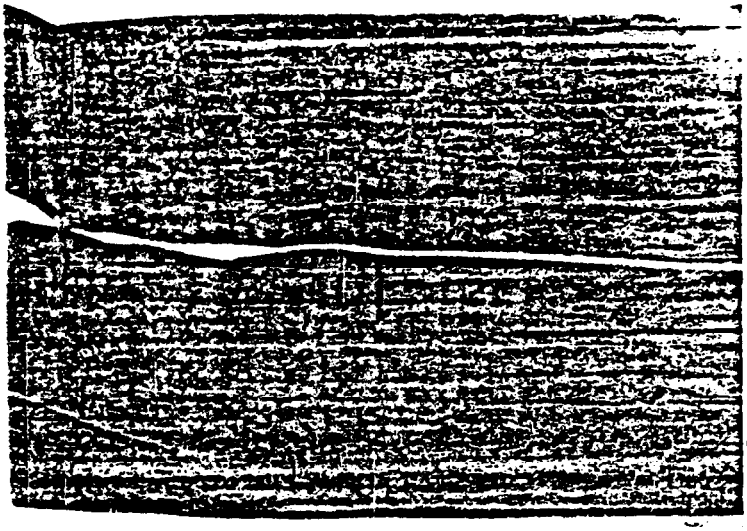
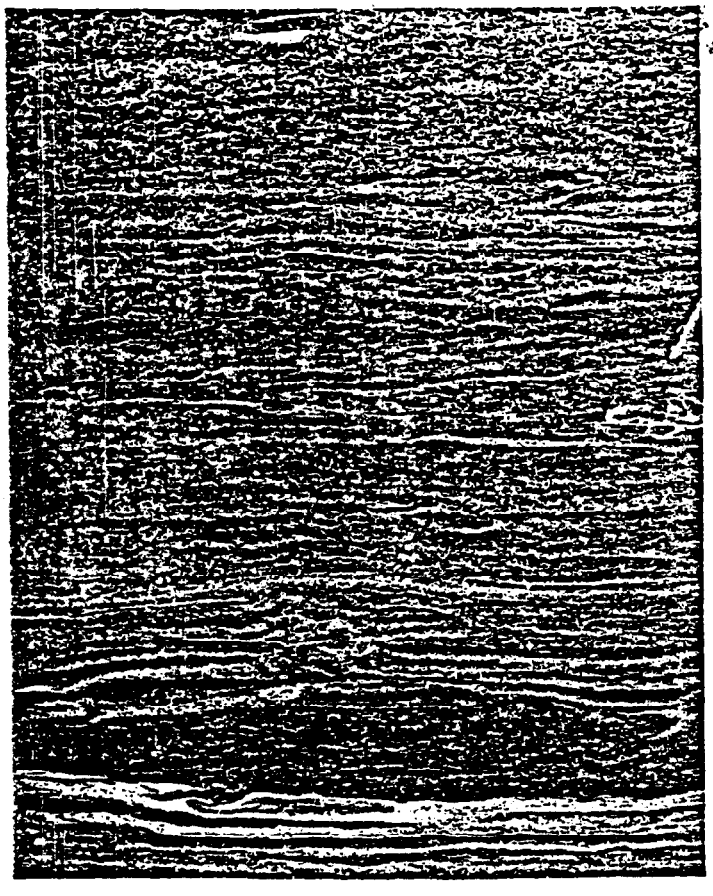
2. Lenticularly Laminated Shale Type (A) Positive print from X-radiograph-depth 3782 (1x); (B) Negative-print image of thin section-depth 3605 (5x). Lenticularly laminated shale shows less lateral continuity than thinly laminated shale but the linear fabric may enhance gas migration through available pore space if porosity increasing pyritic wisps (dark streaks on A) and appreciable organic matter are present. Organic content of lenticularly laminated shale (4.7%) is slightly less than that of thinly laminated shales (5.8%) in Jac 1369. This lithotype is more abundant in the lower portion of the core composing 25% of the interval and is probably associated with productivity due to favorable petrographic fracture types and its high organic matter content.





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3. Banded Shale Type (A) Radiograph positive - depth 3641 (1x); (B) Negative-print image of thin section - depth 3641 (5x). Banded shales comprise 12% of the sample interval and are more abundant in the upper and lower portion of the interval. Individual bands commonly show internal structures such as laminations. Organic matter content of adjacent bands can vary greatly.

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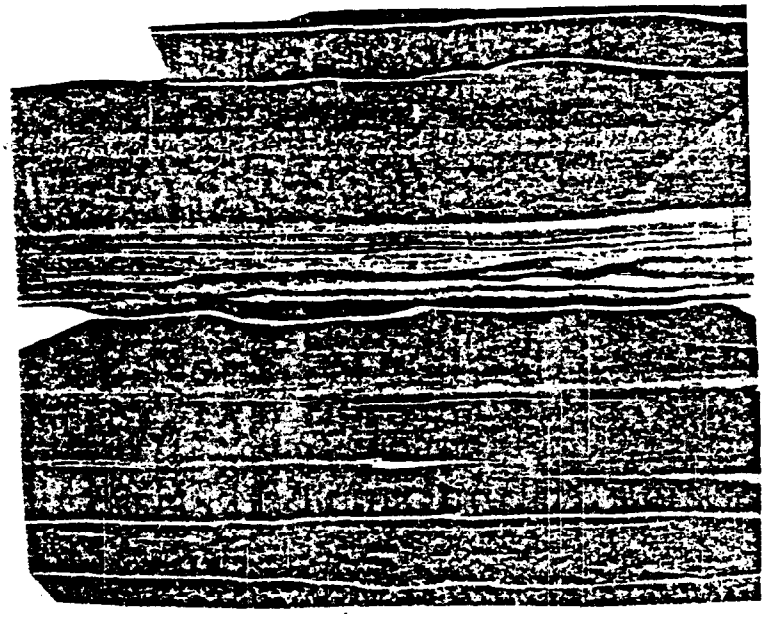
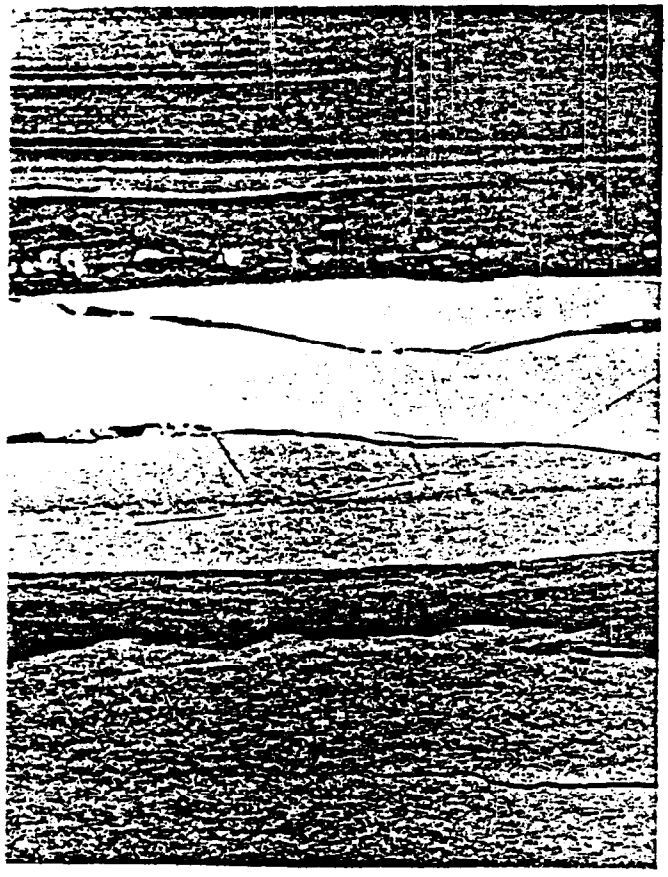
98





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4. Non-banded Shale Type (A) Positive print from X-radiograph - depth 3754 (1x). (B) Negative print from thin section - depth 3455 (5x). Particles of silt, pyrite, and organic matter are dispersed and not concentrated so as to produce a linear fabric. Burrowing, particularly evident in A is responsible in many cases for destruction of such fabric and conversion of laminated types toward nonbanded. Some non-banded shales show little evidence of bioturbation (B) and perhaps represent an original non-laminated fabric reflecting extremely rapid deposition. Non-banded shales comprise 25% of the cored interval.

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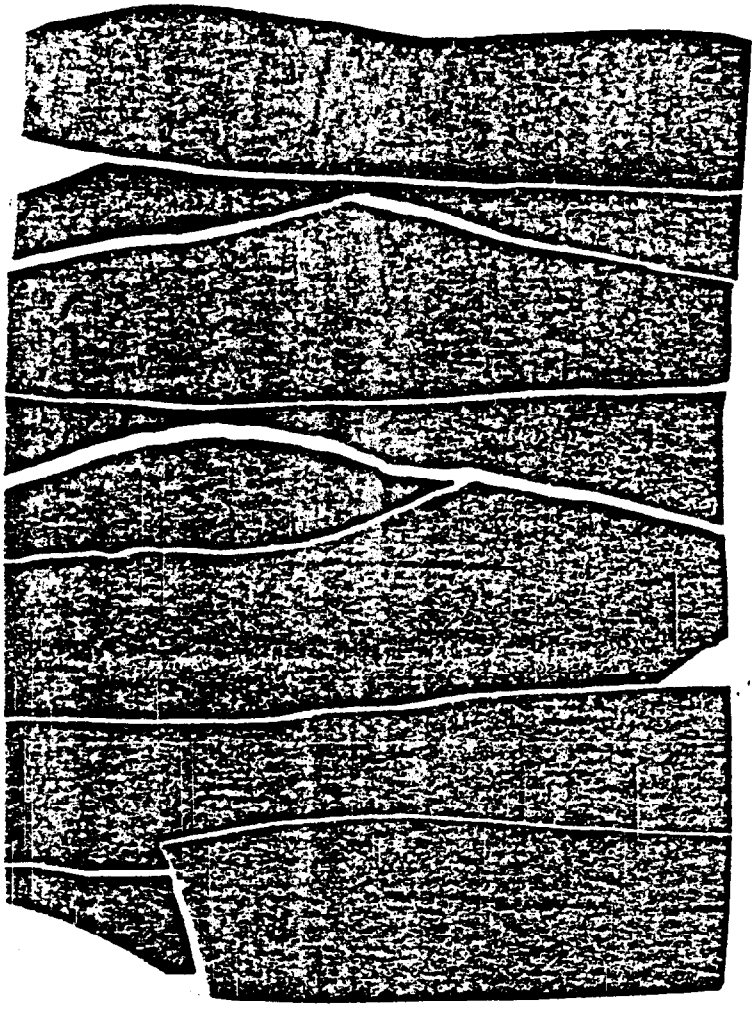

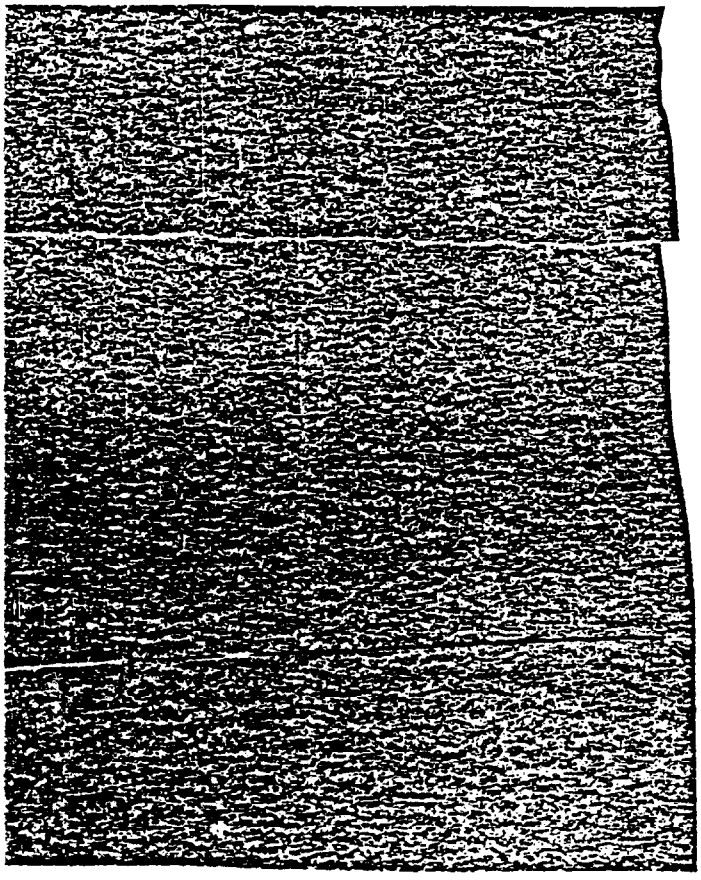

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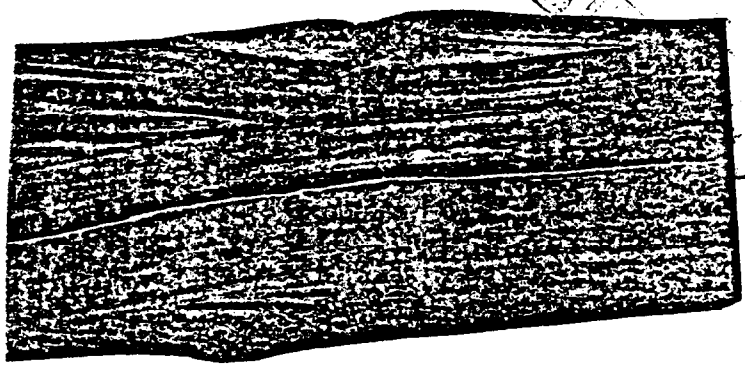
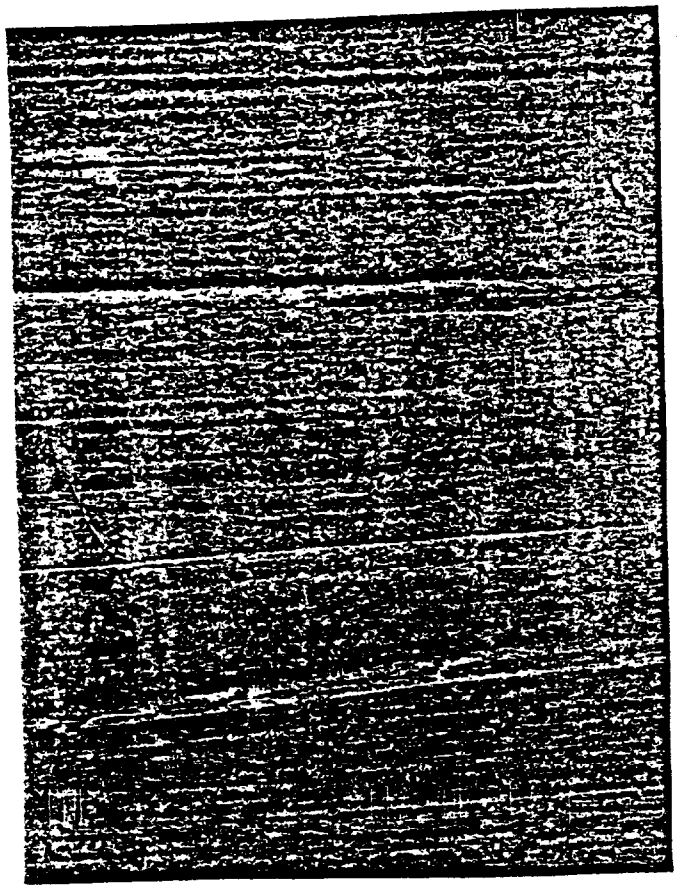
5. Siltstones (A) Positive print from X-radiograph - depth 3634 (1x). (B) Negative-print image of thin section - depth 3634 (5x). Siltstones comprise only about 4% of the cored interval. They are tightly cemented by carbonate and have a high (30%) clay matrix content. Low porosity (1.48%) and organic content (1.65%) offers little potential for gas productivity. Concretions (not illustrated) account for the remainder of the samples.





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FRACTURES

6) Coarse, hackly vertical fracture from zone of gas production noted on temperature log. Radiating hackles have a maximum relief of 5 mm. Slickensided surfaces are evidence for slight vertical movement after initial fracturing. Such movement created highly permeable vugs which are only partially mineralized. This fracture type is interpreted as contributing significantly to the high final open flow (1007 MCF) of Jac 1369. Other examples were noted in a 20 foot interval and appeared to be unrelated to any specific lithotype. Specimen is from a core depth of 3720 feet. Width of core is 4 inches.

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7) Cross fracture developed between two vertical, parallel, tightly mineralized fractures. Surface roughness of the cross fracture combined with slight offsetting created permeable vugs which were slightly infilled by carbonate. Examples of this fracture type were noted in the pay zone of Jac 1369 . Although the length of the fracture is a few centimeters (bounded by the filled vertical fractures) it may extend vertically for some distance. Specimen is from a core depth of 3724 feet. Width of core is 4 inches.

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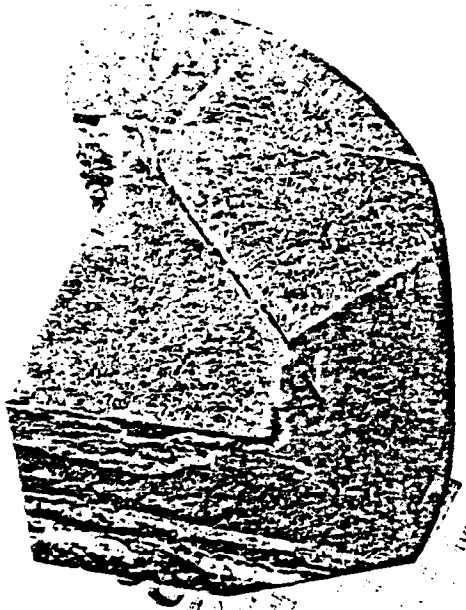

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8) Vertical to sub-vertical smooth fracture that is tightly mineralized. The smoothness of the fracture prevents the development of vugs if slight offsetting occurs. Even though the fracture is tightly mineralized with little pore spore present, permeability may be higher than that of the shale matrix. This fracture type is interpreted as being far less important in establishing the high production of Jac 1369 than the two previously described fracture types. Specimen is from a core depth of 3730 feet. Width of core is 4 inches.

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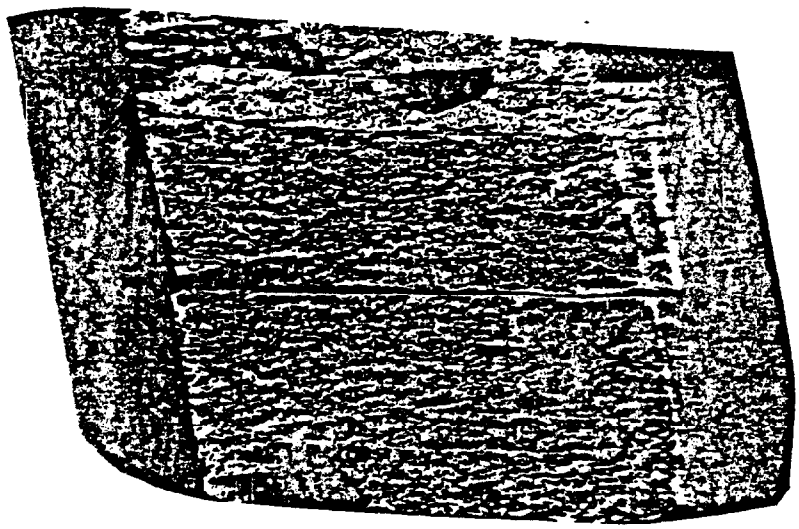

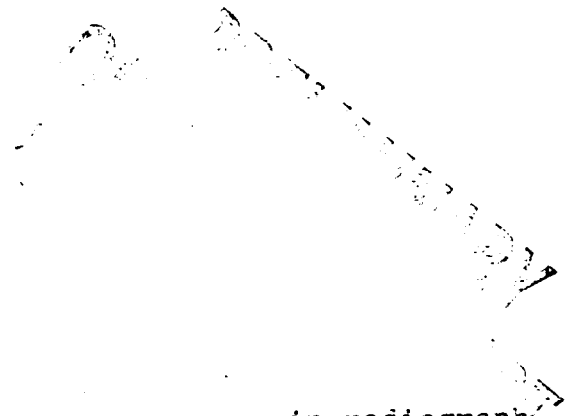

9) Horizontal mineralized fractures as seen in radiograph print (5x). Fractures are very dark 1 mm thick discontinuous bands parallel to stratification. Accompanying photomicrograph shows tightly mineralized nature of fracture. These fractures are from an unproductive zone as indicated by the temperature log. The tight mineralization combined with a horizontal orientation prevents these fractures from draining gas out of an appreciable volume of the shale matrix. Specimen is from a core depth of 3739 feet.

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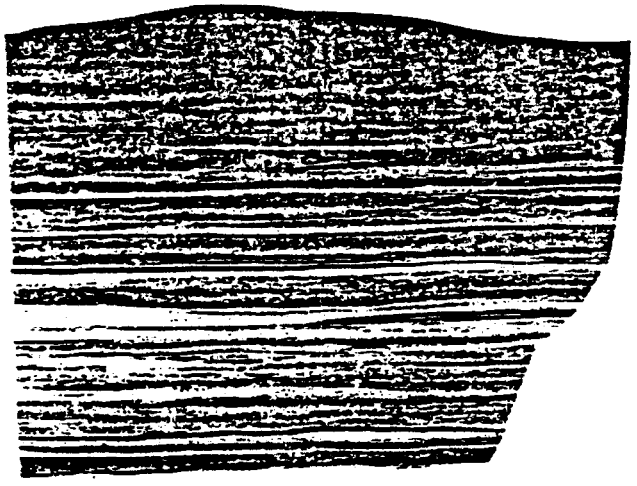

APPENDIX F

UNIVARIATE AND MULTIVARIATE ANALYSIS

ANOVA and MANOVA

Univariate analyses of variance (ANOVA: table 1) treats each variable in isolation; an important advantage in the use of multivariate analysis of variance (MANOVA) lies in the fact that all of the variables are treated simultaneously, and therefore error covariation can be extracted from the data and between-group differences enhanced. Figure 1 of this section illustrates this fact. ANOVA for each of the variates 1 and 2 may show no significant difference between the two groups of points: note the close placement of the means and great overlap of the groups as projected on each axis. However, when the within-group covariance (i.e. "trend") is taken into account, and the points projected on an axis separating the mean in bivariate space, then group separability becomes obvious, and will in fact test as significant.

A second advantage lies in the fact that multivariate data sets commonly have more than two variables, and so a method that projects the sample coordinates onto a few axes allows one to visually asses group separability and study the relative positions of individual samples. MANOVA involves calculation of a set of "eigenvectors" (also called "canonical variates"), representing the axes separating the group means in a multivariate space. The first axis will provide the greatest separation, the second will provide the next greatest, and so forth. Given K groups, MANOVA will calculate a maximum of K-1 axes. The eigenvector representing each axis comprises a number of weighting coefficients, one for each variable, useful for evaluating the relative contribution of each variable

to the group differences along each axis. Matrix multiplication of the eigenvectors by the input data provides the projections of the samples on the axes for subsequent plotting.

Input to MANOVA includes specification of a model, that is, the classification variables that define group membership. For example, the lithologic types comprise a classification variable, and each sample is assigned to the appropriate group. MANOVA calculates a number of statistics, including measures of variance and covariance, and eigenvectors, and tests the null hypothesis that there exists no differences in group means, e.g. the model that the lithologic types show significant differences among lithologic types. One can call this a "lithologic effect".

RESULTS

Both classification variables lithologic type (Table 2) and core (Table 3), were found to be highly significant in the MANOVA. The eigenvectors - with entries for each variable multiplied by the square root of the within-groups error - give some indication of the differences between the two cores and among the three lithologic types. The first eigenvector accounts for 91.97% of the between-groups variation when testing the model, lithologic types. The major discriminators appear to be bulk density, sulfur, grain density, porosity, petrographic quartz, and illite, in descending order of importance (Table 4). Because only two cores comprise the data, the model testing for a core-effect yields a single eigenvector. Major differences between cores can be attributed to expandable-layer clays, porosity, log density, bulk density, and sulfur, in descending order.

Projection of the sample points on the axes calculated from the lithologic effect (Figure 2) shows good group separation despite overlap, with the banded samples intermediate to the finely laminated on the one hand, and the non-banded on the other. This relative placement of the lithologic types is consistent with visual appearance, as well as with interpretation of the post-depositional histories of the various lithologic types.

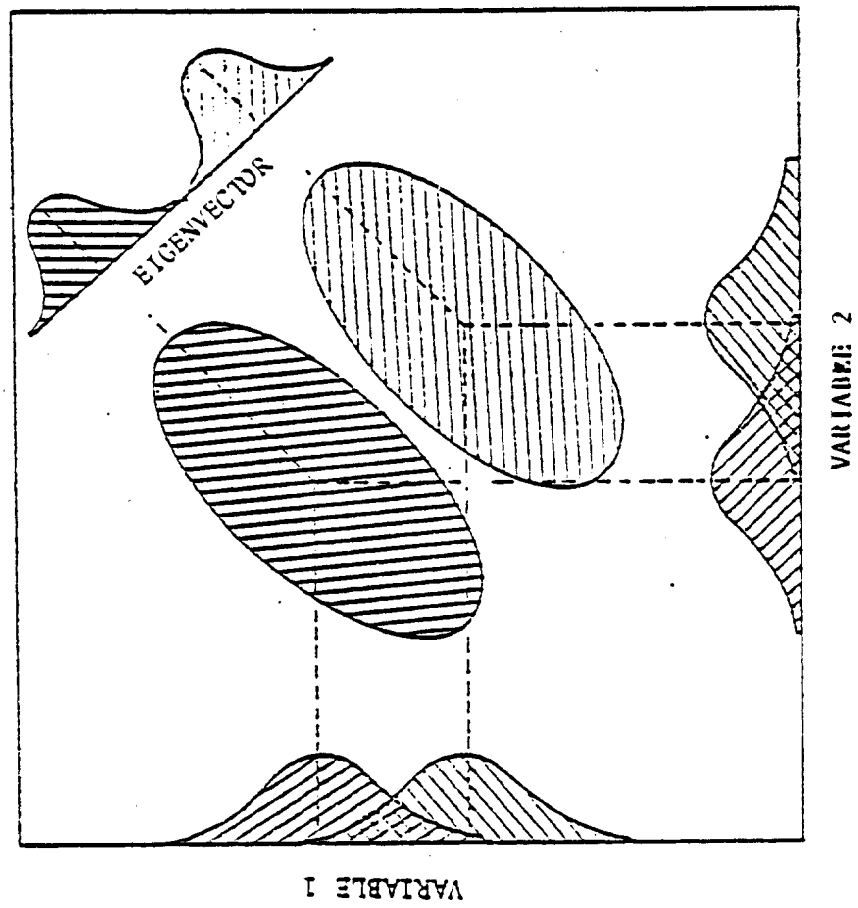

Figure 1. Pictorial example of hypothetical multivariate analysis of variance between two groups that overlap for each variable but show no overlap in multivariate space.

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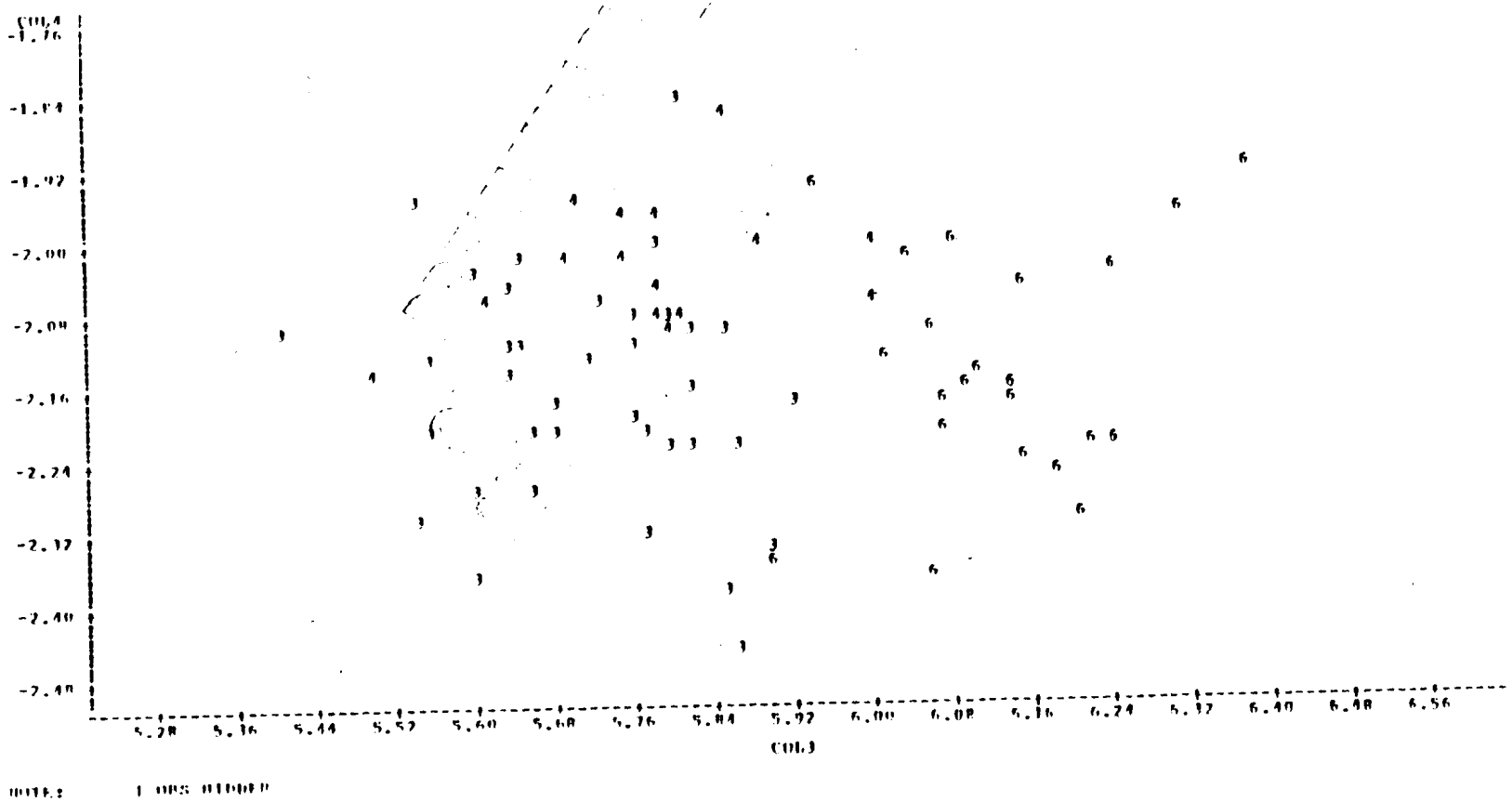

Figure 2. Scores of samples on eigenvectors calculated from lithologic effects model. 3 = finely laminated; 4 = banded; 6 = non-banded. First eigenvector is horizontal axis ("COL3") and second eigenvector is vertical axis ("COL4").

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GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: LOS16500

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	6.40437733	2.13479244	3.26	0.0260	0.121192	24.9309
ERROR	71	46.44042267	0.65409046		STD DEV		LOS16500 MEAN
CORRECTED TOTAL	74	52.84480000			0.80875859		3.24400000

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
LITYPE	2	2.80665327	2.15	0.1245	2	2.52083988	1.93	0.1531
CORE	1	3.59772406	5.50	0.0210	1	3.59772406	5.50	0.0210

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GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: SULFUR

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	15.71449655	5.23816552	4.91	0.0038	0.171870	47.1240
ERROR	71	75.71357011	1.06638831		STD DEV		SULFUR MEAN
CORRECTED TOTAL	74	91.42806667			1.03266079		2.19133333

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
LITYPE	2	15.46822730	7.25	0.0014	2	15.20234007	7.11	0.0015
CORE	1	0.24626925	0.23	0.6323	1	0.24626925	0.23	0.6323

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GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: BULKDEN

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	0.29038699	0.09679566	27.53	0.0001	0.537735	2.2755
ERROR	71	0.24963167	0.00351594		STD DEV		BULKDEN MEAN
CORRECTED TOTAL	74	0.54001867			0.05929535		2.60586667

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
LITYPE	2	0.23318107	33.58	0.0001	2	0.23324932	33.17	0.0001
CORE	1	0.04720592	13.43	0.0005	1	0.04720592	13.43	0.0005

Table 1: Univariate analyses of variance of selected variables. Type IV sums of squares and F-value gives significance of each effect when the other effect is partialled out.

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GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: MATRXDEN

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	0.26189350	0.08729783	24.37	0.0001	0.507283	2.2581
ERROR	71	0.25437316	0.00358272		STD DEV		MATRXDEN MEAN
CORRECTED TOTAL	74	0.51626667			0.05985583		2.65066667

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
LITYPE	2	0.24815697	34.63	0.0001	2	0.24071988	33.59	0.0001
CORE	1	0.01373653	3.83	0.0541	1	0.01373653	3.83	0.0541

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GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: GAMMA

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	50238.33472985	16746.11157662	8.04	0.0001	0.253665	17.4150
ERROR	71	147811.66527015	2081.85444042		STD DEV		GAMMA MEAN
CORRECTED TOTAL	74	198050.00000000			45.62734312		262.00000000

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
LITYPE	2	3524.90829346	0.85	0.4332	2	860.78810144	0.21	0.8137
CORE	1	46713.42643638	22.44	0.0001	1	46713.42643638	22.44	0.0001

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GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: ILL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	0.29796130	0.09932043	16.79	0.0001	0.415081	14.6905
ERROR	71	0.41987818	0.00591378		STD DEV		ILL MEAN
CORRECTED TOTAL	74	0.71783948			0.07690109		0.52347580

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
LITYPE	2	0.11545965	9.76	0.0002	2	0.04473168	3.78	0.0275
CORE	1	0.18250165	30.86	0.0001	1	0.18250165	30.86	0.0001

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GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: HEM

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	0.00738170	0.00246057	6.09	0.0010	0.204606	145.7849
ERROR	71	0.02869599	0.00040417		STD DEV		HEM MEAN
CORRECTED TOTAL	74	0.03607769			0.02010395		0.01379015

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
LITYPE	2	0.00284418	3.52	0.0349	2	0.00295773	3.66	0.0307
CORE	1	0.00453752	11.23	0.0013	1	0.00453752	11.23	0.0013

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GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: PYR

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	0.01953249	0.00651083	7.87	0.0002	0.249478	51.5171
ERROR	71	0.05876095	0.00082762		STD DEV		PYR MEAN
CORRECTED TOTAL	74	0.07829344			0.02876837		0.05584237

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
LITYPE	2	0.00869621	5.25	0.0075	2	0.00519122	3.14	0.0495
CORE	1	0.01083628	13.09	0.0006	1	0.01083628	13.09	0.0006

S T A T I S T I C A L A N A L Y S I S S Y S T E M 11:04 FRIDAY, JANUARY 12, 1979 10

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: GRDEN

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	0.38904879	0.12968293	6.80	0.0005	0.223195	4.8190
ERROR	71	1.35403656	0.01907094		STD DEV		GRDEN MEAN
CORRECTED TOTAL	74	1.74308535			0.13809756		2.86569095

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
LITYPE	2	0.06687629	1.75	0.1806	2	0.03879137	1.02	0.3669
CORE	1	0.32217251	16.89	0.0001	1	0.32217251	16.89	0.0001

S T A T I S T I C A L A N A L Y S I S S Y S T E M 11:04 FRIDAY, JANUARY 12, 1979 11

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: EXP

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	0.00027768	0.00009256	17.23	0.0001	0.421245	27.0472
ERROR	71	0.00038151	0.00000537		STD DEV		EXP MEAN
CORRECTED TOTAL	74	0.00065919			0.00231806		0.00857041

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
LITYPE	2	0.00006873	6.40	0.0020	2	0.00002469	2.30	0.1079
CORE	1	0.00020895	38.89	0.0001	1	0.00020895	38.89	0.0001

S T A T I S T I C A L A N A L Y S I S S Y S T E M 11:04 FRIDAY, JANUARY 12, 1979 12

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: QTZ

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	0.11874818	0.03958273	13.64	0.0001	0.365686	16.4457
ERROR	71	0.20597939	0.00290112		STD DEV		QTZ MEAN
CORRECTED TOTAL	74	0.32472757			0.05386203		0.32751343

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
LITYPE	2	0.05359069	9.24	0.0003	2	0.02395396	4.13	0.0201
CORE	1	0.06515750	22.46	0.0001	1	0.06515750	22.46	0.0001

S T A T I S T I C A L A N A L Y S I S S Y S T E M 11:04 FRIDAY, JANUARY 12, 1979 13

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: PLA

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	0.00024583	0.00008194	1.24	0.3001	0.049921	31.0824
ERROR	71	0.00467858	0.00006590		STD DEV		PLA MEAN
CORRECTED TOTAL	74	0.00492441			0.00811760		0.02611641

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
LITYPE	2	0.00017032	1.29	0.2810	2	0.00010065	0.76	0.4697
CORE	1	0.00007551	1.15	0.2880	1	0.00007551	1.15	0.2880

S T A T I S T I C A L A N A L Y S I S S Y S T E M 11:04 FRIDAY, JANUARY 12, 1979 14

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: LOSIG100

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	131.11767724	43.70589241	5.56	0.0019	0.190302	51.0152
ERROR	71	557.88018942	7.85746746		STD DEV		LOSIG100 MEAN
CORRECTED TOTAL	74	688.99786667			2.80311745		5.49466667

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
LITYPE	2	114.09774386	7.26	0.0014	2	105.50500426	6.71	0.0021
CORE	1	17.01993338	2.17	0.1455	1	17.01993338	2.17	0.1455

S T A T I S T I C A L A N A L Y S I S S Y S T E M 11:04 FRIDAY, JANUARY 12, 1979 15

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: POROSITY

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	20.29323281	6.76441094	6.52	0.0007	0.215946	56.4942
ERROR	71	73.68059919	1.03775492		STD DEV		POROSITY MEAN
CORRECTED TOTAL	74	93.97383200			1.01870257		1.80320000

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
LITYPE	2	0.76489584	0.37	0.6931	2	1.74228230	0.84	0.4362
CORE	1	19.52833696	18.82	0.0001	1	19.52833696	18.82	0.0001

S T A T I S T I C A L A N A L Y S I S S Y S T E M 11:04 FRIDAY, JANUARY 12, 1979 16

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: QUARTZ

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	0.02447141	0.00815714	4.40	0.0069	0.156782	29.2037
ERROR	71	0.13161416	0.00185372		STD DEV		QUARTZ MEAN
CORRECTED TOTAL	74	0.15608558			0.04305486		0.14742933

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
LITYPE	2	0.00617526	1.67	0.1964	2	0.00361628	0.98	0.3820
CORE	1	0.01829616	9.87	0.0025	1	0.01829616	9.87	0.0025

S T A T I S T I C A L A N A L Y S I S S Y S T E M 11:04 FRIDAY, JANUARY 12, 1979 17

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: LOGDEN

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	0.11560310	0.03853437	13.18	0.0001	0.357674	2.1136
ERROR	71	0.20760490	0.00292401		STD DEV		LOGDEN MEAN
CORRECTED TOTAL	74	0.32320800			0.05407414		2.55840000

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
LITYPE	2	0.00633881	1.08	0.3438	2	0.00179682	0.31	0.7364
CORE	1	0.10926429	37.37	0.0001	1	0.10926429	37.37	0.0001

Table 2: Multivariate analysis of variance on lithologic effect.

```
MANOVA TEST CRITERIA FOR THE HYPOTHESIS OF NO OVERALL LITYPE EFFECT

                    H = TYPE IV SS&CP MATRIX FOR: LITYPE
                    E = ERROR SS&CP MATRIX
                    P = DEP. VARIABLES =        16
                    Q = RANK OF H      =         2
                    NE= DF OF E        =        71
                    S = MIN(P,Q)       =         2
                    M = .5(ABS(P-Q)-1) =       6.5
                    N = .5(NE-P-1)     =      27.0
-----------------------------------------------------------------------------------------
HOTELLING-LAWLEY TRACE = TR(E**-1*H) =            2.66571176     (SEE PILLAI'S TABLE #3)
        F APPROXIMATION = 2(S*N+1)*TR(E**-1*H)/(S*S*(2M+S+1))    WITH S(2M+S+1) AND 2(S*N+1) DF
             F(32,110) =      4.58     PROB > F = 0.0001
-----------------------------------------------------------------------------------------
PILLAI'S TRACE          V = TR(H*INV(H+E)) =      0.88652756     (SEE PILLAI'S TABLE #2)
        F APPROXIMATION = (2N+S+1)/(2M+S+1) * V/(S-V)            WITH S(2M+S+1) AND S(2N+S+1) DF
             F(32,114) =      2.84     PROB > F = 0.0001
-----------------------------------------------------------------------------------------
WILKS' CRITERION        L = DET(E)/DET(H+E) =     0.23865007     (SEE RAO 1973 P 555)
        EXACT F = (1-SQRT(L))/SQRT(L)*(NE+Q-P-1)/P               WITH 2P AND 2(NE+Q-P-1) DF
             F(32,112) =      3.66     PROB > F = 0.0001
-----------------------------------------------------------------------------------------
ROY'S MAXIMUM ROOT CRITERION =                    2.45177547     (SEE AMS VOL 31 P 625)
        FIRST CANONICAL VARIABLE YIELDS AN F UPPER BOUND
              F(2,71) =     87.04     (UPPER BOUND)
-----------------------------------------------------------------------------------------
```

Table 3: Multivariate analysis of variance on core effect.

```
MANOVA TEST CRITERIA FOR THE HYPOTHESIS OF NO OVERALL CORE EFFECT

                    H = TYPE IV SS&CP MATRIX FOR1 CORE
                    E = ERROR SS&CP MATRIX
                    P = DEP. VARIABLES =        16
                    Q = RANK OF H      =         1
                   NE = DF OF E        =        71
                    S = MIN(P,Q)       =         1
                    M = .5(ABS(P-Q)-1) =       7.0
                    N = .5(NE-P-1)     =      27.0
-----------------------------------------------------------------------------------------
HOTELLING-LAWLEY TRACE = TR(E**-1*H) =            2.30485011     (SEE PILLAI'S TABLE #3)
        F APPROXIMATION = 2(S*N+1)*TR(E**-1*H)/(S*S*(2M+S+1))   WITH S(2M+S+1) AND 2(S+N+1) DF
              F(16,56) =      8.35      PROB > F = 0.0001
-----------------------------------------------------------------------------------------
PILLAI'S TRACE          V = TR(H*INV(H+E)) =      0.70456664     (SEE PILLAI'S TABLE #2)
        F APPOXIMATION = (2N+S+1)/(2M+S+1) * V/(S-V)            WITH S(2M+S+1) AND S(2N+S+1) DF
              F(16,56) =      8.35      PROB > F = 0.0001
-----------------------------------------------------------------------------------------
WILKS' CRITERION        L = DET(E)/DET(H+E) =     0.29543336     (SEE RAO 1973 P 555)
        EXACT F = (1-L)/L*(NE+Q-P)/P                            WITH P AND NE+Q-P DF
              F(16,56) =      8.35      PROB > F = 0.0001
-----------------------------------------------------------------------------------------
ROY'S MAXIMUM ROOT CRITERION =                    2.30485011     (SEE AMS VOL 31 P 625)
        FIRST CANONICAL VARIABLE YIELDS AN F UPPER BOUND
              F(1,71) =    169.32     (UPPER BOUND)
-----------------------------------------------------------------------------------------
```

UGR File # 157
W.Va. Geological & Economic Survey

Table 4: Eigenvectors from MANOVA of the hypothesis of core and lithologic effects.

Effect	"Litype"		"Core"
Eigenvector #	I	II	I
LOSIG500	-0.119	0.476	-0.315
Sulfur	-0.670	0.304	0.428
Bulkden	1.256	-0.118	-0.510
Matrxden	-0.099	-0.330	0.365
Gamma	0.040	-0.005	0.088
Ill	0.423	0.397	-0.033
Hem	-0.128	0.119	-0.168
Pyr	-0.352	-0.183	-0.084
Grden	0.563	0.512	-0.281
Exp	-0.246	-0.204	0.747
Qtz	0.436	-0.394	-0.210
Pla	0.087	0.670	-0.195
LOSIG100	-0.257	-0.656	0.367
Porosity	0.557	0.303	-0.674
Quartz	0.040	0.137	-0.255
Logden	-0.345	-0.240	0.586
Percent Variance	91.97	8.03	100.0

PRELIMINARY
SUBJECT TO REVISION

Multiple Range Test

Analysis of variance (ANOVA) shows that differences exist by lithotype and/or well for certain mineralogic and physical parameters. When such differences are indicated, the multiple range test can be used to group the means into subgroups of not significantly distinguishable means. The program utilized contained Kramer's extension which corrected for unequal population size. The lower Huron interval in Jac 1369 was compared to the lower Huron interval in Linc 1637 on the basis of lithotypes for selected parameters (Table 1). All means that fall within the same grouping are not significantly different.

Among mineralogic parameters, less total quartz and silt is present in the thinly laminated and lenticularly laminated lithotypes in Jac 1369. More illite is present in all lithotypes in Jac 1369 paralleling the decrease in quartz. The higher clay content is consistent with a postulated deep water environment for the lower Huron in Jackson County. Additionally, less pyrite occurs in the thinly laminated and non-banded lithotypes in Jac 1369. The lower pyrite content along with the lower quartz content may explain the lower mean porosity of Jac 1369. Bulk density, matrix density, and log density are higher in the thinly laminated and lenticularly laminated lithotypes in Jac 1369, probably reflecting the lower porosity and overall lower mean organic matter content. Expandable clay (14°A clay on diffractogram) is significantly higher in Jac 1369, but the amount of this clay is so low, generally 1% or less, that differences may be due to individual bias in interpreting diffractograms or slight matrix differences between

wells.

PRELIMINARY
OPEN FILE
SUBJECT TO REVISION

S T A T I S T I C A L A N A L Y S I S S Y S T E M 12:00 MONDAY, JANUARY 15, 1979 1

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE LOSIG500

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=71 MS=0.654

GROUPING		MEAN	N	LITYPE	CORE
	A	3.500000	25	3	12
	A				
B	A	3.400000	4	4	12
B	A				
B	A	3.350000	12	6	12
B	A				
B	A	3.215385	13	3	21
B	A				
B	A	3.190909	11	4	21
B					
B		2.490000	10	6	21

S T A T I S T I C A L A N A L Y S I S S Y S T E M 12:00 MONDAY, JANUARY 15, 1979 2

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE SULFUR

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=71 MS=1.066

GROUPING			MEAN	N	LITYPE	CORE
	A		2.560400	25	3	12
	A					
B	A		2.519231	13	3	21
B	A					
B	A		2.419091	11	4	21
B	A					
B	A	C	1.990000	4	4	12
B		C				
B		C	1.746667	12	6	12
		C				
		C	1.206000	10	6	21

S T A T I S T I C A L A N A L Y S I S S Y S T E M 12:00 MONDAY, JANUARY 15, 1979 3

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE BULKDEN

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=71 MS=0.00352

GROUPING		MEAN	N	LITYPE	CORE
	A	2.700000	10	6	21
	A				
	A	2.685833	12	6	12
	B	2.625455	11	4	21
	B				
	B	2.596154	13	3	21
	C	2.542000	25	3	12
	C				
	C	2.502500	4	4	12

Table 1. Results of multiple range test for selected parameters. Lithotype code is: 3-thinly laminated shale, 4-lenticularly laminated shale, 6-non-banded shale. Core code is: 12-

S T A T I S T I C A L A N A L Y S I S S Y S T E M 12:00 MONDAY, JANUARY 15, 1979 4

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE MATRADEN

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=71 MS=0.00358

GROUPING			MEAN	N	LITYPE	CORE
	A		2.746667	12	6	12
	A					
	A		2.727000	10	6	21
	B		2.663636	11	4	21
	B					
C	B		2.629231	13	3	21
C						
C			2.592400	25	3	12
C						
C			2.570000	4	4	12

S T A T I S T I C A L A N A L Y S I S S Y S T E M 12:00 MONDAY, JANUARY 15, 1979 5

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE GAMMA

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=71 MS=2081.85

GROUPING			MEAN	N	LITYPE	CORE
	A		297.916667	12	6	12
	A					
B	A		284.800000	25	3	12
B						
B	C		252.727273	11	4	21
B	C					
B	C	D	251.250000	4	4	12
	C	D				
	C	D	237.307692	13	3	21
		D				
		D	208.500000	10	6	21

S T A T I S T I C A L A N A L Y S I S S Y S T E M 12:00 MONDAY, JANUARY 15, 1979 6

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE ILL

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=71 MS=0.00591

GROUPING			MEAN	N	LITYPE	CORE
	A		0.612276	11	4	21
	A					
	A		0.586248	10	6	21
	A					
B	A		0.567702	13	3	21
B						
B			0.509682	12	6	12
B						
B	C		0.500514	[illegible]	4	12
	C					
	C		0.445552	25	3	12

S T A T I S T I C A L A N A L Y S I S S Y S T E M 12:00 MONDAY, JANUARY 15, 1979 7

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE BEM

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=71 MS=4.0E-04

GROUPING		MEAN	N	LITYPE	CORE
	A	0.037919	12	6	12
	A				
B	A	0.017894	4	4	12
B					
B		0.013022	25	3	12
B					
B		0.005730	13	3	21
B					
B		0.005644	10	6	21
B					
B		0.004653	11	4	21

S T A T I S T I C A L A N A L Y S I S S Y S T E M 12:00 MONDAY, JANUARY 15, 1979 8

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE PYR

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=71 MS=8.3E-04

GROUPING			MEAN	N	LITYPE	CORE
	A		0.073559	25	3	12
	A					
B	A		0.060473	12	6	12
B	A					
B	A	C	0.060296	4	4	12
B	A	C				
B	A	C	0.052806	13	3	21
B		C				
B		C	0.040372	11	4	21
		C				
		C	0.025178	10	6	21

S T A T I S T I C A L A N A L Y S I S S Y S T E M 12:00 MONDAY, JANUARY 15, 1979 9

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE GRDEN

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=71 MS=0.0191

GROUPING		MEAN	N	LITYPE	CORE
	A	3.011552	12	6	12
	B	2.893531	25	3	12
	B				
C	B	2.891981	4	4	12
C	B				
C	B	2.812151	13	3	21
C	B				
C	B	2.785921	11	4	21
C					
C		2.767890	10	6	21

S T A T I S T I C A L A N A L Y S I S S Y S T E M 12:00 MONDAY, JANUARY 15, 1979 10

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE EXP

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=71 MS=5.4E-06

GROUPING		MEAN	N	LITYPE	CORE
	A	0.010809	10	6	21
	A	0.010664	11	4	21
	A	0.010352	13	3	21
	B	0.008137	12	6	12
	B	0.007379	4	4	12
C		0.006226	25	3	12
C					
C					

S T A T I S T I C A L A N A L Y S I S S Y S T E M 12:00 MONDAY, JANUARY 15, 1979 11

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE OTZ

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=71 MS=0.0029

GROUPING		MEAN	N	LITYPE	CORE
	A	0.376141	25	3	12
	A	0.354204	[illegible]	4	12
B		0.327923	12	6	12
B		0.308824	[illegible]	[illegible]	21
B	C	0.293445	10	6	21
B	C	0.262275	11	4	21
	C				

S T A T I S T I C A L A N A L Y S I S S Y S T E M 12:00 MONDAY, JANUARY 15, 1979 12

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE PLA

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=71 MS=6.6E-05

GROUPING		MEAN	N	LITYPE	CORE
A	A	0.030441	11	4	21
A	A	0.029347	10	6	21
A	A	0.025950	25	3	12
A	A	0.025491	4	4	12
A	A	0.023966	13	3	21
A	A	0.022342	12	6	12

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DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE LOSIG100

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=71 MS=7.857

GROUPING	MEAN	N	LITYPE	CORE
A	6.964000	25	3	12
A				
A	6.300000	4	4	12
B A				
B A	5.784615	13	3	21
B A				
B A	5.109091	11	4	21
B				
B	3.983333	12	6	12
B				
B	3.360000	10	6	21

S T A T I S T I C A L A N A L Y S I S S Y S T E M 12:00 MONDAY, JANUARY 15, 1979 14

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE POROSITY

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=71 MS=1.0370

GROUPING	MEAN	N	LITYPE	CORE
A	2.615000	4	4	12
A				
A	2.219600	25	3	12
A				
A	2.212500	12	6	12
A				
A	1.504545	11	4	21
B				
B	1.255385	13	3	21
B				
B	0.987000	10	6	21

S T A T I S T I C A L A N A L Y S I S S Y S T E M 12:00 MONDAY, JANUARY 15, 1979 15

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE QUARTZ

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=71 MS=0.00185

GROUPING	MEAN	N	LITYPE	CORE
A	0.171944	25	3	12
A				
A	0.170200	4	4	12
B A				
B A	0.140650	12	6	12
B				
B	0.132000	10	6	21
B				
B	0.130000	11	4	21
B				
B	0.126154	13	3	21

UGR File # 157
W.Va. Geological & Economic Survey

S T A T I S T I C A L A N A L Y S I S S Y S T E M 12:00 MONDAY, JANUARY 15, 1979 16

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE LOGDFN

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05 DF=71 MS=0.00292

GROUPING	MEAN	N	LITYPE	CORE
A	2.629000	10	6	21
A				
A	2.594545	11	4	21
A				
A	2.585385	13	3	21
B	2.531200	25	3	12
B				
B	2.510000	4	4	12
B				
B	2.510000	12	6	12

PRELIMINARY
OPEN-FILE REPORT
SUBJECT TO REVISION

Kolmogorov-Smirnov Test

In comparing means or variances, some properties of the distribution must be known to select the appropriate statistical test. Testing for normality can be quickly accomplished and should be done before comparing data from different lithotypes or wells. The Kolmogorov-Smirnov one sample test for normality compares the sample distribution to a hypothetical normal distribution. Results for the lower Huron interval by lithotype for Lino 1637 and Jac 1369 are given in table I. Generally most parameters are normally distributed indicating that parametric statistical tests such as the multiple range test are generally applicable to the data. Log density and bulk density commonly show a non-normal distribution indicating that a two sample non-parametric goodness of fit test should probably be used for these parameters. Further research on the shape of sample populations by lithotype and core is in progress.

S T A T I S T I C A L A N A L Y S I S S Y S T E M 9:12 TUESDAY, JANUARY 16, 1979 1
LITYPE=3 CORE=12

VARIABLE	N	D-MAX	PROB	SKEWNESS G1	G1/SERG1	P-LEVEL G1	KURTOSIS G2	G2/SERG2	P-LEVEL G2	MEAN	ST DEV
LOSIG500	25	0.1208	>.20	0.148	0.320	0.749	0.084	0.093	0.926	3.5080	0.8475
SULFUR	25	0.1154	>.20	0.589	1.270	0.204	1.201	1.331	0.183	2.5604	0.6789
BULKDEN	25	0.1932	.05	0.409	0.883	0.377	3.852	4.272	0.000	2.5428	0.0710
MATRXDEN	25	0.1714	.10	-0.985	-2.124	0.034	4.430	4.912	0.000	2.5924	0.0743
GAMMA	25	0.1027	>.20	0.011	0.023	0.982	-0.662	-0.734	0.463	284.8000	51.2242
ILL	25	0.1422	>.20	-0.297	-0.641	0.522	1.581	1.753	0.080	0.4456	0.0703
HEM	25	0.4184	.01	1.944	4.193	0.000	2.061	2.286	0.022	0.0130	0.0232
PYR	25	0.1061	>.20	0.237	0.512	0.609	0.215	0.238	0.812	0.0736	0.0343
GRDEN	25	0.2160	.01	1.597	3.444	0.001	2.669	2.960	0.003	2.8935	0.1571
EXP	25	0.0908	>.20	0.106	0.228	0.820	-0.520	-0.577	0.564	0.0062	0.0024
QTZ	25	0.1589	.15	-0.833	-1.796	0.073	2.640	2.928	0.003	0.3761	0.0471
PLA	25	0.1238	>.20	-0.931	-2.008	0.045	1.731	1.919	0.055	0.0260	0.0058
LOSIG100	25	0.1748	.10	0.632	1.363	0.173	2.681	2.973	0.003	6.9640	2.6195
POROSITY	25	0.1459	>.20	0.861	1.857	0.063	1.986	2.203	0.028	2.2196	1.4073
QUARTZ	25	0.1177	>.20	-0.053	-0.114	0.909	-0.469	-0.520	0.603	0.1719	0.0476
LOGDEN	25	0.1883	.05	1.111	2.395	0.017	0.756	0.838	0.402	2.5312	0.0487

S T A T I S T I C A L A N A L Y S I S S Y S T E M 9:12 TUESDAY, JANUARY 16, 1979 2
LITYPE=3 CORE=21

VARIABLE	N	D-MAX	PROB	SKEWNESS G1	G1/SERG1	P-LEVEL G1	KURTOSIS G2	G2/SERG2	P-LEVEL G2	MEAN	ST DEV
LOSIG500	13	0.1478	>.20	0.186	0.302	0.763	-0.700	-0.588	0.557	3.2154	0.5367
SULFUR	13	0.1987	.20	0.260	0.423	0.673	-1.551	-1.302	0.193	2.5192	0.4228
BULKDEN	13	0.1774	>.20	-0.165	-0.268	0.789	-1.241	-1.042	0.297	2.5962	0.0588
MATRXDEN	13	0.1184	>.20	0.129	0.210	0.834	-0.427	-0.358	0.720	2.6292	0.0578
GAMMA	13	0.1556	>.20	0.654	1.061	0.289	-0.104	-0.087	0.930	237.3077	29.1987
ILL	13	0.2150	.10	-1.045	-1.695	0.090	0.260	0.219	0.827	0.5677	0.0832
HEM	13	0.2993	.01	1.986	3.223	0.001	6.452	5.418	0.000	0.0057	0.0023
PYR	13	0.1211	>.20	-0.023	-0.037	0.970	-0.833	-0.699	0.484	0.0520	0.0065
GRDEN	13	0.1874	>.20	0.222	0.360	0.719	-1.748	-1.468	0.142	2.8122	0.0156
EXP	13	0.1625	>.20	-1.021	-1.656	0.098	1.088	0.914	0.361	0.0104	0.0026
QTZ	13	0.1754	>.20	0.648	1.052	0.293	-0.726	-0.609	0.542	0.3068	0.0637
PLA	13	0.2382	.05	0.470	0.762	0.446	-1.480	-1.243	0.214	0.0240	0.0049
LOSIG100	13	0.1447	>.20	-0.479	-0.778	0.437	-0.241	-0.202	0.840	5.7846	1.1357
POROSITY	13	0.2421	.05	0.642	1.042	0.297	-0.486	-0.408	0.683	1.2554	0.8702
QUARTZ	13	0.1410	>.20	-0.090	-0.145	0.884	-1.424	-1.196	0.232	0.1262	0.0269
LOGDEN	13	0.1535	>.20	-0.862	-1.399	0.162	0.840	0.706	0.480	2.5854	0.0553

S T A T I S T I C A L A N A L Y S I S S Y S T E M 9:12 TUESDAY, JANUARY 16, 1979 3
LITYPE=4 CORE=12

VARIABLE	N	D-MAX	PROB	SKEWNESS G1	G1/SERG1	P-LEVEL G1	KURTOSIS G2	G2/SERG2	P-LEVEL G2	MEAN	ST DEV
LOSIG500	4	0.3846	.05	1.932	1.905	0.057	3.751	1.432	0.152	3.4000	0.8716
SULFUR	4	0.2970	>.20	-1.612	-1.589	0.112	2.493	0.952	0.341	1.9900	0.3387
BULKDEN	4	0.2847	>.20	0.517	0.510	0.610	1.649	0.630	0.529	2.5025	0.0287
MATRXDEN	4	0.3332	.15	-1.779	-1.754	0.079	3.135	1.197	0.231	2.5700	0.0476
GAMMA	4	0.2705	>.20	-1.194	-1.177	0.239	0.436	0.166	0.868	251.2500	11.8145
ILL	4	0.3983	.05	1.921	1.894	0.058	3.758	1.435	0.151	0.5095	0.0913
HEM	4	0.4246	.01	1.984	1.956	0.050	3.949	1.508	0.132	0.0179	0.0314
PYR	4	0.2274	>.20	0.184	0.181	0.856	1.366	0.522	0.602	0.0603	0.0212
GRDEN	4	0.3918	.05	1.895	1.868	0.062	3.682	1.406	0.160	2.8920	0.1911
EXP	4	0.2728	>.20	-1.483	-1.462	0.144	2.001	0.764	0.445	0.0074	0.0012
QTZ	4	0.2063	>.20	-0.700	-0.690	0.490	-0.700	-0.267	0.789	0.3542	0.0600
PLA	4	0.1922	>.20	0.155	0.151	0.879	0.933	0.356	0.722	0.0255	0.0041
LOSIG100	4	0.2943	>.20	-1.617	-1.595	0.111	2.454	0.937	0.349	6.3000	2.6957
POROSITY	4	0.1656	>.20	-0.395	-0.390	0.697	-0.587	-0.224	0.823	2.6150	1.1137
QUARTZ	4	0.2944	>.20	-0.215	-0.212	0.832	-4.750	-1.814	0.070	0.1702	0.0395
LOGDEN	4	0.2500	>.20	-0.941	-0.928	0.354	1.500	0.573	0.567	2.5100	0.0294

Table 1. Results of Kolmogorov-Smirnov one sample test for normality on selected parameters in Jac 1369 and Linc 1637 for the lower Huron interval by lithotype. Lithotype code is; 3 - thinly laminated shale, 4 - lenticularly laminated shale, 6 - non-banded shale. Core code is; 12 - Linc 1637 21 - Jac 1369.

S T A T I S T I C A L A N A L Y S I S S Y S T E M 9:12 TUESDAY, JANUARY 16, 1979 4
LITYPE=4 CORE=21

VARIABLE	N	D-MAX	PROB	SKEWNESS G1	G1/SERG1	P-LEVEL G1	KURTOSIS G2	G2/SERG2	P-LEVEL G2	MEAN	ST DEV
LOSIG500	11	0.1524	>.20	-0.381	-0.576	0.565	0.067	0.052	0.958	3.1909	0.7035
SULFUR	11	0.3106	.01	2.527	3.825	0.000	7.690	6.011	0.000	2.4191	2.1501
BULKDEN	11	0.3158	.01	1.251	1.894	0.058	0.463	0.362	0.717	2.6255	0.0692
MATRXDEN	11	0.1400	>.20	0.482	0.730	0.465	-0.571	-0.447	0.655	2.6636	0.0570
GAMMA	11	0.2436	.10	-0.380	-0.575	0.565	-1.054	-1.449	0.147	252.7273	52.5530
ILL	11	0.1986	>.20	-0.483	-0.731	0.464	0.322	0.251	0.801	0.6123	0.0459
HEM	11	0.1940	>.20	-1.674	-2.534	0.011	3.910	3.072	0.002	0.0047	0.0018
PYR	11	0.2022	>.20	-1.346	-2.037	0.042	3.529	2.758	0.006	0.0404	0.0165
GRDEN	11	0.2193	.15	-1.605	-2.429	0.015	4.078	3.167	0.001	2.7059	0.0369
EXP	11	0.1621	>.20	1.108	1.678	0.093	0.895	0.699	0.484	0.0107	0.0025
QTZ	11	0.1731	>.20	0.592	0.896	0.370	1.251	0.978	0.328	0.2623	0.0383
PLA	11	0.1963	>.20	1.167	1.766	0.077	1.809	1.414	0.157	0.0304	0.0091
LOSIG100	11	0.1887	>.20	-0.679	-1.027	0.304	-0.239	-0.187	0.852	5.1091	1.3375
POROSITY	11	0.2165	.20	0.101	0.153	0.878	-0.712	-0.556	0.578	1.5045	0.9431
QUARTZ	11	0.2780	.05	0.840	1.271	0.204	-0.802	-0.627	0.531	0.1100	0.0276
LOGDEN	11	0.2515	.05	1.206	1.826	0.068	0.506	0.396	0.692	2.5945	0.0497

S T A T I S T I C A L A N A L Y S I S S Y S T E M 9:12 TUESDAY, JANUARY 16, 1979 5
LITYPE=6 CORE=12

VARIABLE	N	D-MAX	PROB	SKEWNESS G1	G1/SERG1	P-LEVEL G1	KURTOSIS G2	G2/SERG2	P-LEVEL G2	MEAN	ST DEV
LOSIG500	12	0.2367	.10	1.702	2.671	0.008	4.827	3.917	0.000	3.3500	1.1759
SULFUR	12	0.1350	>.20	0.610	0.957	0.339	0.591	0.479	0.632	1.7467	0.8637
BULKDEN	12	0.1305	>.20	-0.889	-1.394	0.163	1.003	0.814	0.416	2.6858	0.0291
MATRXDEN	12	0.1592	>.20	-0.432	-0.678	0.498	-0.918	-0.745	0.456	2.7467	0.0290
GAMMA	12	0.1121	>.20	-0.536	-0.841	0.400	-0.118	-0.096	0.924	297.9167	38.5804
ILL	12	0.2288	.10	1.466	2.301	0.021	2.165	1.757	0.079	0.5097	0.0793
HEM	12	0.2653	.05	-0.022	-0.034	0.973	-1.822	-1.478	0.139	0.0379	0.0311
PYR	12	0.1439	>.20	1.159	1.819	0.069	2.253	1.828	0.068	0.0605	0.0462
GRDEN	12	0.2318	.10	0.151	0.237	0.813	-1.578	-1.281	0.200	3.0116	0.2195
EXP	12	0.1746	>.20	-0.468	-0.735	0.463	2.735	2.219	0.026	0.0081	0.0019
QTZ	12	0.1979	>.20	-1.069	-1.677	0.093	2.231	1.810	0.070	0.3279	0.0494
PLA	12	0.1551	>.20	-0.019	-0.029	0.977	-1.330	-1.079	0.281	0.0223	0.0058
LOSIG100	12	0.3831	.01	3.250	5.100	0.000	10.881	8.830	0.000	3.9833	5.4589
POROSITY	12	0.1978	>.20	-0.125	-0.196	0.845	-0.363	-0.296	0.768	2.2125	0.4760
QUARTZ	12	0.1039	>.20	-0.154	-0.242	0.809	-0.565	-0.459	0.647	0.1406	0.0515
LOGDEN	12	0.2461	.05	2.280	3.577	0.000	5.907	4.794	0.040	2.5100	0.0499

S T A T I S T I C A L A N A L Y S I S S Y S T E M 9:12 TUESDAY, JANUARY 16, 1979 6
LITYPE=6 CORE=21

VARIABLE	N	D-MAX	PROB	SKEWNESS G1	G1/SERG1	P-LEVEL G1	KURTOSIS G2	G2/SERG2	P-LEVEL G2	MEAN	ST DEV
LOSIG500	10	0.1755	>.20	1.066	1.551	0.121	1.084	0.812	0.417	2.4900	0.4725
SULFUR	10	0.1622	>.20	0.458	0.666	0.505	1.058	0.793	0.428	1.2060	0.7802
BULKDEN	10	0.2643	.05	1.082	1.575	0.115	1.021	0.765	0.444	2.7000	0.0236
MATRXDEN	10	0.1951	>.20	1.049	1.527	0.127	1.359	1.019	0.308	2.7270	0.0291
GAMMA	10	0.1853	>.20	1.123	1.634	0.102	0.437	0.327	0.743	208.5000	39.4441
ILL	10	0.1509	>.20	-1.066	-1.551	0.121	1.618	1.213	0.225	0.5052	0.1030
HEM	10	0.1168	>.20	-0.018	-0.026	0.979	-1.040	-0.780	0.436	0.0056	0.0017
PYR	10	0.1657	>.20	-0.322	-0.469	0.639	-1.445	-1.083	0.279	0.0252	0.0138
GRDEN	10	0.1762	>.20	-0.114	-0.167	0.868	-0.366	-0.274	0.784	2.7679	0.0392
EXP	10	0.1743	>.20	0.805	1.172	0.241	0.111	0.084	0.933	0.0108	0.0025
QTZ	10	0.2287	.15	1.428	2.079	0.038	3.001	2.249	0.025	0.2934	0.0703
PLA	10	0.1261	>.20	-0.533	-0.776	0.438	0.062	0.046	0.963	0.0293	0.0151
LOSIG100	10	0.2446	.10	0.791	1.152	0.249	0.277	0.207	0.836	3.3600	1.0047
POROSITY	10	0.1969	>.20	-0.347	-0.505	0.613	-1.211	-0.908	0.364	0.9870	0.4200
QUARTZ	10	0.1129	>.20	-0.128	-0.186	0.852	-0.772	-0.578	0.563	0.1320	0.0498
LOGDEN	10	0.2616	.05	-1.572	-2.288	0.022	3.344	2.506	0.012	2.6290	0.0709

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Summary of Contractural Fulfillment

Parameter	Required by Contract	Fulfilled
Thin Section Mineralogy	Yes	Yes
X-Ray Diffraction Mineralogy	Yes	Yes
Texture-fabric from thin sections	Yes	Yes
Texture-fabric from X-radiography	No	Yes
Electron Microscopy of selected samples	Yes	Yes
Organic Matter from LOI	No	Yes
Bulk Density	Yes	Yes
Matrix Density	No	Yes
Porosity Measurement	No	Yes
Material Balance Density	No	Yes
Correlation Analyses Whole Well	Yes	Yes
Correlation Analyses by Lithotype	No	Yes
Strip Log Presentations	Yes (major parameters)	Yes (all parameters)
Relate petrology to log data	Yes	Yes
Multivariate Analysis	No	Yes

Contributors by Alphabetical Order

J.L. Clagett - Preparation of radiographs, staining of thin sections, photography.

J.E. Florence - Initial sample preparation, thin-slabbing of shales for X-radiography, preparation of archive material.

M.E. Hohn - Computer generation of gamma log profiles; linear correlation analyses; multivariate analysis.

R.E. Larese - Sample selection, initiation of study.

D.W. Neal - Stratigraphy

E.B. Nuhfer - Design of investigation; methodology, fabric classification of lithotypes by X-radiography and thin section prints, X-ray diffraction study, denisty and porosity evaluation, scanning electron microscopy, log analysis, petrographic interpretation of correlation analyses, organization of data, summary and interpretation, conclusions and recommendations, organization of report, photography.

J.J. Renton - X-ray diffraction analyses.

R.A. Smosna - Coordination and supervision.

R.J. Vinopal - Thin section point count analyses, fabric classification of lithotypes from X-radiography, thin section prints, and thin sections, density-porosity evaluation, loss on ignition determinations, density-porosity measurements, organization of data, petrographic interpretation of correlation analyses, conclusions and recommendations, organization of report, sample selection.