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BEKKI WHITE, DIRECTOR AND STATE GEOLOGIST

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ORGANIC GEOCHEMISTRY AND THERMAL MATURATION ANALYSIS WITHIN THE FAYETTEVILLE SHALE STUDY AREA – EASTERN ARKOMA BASIN AND MISSISSIPPI EMBAYMENT REGIONS, ARKANSAS

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Introduction

The Fayetteville Shale geochemical study is a joint research project between the Arkansas Geological Commission, EOG Resources of Houston, Texas and Oklahoma City, Oklahoma, and Chesapeake Energy of Oklahoma City, Oklahoma. The primary objective of the project is to characterize the organic geochemistry and thermal maturation of selected geologic units within the Fayetteville Shale study area as shown in Figure 1. The Fayetteville Shale Formation is the primary focus of this study although selected shale samples from Pennsylvanian through Devonian stratigraphic units also were analyzed. The Fayetteville Shale Formation is the current focus of a regional shale gas exploration venture by several energy companies within the eastern Arkoma Basin and Mississippi Embayment regions of Arkansas. The information generated from this study is the most extensive collection of published geochemical and thermal maturation data from the Fayetteville Shale Formation to date and will facilitate petroleum exploration programs in Arkansas. The raw geochemical data are included in the publication which permits a detailed analysis of each well's unique geochemistry and permits the reader to independently plot and model the geochemical data. The lead author has modeled selected portions of the data in a series of geochemical and geologic maps that are present on this disk as pdf map files that correspond to Plates 1-23 in the Table of Contents. There has been no attempt to model all of the geochemical data in this study; however, selected data sets are used to model and portray important geologic and geochemical aspects of the Fayetteville Shale Formation and the models have the potential to assist with ongoing petroleum exploration ventures in the region. No geochemical information for this project was derived from commercial shale gas wells in the study area and no information was available from Arkansas state agencies or well operators pertaining to the chemistry or BTU content of produced Fayetteville Shale gas.

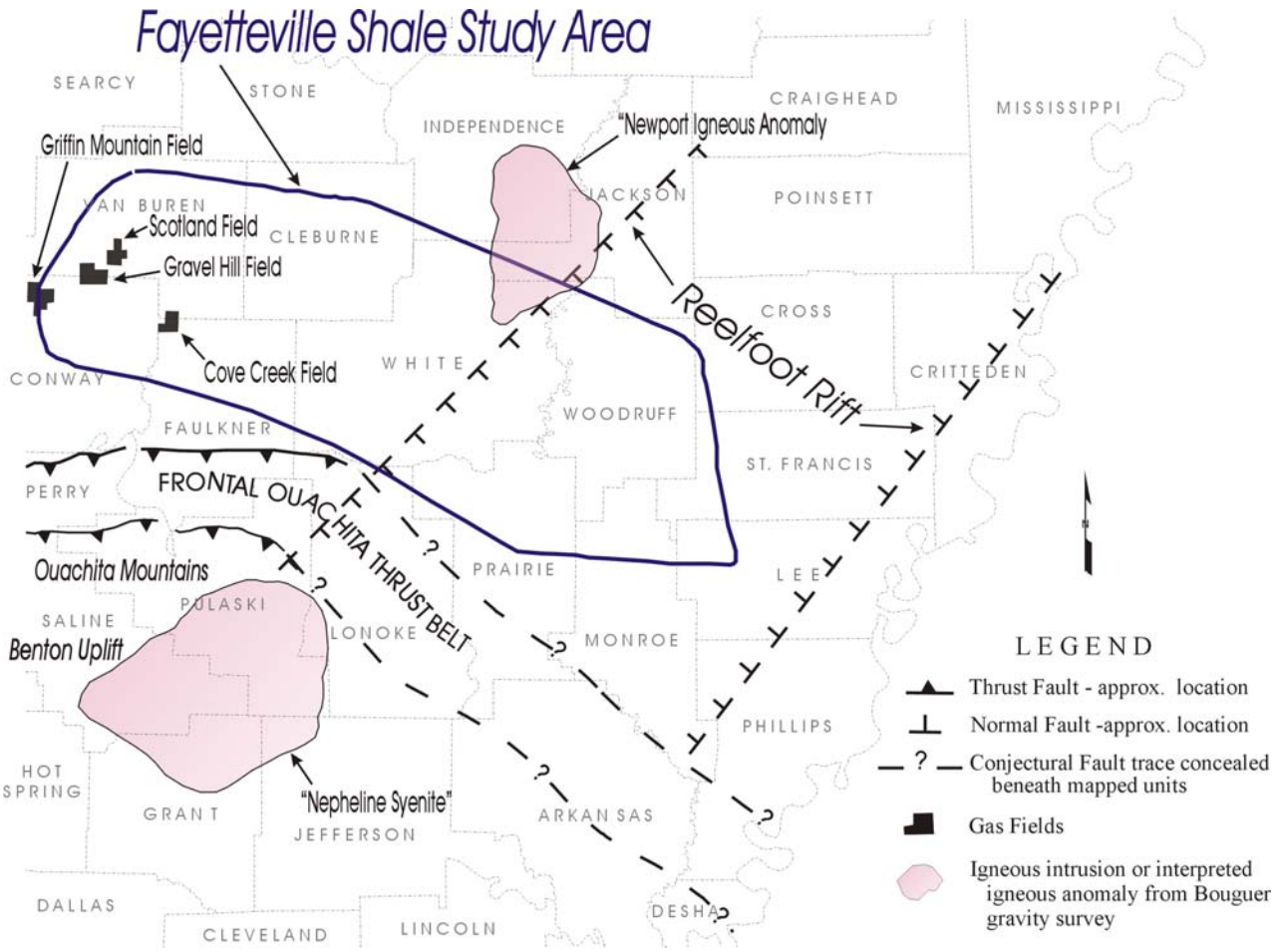

Figure 1. Location map for Fayetteville Shale Study Area with a simplified illustration of major structural features. Modified from Hendricks, J.D., 1988.

Methods of Investigation

The Arkansas Geological Commission is the curator for the Norman F. Williams Well Sample Library in Little Rock, Arkansas and maintains a permanent record of well cuttings and core that have been collected or donated from wells drilled in Arkansas. Samples used in this study were prepared from well cuttings at the Norman F. Williams facility. All of the samples from the project were submitted to Humble Geochemical Services of Humble, Texas for Total Organic Carbon and Rock-Eval analysis. Vitrinite reflectance analysis of the samples was conducted by Dan Pearson of Humble Geochemical Services and Charlie Landis of Minerals End Inc., located in The Wood lands, Texas.

Most of the samples collected and processed in this study are dominated by shale lithology. Subordinate amounts of sandstone and limestone were entrained within the shale dominated well cuttings and are also concentrated near formation and lithologic boundaries. The highly organic rich facies within the Fayetteville Shale is typically present in varying degrees of thickness from the middle part of the formation to the base. This organic rich zone is the stratigraphic interval where natural gas is currently produced from wells in the eastern Arkoma Basin of Arkansas and consequently every effort was made in this project to sample through this interval. The Late Devonian to Early Mississippian (?) Chattanooga Shale was also identified on some geophysical well logs and is considerably thinner than the Fayetteville Shale throughout most of the study area. Chattanooga Shale cuttings were

selectively sampled from some of the wells, but there is considerably less geochemical data and control points compared to the Fayetteville Shale data set. Due to publication time constraints for this project, no geochemical models were developed to illustrate the geochemical character of the Chattanooga Shale. The Chattanooga Shale should be considered a secondary and deeper shale gas exploration target due to its high organic character and relatively close stratigraphic position to the Fayetteville Shale. Outcrop and subsurface samples of the Chattanooga Shale have been examined by Carr (1987) in western Arkansas and were shown to have a mean total organic carbon content of 3.2 wt % and at depths of less than 350 ft it has vitrinite reflectance values of Ro= 0.7%. The Early to Middle Mississippian Boone Formation is in a stratigraphic position between the Fayetteville Shale and the Chattanooga Shale and consists predominately of limestone and chert. The Boone Formation has the potential to be a conventional gas reservoir and also should also be evaluated during shale gas exploration programs in this region.

Most of the samples that were collected and processed for geochemistry in the study are composite samples that represent a collective 30-200 foot measured depth interval of well cuttings. Every attempt was made to provide the best composite sample for the analysis by compositing sample material over the smallest measured depth interval that was feasible. Most samples that were utilized for the study are represented as 50 foot composite samples. Some inherent problems that were encountered during the composite sampling for this study include: (1) missing sample material through some of the zones in the well sample inventory (2) insufficient sample material through certain intervals resulted in either no sample collected, or composite samples that were collected over a larger depth range in order to obtain enough material for laboratory processing (3) insufficient well log information from some of the wells in the study resulting in a decision to composite samples through broad stratigraphic shale sequences where formation boundaries were questionable or unknown. Composite samples with questionable stratigraphic constraints may have incomplete sample representation through the entire Fayetteville Shale sequence. Despite these inherent sampling problems, most wells in the study have an ample sample representation for the Fayetteville Shale sequence that was identified from geophysical well logs.

Geochemical Modeling of Total Organic Carbon Data

Shale-rich well samples were collected for the organic geochemistry portion of the study and were analyzed by Humble Geochemical Services using Rock-Eval and Leco Total Organic Carbon (TOC) analytical techniques. A floating raster model of the Fayetteville Shale Formation was developed at the Arkansas Geological Commission with ESRI® computer software. Microsoft Excel® spreadsheets were loaded with the raw TOC values obtained from the selected wells in the study area and the data was plotted within the Fayetteville Shale raster model. The stratigraphic top of the formation, the top of the pay zone, the bottom of the pay zone, and the bottom of the formation were all delineated within the Fayetteville Shale by well log analysis. TOC values that fall within each of the first three zones listed above were interpolated from well to well using nearest neighbor statistical methods. The interpolated TOC data can be rapidly evaluated by examining a series of geochemical model maps that are located on this disk as pdf map files and are shown in the Table of Contents as Plates 4-13 for the reader's convenience. Maps derived from the TOC model, represent 50 foot vertical slices through the raster model and all of the TOC values that fall within the range of each slice are statistically interpolated between well locations. Some wells had to be eliminated from the TOC model maps due to insufficient data through a given slice that was selected for examination. Even fewer wells had to be eliminated from the TOC model maps due to excessive skewing of the interpolated values between well bores that are spaced over large distances. The Fayetteville Shale pay zone that is identified from well logs and used for modeling TOC data should not be thought of as a discrete lithologic horizon, rather it is an interpreted zone that contains hydrocarbons and thus it can be present at different stratigraphic horizons that generally coincide with the middle to lower portions of the Fayetteville sequence.

Geochemical Modeling of Vitrinite Reflectance Data

Well samples that were collected for the thermal maturation portion of the study were analyzed by standard isolated kerogen or whole rock vitrinite reflectance procedures utilizing reflected light microscopy. Shale-rich samples were collected over a vertical range that exceeded 7,000 ft in some of the wells. Many of the samples that were analyzed were collected above, through, and below the Fayetteville Shale sequence. Indigenous vitrinite values are assigned to specific measured depth intervals for each well bore and were examined with the assistance of ESRI® computer software. The vitrinite reflectance data are statistically interpolated and contoured between wells for a given subsurface slice throughout the study area. The interpolated vitrinite reflectance data can be interpreted

by examining a series of thermal maturity model maps which are located on this disk as pdf map files and are shown in the Table of Contents as Plates 14-22 for the reader's convenience. Some wells had to be eliminated from the model maps due to insufficient data through a given slice that was selected for examination. Even fewer wells had to be eliminated from the thermal maturity maps due to excessive skewing of the interpolated values between well bores that are spaced over large distances. The vitrinite reflectance models are a powerful tool which allows the reader to quickly evaluate the thermal maturity profile of the eastern Arkoma Basin and Mississippi Embayment regions.

Two Component Modeling of Total Organic Carbon and Vitrinite Reflectance Data

A two component geochemical model was developed to examine the relationship between TOC values and vitrinite reflectance values through the interpreted pay zone of the Fayetteville Shale and is listed as Plate 23 in the Table of Contents. Averaged and interpolated vitrinite reflectance data within the Fayetteville pay zone are superimposed on averaged TOC values through the same interval to create a two component geochemical model. The averaged TOC and vitrinite values for the Fayetteville Shale pay zone are not statistically weighted with respect to pay zone thickness. The two component model and map permits the examination of both types of data simultaneously by utilization of color shading for TOC concentration and contours specific for each of the two data sets. An interpretive discussion of the two component model is given under the section titled "Conclusions, Observations and Interpretations" based on an examination of thermal maturation values and minimum threshold values of total organic carbon.

Geochemical Modeling of the Gross Pay Zone in the Fayetteville Shale

The stratigraphic top and bottom of the Fayetteville pay zone were determined from well log analysis throughout the study area. A "gross pay zone thickness" was modeled and is defined as the intervening zone between the uppermost and lowermost stratigraphic interval that contains hydrocarbon potential. The gross pay zone generally coincides with the middle to lower portions of the Fayetteville Shale Formation. Both productive and non-productive beds are included in the gross pay zone and commercial gas wells from the Griffin Mountain, Gravel Hill, Scotland, and Cove Creek Fields have selectively perforated shale beds that exhibit a high gamma ray and high resistivity response defined on well logs. The model is created by assigning a gross pay zone thickness for each well that had suitable well log information for the interpretation. Gross pay thicknesses were statistically interpolated between wells and the information is color shaded and contoured. This presentation on the map, shown as Plate 3 in the Table of Contents, allows the reader to evaluate the stratigraphic thicknesses of the gross pay zone over a large regional area and will possibly facilitate economic considerations for determining drill sites for Fayetteville Shale exploration wells.

Structure Contour Map of the Top of the Fayetteville Shale Formation

A structure contour map for the top of the Fayetteville Shale was constructed for the study area and it is designated as Plate 2 in the Table of Contents. Stratigraphic interpretation for the top of the formation was accomplished by conventional well log analysis. Most of the subsurface control points that are used to develop the map are associated with the same wells that were selected for the geochemical and thermal maturation studies in this project. Four additional control points were derived by interpreting well logs from the Griffin Mountain, Gravel Hill, Scotland, and Cove Creek gas fields. The names of the four Fayetteville Shale gas wells that were used as control points on the map are listed as follows: Thomas No. 1-9, Koone No. 1-34, Hankins No. 1-4, and the Harrison R No. 1-11. Two additional control points were also derived from the Hubach No. 1 and City of Searcy No. 1 wells to help facilitate the contouring of the data in areas that had sparse well control.

Log Character

Subsurface lateral facies within the Fayetteville Shale are poorly known given the fact that the Fayetteville Shale gas play is still in the early stages of development and most of the detailed stratigraphic and reservoir analysis work is held as proprietary information by a few companies. However, a limited program of facies analysis and

recognition can be accomplished by conducting well log analysis beginning in the four Fayetteville Shale gas field areas and correlating these well log signatures to other wells throughout the eastern Arkoma Basin and Mississippi Embayment regions.

The middle to lower Fayetteville Shale sequence has produced commercial quantities of gas and is characterized by very high radioactivity and high resistivity log signatures, which differentiate it easily from the overlying upper Fayetteville Shale and from the underlying Batesville Formation (Sandstone), Moorefield Formation (Shale) and Boone Formation (Limestone/Chert). Gamma Ray values up to 300 API units and resistivities of 35- 800 ohm-meters are common in the Fayetteville pay zone. The highest gamma ray signatures are associated with organic-rich facies and shale lithologies.

The upper Fayetteville Formation consists predominately of black and medium gray shale that forms a consistent shale base line curve on a Gamma Ray log. Gamma Ray values typically fall within a range of 75 to 120 API units through this upper sequence. A low resistivity response is also characteristic of the upper Fayetteville and resistivities less than 15 ohm-meters are common.

The Pitkin Limestone Formation conformably overlies the Fayetteville Shale along the Ozark uplift, but its geophysical signature is noticeably absent on well logs that were examined in the eastern Arkoma Basin and Mississippi Embayment regions. Consequently, selecting the top of the Fayetteville Formation from well log responses can be a challenging proposition due to a shale-on-shale stratigraphic contact between Morrowan age shales of the Hale Formation and Chesterian age shales of the upper Fayetteville Formation. However, a consistent well log response is apparent across this stratigraphic contact and this is easily discernable on most well logs if they have a Gamma Ray, Resistivity, and Conductivity presentation. The well log response that corresponds to the transition from basal Hale Formation lithologies to upper Fayetteville Formation lithologies is based on a subtle, but distinct, positive base line shift of the Gamma Ray curve, and a rather sharp and significant decrease in Resistivity with a significant increase in Conductivity. A characteristic well log signature of the Fayetteville Shale Formation is shown for illustration in Figure 2 based on the Thomas No. 1-9 discovery well located in the Griffin Mountain gas field.

Thomas No. 1-9
S9, T9N, R17W

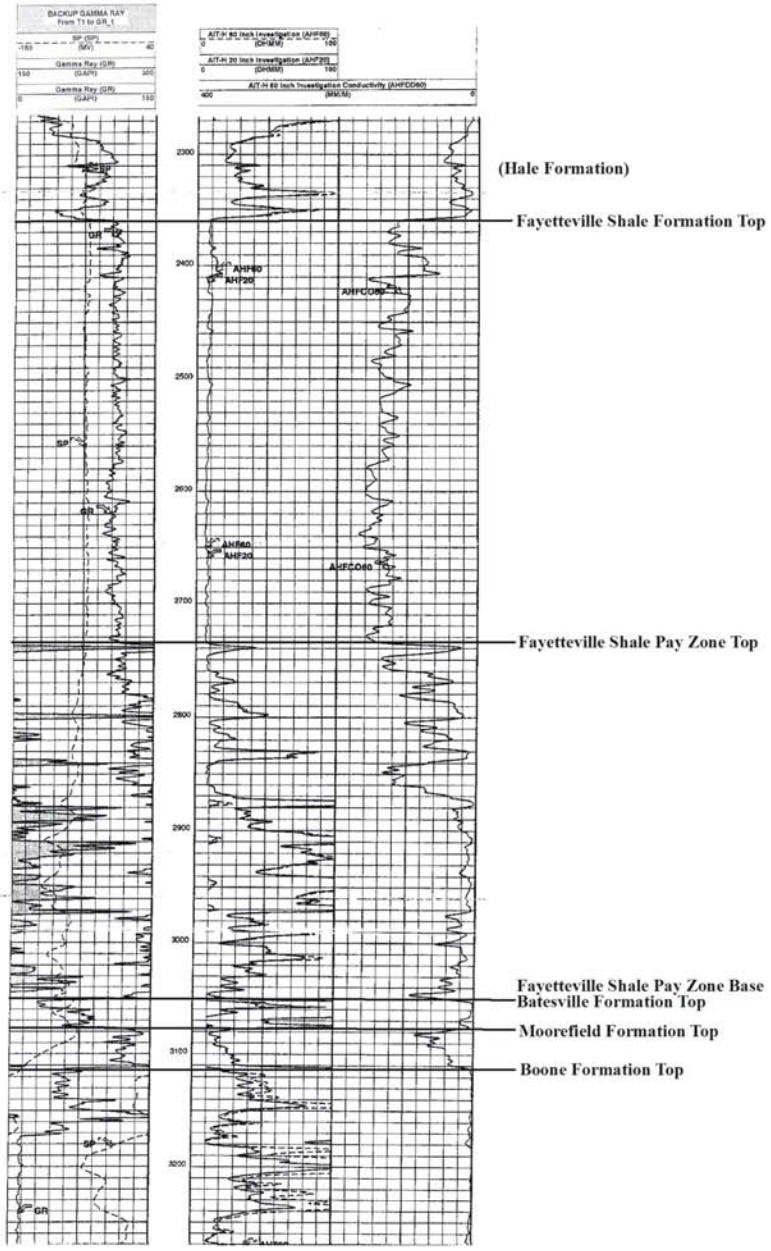

Figure 2. Typical well log response in the Fayetteville Shale, Thomas No. 1 -9 Discovery Well is located in the Griffin Mountain gas field.

Observations, Interpretations, and Conclusions

Thermal Maturity Assessment

A statistical mean value of Ro = 2.84 was calculated for the Fayetteville Shale pay zone by analyzing the average Ro values for each well in that interval. Seventy-six percent of the Ro values fall within one standard deviation of the statistical mean and the range of values through this interval is 2.09 to 3.60.

The classical assessment of oil, wet gas, and dry gas windows can be correlated to vitrinite reflectance values of 0.55 – 1.10%, 1.10-1.4%, and > 1.4% respectively (Montgomery, S.L. et al, 2005). The vitrinite reflectance data collected in this study falls within a range of 1.93 to 5.09 corresponding to the dry gas window. It must be emphasized that the vitrinite data shown on the series of vitrinite model maps (Plates 14-22) does not reflect values that represent present day depths of burial. For example, high thermal maturities of > Ro 2.0 were encountered at relatively shallow depths of approximately 1,000 feet which is in sharp contrast with the normal geothermal gradients associated with undeformed sedimentary basins. Elevated thermal maturity data at shallow depths can be explained in some geologic settings by uplift and subsequent erosion of a thick sedimentary sequence. However, there is insufficient geologic evidence in the sedimentary record of Arkansas to imply that the elevated thermal maturity values documented in this study are a result of burial catagenesis alone. A much more plausible explanation for the abnormally high thermal maturities observed throughout the study area can be explained by the following two orogenic processes. The first explanation involves a northward migrating front of heated orogenic fluids that were displaced from the advancing Ouachita orogenic belt located south of the eastern Arkoma Basin. The heated orogenic fluids would likely be expelled during the folding and thrusting associated with the Late Paleozoic Ouachita Orogeny and could have migrated along faults, fractures, and permeable stratigraphic horizons into the eastern Arkoma Basin. This interpretation is supported by a systematic increase in vitrinite reflectance values toward the Frontal Ouachita Thrust Belt in the southeastern portion of the Arkoma Basin (Plates 14-23) and (Figure 1). The Barnett Shale shows a similar trend of increasing thermal maturity associated with high vitrinite reflectance values proximal to the Ouachita Fold and Thrust Belt in the Fort Worth Basin of Texas (Pollastro et al., 2004).

The second explanation for the high thermal maturities observed in the eastern portion of the study area are attributable to continental rifting in the Reelfoot Rift and Mississippi Embayment regions that culminated in the Mesozoic Era. This rifting resulted in abnormally high geothermal gradients with synkinematic emplacement of small to large intrusive bodies which are shown on U.S. Geological Survey Bouguer Gravity Maps (Hendricks, J.D., 1988). Many of the plutonic bodies that have been identified in the Mississippi Embayment and Gulf Coastal Plain areas to the south are silica deficient and intermediate in composition and would likely expel CO_2 gas into the invaded sedimentary sequence as shown by the geochemical work of Barnes (1979). A large nepheline syenite stock with a maximum diameter of approximately 40 miles is located along the western boundary of the Mississippi Embayment and encompasses portions of Pulaski, Saline, Grant, Jefferson, and Lonoke Counties. A series of buried plutonic bodies are also identified by geophysical surveys to the north of this stock and along the western boundary of the Mississippi Embayment and Reelfoot Rift (Hendricks, J.D., 1988). The Newport Igneous Anomaly extends on both sides of the Reelfoot Rift and encompasses portions of Independence, White, Woodruff, and Jackson Counties (Hendricks, J.D., 1988). Dow (1977), maintains that “a useful rule of thumb is that contact metamorphic affects the thermal maturity of the intruded rocks to a maximum extent of about twice the thickness of the intrusive body, often slightly more above than below”. This suggests that the igneous intrusions cited above could have a significant affect on altering the thermal maturity of the intruded sedimentary sequence at an unknown distance from the sedimentary/igneous contact.

The cumulative effects of both magmatic and orogenic fluids on the reservoir qualities and catagenesis of organic rich constituents within the Mississippi Embayment and eastern Arkoma Basin are unknown. The southeastern portion of the study area has consistent vitrinite reflectance values above Ro = 4.0 which is most likely a cumulative affect of a high geothermal gradient due to crustal extension within the Reelfoot Rift, close proximity to the buried Frontal Ouachita Thrust Belt, and perhaps migration of magmatic fluids or heated meteoric waters associated with proximal intrusives. The high thermal maturities in excess of Ro = 4.0 along the southwestern portion of the study area is most likely due to expelled orogenic fluids from the Ouachita Mountains and perhaps an overlapping thermal imprint from the close spatial association with the Reelfoot Rift as suggested by Houseknecht et al (1985).

The Hazen No. 28-1 well located in Prairie County Section 28, T3N, R5W requires a specific discussion and more thorough analysis. This is the only well in the study that has an inverted thermal maturity profile over a measured depth range from 3000 to 9,300 ft. Vitrinite reflectance values decrease with depth in a uniform fashion from Ro = 5.09 measured at 3,000-3050 ft to Ro = 3.78 measured at 9200-9300 ft. The authors initially suspected that the samples were inadvertently reversed in the laboratory and this would easily explain the inverted thermal maturity profile. We collected a second set of samples for vitrinite reflectance analysis at the 3230-3280 interval and at the 9100-9200 interval. The second set of samples was sent to a different laboratory for vitrinite analysis and the results from the re-sampled intervals also documented the inverted thermal maturity profile. These analytical relations are difficult to explain from a geological context, but two possible scenarios are presented. One possibility is that the Hazen well was drilled into a large recumbent fold or nappe structure, whereby deeper seated and more thermally mature rocks were overturned and placed over less mature rocks. The Hazen well is located proximal to the conjectural subsurface trace of the Frontal Ouachita Thrust Belt in the Mississippi Embayment region as shown in Figure 1. If large thrust sheets exist in the subsurface vicinity of the Hazen well, then this could possibly account for a large overturned fold structure. Still another possible geologic scenario to explain the inverted thermal maturity profile is focused hydrothermal fluid flow, whereby hot hydrothermal fluids have selectively traveled through an upper package of sedimentary rocks and thermally altered a sedimentary sequence from the top down. Further analysis of this inverted thermal maturity profile is beyond the scope of this study and additional data in the form of drilling, seismic reflection, fluid inclusion analysis, or basin modeling will perhaps yield a plausible explanation for these relations.

Organic Geochemistry

A statistical mean concentration of 2.03 wt. % TOC was calculated for the Fayetteville Shale pay zone by analyzing the average TOC values for each well in that interval. Sixty-six percent of the TOC values fall within one standard deviation of the statistical mean and the range of values through this interval is 1.28 to 2.78 wt. % .

Organic content appears to correspond with lithology, being the highest in black, carbonaceous, and pyritic shales that are concentrated in the middle to lower portions of the Fayetteville Shale sequence. This organic-rich facies also contains subordinate amounts of interbedded, siliceous chert, and siltstone. Rock-Eval and TOC analysis of organic richness in the Fayetteville Shale indicates that almost all of the samples have present day values that plot within the Dry Gas-Prone and Type IV Gas Prone windows. Of course, this is reduced from original values (likely TYPE II or mixed Type II/III Kerogen) by high thermal maturities as seen by the measured vitrinite reflectance values and the low remaining generation potentials particularly when compared to Fayetteville Shale outcrop measurements. Fifteen outcrop samples from two locations in Independence County have an average TOC value of 5.27% with hydrogen indices averaging 157 mg HC/g TOC and are about 50% converted based on middle oil window thermal maturities (unpublished data).Calculated vitrinite reflectance and Tmax (thermal maturity) data from the Rock-Eval reports do not represent the true (absolute) temperature and are used by geochemists as a chemical approximation for thermal maturity (Jarvie, 2003). The extent of conversion of organic matter is a true indication of kerogen conversion to hydrocarbons and is indicated by the change in original HI (Kerogen type) values to those of the present day (i.e., kerogen transformation ratio). However, the reader is encouraged to examine the measured vitrinite reflectance data that was analyzed by reflected light microscopy in order to obtain a conventional measurement and understanding of the thermal regime throughout the study area. Examination of the measured S2 values (present day remaining hydrocarbon generation potential) and HI values from the Rock-Eval analysis indicate that the Fayetteville Shale organic matter is highly converted in well samples collected from the eastern Arkoma Basin and Mississippi Embayment regions due to the high thermal regime associated with those areas. The previous statement does not imply that commercial quantities of natural gas can not be developed throughout the study area, it simply reflects the realization that the Fayetteville Shale gas play contains very mature source rocks and the natural gas produced from the wells will be restricted to dry gas. Comparative analysis of geochemical and thermal maturity data between the Fayetteville Shale values published in this report and the published geochemical values from the Barnett Shale (Montgomery et al., 2005; Montgomery, S.L., 2004) indicates that the Barnett Shale will likely contain more gas per given volume of reservoir due to a higher average TOC content and a higher original generation potential.

Two Component Model Interpretive Discussion

The two component map shows an overall progression of higher thermal maturity and decreasing organic richness along most of the southern margin of the study area that is west of the Mississippi Embayment. This area is proximal to the leading edge of the Frontal Ouachita Thrust Belt (Figure 1) which easily explains the higher thermal maturities and decreasing TOC values due to maturation of the organic constituents in the rock. The southeastern portion of the study area is characterized by high thermal maturities in excess of Ro = 4.0; however, the TOC values are still appreciable and range from 1.5 to > 3.0. The extremely high Ro values in the southeastern region do not appear to be consistent with the remaining generation potentials (Rock-Eval S2 and HI values) that remain in these rocks. No satisfactory explanation for these observations can be given unless the thermal maturity or the organic richness of the samples has been over estimated.

An attempt is made to identify the most prospective region for the entire study area for the retention of favorable reservoir properties based on a specified range of thermal maturation values and a minimum threshold value of total organic carbon. These parameters are used as a simplistic tool in an attempt to delineate the best region in the study area for the generation and preservation of methane gas based on the following range of selected and overlapping geochemical and thermal maturation parameters: (1) areas that have a TOC value of >1 wt. % (2) areas that have a vitrinite reflectance range from >Ro = 1.1% to a maximum value of Ro = 3.4%. Commercial gas wells will most likely be developed outside of these two limiting parameters and this approach should be considered simply as a starting point for the evaluation of lower risk and higher yield exploration targets within the Fayetteville Shale.

The >1 wt. % TOC parameter was selected based on published results and findings of Barnett Shale geochemistry and production data throughout the Fort Worth Basin of Texas (Montgomery, S.L., 2004 and Jarvie, D.M., 2003). Their research indicate that well cuttings should have a minimum of 1 wt. % TOC content in order to delineate suitable source rocks for the generation of shale gas (Jarvie, 2003). It should be noted that cuttings will tend to have lower TOC values even with efforts to high-grade due to dilution from organically-lean sediments. The minimum average vitrinite reflectance value determined from analysis of all the samples within the Fayetteville pay zone is Ro = 1.96 % and thus there are no lower threshold issues for assessing minimum thermal maturity parameters within the two component model.

The second parameter, thermal maturity based on vitrinite reflectance values, is an attempt to: (1) delineate areas in the Fayetteville Shale that have retained favorable permeability and porosity attributes in the reservoir and (2) delineate potential areas that are susceptible to the accumulation of unwanted CO_2 gas. High thermal maturity in some petroleum reservoirs can result in mineralogical changes that damage the inherent permeability and porosity. It has been suggested that the Barnett Shale and possibly other shale gas and conventional reservoirs may be altered at high thermal maturity due to mineralogical changes that exceed Ro = 2.1% (Jarvie, 2003). The formation of CO_2 is highly dependent on contact with hydrothermal fluids that could result in dissolution of carbonates into CO_2 and mineral salts (Dan Jarvie, personal communication). Jarvie's (2003) research indicates that unwanted CO_2 gas from carbonate decomposition is an increasing risk factor that is associated with thermal maturities that exceed Ro = 2.1% and CO_2 concentrations will generally be in the 2-3% range. However, other organic geochemists dismiss the significance that CO_2 gas has on assessing the economics of petroleum systems and they believe that CO_2 gas that is generated from the pyrolysis of carbonates takes much higher temperatures that are in excess of Ro = 2.1% (Wallace G. Dow, independent consultant, personal communication). Vitrinite reflectance data from this project suggests that all of the four existing Fayetteville Shale gas fields are producing commercial quantities of shale gas within an approximate thermal range of Ro = 2.2% to Ro = 2.6%. Dow (1977) makes the empirical observation that "although methane is thermally stable it is chemically reactive at high temperatures and commercial reserves are not known in rocks with maturities of greater than Ro = 3.2%." The preceding statement pertains to free gas in conventional reservoirs and does not address the question of adsorbed gas in unconventional reservoirs. Despite these observations, commercial quantities of natural gas above thermal maturities of Ro = 3.2 appear to be noticeably lacking in the literature. Consequently, a value of Ro = 3.2 may be a suitable approximation to define an upper thermal limit for evaluating the most prospective areas in the Fayetteville Shale study area for producing commercial quantities of gas.

By utilizing the two parameters discussed above, the reader can quickly ascertain from the two component map that the area west of the Mississippi Embayment may contain a larger prospective region to produce and retain commercial quantities of natural gas. As more information becomes available pertaining to the reservoir

characteristics within the Fayetteville Shale and the chemistry, concentration, and BTU content of produced gases becomes known, then more sophisticated techniques will be developed to ascertain prospective areas for development of commercial shale gas wells.

Fayetteville Shale Gas Play Limiting Factors

Higher maturity levels and increased drilling depths in the southernmost portions of the Eastern Arkoma Basin and Mississippi Embayment regions, proximal to the leading edge of the Frontal Ouachita Thrust Belt can negatively affect the economics in those areas. These areas are likely to have higher drilling costs, higher bottomhole temperatures, and stratigraphy that is both folded and faulted. Stratigraphic sequences that are highly folded and faulted will be more difficult to drill and test due to strong anisotropic properties within the strata along the thrust belt. A hypothetical scenario, whereby a folded Fayetteville Shale sequence is tested with horizontal directional drilling along the Frontal Ouachita Thrust Belt could prove technically challenging given the fact that the horizontal lateral could inadvertently cut up and down through the stratigraphic section. High resolution seismic data could help facilitate the location of folds and thrusts along this orogenic belt, but seismic data from these areas is often very expensive to acquire and considerable care must be taken to filter out unwanted seismic distortion due to the high angle of stratigraphic reflectors. The potential for reservoir destruction is also higher along the Frontal Ouachita Thrust Belt due to very high thermal maturities that may result in mineralogical changes that decrease permeability and porosity. Furthermore, there is the distinct possibility that CO_2 gas could be encountered along this belt which lowers the BTU content of natural gas. For these reason, the Frontal Ouachita Thrust Belt is considered to be an expensive and fairly high risk exploration proposition for testing commercial quantities of shale gas.

Exploration and production successes for commercial quantities of Fayetteville Shale gas will be partly based on the recognition of subsurface fractures and faults throughout the Arkoma Basin and Mississippi Embayment regions. Montgomery et al, (2005) noted that core studies and patterns of production in the Barnett Shale suggest that microfractures can adversely affect well performance in many cases because the apertures are filled with calcite and thus forms a barrier to fluid flow. He also noted that wells located on structural highs, including areas that are associated with karst-related collapse, where fracturing would be expected, commonly exhibit poorer production compared to wells where the Barnett Shale is flat-lying and undisturbed. A thick sequence of Boone Limestone underlies the Fayetteville Shale throughout most of Arkansas and therefore the potential for karst-related collapse and fracture development in the overlying Fayetteville Shale sequence is a plausible consideration. Barnett Shale wells located in close proximity to known faults commonly exhibit both reduced production levels and increased water production (Montgomery et al, 2005). Many of the considerations and observations discussed above for the Barnett Shale are likely to be equally important in the Fayetteville Shale.

Examination of published geological surface maps throughout the central and northern portions of the eastern Arkoma Basin of Arkansas delineates two normal fault sets, a pronounced northeast-trending fault system, and a less pronounced northwest-trending fault set (Haley et al, 1993). Recent geologic surface mapping along the Ozark uplift by Braden et al (2002a,b; 2003a,b; 2004a,b) provides an opportunity to examine geologic maps with Fayetteville Shale surface exposures, and they also document the northeast and northwest-trending normal fault sets that are discussed above. Similar normal fault relations can be documented in the subsurface by the examination of annotated structure contour maps that Southwestern Energy of Houston, Texas has filed with the Arkansas Oil & Gas Commission (AOGC) in the vicinity of the four Fayetteville Shale gas fields (AOGC 2004; 2005a; 2005b). The northeast-trending faults generally exhibit down-to-basin, normal stratigraphic offset with relative displacement toward the southeast. Alternatively, some of the northeast-trending faults dip steeply to the north with normal stratigraphic offset to the northwest, which results in the development of small graben structures in the Fayetteville Shale sequence. Northwest-trending normal faults with both northerly and southerly dips are also documented on the subsurface maps of Southwestern Energy and these structures locally produce small graben structures when the faults dip toward one another (AOGC 2004; 2005a; 2005b). Recognition of normal fault patterns in the subsurface will help facilitate the reduction of drilling and production risks in the Fayetteville Shale.

Subsurface fault analysis within the Mississippi Embayment region is more problematic, because there is a thin to thick cover 500-3,000 feet of Cretaceous through Quaternary unconsolidated sediments that rests unconformably on the Paleozoic sequences. This physiographical region is also spatially coincident with the Reelfoot Rift, which has a northeast-trending normal fault system along the easternmost boundary of the Arkoma Basin in Arkansas. Poor to sparse well control in the Mississippi Embayment further complicates the understanding

of the stratigraphic position of the Fayetteville Shale and the structural architecture in the subsurface. A few general observations can be made based on an examination of the Structure Contour Map (Plate 2) that was developed from this project. The structure contours along the eastern margin of the study area trend steeply to the southeast reflecting a structural high located in that vicinity. The exact orientation of this proposed structural high is unknown because there is insufficient well control in the area and the lead author does not have access to seismic data for analysis. This structural high is postulated to be a northerly-trending horst block based on the apparent deflection of structural contours to a southeast trend coupled with similar horst and graben type structures that have been identified between some of the Woodruff County wells. Lastly, horst and graben basement architecture would be expected in continental rift basins as seen for example throughout the Great Basin of Nevada. If the postulated horst is confirmed by drilling along the easternmost margin of the study area, then this may add a significant exploration risk based on similar geologic features and associated production problems that have been documented in the Barnett Shale (Montgomery, S.L., 2004).

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API	OPERATOR NAME	LEASE NAME	Well Name	WELL #	LATITUDE	LONGITUDE	MERIDIAN CODE	SEC	TWP	N/S	RNG	E/W	SPOT	COUNTY NAME	CURRENT STATUS	DRILLER TD	COMP DATE	KB ELEV	GROUND ELEV	REF ELEV	ELEV CODE
3045100020000	LONE STAR PROD COMP	E W MOORE ESTATE	E.W. Moore Estate	1	35.22057	-92.26748	5	22	7	N	12	W	C SE SW	FAULKNER	D&A	10500	19740425	313		313	KB
03023100090000	YATES PETROLEUM CORP	LANDRUM-QUITMAN	Landrum Quitman	1	35.42466	-92.21991	5	12	9	N	12	W	E2 W2 SE	CLEBURNE	D&A	7000	19920409	722	711	722	KB
03023100040000	TEXAS O&G CORP	LANDRUM	Landrum	1	35.38066	-92.18659	5	29	9	N	11	W	C SE	CLEBURNE	GAS	5537	19791120		725		
03023100020000	MCRAY C E & ASSOC	SMITH A C	A.C. Smith	1-2	35.62228	-91.92883	5	2	11	N	9	W	SE NW NW	CLEBURNE	D&A	2474	19780828		1052		
03023100030000	TEXAS O&G CORP	LILES	Liles	1	35.38927	-92.05629	5	27	9	N	10	W	SWNWNENW	CLEBURNE	D&A	7200	19781016	858	845	858	KB
03023100010000	MCRAY C E & ASSOC	HEARST	Hearst	1-23	35.57149	-92.13501	5	23	11	N	11	W	NENWNESW	CLEBURNE	D&A-G	5271	19761201		718		
03029000270000	CARTER OIL COMPANY	MORRILTON LBR CO	Morrilton Lumber	1	35.37822	-92.81255	5	33	9	N	17	W	NW SE SW	CONWAY	GAS	3500	19560515			616	DF
03029100010000	ARKLA EXPL CO	CS RAMSEY HEIRS	C.S. Ramsey Heirs	1	35.38361	-92.81093	5	33	9	N	17	W		CONWAY	D&A	6858	19690824	698	683	698	KB
03029300060000	ARKLA EXPL CO	DANCER	Dancer	1	35.33518	-92.59643	5	16	8	N	15	W	SESWSWNE	CONWAY	D&A	5344	19681216		600		
03029300050000	PHILLIPS PETRLM CO	BILLIOT-A	Billot-A	1	35.3474	-92.58176	5	10	8	N	15	W	NE NE SW	CONWAY	D&A	5370	19680613	702	686	702	KB
03029100030000	TEXAS PACIFIC OIL CO	GLENN WRIGHT	Glenn Wright	1	35.30759	-92.58304	5	27	8	N	15	W	N2 SE NW	CONWAY	D&A	6461	19740212	699	684	699	KB
03029100330000	CELERON O&G CO	KAUFMAN	Kaufman	1-2	35.2781	-92.77762	5	2	7	N	17	W	SE NE SW	CONWAY	D&A	5840	19840808	392	376	392	KB
03029100280000	TXO PROD CORP	ZUBER SOUTH	Zuber South	1	35.27662	-92.54859	5	1	7	N	15	W	SW SE NW	CONWAY	D&A	6539	19841027		517		
03037100030000	WOODARD ENERGY CO	LINES GLENDA J	Glenda J. Lines	1	35.27406	-91.02994	5	31	8	N	1	E	SW SW NE	CROSS	D&A	4238	19860612	232	219	232	KB
03023100060000	POGO PRODUCING CO	MCNEW	McNew	1-26	35.3892	-92.14291	5	26	9	N	11	W	NESENWNW	CLEBURNE	D&A-G	6200	19811020	778	766	778	KB
03145000070000	DEEP ROCK OIL CORP	SAMPLE	Sample	1	35.52235	-91.64958	5	4	10	N	6	W	C N2 SW	WHITE	D&A-OG	5073	19530209		535		
03147100090000	WOODARD ENERGY CO	CHILDRESS SALLIE F HEIRS	Childress Sallie	1	35.30235	-91.07435	5	23	8	N	1	W	NW NW SW	WOODRUFF	D&A	3315	19870102		224		
03147100070000	PENNZOIL PRODUCNG CO	MORRIS	Morris	1	35.31697	-91.08291	5	15	8	N	1	W	NWNWNWSE	WOODRUFF	D&A	4800	19821103		210		
03147100060000	PENNZOIL CO INC	RAYMOND	Raymond	1	35.2323	-91.04942	5	13	7	N	1	W	NWNWSWNE	WOODRUFF	D&A	6200	19820830		195		
03145100050000	TEXAS O&G CORP	ROCKA	Rocka	1	35.35776	-91.95881	5	4	8	N	9	W	C NE NE	WHITE	D&A	7400	19790922	646	630	646	KB
03145100040000	CSG EXPLORATION CO	PATTERSON	Patterson	1	35.33611	-92.02953	5	11	8	N	10	W	C NE SE	WHITE	D&A-G	6779	19760807	777	762	777	KB
03045100110000	SANTA FE ENERGY CORP	MCLUNG	McLung	1-33	35.20239	-92.38545	5	33	7	N	13	W	NE SW NE	FAULKNER	D&A	8700	19851205	483	466	483	KB
03145000240000	STEPHENS PRDCTN CO	ALBERT EST ETAL	Albert Estate	1	35.46446	-91.77392	5	29	10	N	7	W	SW	WHITE	D&A	4456	19580919			289	DF
03045100070000	TXO PROD CORP	LEVER	Lever	1	35.33021	-92.42571	5	18	8	N	13	W	NE NW SW	FAULKNER	D&A	5714	19850329		353		
03141100020000	POGO PRODUCING CO	COLLUMS	Collums	1-27	35.47022	-92.35655	5	27	10	N	13	W	NWNWSESE	VAN BUREN	D&A	4600	19810628	736	722	736	KB
03141000110000	PECOS EXPL CORP	HURLEY	Charles Hurley	1	35.56167	-92.43277	5	25	11	N	14	W	C NE SW	VAN BUREN	D&A	3513	19600924			738	DF
03141000100000	PHILLIPS PETRLM CO	COPELAND	Copeland	3	35.66118	-92.62835	5	19	12	N	15	W	SE NW SW	VAN BUREN	D&A	2200	19611208			1421	DF
03141000090000	PHILLIPS PETRLM CO	S I COPELAND	Copeland	1	35.6473	-92.58162	5	28	12	N	15	W	C SE SE	VAN BUREN	D&A	2545	19611027			1457	DF
03141000080000	PHILLIPS PETRLM CO	COPELAND	Copeland	2	35.69697	-92.53167	5	12	12	N	15	W	NE SW NE	VAN BUREN	D&A	1895	19611117			1189	DF
03147600160000	SUNRAY DX OIL CO	G L MORRIS	G.L. Morris	1	35.24705	-91.15137	5	12	7	N	2	W	SW SE NE	WOODRUFF	D&A	6020	19630904	208		208	KB
03145100020000	WYOMING OIL & GAS	BOBBY & LORETE REAPR	Bobby & Lorete Reaper	1	35.50212	-91.70978	5	14	10	N	7	W	NE NE SW	WHITE	D&A-O	6705	19720715		610		
03147100050000	SUNMARK EXPLORATION	NICHOLS TRUST	Nichols Trust	14-1	35.05381	-91.38426	5	14	5	N	4	W	E2W2SESE	WOODRUFF	D&A	13800	19820627	214	179	214	KB
03147600370000	MOBIL OIL CORP	ROY STURGIS	Roy Sturgis	1	35.37463	-91.35482	5	30	9	N	3	W	C SW SW	WOODRUFF	D&A	6002	19540916			217	ES
03145083580000	KILLIAM & MCMILLIAN	CARL	Carl	1	35.41719	-91.52509	5	10	9	N	5	W	C NE SW	WHITE	D&A	4772	19450101			448	ES
03145000120000	SUNRAY DX OIL CO	E WRIGHT	Edgar Wright	1	35.31777	-91.64933	5	16	8	N	6	W	NW NW SE	WHITE	D&A-G	5762	19621002		386		
03145100140000	YATES PETROLEUM CORP	MCRAE	McRae	1	35.10029	-91.93348	5	35	6	N	9	W	SE NW SE	WHITE	D&A	16500	19941130		300		
03123100010000	COCKRELL OIL CORP	CARTER JACK ET UX	Carter	1	34.99212	-91.00325	5	4	4	N	1	E		ST FRANCIS	D&A	14881	19711210		200		
03117100040000	RESERVE OIL INCORP	HAZEN	Hazen	28-1	34.85115	-91.54369	5	28	3	N	5	W	SW	PRAIRIE	D&A	16491	19780916		205		
03095000030000	PAN AMERICAN	HART	Hart	1	34.8195	-91.11371	5	4	2	N	1	W	NW	MONROE	D&A	6315	19631028			190	DF
03077000040000	PAN AMERICAN	BOSNICK OPER UN	Bosnick	1	34.80791	-90.94939	5	1	2	N	1	E		LEE	D&A	8715	19631017			215	DF
03077100010000	COCKRELL CORP	HARRY E BUNCH ETAL	Bunch	1	34.73729	-90.95166	5	36	2	N	1	E	NW NW SE	LEE	D&A	14855	19720526		190	214	DF
03045000050000	SHELL OIL CO	C STEWART	Stewart	1	35.1371	-92.46419	5	23	6	N	14	W	SE SE SW	FAULKNER	D&A	9383	19620807		326	344	DF
03147100030000	STACK, JACK E, JR.	CHB LAND CO.	Stack	1	34.968	-91.363	5	18	4	N	3	W	SW	WOODRUFF	D&A	7613					
03145600150000	LION OIL & REFINING	NALLEY	Nalley	1	35.27653889	-91.75205000	5	33	8	N	7	W	SE NE	WHITE	D&A	6397			425		
03145100100000	EXXON CORP	EMBERSON	Emberson	1	35.17554722	-91.93262222	5	2	6	N	9	W		WHITE	D&A	12354			590		

TOC and ROCK-EVAL DATA REPORT

Arkansas Geological Commission

HGS No.	API Number	Operator	Well Name	Well Number	Top Depth (ft.)	Bottom Depth (ft.)	Median Depth (ft.)	Sample Type	Leco TOC		S1	S2	S3	Tmax (°C)		Cal. %Ro	Meas. %Ro	HI	OI	S2/S3	S1/TOC	PI	Notes Checks	Notes Pyrogram
05-2934-114913	03045000050000	SHELL OIL CO	Stewart	1	3800	3850	3825	cuttings	1.30		0.05	0.11	0.47	462	*	1.16	3.20	8	36	0	4	0.31		n
05-2934-114914	03045000050000	SHELL OIL CO	Stewart	1	4300	4350	4325	cuttings	1.33		0.07	0.20	0.48	428	*	0.54	3.45	15	36	0	5	0.26		n
05-2934-114915	03045000050000	SHELL OIL CO	Stewart	1	4800	4850	4825	cuttings	1.08		0.05	0.18	0.41	432	*	0.62	3.72	17	38	0	5	0.22		n
05-2934-114916	03045000050000	SHELL OIL CO	Stewart	1	5300	5350	5325	cuttings	0.47		0.04	0.21	0.22	396	*	-1.00	3.79	44	46	1	8	0.16		n
05-2934-114917	03045000050000	SHELL OIL CO	Stewart	1	5800	5850	5825	cuttings	0.90		0.05	0.13	0.35	399	*	-1.00	4.10	15	39	0	6	0.28		n
05-2934-114918	03045000050000	SHELL OIL CO	Stewart	1	6300	6350	6325	cuttings	1.17		0.04	0.16	0.27	421	*	0.42	4.17	14	23	1	3	0.20		n
05-2934-114919	03045000050000	SHELL OIL CO	Stewart	1	6600	6650	6625	cuttings	0.55		0.04	0.12	0.17	400	*	-1.00		22	31	1	7	0.25		n
05-2934-114920	03045000050000	SHELL OIL CO	Stewart	1	6650	6700	6675	cuttings	0.79		0.04	0.09	0.22	373	*	-1.00		11	28	0	5	0.31		n
05-2934-114921	03045000050000	SHELL OIL CO	Stewart	1	6700	6750	6725	cuttings	0.69		0.03	0.16	0.19	496	*	1.77		23	28	1	4	0.16		n
05-2934-114922	03045000050000	SHELL OIL CO	Stewart	1	6750	6800	6775	cuttings	0.78		0.02	0.11	0.15	415	*	0.31		14	19	1	3	0.15		n
05-2934-114923	03045000050000	SHELL OIL CO	Stewart	1	6800	6850	6825	cuttings	0.77		0.05	0.13	0.20	345	*	-1.00	4.24	17	26	1	6	0.28		n
05-2934-114924	03045000050000	SHELL OIL CO	Stewart	1	6850	6900	6875	cuttings	0.79		0.07	0.24	0.21	385	*	-1.00		31	27	1	9	0.23		n
05-2934-114925	03045000050000	SHELL OIL CO	Stewart	1	6900	6950	6925	cuttings	0.71		0.03	0.17	0.13	454	*	1.01		24	18	1	4	0.15		n
05-2934-114926	03045000050000	SHELL OIL CO	Stewart	1	6950	7000	6975	cuttings	0.63		0.04	0.10	0.14	390	*	-1.00		16	22	1	6	0.29		n
05-2934-114927	03045000050000	SHELL OIL CO	Stewart	1	7000	7050	7025	cuttings	0.67		0.05	0.11	0.24	414	*	0.29		16	36	0	7	0.31		n
05-2934-114928	03045000050000	SHELL OIL CO	Stewart	1	7050	7100	7075	cuttings	0.69		0.03	0.10	0.19	319	*	-1.00		14	27	1	4	0.23		n
05-2934-114929	03045000050000	SHELL OIL CO	Stewart	1	7100	7150	7125	cuttings	0.92		0.04	0.10	0.22	350	*	-1.00		11	24	0	4	0.29		n
05-2934-114930	03045000050000	SHELL OIL CO	Stewart	1	7150	7200	7175	cuttings	0.88		0.06	0.15	0.29	409	*	0.20		17	33	1	7	0.29		n
05-2934-114931	03045000050000	SHELL OIL CO	Stewart	1	7200	7250	7225	cuttings	0.85		0.05	0.15	0.20	413	*	0.27		18	23	1	6	0.25		n
05-2934-114932	03045000050000	SHELL OIL CO	Stewart	1	7250	7300	7275	cuttings	0.68		0.04	0.15	0.14	455	*	1.03		22	21	1	6	0.21		n
05-2934-114933	03045000050000	SHELL OIL CO	Stewart	1	7300	7350	7325	cuttings	0.77		0.04	0.12	0.16	465	*	1.21	4.42	16	21	1	5	0.25		n
05-2934-114934	03045000050000	SHELL OIL CO	Stewart	1	7350	7400	7375	cuttings	0.64		0.03	0.10	0.18	396	*	-1.00		16	28	1	5	0.23		n
05-2934-114935	03045000050000	SHELL OIL CO	Stewart	1	7400	7450	7425	cuttings	0.68		0.04	0.22	0.16	452	*	0.98		33	24	1	6	0.15		n
05-2934-114936	03045000050000	SHELL OIL CO	Stewart	1	7450	7500	7475	cuttings	0.71		0.02	0.09	0.12	412	*	0.26		13	17	1	3	0.18		n
05-2934-114937	03045000050000	SHELL OIL CO	Stewart	1	7500	7550	7525	cuttings	0.71		0.03	0.14	0.14	484	*	1.55		20	20	1	4	0.18		n
05-2934-114938	03045000050000	SHELL OIL CO	Stewart	1	7550	7600	7575	cuttings	0.62		0.04	0.14	0.15	376	*	-1.00		23	24	1	6	0.22		n
05-2934-114939	03045000050000	SHELL OIL CO	Stewart	1	7600	7650	7625	cuttings	0.60		0.02	0.12	0.14	455	*	1.03		20	23	1	3	0.14		n
05-2934-114940	03045000050000	SHELL OIL CO	Stewart	1	7650	7700	7675	cuttings	0.60		0.03	0.11	0.09	443	*	0.81		18	15	1	5	0.21		n
05-2934-114941	03045000050000	SHELL OIL CO	Stewart	1	7700	7750	7725	cuttings	0.49		0.03	0.12	0.14	455	*	1.03		24	28	1	6	0.20		n
05-2934-114942	03045000050000	SHELL OIL CO	Stewart	1	7750	7800	7775	cuttings	0.67		0.06	0.22	0.19	462	*	1.16		33	28	1	9	0.21	lc	n
05-2934-114943	03045000050000	SHELL OIL CO	Stewart	1	7800	7850	7825	cuttings	0.63		0.06	0.37	0.14	386	*	-1.00	4.65	59	22	3	10	0.14		n
05-2934-114944	03045000050000	SHELL OIL CO	Stewart	1	7850	7900	7875	cuttings	0.61		0.04	0.19	0.09	493	*	1.71		31	15	2	7	0.17		n
05-2934-114945	03045000050000	SHELL OIL CO	Stewart	1	7900	8000	7950	cuttings	0.69		0.03	0.10	0.11	410	*	0.22		14	16	1	4	0.23		n
05-2934-114946	03045000050000	SHELL OIL CO	Stewart	1	8000	8100	8050	cuttings	0.65		0.04	0.17	0.11	454	*	1.01		26	17	2	6	0.19		n
05-2934-114947	03045000050000	SHELL OIL CO	Stewart	1	8100	8200	8150	cuttings	0.57		0.03	0.08	0.10	383	*	-1.00		14	17	1	5	0.27		n
05-2934-114948	03045000050000	SHELL OIL CO	Stewart	1	8200	8300	8250	cuttings	0.53		0.03	0.09	0.12	414	*	0.29		17	23	1	6	0.25		n
05-2934-114949	03045000050000	SHELL OIL CO	Stewart	1	8300	8400	8350	cuttings	0.59		0.03	0.11	0.14	413	*	0.27	4.67	19	24	1	5	0.21		n
05-2934-114950	03045000050000	SHELL OIL CO	Stewart	1	8400	8450	8425	cuttings	0.75		0.09	0.32	0.29	365	*	-1.00		43	39	1	12	0.22		n
05-2934-114951	03045000050000	SHELL OIL CO	Stewart	1	8450	8500	8475	cuttings	0.73		0.02	0.16	0.17	516	*	2.13		22	23	1	3	0.11		n
05-2934-114952	03045000050000	SHELL OIL CO	Stewart	1	8500	8550	8525	cuttings	0.72		0.04	0.12	0.28	421	*	0.42		17	39	0	6	0.25		n
05-2934-114953	03045000050000	SHELL OIL CO	Stewart	1	8550	8600	8575	cuttings	0.82		0.02	0.09	0.31	342	*	-1.00		11	38	0	2	0.18		n
05-2934-114954	03045000050000	SHELL OIL CO	Stewart	1	8600	8650	8625	cuttings	0.82		0.01	0.05	0.27	341	*	-1.00		6	33	0	1	0.17		n
05-2934-114955	03045000050000	SHELL OIL CO	Stewart	1	8650	8700	8675	cuttings	0.87		0.02	0.03	0.25	338	*	-1.00		3	29	0	2	0.40		n
05-2934-114956	03045000050000	SHELL OIL CO	Stewart	1	8700	8750	8725	cuttings	0.94		0.01	0.03	0.26	351	*	-1.00		3	28	0	1	0.25		n
05-2934-114957	03045000050000	SHELL OIL CO	Stewart	1	8750	8800	8775	cuttings	0.92		0.02	0.05	0.27	331	*	-1.00		5	29	0	2	0.29		n
05-2934-114958	03045000050000	SHELL OIL CO	Stewart	1	8800	8850	8825	cuttings	0.95		0.03	0.08	0.28	358	*	-1.00	4.71	8	29	0	3	0.27		n
05-2934-114959	03045000050000	SHELL OIL CO	Stewart	1	8850	8900	8875	cuttings	0.89		0.02	0.05	0.28	423	*	0.45		6	31	0	2	0.29		n
05-2934-114960	03045000050000	SHELL OIL CO	Stewart	1	8900	8950	8925	cuttings	0.81		0.02	0.05	0.19	377	*	-1.00		6	23	0	2	0.29		n
05-2934-114961	03045000050000	SHELL OIL CO	Stewart	1	8950	9000	8975	cuttings	0.85		0.02	0.08	0.20	452	*	0.98		9	24	0	2	0.20		n
05-2934-114962	03045000050000	SHELL OIL CO	Stewart	1	9000	9050	9025	cuttings	0.88		0.03	0.08	0.32	469	*	1.28		9	37	0	3	0.27		n
05-2934-114963	03045000050000	SHELL OIL CO	Stewart	1	9050	9100	9075	cuttings	0.92		0.02	0.07	0.25	377	*	-1.00		8	27	0	2	0.22		n
05-2934-114964	03045000050000	SHELL OIL CO	Stewart	1	9100	9150	9125	cuttings	0.90		0.05	0.14	0.29	377	*	-1.00		16	32	0	6	0.26		n
05-2934-114965	03045000050000	SHELL OIL CO	Stewart	1	9150	9200	9175	cuttings	0.96		0.03	0.08	0.23	422	*	0.44		8	24	0	3	0.27		n
05-2934-114966	03045000050000	SHELL OIL CO	Stewart	1	9200	9250	9225	cuttings	0.92		0.02	0.07	0.19	411	*	0.24		8	21	0	2	0.22		n
05-2934-114967	03045000050000	SHELL OIL CO	Stewart	1	9250	9300	9275	cuttings	0.85		0.02	0.05	0.24	361	*	-1.00		6	28	0	2	0.29		n
05-2934-114968	03045000050000	SHELL OIL CO	Stewart	1	9300	9350	9325	cuttings	0.80		0.02	0.05	0.26	345	*	-1.00	4.77	6	32	0	2	0.29		n
05-2934-114969	03045000050000	SHELL OIL CO	Stewart	1	9350	9380	9365	cuttings	0.89		0.03	0.06	0.34	324	*	-1.00		7	38	0	3	0.33	lc	n
05-2934-114970	03123100010000	OCKRELL OIL COF	Carter	1	2900	2950	2925	cuttings	0.98		0.08	0.24	0.31	419	*	0.38	3.05	25	32	1	8	0.25		n

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HGS No.	API Number	Operator	Well Name	Well Number	Top Depth (ft.)	Bottom Depth (ft.)	Median Depth (ft.)	Sample Type	Leco TOC	S1	S2	S3	Tmax (°C)		Cal. %Ro	Meas. %Ro	HI	OI	S2/S3	S1/TOC	PI	Notes Checks	Notes Pyrogram
05-2934-114971	03123100010000	OCKRELL OIL COF	Carter	1	3350	3400	3375	cuttings	1.23	0.17	0.36	0.31	453	*	0.99		29	25	1	14	0.32		n
05-2934-114972	03123100010000	OCKRELL OIL COF	Carter	1	3400	3450	3425	cuttings	2.52	0.58	0.19	0.31	338	*	-1.00	3.62	8	12	1	23	0.75		n
05-2934-114973	03123100010000	OCKRELL OIL COF	Carter	1	3450	3500	3475	cuttings	2.45	0.52	0.11	0.22	344	*	-1.00		4	9	1	21	0.83		n
05-2934-114974	03123100010000	OCKRELL OIL COF	Carter	1	3900	4000	3950	cuttings	0.85	0.41	0.32	0.22	342	*	-1.00	3.58	38	26	1	48	0.56		n
05-2934-114975	03123100010000	OCKRELL OIL COF	Carter	1	4000	4100	4050	cuttings	1.76	0.11	0.08	0.12	388	*	-1.00		5	7	1	6	0.58		n
05-2934-114976	03123100010000	OCKRELL OIL COF	Carter	1	4100	4200	4150	cuttings	0.61	0.09	0.00	0.07	-1	*	-1.00		0	11	0	15	1.00		n
05-2934-114977	03123100010000	OCKRELL OIL COF	Carter	1	4200	4300	4250	cuttings	0.30	0.04	0.06	0.10	-1	*	-1.00		20	34	1	14	0.40		n
05-2934-114978	03123100010000	OCKRELL OIL COF	Carter	1	4300	4400	4350	cuttings	1.98	0.38	0.32	0.15	340	*	-1.00		16	8	2	19	0.54		n
05-2934-114979	03123100010000	OCKRELL OIL COF	Carter	1	4400	4450	4425	cuttings	1.75	0.20	0.21	0.19	365	*	-1.00	3.67	12	11	1	11	0.49		n
05-2934-114980	03123100010000	OCKRELL OIL COF	Carter	1	4450	4500	4475	cuttings	1.89	0.37	0.26	0.13	343	*	-1.00		14	7	2	20	0.59		n
05-2934-114981	03123100010000	OCKRELL OIL COF	Carter	1	4500	4600	4550	cuttings	1.53	0.26	0.24	0.11	348	*	-1.00		16	7	2	17	0.52		n
05-2934-114982	03123100010000	OCKRELL OIL COF	Carter	1	4600	4700	4650	cuttings	1.51	0.38	0.32	0.19	409	*	0.20	3.60	21	13	2	25	0.54		n
05-2934-114983	03145100140000	ES PETROLEUM C	McRae	1	10000	10050	10025	cuttings	0.85	0.02	0.07	0.56	333	*	-1.00		8	66	0	2	0.22		n
05-2934-114984	03145100140000	ES PETROLEUM C	McRae	1	10050	10100	10075	cuttings	0.91	0.05	0.12	0.50	367	*	-1.00		13	55	0	6	0.29		n
05-2934-114985	03145100140000	ES PETROLEUM C	McRae	1	10100	10150	10125	cuttings	0.87	0.05	0.15	0.43	459	*	1.10		17	50	0	6	0.25		n
05-2934-114986	03145100140000	ES PETROLEUM C	McRae	1	10150	10200	10175	cuttings	0.81	0.05	0.10	0.38	418	*	0.36		12	47	0	6	0.33		n
05-2934-114987	03145100140000	ES PETROLEUM C	McRae	1	10200	10250	10225	cuttings	0.87	0.06	0.10	0.43	372	*	-1.00		11	49	0	7	0.37		n
05-2934-114988	03145100140000	ES PETROLEUM C	McRae	1	10250	10300	10275	cuttings	0.96	0.05	0.05	0.45	367	*	-1.00		5	47	0	5	0.50		n
05-2934-114989	03145100140000	ES PETROLEUM C	McRae	1	10300	10350	10325	cuttings	0.66	0.04	0.05	0.30	429	*	0.56		8	46	0	6	0.44		n
05-2934-114990	03145100140000	ES PETROLEUM C	McRae	1	10350	10400	10375	cuttings	0.82	0.06	0.16	0.50	384	*	-1.00		20	61	0	7	0.27		n
05-2934-114991	03145100140000	ES PETROLEUM C	McRae	1	10400	10450	10425	cuttings	0.86	0.06	0.16	0.47	409	*	0.20		19	55	0	7	0.27		n
05-2934-114992	03145100140000	ES PETROLEUM C	McRae	1	10450	10500	10475	cuttings	0.86	0.06	0.07	0.44	349	*	-1.00		8	51	0	7	0.46		n
05-2934-114993	03145100140000	ES PETROLEUM C	McRae	1	10500	10550	10525	cuttings	0.88	0.07	0.11	0.47	317	*	-1.00		12	53	0	8	0.39		n
05-2934-114994	03145100140000	ES PETROLEUM C	McRae	1	10550	10600	10575	cuttings	0.93	0.05	0.09	0.36	352	*	-1.00		10	39	0	5	0.36		n
05-2934-114995	03145100140000	ES PETROLEUM C	McRae	1	10600	10650	10625	cuttings	0.86	0.04	0.09	0.33	332	*	-1.00		10	38	0	5	0.31		n
05-2934-114996	03145100140000	ES PETROLEUM C	McRae	1	10650	10700	10675	cuttings	0.71	0.04	0.10	0.34	331	*	-1.00		14	48	0	6	0.29		n
05-2934-114997	03145100140000	ES PETROLEUM C	McRae	1	10700	10750	10725	cuttings	0.84	0.07	0.11	0.40	356	*	-1.00		13	48	0	8	0.39		n
05-2934-114998	03145100140000	ES PETROLEUM C	McRae	1	10750	10800	10775	cuttings	0.89	0.04	0.07	0.41	333	*	-1.00		8	46	0	4	0.36		n
05-2934-114999	03145100140000	ES PETROLEUM C	McRae	1	10800	10850	10825	cuttings	0.88	0.05	0.16	0.42	455	*	1.03		18	48	0	6	0.24		n
05-2934-115000	03145100140000	ES PETROLEUM C	McRae	1	10850	10900	10875	cuttings	0.88	0.06	0.14	0.45	395	*	-1.00		16	51	0	7	0.30		n
05-2934-115001	03145100140000	ES PETROLEUM C	McRae	1	10900	10950	10925	cuttings	1.01	0.06	0.12	0.57	346	*	-1.00		12	56	0	6	0.33		n
05-2934-115002	03145100140000	ES PETROLEUM C	McRae	1	10950	11000	10975	cuttings	1.25	0.07	0.15	0.55	350	*	-1.00		12	44	0	6	0.32	lc	n
05-2934-115003	03145000120000	UNRAY DX OIL C	Edgar Wright	1	3300	3350	3325	cuttings	1.03	0.05	0.24	0.35	490	*	1.66		23	34	1	5	0.17		n
05-2934-115004	03145000120000	UNRAY DX OIL C	Edgar Wright	1	3350	3400	3375	cuttings	1.00	0.05	0.18	0.43	461	*	1.14		18	43	0	5	0.22		n
05-2934-115005	03145000120000	UNRAY DX OIL C	Edgar Wright	1	3400	3450	3425	cuttings	1.07	0.06	0.20	0.48	457	*	1.07	2.47	19	45	0	6	0.23		n
05-2934-115006	03145000120000	UNRAY DX OIL C	Edgar Wright	1	3450	3500	3475	cuttings	1.04	0.05	0.23	0.65	464	*	1.19		22	62	0	5	0.18		n
05-2934-115007	03145000120000	UNRAY DX OIL C	Edgar Wright	1	3500	3550	3525	cuttings	1.20	0.06	0.23	0.49	458	*	1.08		19	41	0	5	0.21		n
05-2934-115008	03145000120000	UNRAY DX OIL C	Edgar Wright	1	3550	3600	3575	cuttings	1.26	0.07	0.23	0.40	462	*	1.16		18	32	1	6	0.23		n
05-2934-115009	03145000120000	UNRAY DX OIL C	Edgar Wright	1	3600	3650	3625	cuttings	1.61	0.08	0.25	0.47	509	*	2.00		16	29	1	5	0.24		n
05-2934-115010	03145000120000	UNRAY DX OIL C	Edgar Wright	1	3650	3700	3675	cuttings	1.15	0.06	0.22	0.60	435	*	0.67		19	52	0	5	0.21		n
05-2934-115011	03145000120000	UNRAY DX OIL C	Edgar Wright	1	3700	3750	3725	cuttings	1.12	0.05	0.17	0.47	461	*	1.14		15	42	0	4	0.23		n
05-2934-115012	03145000120000	UNRAY DX OIL C	Edgar Wright	1	3750	3800	3775	cuttings	1.15	0.04	0.19	0.45	459	*	1.10	2.51	17	39	0	3	0.17		n
05-2934-115013	03145000120000	UNRAY DX OIL C	Edgar Wright	1	3800	3850	3825	cuttings	1.29	0.06	0.19	0.44	460	*	1.12		15	34	0	5	0.24		n
05-2934-115014	03145000120000	UNRAY DX OIL C	Edgar Wright	1	3850	3900	3875	cuttings	1.13	0.05	0.17	0.41	460	*	1.12		15	36	0	4	0.23		n
05-2934-115015	03145000120000	UNRAY DX OIL C	Edgar Wright	1	3900	3950	3925	cuttings	1.40	0.05	0.24	0.41	510	*	2.02		17	29	1	4	0.17		n
05-2934-115016	03145000120000	UNRAY DX OIL C	Edgar Wright	1	3950	4000	3975	cuttings	1.32	0.05	0.22	0.36	506	*	1.95		17	27	1	4	0.19		n
05-2934-115017	03145000120000	UNRAY DX OIL C	Edgar Wright	1	4000	4050	4025	cuttings	1.29	0.04	0.17	0.38	504	*	1.91		13	29	0	3	0.19		n
05-2934-115018	03145000120000	UNRAY DX OIL C	Edgar Wright	1	4050	4100	4075	cuttings	1.04	0.04	0.17	0.38	460	*	1.12		16	37	0	4	0.19		n
05-2934-115019	03145000120000	UNRAY DX OIL C	Edgar Wright	1	4100	4150	4125	cuttings	1.10	0.04	0.20	0.34	475	*	1.39		18	31	1	4	0.17		n
05-2934-115020	03145000120000	UNRAY DX OIL C	Edgar Wright	1	4150	4200	4175	cuttings	1.15	0.05	0.17	0.49	458	*	1.08		15	43	0	4	0.23		n
05-2934-115021	03145000120000	UNRAY DX OIL C	Edgar Wright	1	4200	4250	4225	cuttings	1.21	0.04	0.16	0.47	458	*	1.08		13	39	0	3	0.20	c	n
05-2934-115022	03145000120000	UNRAY DX OIL C	Edgar Wright	1	4250	4300	4275	cuttings	1.55	0.04	0.16	0.56	458	*	1.08	2.57	10	36	0	3	0.20		n
05-2934-115023	03145000120000	UNRAY DX OIL C	Edgar Wright	1	4300	4350	4325	cuttings	1.06	0.05	0.19	0.30	466	*	1.23		18	28	1	5	0.21		n
05-2934-115024	03145000120000	UNRAY DX OIL C	Edgar Wright	1	4350	4400	4375	cuttings	1.11	0.04	0.16	0.44	459	*	1.10		14	40	0	4	0.20		n
05-2934-115025	03145000120000	UNRAY DX OIL C	Edgar Wright	1	4400	4450	4425	cuttings	1.24	0.04	0.14	0.31	464	*	1.19		11	25	0	3	0.22		n
05-2934-115026	03145000120000	UNRAY DX OIL C	Edgar Wright	1	4450	4500	4475	cuttings	1.06	0.04	0.13	0.29	456	*	1.05		12	27	0	4	0.24		n
05-2934-115027	03145000120000	UNRAY DX OIL C	Edgar Wright	1	4500	4550	4525	cuttings	1.60	0.09	0.26	0.39	463	*	1.17		16	24	1	6	0.26		n

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HGS No.	API Number	Operator	Well Name	Well Number	Top Depth (ft.)	Bottom Depth (ft.)	Median Depth (ft.)	Sample Type	Leco TOC		S1	S2	S3	Tmax (°C)		Cal. %Ro	Meas. %Ro	HI	OI	S2/S3	S1/TOC	PI	Notes Checks	Notes Pyrogram
05-2934-115028	03145000120000	UNRAY DX OIL C	Edgar Wright	1	4550	4600	4575	cuttings	1.32		0.08	0.20	0.34	459	*	1.10		15	26	1	6	0.29		n
05-2934-115029	03145000120000	UNRAY DX OIL C	Edgar Wright	1	4600	4650	4625	cuttings	2.70		0.37	0.57	0.54	364		-1.00	2.71	21	20	1	14	0.39		n
05-2934-115030	03145000120000	UNRAY DX OIL C	Edgar Wright	1	4650	4700	4675	cuttings	1.62		0.26	0.37	0.47	397	*	-1.00		23	29	1	16	0.41		n
05-2934-115031	03145000120000	UNRAY DX OIL C	Edgar Wright	1	4700	4750	4725	cuttings	1.36		0.15	0.29	0.44	400	*	-1.00		21	32	1	11	0.34		n
05-2934-115032	03145000120000	UNRAY DX OIL C	Edgar Wright	1	4750	4800	4775	cuttings	1.83		0.16	0.39	0.50	401	*	0.06		21	27	1	9	0.29		n
05-2934-115033	03145000120000	UNRAY DX OIL C	Edgar Wright	1	4800	4850	4825	cuttings	1.86		0.15	0.41	0.54	454	*	1.01	2.99	22	29	1	8	0.27		n
05-2934-115034	03145000120000	UNRAY DX OIL C	Edgar Wright	1	4850	4900	4875	cuttings	1.73		0.14	0.23	0.45	367	*	-1.00		13	26	1	8	0.38		n
05-2934-115035	03145083580000	LLIAM & MCMILLI	Carl	1	1400	1500	1450	cuttings	1.58		0.02	0.14	0.73	405	*	0.13		9	46	0	1	0.12		n
05-2934-115036	03145083580000	LLIAM & MCMILLI	Carl	1	1760	1860	1810	cuttings	1.91		0.04	0.38	1.01	551	*	2.76		20	53	0	2	0.10	c	n
05-2934-115037	03145083580000	LLIAM & MCMILLI	Carl	1	2200	2300	2250	cuttings	1.52		0.05	0.21	0.88	481	*	1.50		14	58	0	3	0.19	c	n
05-2934-115038	03145083580000	LLIAM & MCMILLI	Carl	1	2605	2695	2650	cuttings	2.05		0.02	0.14	0.78	412	*	0.26		7	38	0	1	0.12		n
05-2934-115039	03145083580000	LLIAM & MCMILLI	Carl	1	3100	3200	3150	cuttings	1.41		0.05	0.19	0.56	427	*	0.53		13	40	0	4	0.21		n
05-2934-115040	03147100050000	MARK EXPLORAT	Nichols Trust	14-1	6200	6250	6225	cuttings	1.70		1.82	3.08	0.62	407		0.17		181	36	5	107	0.37		n
05-2934-115041	03147100050000	MARK EXPLORAT	Nichols Trust	14-1	6500	6550	6525	cuttings	1.13		1.59	2.80	0.59	426		0.51	4.75	248	52	5	141	0.36		n
05-2934-115042	03147100050000	MARK EXPLORAT	Nichols Trust	14-1	6900	6950	6925	cuttings	1.36		0.94	2.08	0.66	416		0.33	4.77	153	49	3	69	0.31		n
05-2934-115043	03147100050000	MARK EXPLORAT	Nichols Trust	14-1	7100	7150	7125	cuttings	1.77		0.06	0.21	0.35	376	*	-1.00		12	20	1	3	0.22		n
05-2934-115044	03147100050000	MARK EXPLORAT	Nichols Trust	14-1	7150	7200	7175	cuttings	2.07		0.14	0.36	0.53	373	*	-1.00		17	26	1	7	0.28		n
05-2934-115045	03147100050000	MARK EXPLORAT	Nichols Trust	14-1	7200	7250	7225	cuttings	1.01		0.10	0.33	0.29	381	*	-1.00	4.77	33	29	1	10	0.23		n
05-2934-115046	03147100050000	MARK EXPLORAT	Nichols Trust	14-1	7250	7300	7275	cuttings	0.70		0.07	0.38	0.24	380	*	-1.00		54	34	2	10	0.16		n
05-2934-115047	03147100050000	MARK EXPLORAT	Nichols Trust	14-1	7300	7350	7325	cuttings	1.24		0.15	0.59	0.51	391		-1.00		48	41	1	12	0.20		n
05-2934-115048	03147100050000	MARK EXPLORAT	Nichols Trust	14-1	7350	7400	7375	cuttings	1.20		0.25	0.36	0.27	360	*	-1.00	4.70	30	23	1	21	0.41		n
05-2934-115049	03147100050000	MARK EXPLORAT	Nichols Trust	14-1	7400	7450	7425	cuttings	0.69		0.12	0.25	0.45	404	*	0.11		36	65	1	17	0.32		n
05-2934-115050	03147100050000	MARK EXPLORAT	Nichols Trust	14-1	7450	7500	7475	cuttings	2.18		0.52	0.98	0.40	351		-1.00		45	18	2	24	0.35		n
05-2934-115051	03147100050000	MARK EXPLORAT	Nichols Trust	14-1	7500	7540	7520	cuttings	3.95		0.98	1.50	0.67	403		0.09		38	17	2	25	0.40		n;ltS2p
05-2934-115052	03147100050000	MARK EXPLORAT	Nichols Trust	14-1	7800	7850	7825	cuttings	1.15		0.17	0.25	0.21	353	*	-1.00		22	18	1	15	0.40		n
05-2934-115053	03147100050000	MARK EXPLORAT	Nichols Trust	14-1	7850	7900	7875	cuttings	1.18		0.22	0.27	0.19	407	*	0.17	4.77	23	16	1	19	0.45		n
05-2934-115054	03147100050000	MARK EXPLORAT	Nichols Trust	14-1	7910	7950	7930	cuttings	1.05		0.20	0.21	0.20	352	*	-1.00		20	19	1	19	0.49		n
05-2934-115055	03147100050000	MARK EXPLORAT	Nichols Trust	14-1	7950	8000	7975	cuttings	0.98		0.21	0.21	0.20	373	*	-1.00		21	20	1	21	0.50		n
05-2934-115056	03147100050000	MARK EXPLORAT	Nichols Trust	14-1	8000	8050	8025	cuttings	1.01		0.10	0.18	0.15	358	*	-1.00	4.79	18	15	1	10	0.36		n
05-2934-115057	03147100050000	MARK EXPLORAT	Nichols Trust	14-1	8050	8100	8075	cuttings	0.90		0.18	0.21	0.75	416	*	0.33		23	83	0	20	0.46		n
05-2934-115375	03117100040000	SERVE OIL INCO	Hazen	28-1	3000	3050	3025	cuttings	0.64		0.12	0.35	0.47	406	*	0.15	5.09	55	73	1	19	0.26	c	n
05-2934-115376	03117100040000	SERVE OIL INCO	Hazen	28-1	3230	3280	3255	cuttings	0.60		0.12	0.25	0.48	359	*	-1.00	4.95	42	80	1	20	0.32		n
05-2934-115377	03117100040000	SERVE OIL INCO	Hazen	28-1	3650	3700	3675	cuttings	0.71		0.12	0.32	0.49	379	*	-1.00	4.97	45	69	1	17	0.27		n
05-2934-115378	03117100040000	SERVE OIL INCO	Hazen	28-1	4000	4050	4025	cuttings	0.72		0.14	0.40	0.50	389	*	-1.00	4.93	56	69	1	19	0.26		n
05-2934-115379	03117100040000	SERVE OIL INCO	Hazen	28-1	4600	4650	4625	cuttings	0.67		0.10	0.23	0.39	342	*	-1.00	4.93	34	58	1	15	0.30		n
05-2934-115380	03117100040000	SERVE OIL INCO	Hazen	28-1	5000	5050	5025	cuttings	0.75		0.08	0.24	0.31	495	*	1.75	4.95	32	41	1	11	0.25		n
05-2934-115381	03117100040000	SERVE OIL INCO	Hazen	28-1	5300	5350	5325	cuttings	0.73		0.07	0.27	0.31	400	*	-1.00	4.79	37	42	1	10	0.21		n
05-2934-115382	03117100040000	SERVE OIL INCO	Hazen	28-1	5900	5950	5925	cuttings	0.62		0.08	0.15	0.16	403	*	0.09	4.78	24	26	1	13	0.35		n
05-2934-115383	03117100040000	SERVE OIL INCO	Hazen	28-1	6300	6350	6325	cuttings	0.74		0.09	0.22	0.21	446	*	0.87	4.70	30	28	1	12	0.29		n
05-2934-115384	03117100040000	SERVE OIL INCO	Hazen	28-1	6800	6850	6825	cuttings	0.75		0.10	0.21	0.19	386	*	-1.00	4.56	28	25	1	13	0.32		n
05-2934-115385	03117100040000	SERVE OIL INCO	Hazen	28-1	8010	8060	8035	cuttings	0.91		0.14	0.25	0.25	377	*	-1.00	4.47	27	27	1	15	0.36		n
05-2934-115386	03117100040000	SERVE OIL INCO	Hazen	28-1	8200	8250	8225	cuttings	0.94		0.13	0.24	0.28	376	*	-1.00		26	30	1	14	0.35		n
05-2934-115387	03117100040000	SERVE OIL INCO	Hazen	28-1	8250	8300	8275	cuttings	0.98		0.12	0.18	0.24	380	*	-1.00		18	24	1	12	0.40		n
05-2934-115388	03117100040000	SERVE OIL INCO	Hazen	28-1	8300	8350	8325	cuttings	0.99		0.22	0.48	0.26	382	*	-1.00		48	26	2	22	0.31	c	n
05-2934-115389	03117100040000	SERVE OIL INCO	Hazen	28-1	8350	8400	8375	cuttings	1.08		0.13	0.37	0.29	390	*	-1.00		34	27	1	12	0.26		n
05-2934-115390	03117100040000	SERVE OIL INCO	Hazen	28-1	8400	8450	8425	cuttings	1.00		0.13	0.26	0.22	368	*	-1.00	4.23	26	22	1	13	0.33		n
05-2934-115391	03117100040000	SERVE OIL INCO	Hazen	28-1	8450	8500	8475	cuttings	1.03		0.17	0.38	0.22	378	*	-1.00		37	21	2	17	0.31		n
05-2934-115392	03117100040000	SERVE OIL INCO	Hazen	28-1	8500	8550	8525	cuttings	1.01		0.14	0.36	0.25	424	*	0.47		36	25	1	14	0.28		n
05-2934-115393	03117100040000	SERVE OIL INCO	Hazen	28-1	8550	8600	8575	cuttings	1.08		0.19	0.39	0.26	374	*	-1.00		36	24	2	18	0.33		n
05-2934-115394	03117100040000	SERVE OIL INCO	Hazen	28-1	8600	8650	8625	cuttings	1.05		0.15	0.44	0.34	419	*	0.38	4.31	42	32	1	14	0.25		n
05-2934-115395	03117100040000	SERVE OIL INCO	Hazen	28-1	8650	8700	8675	cuttings	1.04		0.18	0.43	0.26	373	*	-1.00		41	25	2	17	0.30		n
05-2934-115396	03117100040000	SERVE OIL INCO	Hazen	28-1	8700	8800	8750	cuttings	1.01		0.19	0.42	0.34	373	*	-1.00		42	34	1	19	0.31		n
05-2934-115397	03117100040000	SERVE OIL INCO	Hazen	28-1	8800	8900	8850	cuttings	1.09		0.20	0.46	0.33	386	*	-1.00	4.03	42	30	1	18	0.30		n
05-2934-115398	03117100040000	SERVE OIL INCO	Hazen	28-1	8900	9000	8950	cuttings	0.99		0.16	0.37	0.28	392	*	-1.00		37	28	1	16	0.30		n
05-2934-115399	03117100040000	SERVE OIL INCO	Hazen	28-1	9000	9100	9050	cuttings	1.15		0.16	0.39	0.26	395	*	-1.00		34	23	2	14	0.29		n
05-2934-115400	03117100040000	SERVE OIL INCO	Hazen	28-1	9100	9200	9150	cuttings	1.40		0.19	0.43	0.26	375	*	-1.00	4.02	31	19	2	14	0.31		n

Arkansas Geological Commission

HGS No.	API Number	Operator	Well Name	Well Number	Top Depth (ft.)	Bottom Depth (ft.)	Median Depth (ft.)	Sample Type	Leco TOC		S1	S2	S3	Tmax (°C)		Cal. %Ro	Meas. %Ro	HI	OI	S2/S3	S1/TOC	PI	Notes Checks	Notes Pyrogram
05-2934-115401	03117100040000	SERVE OIL INCO	Hazen	28-1	9200	9300	9250	cuttings	1.55		0.29	0.61	0.31	384		-1.00	3.78	39	20	2	19	0.32		n
05-2934-115402	03117100040000	SERVE OIL INCO	Hazen	28-1	9300	9400	9350	cuttings	1.27		0.19	0.36	0.23	373	*	-1.00		28	18	2	15	0.35		n
05-2934-115403	03117100040000	SERVE OIL INCO	Hazen	28-1	10580	10630	10605	cuttings	0.15		0.05	0.04	0.01	374	*	-1.00		27	7	4	33	0.56		n
05-2934-115404	03117100040000	SERVE OIL INCO	Hazen	28-1	10630	10680	10655	cuttings	0.16		0.08	0.10	0.05	414	*	0.29		63	31	2	50	0.44	c	n
05-2934-115058	03095000030000	PAN AMERICAN	Hart	1	4500	4530	4515	cuttings	1.07		0.03	0.06	0.22	359	*	-1.00		6	21	0	3	0.33	c	n
05-2934-115059	03095000030000	PAN AMERICAN	Hart	1	4700	4730	4715	cuttings	1.11		0.03	0.06	0.24	358	*	-1.00	4.64	5	22	0	3	0.33		n
05-2934-115060	03095000030000	PAN AMERICAN	Hart	1	4900	4930	4915	cuttings	1.22		0.03	0.06	0.18	383	*	-1.00		5	15	0	2	0.33		n
05-2934-115061	03095000030000	PAN AMERICAN	Hart	1	5100	5130	5115	cuttings	1.05		0.02	0.11	0.28	451	*	0.96	4.76	10	27	0	2	0.15		n
05-2934-115062	03095000030000	PAN AMERICAN	Hart	1	5300	5330	5315	cuttings	0.99		0.03	0.08	0.08	369	*	-1.00		8	8	1	3	0.27		n
05-2934-115063	03095000030000	PAN AMERICAN	Hart	1	5400	5430	5415	cuttings	0.96		0.03	0.09	0.00	451	*	0.96	4.73	9	0	-1	3	0.25		n
05-2934-115064	03095000030000	PAN AMERICAN	Hart	1	5430	5460	5445	cuttings	0.89		0.04	0.26	0.12	450	*	0.94		29	13	2	4	0.13		n
05-2934-115065	03095000030000	PAN AMERICAN	Hart	1	5460	5490	5475	cuttings	0.86		0.02	0.18	0.09	452	*	0.98	4.68	21	10	2	2	0.10		n
05-2934-115066	03095000030000	PAN AMERICAN	Hart	1	5490	5520	5505	cuttings	1.12		0.03	0.07	0.10	333	*	-1.00		6	9	1	3	0.30		n
05-2934-115067	03095000030000	PAN AMERICAN	Hart	1	5520	5550	5535	cuttings	1.40		0.04	0.06	0.22	390	*	-1.00		4	16	0	3	0.40		n
05-2934-115068	03095000030000	PAN AMERICAN	Hart	1	5550	5580	5565	cuttings	1.23		0.03	0.26	0.08	423	*	0.45		21	7	3	2	0.10		n
05-2934-115069	03095000030000	PAN AMERICAN	Hart	1	5580	5610	5595	cuttings	1.24		0.03	0.21	0.08	410	*	0.22		17	6	3	2	0.13		n
05-2934-115070	03095000030000	PAN AMERICAN	Hart	1	5610	5640	5625	cuttings	1.25		0.03	0.24	0.08	493	*	1.71		19	6	3	2	0.11		n
05-2934-115071	03095000030000	PAN AMERICAN	Hart	1	5640	5670	5655	cuttings	1.40		0.02	0.19	0.05	464	*	1.19		14	4	4	1	0.10		n
05-2934-115072	03095000030000	PAN AMERICAN	Hart	1	5670	5700	5685	cuttings	1.68		0.07	0.13	0.15	363	*	-1.00		8	9	1	4	0.35		n
05-2934-115073	03095000030000	PAN AMERICAN	Hart	1	5700	5730	5715	cuttings	1.73		0.09	0.12	0.11	354	*	-1.00		7	6	1	5	0.43		n
05-2934-115074	03095000030000	PAN AMERICAN	Hart	1	5730	5760	5745	cuttings	1.26		0.04	0.07	0.11	365	*	-1.00	4.77	6	9	1	3	0.36		n
05-2934-115075	03095000030000	PAN AMERICAN	Hart	1	5760	5790	5775	cuttings	1.17		0.04	0.06	0.08	359	*	-1.00		5	7	1	3	0.40		n
05-2934-115076	03095000030000	PAN AMERICAN	Hart	1	5790	5820	5805	cuttings	1.47		0.05	0.10	0.03	405	*	0.13		7	2	3	3	0.33		n
05-2934-115077	03095000030000	PAN AMERICAN	Hart	1	5820	5850	5835	cuttings	1.58		0.08	0.11	0.08	357	*	-1.00		7	5	1	5	0.42	c	n
05-2934-115078	03095000030000	PAN AMERICAN	Hart	1	5850	5880	5865	cuttings	1.49		0.08	0.13	0.18	362	*	-1.00		9	12	1	5	0.38		n
05-2934-115079	03095000030000	PAN AMERICAN	Hart	1	5880	5910	5895	cuttings	1.68		0.09	0.17	0.10	363	*	-1.00		10	6	2	5	0.35		n
05-2934-115080	03095000030000	PAN AMERICAN	Hart	1	5910	5940	5925	cuttings	1.11		0.05	0.10	0.08	360	*	-1.00		9	7	1	5	0.33		n
05-2934-115081	03095000030000	PAN AMERICAN	Hart	1	5940	5970	5955	cuttings	0.65		0.02	0.05	0.06	334	*	-1.00		8	9	1	3	0.29		n
05-2934-115082	03095000030000	PAN AMERICAN	Hart	1	5970	6000	5985	cuttings	0.46		0.02	0.04	0.14	421	*	0.42		9	30	0	4	0.33		n
05-2934-115083	03095000030000	PAN AMERICAN	Hart	1	6000	6030	6015	cuttings	0.88		0.01	0.04	0.08	307	*	-1.00		5	9	1	1	0.20		n
05-2934-115084	03095000030000	PAN AMERICAN	Hart	1	6030	6070	6050	cuttings	2.19		0.08	0.34	0.07	500	*	1.84		16	3	5	4	0.19		n
05-2934-115085	03095000030000	PAN AMERICAN	Hart	1	6050	6090	6070	cuttings	2.16		0.04	0.19	0.04	525	*	2.29		9	2	5	2	0.17		n
05-2934-115086	03095000030000	PAN AMERICAN	Hart	1	6090	6120	6105	cuttings	1.04		0.02	0.05	0.03	322	*	-1.00		5	3	2	2	0.29		n
05-2934-115087	03095000030000	PAN AMERICAN	Hart	1	6120	6150	6135	cuttings	2.52		0.05	0.16	0.03	368	*	-1.00	4.83	6	1	5	2	0.24		n
05-2934-115088	03095000030000	PAN AMERICAN	Hart	1	6150	6180	6165	cuttings	2.01		0.04	0.09	0.01	358	*	-1.00		4	0	9	2	0.31		n
05-2934-115089	03077000040000	PAN AMERICAN	Bosnick	1	3700	3750	3725	cuttings	2.21		0.23	0.50	0.15	355		-1.00	3.86	23	7	3	10	0.32		n
05-2934-115090	03077000040000	PAN AMERICAN	Bosnick	1	3750	3800	3775	cuttings	1.62		0.23	0.44	0.17	352	*	-1.00		27	10	3	14	0.34		n
05-2934-115091	03077000040000	PAN AMERICAN	Bosnick	1	3800	3850	3825	cuttings	1.28		0.07	0.36	0.13	389	*	-1.00		28	10	3	5	0.16		n
05-2934-115092	03077000040000	PAN AMERICAN	Bosnick	1	3850	3900	3875	cuttings	1.82		0.10	0.47	0.44	385	*	-1.00		26	24	1	5	0.18		n
05-2934-115093	03077000040000	PAN AMERICAN	Bosnick	1	3900	3950	3925	cuttings	1.15		0.10	0.34	0.17	427	*	0.53	4.10	30	15	2	9	0.23		n
05-2934-115094	03077000040000	PAN AMERICAN	Bosnick	1	3950	4000	3975	cuttings	2.25		0.26	0.38	0.29	352	*	-1.00		17	13	1	12	0.41		n
05-2934-115095	03077000040000	PAN AMERICAN	Bosnick	1	4000	4050	4025	cuttings	2.48		0.55	0.61	0.34	352		-1.00		25	14	2	22	0.47		n
05-2934-115096	03077000040000	PAN AMERICAN	Bosnick	1	4050	4100	4075	cuttings	1.76		0.25	0.43	0.24	355	*	-1.00	4.12	24	14	2	14	0.37		n
05-2934-115097	03077000040000	PAN AMERICAN	Bosnick	1	4100	4150	4125	cuttings	0.76		0.12	0.21	0.18	360	*	-1.00		28	24	1	16	0.36		n
05-2934-115098	03077000040000	PAN AMERICAN	Bosnick	1	4150	4200	4175	cuttings	0.38	**	0.18	0.30	0.18	360	*	-1.00		79	47	2	47	0.38		n
05-2934-115099	03077000040000	PAN AMERICAN	Bosnick	1	4200	4250	4225	cuttings	0.45		0.10	0.12	0.05	355	*	-1.00		27	11	2	22	0.45		n
05-2934-115100	03077000040000	PAN AMERICAN	Bosnick	1	4250	4290	4270	cuttings	0.86		0.14	0.35	0.09	375	*	-1.00		41	10	4	16	0.29		n
05-2934-115101	03077000040000	PAN AMERICAN	Bosnick	1	4290	4350	4320	cuttings	1.46	**	0.73	0.96	0.66	369		-1.00		66	45	1	50	0.43		n
05-2934-115102	03077000040000	PAN AMERICAN	Bosnick	1	4350	4400	4375	cuttings	1.23	**	0.51	0.65	0.48	363		-1.00	4.61	53	39	1	41	0.44		n
05-2934-115103	03077000040000	PAN AMERICAN	Bosnick	1	4400	4450	4425	cuttings	1.24	**	0.47	0.70	0.63	371		-1.00		56	51	1	38	0.40		n
05-2934-115104	03077000040000	PAN AMERICAN	Bosnick	1	4450	4500	4475	cuttings	0.24	**	0.11	0.12	0.10	361	*	-1.00		50	42	1	46	0.48		n
05-2934-115105	03077100010000	COCKRELL CORP	Bunch	1	3700	3750	3725	cuttings	3.52		0.69	0.46	0.28	343	*	-1.00	4.68	13	8	2	20	0.60		n
05-2934-115106	03077100010000	COCKRELL CORP	Bunch	1	3750	3800	3775	cuttings	3.38		0.52	0.48	0.30	347	*	-1.00		14	9	2	15	0.52		n
05-2934-115107	03077100010000	COCKRELL CORP	Bunch	1	3800	3850	3825	cuttings	3.19		0.71	0.80	0.23	331		-1.00	4.38	25	7	3	22	0.47		n
05-2934-115108	03077100010000	COCKRELL CORP	Bunch	1	3850	3900	3875	cuttings	2.49		0.45	0.96	0.21	428		0.54		39	8	5	18	0.32		n;ltS2p
05-2934-115110	03077100010000	COCKRELL CORP	Bunch	1	4000	4050	4025	cuttings	2.86		0.76	0.89	0.25	377		-1.00		31	9	4	27	0.46		n;ltS2p

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HGS No.	API Number	Operator	Well Name	Well Number	Top Depth (ft.)	Bottom Depth (ft.)	Median Depth (ft.)	Sample Type	Leco TOC		S1	S2	S3	Tmax (°C)		Cal. %Ro	Meas. %Ro	HI	OI	S2/S3	S1/TOC	PI	Notes Checks	Notes Pyrogram
05-2934-115111	03077100010000	COCKRELL CORP	Bunch	1	4050	4100	4075	cuttings	1.62		0.41	0.30	0.16	346	*	-1.00	4.53	19	10	2	25	0.58	c	n
05-2934-115112	03077100010000	COCKRELL CORP	Bunch	1	4100	4150	4125	cuttings	0.86		0.21	0.21	0.10	347	*	-1.00		24	12	2	24	0.50		n
05-2934-115113	03077100010000	COCKRELL CORP	Bunch	1	4150	4200	4175	cuttings	0.61		0.11	0.20	0.13	398	*	-1.00		33	21	2	18	0.35		n
05-2934-115114	03077100010000	COCKRELL CORP	Bunch	1	4200	4250	4225	cuttings	2.84		0.80	0.74	0.31	368		-1.00		26	11	2	28	0.52		n
05-2934-115115	03077100010000	COCKRELL CORP	Bunch	1	4250	4300	4275	cuttings	1.90		0.50	0.57	0.31	355		-1.00		30	16	2	26	0.47	c	n
05-2934-115116	03077100010000	COCKRELL CORP	Bunch	1	4300	4350	4325	cuttings	2.00		0.30	0.37	0.18	367	*	-1.00		19	9	2	15	0.45		n
05-2934-115117	03077100010000	COCKRELL CORP	Bunch	1	4350	4400	4375	cuttings	2.70		0.48	0.58	0.29	369		-1.00	4.53	21	11	2	18	0.45		n
05-2934-115118	03077100010000	COCKRELL CORP	Bunch	1	4400	4430	4415	cuttings	0.82		0.20	0.18	0.14	360	*	-1.00		22	17	1	24	0.53	c	n
05-2934-115664	03147600370000	MOBIL OIL CORP	Roy Sturgis	1	2000	2050	2025	cuttings	0.95		0.12	0.45	0.47	457	*	1.07	2.41	47	49	1	13	0.21	c	n
05-2934-115665	03147600370000	MOBIL OIL CORP	Roy Sturgis	1	2500	2550	2525	cuttings	0.75		0.09	0.28	0.60	366	*	-1.00	2.52	37	80	0	12	0.24		n
05-2934-115666	03147600370000	MOBIL OIL CORP	Roy Sturgis	1	2900	2950	2925	cuttings	0.97		0.16	0.35	0.29	406	*	0.15	2.59	36	30	1	16	0.31		n
05-2934-115667	03147600370000	MOBIL OIL CORP	Roy Sturgis	1	2950	3000	2975	cuttings	1.14		0.16	0.42	0.21	465	*	1.21		37	18	2	14	0.28		n
05-2934-115668	03147600370000	MOBIL OIL CORP	Roy Sturgis	1	3000	3050	3025	cuttings	1.83		0.19	0.33	0.21	451	*	0.96	2.61	18	11	2	10	0.37		n
05-2934-115669	03147600370000	MOBIL OIL CORP	Roy Sturgis	1	3050	3100	3075	cuttings	2.47		0.38	0.29	0.26	395	*	-1.00		12	11	1	15	0.57		n
05-2934-115670	03147600370000	MOBIL OIL CORP	Roy Sturgis	1	3100	3150	3125	cuttings	2.26		0.31	0.29	0.22	450	*	0.94		13	10	1	14	0.52		n
05-2934-115671	03147600370000	MOBIL OIL CORP	Roy Sturgis	1	3150	3200	3175	cuttings	2.69		0.49	0.61	0.25	505		1.93	2.70	23	9	2	18	0.45		n
05-2934-115672	03147600370000	MOBIL OIL CORP	Roy Sturgis	1	3200	3250	3225	cuttings	1.71		0.29	0.41	0.18	501	*	1.86		24	11	2	17	0.41	c	n
05-2934-115673	03147600370000	MOBIL OIL CORP	Roy Sturgis	1	3250	3300	3275	cuttings	1.09		0.15	0.25	0.21	418	*	0.36		23	19	1	14	0.38		n
05-2934-115674	03147600370000	MOBIL OIL CORP	Roy Sturgis	1	3300	3350	3325	cuttings	1.47		0.20	0.27	0.21	376	*	-1.00	2.73	18	14	1	14	0.43		n
05-2934-115675	03147600370000	MOBIL OIL CORP	Roy Sturgis	1	3350	3400	3375	cuttings	1.10		0.11	0.26	0.25	365	*	-1.00		24	23	1	10	0.30		n
05-2934-115676	03147600370000	MOBIL OIL CORP	Roy Sturgis	1	3400	3450	3425	cuttings	1.28		0.12	0.26	0.18	375	*	-1.00		20	14	1	9	0.32		n
05-2934-115677	03147600370000	MOBIL OIL CORP	Roy Sturgis	1	3450	3500	3475	cuttings	1.10		0.07	0.25	0.17	348	*	-1.00	2.80	23	15	1	6	0.22		n
05-2934-115678	03147600370000	MOBIL OIL CORP	Roy Sturgis	1	3550	3600	3575	cuttings	1.14		0.09	0.22	0.22	343	*	-1.00		19	19	1	8	0.29		n
05-2934-115679	03147600370000	MOBIL OIL CORP	Roy Sturgis	1	3600	3650	3625	cuttings	2.35		0.11	0.34	0.30	456	*	1.05	2.84	14	13	1	5	0.24	c	n
05-2934-116159	3147100030000	JACK E. STACK	Stack	1	6500	6550	6525	cuttings	0.97		0.01	0.69	0.31	453		0.99		71	32	2	1	0.01	c	n;ltS2p
05-2934-116160	3147100030000	JACK E. STACK	Stack	1	6550	6600	6575	cuttings	0.57		0.00	0.02	0.12	350	*	-1.00		4	21	0	0	0.00		f
05-2934-116161	3147100030000	JACK E. STACK	Stack	1	6600	6650	6625	cuttings	0.62		0.02	0.12	0.11	416	*	0.33		19	18	1	3	0.14		n
05-2934-116162	3147100030000	JACK E. STACK	Stack	1	6650	6700	6675	cuttings	0.69		0.00	0.01	0.19	309	*	-1.00		1	28	0	0	0.00		f
05-2934-116163	3147100030000	JACK E. STACK	Stack	1	6700	6750	6725	cuttings	0.91		0.00	0.06	0.18	336	*	-1.00		7	20	0	0	0.00		n
05-2934-116164	3147100030000	JACK E. STACK	Stack	1	6750	6800	6775	cuttings	0.88		0.00	0.08	0.19	-1	*	-1.00		9	22	0	0	0.00		n
05-2934-116165	3145100100000	EXXON CORP	Emberson	1	6900	6950	6925	cuttings	0.80		0.06	0.18	0.42	354	*	-1.00		23	52	0	7	0.25		n;ltS2p
05-2934-116166	3145100100000	EXXON CORP	Emberson	1	6950	7000	6975	cuttings	0.80		0.05	0.31	0.47	427	*	0.53		39	59	1	6	0.14		n;ltS2p
05-2934-116167	3145100100000	EXXON CORP	Emberson	1	7000	7050	7025	cuttings	0.69		0.03	0.14	0.35	411	*	0.24		20	51	0	4	0.18		n;ltS2p
05-2934-116168	3145100100000	EXXON CORP	Emberson	1	7050	7100	7075	cuttings	0.73		0.04	0.18	0.38	429	*	0.56		25	52	0	5	0.18	c	n
05-2934-116169	3145100100000	EXXON CORP	Emberson	1	7100	7150	7125	cuttings	0.94		0.03	0.13	0.37	384	*	-1.00		14	39	0	3	0.19		n
05-2934-116170	3145100100000	EXXON CORP	Emberson	1	7350	7400	7375	cuttings	0.94		0.03	0.39	0.49	416	*	0.33		41	52	1	3	0.07		n
05-2934-116171	3145100100000	EXXON CORP	Emberson	1	7400	7450	7425	cuttings	0.96		0.04	0.22	0.42	420	*	0.40		23	44	1	4	0.15		n
05-2934-116172	3145100100000	EXXON CORP	Emberson	1	7450	7500	7475	cuttings	0.84		0.04	0.15	0.32	385	*	-1.00		18	38	0	5	0.21		n
05-2934-116173	3145100100000	EXXON CORP	Emberson	1	7500	7550	7525	cuttings	0.86		0.02	0.11	0.30	391	*	-1.00		13	35	0	2	0.15		n
05-2934-116174	3145100100000	EXXON CORP	Emberson	1	7550	7600	7575	cuttings	0.94		0.05	0.22	0.30	383	*	-1.00		23	32	1	5	0.19		n
05-2934-116175	3145100100000	EXXON CORP	Emberson	1	7600	7650	7625	cuttings	0.78		0.05	0.13	0.28	334	*	-1.00		17	36	0	6	0.28		n
05-2934-116176	3145100100000	EXXON CORP	Emberson	1	7650	7700	7675	cuttings	0.85		0.06	0.11	0.30	353	*	-1.00		13	35	0	7	0.35		n
05-2934-116177	3145100100000	EXXON CORP	Emberson	1	7700	7750	7725	cuttings	0.88		0.07	0.12	0.40	320	*	-1.00		14	45	0	8	0.37		n
05-2934-116178	3145100100000	EXXON CORP	Emberson	1	7750	7800	7775	cuttings	0.85		0.03	0.14	0.27	401	*	0.06		16	32	1	4	0.18	c	n
05-2934-116179	3145100100000	EXXON CORP	Emberson	1	7800	7850	7825	cuttings	0.87		0.07	0.28	0.25	331	*	-1.00		32	29	1	8	0.20	c	n;ltS2p
05-2934-116180	3145100100000	EXXON CORP	Emberson	1	7850	7900	7875	cuttings	0.84		0.02	0.07	0.25	395	*	-1.00		8	30	0	2	0.22		n
05-2934-116181	3145100100000	EXXON CORP	Emberson	1	7900	7950	7925	cuttings	1.03		0.03	0.12	0.18	320	*	-1.00		12	17	1	3	0.20		n
05-2934-116182	3145100100000	EXXON CORP	Emberson	1	7950	8000	7975	cuttings	0.92		0.05	0.23	0.31	393	*	-1.00		25	34	1	5	0.18		n
05-2934-116183	3145100100000	EXXON CORP	Emberson	1	8000	8050	8025	cuttings	0.83		0.03	0.13	0.30	392	*	-1.00		16	36	0	4	0.19		n
05-2934-116184	3145100100000	EXXON CORP	Emberson	1	8050	8100	8075	cuttings	0.83		0.03	0.14	0.33	364	*	-1.00		17	40	0	4	0.18		n
05-2934-116185	3145100100000	EXXON CORP	Emberson	1	8100	8150	8125	cuttings	0.83		0.03	0.11	0.20	315	*	-1.00		13	24	1	4	0.21		n
05-2934-116186	3145100100000	EXXON CORP	Emberson	1	8150	8200	8175	cuttings	0.90		0.03	0.09	0.22	351	*	-1.00		10	24	0	3	0.25		n
05-2934-116187	3145100100000	EXXON CORP	Emberson	1	8200	8250	8225	cuttings	0.90		0.01	0.08	0.23	372	*	-1.00		9	26	0	1	0.11		n
05-2934-116188	3145100100000	EXXON CORP	Emberson	1	8250	8300	8275	cuttings	0.95		0.03	0.09	0.24	349	*	-1.00		9	25	0	3	0.25		n
05-2934-116189	3145100100000	EXXON CORP	Emberson	1	8300	8350	8325	cuttings	1.03		0.02	0.05	0.17	-1	*	-1.00		5	17	0	2	0.29	c	n
05-2934-116190	3145100100000	EXXON CORP	Emberson	1	8350	8400	8375	cuttings	1.02		0.03	0.08	0.16	365	*	-1.00		8	16	1	3	0.27		n

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HGS No.	API Number	Operator	Well Name	Well Number	Top Depth (ft.)	Bottom Depth (ft.)	Median Depth (ft.)	Sample Type	Leco TOC		S1	S2	S3	Tmax (°C)		Cal. %Ro	Meas. %Ro	HI	OI	S2/S3	S1/TOC	PI	Notes Checks	Notes Pyrogram
05-2934-116191	3145100100000	EXXON CORP	Emberson	1	8400	8450	8425	cuttings	0.98		0.02	0.06	0.21	356	*	-1.00		6	21	0	2	0.25		n
05-2934-116192	3145100100000	EXXON CORP	Emberson	1	8450	8500	8475	cuttings	1.06		0.03	0.08	0.14	329	*	-1.00		8	13	1	3	0.27		n
05-2934-116193	3145100100000	EXXON CORP	Emberson	1	8500	8550	8525	cuttings	1.03		0.02	0.14	0.16	452	*	0.98		14	16	1	2	0.12		n
05-2934-116194	3145100100000	EXXON CORP	Emberson	1	8550	8590	8570	cuttings	1.65		0.18	0.50	0.18	385		-1.00		30	11	3	11	0.26		n;ltS2p
05-2934-116195	3145100100000	EXXON CORP	Emberson	1	8600	8650	8625	cuttings	1.12		0.04	0.20	0.21	411	*	0.24		18	19	1	4	0.17		n
05-2934-116196	3145100100000	EXXON CORP	Emberson	1	8650	8690	8670	cuttings	1.04		0.13	0.32	0.19	326	*	-1.00		31	18	2	13	0.29		n;ltS2p
05-2934-116197	3145100100000	EXXON CORP	Emberson	1	8700	8750	8725	cuttings	2.49		0.33	0.86	0.19	352		-1.00		35	8	5	13	0.28		n;ltS2p
05-2934-116198	3145100100000	EXXON CORP	Emberson	1	8750	8800	8775	cuttings	1.87		0.28	0.57	0.32	353		-1.00		30	17	2	15	0.33	c	n;ltS2p
05-2934-116199	3145100100000	EXXON CORP	Emberson	1	8800	8850	8825	cuttings	1.80		0.45	0.65	0.16	429		0.56		36	9	4	25	0.41	c	n;ltS2p
05-2934-116200	3145100100000	EXXON CORP	Emberson	1	8850	8900	8875	cuttings	2.22		0.48	0.58	0.40	354		-1.00		26	18	1	22	0.45		n
05-2934-116201	3145100100000	EXXON CORP	Emberson	1	8900	8950	8925	cuttings	1.72		0.26	0.68	0.23	390		-1.00		40	13	3	15	0.28		n
05-2934-116202	3145100100000	EXXON CORP	Emberson	1	8950	9000	8975	cuttings	1.65		0.27	0.87	0.29	436		0.69		53	18	3	16	0.24		n;ltS2p
05-2934-116203	3145100100000	EXXON CORP	Emberson	1	9000	9050	9025	cuttings	2.14		0.54	0.78	0.23	361		-1.00		36	11	3	25	0.41		n;ltS2p
05-2934-116204	3145100100000	EXXON CORP	Emberson	1	9050	9100	9075	cuttings	2.30		0.41	0.66	0.26	354		-1.00		29	11	3	18	0.38		n;ltS2p
05-2934-116205	3145600150000	ON OIL & REFININ	Nalley	1	3693	3805	3749	cuttings	0.80		0.11	0.34	0.58	386	*	-1.00		42	72	1	14	0.24		n
05-2934-116206	3145600150000	ON OIL & REFININ	Nalley	1	3805	3905	3855	cuttings	0.77		0.13	0.45	0.48	456	*	1.05		58	62	1	17	0.22		n;ltS2p
05-2934-116207	3145600150000	ON OIL & REFININ	Nalley	1	3912	4002	3957	cuttings	0.77		0.14	0.26	0.43	390	*	-1.00		34	56	1	18	0.35		n
05-2934-116208	3145600150000	ON OIL & REFININ	Nalley	1	4002	4105	4053.5	cuttings	0.74		0.14	0.31	0.67	480	*	1.48		42	91	0	19	0.31		n;ltS2p
05-2934-116209	3145600150000	ON OIL & REFININ	Nalley	1	4105	4207	4156	cuttings	0.89		0.14	0.21	0.46	351	*	-1.00		24	52	0	16	0.40		n
05-2934-116210	3145600150000	ON OIL & REFININ	Nalley	1	4227	4337	4282	cuttings	0.73		0.12	0.32	0.74	402	*	0.08		44	101	0	16	0.27		n
05-2934-116211	3145600150000	ON OIL & REFININ	Nalley	1	4337	4427	4382	cuttings	0.95		0.09	0.25	0.74	404	*	0.11		26	78	0	9	0.26	c	n;ltS2p
05-2934-116212	3145600150000	ON OIL & REFININ	Nalley	1	4427	4525	4476	cuttings	0.95		0.15	0.29	0.70	440	*	0.76		31	74	0	16	0.34		n
05-2934-116213	3145600150000	ON OIL & REFININ	Nalley	1	4525	4620	4572.5	cuttings	0.84		0.09	0.27	0.40	436	*	0.69		32	48	1	11	0.25		n
05-2934-116214	3145600150000	ON OIL & REFININ	Nalley	1	4620	4722	4671	cuttings	0.84		0.09	0.18	0.53	399	*	-1.00		21	63	0	11	0.33		n
05-2934-116215	3145600150000	ON OIL & REFININ	Nalley	1	4722	4818	4770	cuttings	0.86		0.10	0.16	0.52	391	*	-1.00		19	60	0	12	0.38		n
05-2934-116216	3145600150000	ON OIL & REFININ	Nalley	1	4818	4910	4864	cuttings	0.90		0.10	0.20	0.48	454	*	1.01		22	53	0	11	0.33		n
05-2934-116217	3145600150000	ON OIL & REFININ	Nalley	1	4915	4992	4953.5	cuttings	0.87		0.08	0.14	0.43	387	*	-1.00		16	49	0	9	0.36		n
05-2934-116218	3145600150000	ON OIL & REFININ	Nalley	1	5198	5302	5250	cuttings	2.91		0.61	0.79	0.58	429		0.56		27	20	1	21	0.44		n;ltS2p
05-2934-116219	3145600150000	ON OIL & REFININ	Nalley	1	5302	5425	5363.5	cuttings	2.11		0.46	0.76	0.35	482		1.52		36	17	2	22	0.38		n;ltS2p
05-2934-116220	3145600150000	ON OIL & REFININ	Nalley	1	5425	5522	5473.5	cuttings	2.37		0.74	0.86	0.35	352		-1.00		36	15	2	31	0.46		n;ltS2p
05-2934-116221	3145600150000	ON OIL & REFININ	Nalley	1	5522	5551	5536.5	cuttings	0.75		0.24	0.24	0.17	369	*	-1.00		32	23	1	32	0.50		n
05-2934-116222	3145600150000	ON OIL & REFININ	Nalley	1	5551	5607	5579	cuttings	0.97	**	0.28	0.57	0.47	366		-1.00		59	48	1	29	0.33	c	n

Note: "-1" indicates not measured or meaningless ratio

* Tmax data not reliable due to poor S2 peak
** very little sample received, ran Rock-Eval TOC

TOC = weight percent organic carbon in rock
S1, S2 = mg hydrocarbons per gram of rock
S3 = mg carbon dioxide per gram of rock
Tmax = °C

HI = hydrogen index = S2 x 100 / TOC
OI = oxygen index = S3 x 100 / TOC
S1/TOC = normalized oil content = S1 x 100 / TOC
PI = production index = S1 / (S1+S2)
Cal. %Ro = calculated vitrinite reflectance based on Tmax
Measured %Ro = measured vitrinite reflectance

Notes:
c = Rock-Eval analysis checked and confirmed
lc = Leco TOC analysis checked and confirmed

Pyrogram:
n=normal
ltS2sh = low temperature S2 shoulder
ltS2p = low temperature S2 peak
htS2p = high temperature S2 peak
f = flat S2 peak
na = printer malfunction pyrogram not available

Geochemical Log

Arkansas Geological Commission

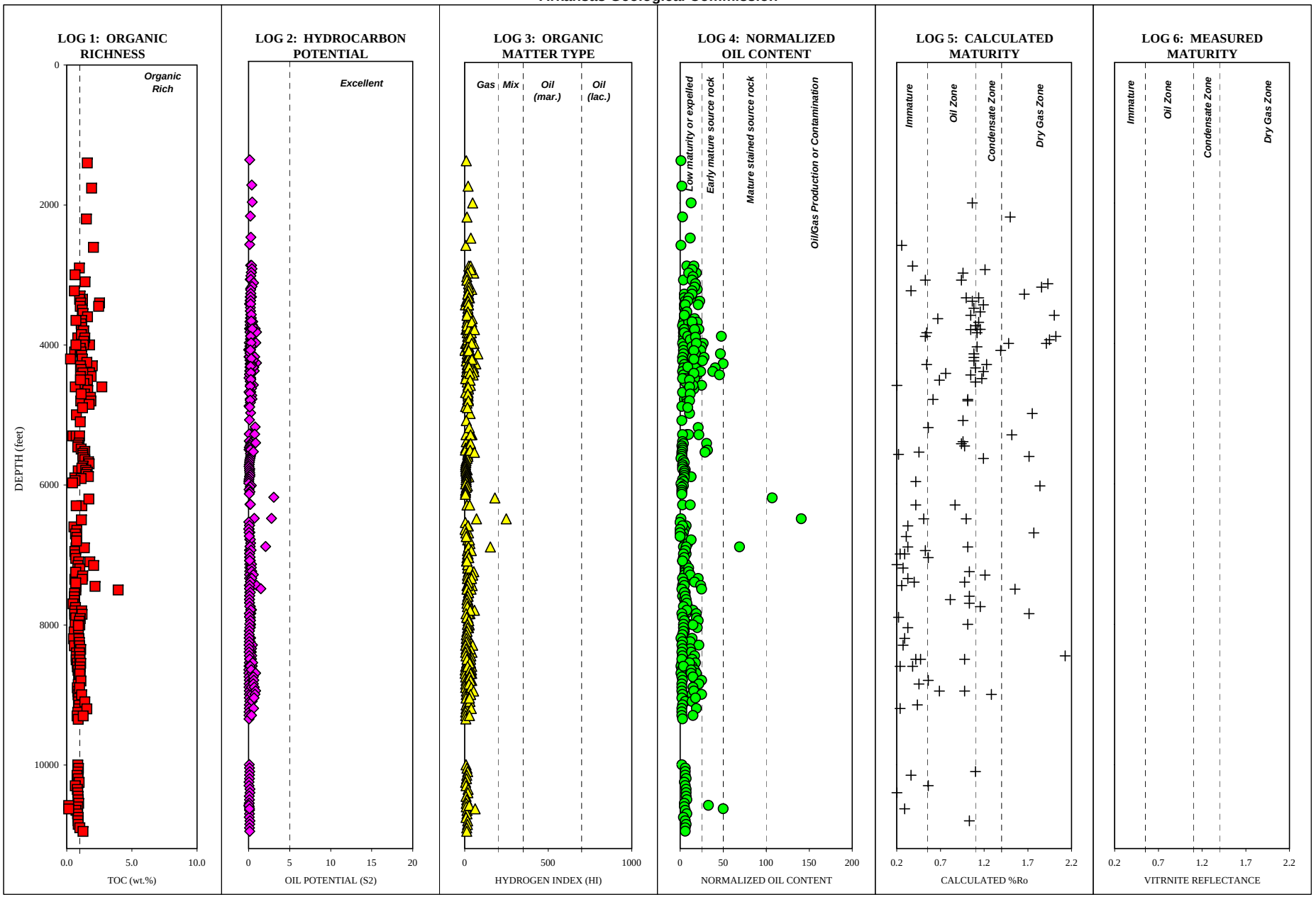

Figure 1. Geochemical log of TOC, remaining potential (S2), kerogen type (HI), normalized oil content, and calculated and measured vitrinite reflectance.

Humble Geochemical Services Division

KEROGEN QUALITY

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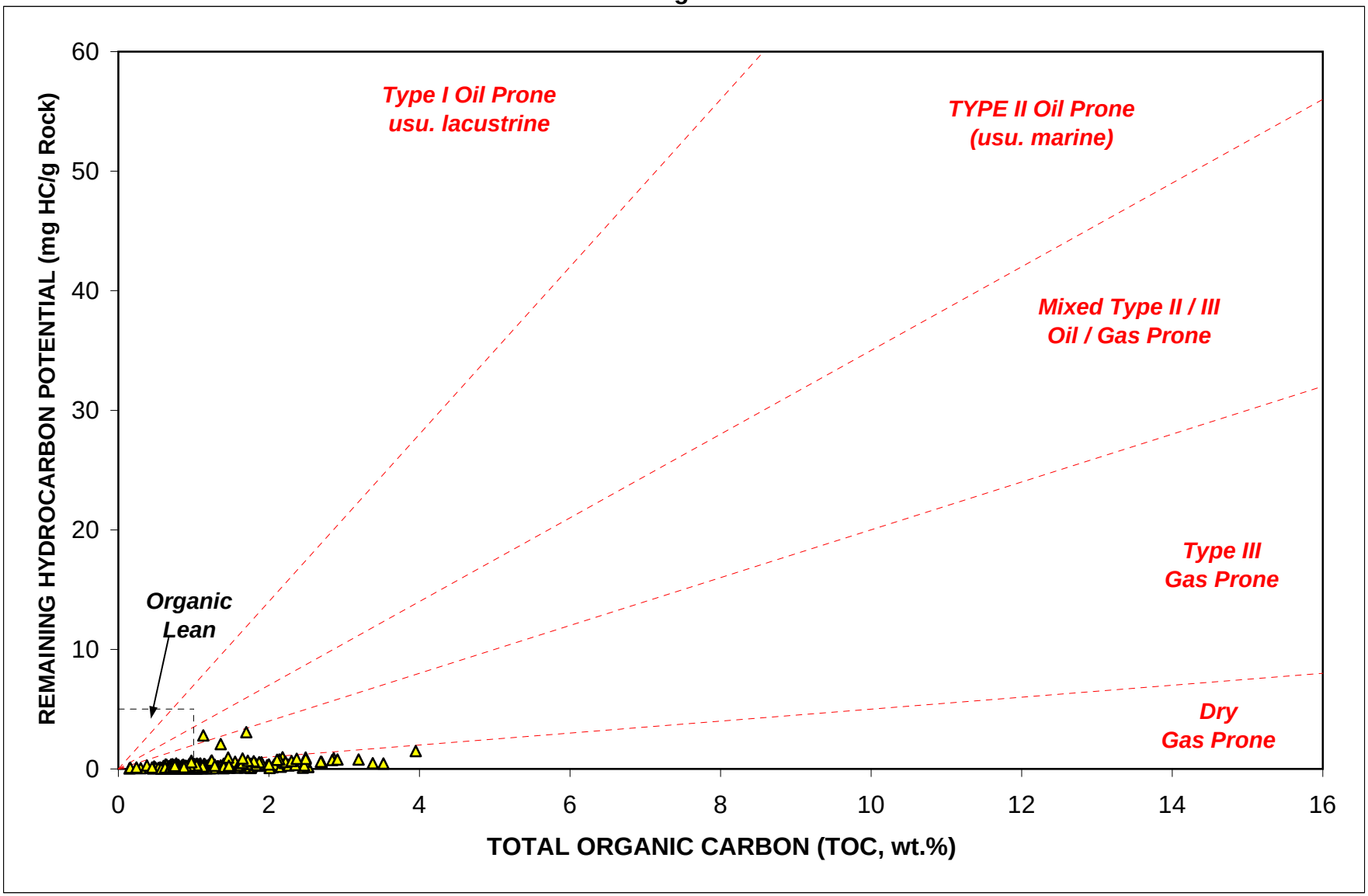

Figure 2. Kerogen Quality

Humble Geochemical Services Division

KEROGEN TYPE
Arkansas Geological Commission

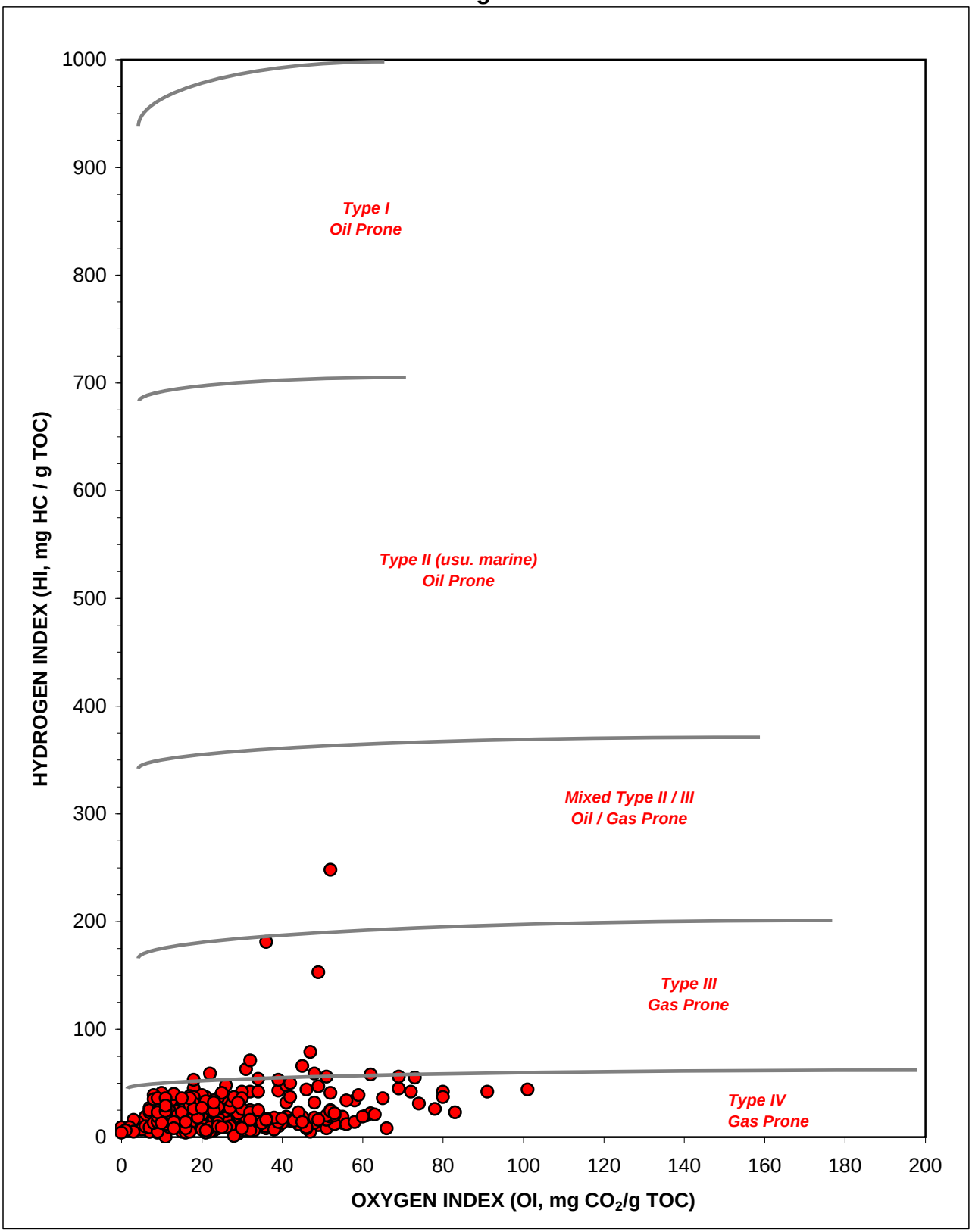

Figure 3. Kerogen type

KEROGEN TYPE and MATURITY

Arkansas Geological Commission

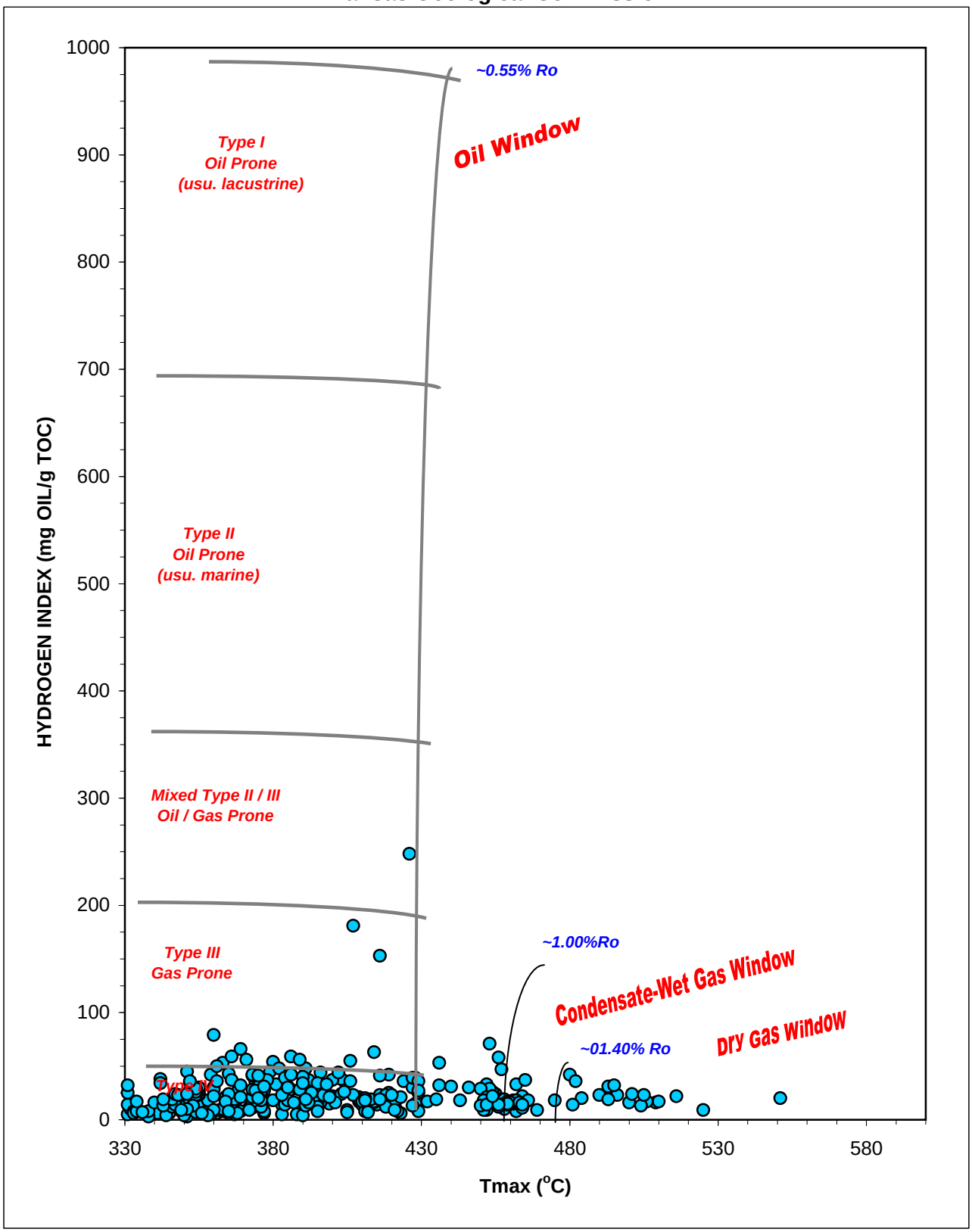

Figure 4a. Kerogen Type and Maturity (Tmax)

Humble Geochemical Services Division

KEROGEN TYPE and MATURITY

Arkansas Geological Commission

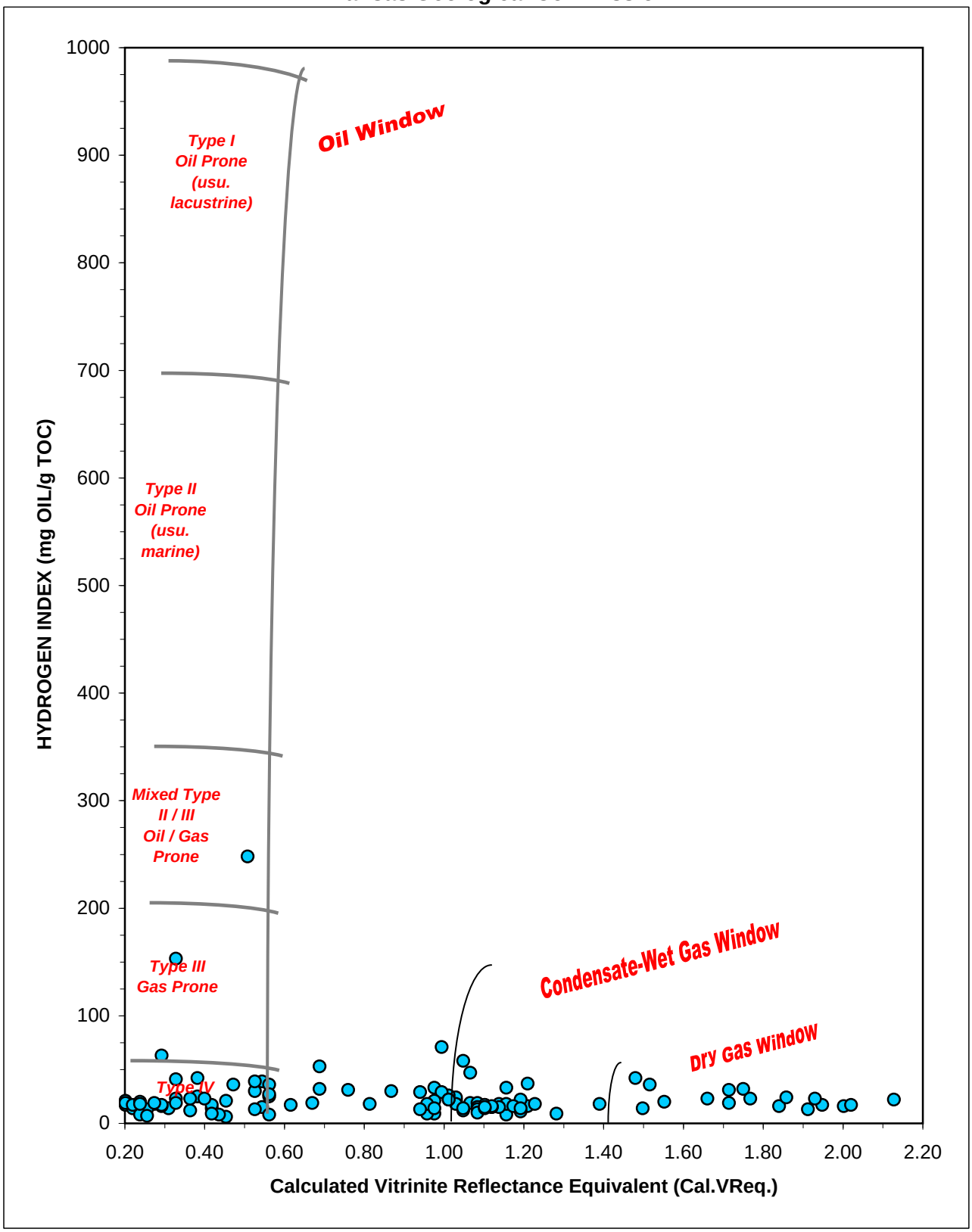

Figure 4b. Kerogen Type and Maturity (Tmax calculated %VRo)

Humble Geochemical Services Division

KEROGEN TYPE and MATURITY

Arkansas Geological Commission

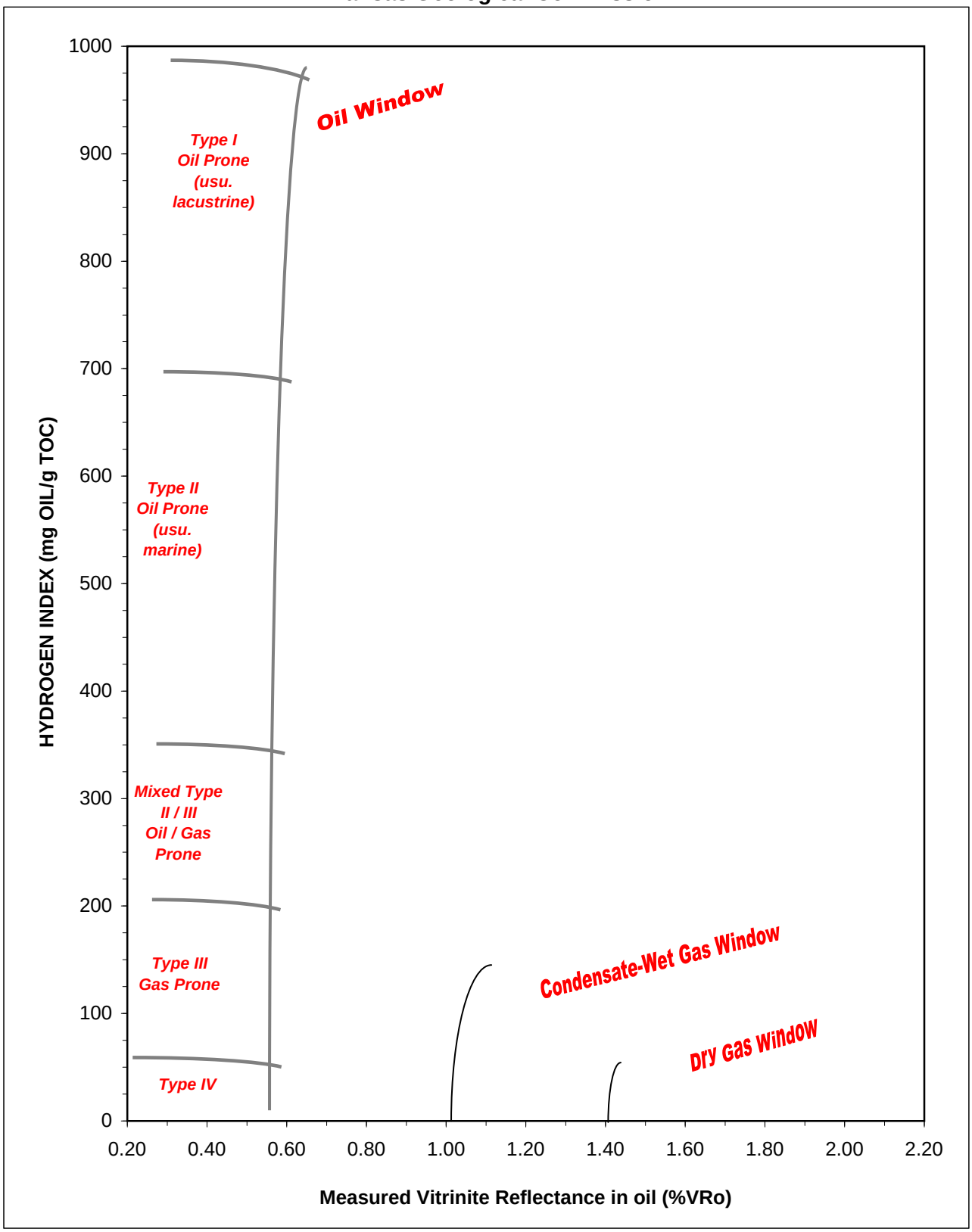

Figure 4c. Kerogen Type and Maturity (Measured vitrinite reflectance)

Humble Geochemical Services Division

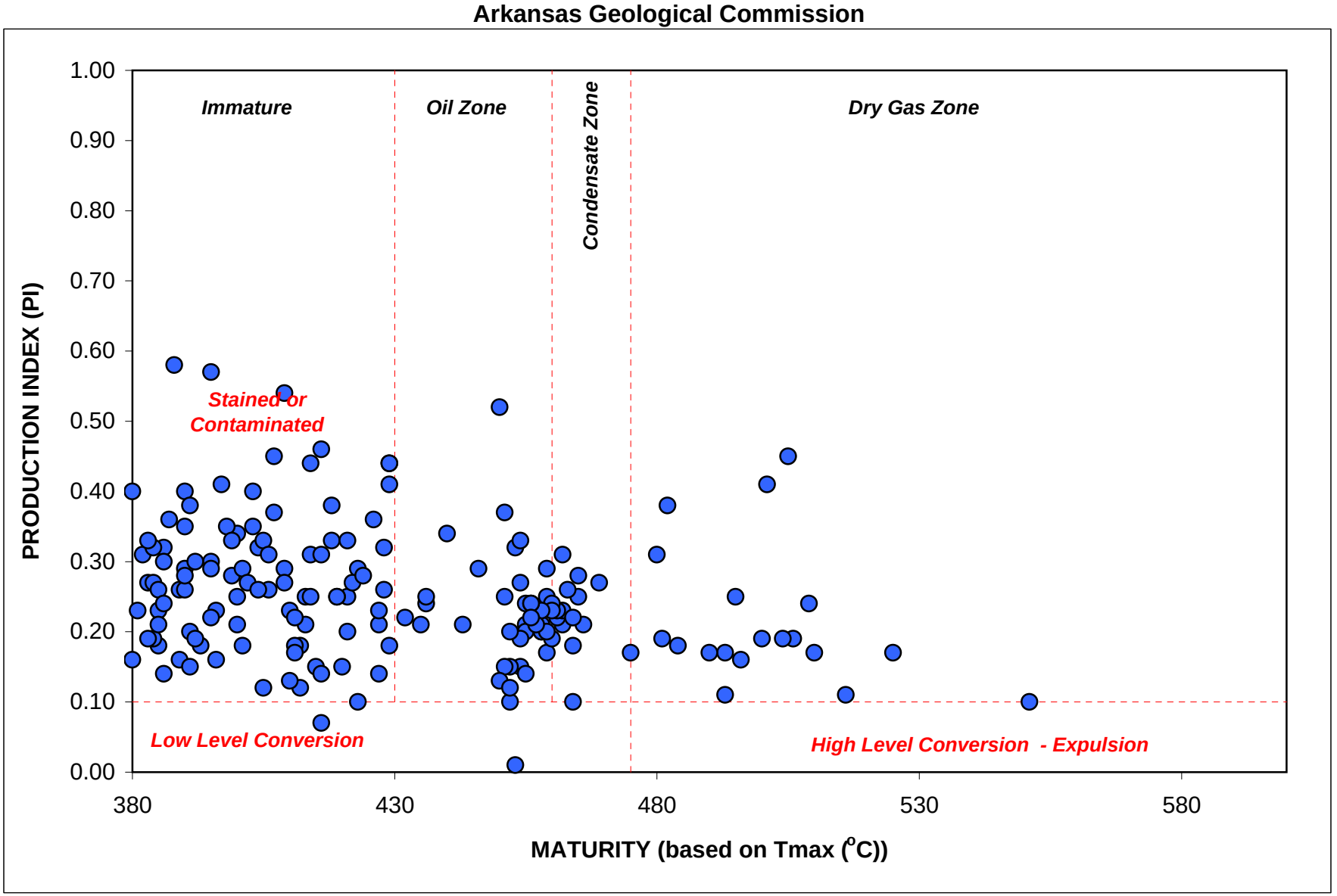

Figure 5a. Kerogen conversion and maturity (based on Tmax).

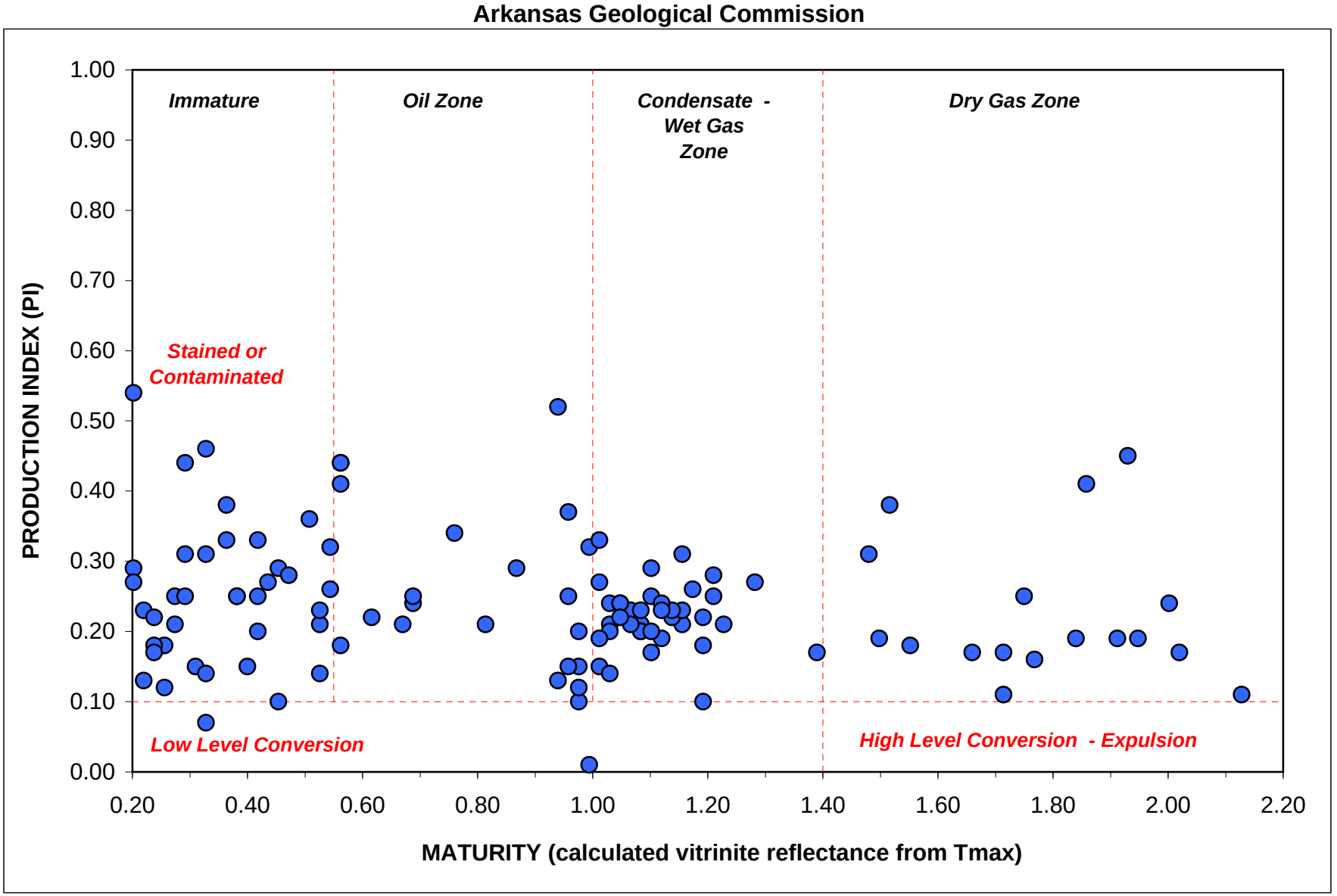

Figure 5b. Kerogen conversion and maturity (calculated %VRo from Tmax).

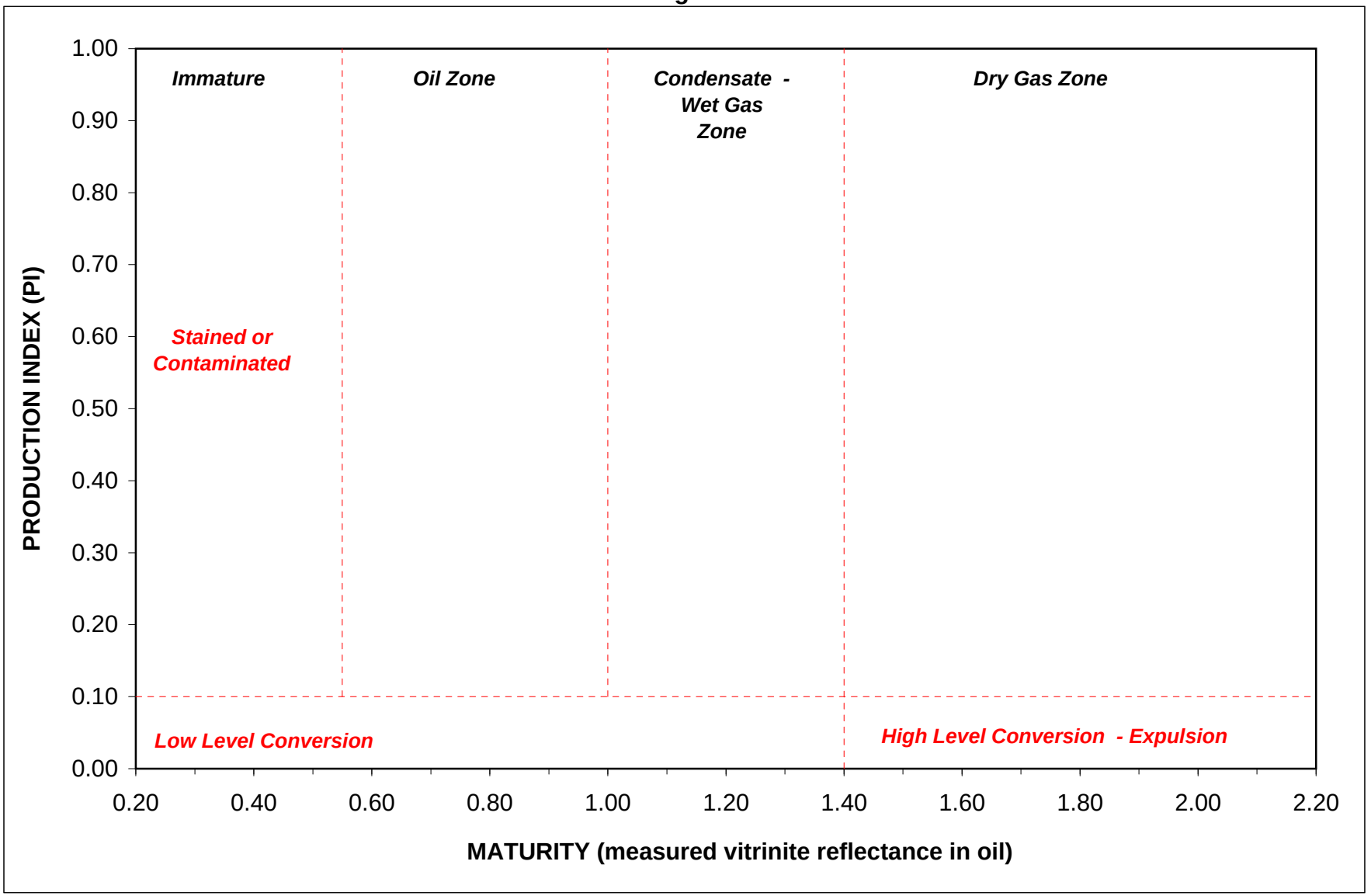

Figure 5c. Kerogen conversion and maturity (measured vitrinite reflectance).

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HGS No.	API Number	Operator	Well Name	Well Number	Top Depth (ft.)	Bottom Depth (ft.)	Median Depth (ft.)	Sample Type	Leco TOC	S1	S2	S3	Tmax (°C)		Cal. %Ro	Meas. %Ro	HI	OI	S2/S3	S1/TOC	PI	Notes Checks	Notes Pyrogram
05-2964-116223	03023100060000	POGO PRODUCING CO	McNew	1-26	2360	2400	2380	cuttings	0.67	0.03	0.05	0.41	362	*	-1.00		7	61	0	4	0.37	c	n
05-2964-116224	03023100060000	POGO PRODUCING CO	McNew	1-26	3000	3050	3025	cuttings	0.35	0.04	0.05	0.09	382	*	-1.00		14	26	1	11	0.44		n
05-2964-116225	03023100060000	POGO PRODUCING CO	McNew	1-26	3780	3830	3805	cuttings	0.70	0.03	0.06	0.22	313	*	-1.00		9	31	0	4	0.33		n
05-2964-116226	03023100060000	POGO PRODUCING CO	McNew	1-26	4000	4050	4025	cuttings	0.96	0.04	0.10	0.25	375	*	-1.00		10	26	0	4	0.29		n
05-2964-116227	03023100060000	POGO PRODUCING CO	McNew	1-26	4300	4350	4325	cuttings	1.18	0.11	0.17	0.34	387	*	-1.00		14	29	1	9	0.39		n
05-2964-116228	03023100060000	POGO PRODUCING CO	McNew	1-26	4570	4620	4595	cuttings	1.29	0.11	0.13	0.20	355	*	-1.00		10	16	1	9	0.46		n
05-2964-116229	03023100060000	POGO PRODUCING CO	McNew	1-26	4620	4670	4645	cuttings	1.22	0.12	0.14	0.38	414	*	0.29		11	31	0	10	0.46		n
05-2964-116230	03023100060000	POGO PRODUCING CO	McNew	1-26	4670	4720	4695	cuttings	1.53	0.19	0.10	0.21	348	*	-1.00		7	14	0	12	0.66		n
05-2964-116231	03023100060000	POGO PRODUCING CO	McNew	1-26	4720	4770	4745	cuttings	1.97	0.22	0.17	0.26	405	*	0.13		9	13	1	11	0.56		n
05-2964-116232	03023100060000	POGO PRODUCING CO	McNew	1-26	4770	4820	4795	cuttings	2.54	0.28	0.14	0.33	359	*	-1.00		6	13	0	11	0.67		n
05-2964-116233	03023100060000	POGO PRODUCING CO	McNew	1-26	4820	4870	4845	cuttings	1.58	0.16	0.16	0.30	365	*	-1.00		10	19	1	10	0.50	c	n
05-2964-116234	03023100060000	POGO PRODUCING CO	McNew	1-26	4890	4940	4915	cuttings	2.45	0.42	0.23	0.24	351	*	-1.00		9	10	1	17	0.65		n;ltS2p
05-2964-116235	03023100060000	POGO PRODUCING CO	McNew	1-26	4940	4990	4965	cuttings	1.45	0.27	0.13	0.17	351	*	-1.00		9	12	1	19	0.68		n
05-2964-116236	03023100060000	POGO PRODUCING CO	McNew	1-26	4990	5040	5015	cuttings	1.93	0.30	0.11	0.20	405	*	0.13		6	10	1	16	0.73		n
05-2964-116237	03023100060000	POGO PRODUCING CO	McNew	1-26	5040	5100	5070	cuttings	1.88	0.29	0.08	0.14	365	*	-1.00		4	7	1	15	0.78		n
05-2964-116238	03023100060000	POGO PRODUCING CO	McNew	1-26	5100	5150	5125	cuttings	1.93	0.33	0.07	0.16	353	*	-1.00		4	8	0	17	0.83		n
05-2964-116239	03023100060000	POGO PRODUCING CO	McNew	1-26	5150	5200	5175	cuttings	1.20	0.25	0.06	0.09	345	*	-1.00		5	8	1	21	0.81		n
05-2964-116240	03023100060000	POGO PRODUCING CO	McNew	1-26	5290	5340	5315	cuttings	0.58	0.08	0.03	0.08	313	*	-1.00		5	14	0	14	0.73		n
05-2964-116241	03023100060000	POGO PRODUCING CO	McNew	1-26	5350	5400	5375	cuttings	0.68	0.07	0.02	0.13	313	*	-1.00		3	19	0	10	0.78		n
05-2964-116242	03145100050000	TEXAS O&G CORP	Rocka	1	2200	2250	2225	cuttings	0.56	0.02	0.04	0.32	364	*	-1.00		7	57	0	4	0.33	c	n
05-2964-116243	03145100050000	TEXAS O&G CORP	Rocka	1	2400	2450	2425	cuttings	0.66	0.03	0.06	0.30	380	*	-1.00		9	45	0	5	0.33	c	n
05-2964-116244	03145100050000	TEXAS O&G CORP	Rocka	1	2500	2550	2525	cuttings	0.54	0.03	0.07	0.33	385	*	-1.00		13	61	0	6	0.30		n
05-2964-116245	03145100050000	TEXAS O&G CORP	Rocka	1	3900	3950	3925	cuttings	0.75	0.04	0.10	0.25	372	*	-1.00		13	33	0	5	0.29		n
05-2964-116246	03145100050000	TEXAS O&G CORP	Rocka	1	4400	4450	4425	cuttings	0.89	0.06	0.09	0.21	420	*	0.40		10	24	0	7	0.40		n
05-2964-116247	03145100050000	TEXAS O&G CORP	Rocka	1	4700	4750	4725	cuttings	1.08	0.10	0.18	0.43	380	*	-1.00		17	40	0	9	0.36		n
05-2964-116248	03145100050000	TEXAS O&G CORP	Rocka	1	4750	4800	4775	cuttings	1.47	0.25	0.17	0.18	361	*	-1.00		12	12	1	17	0.60		n
05-2964-116249	03145100050000	TEXAS O&G CORP	Rocka	1	4800	4900	4850	cuttings	2.99	0.66	1.13	0.85	430		0.58		38	28	1	22	0.37	lc, c	n;ltS2p
05-2964-116250	03145100050000	TEXAS O&G CORP	Rocka	1	4900	4950	4925	cuttings	2.60	0.50	1.78	1.03	433		0.63		68	40	2	19	0.22	lc, c	n;ltS2p
05-2964-116251	03145100050000	TEXAS O&G CORP	Rocka	1	4950	5000	4975	cuttings	1.73	0.39	0.34	0.32	370	*	-1.00		20	18	1	23	0.53		n;ltS2p
05-2964-116252	03145100050000	TEXAS O&G CORP	Rocka	1	5000	5050	5025	cuttings	2.38	0.65	0.34	0.28	360	*	-1.00		14	12	1	27	0.66		n;ltS2p
05-2964-116253	03145100050000	TEXAS O&G CORP	Rocka	1	5050	5100	5075	cuttings	2.19	0.58	0.33	0.33	358	*	-1.00		15	15	1	26	0.64	c	n
05-2964-116254	03145100050000	TEXAS O&G CORP	Rocka	1	5100	5150	5125	cuttings	2.30	0.47	0.44	0.26	364	*	-1.00		19	11	2	20	0.52		n
05-2964-116255	03145100050000	TEXAS O&G CORP	Rocka	1	5150	5200	5175	cuttings	2.10	0.68	0.41	0.28	360	*	-1.00		20	13	1	32	0.62		n
05-2964-116256	03145100050000	TEXAS O&G CORP	Rocka	1	5200	5250	5225	cuttings	2.37	0.51	0.34	0.20	361	*	-1.00		14	8	2	22	0.60		n
05-2964-116257	03145100050000	TEXAS O&G CORP	Rocka	1	5250	5300	5275	cuttings	1.99	0.65	0.80	0.36	370		-1.00		40	18	2	33	0.45	lc, c	n
05-2964-116258	03145100050000	TEXAS O&G CORP	Rocka	1	5300	5350	5325	cuttings	2.05	0.56	0.29	0.30	373	*	-1.00		14	15	1	27	0.66		n
05-2964-116259	03145100050000	TEXAS O&G CORP	Rocka	1	5350	5400	5375	cuttings	1.34	0.38	0.49	0.32	378	*	-1.00		37	24	2	28	0.44		n
05-2964-116260	03145100050000	TEXAS O&G CORP	Rocka	1	5530	5560	5545	cuttings	0.50	0.60	0.57	0.43	376		-1.00		114	86	1	120	0.51	lc, c	n
05-2964-116261	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	1500	1550	1525	cuttings	0.80	0.04	0.05	0.47	381	*	-1.00		6	59	0	5	0.44		n
05-2964-116262	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	1950	2000	1975	cuttings	1.08	0.06	0.09	0.38	346	*	-1.00		8	35	0	6	0.40	c	n
05-2964-116263	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	2250	2300	2275	cuttings	0.48	0.06	0.11	0.33	388	*	-1.00		23	69	0	13	0.35	c	n
05-2964-116264	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	2500	2550	2525	cuttings	0.84	0.04	0.08	0.48	420	*	0.40		10	57	0	5	0.33		n;ltS2p
05-2964-116265	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	3300	3350	3325	cuttings	0.45	0.04	0.08	0.19	380	*	-1.00		18	42	0	9	0.33		n
05-2964-116266	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	3850	3900	3875	cuttings	0.33	0.03	0.06	0.18	341	*	-1.00		18	55	0	9	0.33		n
05-2964-116267	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	4240	4290	4265	cuttings	0.57	0.05	0.12	0.24	377	*	-1.00		21	42	1	9	0.29		n
05-2964-116268	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	4700	4750	4725	cuttings	0.50	0.06	0.12	0.26	401	*	0.06		24	52	0	12	0.33		n
05-2964-116269	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	4700	4750	4725	cuttings	0.50	0.06	0.13	0.24	375	*	-1.00		26	48	1	12	0.32		n
05-2964-116270	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	5050	5100	5075	cuttings	1.27	0.17	0.17	0.20	365	*	-1.00		13	16	1	13	0.50		n
05-2964-116271	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	5250	5300	5275	cuttings	2.20	0.22	0.16	0.14	359	*	-1.00		7	6	1	10	0.58		n
05-2964-116272	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	5300	5350	5325	cuttings	2.64	0.37	0.22	0.23	359	*	-1.00		8	9	1	14	0.63		n
05-2964-116273	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	5350	5400	5375	cuttings	3.16	0.39	0.29	0.19	361	*	-1.00		9	6	2	12	0.57	lc, c	n
05-2964-116274	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	5400	5450	5425	cuttings	2.98	0.29	0.15	0.15	358	*	-1.00		5	5	1	10	0.66		n;ltS2p
05-2964-116275	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	5450	5500	5475	cuttings	2.44	0.27	0.15	0.15	362	*	-1.00		6	6	1	11	0.64		n
05-2964-116276	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	5500	5550	5525	cuttings	1.22	0.11	0.09	0.08	368	*	-1.00		7	7	1	9	0.55		n
05-2964-116277	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	5550	5600	5575	cuttings	1.53	0.27	0.20	0.08	359	*	-1.00		13	5	3	18	0.57		n
05-2964-116278	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	5600	5650	5625	cuttings	1.25	0.26	0.22	0.10	358	*	-1.00		18	8	2	21	0.54		n
05-2964-116279	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	5820	5860	5840	cuttings	0.29	0.06	0.05	0.00	365	*	-1.00		17	0	-1	21	0.55		n

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HGS No.	API Number	Operator	Well Name	Well Number	Top Depth (ft.)	Bottom Depth (ft.)	Median Depth (ft.)	Sample Type	Leco TOC	S1	S2	S3	Tmax (°C)		Cal. %Ro	Meas. %Ro	HI	OI	S2/S3	S1/TOC	PI	Notes Checks	Notes Pyrogram
05-2964-116280	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	5860	5900	5880	cuttings	2.46	0.22	0.21	0.09	363	*	-1.00		9	4	2	9	0.51		n
05-2964-116281	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	5900	5950	5925	cuttings	0.86	0.12	0.12	0.03	364	*	-1.00		14	3	4	14	0.50		n
05-2964-116282	03029100030000	TEXAS PACIFIC OIL CO	Glenn Wright	1	5950	6000	5975	cuttings	1.15	0.25	0.15	0.09	362	*	-1.00		13	8	2	22	0.62	c	n
05-2964-116283	03029000270000	CARTER OIL COMPANY	Morrilton Lumber	1	955	1006	980.5	cuttings	0.82	0.04	0.06	0.16	331	*	-1.00		7	20	0	5	0.40	c	n
05-2964-116284	03029000270000	CARTER OIL COMPANY	Morrilton Lumber	1	1006	1050	1028	cuttings	1.15	0.04	0.08	0.49	359	*	-1.00		7	43	0	3	0.33		n
05-2964-116285	03029000270000	CARTER OIL COMPANY	Morrilton Lumber	1	1600	1650	1625	cuttings	0.52	0.01	0.03	0.26	314	*	-1.00		6	50	0	2	0.25		n
05-2964-116286	03029000270000	CARTER OIL COMPANY	Morrilton Lumber	1	1650	1700	1675	cuttings	0.56	0.03	0.07	0.26	314	*	-1.00		13	46	0	5	0.30		n
05-2964-116287	03029000270000	CARTER OIL COMPANY	Morrilton Lumber	1	2600	2650	2625	cuttings	0.31	0.03	0.05	0.45	314	*	-1.00		16	145	0	10	0.37		n
05-2964-116288	03029000270000	CARTER OIL COMPANY	Morrilton Lumber	1	2650	2700	2675	cuttings	0.40	0.03	0.08	0.67	348	*	-1.00		20	168	0	7	0.27		n
05-2964-116289	03029000270000	CARTER OIL COMPANY	Morrilton Lumber	1	2700	2745	2722.5	cuttings	0.43	0.03	0.08	0.27	364	*	-1.00		19	63	0	7	0.27		
05-2964-116290	03029000270000	CARTER OIL COMPANY	Morrilton Lumber	1	2756	2802	2779	cuttings	0.49	0.02	0.04	0.27	339	*	-1.00		8	55	0	4	0.33		n
05-2964-116291	03029000270000	CARTER OIL COMPANY	Morrilton Lumber	1	2802	2850	2826	cuttings	0.49	0.06	0.23	0.44	394	*	-1.00		47	90	1	12	0.21	lc, c	n
05-2964-116292	03029000270000	CARTER OIL COMPANY	Morrilton Lumber	1	2850	2901	2875.5	cuttings	0.37	0.02	0.04	0.36	314	*	-1.00		11	97	0	5	0.33		n
05-2964-116293	03029000270000	CARTER OIL COMPANY	Morrilton Lumber	1	2901	2951	2926	cuttings	0.47	0.03	0.05	0.27	366	*	-1.00		11	57	0	6	0.37	c	n
05-2964-116294	03029000270000	CARTER OIL COMPANY	Morrilton Lumber	1	2950	3000	2975	cuttings	0.60	0.44	0.77	0.50	385		-1.00		128	83	2	73	0.36	lc, c	n
05-2964-116295	03029000270000	CARTER OIL COMPANY	Morrilton Lumber	1	3000	3050	3025	cuttings	0.58	0.08	0.14	0.18	382	*	-1.00		24	31	1	14	0.36		n
05-2964-116296	03029000270000	CARTER OIL COMPANY	Morrilton Lumber	1	3050	3098	3074	cuttings	0.54	0.05	0.10	0.23	339	*	-1.00		19	43	0	9	0.33		n
05-2964-116297	03029000270000	CARTER OIL COMPANY	Morrilton Lumber	1	3298	3351	3324.5	cuttings	0.85	0.07	0.08	0.19	361	*	-1.00		9	22	0	8	0.47		n
05-2964-116298	03029000270000	CARTER OIL COMPANY	Morrilton Lumber	1	3351	3398	3374.5	cuttings	0.86	0.06	0.11	0.12	314	*	-1.00		13	14	1	7	0.35		n
05-2964-116299	03029000270000	CARTER OIL COMPANY	Morrilton Lumber	1	3398	3450	3424	cuttings	0.76	0.08	0.11	0.17	355	*	-1.00		14	22	1	11	0.42		n
05-2964-116300	03141000090000	PHILLIPS PETRLM CO	Copeland	1	900	950	925	cuttings	1.05	0.03	0.16	0.43	520	*	2.20		15	41	0	3	0.16		n
05-2964-116301	03141000090000	PHILLIPS PETRLM CO	Copeland	1	950	1000	975	cuttings	1.38	0.03	0.24	0.28	529	*	2.36		17	20	1	2	0.11		n
05-2964-116302	03141000090000	PHILLIPS PETRLM CO	Copeland	1	1000	1050	1025	cuttings	1.07	0.04	0.29	0.40	528	*	2.34		27	37	1	4	0.12	c	n
05-2964-116303	03141000090000	PHILLIPS PETRLM CO	Copeland	1	1050	1100	1075	cuttings	2.22	0.21	0.49	0.37	525	*	2.29		22	17	1	9	0.30	c	n;ltS2p
05-2964-116304	03141000090000	PHILLIPS PETRLM CO	Copeland	1	1100	1150	1125	cuttings	2.93	0.39	0.71	0.38	475		1.39		24	13	2	13	0.35		n;ltS2p
05-2964-116305	03141000090000	PHILLIPS PETRLM CO	Copeland	1	1150	1200	1175	cuttings	1.88	0.18	0.71	0.34	378		-1.00		38	18	2	10	0.20		n;ltS2p
05-2964-116306	03141000090000	PHILLIPS PETRLM CO	Copeland	1	1200	1250	1225	cuttings	2.52	0.30	0.72	0.37	422		0.44		29	15	2	12	0.29		n;ltS2p
05-2964-116307	03141000090000	PHILLIPS PETRLM CO	Copeland	1	1250	1300	1275	cuttings	3.11	0.36	0.70	0.41	516		2.13		23	13	2	12	0.34		n;ltS2p
05-2964-116308	03141000090000	PHILLIPS PETRLM CO	Copeland	1	1300	1350	1325	cuttings	4.78	0.70	1.21	0.44	467		1.25		25	9	3	15	0.37		n;ltS2p
05-2964-116309	03141000090000	PHILLIPS PETRLM CO	Copeland	1	1350	1390	1370	cuttings	4.34	0.47	0.88	0.39	517		2.15		20	9	2	11	0.35		n;ltS2p
05-2964-116310	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	1300	1350	1325	cuttings	1.64	0.29	0.82	0.22	470		1.30		50	13	4	18	0.26		n;ltS2p
05-2964-116311	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	1350	1400	1375	cuttings	2.32	0.75	1.47	0.32	460		1.12		63	14	5	32	0.34		n;ltS2p
05-2964-116312	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	1400	1450	1425	cuttings	2.20	0.77	1.04	0.29	458		1.08		47	13	4	35	0.43		n;ltS2p
05-2964-116313	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	1450	1500	1475	cuttings	1.07	0.17	0.41	0.21	468	*	1.26		38	20	2	16	0.29	c	n;ltS2p
05-2964-116314	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	1500	1550	1525	cuttings	1.28	0.08	0.42	0.21	503	*	1.89		33	16	2	6	0.16		n;ltS2p
05-2964-116315	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	1550	1600	1575	cuttings	1.42	0.14	0.49	0.24	491	*	1.68		35	17	2	10	0.22		n;ltS2p
05-2964-116316	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	1600	1650	1625	cuttings	1.32	0.17	0.39	0.15	475	*	1.39		30	11	3	13	0.30		n;ltS2p
05-2964-116317	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	1650	1700	1675	cuttings	1.03	0.16	0.30	0.13	467	*	1.25		29	13	2	16	0.35		n;ltS2p
05-2964-116318	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	1700	1750	1725	cuttings	1.58	0.51	0.87	0.28	455		1.03		55	18	3	32	0.37		n;ltS2p
05-2964-116319	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	1750	1800	1775	cuttings	2.33	0.80	1.48	0.33	456		1.05		64	14	4	34	0.35		n;ltS2p
05-2964-116320	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	1800	1860	1830	cuttings	2.38	0.98	1.66	0.35	459		1.10		70	15	5	41	0.37		n;ltS2p
05-2964-116321	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	1860	1900	1880	cuttings	5.04	1.73	4.12	0.43	455		1.03		82	9	10	34	0.30		n;ltS2p
05-2964-116322	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	1900	1950	1925	cuttings	3.39	1.21	1.80	0.35	458		1.08		53	10	5	36	0.40	c	n;ltS2p
05-2964-116323	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	1950	2000	1975	cuttings	1.30	0.51	0.58	0.24	463		1.17		45	18	2	39	0.47	c	n;ltS2p
05-2964-116324	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	2000	2050	2025	cuttings	0.50	0.08	0.17	0.14	417	*	0.35		34	28	1	16	0.32	c	n;ltS2p
05-2964-116325	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	2050	2100	2075	cuttings	0.79	0.13	0.23	0.14	442	*	0.80		29	18	2	16	0.36	c	n
05-2964-116326	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	2100	2150	2125	cuttings	1.47	0.35	0.73	0.20	458		1.08		50	14	4	24	0.32		n;ltS2p
05-2964-116327	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	2150	2200	2175	cuttings	1.14	0.42	0.57	0.16	455		1.03		50	14	4	37	0.42		n;ltS2p
05-2964-116328	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	2200	2250	2225	cuttings	1.54	0.56	0.65	0.19	460		1.12		42	12	3	36	0.46		n;ltS2p
05-2964-116329	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	2250	2300	2275	cuttings	1.21	0.39	0.60	0.23	460		1.12		50	19	3	32	0.39		n;ltS2p
05-2964-116330	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	2300	2350	2325	cuttings	0.85	0.16	0.15	0.22	312	*	-1.00		18	26	1	19	0.52	c	n
05-2964-116331	03023100020000	MCRAY C E & ASSOC	A.C. Smith	1-2	2350	2400	2375	cuttings	0.75	0.22	0.23	0.29	360	*	-1.00		31	39	1	29	0.49	c	n;ltS2p
05-2964-116332	03141000110000	PECOS EXPL CORP	Charles Hurley	1	810	862	836	cuttings	0.61	0.33	0.20	0.35	0	*	-1.00		33	57	1	54	0.62	c	n
05-2964-116333	03141000110000	PECOS EXPL CORP	Charles Hurley	1	1000	1051	1025.5	cuttings	0.33	0.01	0.06	0.18	437	*	0.71		18	55	0	3	0.14	lc, c	n
05-2964-116334	03141000110000	PECOS EXPL CORP	Charles Hurley	1	1499	1593	1546	cuttings	1.27	0.07	0.22	0.29	553	*	2.79		17	23	1	6	0.24	c	n

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HGS No.	API Number	Operator	Well Name	Well Number	Top Depth (ft.)	Bottom Depth (ft.)	Median Depth (ft.)	Sample Type	Leco TOC	S1	S2	S3	Tmax (°C)		Cal. %Ro	Meas. %Ro	HI	OI	S2/S3	S1/TOC	PI	Notes Checks	Notes Pyrogram
05-2964-116335	03141000110000	PECOS EXPL CORP	Charles Hurley	1	1593	1643	1618	cuttings	2.29	0.25	0.22	0.13	549	*	2.72		10	6	2	11	0.53		n
05-2964-116336	03141000110000	PECOS EXPL CORP	Charles Hurley	1	1643	1690	1666.5	cuttings	2.87	0.37	0.36	0.18	572	*	3.14		13	6	2	13	0.51		n
05-2964-116337	03141000110000	PECOS EXPL CORP	Charles Hurley	1	1690	1740	1715	cuttings	2.64	0.34	0.32	0.20	575	*	3.19		12	8	2	13	0.52		n
05-2964-116338	03141000110000	PECOS EXPL CORP	Charles Hurley	1	1740	1790	1765	cuttings	1.94	0.18	0.20	0.22	565	*	3.01		10	11	1	9	0.47		n
05-2964-116339	03141000110000	PECOS EXPL CORP	Charles Hurley	1	1790	1840	1815	cuttings	2.82	0.29	0.33	0.18	573	*	3.15		12	6	2	10	0.47		n
05-2964-116340	03141000110000	PECOS EXPL CORP	Charles Hurley	1	1840	1891	1865.5	cuttings	3.72	0.49	0.47	0.19	582	*	3.32		13	5	2	13	0.51	lc, c	n
05-2964-116341	03141000110000	PECOS EXPL CORP	Charles Hurley	1	1891	1945	1918	cuttings	3.40	0.36	0.34	0.18	561	*	2.94		10	5	2	11	0.51		n
05-2964-116342	03141000110000	PECOS EXPL CORP	Charles Hurley	1	1945	2000	1972.5	cuttings	3.55	0.29	0.34	0.18	577	*	3.23		10	5	2	8	0.46		n
05-2964-116343	03141000110000	PECOS EXPL CORP	Charles Hurley	1	2438	2463	2450.5	cuttings	1.71	0.26	0.28	0.12	532	*	2.42		16	7	2	15	0.48		n
05-2964-116344	03141000110000	PECOS EXPL CORP	Charles Hurley	1	2475	2497	2486	cuttings	0.19	0.03	0.03	0.03	367	*	-1.00		16	16	1	16	0.50	c	n

Note: "-1" indicates not measured or meaningless ratio

* Tmax data not reliable due to poor S2 peak

TOC = weight percent organic carbon in rock
S1, S2 = mg hydrocarbons per gram of rock
S3 = mg carbon dioxide per gram of rock
Tmax = °C

HI = hydrogen index = S2 x 100 / TOC
OI = oxygen index = S3 x 100 / TOC
S1/TOC = normalized oil content = S1 x 100 / TOC
PI = production index = S1 / (S1+S2)
Cal. %Ro = calculated vitrinite reflectance based on Tmax
Measured %Ro = measured vitrinite reflectance

Notes:
c = Rock-Eval analysis checked and confirmed
lc = Leco TOC analysis checked and confirmed

Pyrogram:
n=normal
ltS2sh = low temperature S2 shoulder
ltS2p = low temperature S2 peak
htS2p = high temperature S2 peak
f = flat S2 peak
na = printer malfunction pyrogram not available

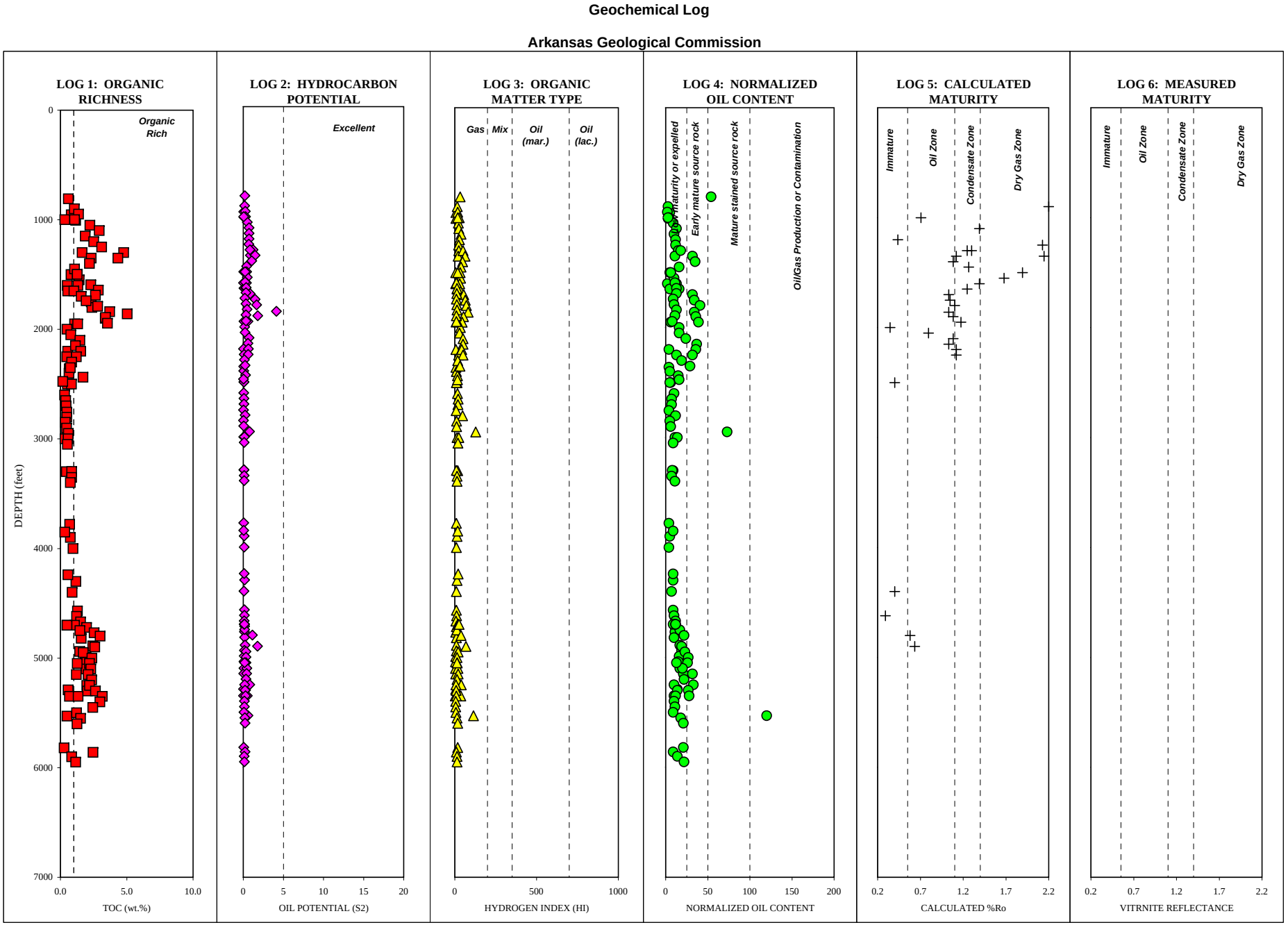

Figure 1. Geochemical log of TOC, remaining potential (S2), kerogen type (HI), normalized oil content, and calculated and measured vitrinite reflectance.

Humble Geochemical Services Division

KEROGEN QUALITY

Arkansas Geological Commission

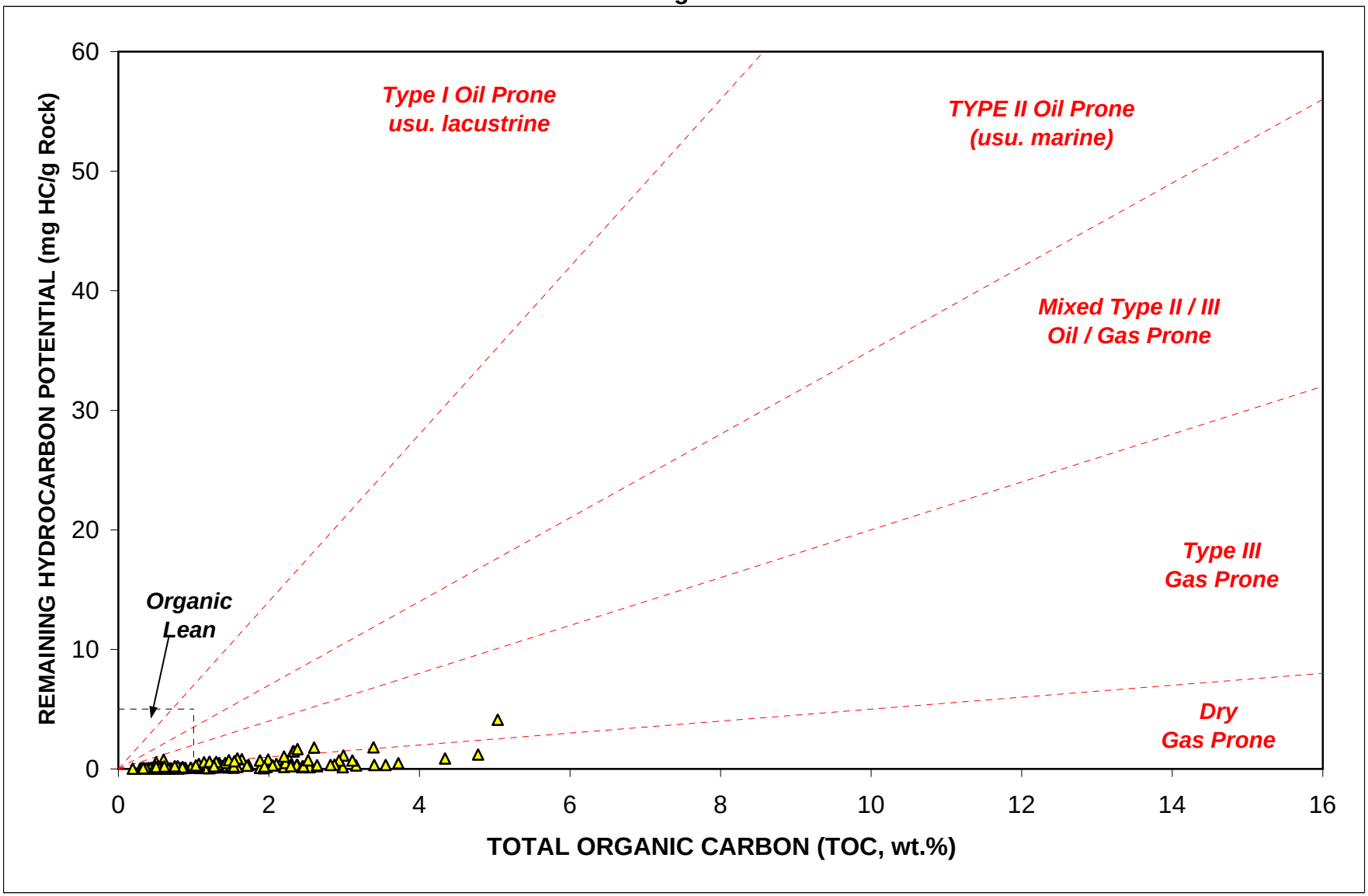

Figure 2. Kerogen Quality

Humble Geochemical Services Division

KEROGEN TYPE
Arkansas Geological Commission

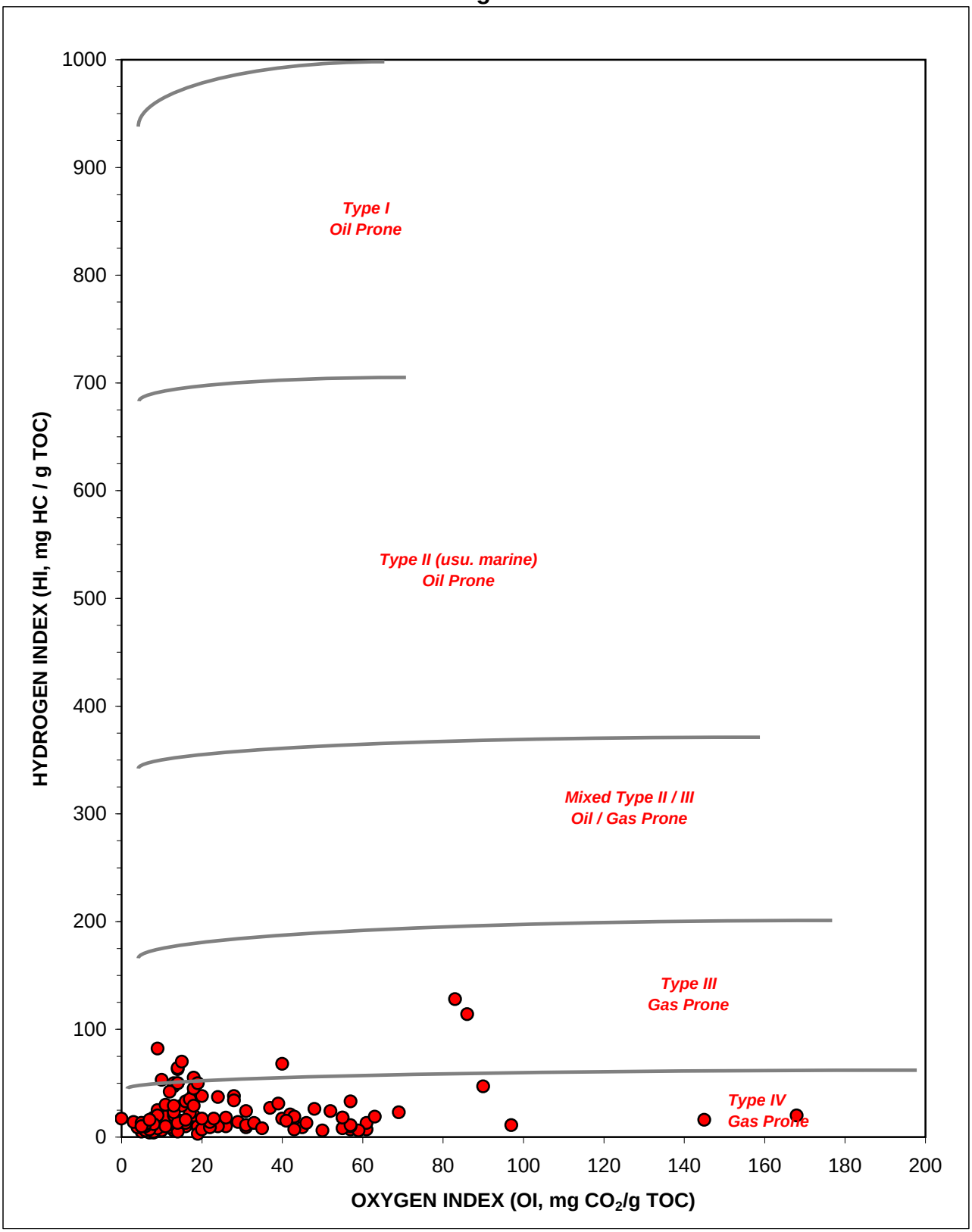

Figure 3. Kerogen type

KEROGEN TYPE and MATURITY

Arkansas Geological Commission

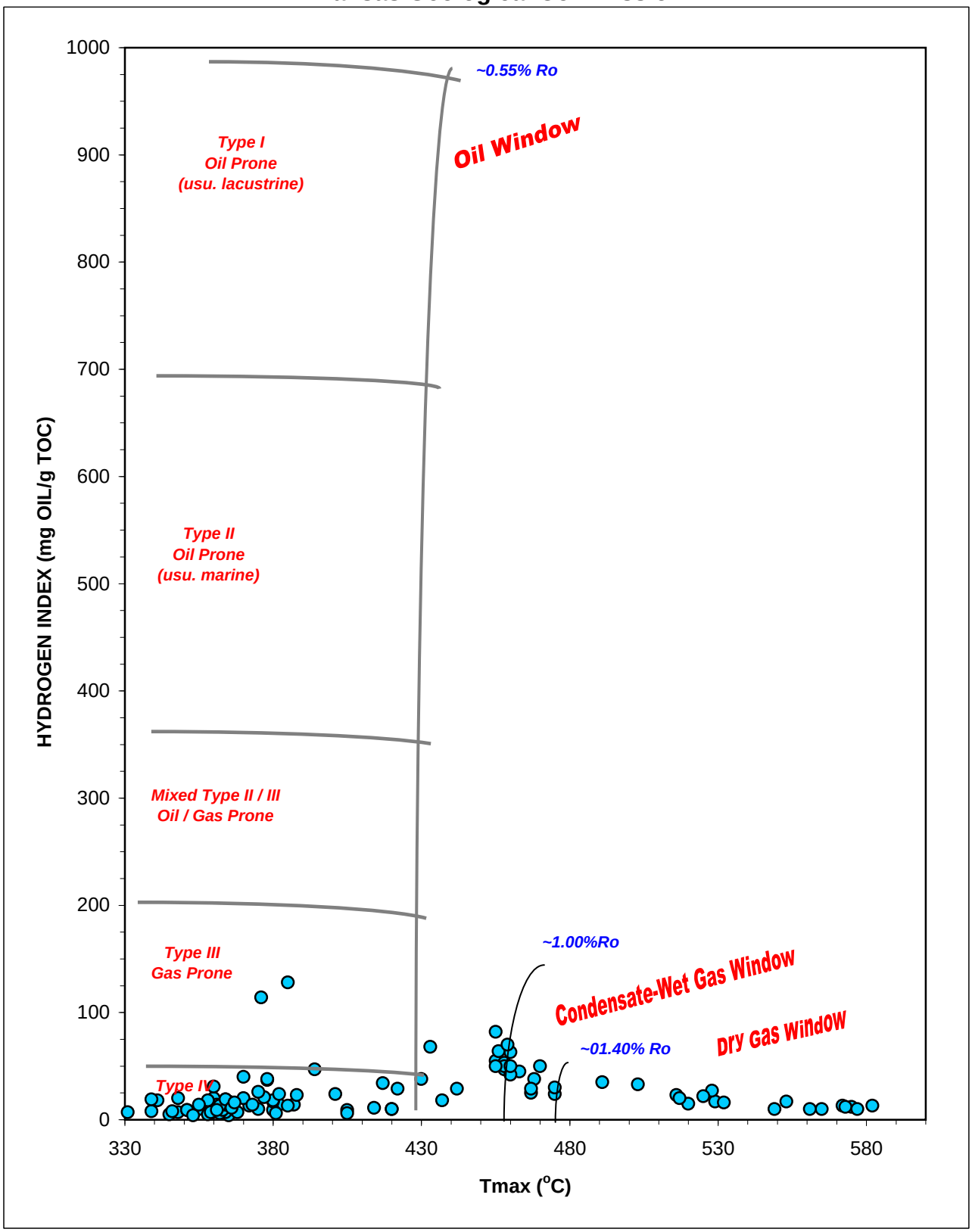

Figure 4a. Kerogen Type and Maturity (Tmax)

Humble Geochemical Services Division

KEROGEN TYPE and MATURITY

Arkansas Geological Commission

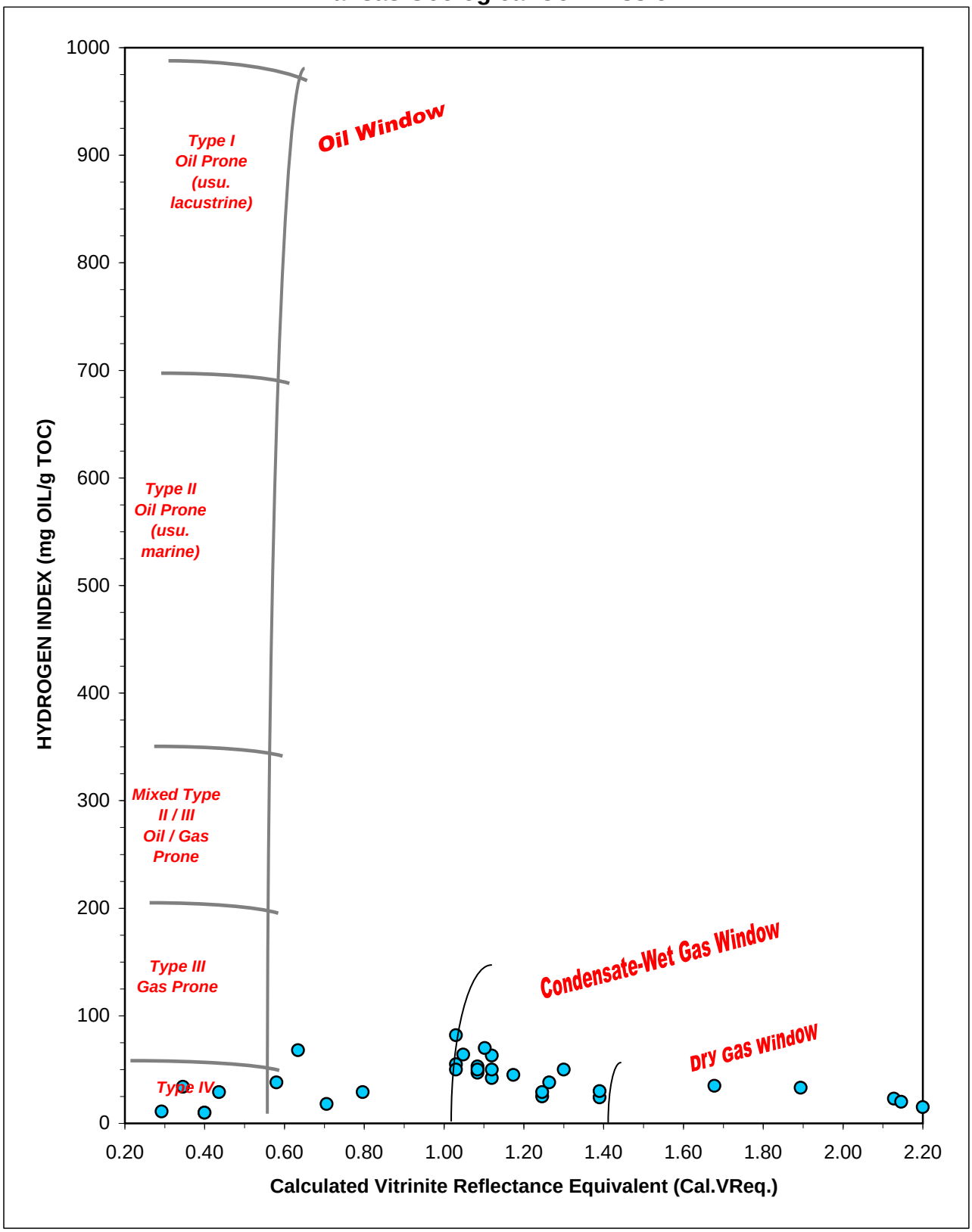

Figure 4b. Kerogen Type and Maturity (Tmax calculated %VRo)

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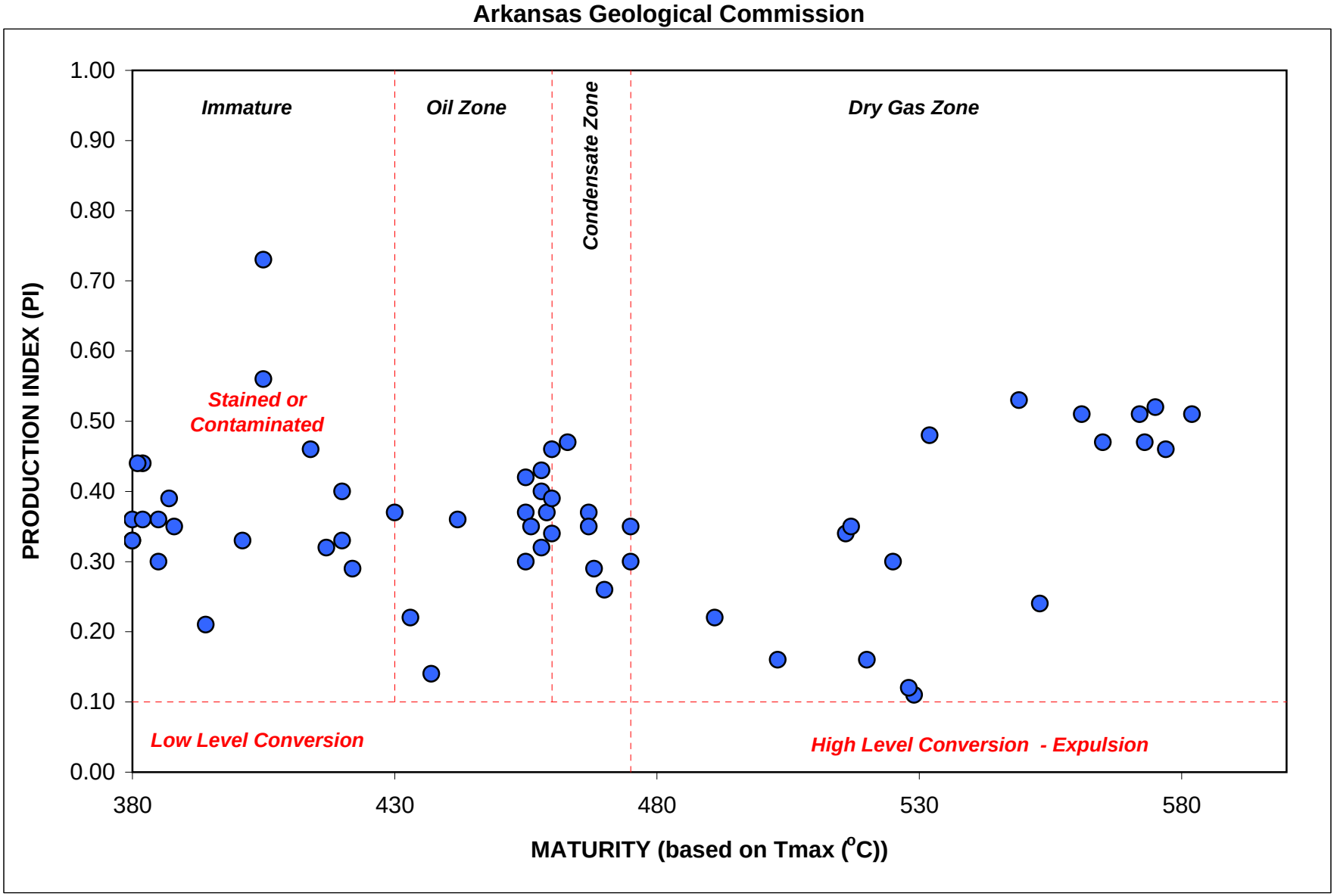

Figure 5a. Kerogen conversion and maturity (based on Tmax).

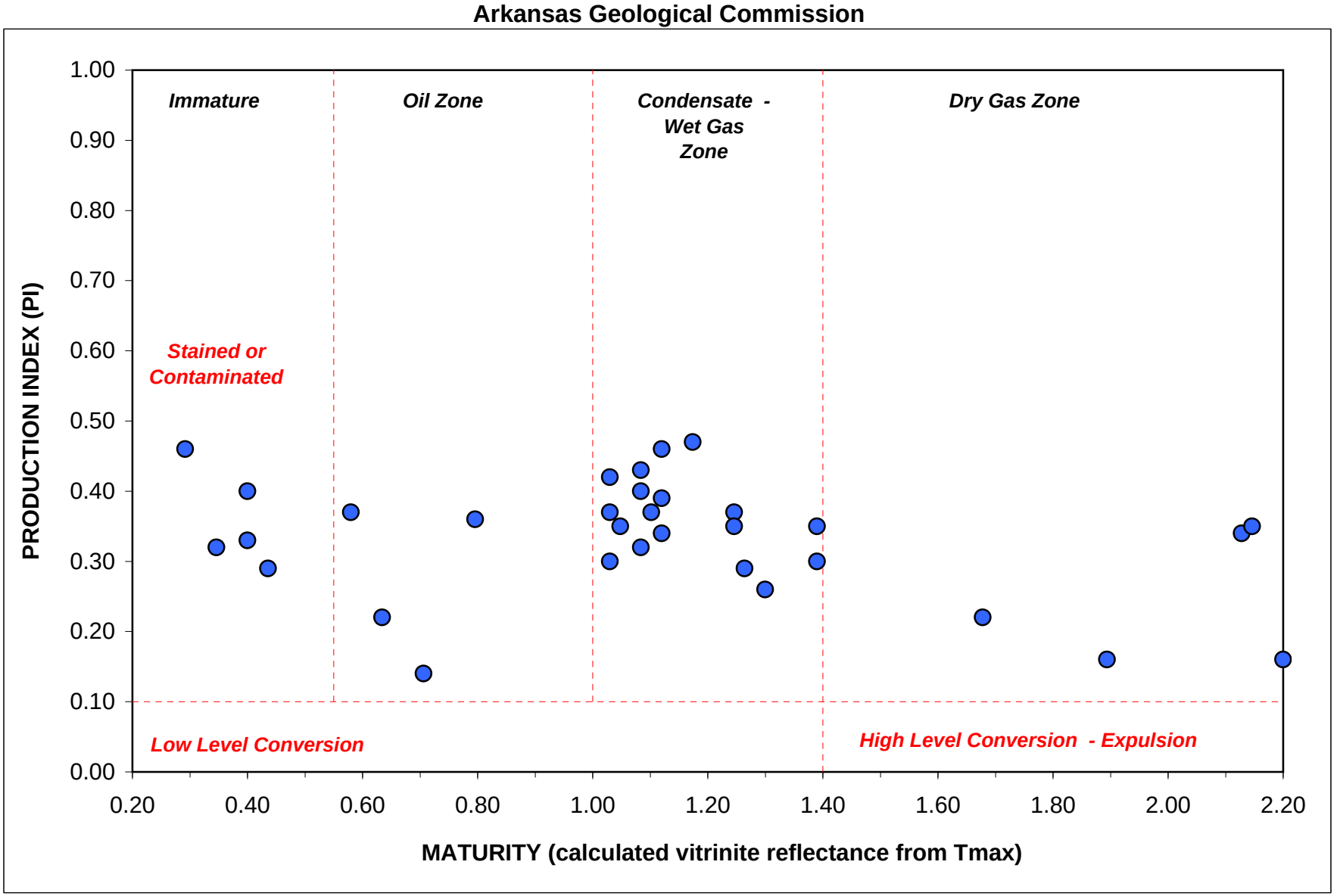

Figure 5b. Kerogen conversion and maturity (calculated %VRo from Tmax).

TOC and ROCK-EVAL DATA REPORT

Arkansas Geological Commission

HGS No.	API Number	Operator	Well Name	Well Number	Top Depth (ft.)	Bottom Depth (ft.)	Median Depth (ft.)	Sample Type	Leco TOC	S1	S2	S3	Tmax (°C)		Cal. %Ro	Meas. %Ro	HI	OI	S2/S3	S1/TOC	PI	Notes Checks	Notes Pyrogram
05-2965-116345	03145000240000	STEPHENS PRDCTN CO	Albert Estate	1	2650	2680	2665	cuttings	2.49	0.34	0.47	0.14	500	*	1.84		19	6	3	14	0.42	c	n
05-2965-116346	03145000240000	STEPHENS PRDCTN CO	Albert Estate	1	2800	2830	2815	cuttings	3.38	0.52	0.42	0.40	450	*	0.94		12	12	1	15	0.55	c, lc	n
05-2965-116347	03145000240000	STEPHENS PRDCTN CO	Albert Estate	1	3000	3030	3015	cuttings	1.37	0.11	0.60	0.26	495		1.75		44	19	2	8	0.15	c, lc	n
05-2965-116348	03145000240000	STEPHENS PRDCTN CO	Albert Estate	1	3150	3180	3165	cuttings	2.25	0.36	0.51	0.22	540		2.56		23	10	2	16	0.41		n;ltS2p
05-2965-116349	03145000240000	STEPHENS PRDCTN CO	Albert Estate	1	3200	3230	3215	cuttings	2.63	0.55	0.44	0.18	560	*	2.92		17	7	2	21	0.56		n
05-2965-116350	03145000240000	STEPHENS PRDCTN CO	Albert Estate	1	3230	3260	3245	cuttings	2.22	0.33	0.50	0.17	544		2.63		23	8	3	15	0.40		n
05-2965-116351	03145000240000	STEPHENS PRDCTN CO	Albert Estate	1	3260	3290	3275	cuttings	2.71	0.51	0.41	0.23	545	*	2.65		15	8	2	19	0.55		n
05-2965-116352	03145000240000	STEPHENS PRDCTN CO	Albert Estate	1	3290	3320	3305	cuttings	3.02	0.76	0.51	0.24	448		0.90		17	8	2	25	0.60		n
05-2965-116353	03145000240000	STEPHENS PRDCTN CO	Albert Estate	1	3320	3350	3335	cuttings	2.63	0.54	0.46	0.18	462	*	1.16		17	7	3	21	0.54		n
05-2965-116354	03145000240000	STEPHENS PRDCTN CO	Albert Estate	1	3350	3380	3365	cuttings	2.69	0.51	0.26	0.21	450	*	0.94		10	8	1	19	0.66		n
05-2965-116355	03145000240000	STEPHENS PRDCTN CO	Albert Estate	1	3380	3410	3395	cuttings	2.45	0.47	0.39	0.20	421	*	0.42		16	8	2	19	0.55	c	n
05-2965-116356	03145000240000	STEPHENS PRDCTN CO	Albert Estate	1	3410	3440	3425	cuttings	1.57	0.31	0.16	0.22	329	*	-1.00		10	14	1	20	0.66		n
05-2965-116357	03145000240000	STEPHENS PRDCTN CO	Albert Estate	1	3440	3470	3455	cuttings	0.65	0.10	0.14	0.17	372	*	-1.00		22	26	1	15	0.42	c	n
05-2965-116358	03145000240000	STEPHENS PRDCTN CO	Albert Estate	1	3470	3500	3485	cuttings	1.02	0.12	0.15	0.21	397	*	-1.00		15	21	1	12	0.44		n
05-2965-116359	03145000240000	STEPHENS PRDCTN CO	Albert Estate	1	3500	3530	3515	cuttings	1.03	0.23	0.17	0.18	396	*	-1.00		17	17	1	22	0.58		n
05-2965-116360	03145000240000	STEPHENS PRDCTN CO	Albert Estate	1	3570	3590	3580	cuttings	4.31	0.14	0.50	0.23	575		3.19		12	5	2	3	0.22		n
05-2965-116361	03145000240000	STEPHENS PRDCTN CO	Albert Estate	1	3590	3610	3600	cuttings	1.10	0.08	0.17	0.09	378	*	-1.00		15	8	2	7	0.32	c	n
05-2965-116362	03023100040000	TEXAS O&G CORP	Landrum	1	4100	4150	4125	cuttings	1.15	0.07	0.21	0.17	448	*	0.90		18	15	1	6	0.25		n
05-2965-116363	03023100040000	TEXAS O&G CORP	Landrum	1	4400	4460	4430	cuttings	1.28	0.05	0.24	0.23	453	*	0.99		19	18	1	4	0.17		n
05-2965-116364	03023100040000	TEXAS O&G CORP	Landrum	1	4600	4650	4625	cuttings	1.13	0.09	0.19	0.30	407	*	0.17		17	27	1	8	0.32	c	n
05-2965-116365	03023100040000	TEXAS O&G CORP	Landrum	1	4650	4700	4675	cuttings	1.30	0.10	0.21	0.43	449	*	0.92		16	33	0	8	0.32	c	n
05-2965-116366	03023100040000	TEXAS O&G CORP	Landrum	1	4700	4750	4725	cuttings	1.18	0.06	0.12	0.17	391	*	-1.00		10	14	1	5	0.33		n
05-2965-116367	03023100040000	TEXAS O&G CORP	Landrum	1	4750	4800	4775	cuttings	2.09	0.19	0.30	0.21	443	*	0.81		14	10	1	9	0.39		n
05-2965-116368	03023100040000	TEXAS O&G CORP	Landrum	1	4800	4850	4825	cuttings	1.55	0.11	0.17	0.16	421	*	0.42		11	10	1	7	0.39		n
05-2965-116369	03023100040000	TEXAS O&G CORP	Landrum	1	4850	4900	4875	cuttings	1.94	0.19	0.31	0.22	369	*	-1.00		16	11	1	10	0.38	c, lc	n
05-2965-116370	03023100040000	TEXAS O&G CORP	Landrum	1	4900	4950	4925	cuttings	1.35	0.17	0.18	0.08	407	*	0.17		13	6	2	13	0.49		n;ltS2p
05-2965-116371	03023100040000	TEXAS O&G CORP	Landrum	1	4950	5000	4975	cuttings	1.45	0.19	0.14	0.09	362	*	-1.00		10	6	2	13	0.58		n
05-2965-116372	03023100040000	TEXAS O&G CORP	Landrum	1	5000	5050	5025	cuttings	1.20	0.18	0.09	0.19	350	*	-1.00		7	16	0	15	0.67	c, lc	n
05-2965-116373	03023100030000	TEXAS O&G CORP	Liles	1	4050	4100	4075	cuttings	0.84	0.09	0.11	0.20	396	*	-1.00		13	24	1	11	0.45		n
05-2965-116374	03023100030000	TEXAS O&G CORP	Liles	1	4300	4360	4330	cuttings	1.08	0.09	0.22	0.14	372	*	-1.00		20	13	2	8	0.29		n
05-2965-116375	03023100030000	TEXAS O&G CORP	Liles	1	4560	4600	4580	cuttings	1.13	0.20	0.30	0.45	446	*	0.87		27	40	1	18	0.40	c	n
05-2965-116376	03023100030000	TEXAS O&G CORP	Liles	1	4600	4650	4625	cuttings	1.87	0.28	0.47	0.18	438	*	0.72		25	10	3	15	0.37		n;ltS2p
05-2965-116377	03023100030000	TEXAS O&G CORP	Liles	1	4650	4690	4670	cuttings	1.30	0.19	0.30	0.16	395	*	-1.00		23	12	2	15	0.39		n
05-2965-116378	03023100030000	TEXAS O&G CORP	Liles	1	4700	4750	4725	cuttings	1.62	0.19	0.15	0.31	376	*	-1.00		9	19	0	12	0.56	c, lc	n
05-2965-116379	03023100030000	TEXAS O&G CORP	Liles	1	4750	4800	4775	cuttings	1.43	0.17	0.26	0.22	445	*	0.85		18	15	1	12	0.40		n
05-2965-116380	03023100030000	TEXAS O&G CORP	Liles	1	4800	4820	4810	cuttings	2.02	0.43	0.50	0.24	338		-1.00		25	12	2	21	0.46		n
05-2965-116381	03023100030000	TEXAS O&G CORP	Liles	1	4850	4870	4860	cuttings	2.00	0.48	0.30	0.41	344	*	-1.00		15	20	1	24	0.62		n
05-2965-116382	03023100030000	TEXAS O&G CORP	Liles	1	4900	4950	4925	cuttings	1.42	0.29	0.37	0.26	388	*	-1.00		26	18	1	20	0.44		n
05-2965-116383	03023100030000	TEXAS O&G CORP	Liles	1	4950	4990	4970	cuttings	2.31	0.69	0.49	0.20	354	*	-1.00		21	9	2	30	0.58	c, lc	n
05-2965-116384	03023100030000	TEXAS O&G CORP	Liles	1	5000	5050	5025	cuttings	2.72	1.02	1.41	0.97	366		-1.00		52	36	1	37	0.42	c	n
05-2965-116385	03023100030000	TEXAS O&G CORP	Liles	1	5050	5100	5075	cuttings	2.30	0.73	1.20	0.61	354		-1.00		52	27	2	32	0.38	c	n
05-2965-116386	03023100030000	TEXAS O&G CORP	Liles	1	5100	5150	5125	cuttings	2.27	0.67	1.07	0.43	359		-1.00		47	19	2	30	0.39		n;ltS2p
05-2965-116387	03023100030000	TEXAS O&G CORP	Liles	1	5150	5200	5175	cuttings	1.91	0.62	0.74	0.39	351		-1.00		39	20	2	32	0.46		n;ltS2p
05-2965-116388	03023100030000	TEXAS O&G CORP	Liles	1	5270	5300	5285	cuttings	1.63	1.04	1.30	0.55	376		-1.00		80	34	2	64	0.44	c, lc	n;ltS2p
05-2965-116389	03023100030000	TEXAS O&G CORP	Liles	1	5300	5350	5325	cuttings	0.33	0.16	0.24	0.19	347	*	-1.00		73	58	1	48	0.40		n
05-2965-116390	03023100030000	TEXAS O&G CORP	Liles	1	5350	5400	5375	cuttings	3.17	0.59	0.86	0.37	359		-1.00		27	12	2	19	0.41		n;ltS2p
05-2965-116391	03145000070000	DEEP ROCK OIL CORP	Sample	1	1500	1550	1525	cuttings	1.32	0.04	0.45	0.50	502	*	1.88		34	38	1	3	0.08		n
05-2965-116392	03145000070000	DEEP ROCK OIL CORP	Sample	1	1800	1850	1825	cuttings	1.77	0.19	0.73	0.35	491		1.68		41	20	2	11	0.21		n;ltS2p
05-2965-116393	03145000070000	DEEP ROCK OIL CORP	Sample	1	1900	2000	1950	cuttings	2.14	0.22	0.79	0.36	491		1.68		37	17	2	10	0.22		n;ltS2p
05-2965-116394	03145000070000	DEEP ROCK OIL CORP	Sample	1	2000	2100	2050	cuttings	2.20	0.50	1.42	0.80	512		2.06		65	36	2	23	0.26		n;ltS2p
05-2965-116395	03145000070000	DEEP ROCK OIL CORP	Sample	1	2100	2200	2150	cuttings	3.68	0.55	1.43	0.57	468		1.26		39	15	3	15	0.28	c	n;ltS2p
05-2965-116396	03145000070000	DEEP ROCK OIL CORP	Sample	1	2200	2300	2250	cuttings	2.91	0.37	0.96	0.55	447		0.89		33	19	2	13	0.28		n;ltS2p
05-2965-116397	03145000070000	DEEP ROCK OIL CORP	Sample	1	2300	2400	2350	cuttings	2.34	0.17	0.88	0.49	448		0.90		38	21	2	7	0.16		n;ltS2p
05-2965-116398	03145000070000	DEEP ROCK OIL CORP	Sample	1	2400	2500	2450	cuttings	2.11	0.20	0.83	0.38	448		0.90		39	18	2	9	0.19		n;ltS2p
05-2965-116399	03145000070000	DEEP ROCK OIL CORP	Sample	1	2500	2600	2550	cuttings	2.30	0.25	1.21	0.36	451		0.96		53	16	3	11	0.17		n;ltS2p
05-2965-116400	03145000070000	DEEP ROCK OIL CORP	Sample	1	2600	2700	2650	cuttings	2.36	0.30	0.98	0.37	446		0.87		42	16	3	13	0.23		n;ltS2p
05-2965-116401	03145000070000	DEEP ROCK OIL CORP	Sample	1	2700	2800	2750	cuttings	2.52	0.66	1.05	0.58	345		-1.00		42	23	2	26	0.39		n;ltS2p
05-2965-116402	03145000070000	DEEP ROCK OIL CORP	Sample	1	2800	2900	2850	cuttings	1.70	0.10	0.45	0.41	449	*	0.92		26	24	1	6	0.18		n
05-2965-116403	03145100020000	WYOMING OIL & GAS	Bobby & Lorete Reaper	1	2000	2050	2025	cuttings	0.68	0.03	0.31	0.30	495	*	1.75		46	44	1	4	0.09		n
05-2965-116404	03145100020000	WYOMING OIL & GAS	Bobby & Lorete Reaper	1	2500	2550	2525	cuttings	1.04	0.13	0.71	1.07	404		0.11		68	103	1	13	0.15	c	n;ltS2p

Arkansas Geological Commission

HGS No.	API Number	Operator	Well Name	Well Number	Top Depth (ft.)	Bottom Depth (ft.)	Median Depth (ft.)	Sample Type	Leco TOC	S1	S2	S3	Tmax (°C)		Cal. %Ro	Meas. %Ro	HI	OI	S2/S3	S1/TOC	PI	Notes Checks	Notes Pyrogram
05-2965-116405	03145100020000	WYOMING OIL & GAS	Bobby & Lorete Reaper	1	2700	2750	2725	cuttings	2.57	0.34	1.10	0.45	510		2.02		43	18	2	13	0.24	c, lc	n;ltS2p
05-2965-116406	03145100020000	WYOMING OIL & GAS	Bobby & Lorete Reaper	1	2800	2890	2845	cuttings	2.51	0.36	1.25	1.21	399		-1.00		50	48	1	14	0.22		n;ltS2p
05-2965-116407	03145100020000	WYOMING OIL & GAS	Bobby & Lorete Reaper	1	2900	2950	2925	cuttings	3.45	0.53	1.68	1.00	340		-1.00		49	29	2	15	0.24		n;ltS2p
05-2965-116408	03145100020000	WYOMING OIL & GAS	Bobby & Lorete Reaper	1	2950	3000	2975	cuttings	3.22	0.59	2.21	0.95	400		-1.00		69	30	2	18	0.21		n;ltS2p
05-2965-116409	03145100020000	WYOMING OIL & GAS	Bobby & Lorete Reaper	1	3000	3050	3025	cuttings	2.30	0.40	1.55	0.82	501		1.86		67	36	2	17	0.21		n;ltS2p
05-2965-116410	03145100020000	WYOMING OIL & GAS	Bobby & Lorete Reaper	1	3050	3100	3075	cuttings	2.04	0.29	1.42	0.78	502		1.88		70	38	2	14	0.17		n;ltS2p
05-2965-116411	03145100020000	WYOMING OIL & GAS	Bobby & Lorete Reaper	1	3100	3150	3125	cuttings	1.84	0.28	1.17	0.89	482		1.52		64	48	1	15	0.19		
05-2965-116412	03145100020000	WYOMING OIL & GAS	Bobby & Lorete Reaper	1	3150	3200	3175	cuttings	2.26	0.34	1.20	0.93	420		0.40		53	41	1	15	0.22		n;ltS2p
05-2965-116413	03145100020000	WYOMING OIL & GAS	Bobby & Lorete Reaper	1	3200	3250	3225	cuttings	2.45	0.33	1.36	0.99	342		-1.00		56	40	1	13	0.20		n;ltS2p
05-2965-116414	03145100020000	WYOMING OIL & GAS	Bobby & Lorete Reaper	1	3250	3300	3275	cuttings	2.25	0.14	0.38	0.73	448	*	0.90		17	32	1	6	0.27		n
05-2965-116415	03145100020000	WYOMING OIL & GAS	Bobby & Lorete Reaper	1	3300	3350	3325	cuttings	2.74	0.37	0.70	0.41	432		0.62		26	15	2	14	0.35	c, lc	n;ltS2p
05-2965-116416	03145100020000	WYOMING OIL & GAS	Bobby & Lorete Reaper	1	3350	3380	3365	cuttings	1.45	0.14	0.36	0.49	535	*	2.47		25	34	1	10	0.28		n;ltS2p
05-2965-116417	03141100020000	POGO PRODUCING CO	Collums	1-27	1200	1250	1225	cuttings	0.38	0.01	0.04	0.49	372	*	-1.00		11	129	0	3	0.20		f
05-2965-116418	03141100020000	POGO PRODUCING CO	Collums	1-27	1430	1480	1455	cuttings	0.49	0.00	0.06	0.62	367	*	-1.00		12	127	0	0	0.00		n
05-2965-116419	03141100020000	POGO PRODUCING CO	Collums	1-27	1800	1850	1825	cuttings	0.49	0.01	0.05	0.54	344	*	-1.00		10	110	0	2	0.17		f
05-2965-116420	03141100020000	POGO PRODUCING CO	Collums	1-27	2000	2050	2025	cuttings	0.63	0.00	0.05	0.62	316	*	-1.00		8	98	0	0	0.00		f
05-2965-116421	03141100020000	POGO PRODUCING CO	Collums	1-27	2200	2250	2225	cuttings	0.77	0.02	0.08	0.47	390	*	-1.00		10	61	0	3	0.20		f
05-2965-116422	03141100020000	POGO PRODUCING CO	Collums	1-27	2600	2650	2625	cuttings	0.96	0.02	0.12	0.57	451	*	0.96		13	59	0	2	0.14		n
05-2965-116423	03141100020000	POGO PRODUCING CO	Collums	1-27	2750	2800	2775	cuttings	1.08	0.03	0.25	0.42	507	*	1.97		23	39	1	3	0.11	c	n
05-2965-116424	03141100020000	POGO PRODUCING CO	Collums	1-27	2900	2950	2925	cuttings	1.21	0.03	0.18	0.35	445	*	0.85		15	29	1	2	0.14	c	n
05-2965-116425	03141100020000	POGO PRODUCING CO	Collums	1-27	3000	3050	3025	cuttings	1.71	0.12	0.28	0.24	504	*	1.91		16	14	1	7	0.30		n
05-2965-116426	03141100020000	POGO PRODUCING CO	Collums	1-27	3050	3100	3075	cuttings	2.54	0.20	0.30	0.24	450	*	0.94		12	9	1	8	0.40		n
05-2965-116427	03141100020000	POGO PRODUCING CO	Collums	1-27	3100	3150	3125	cuttings	2.21	0.26	0.40	0.26	440	*	0.76		18	12	2	12	0.39		n
05-2965-116428	03141100020000	POGO PRODUCING CO	Collums	1-27	3150	3200	3175	cuttings	2.02	0.20	0.37	0.30	456	*	1.05		18	15	1	10	0.35		n
05-2965-116429	03141100020000	POGO PRODUCING CO	Collums	1-27	3200	3250	3225	cuttings	1.58	0.12	0.29	0.26	438	*	0.72		18	16	1	8	0.29		n
05-2965-116430	03141100020000	POGO PRODUCING CO	Collums	1-27	3250	3300	3275	cuttings	1.94	0.17	0.28	0.25	491	*	1.68		14	13	1	9	0.38	lc	n
05-2965-116431	03141100020000	POGO PRODUCING CO	Collums	1-27	3300	3350	3325	cuttings	2.19	0.15	0.37	0.23	485	*	1.57		17	11	2	7	0.29		n
05-2965-116432	03141100020000	POGO PRODUCING CO	Collums	1-27	3350	3400	3375	cuttings	0.98	0.13	0.18	0.64	440	*	0.76		18	65	0	13	0.42		n
05-2965-116433	03141100020000	POGO PRODUCING CO	Collums	1-27	3400	3450	3425	cuttings	1.69	0.18	0.22	0.29	436	*	0.69		13	17	1	11	0.45		n
05-2965-116434	03141100020000	POGO PRODUCING CO	Collums	1-27	3450	3480	3465	cuttings	1.56	0.27	0.26	0.20	324	*	-1.00		17	13	1	17	0.51	c	n
05-2965-116435	03141100020000	POGO PRODUCING CO	Collums	1-27	3700	3720	3710	cuttings	0.87	0.16	0.12	0.16	334	*	-1.00		14	18	1	18	0.57		n
05-2965-116436	03141100020000	POGO PRODUCING CO	Collums	1-27	3830	3870	3850	cuttings	1.43	0.14	0.13	0.10	334	*	-1.00		9	7	1	10	0.52		n
05-2965-116437	03141100020000	POGO PRODUCING CO	Collums	1-27	3880	3910	3895	cuttings	3.89	0.33	0.35	0.20	512	*	2.06		9	5	2	8	0.49		n
05-2965-116438	03141100020000	POGO PRODUCING CO	Collums	1-27	3910	3940	3925	cuttings	2.02	0.17	0.19	0.11	403	*	0.09		9	5	2	8	0.47		n
05-2965-116439	03141000080000	PHILLIPS PETRLM CO	Copeland	2	600	650	625	cuttings	1.23	0.02	0.32	0.26	524	*	2.27		26	21	1	2	0.06		n
05-2965-116440	03141000080000	PHILLIPS PETRLM CO	Copeland	2	650	700	675	cuttings	1.59	0.02	0.48	0.28	517	*	2.15		30	18	2	1	0.04		n
05-2965-116441	03141000080000	PHILLIPS PETRLM CO	Copeland	2	700	750	725	cuttings	3.56	0.30	1.30	0.26	489		1.64		37	7	5	8	0.19		n
05-2965-116442	03141000080000	PHILLIPS PETRLM CO	Copeland	2	750	800	775	cuttings	1.49	0.12	0.66	0.16	516		2.13		44	11	4	8	0.15		n
05-2965-116443	03141000080000	PHILLIPS PETRLM CO	Copeland	2	800	850	825	cuttings	1.53	0.05	0.39	0.24	493	*	1.71		25	16	2	3	0.11	c	n
05-2965-116444	03141000080000	PHILLIPS PETRLM CO	Copeland	2	850	900	875	cuttings	1.61	0.10	0.32	0.24	462	*	1.16		20	15	1	6	0.24	c	n
05-2965-116445	03141000080000	PHILLIPS PETRLM CO	Copeland	2	900	950	925	cuttings	1.56	0.13	0.38	0.19	471	*	1.32		24	12	2	8	0.25		n
05-2965-116446	03141000080000	PHILLIPS PETRLM CO	Copeland	2	950	1000	975	cuttings	2.98	0.49	1.36	0.26	468		1.26		46	9	5	16	0.26		n
05-2965-116447	03141000080000	PHILLIPS PETRLM CO	Copeland	2	1000	1050	1025	cuttings	3.56	0.39	1.29	0.30	492		1.70		36	8	4	11	0.23		n
05-2965-116448	03141000100000	PHILLIPS PETRLM CO	Copeland	3	800	840	820	cuttings	1.01	0.02	0.27	0.48	476	*	1.41		27	48	1	2	0.07		n
05-2965-116449	03141000100000	PHILLIPS PETRLM CO	Copeland	3	850	900	875	cuttings	1.26	0.02	0.28	0.50	509	*	2.00		22	40	1	2	0.07		n
05-2965-116450	03141000100000	PHILLIPS PETRLM CO	Copeland	3	900	950	925	cuttings	1.64	0.12	0.77	0.64	478		1.44		47	39	1	7	0.13		n
05-2965-116451	03141000100000	PHILLIPS PETRLM CO	Copeland	3	950	1000	975	cuttings	3.97	0.54	1.37	0.43	480		1.48		35	11	3	14	0.28	lc	n
05-2965-116452	03141000100000	PHILLIPS PETRLM CO	Copeland	3	1000	1050	1025	cuttings	1.93	0.13	0.72	0.33	491		1.68		37	17	2	7	0.15		n
05-2965-116453	03141000100000	PHILLIPS PETRLM CO	Copeland	3	1050	1100	1075	cuttings	3.02	0.29	0.97	0.36	472		1.34		32	12	3	10	0.23		n
05-2965-116454	03141000100000	PHILLIPS PETRLM CO	Copeland	3	1100	1150	1125	cuttings	3.28	0.52	1.36	0.33	502		1.88		41	10	4	16	0.28	c	n;ltS2p
05-2965-116455	03141000100000	PHILLIPS PETRLM CO	Copeland	3	1150	1200	1175	cuttings	3.80	0.55	1.15	0.34	491		1.68		30	9	3	14	0.32		n;ltS2p
05-2965-116456	03141000100000	PHILLIPS PETRLM CO	Copeland	3	1200	1250	1225	cuttings	3.61	0.45	1.50	0.43	489		1.64		42	12	3	12	0.23		n;ltS2p
05-2965-116457	03023100010000	MCRAY C E & ASSOC	Hearst	1-23	1800	1900	1850	cuttings	1.71	0.14	1.06	0.44	425		0.49		62	26	2	8	0.12		n;ltS2p
05-2965-116458	03023100010000	MCRAY C E & ASSOC	Hearst	1-23	1900	2000	1950	cuttings	2.47	0.23	0.77	0.40	479		1.46		31	16	2	9	0.23		n;ltS2p
05-2965-116459	03023100010000	MCRAY C E & ASSOC	Hearst	1-23	2650	2700	2675	cuttings	1.82	0.26	0.57	0.51	340		-1.00		31	28	1	14	0.31		n;ltS2p
05-2965-116460	03023100010000	MCRAY C E & ASSOC	Hearst	1-23	2700	2750	2725	cuttings	1.84	0.66	1.04	0.85	429		0.56		57	46	1	36	0.39		n;ltS2p
05-2965-116461	03023100010000	MCRAY C E & ASSOC	Hearst	1-23	2920	3000	2960	cuttings	0.22	0.16	0.20	0.34	417	*	0.35		91	155	1	73	0.44	c, lc	n
05-2965-116462	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	1500	1550	1525	cuttings	0.69	0.04	0.12	0.38	350	*	-1.00		17	55	0	6	0.25		n
05-2965-116463	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	2700	2750	2725	cuttings	0.66	0.04	0.08	0.38	330	*	-1.00		12	58	0	6	0.33	c	n

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HGS No.	API Number	Operator	Well Name	Well Number	Top Depth (ft.)	Bottom Depth (ft.)	Median Depth (ft.)	Sample Type	Leco TOC	S1	S2	S3	Tmax (°C)		Cal. %Ro	Meas. %Ro	HI	OI	S2/S3	S1/TOC	PI	Notes Checks	Notes Pyrogram
05-2965-116464	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	3200	3250	3225	cuttings	0.86	0.05	0.11	0.38	315	*	-1.00		13	44	0	6	0.31	c	n
05-2965-116465	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	4000	4050	4025	cuttings	0.80	0.03	0.09	0.41	-1	*	-1.00		11	51	0	4	0.25		n
05-2965-116466	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	5700	5750	5725	cuttings	0.47	0.03	0.04	0.28	-1	*	-1.00		9	60	0	6	0.43		f
05-2965-116467	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	6400	6450	6425	cuttings	0.58	0.04	0.11	0.26	388	*	-1.00		19	45	0	7	0.27		n
05-2965-116468	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	6900	6950	6925	cuttings	0.84	0.10	0.12	0.22	-1	*	-1.00		14	26	1	12	0.45		n
05-2965-116469	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	7500	7550	7525	cuttings	0.84	0.09	0.09	0.15	-1	*	-1.00		11	18	1	11	0.50		n
05-2965-116470	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	7700	7750	7725	cuttings	1.18	0.07	0.12	0.18	-1	*	-1.00		10	15	1	6	0.37		n
05-2965-116471	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	7860	7900	7880	cuttings	1.59	0.17	0.20	0.19	336	*	-1.00		13	12	1	11	0.46		n
05-2965-116472	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	7900	7950	7925	cuttings	2.56	0.38	0.23	0.16	439	*	0.74		9	6	1	15	0.62		n
05-2965-116473	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	7950	8000	7975	cuttings	2.42	0.35	0.25	0.30	342	*	-1.00		10	12	1	14	0.58		n
05-2965-116474	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	8000	8050	8025	cuttings	2.03	0.29	0.22	0.21	342	*	-1.00		11	10	1	14	0.57	c	n
05-2965-116475	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	8050	8100	8075	cuttings	1.72	0.26	0.20	0.17	339	*	-1.00		12	10	1	15	0.57		n
05-2965-116476	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	8100	8150	8125	cuttings	1.61	0.35	0.26	0.19	343	*	-1.00		16	12	1	22	0.57		n
05-2965-116477	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	8150	8200	8175	cuttings	1.74	0.30	0.22	0.17	346	*	-1.00		13	10	1	17	0.58		n
05-2965-116478	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	8200	8250	8225	cuttings	1.24	0.21	0.08	0.16	-1	*	-1.00		6	13	1	17	0.72		n
05-2965-116479	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	8250	8300	8275	cuttings	1.65	0.27	0.10	0.16	-1	*	-1.00		6	10	1	16	0.73	lc	n
05-2965-116480	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	8505	8530	8517.5	cuttings	0.80	0.16	0.08	0.06	-1	*	-1.00		10	7	1	20	0.67		n
05-2965-116481	03045100110000	SANTA FE ENERGY CORP	McLung	1-33	8530	8550	8540	cuttings	1.03	0.20	0.13	0.12	-1	*	-1.00		13	12	1	19	0.61		n
05-2965-116482	03045100070000	TXO PROD CORP	Lever	1	4300	4350	4325	cuttings	0.87	0.16	0.25	0.37	387	*	-1.00		29	43	1	18	0.39		n
05-2965-116483	03045100070000	TXO PROD CORP	Lever	1	4350	4400	4375	cuttings	1.13	0.31	0.85	0.36	410		0.22		75	32	2	27	0.27	c, lc	n;ltS2p
05-2965-116484	03045100070000	TXO PROD CORP	Lever	1	4400	4450	4425	cuttings	2.75	0.44	0.45	0.27	339	*	-1.00		16	10	2	16	0.49	c	n
05-2965-116485	03045100070000	TXO PROD CORP	Lever	1	4450	4500	4475	cuttings	2.42	0.38	0.46	0.26	340	*	-1.00		19	11	2	16	0.45		n
05-2965-116486	03045100070000	TXO PROD CORP	Lever	1	4500	4550	4525	cuttings	2.50	0.42	0.50	0.27	340		-1.00		20	11	2	17	0.46		n
05-2965-116487	03045100070000	TXO PROD CORP	Lever	1	4550	4580	4565	cuttings	2.44	0.39	0.56	0.28	343		-1.00		23	11	2	16	0.41		n
05-2965-116488	03045100070000	TXO PROD CORP	Lever	1	4580	4600	4590	cuttings	1.03	0.29	0.46	0.37	357	*	-1.00		45	36	1	28	0.39	c	n
05-2965-116489	03045100070000	TXO PROD CORP	Lever	1	4600	4650	4625	cuttings	1.06	0.41	0.25	0.24	339	*	-1.00		24	23	1	39	0.62		n
05-2965-116490	03045100070000	TXO PROD CORP	Lever	1	4650	4700	4675	cuttings	1.05	0.40	0.29	0.26	338	*	-1.00		28	25	1	38	0.58		n
05-2965-116491	03045100070000	TXO PROD CORP	Lever	1	4920	4960	4940	cuttings	0.80	0.19	0.23	0.24	370	*	-1.00		29	30	1	24	0.45	c	n

Note: "-1" indicates not measured or meaningless ratio

* Tmax data not reliable due to poor S2 peak

TOC = weight percent organic carbon in rock
S1, S2 = mg hydrocarbons per gram of rock
S3 = mg carbon dioxide per gram of rock
Tmax = °C

HI = hydrogen index = S2 x 100 / TOC
OI = oxygen index = S3 x 100 / TOC
S1/TOC = normalized oil content = S1 x 100 / TOC
PI = production index = S1 / (S1+S2)
Cal. %Ro = calculated vitrinite reflectance based on Tmax
Measured %Ro = measured vitrinite reflectance

Notes:
c = Rock-Eval analysis checked and confirmed
lc = Leco TOC analysis checked and confirmed

Pyrogram:
n=normal
ltS2sh = low temperature S2 shoulder
ltS2p = low temperature S2 peak
htS2p = high temperature S2 peak
f = flat S2 peak
na = printer malfunction pyrogram not available

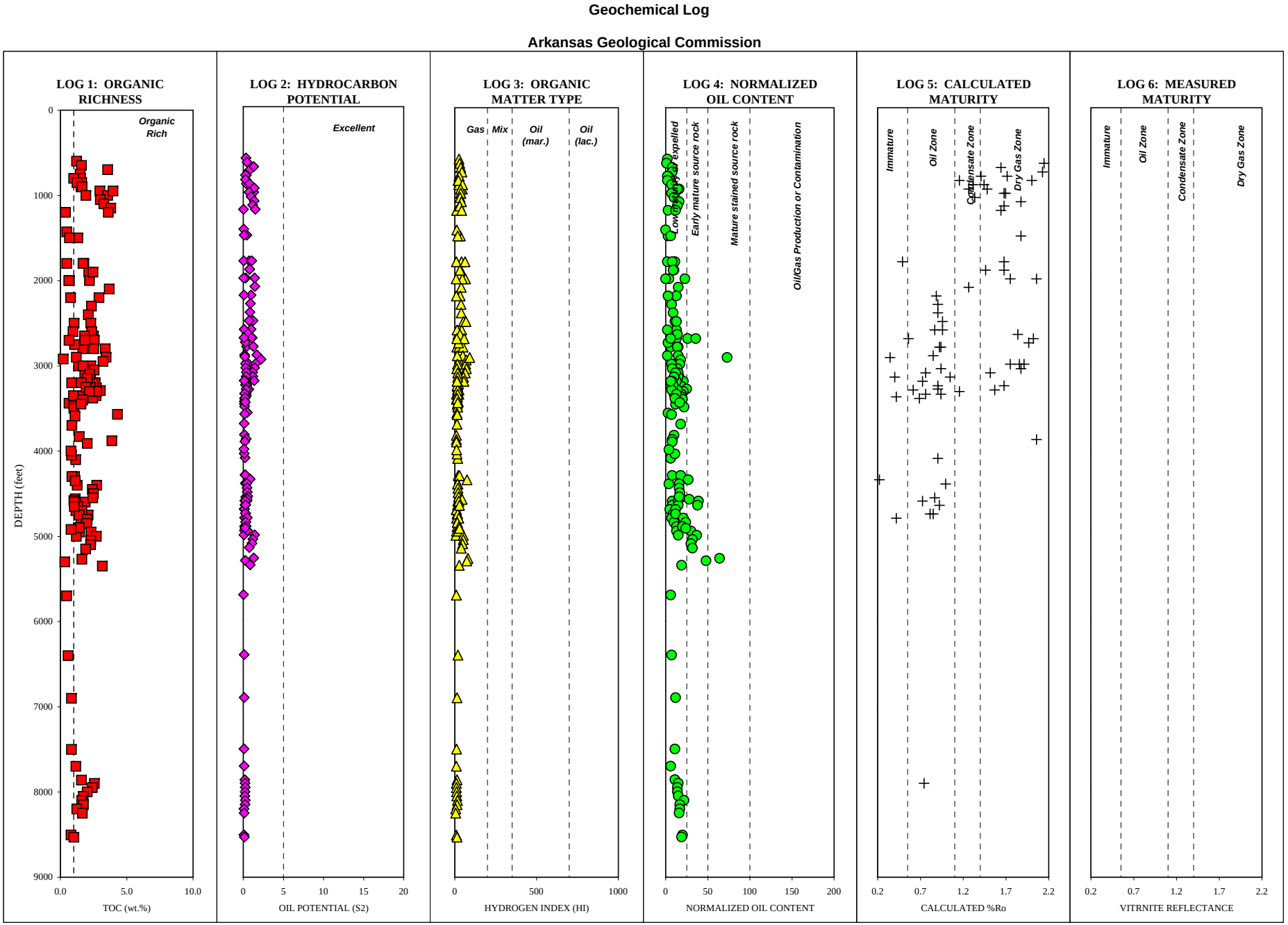

Figure 1. Geochemical log of TOC, remaining potential (S2), kerogen type (HI), normalized oil content, and calculated and measured vitrinite reflectance.

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KEROGEN QUALITY

Arkansas Geological Commission

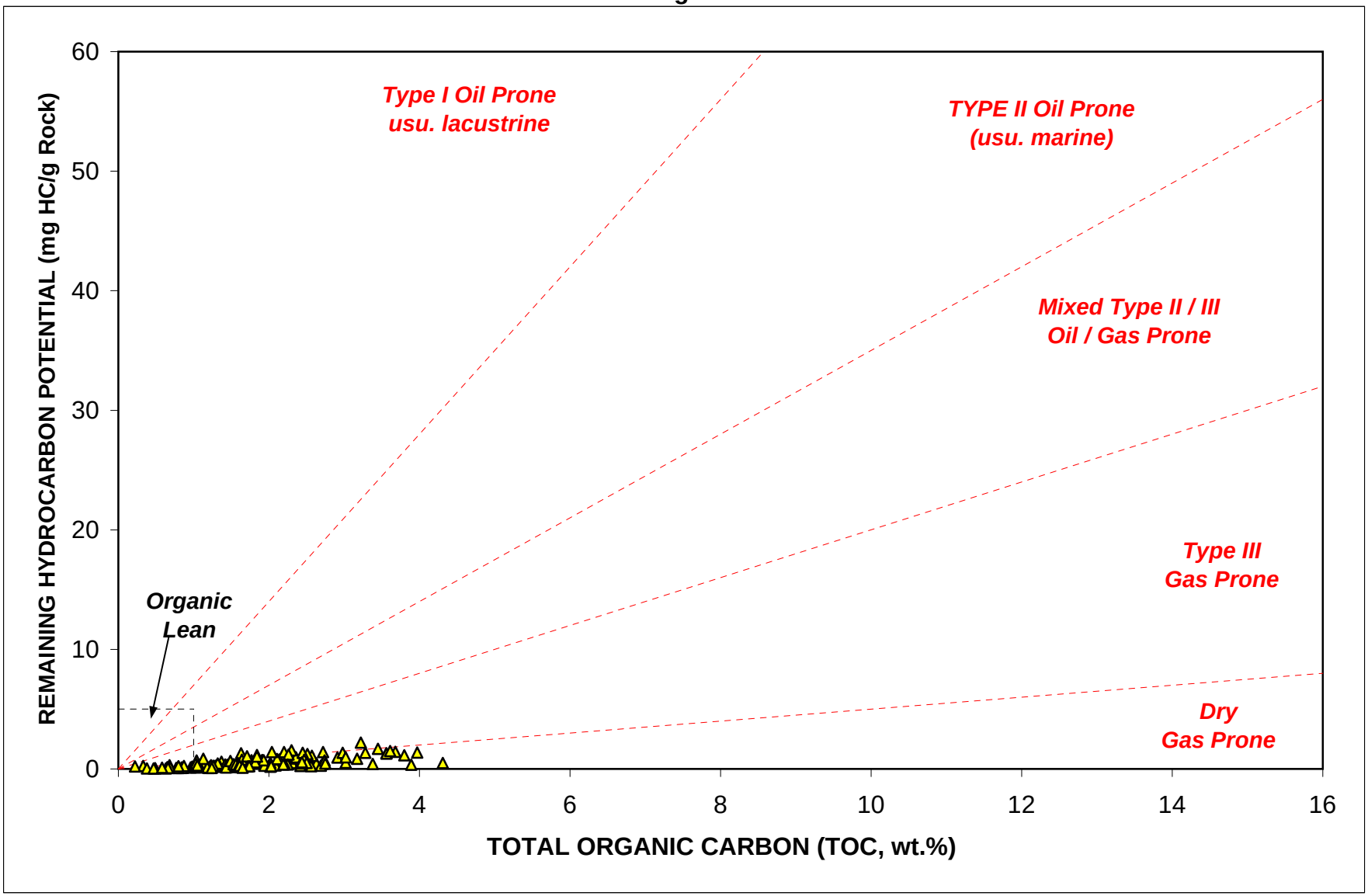

Figure 2. Kerogen Quality

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KEROGEN TYPE
Arkansas Geological Commission

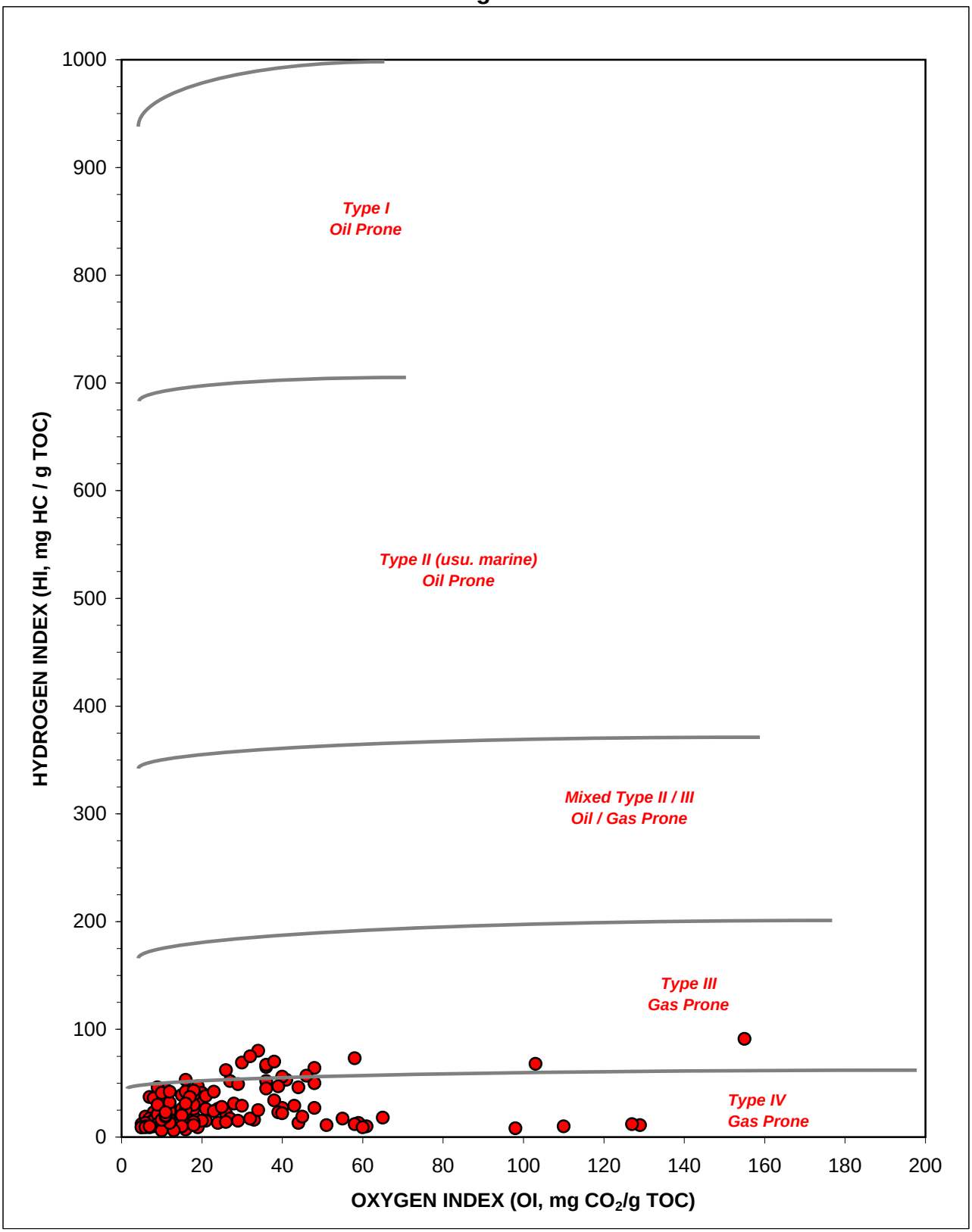

Figure 3. Kerogen type

KEROGEN TYPE and MATURITY

Arkansas Geological Commission

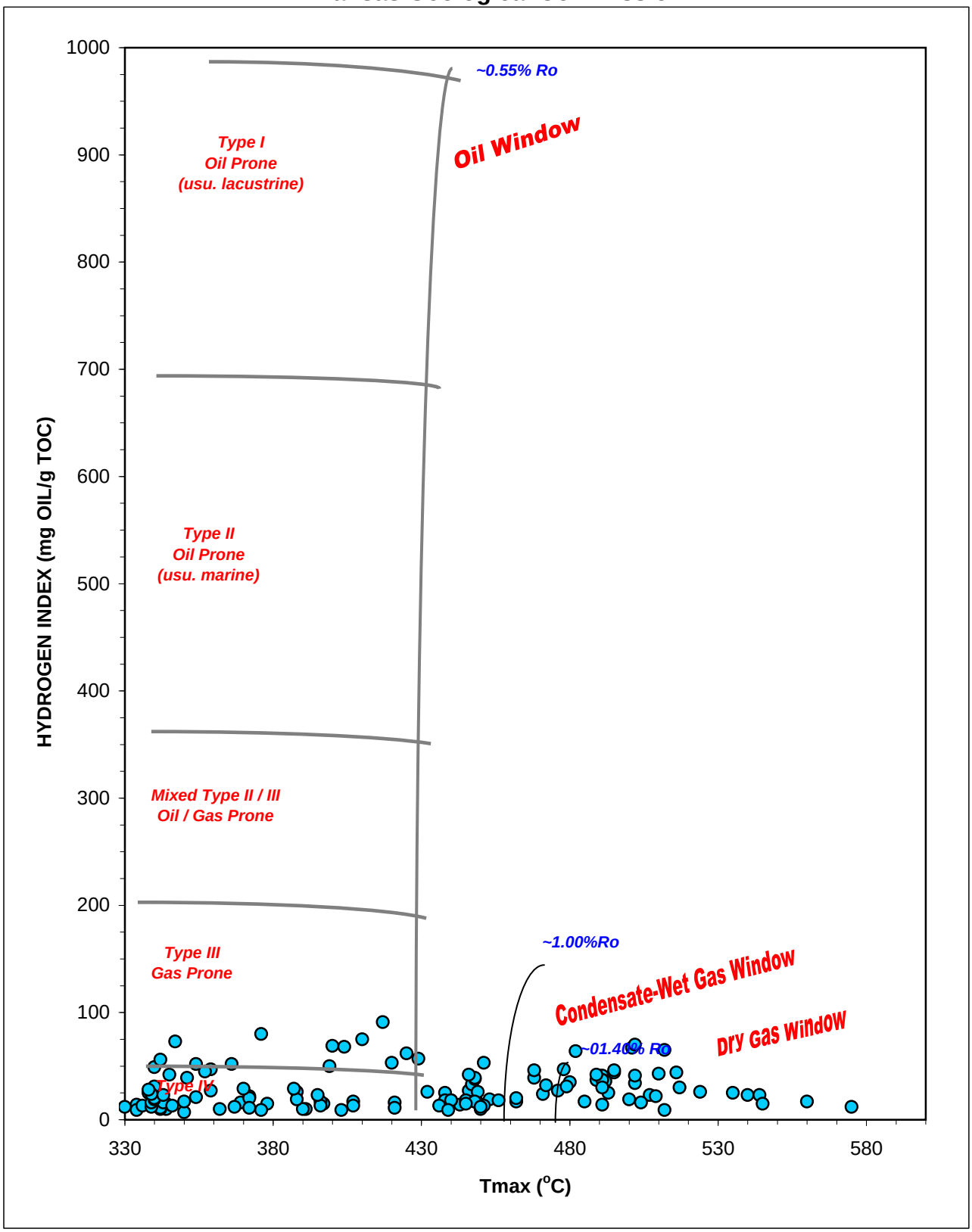

Figure 4a. Kerogen Type and Maturity (Tmax)

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KEROGEN TYPE and MATURITY

Arkansas Geological Commission

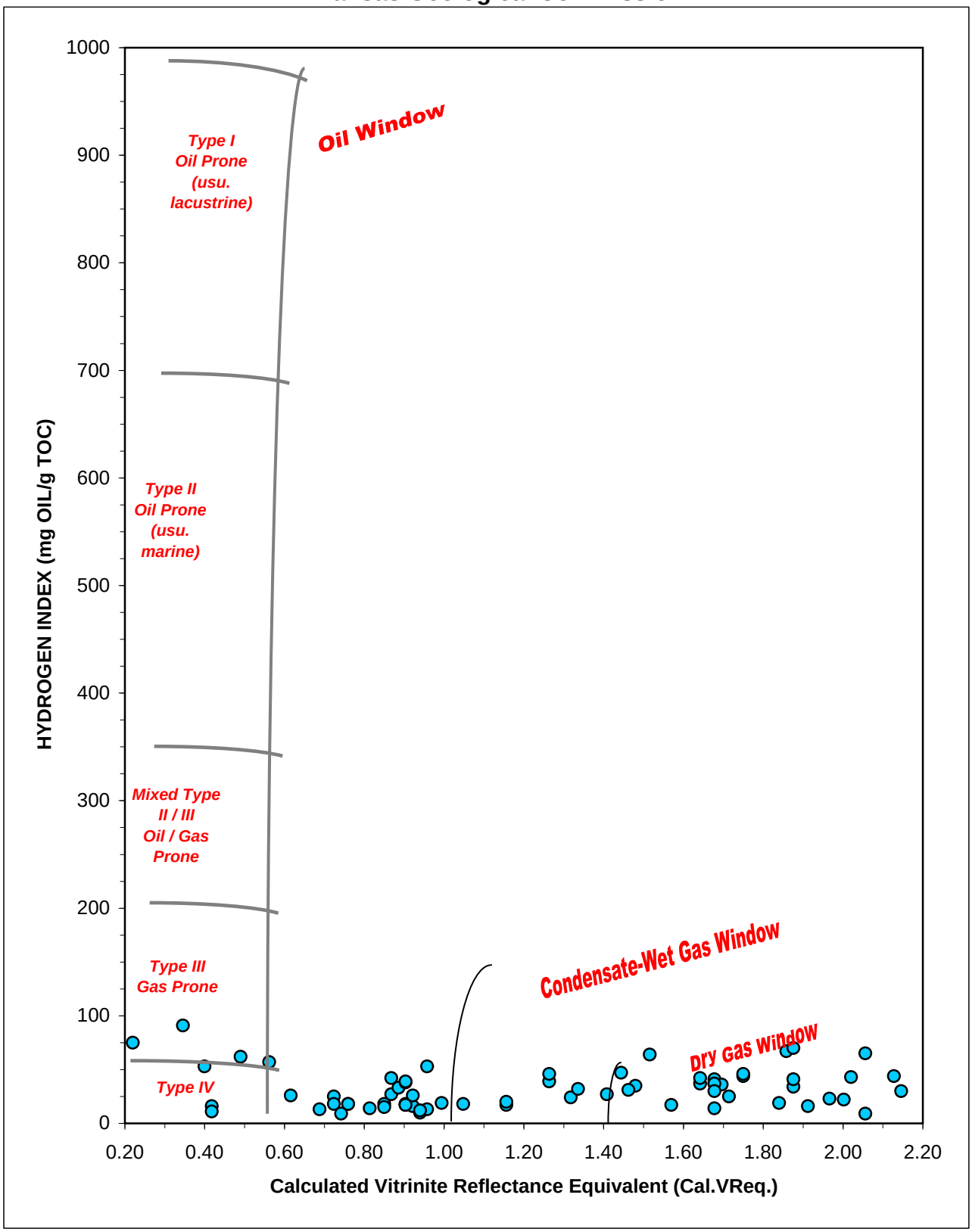

Figure 4b. Kerogen Type and Maturity (Tmax calculated %VRo)

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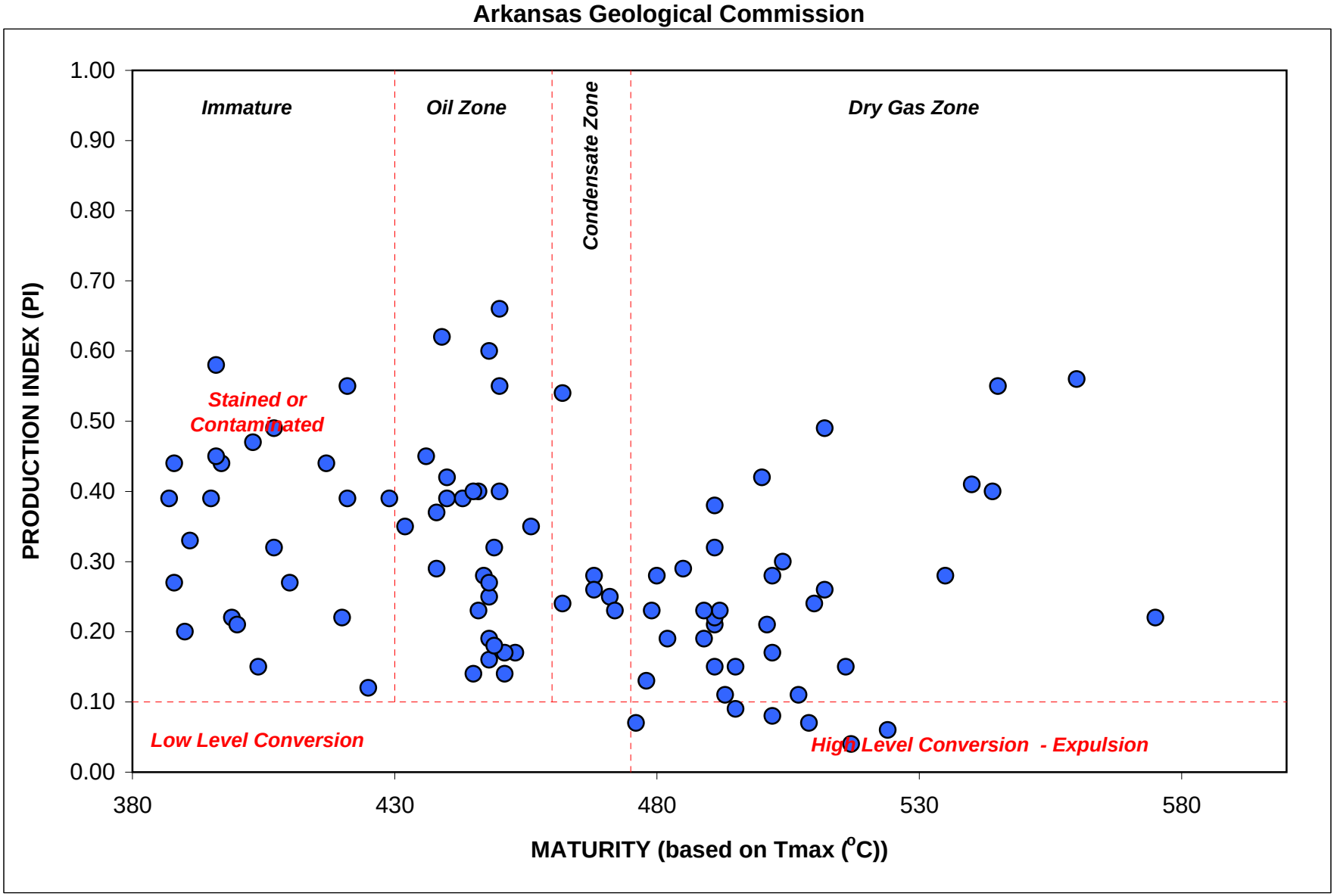

Figure 5a. Kerogen conversion and maturity (based on Tmax).

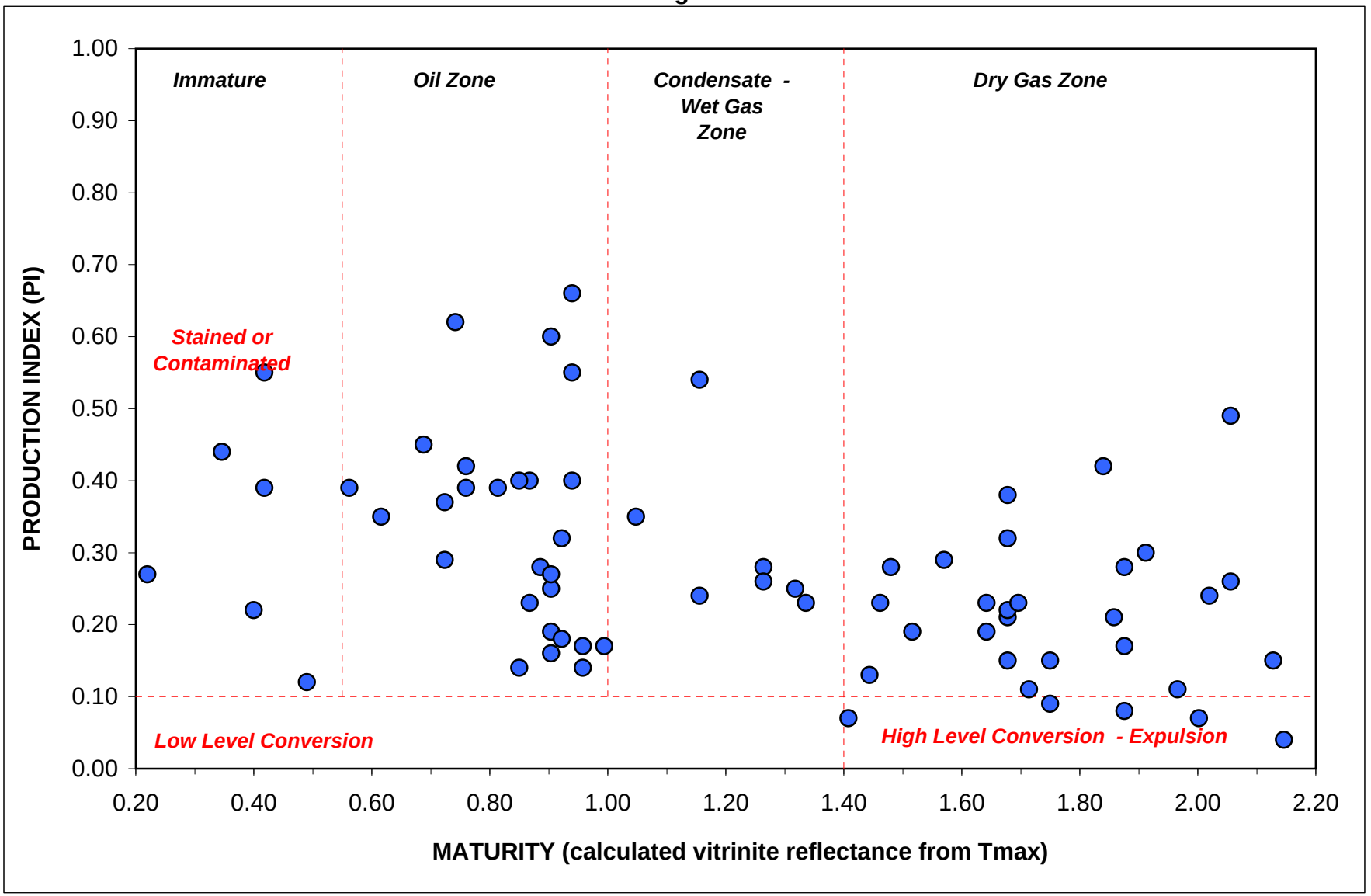

Figure 5b. Kerogen conversion and maturity (calculated %VRo from Tmax).

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HGS No.	API Number	Operator	Well Name	Well Number	Top Depth (ft.)	Bottom Depth (ft.)	Median Depth (ft.)	Sample Type	Leco TOC		S1	S2	S3	Tmax (°C)		Cal. %Ro	Meas. %Ro	HI	OI	S2/S3	S1/TOC	PI	Notes Checks	Notes Pyrogram
05-2995-117958	03023100090000	YATES PETROLEUM CORP	Landrum Quitman	1	3400	3450	3425	cuttings	1.40		0.12	0.57	0.82	458		1.08		41	59	1	9	0.17	c, lc	n;lts2p
05-2995-117959	03023100090000	YATES PETROLEUM CORP	Landrum Quitman	1	3700	3750	3725	cuttings	3.73		0.43	0.49	0.76	381	*	-1.00		13	20	1	12	0.47		n
05-2995-117960	03023100090000	YATES PETROLEUM CORP	Landrum Quitman	1	3750	3800	3775	cuttings	2.18		0.28	0.42	0.75	411	*	0.24		19	34	1	13	0.40		n
05-2995-117961	03023100090000	YATES PETROLEUM CORP	Landrum Quitman	1	3800	3850	3825	cuttings	3.75		0.51	0.50	0.67	385		-1.00		13	18	1	14	0.50		n
05-2995-117962	03023100090000	YATES PETROLEUM CORP	Landrum Quitman	1	3850	3900	3875	cuttings	3.34		0.49	0.43	0.52	342	*	-1.00		13	16	1	15	0.53		n
05-2995-117963	03023100090000	YATES PETROLEUM CORP	Landrum Quitman	1	3900	3950	3925	cuttings	3.24		0.37	0.65	0.55	354		-1.00		20	17	1	11	0.36		n
05-2995-117964	03023100090000	YATES PETROLEUM CORP	Landrum Quitman	1	3950	4000	3975	cuttings	2.26		0.34	0.45	0.59	423	*	0.45		20	26	1	15	0.43		n
05-2995-117965	03023100090000	YATES PETROLEUM CORP	Landrum Quitman	1	4000	4050	4025	cuttings	1.43		0.23	0.48	0.67	395	*	-1.00		34	47	1	16	0.32	lc	n
05-2995-117966	03023100090000	YATES PETROLEUM CORP	Landrum Quitman	1	4050	4100	4075	cuttings	2.27		0.42	0.41	0.53	449	*	0.92		18	23	1	19	0.51		n
05-2995-117967	03023100090000	YATES PETROLEUM CORP	Landrum Quitman	1	4100	4150	4125	cuttings	1.06		0.19	0.17	0.48	422	*	0.44		16	45	0	18	0.53		n
05-2995-117968	03023100090000	YATES PETROLEUM CORP	Landrum Quitman	1	4150	4200	4175	cuttings	1.04		0.31	0.27	0.40	424	*	0.47		26	38	1	30	0.53	c	n
05-2995-117969	03023100090000	YATES PETROLEUM CORP	Landrum Quitman	1	4430	4490	4460	cuttings	2.64		0.88	0.77	0.76	374		-1.00		29	29	1	33	0.53		n
05-2995-117970	03145100040000	CSG EXPLORATION CO	Patterson	1	5000	5050	5025	cuttings	0.92		0.05	0.22	0.30	413	*	0.27		24	33	1	5	0.19		n
05-2995-117971	03145100040000	CSG EXPLORATION CO	Patterson	1	5310	5350	5330	cuttings	1.17		0.07	0.21	0.32	417	*	0.35		18	27	1	6	0.25		n
05-2995-117972	03145100040000	CSG EXPLORATION CO	Patterson	1	5350	5400	5375	cuttings	1.52		0.11	0.35	0.33	414	*	0.29		23	22	1	7	0.24		n
05-2995-117973	03145100040000	CSG EXPLORATION CO	Patterson	1	5400	5440	5420	cuttings	2.34		0.21	0.55	0.29	415		0.31		24	12	2	9	0.28		n
05-2995-117974	03145100040000	CSG EXPLORATION CO	Patterson	1	5450	5500	5475	cuttings	2.01		0.25	0.61	0.39	366		-1.00		30	19	2	12	0.29		n
05-2995-117975	03145100040000	CSG EXPLORATION CO	Patterson	1	5500	5550	5525	cuttings	1.66		0.37	0.73	0.38	360		-1.00		44	23	2	22	0.34		n
05-2995-117976	03145100040000	CSG EXPLORATION CO	Patterson	1	5550	5590	5570	cuttings	1.30		0.38	0.46	0.30	352	*	-1.00		35	23	2	29	0.45		n
05-2995-117977	03145100040000	CSG EXPLORATION CO	Patterson	1	5650	5700	5675	cuttings	1.52		0.29	0.42	0.40	343	*	-1.00		28	26	1	19	0.41	c	n
05-2995-117978	03145100040000	CSG EXPLORATION CO	Patterson	1	5700	5750	5725	cuttings	1.55		0.59	0.66	0.37	355		-1.00		43	24	2	38	0.47	c	n
05-2995-117979	03145100040000	CSG EXPLORATION CO	Patterson	1	5750	5800	5775	cuttings	2.68		0.48	0.61	0.31	340		-1.00		23	12	2	18	0.44		n
05-2995-117980	03145100040000	CSG EXPLORATION CO	Patterson	1	5800	5850	5825	cuttings	1.80		0.40	0.42	0.28	340	*	-1.00		23	16	1	22	0.49		n
05-2995-117981	03145100040000	CSG EXPLORATION CO	Patterson	1	5850	5900	5875	cuttings	1.57		0.18	0.27	0.28	348	*	-1.00		17	18	1	11	0.40		n
05-2995-117982	03029100330000	CELERON O&G CO	Kaufman	1-2	5300	5350	5325	cuttings	0.94		0.12	0.18	0.30	365	*	-1.00		19	32	1	13	0.40		n
05-2995-117983	03029100330000	CELERON O&G CO	Kaufman	1-2	5400	5450	5425	cuttings	1.37		0.21	0.23	0.26	424	*	0.47		17	19	1	15	0.48		n
05-2995-117984	03029100330000	CELERON O&G CO	Kaufman	1-2	5500	5550	5525	cuttings	2.79		0.43	0.43	0.45	370	*	-1.00		15	16	1	15	0.50		n
05-2995-117985	03029100330000	CELERON O&G CO	Kaufman	1-2	5550	5600	5575	cuttings	2.93		0.39	0.30	0.28	346	*	-1.00		10	10	1	13	0.57		n
05-2995-117986	03029100330000	CELERON O&G CO	Kaufman	1-2	5600	5650	5625	cuttings	3.52		0.51	0.46	0.30	351	*	-1.00		13	9	2	14	0.53		n
05-2995-117987	03029100330000	CELERON O&G CO	Kaufman	1-2	5650	5700	5675	cuttings	3.54		0.52	0.33	0.32	375	*	-1.00		9	9	1	15	0.61	lc	n
05-2995-117988	03029100330000	CELERON O&G CO	Kaufman	1-2	5700	5750	5725	cuttings	3.50		0.53	0.43	0.31	372	*	-1.00		12	9	1	15	0.55	c	n
05-2995-117989	03029100330000	CELERON O&G CO	Kaufman	1-2	5750	5800	5775	cuttings	1.24		0.28	0.24	0.25	373	*	-1.00		19	20	1	23	0.54		n
05-2995-117990	03029100330000	CELERON O&G CO	Kaufman	1-2	5800	5830	5815	cuttings	1.12		0.30	0.18	0.24	318	*	-1.00		16	21	1	27	0.63		n
05-2995-117991	03029100010000	ARKLA EXPL CO	C.S. Ramsey Heirs	1	3800	3900	3850	cuttings	1.94		0.30	0.44	0.28	383	*	-1.00		23	14	2	15	0.41		n
05-2995-117992	03029100010000	ARKLA EXPL CO	C.S. Ramsey Heirs	1	3900	4000	3950	cuttings	3.12		0.60	0.69	0.43	336		-1.00		22	14	2	19	0.47		n
05-2995-117993	03029100010000	ARKLA EXPL CO	C.S. Ramsey Heirs	1	4000	4100	4050	cuttings	2.86		0.64	0.78	0.35	335		-1.00		27	12	2	22	0.45		n;lts2p
05-2995-117994	03029100010000	ARKLA EXPL CO	C.S. Ramsey Heirs	1	4400	4470	4435	cuttings	1.00		0.24	0.56	0.29	381		-1.00		56	29	2	24	0.30	lc	n
05-2995-117995	03029100010000	ARKLA EXPL CO	C.S. Ramsey Heirs	1	4470	4480	4475	cuttings	0.57		0.11	0.12	0.36	425	*	0.49		21	63	0	19	0.48		n
05-2995-117996	03029300060000	ARKLA EXPL CO	Dancer	1	4050	4100	4075	cuttings	0.86		0.11	0.24	0.23	434	*	0.65		28	27	1	13	0.31		n
05-2995-117997	03029300060000	ARKLA EXPL CO	Dancer	1	4100	4150	4125	cuttings	1.22		0.14	0.46	0.12	510	*	2.02		38	10	4	11	0.23	c	n
05-2995-117998	03029300060000	ARKLA EXPL CO	Dancer	1	4150	4200	4175	cuttings	2.23		0.40	0.56	0.30	469		1.28		25	13	2	18	0.42	lc	n
05-2995-117999	03029300060000	ARKLA EXPL CO	Dancer	1	4200	4250	4225	cuttings	3.27		0.34	0.34	0.24	503	*	1.89		10	7	1	10	0.50		n
05-2995-118000	03029300060000	ARKLA EXPL CO	Dancer	1	4250	4300	4275	cuttings	3.63		0.23	0.31	0.30	451	*	0.96		9	8	1	6	0.43		n
05-2995-118001	03029300060000	ARKLA EXPL CO	Dancer	1	4300	4330	4315	cuttings	3.69		0.34	0.33	0.34	449	*	0.92		9	9	1	9	0.51		n
05-2995-118002	03029300060000	ARKLA EXPL CO	Dancer	1	4330	4370	4350	cuttings	2.86		0.19	0.21	0.31	426	*	0.51		7	11	1	7	0.48	lc	n
05-2995-118003	03029300060000	ARKLA EXPL CO	Dancer	1	4400	4450	4425	cuttings	3.72		0.22	0.40	0.34	534	*	2.45		11	9	1	6	0.35		n
05-2995-118004	03029300060000	ARKLA EXPL CO	Dancer	1	4450	4500	4475	cuttings	1.88		0.11	0.18	0.28	452	*	0.98		10	15	1	6	0.38		n
05-2995-118005	03029300060000	ARKLA EXPL CO	Dancer	1	4500	4550	4525	cuttings	1.19		0.14	0.25	0.22	441	*	0.78		21	18	1	12	0.36		n
05-2995-118006	03029300060000	ARKLA EXPL CO	Dancer	1	4550	4590	4570	cuttings	0.81		0.16	0.26	0.14	451	*	0.96		32	17	2	20	0.38		n
05-2995-118007	03029300060000	ARKLA EXPL CO	Dancer	1	4870	4900	4885	cuttings	0.60		0.14	0.30	0.22	379	*	-1.00		50	37	1	23	0.32		n
05-2995-118008	03029300050000	PHILLIPS PETRLM CO	Billot-A	1	3500	3550	3525	cuttings	0.76		0.10	0.23	0.23	451	*	0.96		30	30	1	13	0.30		n
05-2995-118009	03029300050000	PHILLIPS PETRLM CO	Billot-A	1	3800	3850	3825	cuttings	1.26		0.11	0.26	0.24	512	*	2.06		21	19	1	9	0.30		n
05-2995-118010	03029300050000	PHILLIPS PETRLM CO	Billot-A	1	4000	4050	4025	cuttings	1.48		0.12	0.41	0.22	543	*	2.61		28	15	2	8	0.23		n
05-2995-118011	03029300050000	PHILLIPS PETRLM CO	Billot-A	1	4050	4100	4075	cuttings	1.79		0.29	0.39	0.17	479	*	1.46		22	9	2	16	0.43		n
05-2995-118012	03029300050000	PHILLIPS PETRLM CO	Billot-A	1	4100	4150	4125	cuttings	2.56		0.42	0.52	0.27	502		1.88		20	11	2	16	0.45		n
05-2995-118013	03029300050000	PHILLIPS PETRLM CO	Billot-A	1	4150	4200	4175	cuttings	2.73		0.56	0.60	0.27	444		0.83		22	10	2	21	0.48		n
05-2995-118014	03029300050000	PHILLIPS PETRLM CO	Billot-A	1	4200	4250	4225	cuttings	2.74		0.55	0.36	0.21	407	*	0.17		13	8	2	20	0.60		n
05-2995-118015	03029300050000	PHILLIPS PETRLM CO	Billot-A	1	4250	4270	4260	cuttings	2.61		0.49	0.49	0.24	447	*	0.89		19	9	2	19	0.50		n
05-2995-118016	03029300050000	PHILLIPS PETRLM CO	Billot-A	1	4270	4300	4285	cuttings	0.91		0.10	0.21	0.20	533	*	2.43		23	22	1	11	0.32		n

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HGS No.	API Number	Operator	Well Name	Well Number	Top Depth (ft.)	Bottom Depth (ft.)	Median Depth (ft.)	Sample Type	Leco TOC		S1	S2	S3	Tmax (°C)		Cal. %Ro	Meas. %Ro	HI	OI	S2/S3	S1/TOC	PI	Notes Checks	Notes Pyrogram
05-2995-118017	03029300050000	PHILLIPS PETRLM CO	Billot-A	1	4300	4350	4325	cuttings	1.30		0.36	0.31	0.19	483	*	1.53		24	15	2	28	0.54		n
05-2995-118018	03029300050000	PHILLIPS PETRLM CO	Billot-A	1	4420	4450	4435	cuttings	1.08		0.21	0.19	0.09	340	*	-1.00		18	8	2	19	0.52	c, lc	n
05-2995-118019	03029300050000	PHILLIPS PETRLM CO	Billot-A	1	4630	4680	4655	cuttings	1.05		0.21	0.38	0.19	449	*	0.92		36	18	2	20	0.36		n
05-2995-118020	03029300050000	PHILLIPS PETRLM CO	Billot-A	1	4680	4700	4690	cuttings	1.02		0.28	0.40	0.21	399	*	-1.00		39	21	2	27	0.41		n
05-2995-118021	03029100280000	TXO PROD CORP	Zuber South	1	5250	5300	5275	cuttings	1.99		0.26	0.53	0.28	359		-1.00		27	14	2	13	0.33		n
05-2995-118022	03029100280000	TXO PROD CORP	Zuber South	1	5350	5400	5375	cuttings	1.53		0.17	0.30	0.22	419	*	0.38		20	14	1	11	0.36		n
05-2995-118023	03029100280000	TXO PROD CORP	Zuber South	1	5400	5450	5425	cuttings	1.30		0.11	0.48	0.23	381	*	-1.00		37	18	2	8	0.19		n
05-2995-118024	03029100280000	TXO PROD CORP	Zuber South	1	5450	5500	5475	cuttings	1.19		0.11	0.30	0.36	496	*	1.77		25	30	1	9	0.27		
05-2995-118025	03029100280000	TXO PROD CORP	Zuber South	1	5500	5550	5525	cuttings	1.25		0.10	0.26	0.32	458	*	1.08		21	26	1	8	0.28		n
05-2995-118026	03029100280000	TXO PROD CORP	Zuber South	1	5550	5600	5575	cuttings	1.32		0.10	0.26	0.20	519	*	2.18		20	15	1	8	0.28		n
05-2995-118027	03029100280000	TXO PROD CORP	Zuber South	1	5600	5650	5625	cuttings	1.23		0.23	0.29	0.20	344	*	-1.00		24	16	1	19	0.44		n
05-2995-118028	03029100280000	TXO PROD CORP	Zuber South	1	5650	5700	5675	cuttings	1.13		0.11	0.15	0.12	419	*	0.38		13	11	1	10	0.42	c, lc	n
05-2995-118029	03029100280000	TXO PROD CORP	Zuber South	1	5820	5870	5845	cuttings	1.33		0.11	0.26	0.15	470	*	1.30		20	11	2	8	0.30		n
05-2995-118030	03029100280000	TXO PROD CORP	Zuber South	1	5870	5900	5885	cuttings	1.47		0.16	0.27	0.20	403	*	0.09		18	14	1	11	0.37		n
05-2995-118031	03029100280000	TXO PROD CORP	Zuber South	1	5900	5950	5925	cuttings	1.12		0.24	0.35	0.20	445	*	0.85		31	18	2	21	0.41		n
05-2995-118032	03029100280000	TXO PROD CORP	Zuber South	1	5950	5990	5970	cuttings	1.83		0.48	0.37	0.17	403	*	0.09		20	9	2	26	0.56		n
05-2995-118033	03045100020000	LONE STAR PROD COMP	E.W. Moore Estate	1	7100	7220	7160	cuttings	2.18	**	1.00	1.93	0.61	379		-1.00		89	28	3	46	0.34		n;lts2p
05-2995-118034	03045100020000	LONE STAR PROD COMP	E.W. Moore Estate	1	7400	7450	7425	cuttings	1.94	**	1.02	1.47	0.72	362		-1.00		76	37	2	53	0.41		n;lts2p
05-2995-118035	03045100020000	LONE STAR PROD COMP	E.W. Moore Estate	1	7450	7500	7475	cuttings	1.70	**	1.03	1.36	0.69	362		-1.00		80	41	2	61	0.43		n;lts2p
05-2995-118036	03045100020000	LONE STAR PROD COMP	E.W. Moore Estate	1	7500	7600	7550	cuttings	1.68	**	1.05	1.10	0.74	373		-1.00		65	44	1	62	0.49		n;lts2p
05-2995-118037	03147600160000	SUNRAY DX OIL CO	G.L. Morris	1	3100	3150	3125	cuttings	0.72		0.29	0.45	0.28	368	*	-1.00		62	39	2	40	0.39		n
05-2995-118038	03147600160000	SUNRAY DX OIL CO	G.L. Morris	1	3500	3550	3525	cuttings	0.51		0.28	0.33	0.18	384	*	-1.00		65	35	2	55	0.46	c	n
05-2995-118039	03147600160000	SUNRAY DX OIL CO	G.L. Morris	1	4000	4050	4025	cuttings	0.94		0.41	0.59	0.09	442		0.80		63	10	7	44	0.41	c	n
05-2995-118040	03147600160000	SUNRAY DX OIL CO	G.L. Morris	1	4250	4300	4275	cuttings	0.97		0.32	0.60	0.15	439		0.74		62	15	4	33	0.35		n
05-2995-118041	03147600160000	SUNRAY DX OIL CO	G.L. Morris	1	4300	4350	4325	cuttings	0.85		0.37	0.47	0.33	387	*	-1.00		55	39	1	44	0.44		n
05-2995-118042	03147600160000	SUNRAY DX OIL CO	G.L. Morris	1	4400	4450	4425	cuttings	0.55		0.40	0.35	0.39	383	*	-1.00		64	71	1	73	0.53		n
05-2995-118043	03147600160000	SUNRAY DX OIL CO	G.L. Morris	1	4450	4500	4475	cuttings	0.34		0.30	0.33	0.30	435	*	0.67		97	88	1	88	0.48	lc	n
05-2995-118044	03147600160000	SUNRAY DX OIL CO	G.L. Morris	1	4500	4550	4525	cuttings	0.32		0.38	0.47	0.30	425	*	0.49		147	94	2	119	0.45		n
05-2995-118045	03147600160000	SUNRAY DX OIL CO	G.L. Morris	1	4550	4600	4575	cuttings	0.25		0.31	0.47	0.21	485	*	1.57		188	84	2	124	0.40	lc	n
05-2995-118046	03147600160000	SUNRAY DX OIL CO	G.L. Morris	1	4750	4760	4755	cuttings	0.41		0.23	0.41	0.14	451	*	0.96		100	34	3	56	0.36		n
05-2995-118047	03147100090000	WOODARD ENERGY CO	Childress Sallie	1	2010	2040	2025	cuttings	0.49		0.03	0.14	0.06	407	*	0.17		29	12	2	6	0.18		n
05-2995-118048	03147100090000	WOODARD ENERGY CO	Childress Sallie	1	2300	2350	2325	cuttings	0.60		0.04	0.22	0.00	512	*	2.06		37	0	-1	7	0.15		n
05-2995-118049	03147100090000	WOODARD ENERGY CO	Childress Sallie	1	2500	2550	2525	cuttings	0.70		0.04	0.19	0.21	425	*	0.49		27	30	1	6	0.17	c	n
05-2995-118050	03147100090000	WOODARD ENERGY CO	Childress Sallie	1	2550	2600	2575	cuttings	0.65		0.04	0.16	0.26	437	*	0.71		25	40	1	6	0.20		n
05-2995-118051	03147100090000	WOODARD ENERGY CO	Childress Sallie	1	2600	2650	2625	cuttings	0.64		0.05	0.22	0.18	419	*	0.38		34	28	1	8	0.19		n
05-2995-118052	03147100090000	WOODARD ENERGY CO	Childress Sallie	1	2650	2700	2675	cuttings	0.38		0.01	0.07	0.05	336	*	-1.00		18	13	1	3	0.12		n
05-2995-118053	03147100090000	WOODARD ENERGY CO	Childress Sallie	1	2750	2780	2765	cuttings	0.89		0.13	0.15	0.17	406	*	0.15		17	19	1	15	0.46	lc	n
05-2995-118054	03147100090000	WOODARD ENERGY CO	Childress Sallie	1	3010	3040	3025	cuttings	0.27		0.02	0.07	0.09	454	*	1.01		26	33	1	7	0.22		n
05-2995-118055	03147100070000	PENNZOIL PRODUCNG CO	Morris	1	2200	2250	2225	cuttings	0.43		0.04	0.21	0.18	458	*	1.08		49	42	1	9	0.16		n
05-2995-118056	03147100070000	PENNZOIL PRODUCNG CO	Morris	1	2600	2650	2625	cuttings	0.61		0.05	0.24	0.17	458	*	1.08		39	28	1	8	0.17		n
05-2995-118057	03147100070000	PENNZOIL PRODUCNG CO	Morris	1	2900	2950	2925	cuttings	0.41		0.05	0.29	0.26	515	*	2.11		71	63	1	12	0.15		n
05-2995-118058	03147100070000	PENNZOIL PRODUCNG CO	Morris	1	2950	3000	2975	cuttings	0.41		0.06	0.29	0.27	504	*	1.91		71	66	1	15	0.17	c	n
05-2995-118059	03147100070000	PENNZOIL PRODUCNG CO	Morris	1	3000	3050	3025	cuttings	0.50		0.05	0.42	0.20	528	*	2.34		84	40	2	10	0.11	c	n
05-2995-118060	03147100070000	PENNZOIL PRODUCNG CO	Morris	1	3050	3100	3075	cuttings	0.55		0.05	0.25	0.24	445	*	0.85		45	44	1	9	0.17		n
05-2995-118061	03147100070000	PENNZOIL PRODUCNG CO	Morris	1	3100	3150	3125	cuttings	0.65		0.09	0.21	0.35	460	*	1.12		32	54	1	14	0.30		n
05-2995-118062	03147100070000	PENNZOIL PRODUCNG CO	Morris	1	3150	3200	3175	cuttings	0.56		0.11	0.45	0.27	517	*	2.15		80	48	2	20	0.20		n
05-2995-118063	03147100070000	PENNZOIL PRODUCNG CO	Morris	1	3380	3400	3390	cuttings	0.53		0.09	0.95	0.14	505		1.93		179	26	7	17	0.09	lc	n
05-2995-118064	03147100060000	PENNZOIL CO INC	Raymond	1	3000	3050	3025	cuttings	0.98		0.20	0.52	0.29	367		-1.00		53	30	2	20	0.28		n
05-2995-118065	03147100060000	PENNZOIL CO INC	Raymond	1	3050	3100	3075	cuttings	0.90		0.15	0.49	0.36	389	*	-1.00		54	40	1	17	0.23		n
05-2995-118066	03147100060000	PENNZOIL CO INC	Raymond	1	3300	3350	3325	cuttings	0.71		0.10	0.47	0.39	412	*	0.26		66	55	1	14	0.18		n
05-2995-118067	03147100060000	PENNZOIL CO INC	Raymond	1	3500	3550	3525	cuttings	1.14		0.19	0.73	0.72	406		0.15		64	63	1	17	0.21		n
05-2995-118068	03147100060000	PENNZOIL CO INC	Raymond	1	3550	3600	3575	cuttings	0.54		0.14	0.29	0.08	395	*	-1.00		54	15	4	26	0.33		n
05-2995-118069	03147100060000	PENNZOIL CO INC	Raymond	1	4150	4190	4170	cuttings	1.62		0.26	0.43	0.14	357	*	-1.00		27	9	3	16	0.38	c	n
05-2995-118070	03147100060000	PENNZOIL CO INC	Raymond	1	4190	4220	4205	cuttings	1.61		0.34	0.69	0.33	387		-1.00		43	20	2	21	0.33		n
05-2995-118071	03037100030000	WOODARD ENERGY CO	Glenda J. Lines	1	2300	2350	2325	cuttings	0.45		0.04	0.11	0.00	440	*	0.76		24	0	-1	9	0.27		n
05-2995-118072	03037100030000	WOODARD ENERGY CO	Glenda J. Lines	1	2400	2450	2425	cuttings	0.55		0.04	0.13	0.08	448	*	0.90		24	15	2	7	0.24		n
05-2995-118073	03037100030000	WOODARD ENERGY CO	Glenda J. Lines	1	2520	2540	2530	cuttings	1.01		0.12	0.15	0.00	345	*	-1.00		15	0	-1	12	0.44		n

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HGS No.	API Number	Operator	Well Name	Well Number	Top Depth (ft.)	Bottom Depth (ft.)	Median Depth (ft.)	Sample Type	Leco TOC		S1	S2	S3	Tmax (°C)		Cal. %Ro	Meas. %Ro	HI	OI	S2/S3	S1/TOC	PI	Notes Checks	Notes Pyrogram
05-2995-118074	03037100030000	WOODARD ENERGY CO	Glenda J. Lines	1	2540	2590	2565	cuttings	1.05		0.16	0.16	0.00	452	*	0.98		15	0	-1	15	0.50		n
05-2995-118075	03037100030000	WOODARD ENERGY CO	Glenda J. Lines	1	2590	2640	2615	cuttings	1.53		0.31	0.17	0.03	0	*	-1.00		11	2	6	20	0.65		n
05-2995-118076	03037100030000	WOODARD ENERGY CO	Glenda J. Lines	1	2640	2660	2650	cuttings	0.88		0.17	0.19	0.00	332	*	-1.00		22	0	-1	19	0.47		n
05-2995-118077	03037100030000	WOODARD ENERGY CO	Glenda J. Lines	1	3050	3080	3065	cuttings	0.14		0.01	0.06	0.00	391	*	-1.00		43	0	-1	7	0.14	c, lc	n

Note: "-1" indicates not measured or meaningless ratio

* Tmax data not reliable due to poor S2 peak
** very little sample, Rock-Eval TOC was run

TOC = weight percent organic carbon in rock
S1, S2 = mg hydrocarbons per gram of rock
S3 = mg carbon dioxide per gram of rock
Tmax = °C

HI = hydrogen index = S2 x 100 / TOC
OI = oxygen index = S3 x 100 / TOC
S1/TOC = normalized oil content = S1 x 100 / TOC
PI = production index = S1 / (S1+S2)
Cal. %Ro = calculated vitrinite reflectance based on Tmax
Measured %Ro = measured vitrinite reflectance

Notes:
c = Rock-Eval analysis checked and confirmed
lc = Leco TOC analysis checked and confirmed

Pyrogram:
n=normal
ltS2sh = low temperature S2 shoulder
ltS2p = low temperature S2 peak
htS2p = high temperature S2 peak
f = flat S2 peak

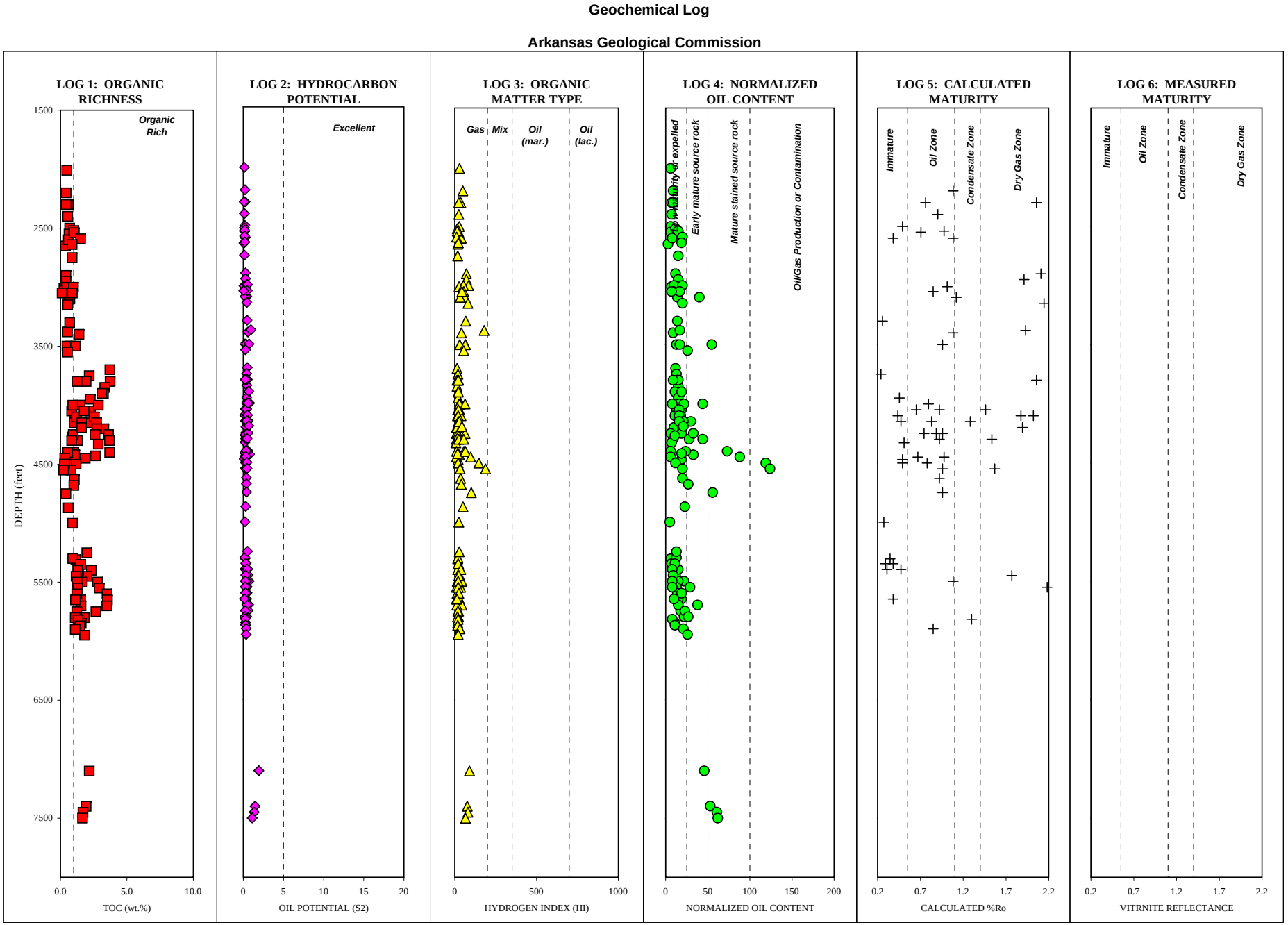


Figure 1. Geochemical log of TOC, remaining potential (S2), kerogen type (HI), normalized oil content, and calculated and measured vitrinite reflectance.

Humble Geochemical Services Division

KEROGEN QUALITY

Arkansas Geological Commission

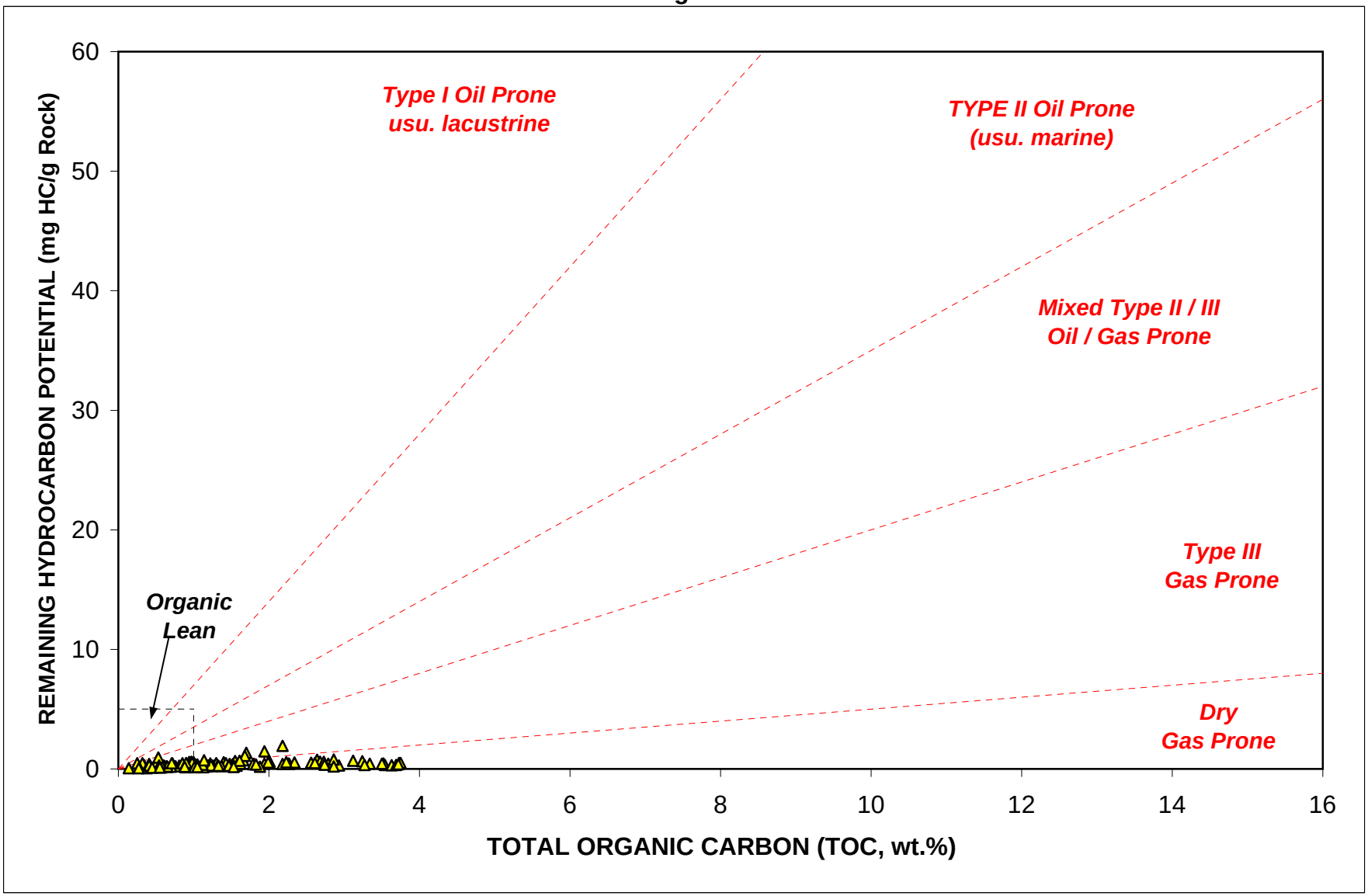


Figure 2. Kerogen Quality

KEROGEN TYPE
Arkansas Geological Commission

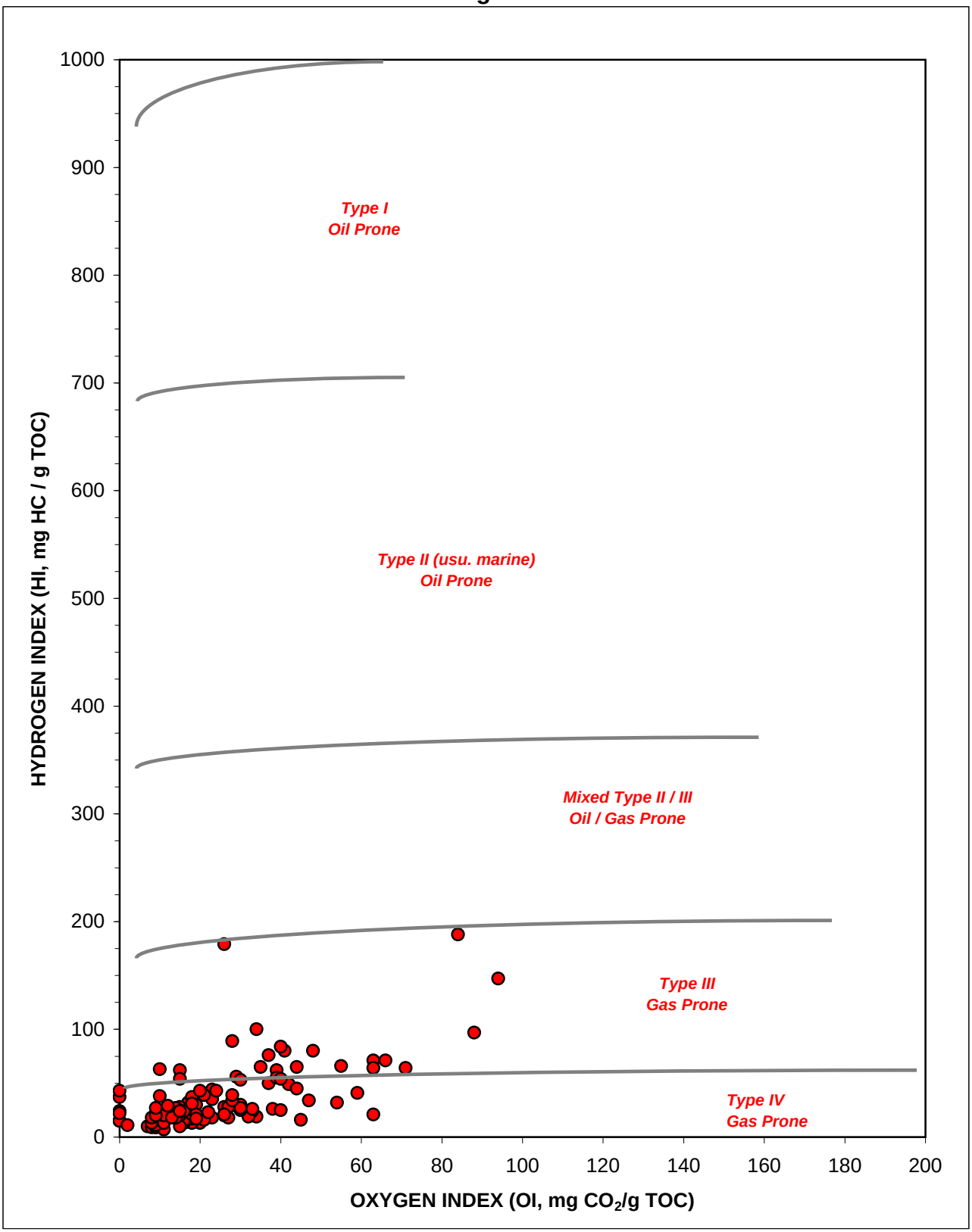


Figure 3. Kerogen type

KEROGEN TYPE and MATURITY

Arkansas Geological Commission

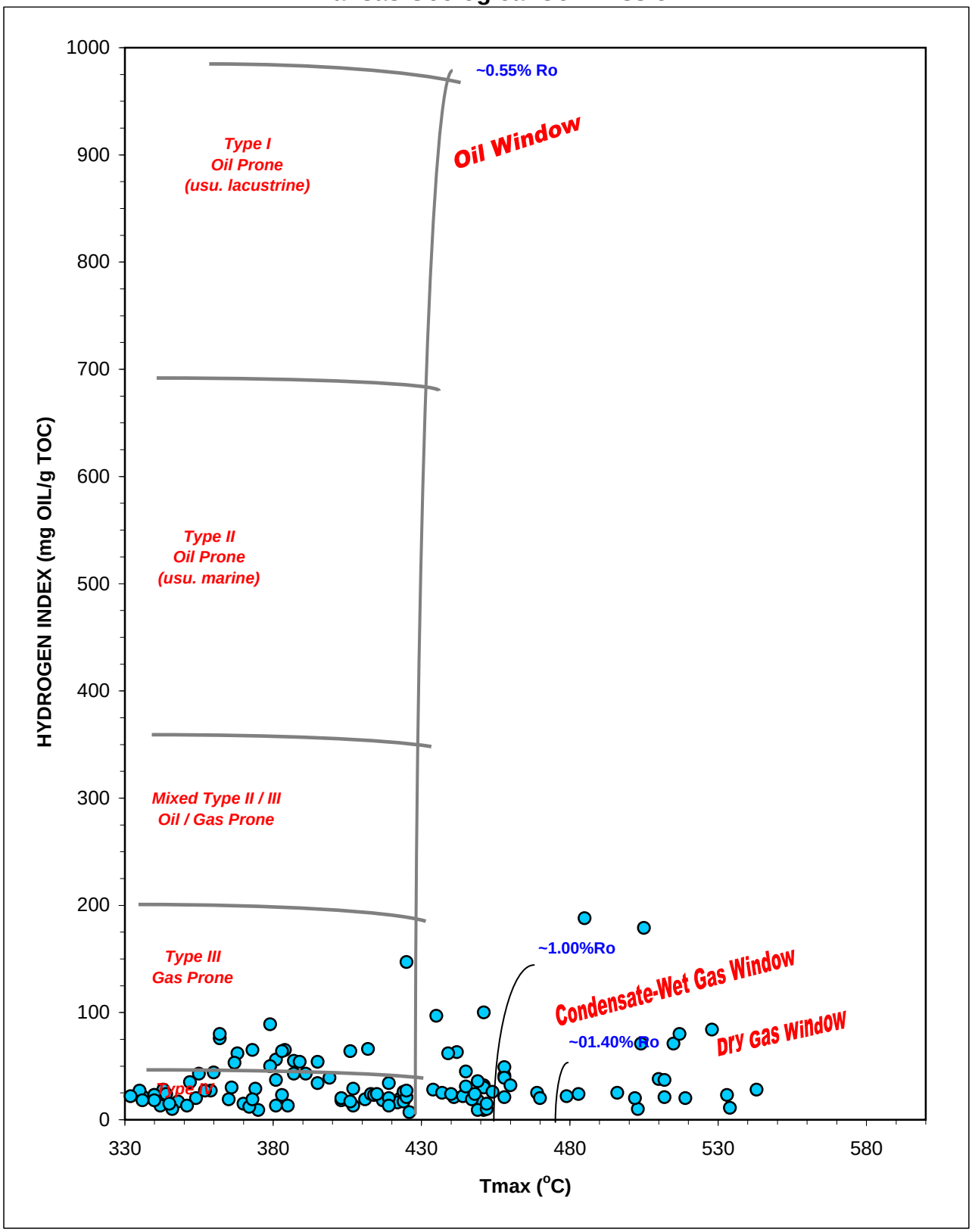


Figure 4. Kerogen Type and Maturity (Tmax)

Humble Geochemical Services Division

KEROGEN TYPE and MATURITY

Arkansas Geological Commission

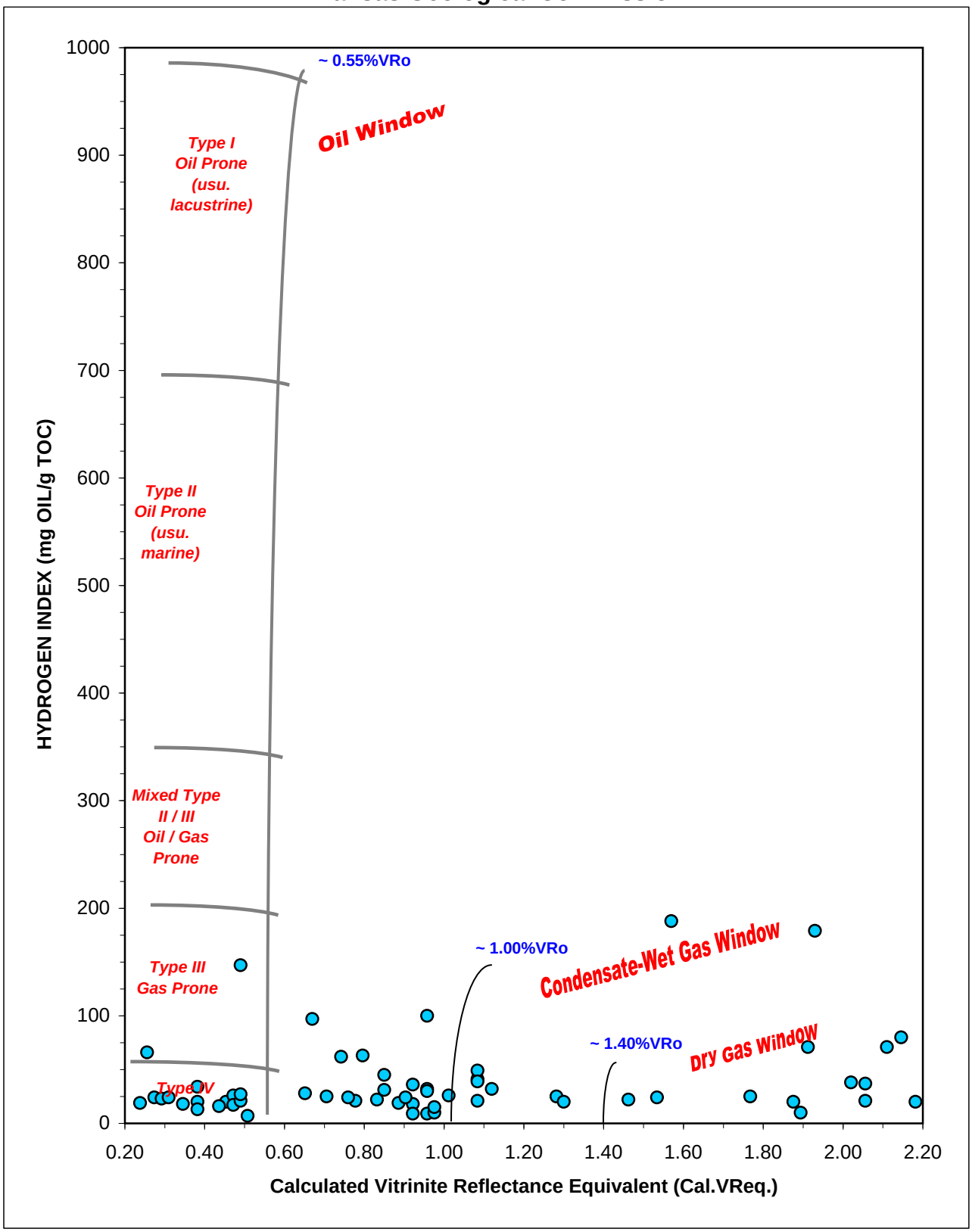


Figure 4. Kerogen Type and Maturity (Tmax calculated %VRo)

Humble Geochemical Services Division

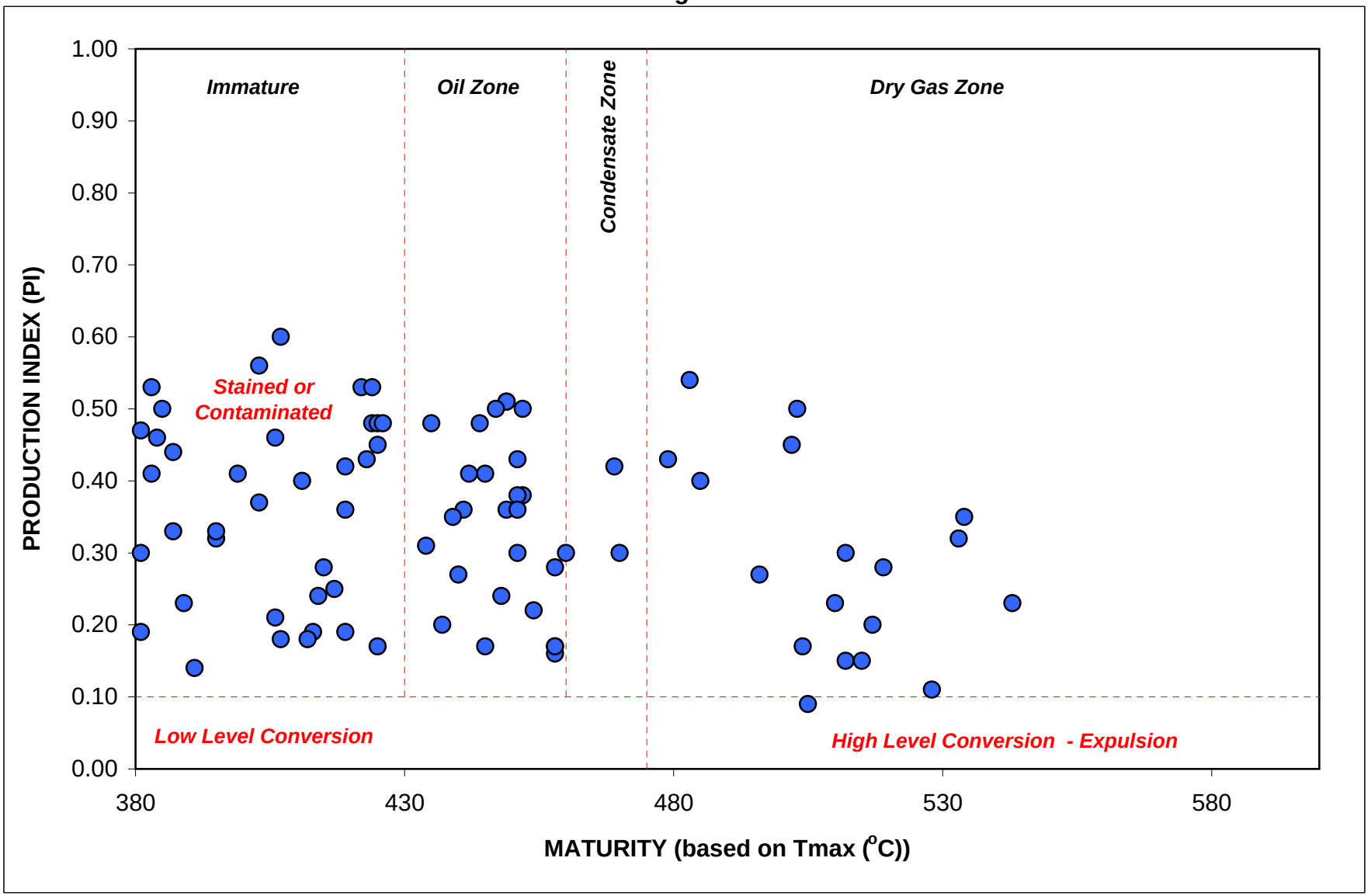


Figure 5. Kerogen conversion and maturity (based on Tmax).

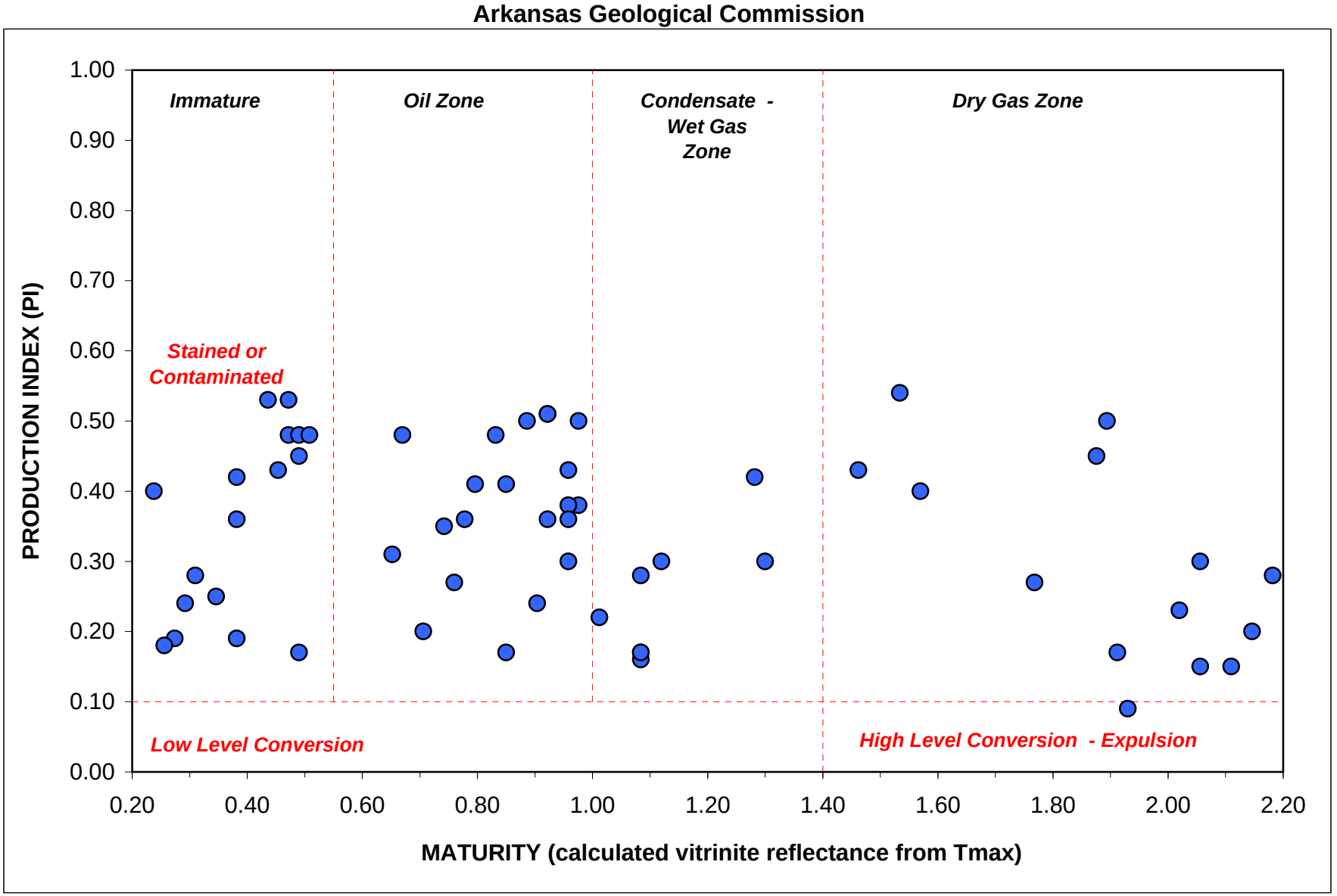
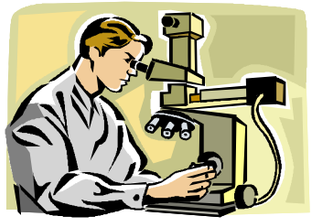


Figure 5. Kerogen conversion and maturity (calculated %VRo from Tmax).



API # 03145000240000 | **Albert Estate No. 1** | **Project: 05/0006**

Visual Kerogen Analysis

ORGANIC MATTER (%) | **RELATIVE ABUNDANCE** | **LITHOLOGIC DESCRIPTIONS** | **Ro**

Sample Number	Minerals End, Inc. — Sample Id or Depth	Preparation/Sample Type	LIPIDS: UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS: STRUCTURED: Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Recycled Vitrinite	Inertodetrinite	Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	TYPE I: SHALE: Color	Intensity	TYPE I: QUARTZ: Color	Intensity	Background Intensity	TYPE II: SHALE:			TYPE II: QUARTZ:			Vit. Reflectance or Equiv.
1	2650	WR / CTG		95			LD / Tr	U / nd			1	Tr	Tr	VR / 3	O / 1																				- / V 2.58
Comments:	*Microniazed AOM; rich II source post-mature II kerogen (good network) pyrotic, bitumen lumps, clay-rich shales , 1% coals, 2% qtz grav*																																		
2	3000	WR / CTG		85			LD / Tr	U / Tr			2	nd	Tr	VR / 10	O / 3																				- / V 2.61
Comments:	*Micrinized AOM good network, silty laminated shale, qtz 35, clay 6*																																		
3	3230	WR / CTG		90			LD / Tr	U / Tr			3	nd	Tr	VR / 6	O / 1																				- / V 2.61
Comments:	*Massive to micrinized AOM, good network, gtz 25%, clay 55% carbs 15%*																																		
4	3350	WR / CTG		90			LD / Tr	U / Tr			3	nd	Tr	VR / 6	O / 1																				- / V 2.62
Comments:	*Excellent AOM, micrinized AOM qtz 35%, carbs 1%, clay 55%*																																		
5	3470	WR / CTG		95			LD / Tr	O / Tr			1	Tr	Tr	VR / 3	O / 1																				- / V 2.63
Comments:	*Excellent AOM return, micronized, qtz 35%, carbs 20%, clay 40%*																																		

ANALYST

X **Landis**

MICROSCOPE

X **Zeiss**

Jena

Leitz

SAMPLE TYPE/PREP

- **CTG** Cuttings
- **CC** Conv. Core
- **SWC** SideWallCore
- **OC** Outcrop
- **NI** No Inform.
- **C** Coal
- **K** Kerogen
- **WR** Whole Rock
- **n.d.** Not Determined

STRUCTURED LIPIDS

- **AL** Alginite
- **SB** Suberinite
- **C** Cutinite
- **LD** Liptodetrinite
- **U** Undiffer.
- **S** Sporinite
- **R** Resinite
- **O** Other

OTHER ORGANIC MATTER

- **E** Exsudatinite
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** VitriniteContamination
- **VR** Recycled Vitrinite

PYRITE

- **E** Euhedral
- **F** Framboid
- **MA** Massive
- **RI** Replace-infill

ABUND.

- **N** None
- **T** Trace
- **-** Small Amt.
- **M** Mod. Amt.
- **+** Large Amt.
- **++** Abundant

FLUOR. INTENS.

- **0** None
- **1** Weak
- **2** Moderate
- **3** Strong
- **4** Intense

VIT. REFLECT. EQUIVALENCE

- **B** Bitumen
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** Vitrinite Contam.
- **VR** Recycled Vitrinite

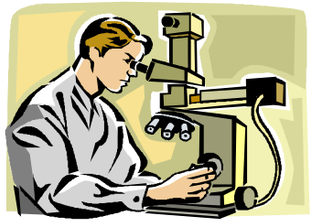
FLUOR. COLOR

- **W** White
- **G** Green
- **Y** Yellow
- **O** Orange
- **R** Red
- **B** Brown
- **BL** Black
- **L** Light
- **D** Dark

TAI COLOR VALUES

- **1-** Straw Yellow
- **1** Pale Yellow
- **1+** Yellow
- **2-** Yellow-Orange
- **2** Golden
- **2+** Amber
- **3-** Reddish Brown
- **3** Medium Brown
- **3+** Dark Brown
- **4-** Brown-Black
- **4** Black
- **4+** Black-Opaque

MINERALS END INC.



API # 03145000240000 | **Albert Estate No. 1** | **Project: 05/0006**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Recycled Vitrinite	Inertodetrinite	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I SHALE: Color	Intensity	TYPE I QUARTZ: Color	Intensity	Background Intensity	TYPE II SHALE			TYPE II QUARTZ			Ro: Vit. Reflectance or Equiv.
6	3570	WR CTG		95			LD nd	O Tr			5	nd	Tr	VR Tr	O Tr																				B 2.55 V 2.56

Comments: *Extremely rich II kerogen, AOM massive, micrinized return, biogenic silica, ostracods, excellent AOM return, carbs 15% pitte*

Comments:

Comments:

Comments:

Comments:

ANALYST

X **Landis**

MICROSCOPE

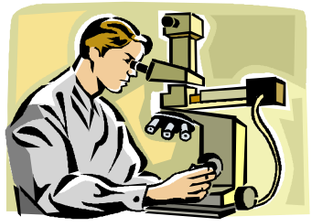
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03023100040000 | **Landrum No. 1** | **Project: 05/0006**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Recycled Vitrinite	Inertodetrinite	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I SHALE: Color	Intensity	TYPE I QUARTZ: Color	Intensity	Background Intensity	TYPE II SHALE			TYPE II QUARTZ			Ro: Vit. Reflectance or Equiv.
7	4100	WR					LD	U						VR	O																			B 2.24
		CTG		70			5	5			Tr	Tr	1	15	4																			V 2.25
Comments:	*Mature silty shale, 50-50 massive-micrinized, definite V, definite qtz - 10%, carbs - 5%, clay 6*																																	
8	4400	WR																																-
		CTG		75																														V 2.28
Comments:	*Diluted, post mature Type III kerogen, clay >60%, carbs < 5%, micrinized AOI*																																	
9	4600	WR					LD	O						VR	O																			-
		CTG		75			nd	1			3	nd	1	10	10																			V 2.27
Comments:	*Type III kerogen, good AOM return, micrinized, Clay - >60%, Carbs - <5%, qtz - 25%*																																	
10	4700	WR					LD	O						VR	O																			-
		CTG		85			2	1			2	nd	Tr	10	Tr																			V 2.29
Comments:	*Good AOM network, micrinized, laminated clay-rich > 60%*																																	
11	1560	WR					LD	U						VC	O																			-
		CTG		75			Tr	1			3	nd	1	15	5																			V 2.40
Comments:	*Mix of dilited silty shale and Type II poorly developed AOM networks, micrinize*																																	

ANALYST

X **Landis**

MICROSCOPE

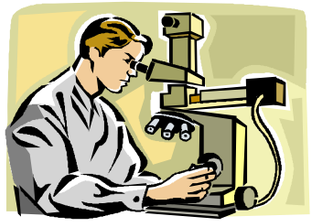
X **Zeiss**

Jena

Leitz

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03023100040000 | **Landrum No. 1** | **Project: 05/0006**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%)													RELATIVE ABUNDANCE							LITHOLOGIC DESCRIPTIONS												Ro
			LIPIDS									HUMIC		OTHER					VITRINITE					TYPE I					TYPE II							
			UNSTRUCTURED				STRUCTURED																	SHALE		QUARTZ			SHALE			QUARTZ				
			Undifferentiated	Amorphous	Massive	Micrinized	Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	Inertinite	Vitrinite	Recycled Vitrinite	Inertodetrinite	Pyrite Type	Pyrite	Organic Concentration	Normal	Rough	Lipid-Rich	Oxidized	Coked	Color	Intensity	Color	Intensity	Background Intensity								Vit. Reflectance or Equiv.
12	4700	WR					LD	U						VR	O																				-
		CTG		75			Tr	1			2	nd	Tr	15	7																				V 2.43
Comments:	*Mix of diluted silty shale and Type II, micrinized AOM, poor AOM networ*																																		
13	4800	WR					LD	U						VR	O																				-
		CTG		80			1	Tr			1	nd	Tr	15	3																				V 2.31
Comments:	*Good micrinized Aom network, laminated clay shale, 60% clay, 30% qtz, 5% carb*																																		
14	4900	WR					LD	U						VC	O																				-
		CTG		95			Tr	Tr			1	nd	Tr	3	1																				V 2.29
Comments:	*Type II, excellent micrinized Aom, 30% qtz, 60% clay, <6% car*																																		
15	5000	WR					LD	U						VR																						B 2.41
		CTG		90			5	Tr			5	nd	Tr	Tr	Tr																				-
Comments:	*Mixed calcareous and silicous shale, No Vit, clay 40%, Qtz cement/ biogenic 35%, carbs 20%, intergranular slt properties, massive to micrinized AC*																																		
Comments:																																			

ANALYST

X **Landis**

MICROSCOPE

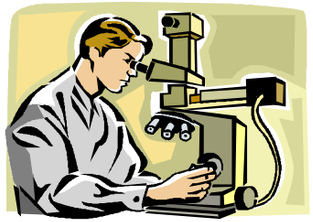
X **Zeiss**

Jena

Leitz

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03023100030000 | **Liles No. 1** | **Project: 05/0006**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Recycled Vitrinite	Inertodetrinite	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II: SHALE			QUARTZ			Ro: Vit. Reflectance or Equiv.
16	4050	WR					LD	U						VR	O																				-
		CTG		75			Tr	1			1	nd	1	15	7																				V 2.39
Comments:	*Post-mature, diluted shale, no Aom network (micrinizzed) clay > 60%, carbs, < 5%, qtz, 25*																																		
17	4300	WR					LD	U						VR	O																				B 2.33
		CTG		60			5	2			3	nd	Tr	25	5																				V 2.44
Comments:	*Post-mature clay rich shale, atz < 20%, pyrite 1%, massive to micrinized AOM, carbs < 5%, Type II and III kerogen originally, rework*																																		
18	4850	WR					LD	U						VR	O																				-
		CTG		75			1	1			1	nd	Tr	12	10																				V 2.39
Comments:	*Mix or diluted silty shale and type II micrinized Aom, poor Aom networ*																																		
19	5000	WR					LD	U						VR	O																				-
		CTG		95			Tr	nd			2	nd	Tr	3	Tr																				V 2.45
Comments:	*High TOC, Type II/micrinized AOM, good network, qtz cement/biogenic 35%,, pyrite 2%,carbs 10*																																		
20	5150	WR					LD	U						VR	O																				B 2.53
		CTG		85			nd	nd			10	nd	Tr	5	Tr																				V 2.45
Comments:	*Massive 2% with 80% micrinized AOM, Type II, rich good network, pyrite 2%. Residual TOC, biogenic, qtz cement 35%, Clay (?), det. Qtz. 10% carbs 10%.*																																		

ANALYST

X **Landis**

MICROSCOPE

X **Zeiss**

Jena

Leitz

SAMPLE TYPE/PREP

- **CTG** Cuttings
- **CC** Conv. Core
- **SWC** SideWallCore
- **OC** Outcrop
- **NI** No Inform.
- **C** Coal
- **K** Kerogen
- **WR** Whole Rock
- **n.d.** Not Determined

STRUCTURED LIPIDS

- **AL** Alginite
- **SB** Suberinite
- **C** Cutinite
- **LD** Liptodetrinite
- **U** Undiffer.
- **S** Sporinite
- **R** Resinite
- **O** Other

OTHER ORGANIC MATTER

- **E** Exsudatinite
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** VitriniteContamination
- **VR** Recycled Vitrinite

PYRITE

- **E** Euhedral
- **F** Framboid
- **MA** Massive
- **RI** Replace-infill

ABUND.

- **N** None
- **T** Trace
- **-** Small Amt.
- **M** Mod. Amt.
- **+** Large Amt.
- **++** Abundant

FLUOR. INTENS.

- **0** None
- **1** Weak
- **2** Moderate
- **3** Strong
- **4** Intense

VIT. REFLECT. EQUIVALENCE

- **B** Bitumen
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** Vitrinite Contam.
- **VR** Recycled Vitrinite

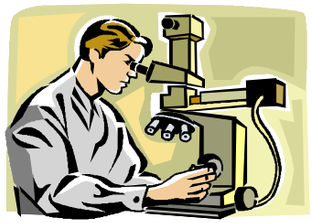
FLUOR. COLOR

- **W** White
- **G** Green
- **Y** Yellow
- **O** Orange
- **R** Red
- **B** Brown
- **BL** Black
- **L** Light
- **D** Dark

TAI COLOR VALUES

- **1-** Straw Yellow
- **1** Pale Yellow
- **1+** Yellow
- **2-** Yellow-Orange
- **2** Golden
- **2+** Amber
- **3-** Reddish Brown
- **3** Medium Brown
- **3+** Dark Brown
- **4-** Brown-Black
- **4** Black
- **4+** Black-Opaque

MINERALS END INC.



API # 03023100030000 | **Liles No. 1** | **Project: 05/0006**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%)												RELATIVE ABUNDANCE										LITHOLOGIC DESCRIPTIONS TYPE I					TYPE II						Ro
			LIPIDS									HUMIC		OTHER																					
			UNSTRUCTURED				STRUCTURED												VITRINITE					SHALE		QUARTZ			SHALE		QUARTZ				
			Undifferentiated	Amorphous	Massive	Micrinized	Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	Inertinite	Vitrinite	Recycled Vitrinite	Inertodetrinite	Pyrite Type	Pyrite	Organic Concentration	Normal	Rough	Lipid-Rich	Oxidized	Coked	Color	Intensity	Color	Intensity	Background Intensity								Vit. Reflectance or Equiv.
21	5270	WR CTG		95			LD 1	U 1			1	nd	Tr	VR 1	O 1																				- V 2.45

Comments: *AOM micrinized, good network, clay 85%, qtz 35%, carbs < 5%, pyrite 2%*

Comments:

Comments:

Comments:

Comments:

ANALYST

X **Landis**

MICROSCOPE

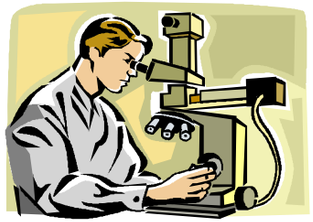
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-infill	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite			**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
n.d.	Not Determined													**L**	Light	**4-**	Brown-Black
														D	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03145000070000 | **Sample No. 1** | **Project: 05/0006**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Recycled Vitrinite	Inertodetrinite	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II: SHALE			QUARTZ			Ro: Vit. Reflectance or Equiv.
22	1500	WR					LD	U						VR	O																				B 1.99
		CTG		60			5	5			5	nd	Tr	20	5																				V 2.02
Comments:		*Massive AOM on diluted Type III kerogen, clay > 60%, qtz 25%, carbs < 5%. Poor AOM network*																																	
23	1800	WR					LD	U						VR	O																				-
		CTG		75			Tr	Tr			Tr	nd	Tr	20	5																				V 1.95
Comments:		*Diluted, terrestrial clay, poor AOM network, micrinize*																																	
24	2000	WR					LD	U						VR	O																				-
		CTG		85			1	1			2	nd	Tr	10	1																				V 2.08
Comments:		*Clay rich micrinized AOM, good network, qtz 3%, clay 60%, carb 5%*																																	
25	2200	WR					LD	U						VR	O																				-
		CTG		95			Tr	Tr			1	nd	Tr	3	1																				V 2.12
Comments:		*Excellent Type II, micrinized AOM network, clay > 60%, qtz, 30%, carb < 5%*																																	
26	2400	WR					LD	U						VR	O																				-
		CTG		90			1	Tr			3	nd	Tr	5	1																				V 2.16
Comments:		*Qtz 30%, (biogenic), good AOM network micrinize*																																	

ANALYST

X **Landis**

MICROSCOPE

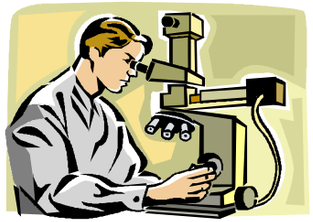
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03145000070000 **Sample No. 1** **Project: 05/0006**

Visual Kerogen Analysis

Sample Number	Minerals End, Inc. Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%)													RELATIVE ABUNDANCE						LITHOLOGIC DESCRIPTIONS TYPE I					LITHOLOGIC DESCRIPTIONS TYPE II						Ro
			LIPIDS									HUMIC		OTHER					VITRINITE													
			UNSTRUCTURED				STRUCTURED															SHALE		QUARTZ			SHALE			QUARTZ			
			Undifferentiated	Amorphous	Massive	Micrinized	Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	Inertinite	Vitrinite	Recycled Vitrinite	Inertodetrinite	Pyrite Type	Pyrite	Organic Concentration	Normal	Rough	Lipid-Rich	Oxidized	Coked	Color	Intensity	Color	Intensity	Background Intensity						Vit. Reflectance or Equiv.
27	2600	WR CTG		90			LD 1	U Tr			3	nd	Tr	VR 5	O 1																	- V 2.19
Comments:	*Excellent micrinized AOM network, laminated clay 60%, qtz 30%*																															
28	2800	WR CTG		75			LD 5	U Tr			5	nd	Tr	VR 10	O 5																	B 2.06 V 2.16
Comments:	*Mix 50-80 of silty shale, clay >60%, qtz <10%, qtz cemented/biogenic >35%, shale facies, pyrite 5% laminate, massive-micrinized AOM 50-80 bitumen porelinings,Type II kerogen in silica rock h*																															
Comments:																																
Comments:																																
Comments:																																

ANALYST

X **Landis**

MICROSCOPE

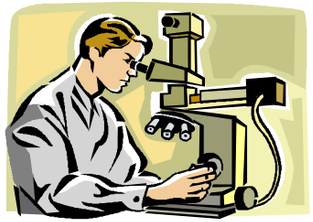
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	-	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	+	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					++	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03145100020000 **Bobby & Lorete Reaper No. 1** **Project: 05/0006**

Visual Kerogen Analysis

ORGANIC MATTER (%) | **RELATIVE ABUNDANCE** | **LITHOLOGIC DESCRIPTIONS** | **Ro**

LIPIDS (UNSTRUCTURED / STRUCTURED) | **HUMIC** | **OTHER** | **VITRINITE** | **TYPE I** (SHALE / QUARTZ) | **TYPE II** (SHALE / QUARTZ)

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	Undifferentiated	Amorphous	Massive	Micrinized	Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	Inertinite	Vitrinite	Recycled Vitrinite	Inertodetrinite	Pyrite Type	Pyrite	Organic Concentration	Normal	Rough	Lipid-Rich	Oxidized	Coked	Color	Intensity	Color	Intensity	Background Intensity						Vit. Reflectance or Equiv.
29	2500	WR					LD	U						VR	O																		B 2.16
		CTG		75			2	4			2		Trnd	15	2																		V 2.20
Comments:	*Post mature massive to micrinized LCM, high residual TOC, clay > 60%, qtz ~ 3%, carbs 10%, pyrite 1%, weakly laminated clay sha*																																	
30	2700	WR					LD	U						VR	O																		-
		CTG		80			1	3			1	nd	Tr	10	5																		V 2.18
Comments:	*Weakly laminated shale, massive AOM, poor LCM network, carbs 5%,clay 60%, qtz 30%*																																	
31	2800	WR					C	U						VR	O																		-
		CTG		75			Tr	4			1	nd	Tr	15	5																		V 2.22
Comments:	*Weakly laminated shale with silty RIP-UPS, poor LCM network (massive*																																	
32	3000	WR					LD	U						VR	O																		-
		CTG		80			3	1			1	nd	Tr	10	5																		V 2.22
Comments:	*Massive LCM, poor network, laminated clay shale, carbs 5%, clay 60%, qtz 25%*																																	
33	3100	WR					LD	U						VR	O																		-
		CTG		90			2	1			1	nd	Tr	6	Tr																		V 2.32
Comments:	*Massive LCM, good LCM network, qtz 40%, clay 50%, carbs 5%, no pyrite*																																	

ANALYST

X **Landis**

MICROSCOPE

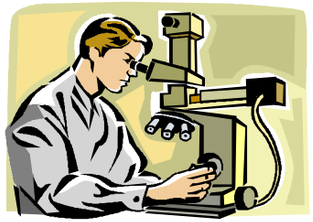
X **Zeiss**

Jena

Leitz

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03145100020000 | **Bobby & Lorete Reaper No. 1** | **Project: 05/0006**

Visual Kerogen Analysis

Sample Number	Minerals End, Inc. Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Recycled Vitrinite	Inertodetrinite	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	SHALE Intensity	QUARTZ Color	QUARTZ Intensity	Background Intensity	TYPE II: SHALE			QUARTZ			Ro: Vit. Reflectance or Equiv.
34	3200	WR CTG		90			LD 2	U 1			1	nd	Tr	VR 4	O 2																				- V 2.28
Comments:	*Identical to 3100*																																		
35	3300	WR CTG		95			LD Tr	U 1			1		Trnd	VR 2	O 1																				- V 2.32
Comments:	*Post-mature Type II, residual TOC, excellent AOM network, micrinized ACXM (10%), qtz - 40%, clay - 45%, carbs - 10%, pyrite - 1*																																		
Comments:																																			
Comments:																																			
Comments:																																			

ANALYST

X **Landis**

MICROSCOPE

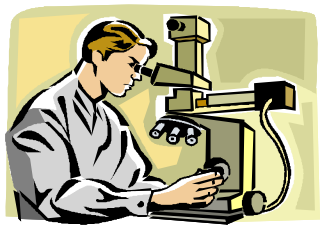
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03141100020000 **Collums No. 1-27** **Project: 05/0006**

Visual Kerogen Analysis

ORGANIC MATTER (%)

LIPIDS

UNSTRUCTURED: Undifferentiated | Amorphous | Massive | Micrinized

STRUCTURED: Liptiniate | Liptodetrinite | Type | Type | Solid Bitumen

HUMIC: Inertinite | Vitrinite

OTHER: Recycled Vitrinite | Inertodetrinite

RELATIVE ABUNDANCE

Pyrite Type | Pyrite | Organic Concentration

VITRINITE: Normal | Rough | Lipid-Rich | Oxidized | Coked

LITHOLOGIC DESCRIPTIONS

TYPE I: SHALE (Color | Intensity) | QUARTZ (Color | Intensity)

Background Intensity

TYPE II: SHALE | QUARTZ

Ro: Vit. Reflectance or Equiv.

Sample Number	Sample Id or Depth	Preparation/Sample Type	Undifferentiated	Amorphous	Massive	Micrinized	Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	Inertinite	Vitrinite	Recycled Vitrinite	Inertodetrinite	Pyrite Type	Pyrite	Organic Concentration	Normal	Rough	Lipid-Rich	Oxidized	Coked	Color	Intensity	Color	Intensity	Background Intensity	Vit. Reflectance or Equiv.
36	1200	WR					LD	U						VR	O														-
		CTG		15			Tr	1			Tr	nd	Tr	64	20														V 2.12
Comments:	*Essentially barren, but what is here are elongated laths of V, no AOM network, 80% qtz, silt*																												
37	1430	WR					LD	U						VR	O														-
		CTG		65			1	2			1	nd	1	20	10														V 2.09
Comments:	*Diluted clastic shale, clay > 60%, carb 5%, qtz 30%, massive LCM*																												
38	1800	WR					LD	U						VC	O														-
		CTG		65			3	1			1	nd	Tr	20	10														V 2.18
Comments:	*Diluted clastic shale, clay > 60%, carb 5%, qtz 3%, massive LCM*																												
39	2000	WR					LD	U						VR	O														B 2.11
		CTG		75			1	2			2	nd	Tr	15	5														V 2.17
Comments:	*Post-mature, 29% massive to 8% micrinized LCM, weakly laminated clay shale, qtz 4%, clay 50%, carb 10%, pyrite*																												
40	2200	WR					LD	U						VR	O														-
		CTG		75			3	2			1	nd	Tr	15	4														V 2.16
Comments:	*Weakly laminated massive AOM 25%, micrinized AOM 75%, clay 70%, qtz 25%, carbs 5%*																												

ANALYST

X **Landis**

MICROSCOPE

X **Zeiss**

Jena

Leitz

SAMPLE TYPE/PREP

CTG	Cuttings
CC	Conv. Core
SWC	SideWallCore
OC	Outcrop
NI	No Inform.
C	Coal
K	Kerogen
WR	Whole Rock
n.d.	Not Determined

STRUCTURED LIPIDS

AL	Alginite
SB	Suberinite
C	Cutinite
LD	Liptodetrinite
U	Undiffer.
S	Sporinite
R	Resinite
O	Other

OTHER ORGANIC MATTER

E	Exsudatinite
G	Graptolites
VL	Lipid-Rich Vitrinite
VC	VitriniteContamination
VR	Recycled Vitrinite

PYRITE

E	Euhedral
F	Framboid
MA	Massive
RI	Replace-infill

ABUND.

N	None
T	Trace
-	Small Amt.
M	Mod. Amt.
+	Large Amt.
++	Abundant

FLUOR. INTENS.

0	None
1	Weak
2	Moderate
3	Strong
4	Intense

VIT. REFLECT. EQUIVALENCE

B	Bitumen
G	Graptolites
VL	Lipid-Rich Vitrinite
VC	Vitrinite Contam.
VR	Recycled Vitrinite

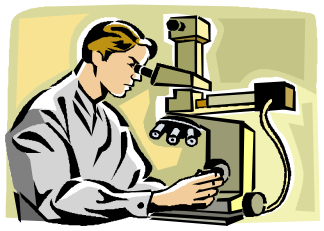
FLUOR. COLOR

W	White
G	Green
Y	Yellow
O	Orange
R	Red
B	Brown
BL	Black
L	Light
D	Dark

TAI COLOR VALUES

1-	Straw Yellow
1	Pale Yellow
1+	Yellow
2-	Yellow-Orange
2	Golden
2+	Amber
3-	Reddish Brown
3	Medium Brown
3+	Dark Brown
4-	Brown-Black
4	Black
4+	Black-Opaque

MINERALS END INC.



API # 03141100020000 **Collums No. 1-27** **Project: 05/0006**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Recycled Vitrinite	Inertodetrinite	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I SHALE: Color	Intensity	TYPE I QUARTZ: Color	Intensity	Background Intensity	TYPE II SHALE			TYPE II QUARTZ			Vit. Reflectance or Equiv.
41	2780	WR					LD	U						VR	O																			B 2.19
		CTG		75			3	1			1	nd	Tr	10	10																			V 2.19
Comments:	*Post-mature, weakly laminated 30% massive to 70% micrinized LCM, qtz 35%, clay 60%, carb <5%, pyrite*																																	
42	2600	WR					LD	U						VR	O																			-
		CTG		65			Tr	2			Tr	2	1	20	10																			V 2.18
Comments:	*Qtz - 40%, clay - 50%, carbs ~5%*																																	
43	2900	WR					LD	U						VR	O																			B 1.95
		CTG		65			5	Tr			5	Tr	Tr	20	5																			V 2.08
Comments:	*Post mature mixed types II/III kerogen with bitumen linings, residual TOC, massive to micrinized LCM, qts >35%, clay 50% carbs 5% pyrite 2 - 3%*																																	
44	3050	WR					LD	U						VR	O																			-
		CTG		75			5	Tr			5	nd	Tr	10	5																			V 2.08
Comments:	*Predominantly Type II post mature with massive to micriized, pyrobitumen, qtz 30% split between detroital.cement clay 50%, pyrite*																																	
45	3200	WR					LD	U						VC	O																			-
		CTG		90			2	Tr			2	nd	Tr	5	1																			V 2.12
Comments:	*Silicified tusmanite!! Massive to micrinized AOM, clay rich >60%, qtz >30% carbs 5%, pyrite 2-3%*																																	

ANALYST

X **Landis**

MICROSCOPE

X **Zeiss**

Jena

Leitz

SAMPLE TYPE/PREP

CTG	Cuttings
CC	Conv. Core
SWC	SideWallCore
OC	Outcrop
NI	No Inform.
C	Coal
K	Kerogen
WR	Whole Rock
n.d.	Not Determined

STRUCTURED LIPIDS

AL	Alginite
SB	Suberinite
C	Cutinite
LD	Liptodetrinite
U	Undiffer.
S	Sporinite
R	Resinite
O	Other

OTHER ORGANIC MATTER

E	Exsudatinite
G	Graptolites
VL	Lipid-Rich Vitrinite
VC	VitriniteContamination
VR	Recycled Vitrinite

PYRITE

E	Euhedral
F	Framboid
MA	Massive
RI	Replace-infill

ABUND.

N	None
T	Trace
-	Small Amt.
M	Mod. Amt.
+	Large Amt.
++	Abundant

FLUOR. INTENS.

0	None
1	Weak
2	Moderate
3	Strong
4	Intense

VIT. REFLECT. EQUIVALENCE

B	Bitumen
G	Graptolites
VL	Lipid-Rich Vitrinite
VC	Vitrinite Contam.
VR	Recycled Vitrinite

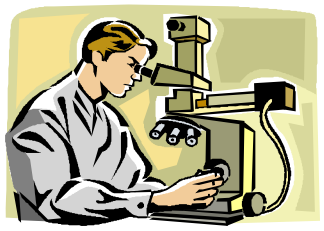
FLUOR. COLOR

W	White
G	Green
Y	Yellow
O	Orange
R	Red
B	Brown
BL	Black
L	Light
D	Dark

TAI COLOR VALUES

1-	Straw Yellow
1	Pale Yellow
1+	Yellow
2-	Yellow-Orange
2	Golden
2+	Amber
3-	Reddish Brown
3	Medium Brown
3+	Dark Brown
4-	Brown-Black
4	Black
4+	Black-Opaque

MINERALS END INC.



API # 03141100020000 **Collums No. 1-27** **Project: 05/0006**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Recycled Vitrinite	Inertodetrinite	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II: SHALE		QUARTZ			Ro: Vit. Reflectance or Equiv.
46	3300	WR					LD	U						VR	O																			-
		CTG		85			2	1			1	nd	Tr	10	1																			V 2.13
Comments:	*Calcareous type II with massive AOM network, Carbs <2%, qtz 25% (occurs in laminate as cement), clay 50%, pyrite 1%, bitumen grain linings*																																	
47	3400	WR					LD	U						VR	O																			B 1.96
		CTG		65			5	Tr			5	nd	Tr	20	5																			V 2.05
Comments:	*Very similar to 2400 except qtz cement. Qtz < 35%, clay >50%, pyrite 2%, carbs 10%, massive to micrinized AOM*																																	
48	3880	WR					LD	U						VC	O																			-
		CTG		95			1	Tr			2	nd	Tr	Tr	2																			V 2.14
Comments:	*Excellent type II source rock, micrinized AOM, excellent residual TOC, good AOM network, Clay >60%, qtz 25%, carbs 10%*																																	
Comments:																																		
Comments:																																		

ANALYST

X **Landis**

MICROSCOPE

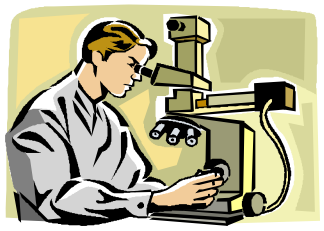
X **Zeiss**

Jena

Leitz

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	-	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	+	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					++	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03141000080000 **Copeland No. 2** **Project: 05/0006**

Visual Kerogen Analysis

ORGANIC MATTER (%)

LIPIDS

UNSTRUCTURED: Undifferentiated; Amorphous; Massive; Micrinized

STRUCTURED: Liptiniate; Liptodetrinite; Type; Type; Solid Bitumen

HUMIC: Inertinite; Vitrinite

OTHER: Recycled Vitrinite; Inertodetrinite

RELATIVE ABUNDANCE

Pyrite Type; Pyrite; Organic Concentration

VITRINITE: Normal; Rough; Lipid-Rich; Oxidized; Coked

LITHOLOGIC DESCRIPTIONS

TYPE I: SHALE (Color; Intensity); QUARTZ (Color; Intensity)

Background Intensity

TYPE II: SHALE; QUARTZ

Ro: Vit. Reflectance or Equiv.

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	Undifferentiated	Amorphous	Massive	Micrinized	Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	Inertinite	Vitrinite	Recycled Vitrinite	Inertodetrinite	Pyrite Type	Pyrite	Organic Concentration	Normal	Rough	Lipid-Rich	Oxidized	Coked	Color	Intensity	Color	Intensity	Background Intensity						Vit. Reflectance or Equiv.
49	600	WR					LD	U						VR	O																		-
		CTG		60			3	2			Tr	Trt	Tr	25	10																		V 2.02
Comments:	*Diluted shale, clay 60%, no AOM network, massive AOM*																																	
50	650	WR												VR	O																		-
		CTG		80			nd	1			1	nd	1	10	7																		V 2.05
Comments:	*Similar/identical to 600 with good AOM network, qtz (biogenic) 30%, clay 60%*																																	
51	750	WR					LD	U						VR																			-
		CTG		80			nd	2			3	nd	Tr	10	5																		V 2.06
Comments:	*Excellent biogenic qtz, good AOM network, massive, qtz 35%, clay 55%, carb 5%, pyrite 1%*																																	
52	850	WR					LD	U						VR	O																		-
		CTG		70			1	5			2	nd	Tr	15	7																		V 2.08
Comments:	*Weakly laminated shale, good AOM network, massive AOM, clay 60%, qtz 25%, carbs 1%*																																	
53	950	WR					LD	U						VR	O																		B 2.02
		CTG		85			5	1			2	nd	Tr	5	2																		V 2.11
Comments:	*Well-developoed massive to micrinized K , qtz cement 25%, clay matrix 60%, carbs 5%, laminated AOM-rich Type II (l) shale*																																	

ANALYST

X **Landis**

MICROSCOPE

X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP

- **CTG** Cuttings
- **CC** Conv. Core
- **SWC** SideWallCore
- **OC** Outcrop
- **NI** No Inform.
- **C** Coal
- **K** Kerogen
- **WR** Whole Rock
- **n.d.** Not Determined

STRUCTURED LIPIDS

- **AL** Alginite
- **SB** Suberinite
- **C** Cutinite
- **LD** Liptodetrinite
- **U** Undiffer.
- **S** Sporinite
- **R** Resinite
- **O** Other

OTHER ORGANIC MATTER

- **E** Exsudatinite
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** VitriniteContamination
- **VR** Recycled Vitrinite

PYRITE

- **E** Euhedral
- **F** Framboid
- **MA** Massive
- **RI** Replace-infill

ABUND.

- **N** None
- **T** Trace
- **-** Small Amt.
- **M** Mod. Amt.
- **+** Large Amt.
- **++** Abundant

FLUOR. INTENS.

- **0** None
- **1** Weak
- **2** Moderate
- **3** Strong
- **4** Intense

VIT. REFLECT. EQUIVALENCE

- **B** Bitumen
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** Vitrinite Contam.
- **VR** Recycled Vitrinite

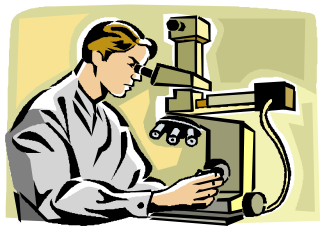
FLUOR. COLOR

- **W** White
- **G** Green
- **Y** Yellow
- **O** Orange
- **R** Red
- **B** Brown
- **BL** Black
- **L** Light
- **D** Dark

TAI COLOR VALUES

- **1-** Straw Yellow
- **1** Pale Yellow
- **1+** Yellow
- **2-** Yellow-Orange
- **2** Golden
- **2+** Amber
- **3-** Reddish Brown
- **3** Medium Brown
- **3+** Dark Brown
- **4-** Brown-Black
- **4** Black
- **4+** Black-Opaque

MINERALS END INC.



API # 03141000100000 | **Copeland No. 3** | **Project: 05/0006**

Visual Kerogen Analysis

ORGANIC MATTER (%)

LIPIDS

UNSTRUCTURED: Undifferentiated; Amorphous; Massive; Micrinized

STRUCTURED: Liptiniate; Liptodetrinite; Type; Type; Solid Bitumen

HUMIC: Inertinite; Vitrinite

OTHER: Recycled Vitrinite; Inertodetrinite

RELATIVE ABUNDANCE

Pyrite Type; Pyrite; Organic Concentration

VITRINITE: Normal; Rough; Lipid-Rich; Oxidized; Coked

LITHOLOGIC DESCRIPTIONS

TYPE I: SHALE (Color; Intensity); QUARTZ (Color; Intensity)

Background Intensity

TYPE II: SHALE; QUARTZ

Ro: Vit. Reflectance or Equiv.

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	Undifferentiated	Amorphous	Massive	Micrinized	Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	Inertinite	Vitrinite	Recycled Vitrinite	Inertodetrinite	Pyrite Type	Pyrite	Organic Concentration	Normal	Rough	Lipid-Rich	Oxidized	Coked	Color	Intensity	Color	Intensity	Background Intensity	Vit. Reflectance or Equiv.
54	800	WR					LD	U						VR	O														-
		CTG		55			Tr	4			1	nd	Tr	25	15														V 2.18
Comments:	*Diluted clastic shale, massive poor AOM network, clay 76%, qtz 25%, carb 5%*																												
55	900	WR					LD	U						VR	O														-
		CTG		90			Tr	3			1	nd	Tr	1	5														V 2.22
Comments:	*Excellent Type II, massive AOM, good network, qtz 25%, clay 60%, carb 1%*																												
56	1050	WR					LD	U						VR	O														-
		CTG		90			1	4			1	nd	Tr	3	1														V 2.25
Comments:	*Pyritized ostracods, AOM massive, well-developed network, pyrite 4%, clay 50%, qtz 35%, carbs <5%*																												
57	1150	WR					LD	U						VL	O														B 2.31
		CTG		90			1	2			1	nd	Tr	5	1														V 2.26
Comments:	*Post-mature type II, Source, 5% massive - 50% micrinized AOM, well connected AOM, qtz 40%, clay 50%, carbs 1%, pyrite <1%*																												
58	1200	WR					LD	U						VR	O														-
		CTG		95			1	2			1	nd	Tr	1	Tr														V 2.24
Comments:	*Excellent original Type II, massive 8%, micrinized 2% AOM, great AOM network, clay 55%, qtz 35%, pyrite 2%, carbs 5%*																												

ANALYST

X **Landis**

MICROSCOPE

X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP

CTG	Cuttings
CC	Conv. Core
SWC	SideWallCore
OC	Outcrop
NI	No Inform.
C	Coal
K	Kerogen
WR	Whole Rock
n.d.	Not Determined

STRUCTURED LIPIDS

AL	Alginite
SB	Suberinite
C	Cutinite
LD	Liptodetrinite
U	Undiffer.
S	Sporinite
R	Resinite
O	Other

OTHER ORGANIC MATTER

E	Exsudatinite
G	Graptolites
VL	Lipid-Rich Vitrinite
VC	VitriniteContamination
VR	Recycled Vitrinite

PYRITE

E	Euhedral
F	Framboid
MA	Massive
RI	Replace-infill

ABUND.

N	None
T	Trace
-	Small Amt.
M	Mod. Amt.
+	Large Amt.
++	Abundant

FLUOR. INTENS.

0	None
1	Weak
2	Moderate
3	Strong
4	Intense

VIT. REFLECT. EQUIVALENCE

B	Bitumen
G	Graptolites
VL	Lipid-Rich Vitrinite
VC	Vitrinite Contam.
VR	Recycled Vitrinite

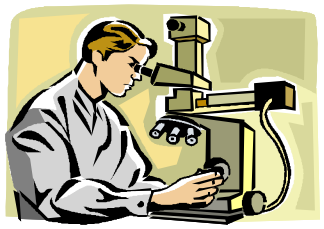
FLUOR. COLOR

W	White
G	Green
Y	Yellow
O	Orange
R	Red
B	Brown
BL	Black
L	Light
D	Dark

TAI COLOR VALUES

1-	Straw Yellow
1	Pale Yellow
1+	Yellow
2-	Yellow-Orange
2	Golden
2+	Amber
3-	Reddish Brown
3	Medium Brown
3+	Dark Brown
4-	Brown-Black
4	Black
4+	Black-Opaque

MINERALS END INC.



API # 03023100010000 **Hearst No. 1-23** **Project: 05/0006**

Visual Kerogen Analysis

Sample Number	Minerals End, Inc. Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Recycled Vitrinite	Inertodetrinite	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II: SHALE			QUARTZ			Ro: Vit. Reflectance or Equiv.
59	1800	WR					LD	U						VR	O																			-
		CTG		60			2	1			1	nd	1	25	10																			V 1.93
Comments:	*Diluted shale, 80% massive, 20% MICRINIZED aom, POOR NETWORK, CLAY >60%, CARBS <5%, qtz 35%*																																	
60	1900	WR					LD	U						VR																			B 2.01
		CTG		85			2	1			Ttr	nd	Tr	10	2																			V 1.92
Comments:	*50% massive to 50% micrinized AOM, 50-80 blend of Type II pyritic kerogen, clay rich AOM network with diluted qtz silt and cement, shale, poor AOM network*																																	
61	2650	WR					LD	U						VC	O																			-
		CTG		80			1	1			2	nd	Tr	15	1																			V 1.99
Comments:	*Pyritized perq, qtz 35% mainly cement, clay 50% pyrite 5%, carbs 5%, massive AOM, good network*																																	
62	2700	WR					LD	U						VR	O																			B 2.12
		CTG		95			nd	nd			1	nd	Tr	3	1																			V 2
Comments:	*Best example of extensively qtz cemented shale 45%, post-mature type II network AOM predominantly micrinized very little clay <20%, Carbs < 10%*																																	
Comments:																																		

ANALYST

X **Landis**

MICROSCOPE

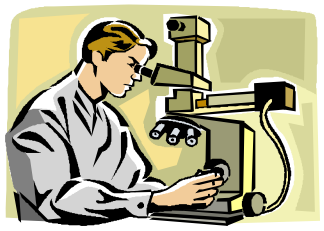
X **Zeiss**

Jena

Leitz

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03045100110000 **McLung No. 1-33** **Project: 05/0006**

Visual Kerogen Analysis

ORGANIC MATTER (%)

LIPIDS

UNSTRUCTURED: Undifferentiated | Amorphous | Massive | Micrinized

STRUCTURED: Liptiniate | Liptodetrinite | Type | Type | Solid Bitumen

HUMIC: Inertinite | Vitrinite

OTHER: Recycled Vitrinite | Inertodetrinite

RELATIVE ABUNDANCE

Pyrite Type | Pyrite | Organic Concentration

VITRINITE: Normal | Rough | Lipid-Rich | Oxidized | Coked

LITHOLOGIC DESCRIPTIONS

TYPE I: SHALE (Color | Intensity) | QUARTZ (Color | Intensity)

Background Intensity

TYPE II: SHALE | | | QUARTZ | | |

Ro: Vit. Reflectance or Equiv.

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	Undifferentiated	Amorphous	Massive	Micrinized	Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	Inertinite	Vitrinite	Recycled Vitrinite	Inertodetrinite	Pyrite Type	Pyrite	Organic Concentration	Normal	Rough	Lipid-Rich	Oxidized	Coked	Color	Intensity	Color	Intensity	Background Intensity						Vit. Reflectance or Equiv.
63	1500	WR					LD	U						VR	O																		-
		CTG		50			nd	3			2	nd	Tr	35	10																		V 2.13
Comments:	*Silty qtz shale no AOM network (massive) lean qtz > 50%*																																	
64	2700	WR					LD	U						VR	O																		-
		CTG		60			1	2			1	nd	1	20	15																		V 2.16
Comments:	*Diluted, weakly laminated silty shale, clay >60%, qtz 30%, carbs 5%*																																	
65	3200	WR					LD	U						VR	O																		B 2.12
		CTG		75			Tr	4			1	nd	Tr	15	5																		V 2.26
Comments:	*Post-mature, qtz 30%, massive - micrinized, clay 55%, weakly laminated, carbs 10% poor AOM network, pyrite <1%*																																	
66	4000	WR					LD	U						VR	O																		-
		CTG		65			3	1			1	nd	Tr	20	10																		V 2.25
Comments:	*Identical to 2700*																																	
67	5700	WR					LD	U						VR	O																		-
		CTG		65			1	3			1	nd	Tr	20	10																		V 2.29
Comments:	*Identical to 4000*																																	

ANALYST

X **Landis**

MICROSCOPE

X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP

- **CTG** Cuttings
- **CC** Conv. Core
- **SWC** SideWallCore
- **OC** Outcrop
- **NI** No Inform.
- **C** Coal
- **K** Kerogen
- **WR** Whole Rock
- **n.d.** Not Determined

STRUCTURED LIPIDS

- **AL** Alginite
- **SB** Suberinite
- **C** Cutinite
- **LD** Liptodetrinite
- **U** Undiffer.
- **S** Sporinite
- **R** Resinite
- **O** Other

OTHER ORGANIC MATTER

- **E** Exsudatinite
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** VitriniteContamination
- **VR** Recycled Vitrinite

PYRITE

- **E** Euhedral
- **F** Framboid
- **MA** Massive
- **RI** Replace-infill

ABUND.

- **N** None
- **T** Trace
- **-** Small Amt.
- **M** Mod. Amt.
- **+** Large Amt.
- **++** Abundant

FLUOR. INTENS.

- **0** None
- **1** Weak
- **2** Moderate
- **3** Strong
- **4** Intense

VIT. REFLECT. EQUIVALENCE

- **B** Bitumen
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** Vitrinite Contam.
- **VR** Recycled Vitrinite

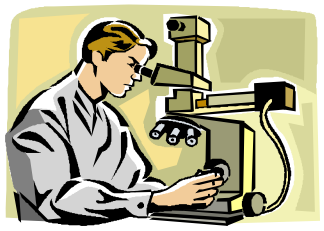
FLUOR. COLOR

- **W** White
- **G** Green
- **Y** Yellow
- **O** Orange
- **R** Red
- **B** Brown
- **BL** Black
- **L** Light
- **D** Dark

TAI COLOR VALUES

- **1-** Straw Yellow
- **1** Pale Yellow
- **1+** Yellow
- **2-** Yellow-Orange
- **2** Golden
- **2+** Amber
- **3-** Reddish Brown
- **3** Medium Brown
- **3+** Dark Brown
- **4-** Brown-Black
- **4** Black
- **4+** Black-Opaque

MINERALS END INC.



API # 03045100110000 | **McLung No. 1-33** | **Project: 05/0006**

Visual Kerogen Analysis

Sample Number	Minerals End, Inc. Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Recycled Vitrinite	Inertodetrinite	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	SHALE Intensity	QUARTZ Color	QUARTZ Intensity	Background Intensity	TYPE II: SHALE			QUARTZ			Ro: Vit. Reflectance or Equiv.
68	6400	WR / CTG		65			LD 1	U 3			1	nd	Tr	VR 20	O 10																			- V 2.37
Comments:	*Identical to 4000*																																		
69	6900	WR / CTG		75			LD Tr	U 2			1	nd	Tr	VR 12	O 10																			- V 2.46
Comments:	*Type II, good network of 20% massive AOM - micrinized 80%, qtz 35%, clay 60%, no pyrite*																																		
70	7500	WR / CTG		85			LD 2	U 2			2	nd	Tr	VR 7	O 2																			- V 2.56
Comments:	*Micrinized (80%) to massive (20%), good AOM network, Type II, laminated shale, clay 60%, qtz 30%, carbs 5%*																																		
71	7700	WR / CTG		90			LD 2	U 3			1	nd	Tr	VR 4	O Tr																			- V 2.64
Comments:	*Post mature type II, residual TOC, micrinized AOM 100%, well-connected AOM network, qtz 40%, clay 55%, carbs 3%, pyrite <2%*																																		
72	7860	WR / CTG		90			LD 1	U 2			2	nd	Tr	VR 4	O 1																			- V 2.68
Comments:	*Identical to 7700*																																		

ANALYST

X **Landis**

MICROSCOPE

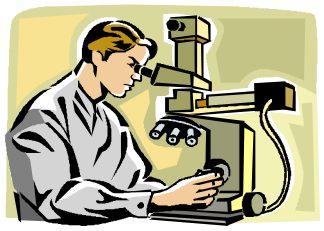
X **Zeiss**

Jena

Leitz

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	AL	Alginite	E	Exsudatinite	E	Euhedral	N	None	0	None	B	Bitumen	W	White	1-	Straw Yellow
CC	Conv. Core	SB	Suberinite	G	Graptolites	F	Framboid	T	Trace	1	Weak	G	Graptolites	G	Green	1	Pale Yellow
SWC	SideWallCore	C	Cutinite	VL	Lipid-Rich Vitrinite	MA	Massive	-	Small Amt.	2	Moderate	VL	Lipid-Rich Vitrinite	Y	Yellow	1+	Yellow
OC	Outcrop	LD	Liptodetrinite	VC	VitriniteContamination	RI	Replace-	M	Mod. Amt.	3	Strong	VC	Vitrinite Contam.	O	Orange	2-	Yellow-Orange
NI	No Inform.	U	Undiffer.	VR	Recycled Vitrinite		infill	+	Large Amt.	4	Intense	VR	Recycled Vitrinite	R	Red	2	Golden
C	Coal	S	Sporinite					++	Abundant					B	Brown	2+	Amber
		R	Resinite											BL	Black	3-	Reddish Brown
K	Kerogen	O	Other													3	Medium Brown
WR	Whole Rock															3+	Dark Brown
														L	Light	4-	Brown-Black
n.d.	Not Determined													D	Dark	4	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03045100110000 **McLung No. 1-33** **Project: 05/0006**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Recycled Vitrinite	Inertodetrinite	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	SHALE Intensity	QUARTZ Color	QUARTZ Intensity	Background Intensity	TYPE II: SHALE			QUARTZ			Ro: Vit. Reflectance or Equiv.
73	7950	WR CTG		90			LD Tr	U 2			1	nd	Tr	VR 5	O 2																				- V 2.69
Comments:	*Similar to 7700, but pyrite = 3%*																																		
74	8050	WR CTG		95			LD 1	U 1			2	nd	Tr	VR Tr	O 1																				- V 2.71
Comments:	*Micrinized AOM network, excellent type II, qtz 35%, carbs 5%, clay 50%*																																		
75	8150	WR CTG		95			LD Tr	U 1			1	nd	Tr	VR Tr	O 3																				- V 2.77
Comments:	*Identical to 8050, excellent Type II*																																		
76	8505	WR CTG		95			LD nd	U 1			Tr	nd	Tr	VR 1	O 3																				- V 2.72
Comments:	*Excellent type II, post mature micrinized AOM network, qtz 40%, clay 45%, carbs 10%, pyrite 1%*																																		
77	8280	WR CTG		90			LD Tr	U 2			1	nd	Tr	VR 5	O 2																				B 2.48 V 2.72
Comments:	*Post-mature type II, residual TOC, micrinized AOM 100%, well-connected AOM network,qtz 40%, clay 50%, pyrite 2%, carb 1%*																																		

ANALYST

X **Landis**

MICROSCOPE

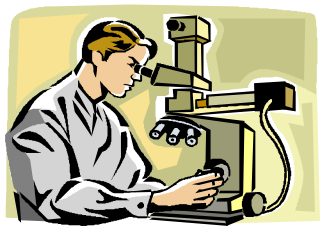
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03045100070000 | **Lever No. 1** | **Project: 05/0006**

Visual Kerogen Analysis

Sample Number	Minerals End, Inc. / Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%)												RELATIVE ABUNDANCE										LITHOLOGIC DESCRIPTIONS												Ro
			LIPIDS									HUMIC		OTHER					VITRINITE					TYPE I					TYPE II								
			UNSTRUCTURED				STRUCTURED																	SHALE		QUARTZ			SHALE			QUARTZ					
			Undifferentiated	Amorphous	Massive	Micrinized	Liptiniate	Liptodetrinite	Type	Type	Solid Bitumen	Inertinite	Vitrinite	Recycled Vitrinite	Inertodetrinite	Pyrite Type	Pyrite	Organic Concentration	Normal	Rough	Lipid-Rich	Oxidized	Coked	Color	Intensity	Color	Intensity	Background Intensity										Vit. Reflectance or Equiv.
78	4350	WR					LD	U						VR	O																					B 2.21
		CTG		75			3	1			1	nd	Tr	15	5																					V 2.22
Comments:	*Micrinized AOM, no biogenic qtz, 15% detroital qtz, diluted clay rich shale, pyritic, spent poor AOM network*																																				
79	4450	WR					LD	U						VR	O																					-
		CTG		90			1	1			2	nd	1	5	Tr																					V 2.20
Comments:	*Excellent residual TOC, micrinized AOM, good AOM network, laminate, TOC shale, carb <5%, qtz 25%, clay 60%, pyrite 2%*																																				
80	4550	WR					LD	U						VR	O																					-
		CTG		95			1	Tr			2	nd	Tr	1	1																					V 2.27
Comments:	*Excellent TOC, massive (20%) AOM network, micrinized (*0%), clay 60%, qtz 30%, carbs 10%*																																				
81	4650	WR					LD	U						VR	O																					B 2.29
		CTG		90			3	Tr			1	Tr	Tr	5	1																					V 2.28
Comments:	*Post-mature, rich Type II qtz cemented kerogen (good AOM network), intermingled with carbonace (pitted) facies, meta-liptinite*																																				
82	4920	WR					LD	U						VR	O																					-
		CTG		90			2	Tr			1	nd	Tr	4	3																					V 2.25
Comments:	*Type II, qtz 30%, cement biogenic, good micrinized AOM network with qtz cement, clay 50%*																																				

ANALYST

X **Landis**

MICROSCOPE

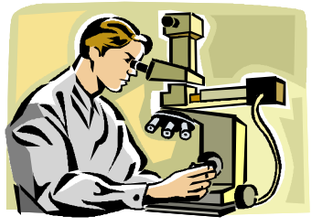
X **Zeiss**

Jena

Leitz

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03023100090000 **Landrum Quitman No. 1** **Project: 05/0008**

Visual Kerogen Analysis

Sample Number	Minerals End, Inc. Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Liptodetrinite	Liptiniate	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Recycled Vitrinite	Inertodetrinite	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	SHALE Intensity	QUARTZ Color	QUARTZ Intensity	Background Intensity	TYPE II: SHALE		QUARTZ				Ro: Vit. Reflectance or Equiv.
1	3400	K CTG				80	LD 3	U 3	O		1	nd	tr	VR 10	O 3																			- V 2.55
Comments:	*diluted type II kerogen; weakly laminated black shale; good AOM network; qtz 35% (detrital > biogenic), clay 55%, carbonate 5%, pyrite 1*																																		
2	3750	K CTG				70	LD 5	U 5	O		1	nd	tr	VR 15	O 4																			- V 2.58
Comments:	*silimar to 3400-3450' but slightly more silt*																																		
3	3900	K CTG				90	LD 2	U tr	O		2	nd	tr	VR 4	O 2																			- V 2.61
Comments:	*excellent type II post mautre kerogen, excellent AOM network, clay 55%, qtz 35%, carbonate <5%, pyrite 2*																																		
4	4050	K CTG			45	50	LD 2	U tr	O		2	nd	tr	VR 1	O tr																			B 2.56 V 2.56
Comments:	*excellent post mature type II kerogen, clay 45% qtz 45% carbonate 55 pyrite 2*																																		
5	4430	K CTG			45	50	LD 1	U tr	O		1	nd	tr	VR 3	O tr																			- V 2.62
Comments:	*similar to 4050-4100' but with higher proportion of biogenic silic*																																		

ANALYST

X **Landis**

MICROSCOPE

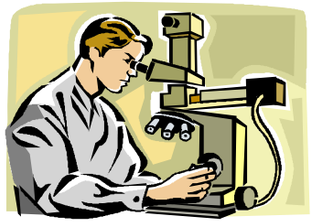
X **Zeiss**

Jena

Leitz

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	AL	Alginite	E	Exsudatinite	E	Euhedral	N	None	0	None	B	Bitumen	W	White	1-	Straw Yellow
CC	Conv. Core	SB	Suberinite	G	Graptolites	F	Framboid	T	Trace	1	Weak	G	Graptolites	G	Green	1	Pale Yellow
SWC	SideWallCore	C	Cutinite	VL	Lipid-Rich Vitrinite	MA	Massive	-	Small Amt.	2	Moderate	VL	Lipid-Rich Vitrinite	Y	Yellow	1+	Yellow
OC	Outcrop	LD	Liptodetrinite	VC	VitriniteContamination	RI	Replace-infill	M	Mod. Amt.	3	Strong	VC	Vitrinite Contam.	O	Orange	2-	Yellow-Orange
NI	No Inform.	U	Undiffer.	VR	Recycled Vitrinite			+	Large Amt.	4	Intense	VR	Recycled Vitrinite	R	Red	2	Golden
C	Coal	S	Sporinite					++	Abundant					B	Brown	2+	Amber
		R	Resinite											BL	Black	3-	Reddish Brown
K	Kerogen	O	Other													3	Medium Brown
WR	Whole Rock															3+	Dark Brown
n.d.	Not Determined													L	Light	4-	Brown-Black
														D	Dark	4	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03145100040000 | **Patterson No. 1** | **Project: 05/0008**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Liptodetrinite	Liptiniate	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Recycled Vitrinite	Inertodetrinite	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I SHALE: Color	Intensity	TYPE I QUARTZ: Color	Intensity	Background Intensity	TYPE II SHALE			TYPE II QUARTZ			Ro: Vit. Reflectance or Equiv.
6	5000	K CTG			10	45	LD 10	U 2	O		5	nd	tr	VR 25	O 3																			- V 2.58
Comments:	*diluted lean mix of type II & III kerogen, poor AOM network, clay 60%, qtz 35% (detrital.biogenic), carbonate 5%, pyrite*																																	
7	5310	K CTG			18	72	LD 1	U TR	O		2	nd	tr	VR 5	O 2																			- V 2.69
Comments:	*excellent post mature type II kerogen, excellent AOM network, clay 50% qtz 40% (det. = bio) carbonaite 10*																																	
8	5450	K CTG			20	60	LD tr	U 1	O		2	nd	tr	VR 15	O 2																			B 2.66 V 2.64
Comments:	*mix of III and II kerogen (20% & 80%, respectively), clay 50%, qtz 35% carbonate 10% pyrite 2*																																	
9	5550	K CTG			20	60	LD tr	U 1	O		2	nd	tr	VR 15	O 2																			- V 2.68
Comments:	*similar to 5450-5500*																																	
10	5650	K CTG			5	70	LD 2	U 1	O		2	nd	tr	VR 15	O 5																			- V 2.71
Comments:	*50-50 mix of II and III kerogen, clay 555, qtz 35%, carbonate 10%, pyrite 2*																																	

ANALYST

X **Landis**

MICROSCOPE

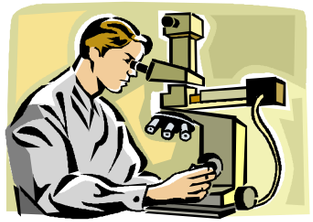
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03145100040000 | **Patterson No. 1** | **Project: 05/0008**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%)													RELATIVE ABUNDANCE						LITHOLOGIC DESCRIPTIONS												Ro
			LIPIDS									HUMIC		OTHER					VITRINITE					TYPE I					TYPE II						
			UNSTRUCTURED				STRUCTURED																	SHALE		QUARTZ			SHALE			QUARTZ			
			Undifferentiated	Amorphous	Massive	Micrinized	Liptodetrinite	Liptiniate	Type	Type	Solid Bitumen	Inertinite	Vitrinite	Recycled Vitrinite	Inertodetrinite	Pyrite Type	Pyrite	Organic Concentration	Normal	Rough	Lipid-Rich	Oxidized	Coked	Color	Intensity	Color	Intensity	Background Intensity							Vit. Reflectance or Equiv.
11	5800	K CTG			5	65	LD 3	U 1	O		1	nd	tr	VR 20	O 5																		- V 2.71

Comments: *similar to 5650' with higher qtz content, clay 50% qtz 40% pyrite 1% carbonate 5*

Comments:

Comments:

Comments:

Comments:

ANALYST

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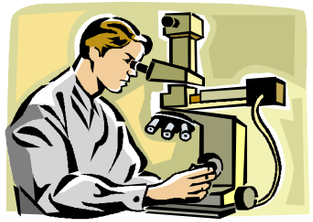
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03029100330000 **Kaufman No. 1-2** **Project: 05/0008**

Visual Kerogen Analysis

Sample Number	Minerals End, Inc. Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED Liptodetrinite	Liptiniate	Type	Type	Solid Bitumen	HUMIC Inertinite	Vitrinite	OTHER Recycled Vitrinite	Inertodetrinite	RELATIVE ABUNDANCE Pyrite Type	Pyrite	Organic Concentration	VITRINITE Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II SHALE			QUARTZ			Ro Vit. Reflectance or Equiv.
12	5300	K CTG			15	50	LD 2	U 1	O		1	nd	tr	VR 25	O 6																			- V 2.69
Comments:	*mix of diluted shale qtz with type II source rock; overall poor network clay 45% qtz 40% carbonate 10% pyrite 2*																																	
13	5550	K CTG			5	80	LD 2	U 1	O		2	nd	tr	VR 8	O 2																			- V 2.73
Comments:	*domiante by exeellent type II kerogen, laminated black shale, clay 55% qtz 35% carbonate 5% pyrite 1*																																	
14	5650	K CTG			10	80	LD 3	U 1	O		1	nd	tr	VR 5	O tr																			- V 2.72
Comments:	*post-mature type II laminated black shale; silicified Tasmanites, clay 55% qtz 40% carbonate 5% excellent AOM netwo*																																	
15	5750	K CTG			20	75	LD 1	U 1	O		3	nd	tr	VR tr	O tr																			B 2.59 V 2.68
Comments:	*laminated pyritic black shale clay 40% qtz 35% (biogenic > detrital) carbonate 15% pyrite 4*																																	
Comments:																																		

ANALYST

X **Landis**

MICROSCOPE

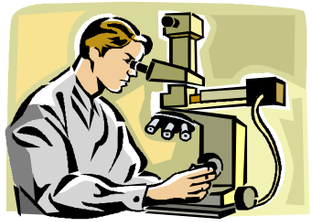
X **Zeiss**

Jena

Leitz

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03029100010000 | **C.S. Ramsey Heirs No. 1** | **Project: 05/0008**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Liptodetrinite	Liptiniate	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Recycled Vitrinite	Inertodetrinite	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	SHALE Intensity	QUARTZ Color	QUARTZ Intensity	Background Intensity	TYPE II: SHALE			QUARTZ			Ro: Vit. Reflectance or Equiv.
16	3800	K CTG			30	45	LD 2	U tr	O		1	nd	tr	VR 20	O 2																				- V 2.57
Comments:	*good post-mature type II kerogen; clay 50% qtz 35% carbonate 10%*																																		
17	3900	K CTG			30	65	LD tr	U tr	O		2	nd	tr	VR 1	O 2																				- V 2.58
Comments:	*excellent post-mature type II kerogen, clay 55% qtz 40% carbonate 5%*																																		
18	4000	K CTG			35	55	LD 1	U 1	O		3	nd	tr	VR 3	O 2																				B 2.56 V 2.56
Comments:	*similar to 3900-400*																																		
19	4400	K CTG			36	54	LD 2	U 1	O		1	nd	tr	VR 3	O 3																				- V 2.61
Comments:	*similar to 3900-400*																																		
20	4470	K CTG			22	68	LD tr	U tr	O		10	nd	tr	VR tr	O tr																				B 2.74 -
Comments:	*relatively lean type Ii kerogen, lean barren shale, qtz 45%(biogenic=detrital), clay 40% carbonate 10*																																		

ANALYST

X **Landis**

MICROSCOPE

X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP

- **CTG** Cuttings
- **CC** Conv. Core
- **SWC** SideWallCore
- **OC** Outcrop
- **NI** No Inform.
- **C** Coal
- **K** Kerogen
- **WR** Whole Rock
- **n.d.** Not Determined

STRUCTURED LIPIDS

- **AL** Alginite
- **SB** Suberinite
- **C** Cutinite
- **LD** Liptodetrinite
- **U** Undiffer.
- **S** Sporinite
- **R** Resinite
- **O** Other

OTHER ORGANIC MATTER

- **E** Exsudatinite
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** VitriniteContamination
- **VR** Recycled Vitrinite

PYRITE

- **E** Euhedral
- **F** Framboid
- **MA** Massive
- **RI** Replace-infill

ABUND.

- **N** None
- **T** Trace
- **-** Small Amt.
- **M** Mod. Amt.
- **+** Large Amt.
- **++** Abundant

FLUOR. INTENS.

- **0** None
- **1** Weak
- **2** Moderate
- **3** Strong
- **4** Intense

VIT. REFLECT. EQUIVALENCE

- **B** Bitumen
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** Vitrinite Contam.
- **VR** Recycled Vitrinite

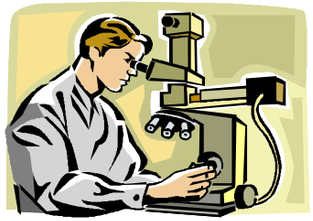
FLUOR. COLOR

- **W** White
- **G** Green
- **Y** Yellow
- **O** Orange
- **R** Red
- **B** Brown
- **BL** Black
- **L** Light
- **D** Dark

TAI COLOR VALUES

- **1-** Straw Yellow
- **1** Pale Yellow
- **1+** Yellow
- **2-** Yellow-Orange
- **2** Golden
- **2+** Amber
- **3-** Reddish Brown
- **3** Medium Brown
- **3+** Dark Brown
- **4-** Brown-Black
- **4** Black
- **4+** Black-Opaque

MINERALS END INC.



API # 03029300060000 **Dancer No. 1** **Project: 05/0008**

Visual Kerogen Analysis

ORGANIC MATTER (%)

Sample Number	Sample Id or Depth	Preparation/Sample Type	LIPIDS: UNSTRUCTURED: Undifferentiated	LIPIDS: UNSTRUCTURED: Amorphous	LIPIDS: UNSTRUCTURED: Massive	LIPIDS: UNSTRUCTURED: Micrinized	LIPIDS: STRUCTURED: Liptodetrinite	LIPIDS: STRUCTURED: Liptiniate	LIPIDS: STRUCTURED: Type	LIPIDS: STRUCTURED: Type	LIPIDS: STRUCTURED: Solid Bitumen	HUMIC: Inertinite	HUMIC: Vitrinite	OTHER: Recycled Vitrinite	OTHER: Inertodetrinite
21	4100	K CTG			5	45	LD 2	U 2	O		1	nd	tr	VR 35	O 10
Comments:	*lean diluted shale, reworked kerogen, clay 555, qtz 35% carbonate 5%*														
22	4280	K CTG			10	80	LD 2	U tr	O		tr	nd	tr	VR 5	O 3
Comments:	*excellent post mature II kerogen, clay 50% qtz 35% carbonate 10% pyrite 1%*														
23	4330	K CTG			10	80	LD 2	U tr	O		5	nd	tr	VR 2	O 1
Comments:	*similar to 4250-430(*														
24	4400	K CTG				90	LD 1	U tr	O		2	nd	tr	VR 5	O 2
Comments:	*excellent post mature type II kerogen, laminated black shale with pyritic replacement of carbonate, clay 50%, qtz 40% carbonate 10% pyrite 3*														
25	4500	K CTG			5	80	LD 3	U tr	O		2	nd	tr	VR 5	O 5
Comments:	*excellent post mature type II kerogen, clay 40% qtz 45% carbonate 10% pyrite 1%*														

RELATIVE ABUNDANCE

Sample Number	Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	VITRINITE: Rough	VITRINITE: Lipid-Rich	VITRINITE: Oxidized	VITRINITE: Coked
21								
22								
23								
24								
25								

LITHOLOGIC DESCRIPTIONS

Sample Number	TYPE I: SHALE: Color	TYPE I: SHALE: Intensity	TYPE I: QUARTZ: Color	TYPE I: QUARTZ: Intensity	Background Intensity	TYPE II: SHALE	TYPE II: QUARTZ	Ro: Vit. Reflectance or Equiv.
21								- V 2.66
22								- V 2.67
23								- V 2.65
24								B 2.61 V 2.66
25								- V 2.68

ANALYST

X **Landis**

MICROSCOPE

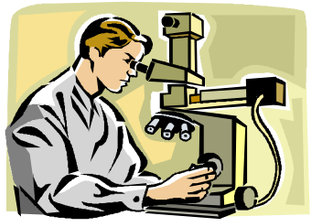
X **Zeiss**

Jena

Leitz

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	AL	Alginite	E	Exsudatinite	E	Euhedral	N	None	0	None	B	Bitumen	W	White	1-	Straw Yellow
CC	Conv. Core	SB	Suberinite	G	Graptolites	F	Framboid	T	Trace	1	Weak	G	Graptolites	G	Green	1	Pale Yellow
SWC	SideWallCore	C	Cutinite	VL	Lipid-Rich Vitrinite	MA	Massive	-	Small Amt.	2	Moderate	VL	Lipid-Rich Vitrinite	Y	Yellow	1+	Yellow
OC	Outcrop	LD	Liptodetrinite	VC	VitriniteContamination	RI	Replace-infill	M	Mod. Amt.	3	Strong	VC	Vitrinite Contam.	O	Orange	2-	Yellow-Orange
NI	No Inform.	U	Undiffer.	VR	Recycled Vitrinite			+	Large Amt.	4	Intense	VR	Recycled Vitrinite	R	Red	2	Golden
C	Coal	S	Sporinite					++	Abundant					B	Brown	2+	Amber
		R	Resinite											BL	Black	3-	Reddish Brown
K	Kerogen	O	Other													3	Medium Brown
WR	Whole Rock															3+	Dark Brown
n.d.	Not Determined													L	Light	4-	Brown-Black
														D	Dark	4	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03029300060000 | **Dancer No. 1** | **Project: 05/0008**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Liptodetrinite	Liptiniate	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Recycled Vitrinite	Inertodetrinite	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I SHALE: Color	Intensity	TYPE I QUARTZ: Color	Intensity	Background Intensity	TYPE II SHALE			TYPE II QUARTZ			Ro: Vit. Reflectance or Equiv.
26	4870	K CTG				90	LD tr	U tr	O		5	nd	tr	VR 4	O 1																			- V 2.68

Comments: *post mature type II kerogen, clay 35% qtz 45% biogenic > detrita*

Comments:

Comments:

Comments:

Comments:

ANALYST

X **Landis**

MICROSCOPE

X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP

- **CTG** Cuttings
- **CC** Conv. Core
- **SWC** SideWallCore
- **OC** Outcrop
- **NI** No Inform.
- **C** Coal
- **K** Kerogen
- **WR** Whole Rock
- **n.d.** Not Determined

STRUCTURED LIPIDS

- **AL** Alginite
- **SB** Suberinite
- **C** Cutinite
- **LD** Liptodetrinite
- **U** Undiffer.
- **S** Sporinite
- **R** Resinite
- **O** Other

OTHER ORGANIC MATTER

- **E** Exsudatinite
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** VitriniteContamination
- **VR** Recycled Vitrinite

PYRITE

- **E** Euhedral
- **F** Framboid
- **MA** Massive
- **RI** Replace-infill

ABUND.

- **N** None
- **T** Trace
- **-** Small Amt.
- **M** Mod. Amt.
- **+** Large Amt.
- **++** Abundant

FLUOR. INTENS.

- **0** None
- **1** Weak
- **2** Moderate
- **3** Strong
- **4** Intense

VIT. REFLECT. EQUIVALENCE

- **B** Bitumen
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** Vitrinite Contam.
- **VR** Recycled Vitrinite

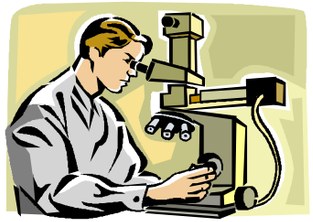
FLUOR. COLOR

- **W** White
- **G** Green
- **Y** Yellow
- **O** Orange
- **R** Red
- **B** Brown
- **BL** Black
- **L** Light
- **D** Dark

TAI COLOR VALUES

- **1-** Straw Yellow
- **1** Pale Yellow
- **1+** Yellow
- **2-** Yellow-Orange
- **2** Golden
- **2+** Amber
- **3-** Reddish Brown
- **3** Medium Brown
- **3+** Dark Brown
- **4-** Brown-Black
- **4** Black
- **4+** Black-Opaque

MINERALS END INC.



API # 03029300050000 **Billot - A** **Project: 05/0008**

Visual Kerogen Analysis

Sample Number	Minerals End, Inc. Sample Id or Depth	Prep/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Liptodetrinite	Liptiniate	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Recycled Vitrinite	Inertodetrinite	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I SHALE: Color	Intensity	TYPE I QUARTZ: Color	Intensity	Background Intensity	TYPE II SHALE			TYPE II QUARTZ			Ro: Vit. Reflectance or Equiv.
27	3500	K CTG				80	LD 2	U tr	O		3	nd	tr	VR 10	O 5																			- V 2.49
Comments:	*lean diluted post mature shale clay 50% qtz 35% carbonate 10% pyrite 1*																																		
28	4000	K CTG				90	LD 2	U tr	O		5	nd	tr	VR 3	O tr																			- V 2.52
Comments:	*excellent post mature type II kerogen network, clay 55% qtz 35% (biogenic>detrital), carbonate 10*																																		
29	4100	K CTG				90	LD 2	U tr	O		5	nd	tr	VR 3	O tr																			- V 2.53
Comments:	*similar to 4000-4050*																																		
30	4200	K CTG				95	LD 1	U tr	O		2	nd	tr	VR 2	O tr																			- V 2.52
Comments:	*similar to 4000-4050*																																		
31	4300	K CTG			15	70	LD 4	U tr	O		1	nd	tr	VR 5	O 5																			- V 2.52
Comments:	*excellent post mature type II kerogen network, clay 40%, qtz 40% (biogenic>detrital),carbonate 5%, pyrite 2*																																		

ANALYST

X **Landis**

MICROSCOPE

X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP

- **CTG** Cuttings
- **CC** Conv. Core
- **SWC** SideWallCore
- **OC** Outcrop
- **NI** No Inform.
- **C** Coal
- **K** Kerogen
- **WR** Whole Rock
- **n.d.** Not Determined

STRUCTURED LIPIDS

- **AL** Alginite
- **SB** Suberinite
- **C** Cutinite
- **LD** Liptodetrinite
- **U** Undiffer.
- **S** Sporinite
- **R** Resinite
- **O** Other

OTHER ORGANIC MATTER

- **E** Exsudatinite
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** VitriniteContamination
- **VR** Recycled Vitrinite

PYRITE

- **E** Euhedral
- **F** Framboid
- **MA** Massive
- **RI** Replace-infill

ABUND.

- **N** None
- **T** Trace
- **-** Small Amt.
- **M** Mod. Amt.
- **+** Large Amt.
- **++** Abundant

FLUOR. INTENS.

- **0** None
- **1** Weak
- **2** Moderate
- **3** Strong
- **4** Intense

VIT. REFLECT. EQUIVALENCE

- **B** Bitumen
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** Vitrinite Contam.
- **VR** Recycled Vitrinite

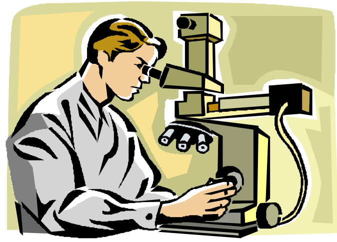
FLUOR. COLOR

- **W** White
- **G** Green
- **Y** Yellow
- **O** Orange
- **R** Red
- **B** Brown
- **BL** Black
- **L** Light
- **D** Dark

TAI COLOR VALUES

- **1-** Straw Yellow
- **1** Pale Yellow
- **1+** Yellow
- **2-** Yellow-Orange
- **2** Golden
- **2+** Amber
- **3-** Reddish Brown
- **3** Medium Brown
- **3+** Dark Brown
- **4-** Brown-Black
- **4** Black
- **4+** Black-Opaque

MINERALS END INC.



API # 03029300050000 **Billot - A** **Project: 05/0008**

Visual Kerogen Analysis

Sample Number	Minerals End, Inc. — Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) — LIPIDS — UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	STRUCTURED: Liptodetrinite	Liptiniate	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Recycled Vitrinite	Inertodetrinite	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I — SHALE: Color	Intensity	QUARTZ: Color	Intensity	Background Intensity	TYPE II — SHALE			QUARTZ			Ro — Vit. Reflectance or Equiv.
32	4420	K CTG				90	LD 1	U 1	O		2	nd	tr	VR 5	O 1																				- V 2.59
Comments:	*excellent post mature type II kerogen network, clay 45% qtz 40% (biogenic >>detrita*																																		
33	4680	K CTG				95	LD tr	U tr	O		5	nd	tr	VR tr	O tr																				- V 2.54
Comments:	*similar to 4000-4050*																																		
Comments:																																			
Comments:																																			
Comments:																																			

ANALYST

X Landis

MICROSCOPE

X Zeiss
Jena
Leitz

SAMPLE TYPE/PREP
- CTG Cuttings
- CC Conv. Core
- SWC SideWallCore
- OC Outcrop
- NI No Inform.
- C Coal
- K Kerogen
- WR Whole Rock
- n.d. Not Determined

STRUCTURED LIPIDS
- AL Alginite
- SB Suberinite
- C Cutinite
- LD Liptodetrinite
- U Undiffer.
- S Sporinite
- R Resinite
- O Other

OTHER ORGANIC MATTER
- E Exsudatinite
- G Graptolites
- VL Lipid-Rich Vitrinite
- VC VitriniteContamination
- VR Recycled Vitrinite

PYRITE
- E Euhedral
- F Framboid
- MA Massive
- RI Replace-infill

ABUND.
- N None
- T Trace
- \- Small Amt.
- M Mod. Amt.
- \+ Large Amt.
- ++ Abundant

FLUOR. INTENS.
- 0 None
- 1 Weak
- 2 Moderate
- 3 Strong
- 4 Intense

VIT. REFLECT. EQUIVALENCE
- B Bitumen
- G Graptolites
- VL Lipid-Rich Vitrinite
- VC Vitrinite Contam.
- VR Recycled Vitrinite

FLUOR. COLOR
- W White
- G Green
- Y Yellow
- O Orange
- R Red
- B Brown
- BL Black
- L Light
- D Dark

TAI COLOR VALUES
- 1- Straw Yellow
- 1 Pale Yellow
- 1+ Yellow
- 2- Yellow-Orange
- 2 Golden
- 2+ Amber
- 3- Reddish Brown
- 3 Medium Brown
- 3+ Dark Brown
- 4- Brown-Black
- 4 Black
- 4+ Black-Opaque

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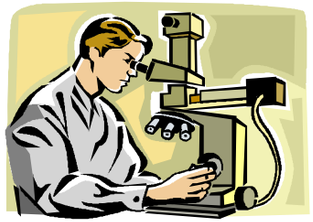


API # 03029100280000 | **Zuber South No. 1** | **Project: 05/0008**

Visual Kerogen Analysis

ORGANIC MATTER (%)

LIPIDS — UNSTRUCTURED: Undifferentiated, Amorphous, Massive, Micrinized; STRUCTURED: Liptodetrinite, Liptiniate, Type, Type, Solid Bitumen

HUMIC: Inertinite, Vitrinite

OTHER: Recycled Vitrinite, Inertodetrinite

RELATIVE ABUNDANCE

Pyrite Type, Pyrite, Organic Concentration

VITRINITE: Normal, Rough, Lipid-Rich, Oxidized, Coked

LITHOLOGIC DESCRIPTIONS

TYPE I: SHALE (Color, Intensity); QUARTZ (Color, Intensity)

Background Intensity

TYPE II: SHALE; QUARTZ

Ro: Vit. Reflectance or Equiv.

Sample Number	Sample Id or Depth	Preparation/Sample Type	Undifferentiated	Amorphous	Massive	Micrinized	Liptodetrinite	Liptiniate	Type	Type	Solid Bitumen	Inertinite	Vitrinite	Recycled Vitrinite	Inertodetrinite	Pyrite Type	Pyrite	Organic Concentration	Normal	Rough	Lipid-Rich	Oxidized	Coked	Color	Intensity	Color	Intensity	Background Intensity	Vit. Reflectance or Equiv.
34	5250	K CTG				95	LD 1	U tr	O		3	nd	tr	VR 1	O tr													- V 2.62
Comments:	*excellent post matue type II kerogen network, clay 50% qtz 35% carbonate 10%*																												
35	5450	K CTG				90	LD 1	U 1	O		4	nd	tr	VR 3	O 1													- V 2.67
Comments:	*excellent post mature type II kerogen network, clay 50% qtz 35% carbonate 10%*																												
36	5550	K CTG				90	LD 1	U 1	O		5	nd	tr	VR 3	O tr													- V 2.68
Comments:	*similar to 5450-550*																												
37	5650	K CTG				85	LD 2	U tr	O		3	nd	tr	VR 10	O tr													- V 2.69
Comments:	*mix of diluted clastic shale and excellent type II kerogen, clay 40% qtz 45% carbonate 10% pyrite 1*																												
38	5820	K CTG				85	LD 1	U tr	O		4	nd	tr	VR 8	O 2													- V 2.68
Comments:	*similar to 5650-5700*																												

Minerals End, Inc.

ANALYST

X **Landis**

MICROSCOPE

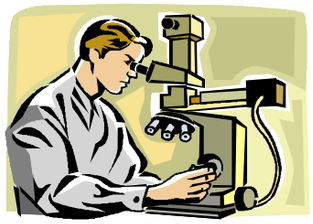
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03029100280000 | **Zuber South No. 1** | **Project: 05/0008**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%)													RELATIVE ABUNDANCE						LITHOLOGIC DESCRIPTIONS												Ro
			LIPIDS									HUMIC		OTHER					VITRINITE					TYPE I					TYPE II						
			UNSTRUCTURED				STRUCTURED																	SHALE		QUARTZ			SHALE			QUARTZ			
			Undifferentiated	Amorphous	Massive	Micrinized	Liptodetrinite	Liptiniate	Type	Type	Solid Bitumen	Inertinite	Vitrinite	Recycled Vitrinite	Inertodetrinite	Pyrite Type	Pyrite	Organic Concentration	Normal	Rough	Lipid-Rich	Oxidized	Coked	Color	Intensity	Color	Intensity	Background Intensity							Vit. Reflectance or Equiv.
39	5950	K CTG			19	76	LD 1	U 1	O		1	nd	tr	VR 2	O tr																			- V 2.72

Comments: *excellent post mature type II kerogen network, silicified alginite, clay 45% qtz 40% (biogenic>>detrital) carbonate 10% pyrite*

Comments:

Comments:

Comments:

Comments:

ANALYST

X **Landis**

MICROSCOPE

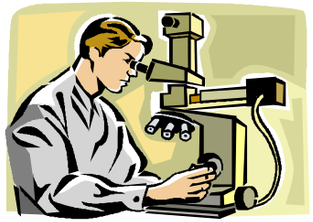
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-infill	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite			**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03045100020000 | **E.W. Moore Estate No. 1** | **Project: 05/0008**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Liptodetrinite	Liptiniate	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Recycled Vitrinite	Inertodetrinite	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I SHALE: Color	Intensity	TYPE I QUARTZ: Color	Intensity	Background Intensity	TYPE II SHALE			TYPE II QUARTZ			Ro: Vit. Reflectance or Equiv.
40	7100	K CTG				95	LD tr	U nd	O		1	nd	tr	VR 3	O 1																			- V 3.89
Comments:	*excellent post mature type II kerogen network, clay 55% qtz 35% carbonate 10%*																																	
41	7400	K CTG				95	LD 1	U tr	O		1	nd	tr	VR 2	O 1																			- V 3.98
Comments:	*excellent post mature type II kerogen network, clay 50% qtz 40% (biogenic>detrital) carbonate 5%, pyrite 2*																																	
42	7450	K CTG				95	LD 1	U nd	O		tr	nd	tr	VR 2	O 2																			- V 3.73
Comments:	*good type II kerogen network, clay 50% qtz 35% carbonate 5% pyrite 1%*																																	
43	7500	K CTG				95	LD 1	U nd	O		tr	nd	tr	VR 2	O 2																			- V 3.98
Comments:	*similar to 7450-750(*																																	
Comments:																																		

ANALYST

X **Landis**

MICROSCOPE

X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

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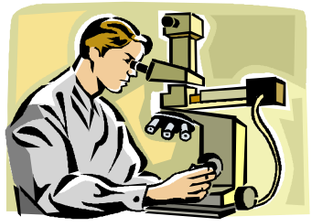


API # 03147600160000 | **G.L. Morris No. 1** | **Project: 05/0008**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%)													RELATIVE ABUNDANCE						LITHOLOGIC DESCRIPTIONS												Ro
			LIPIDS									HUMIC		OTHER					VITRINITE					TYPE I					TYPE II						
			UNSTRUCTURED				STRUCTURED																	SHALE		QUARTZ			SHALE			QUARTZ			
			Undifferentiated	Amorphous	Massive	Micrinized	Liptodetrinite	Liptiniate	Type	Type	Solid Bitumen	Inertinite	Vitrinite	Recycled Vitrinite	Inertodetrinite	Pyrite Type	Pyrite	Organic Concentration	Normal	Rough	Lipid-Rich	Oxidized	Coked	Color	Intensity	Color	Intensity	Background Intensity							Vit. Reflectance or Equiv.
44	3100	K CTG				40	LD 5	U tr	O		2	nd	tr	VR 43	O 10																			- V 3.09
Comments:	*lean barrent diluted shale, no AOM network, clay 50% qtz 40% carbonate 10%*																																	
45	3500	K CTG				30	LD 10	U 1	O		3	nd	tr	VR 41	O 15																			- V 3.19
Comments:	*similar to 3100-3150*																																	
46	4000	K CTG				90	LD 1	U nd	O		tr	nd	1	VR 5	O 3																			B 3.09 V 3.48
Comments:	*mix of diluted lean shale with type II kerogen sourc rock, clay 50% qtz 40% (biogenic=detrital), carbonate 10% pyrite 1*																																	
47	4300	K CTG				90	LD 2	U nd	O		1	nd	tr	VR 4	O 3																			- V 3.50
Comments:	*excellent post maturetype II kerogen network*																																	
48	4500	K CTG				45	LD 5	U nd	O		2	nd	tr	VR 40	O 8																			- V 3.50
Comments:	*diluted shale poor AOM network, clay 50% qtz 35% carbonate 10% pyrite 1*																																	

ANALYST

X **Landis**

MICROSCOPE

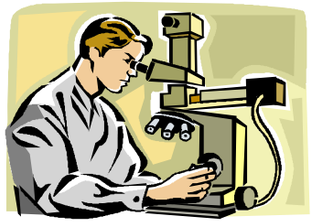
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03147600160000 | **G.L. Morris No. 1** | **Project: 05/0008**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%)													RELATIVE ABUNDANCE						LITHOLOGIC DESCRIPTIONS												Ro
			LIPIDS									HUMIC		OTHER					VITRINITE					TYPE I					TYPE II						
			UNSTRUCTURED				STRUCTURED																	SHALE		QUARTZ			SHALE			QUARTZ			
			Undifferentiated	Amorphous	Massive	Micrinized	Liptodetrinite	Liptiniate	Type	Type	Solid Bitumen	Inertinite	Vitrinite	Recycled Vitrinite	Inertodetrinite	Pyrite Type	Pyrite	Organic Concentration	Normal	Rough	Lipid-Rich	Oxidized	Coked	Color	Intensity	Color	Intensity	Background Intensity							Vit. Reflectance or Equiv.
49	4750	K CTG				5	LD nd	U nd	O		25	nd	nd	VR 60	O 10																			- V 0

Comments: *completely barren diluted shale*

Comments:

Comments:

Comments:

Comments:

ANALYST

X **Landis**

MICROSCOPE

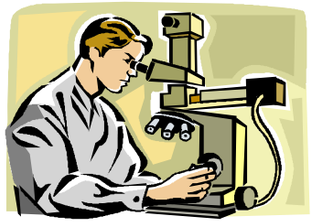
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 0314710009000 | **Childress Sallie No. 1** | **Project: 05/0008**

Visual Kerogen Analysis

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%)													RELATIVE ABUNDANCE						LITHOLOGIC DESCRIPTIONS TYPE I					LITHOLOGIC DESCRIPTIONS TYPE II						Ro
			LIPIDS									HUMIC		OTHER					VITRINITE														
			UNSTRUCTURED				STRUCTURED																	SHALE		QUARTZ			SHALE			QUARTZ			
	Minerals End, Inc.		Undifferentiated	Amorphous	Massive	Micrinized	Liptodetrinite	Liptiniate	Type	Type	Solid Bitumen	Inertinite	Vitrinite	Recycled Vitrinite	Inertodetrinite	Pyrite Type	Pyrite	Organic Concentration	Normal	Rough	Lipid-Rich	Oxidized	Coked	Color	Intensity	Color	Intensity	Background Intensity						Vit. Reflectance or Equiv.
A30		K					LD	U	O					VR	O																		-
50	2010	CTG				25	8	2			nd	nd	tr	45	20																		V 2.50
Comments:	*lean barren diluted shale no AOM network, clay 60% qtz 35% carbonate 5% pyrite 1*																																
		K					LD	U	O					VR	O																		-
51	2300	CTG				35	10	3			2	nd	tr	40	10																		V 2.57
Comments:	*lean diluted shale*																																
		K					LD	U	O					VR	O																		-
52	2550	CTG				65	5	2			2	nd	1	20	5																		V 2.57
Comments:	*mix of diluted shale and type II kerogen, clay 50%, qtz 40% carbonate 10% pyrite 1*																																
		K					LD	U	O					VR	O																		B 2.48
53	2750	CTG			15	60	3	1			2	nd	1	13	5																		V 2.55
Comments:	*diluted silty shale clay 55% qtz 35% carbonate 5*																																
		K					LD	U	O					VR	O																		-
54	3010	CTG				15	5	3			2	nd	tr	60	15																		V 2.62
Comments:	*lean barren shale clay 45% qtz 50% carbonate 5*																																

ANALYST

X **Landis**

MICROSCOPE

X **Zeiss**

Jena

Leitz

SAMPLE TYPE/PREP

CTG	Cuttings
CC	Conv. Core
SWC	SideWallCore
OC	Outcrop
NI	No Inform.
C	Coal
K	Kerogen
WR	Whole Rock
n.d.	Not Determined

STRUCTURED LIPIDS

AL	Alginite
SB	Suberinite
C	Cutinite
LD	Liptodetrinite
U	Undiffer.
S	Sporinite
R	Resinite
O	Other

OTHER ORGANIC MATTER

E	Exsudatinite
G	Graptolites
VL	Lipid-Rich Vitrinite
VC	VitriniteContamination
VR	Recycled Vitrinite

PYRITE

E	Euhedral
F	Framboid
MA	Massive
RI	Replace-infill

ABUND.

N	None
T	Trace
-	Small Amt.
M	Mod. Amt.
+	Large Amt.
++	Abundant

FLUOR. INTENS.

0	None
1	Weak
2	Moderate
3	Strong
4	Intense

VIT. REFLECT. EQUIVALENCE

B	Bitumen
G	Graptolites
VL	Lipid-Rich Vitrinite
VC	Vitrinite Contam.
VR	Recycled Vitrinite

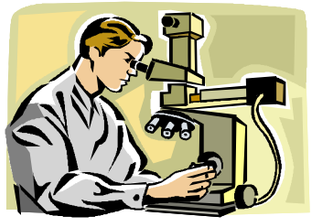
FLUOR. COLOR

W	White
G	Green
Y	Yellow
O	Orange
R	Red
B	Brown
BL	Black
L	Light
D	Dark

TAI COLOR VALUES

1-	Straw Yellow
1	Pale Yellow
1+	Yellow
2-	Yellow-Orange
2	Golden
2+	Amber
3-	Reddish Brown
3	Medium Brown
3+	Dark Brown
4-	Brown-Black
4	Black
4+	Black-Opaque

MINERALS END INC.



API # 03147100070000 | **Morris No. 1** | **Project: 05/0008**

Visual Kerogen Analysis

Sample Number	Minerals End, Inc. Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Liptodetrinite	Liptiniate	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Recycled Vitrinite	Inertodetrinite	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II: SHALE		QUARTZ				Ro: Vit. Reflectance or Equiv.
55	2200	K CTG				10	LD 5	U nd	O		nd	nd	nd	VR 70	O 15																				- V 2.79
Comments:	*lean diluted shale clay 60% qtz 30% pyrite 1%*																																		
56	2600	K CTG				30	LD 10	U tr	O		5	nd	tr	VR 50	O 5																					- V 2.93
Comments:	*lean diluted shale*																																		
57	2900	K CTG				30	LD 10	U 10	O		5	nd	tr	VR 35	O 10																					- V 3.01
Comments:	*lean diluted shale*																																		
58	3050	K CTG				35	LD 5	U 5	O		5	nd	tr	VR 35	O 15																					- V 3.18
Comments:	*lean diluted shale with slightly more AOM*																																		
59	3150	K CTG				40	LD 5	U 5	O		2	nd	tr	VR 45	O 3																					- V 3.20
Comments:	*lean diluted shale*																																		

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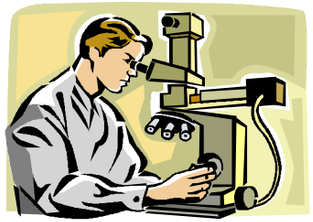
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.	VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	AL	Alginite	E	Exsudatinite	E	Euhedral	N	None	0 None	B	Bitumen	W	White	1-	Straw Yellow
CC	Conv. Core	SB	Suberinite	G	Graptolites	F	Framboid	T	Trace	1 Weak	G	Graptolites	G	Green	1	Pale Yellow
SWC	SideWallCore	C	Cutinite	VL	Lipid-Rich Vitrinite	MA	Massive	-	Small Amt.	2 Moderate	VL	Lipid-Rich Vitrinite	Y	Yellow	1+	Yellow
OC	Outcrop	LD	Liptodetrinite	VC	VitriniteContamination	RI	Replace-infill	M	Mod. Amt.	3 Strong	VC	Vitrinite Contam.	O	Orange	2-	Yellow-Orange
NI	No Inform.	U	Undiffer.	VR	Recycled Vitrinite			+	Large Amt.	4 Intense	VR	Recycled Vitrinite	R	Red	2	Golden
C	Coal	S	Sporinite					++	Abundant				B	Brown	2+	Amber
		R	Resinite										BL	Black	3-	Reddish Brown
K	Kerogen	O	Other												3	Medium Brown
WR	Whole Rock														3+	Dark Brown
													L	Light	4-	Brown-Black
n.d.	Not Determined												D	Dark	4	Black
															4+	Black-Opaque

MINERALS END INC.



API # 03147100070000 | **Morris No. 1** | **Project: 05/0008**

Visual Kerogen Analysis

Sample Number	Minerals End, Inc. Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%)												RELATIVE ABUNDANCE							LITHOLOGIC DESCRIPTIONS TYPE I					LITHOLOGIC DESCRIPTIONS TYPE II						Ro
			LIPIDS									HUMIC		OTHER					VITRINITE					SHALE		QUARTZ			SHALE			QUARTZ			
			UNSTRUCTURED				STRUCTURED																										
			Undifferentiated	Amorphous	Massive	Micrinized	Liptodetrinite	Liptiniate	Type	Type	Solid Bitumen	Inertinite	Vitrinite	Recycled Vitrinite	Inertodetrinite	Pyrite Type	Pyrite	Organic Concentration	Normal	Rough	Lipid-Rich	Oxidized	Coked	Color	Intensity	Color	Intensity	Background Intensity						Vit. Reflectance or Equiv.
60	3380	K CTG				70	LD 5	U tr	O		5	nd	tr	VR 15	O 5																		B 3.07 V 3.28

Comments: *lean diluted shale, clay 60% qtz 35% carbonates 5% pyrite 1%*

Comments:

Comments:

Comments:

Comments:

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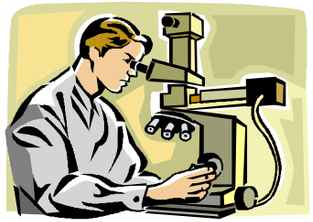
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-infill	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite			**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03147100060000 | **Raymond No. 1** | **Project: 05/0008**

Visual Kerogen Analysis

Sample Number	Minerals End, Inc. Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%)												RELATIVE ABUNDANCE										LITHOLOGIC DESCRIPTIONS TYPE I												Ro
			LIPIDS									HUMIC		OTHER					VITRINITE						SHALE		QUARTZ			TYPE II						
			UNSTRUCTURED				STRUCTURED																							SHALE			QUARTZ			
			Undifferentiated	Amorphous	Massive	Micrinized	Liptodetrinite	Liptiniate	Type	Type	Solid Bitumen	Inertinite	Vitrinite	Recycled Vitrinite	Inertodetrinite	Pyrite Type	Pyrite	Organic Concentration	Normal	Rough	Lipid-Rich	Oxidized	Coked	Color	Intensity	Color	Intensity	Background Intensity									Vit. Reflectance or Equiv.
61	3000	K CTG				65	LD 5	U 2	O		3	nd	tr	VR 15	O 10																					- V 3.50
Comments:	*laminated mixed kerogen II/I*																																				
62	3500	K CTG				90	LD 2	U tr	O		1	nd	tr	VR 5	O 2																					- V 3.38
Comments:	*laminated black shale with good residual AOM network (type II kerogen), clay 45%, qtz 40% (detrital >biogenic), carboante 10% pyrite 2*																																				
63	3550	K CTG				65	LD 5	U 5	O		2	nd	tr	VR 15	O 8																					- V 3.64
Comments:	*diluted lean mixed II/III kerogen, clay 40% qtz 40% carbonate 10% pyrite 1*																																				
64	4150	K CTG				95	LD 2	U tr	O		1	nd	tr	VR 1	O 1																					- V 3.62
Comments:	*laminated post mature type II kerogen network, clay 50%, qtz 40% (biogenic>detrital) carboante 10% pyrite 1*																																				
Comments:																																					

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X **Landis**

MICROSCOPE

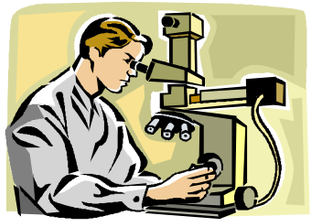
X **Zeiss**

Jena

Leitz

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03037100030000 | **Glenda J. Lines No. 1** | **Project: 05/0008**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%)													RELATIVE ABUNDANCE						LITHOLOGIC DESCRIPTIONS												Ro
			LIPIDS									HUMIC		OTHER					VITRINITE					TYPE I					TYPE II						
			UNSTRUCTURED				STRUCTURED																	SHALE		QUARTZ			SHALE			QUARTZ			
			Undifferentiated	Amorphous	Massive	Micrinized	Liptodetrinite	Liptiniate	Type	Type	Solid Bitumen	Inertinite	Vitrinite	Recycled Vitrinite	Inertodetrinite	Pyrite Type	Pyrite	Organic Concentration	Normal	Rough	Lipid-Rich	Oxidized	Coked	Color	Intensity	Color	Intensity	Background Intensity							Vit. Reflectance or Equiv.
65	2300	K CTG				65	LD 5	U 5	O		2	nd	tr	VR 15	O 8																			- V 3.14
Comments:	*mix of diluted shale (III) with good II kerogen source rock, clay 50% qtz 40% carbonate 5% pyrite 1*																																	
66	2540	K CTG				95	LD tr	U tr	O		3	nd	tr	VR 1	O 1																			B 3.06 V 3.18
Comments:	*excellent post mature type II kerogen network, clay 35%, qtz 50% (biogenic >>detrital) carboante 10% pyrite 1*																																	
67	2640	K CTG				90	LD 1	U tr	O		2	nd	tr	VR 5	O 2																			- V 3.22
Comments:	*similar to 2640-2660*																																	
68	3050	K CTG				15	LD 5	U nd	O		nd	nd	tr	VR 60	O 20																			- V 3.26
Comments:	*barren diluted shale (hematitic*																																	
Comments:																																		

ANALYST

X **Landis**

MICROSCOPE

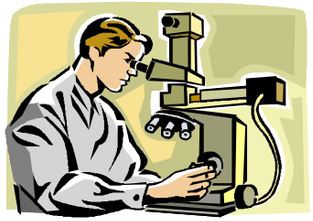
X **Zeiss**

Jena

Leitz

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03023100060000 | **McNew No. 1-26** | **DGSI Project: 05/0002**

Visual Kerogen Analysis

Sample Number	Minerals End, Inc. Sample Id or Depth		Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Type	Type	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Type	Type	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II: SHALE		QUARTZ				Ro: Vit. Reflectance or Equiv.
1	A4 2360	2400	WR	1			65	O	LD			3		tr	VR						T																B 2.27
			CTG					10	1						20																						V 2.24
Comments:	*Micrinized Amorphous Organic Matter (AOM), laminated siliceous clay-rich shale (60% clay), TR carbonates (<5%); pore lining/filling solid hydrocarbon; quartz about 30% dominated by quartz cem*																																					
2	A4 3000	3050	WR					LD	U	O					VR																							B 2.38
			CTG				20	tr	tr	10		45		tr	25																						V 2.29
Comments:	*Micrinized AOM but relatively lean TOC, sparse carbonates (<5%); pore lining/filling solid hydrocarbon; quartz cement approximately 35% dominate, some pyrite*																																					
3	A4 3780	3830	WR					O	U	LD					VR																							B 2.27
			CTG				70	4	5	tr		5	nd	1	15																							V 2.22
Comments:	*Micrinized AOM, laminated siliceous clay-rich shale (60% clay), TR carbonates (<5%); pore lining/filling solid hydrocarbon; quartz about 10% dominated by quartz; slightly more diluted with detrital te*																																					
4	A4 4050	4000	WR					U	LD	O					VR																							B 2.34
			CTG				65	1	tr	4		5	nd	tr	25																							V 2.32
Comments:	*Lean, silty shale, no AOM network, silt sized pyrite framboid*																																					
5	A4 4300	4350	WR					U	LD	O					VC																							B 2.38
			CTG				60	tr	2	10		3	nd	tr	25																							V 2.33
Comments:	*Lean, silty shale, no AOM network, 15% qtz cement silt sized pyrite framboids 2%, 60% cla*																																					

ANALYST

X **Landis**

MICROSCOPE

X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP

- **CTG** Cuttings
- **CC** Conv. Core
- **SWC** SideWallCore
- **OC** Outcrop
- **NI** No Inform.
- **C** Coal
- **K** Kerogen
- **WR** Whole Rock
- **n.d.** Not Determined

STRUCTURED LIPIDS

- **AL** Alginite
- **SB** Suberinite
- **C** Cutinite
- **LD** Liptodetrinite
- **U** Undiffer.
- **S** Sporinite
- **R** Resinite
- **O** Other

OTHER ORGANIC MATTER

- **E** Exsudatinite
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** VitriniteContamination
- **VR** Recycled Vitrinite

PYRITE

- **E** Euhedral
- **F** Framboid
- **MA** Massive
- **RI** Replace-infill

ABUND.

- **N** None
- **T** Trace
- **-** Small Amt.
- **M** Mod. Amt.
- **+** Large Amt.
- **++** Abundant

FLUOR. INTENS.

- **0** None
- **1** Weak
- **2** Moderate
- **3** Strong
- **4** Intense

VIT. REFLECT. EQUIVALENCE

- **B** Bitumen
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** Vitrinite Contam.
- **VR** Recycled Vitrinite

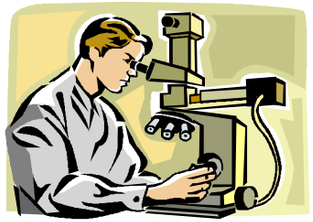
FLUOR. COLOR

- **W** White
- **G** Green
- **Y** Yellow
- **O** Orange
- **R** Red
- **B** Brown
- **BL** Black
- **L** Light
- **D** Dark

TAI COLOR VALUES

- **1-** Straw Yellow
- **1** Pale Yellow
- **1+** Yellow
- **2-** Yellow-Orange
- **2** Golden
- **2+** Amber
- **3-** Reddish Brown
- **3** Medium Brown
- **3+** Dark Brown
- **4-** Brown-Black
- **4** Black
- **4+** Black-Opaque

MINERALS END INC.



API # 03023100060000 | **McNew No. 1-26** | **DGSI Project: 05/0002**

Visual Kerogen Analysis

Sample Number	Minerals End, Inc. Sample Id or Depth		Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Type	Type	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Type	Type	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II: SHALE		QUARTZ			Ro: Vit. Reflectance or Equiv.
6	A4	4570 4620	WR					U	LD	O					VR																				B 2.41
			CTG				40	5	nd	10		5	nd	5	35																				V 2.38
Comments:	*Lean, silty shale, no AOM network, 20% detrital qtz, 60% cla*																																			
7	A4	4670 4720	WR					U	LD	R					VR																				B 2.38
			CTG				75	tr	2	1		5	nd	2	15																				V 2.38
Comments:	*Micrinized AOM but slightly diluted TOC, sparse carbonates (<5%); formerly rich Type II kerogen now post mature pore lining/filling solid hydrocarbon; quartz cement approximately 25% domin*																																			
8	A4	4770 4820	WR					U	C	O					VC																				B 2.40
			CTG				85	2	tr	1		5	nd	tr	7																				V 2.37
Comments:	*80% sample is Micrinized AOM, slightly diluted TOC, formerly rich Type II kerogen now post mature pore lining/filling solid hydrocarbon; 20% calcite; other 20% of diluted silty shale composed of >4*																																			
9	A4	4890 4940	WR					U	LD	O					VR																				B 2.41
			CTG				90	2	1	tr		3	nd	tr	4																				V 2.45
Comments:	*Micrinized AOM, slightly diluted TOC, carbonates (15%); formerly rich Type II kerogen now post mature pore lining/filling solid hydrocarbon; quartz cement about 25% dominate, metaliptinite (meta-a*																																			
10	A4	4990 5040	WR					U	LD	O					VR																				B 2.52
			CTG				75	tr	tr	5		5	nd	tr	15																				V 2.45
Comments:	*Silt sized carbonate (euhedral pitted) micrinized AOM, metaliptinite calcareous shale, pore lining and grain coating pyrobitum*																																			

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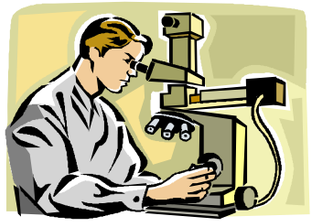
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03023100060000 | **McNew No. 1-26** | **DGSI Project: 05/0002**

Visual Kerogen Analysis

Sample Number	Minerals End, Inc. Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED Type	Type	Type	Type	Solid Bitumen	HUMIC Inertinite	Vitrinite	OTHER Type	Type	RELATIVE ABUNDANCE Pyrite Type	Pyrite	Organic Concentration	VITRINITE Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II SHALE			QUARTZ			Ro Vit. Reflectance or Equiv.
11	A4 5100 5150	WR					U	LD	R					VR																				
		CTG				85	5	nd	tr		5	nd	tr	5																					B 2.37 V 2.44
Comments:	*Micrinized AOM, slightly diluted TOC, sparse carbonates (<5%); formerly rich Type II kerogen now post mature pore lining/filling solid hydrocarbon; quartz cement approximately 30% domir*																																	
12	A4 5340 5290	WR					U	LD	O					VR																				
		CTG				30	tr	5	10		15	nd	tr	30																					B 2.51 V 2.46
Comments:	*75% lean diluted non-source shale; 25% laminated post mature type II source roc*																																	
13	A4 5350 5400	WR					U	LD	O					VR																				
		CTG				30	5	5	15		10	nd	tr	35																					B 2.57 V 2.53
Comments:	*identical to 12 except 50-50 between the two rock types*																																	
Comments:																																		
Comments:																																		

ANALYST

X **Landis**

MICROSCOPE

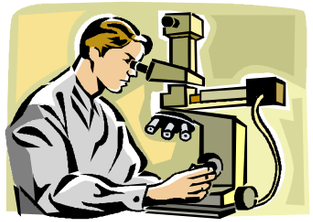
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03145100050000 | **Rocka No. 1** | **DGSI Project: 05/0002**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Prep/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Type	Type	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Type	Type	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II: SHALE			QUARTZ			Ro: Vit. Reflectance or Equiv.
14	A10 2200 2250	WR					LD	U	O					VR																					B 2.01
		CTG				35	tr	tr	20		10	tr	5	30																					V 2.30
Comments:	*lean diluted black shale, 60% clay, 15% detrital qtz, 5% qtz cement no AOM netwo*																																		
15	A10 2400 2450	WR					LD	U	O					VR																					B 2.42
		CTG				55	10	2	3		5	nd	tr	25																					V 2.40
Comments:	*lean diluted black shale, 50% clay, 30% detrital qtz, 5% qtz cement no AOM netwo*																																		
16	A10 2500 2550	WR					LD	U	O					VR																					B 2.39
		CTG				30	tr	nd	5		30	nd	tr	35																					V 2.38
Comments:	*lean diluted black shale, 50% clay, 15% detrital qtz, 5% biogenic qtz welded with qtz cement and no AOM netwo*																																		
17	A10 3900 3980	WR					LD	U	O					VR																					B 2.40
		CTG				35	5	2	3		5	nd	tr	50																					V 2.41
Comments:	*lean diluted black shale, 50% clay, 30% detrital qtz, 5% qtz cement no AOM netwo*																																		
18	A10 4400 4450	WR					LD	U	O					VR																					B 2.45
		CTG				40	5	2	10		3	nd	tr	40																					V 2.39
Comments:	*same as 17*																																		

ANALYST

X **Landis**

MICROSCOPE

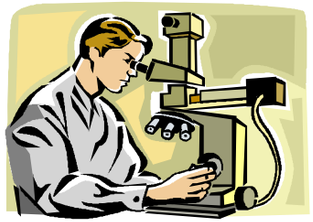
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03145100050000 **Rocka No. 1** **DGSI Project: 05/0002**

Visual Kerogen Analysis

Sample Number	Minerals End, Inc. Sample Id or Depth			Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED Type	Type	Type	Type	Solid Bitumen	HUMIC Inertinite	Vitrinite	OTHER Type	Type	RELATIVE ABUNDANCE Pyrite Type	Pyrite	Organic Concentration	VITRINITE Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II SHALE			QUARTZ			Ro Vit. Reflectance or Equiv.
19	A10	4700	4750	WR					LD	U	O					VR																						B 2.33
				CTG				40	0	5	10		10	nd	5	30																						V 2.44
Comments:	*lean diluted black shale, 50% clay, 30% detrital qtz, metaliptinite no AOM network, mix of type II and type III kerog*																																					
20	A10	4800	4900	WR					LD	U	O					VR																						B 2.46
				CTG				85	tr	tr	tr		5	nd	tr	10																						V 2.45
Comments:	*Micrinized AOM, slightly diluted TOC, sparse carbonates (<5%); formerly rich Type II kerogen now post mature pore lining/filling solid hydrocarbon; quartz cement approximately 30% domin*																																					
21	A10	5050	5100	WR					LD	U	O					VR																						B 2.52
				CTG				80	2	nd	2		10	nd	1	5																						V 2.48
Comments:	*Micrinized AOM, slightly diluted TOC, sparse carbonates (<5%); formerly rich Type II kerogen now post mature pore lining/filling solid hydrocarbon; quartz cement approximately 40% domin*																																					
22	A10	5300	5350	WR					LD	U	O					VR																						B 2.41
				CTG				85	0	tr	5		5	nd	tr	5																						V 2.53
Comments:	*Micrinized AOM, slightly diluted TOC, sparse carbonates (<5%); formerly rich Type II kerogen now post mature pore lining/filling solid hydrocarbon; quartz cement approximately 40% domir*																																					
23	A10	5530	5560	WR					LD	U	O					VR																						B 2.65
				CTG				70	nd	nd	3		15	nd	2	10																						V 2.55
Comments:	*Micrinized AOM, slightly diluted TOC, sparse carbonates (<5%); formerly Type II kerogen now post mature pore lining/filling solid hydrocarbon; biogenic quartz& qtz cement approximately 40% domi*																																					

ANALYST

X **Landis**

MICROSCOPE

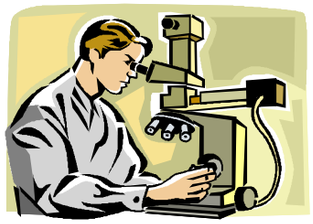
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03029100030000 | **Glenn Wright No. 1** | **DGSI Project: 05/0002**

Visual Kerogen Analysis

Sample Number	Minerals End, Inc. Sample Id or Depth		Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Type	Type	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Type	Type	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II: SHALE		QUARTZ			Ro: Vit. Reflectance or Equiv.
24	A14	1500 1550	WR					LD	U	O		3			VR																					B 2.26
			CTG				80	1	1	5			nd	tr	10																					V 2.24
Comments:				*Micrinized AOM but slightly diluted TOC, sparse carbonates (<5%); formerly rich Type II kerogen now post mature pore lining/filling solid hydrocarbon; quartz cement approximately 45% domir*																																		
25	A14	2250 2300	WR					LD	U	O					VR																					B 2.33
			CTG				70	1	nd	10		2	nd	1	16																					V 2.31
Comments:				*Micrinized AOM, slight dilute TOC, TR carbonates (<5%); slightly lean formerly Type II kerogen now post mature pore lining/filling solid HC; detrital qtz more evident than cement total qtz 45% domin*																																		
26	A14	1950 2000	WR					LD	U	O					VR																					B 2.23
			CTG				80	1	tr	3		5	nd	1	10																					V 2.26
Comments:				*Poor AOM network, diluted Type II/III silty shal*																																		
27	A14	2800 2550	WR					LD	U	O					VR																					B 2.36
			CTG				80	1	2	2		5	nd	tr	10																					V 2.33
Comments:				*lean diluted black shale, 50% clay, 35% detrital qtz, 5% qtz cement poor AOM networ*																																		
28	A14	3300 3350	WR					LD	U	O					VR																					B 2.45
			CTG				65	1	1	5		3	nd	tr	25																					V 2.40
Comments:				*lean diluted black shale, 50% clay, 35% detrital qtz, 5% qtz cement poor AOM networ*																																		

ANALYST

X **Landis**

MICROSCOPE

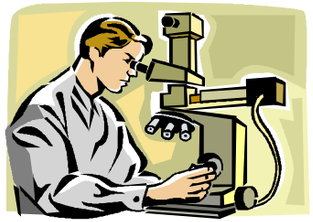
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
n.d.	Not Determined													**L**	Light	**4-**	Brown-Black
														D	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03029100030000 | **Glenn Wright No. 1** | **DGSI Project: 05/0002**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Prep/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Type	Type	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Type	Type	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II: SHALE			QUARTZ			Ro: Vit. Reflectance or Equiv.
29	A14 3850 3900	WR					LD	U	O					VR																				
		CTG				60	2	2	5		5	nd	1	25																					B 2.54 V 2.45
Comments:	*lean diluted black shale, 50% clay, 25% detrital qtz, 5% qtz cement poor AOM networ*																																	
30	A14 4240 4290	WR					LD	U	O					VR																				
		CTG				70	nd	tr	5		5	nd	tr	20																					B 2.58 V 2.49
Comments:	*lean diluted black shale, 50% clay, 35% detrital qtz, 5% qtz cement poor AOM network but slightly richer TOC than*																																	
31	A14 4700 4750	WR					LD	U	O					VR																				
		CTG				70	1	1	5		2	nd	1	20																					B 2.55 V 2.55
Comments:	*lean diluted black shale, 50% clay, 30% detrital qtz, 5% qtz cement poor AOM network but slightly richer TOC than*																																	
32	A14 5050 5100	WR					LD	U	O					VR																				
		CTG				85	nd	1	1		7	nd	tr	6																					B 2.64 V 2.58
Comments:	*Micrinized AOM, high residual TOC, TR carbonates (<5%); formerly rich Type II kerogen now post mature pore lining/filling solid hydrocarbon; mix of detrital quartz & cement about 35% dominate, cl*																																	
33	A14 5250 5300	WR					LD	U	O					VR																				
		CTG				90	nd	1	tr		5	nd	tr	4																					B 2.70 V 2.62
Comments:	*Micrinized AOM, high residual TOC, TR carbonates (<5%); formerly rich Type II kerogen now post mature pore lining/filling solid hydrocarbon; mix of detrital quartz & cement about 35% dominate, cl*																																	

ANALYST

X **Landis**

MICROSCOPE

X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP

- **CTG** Cuttings
- **CC** Conv. Core
- **SWC** SideWallCore
- **OC** Outcrop
- **NI** No Inform.
- **C** Coal
- **K** Kerogen
- **WR** Whole Rock
- **n.d.** Not Determined

STRUCTURED LIPIDS

- **AL** Alginite
- **SB** Suberinite
- **C** Cutinite
- **LD** Liptodetrinite
- **U** Undiffer.
- **S** Sporinite
- **R** Resinite
- **O** Other

OTHER ORGANIC MATTER

- **E** Exsudatinite
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** VitriniteContamination
- **VR** Recycled Vitrinite

PYRITE

- **E** Euhedral
- **F** Framboid
- **MA** Massive
- **RI** Replace-infill

ABUND.

- **N** None
- **T** Trace
- **-** Small Amt.
- **M** Mod. Amt.
- **+** Large Amt.
- **++** Abundant

FLUOR. INTENS.

- **0** None
- **1** Weak
- **2** Moderate
- **3** Strong
- **4** Intense

VIT. REFLECT. EQUIVALENCE

- **B** Bitumen
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** Vitrinite Contam.
- **VR** Recycled Vitrinite

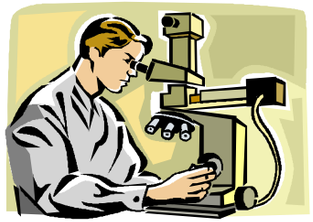
FLUOR. COLOR

- **W** White
- **G** Green
- **Y** Yellow
- **O** Orange
- **R** Red
- **B** Brown
- **BL** Black
- **L** Light
- **D** Dark

TAI COLOR VALUES

- **1-** Straw Yellow
- **1** Pale Yellow
- **1+** Yellow
- **2-** Yellow-Orange
- **2** Golden
- **2+** Amber
- **3-** Reddish Brown
- **3** Medium Brown
- **3+** Dark Brown
- **4-** Brown-Black
- **4** Black
- **4+** Black-Opaque

MINERALS END INC.



API # 03029100030000 | **Glenn Wright No. 1** | **DGSI Project: 05/0002**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Prep/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Type	Type	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Type	Type	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II: SHALE		QUARTZ			Vit. Reflectance or Equiv.
34	A14 5350 5400	WR					LD	U	O					VR																				B 2.74
		CTG				85	tr	tr	2		5	2	tr	6																				V 2.69
Comments:	*Micrinized AOM, high residual TOC, TR carbonates (<5%); formerly rich Type II kerogen now post mature pore lining/filling solid hydrocarbon; mix of detrital quartz & cement about 30% dominate, cl*																																	
35	A14 5450 5550	WR					LD	U	O					VR																				-
		CTG				90	nd	1	1		3	nd	tr	5																				V 2.66
Comments:	*Micrinized AOM, high residual TOC, TR carbonates (<5%); formerly rich Type II kerogen now post mature pore lining/filling solid hydrocarbon; mix of detrital quartz & cement about 35% dominate, cl*																																	
36	A14 5550 5600	WR					LD	U	?					VR																				B 2.78
		CTG				85	nd	1	1		3	nd	tr	10																				V 2.72
Comments:	*Micrinized AOM, high residual TOC, TR carbonates (<5%); formerly rich Type II kerogen now post mature pore lining/filling solid hydrocarbon; mix of detrital quartz & cement about 35% dominate, cl*																																	
37	A14 5860 5900	WR					LD	U	O					VR																				B 2.59
		CTG				90	tr	tr	tr		10	nd	tr	tr																				V 2.71
Comments:	*Micrinized AOM, high residual TOC, TR carbonates (<5%); formerly rich Type II kerogen now post mature pore lining/filling solid hydrocarbon; mix of detrital quartz & cement about 35% dominate, cl*																																	
38	A14 5900 5950	WR					LD	U	O					VR																				-
		CTG				90	nd	nd	2		3	nd	nd	5																				V 2.60
Comments:	*Micrinized AOM but high residual TOC, carbonates (30%); Type II kerogen now post mature pore lining/filling solid hydrocarbon; mix of detrital quartz & cement approximately 40% dominate, clay*																																	

ANALYST

X **Landis**

MICROSCOPE

X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP

- **CTG** Cuttings
- **CC** Conv. Core
- **SWC** SideWallCore
- **OC** Outcrop
- **NI** No Inform.
- **C** Coal
- **K** Kerogen
- **WR** Whole Rock
- **n.d.** Not Determined

STRUCTURED LIPIDS

- **AL** Alginite
- **SB** Suberinite
- **C** Cutinite
- **LD** Liptodetrinite
- **U** Undiffer.
- **S** Sporinite
- **R** Resinite
- **O** Other

OTHER ORGANIC MATTER

- **E** Exsudatinite
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** VitriniteContamination
- **VR** Recycled Vitrinite

PYRITE

- **E** Euhedral
- **F** Framboid
- **MA** Massive
- **RI** Replace-infill

ABUND.

- **N** None
- **T** Trace
- **-** Small Amt.
- **M** Mod. Amt.
- **+** Large Amt.
- **++** Abundant

FLUOR. INTENS.

- **0** None
- **1** Weak
- **2** Moderate
- **3** Strong
- **4** Intense

VIT. REFLECT. EQUIVALENCE

- **B** Bitumen
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** Vitrinite Contam.
- **VR** Recycled Vitrinite

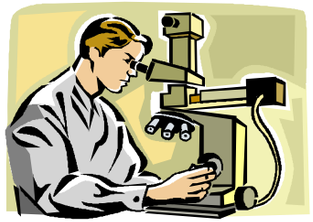
FLUOR. COLOR

- **W** White
- **G** Green
- **Y** Yellow
- **O** Orange
- **R** Red
- **B** Brown
- **BL** Black
- **L** Light
- **D** Dark

TAI COLOR VALUES

- **1-** Straw Yellow
- **1** Pale Yellow
- **1+** Yellow
- **2-** Yellow-Orange
- **2** Golden
- **2+** Amber
- **3-** Reddish Brown
- **3** Medium Brown
- **3+** Dark Brown
- **4-** Brown-Black
- **4** Black
- **4+** Black-Opaque

MINERALS END INC.



API # 03029000270000 **Morrilton Lumber No. 1** **DGSI Project: 05/0002**

Visual Kerogen Analysis

Sample Number	Minerals End, Inc. Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Type	Type	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Type	Type	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II: SHALE			QUARTZ			Ro: Vit. Reflectance or Equiv.
39	A17 1006 1050	WR / CTG				75	LD nd	U 5	O 5		5	nd	tr	VR 10																				B 2.31 V 2.43
Comments:	*Micrinized AOM, high residual TOC, TR carbonates; Type II kerogen post mature pore lining/filling solidHC; mix detrital quartz & cement about 35% dominate, clay 40%, pyritic, coked & vesiculated*																																	
40	A17 1680 1700	WR / CTG				70	LD 1	U tr	O 5		8	nd	1	VR 15																				B 2.54 V 2.47
Comments:	*Lean mix of II/III kerogen, poor AOM network, some hematite oxidatio*																																	
41	A17 2650 2700	WR / CTG				50	LD 1	U tr	O 10		4	nd	tr	VR 35																				B 2.55 V 2.48
Comments:	*Silty dilute shale, not a source no AOM network, isolated micrinized AOM fragments, micaceou*																																	
42	A17 2802 2850	WR / CTG				50	LD tr	U tr	O 5		2	nd	1	VR 42																				B 2.54 V 2.51
Comments:	*Identical to 41*																																	
43	A17 2950 3000	WR / CTG				55	LD 0	U tr	O 5		10	nd	tr	VR 30																				B 2.66 V 2.56
Comments:	*Slightly higher TOC than 41 & 42 with pyrobitumen in biogenic faunal relics and intergranular coatings to cemented gra*																																	

ANALYST

X **Landis**

MICROSCOPE

X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP

- **CTG** Cuttings
- **CC** Conv. Core
- **SWC** SideWallCore
- **OC** Outcrop
- **NI** No Inform.
- **C** Coal
- **K** Kerogen
- **WR** Whole Rock
- **n.d.** Not Determined

STRUCTURED LIPIDS

- **AL** Alginite
- **SB** Suberinite
- **C** Cutinite
- **LD** Liptodetrinite
- **U** Undiffer.
- **S** Sporinite
- **R** Resinite
- **O** Other

OTHER ORGANIC MATTER

- **E** Exsudatinite
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** VitriniteContamination
- **VR** Recycled Vitrinite

PYRITE

- **E** Euhedral
- **F** Framboid
- **MA** Massive
- **RI** Replace-infill

ABUND.

- **N** None
- **T** Trace
- **-** Small Amt.
- **M** Mod. Amt.
- **+** Large Amt.
- **++** Abundant

FLUOR. INTENS.

- **0** None
- **1** Weak
- **2** Moderate
- **3** Strong
- **4** Intense

VIT. REFLECT. EQUIVALENCE

- **B** Bitumen
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** Vitrinite Contam.
- **VR** Recycled Vitrinite

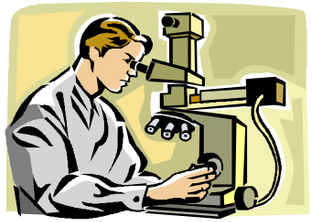
FLUOR. COLOR

- **W** White
- **G** Green
- **Y** Yellow
- **O** Orange
- **R** Red
- **B** Brown
- **BL** Black
- **L** Light
- **D** Dark

TAI COLOR VALUES

- **1-** Straw Yellow
- **1** Pale Yellow
- **1+** Yellow
- **2-** Yellow-Orange
- **2** Golden
- **2+** Amber
- **3-** Reddish Brown
- **3** Medium Brown
- **3+** Dark Brown
- **4-** Brown-Black
- **4** Black
- **4+** Black-Opaque

MINERALS END INC.



API # 03029000270000 **Morrilton Lumber No. 1** **DGSI Project: 05/0002**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%)													RELATIVE ABUNDANCE						LITHOLOGIC DESCRIPTIONS										Ro
			LIPIDS									HUMIC		OTHER					VITRINITE					TYPE I					TYPE II					
			UNSTRUCTURED				STRUCTURED																	SHALE		QUARTZ			SHALE			QUARTZ			
			Undifferentiated	Amorphous	Massive	Micrinized	Type	Type	Type	Type	Solid Bitumen	Inertinite	Vitrinite	Type	Type	Pyrite Type	Pyrite	Organic Concentration	Normal	Rough	Lipid-Rich	Oxidized	Coked	Color	Intensity	Color	Intensity	Background Intensity						Vit. Reflectance or Equiv.
44	A17 3351 3398	WR CTG				50	LD nd	U 5	O 15		5	nd	tr	VR 25																			B 2.55 V 2.54

Comments: *Similar to 43 with slightly more detrital qtz (15%) than cement (10%) clay = 65*

Comments:

Comments:

Comments:

Comments:

ANALYST

X **Landis**

MICROSCOPE

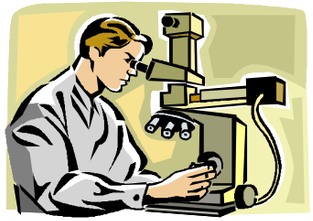
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03141000090000 **Copeland No. 1** **DGSI Project: 05/0002**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth		Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Type	Type	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Type	Type	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II: SHALE		QUARTZ			Ro: Vit. Reflectance or Equiv.
45	A21	950 1000	WR					LD	U	O					VR																				B 2.07
			CTG				40	5	10	10		5	nd	5	25																				V 2.10
Comments:				*lean diluted black shale, 70% clay, 10% detrital qtz, 15% qtz cement poor AOM networ*																																	
46	A21	1100 1450	WR					LD	U	O					VR																				B 2.08
			CTG				90	tr	2	tr		5	nd	tr	3																				V 2.09
Comments:				*Micrinized AOM, high residual TOC, TR carbonates (<5%); formerly rich Type II kerogen - post mature pore lining/filling solid hydrocarbon; mix of detrital quartz (10%) & cement about 25% dominate*																																	
47	A21	1200 1250	WR					LD	LD	O					VR																				B 2.08
			CTG				90	tr	tr	tr		5	nd	tr	5																				V 2.15
Comments:				*Micrinized AOM, high residual TOC, carbonates (5%); formerly rich Type II kerogen now post mature pore lining/filling solid HC; mix of detrital quartz (10%) & cement about 20% dominate, clay 60%*																																	
48	A21	1300 1350	WR					LD	U	O					VR																				B 4.42
			CTG				85	2	1	5		2	nd	tr	5																				V 2.14
Comments:				*Micrinized AOM, high residual TOC, carbonates (10%); formerly rich Type II kerogen - post mature pore lining/filling solid HC; mix of detrital quartz (<10%) & cement about 20% dominate, clay 60%,*																																	
Comments:																																				

ANALYST

X **Landis**

MICROSCOPE

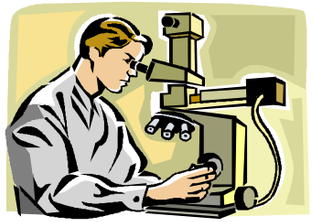
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
n.d.	Not Determined													**L**	Light	**4-**	Brown-Black
														D	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03023100020000 **A.C. Smith No. 1-2** **DGSI Project: 05/0002**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Prep/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Type	Type	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Type	Type	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II: SHALE			QUARTZ			Ro: Vit. Reflectance or Equiv.
49	A23 1350 1400	WR					LD	U	O					VR																				B 1.98
		CTG				85	5	1	2		2	nd	tr	5																				V 1.92
Comments:	*Qtz cemented 40% shale, micrinized to massive AOM carbonate = 10%, clay 50%*																																	
50	A23 1500 1550	WR					LD	U	O					VR																				B 2.03
		CTG				50	2	2	10		10	nd	1	25																				V 1.98
Comments:	*Silty dilute shale, unlikey source no AOM network, micrinized AOM fragments*																																	
51	A23 1650 1700	WR					LD	U	O					VR																				B 2.02
		CTG				70	tr	2	7		5	nd	1	15																				V 1.94
Comments:	*Calcareous (30%) micrinized AOM, gray shale clay 30%, qtz 30% mix of type II and type II kerogen*																																	
52	A23 1800 1850	WR					LD	U	O					VR																				B 1.99
		CTG				75	tr	2	2		10	nd	1	10																				V 1.95
Comments:	*Calcareous (15%) micrinized AOM, gray shale clay 50%, qtz 30% mix of type II and type II kerogen*																																	
53	A23 1950 2000	WR					LD	U	O					VR																				B 1.98
		CTG				90	2	1	tr		5	nd	tr	2																				V 1.96
Comments:	*Micrinized AOM, high residual TOC, carbonates (5%); formerly rich Type II kerogen - post mature pore lining/filling solid HC; mix of detrital quartz (5%) & cement aabout 20% dominate, clay 60%, py*																																	

ANALYST

X **Landis**

MICROSCOPE

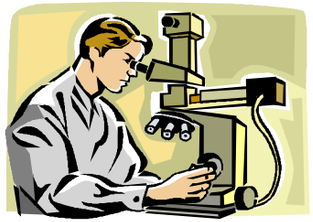
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	**AL**	Alginite	**E**	Exsudatinite	**E**	Euhedral	**N**	None	**0**	None	**B**	Bitumen	**W**	White	**1-**	Straw Yellow
CC	Conv. Core	**SB**	Suberinite	**G**	Graptolites	**F**	Framboid	**T**	Trace	**1**	Weak	**G**	Graptolites	**G**	Green	**1**	Pale Yellow
SWC	SideWallCore	**C**	Cutinite	**VL**	Lipid-Rich Vitrinite	**MA**	Massive	**-**	Small Amt.	**2**	Moderate	**VL**	Lipid-Rich Vitrinite	**Y**	Yellow	**1+**	Yellow
OC	Outcrop	**LD**	Liptodetrinite	**VC**	VitriniteContamination	**RI**	Replace-	**M**	Mod. Amt.	**3**	Strong	**VC**	Vitrinite Contam.	**O**	Orange	**2-**	Yellow-Orange
NI	No Inform.	**U**	Undiffer.	**VR**	Recycled Vitrinite		infill	**+**	Large Amt.	**4**	Intense	**VR**	Recycled Vitrinite	**R**	Red	**2**	Golden
C	Coal	**S**	Sporinite					**++**	Abundant					**B**	Brown	**2+**	Amber
		R	Resinite											**BL**	Black	**3-**	Reddish Brown
K	Kerogen	**O**	Other													**3**	Medium Brown
WR	Whole Rock															**3+**	Dark Brown
														L	Light	**4-**	Brown-Black
n.d.	Not Determined													**D**	Dark	**4**	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03023100020000 **A.C. Smith No. 1-2** **DGSI Project: 05/0002**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Type	Type	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Type	Type	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II: SHALE			QUARTZ			Ro: Vit. Reflectance or Equiv.
54	A23 2100 2150	WR					LD	U	O					VR																				B 2.01
		CTG				50	nd	nd	5		30	nd	nd	15																				-
Comments:	*High intergranular pyrobitumen, micrinized AOM, 50% silica split 50-50 between detrital and qtz cement, 20% calcite, 25% cl*																																	
55	A23 2250 2300	WR					LD	U	O					VR																				B 1.78
		CTG				70	5	3	4		7	nd	1	10																				V 1.96
Comments:	*Mix of silty diluted shale and excellent type II kerogen, micrinized AOM and completely filled pore filling pyrobitum*																																	
56	A23 2475 2494	WR					LD	U	O					VR																				B 0.34
		CTG				20	0	0	0		80	0	0	0																				V 0
Comments:	*Barren of measurable organic materia*																																	
Comments:																																		
Comments:																																		

ANALYST

X **Landis**

MICROSCOPE

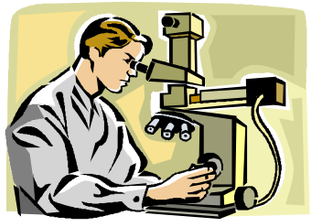
X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	AL	Alginite	E	Exsudatinite	E	Euhedral	N	None	0	None	B	Bitumen	W	White	1-	Straw Yellow
CC	Conv. Core	SB	Suberinite	G	Graptolites	F	Framboid	T	Trace	1	Weak	G	Graptolites	G	Green	1	Pale Yellow
SWC	SideWallCore	C	Cutinite	VL	Lipid-Rich Vitrinite	MA	Massive	-	Small Amt.	2	Moderate	VL	Lipid-Rich Vitrinite	Y	Yellow	1+	Yellow
OC	Outcrop	LD	Liptodetrinite	VC	VitriniteContamination	RI	Replace-	M	Mod. Amt.	3	Strong	VC	Vitrinite Contam.	O	Orange	2-	Yellow-Orange
NI	No Inform.	U	Undiffer.	VR	Recycled Vitrinite		infill	+	Large Amt.	4	Intense	VR	Recycled Vitrinite	R	Red	2	Golden
C	Coal	S	Sporinite					++	Abundant					B	Brown	2+	Amber
		R	Resinite											BL	Black	3-	Reddish Brown
K	Kerogen	O	Other													3	Medium Brown
WR	Whole Rock															3+	Dark Brown
														L	Light	4-	Brown-Black
n.d.	Not Determined													D	Dark	4	Black
																4+	Black-Opaque

MINERALS END INC.



API # 03141000110000 | **Charles Hurley No. 1** | **DGSI Project: 05/0002**

Visual Kerogen Analysis

Sample Number	Minerals End, Inc. Sample Id or Depth	Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Type	Type	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Type	Type	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II: SHALE		QUARTZ			Ro: Vit. Reflectance or Equiv.
57	A25 810 862	WR / CTG				45	LD 3	U 1	O 10		5	nd	1	VR 35																				B 2.57 / V 2.47
Comments:	*Mix of silty diluted shale and excellent type II kerogen, micrinized AOM and completely filled pore filling pyrobitum*																																	
58	A25 1000 1051	WR / CTG				20	LD nd	U nd	O nd		70	nd	nd	VR 10																				B 2.52 / -
Comments:	*Siliceous barren shale with intergranular pyrobitume*																																	
59	A25 1499 1593	WR / CTG				85	LD nd	U 1	O 3		5	nd	tr	VR 6																				B 2.58 / V 2.57
Comments:	*Micrinized AOM, high residual TOC, carbonates (10%); formerly rich Type II kerogen - post mature pore lining/filling solidHC; mix of detrital quartz (20%) & cement about 10% dominate, clay 60%, p*																																	
60	A25 1643 1690	WR / CTG				85	LD nd	U tr	O 3		5	nd	tr	VR 7																				- / V 2.60
Comments:	*Micrinized AOM, high residual TOC, carbonates (5%); formerly rich Type II kerogen - post mature pore lining/filling solid HC; mix of detrital quartz (20%) & cement about 10% dominate, clay 60%, py*																																	
61	A25 1740 1790	WR / CTG				80	LD nd	LD nd	O 3		5	nd	tr	VR 12																				B 2.60 / V 2.57
Comments:	*Micrinized AOM, high residual TOC, carbonates (5%); formerly rich Type II kerogen- post mature pore lining/filling solid HC; mix of detrital quartz (20%) & cement about 10% dominate, clay 60%, py*																																	

ANALYST

X **Landis**

MICROSCOPE

X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP

- **CTG** Cuttings
- **CC** Conv. Core
- **SWC** SideWallCore
- **OC** Outcrop
- **NI** No Inform.
- **C** Coal
- **K** Kerogen
- **WR** Whole Rock
- **n.d.** Not Determined

STRUCTURED LIPIDS

- **AL** Alginite
- **SB** Suberinite
- **C** Cutinite
- **LD** Liptodetrinite
- **U** Undiffer.
- **S** Sporinite
- **R** Resinite
- **O** Other

OTHER ORGANIC MATTER

- **E** Exsudatinite
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** VitriniteContamination
- **VR** Recycled Vitrinite

PYRITE

- **E** Euhedral
- **F** Framboid
- **MA** Massive
- **RI** Replace-infill

ABUND.

- **N** None
- **T** Trace
- **-** Small Amt.
- **M** Mod. Amt.
- **+** Large Amt.
- **++** Abundant

FLUOR. INTENS.

- **0** None
- **1** Weak
- **2** Moderate
- **3** Strong
- **4** Intense

VIT. REFLECT. EQUIVALENCE

- **B** Bitumen
- **G** Graptolites
- **VL** Lipid-Rich Vitrinite
- **VC** Vitrinite Contam.
- **VR** Recycled Vitrinite

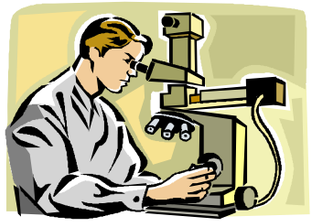
FLUOR. COLOR

- **W** White
- **G** Green
- **Y** Yellow
- **O** Orange
- **R** Red
- **B** Brown
- **BL** Black
- **L** Light
- **D** Dark

TAI COLOR VALUES

- **1-** Straw Yellow
- **1** Pale Yellow
- **1+** Yellow
- **2-** Yellow-Orange
- **2** Golden
- **2+** Amber
- **3-** Reddish Brown
- **3** Medium Brown
- **3+** Dark Brown
- **4-** Brown-Black
- **4** Black
- **4+** Black-Opaque

MINERALS END INC.



API # 03141000110000 | **Charles Hurley No. 1** | **DGSI Project: 05/0002**

Visual Kerogen Analysis

Minerals End, Inc.

Sample Number	Sample Id or Depth		Preparation/Sample Type	ORGANIC MATTER (%) LIPIDS UNSTRUCTURED: Undifferentiated	Amorphous	Massive	Micrinized	LIPIDS STRUCTURED: Type	Type	Type	Type	Solid Bitumen	HUMIC: Inertinite	Vitrinite	OTHER: Type	Type	RELATIVE ABUNDANCE: Pyrite Type	Pyrite	Organic Concentration	VITRINITE: Normal	Rough	Lipid-Rich	Oxidized	Coked	LITHOLOGIC DESCRIPTIONS TYPE I: SHALE Color	Intensity	QUARTZ Color	Intensity	Background Intensity	TYPE II: SHALE		QUARTZ			Ro: Vit. Reflectance or Equiv.
62	A25	1840 1871	WR					LD	U	O					VR																				B 2.60
			CTG				85	nd	2	1		6	nd	1	5																				V 2.56
Comments:				*Micrinized AOM, high residual TOC, carbonates (10%); formerly rich Type II kerogen now post mature pore lining/filling solid hydrocarbon; mix of detrital quartz (20%) & cement about 10% dominate*																																		
63	A25	2438 2463	WR					LD	U	O					VC																				B 2.64
			CTG				85	nd	tr	2		9	nd	tr	4																				V 2.52
Comments:				*Micrinized AOM, high residual TOC, carbonates (5%); formerly rich Type II kerogen now post mature pore lining/filling solid hydrocarbon; mix of detrital quartz (20%) & cement about 30% dominate,*																																		
64	A25	1945 2000	WR					LD	U	O					VR																				B 2.38
			CTG				90	1	1	1		3	nd	tr	4																				V 2.58
Comments:				*Micrinized AOM, high residual TOC, carbonates (5%); formerly rich Type II kerogen now post mature pore lining/filling solid hydrocarbon; mix of detrital quartz (15%) & cement about 15% dominate,*																																		
Comments:																																				
Comments:																																				

ANALYST

X **Landis**

MICROSCOPE

X **Zeiss**

_____ **Jena**

_____ **Leitz**

SAMPLE TYPE/PREP		STRUCTURED LIPIDS		OTHER ORGANIC MATTER		PYRITE		ABUND.		FLUOR. INTENS.		VIT. REFLECT. EQUIVALENCE		FLUOR. COLOR		TAI COLOR VALUES	
CTG	Cuttings	AL	Alginite	E	Exsudatinite	E	Euhedral	N	None	0	None	B	Bitumen	W	White	1-	Straw Yellow
CC	Conv. Core	SB	Suberinite	G	Graptolites	F	Framboid	T	Trace	1	Weak	G	Graptolites	G	Green	1	Pale Yellow
SWC	SideWallCore	C	Cutinite	VL	Lipid-Rich Vitrinite	MA	Massive	-	Small Amt.	2	Moderate	VL	Lipid-Rich Vitrinite	Y	Yellow	1+	Yellow
OC	Outcrop	LD	Liptodetrinite	VC	VitriniteContamination	RI	Replace-	M	Mod. Amt.	3	Strong	VC	Vitrinite Contam.	O	Orange	2-	Yellow-Orange
NI	No Inform.	U	Undiffer.	VR	Recycled Vitrinite		infill	+	Large Amt.	4	Intense	VR	Recycled Vitrinite	R	Red	2	Golden
C	Coal	S	Sporinite					++	Abundant					B	Brown	2+	Amber
		R	Resinite											BL	Black	3-	Reddish Brown
K	Kerogen	O	Other													3	Medium Brown
WR	Whole Rock															3+	Dark Brown
														L	Light	4-	Brown-Black
n.d.	Not Determined													D	Dark	4	Black
																4+	Black-Opaque

MINERALS END INC.

Humble Geochemical Services

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September 19, 2006

Arkansas Geological Commission
API: 03077000040000
Pan American, Bosnick #1

Introduction:

Four cuttings samples from 3700 to 4400 feet from Bosnick #1 were analyzed for vitrinite reflectance (%Ro), visual kerogen, and thermal alteration index (TAI). Maturity data indicate that the upper sample is in the late 'Dry gas window ' zone and that the 3 deeper samples are in higher thermal maturity than what is normally considered as the 'Dry gas window' (Table 1). Ro data are consistent with the TAI (Thermal Alteration Index or 'spore color') and fluorescence data. Terrestrial kerogen strongly dominates these 4 samples.

Discussion:

Vitrinite reflectance data quality is only fair overall. Ro values range from 3.86% to 4.61%. Organic recovery was sparse in all 4 samples. Spores are common overall and allow for a more confident TAI interpretation. However, at this high maturity everything present is black.

Framboidal pyrite is very rare to nil in these samples. This may indicate minimal marine influence here (Table 3). A single marine palynomorph (acritarch) was noted in the 3900' sample. *Lycospora* spp. spores were noted in several of the upper samples. *Lycospora* is typical of Middle Pennsylvanian (Desmoinesian) through Mississippian age rocks. Several species also range on down into the Devonian. Various other Paleozoic spores from terrestrial environments were also noted. A single *Tripartites* sp. spore was noted in the 3900' sample. This spore is typical of Mississippian age section.

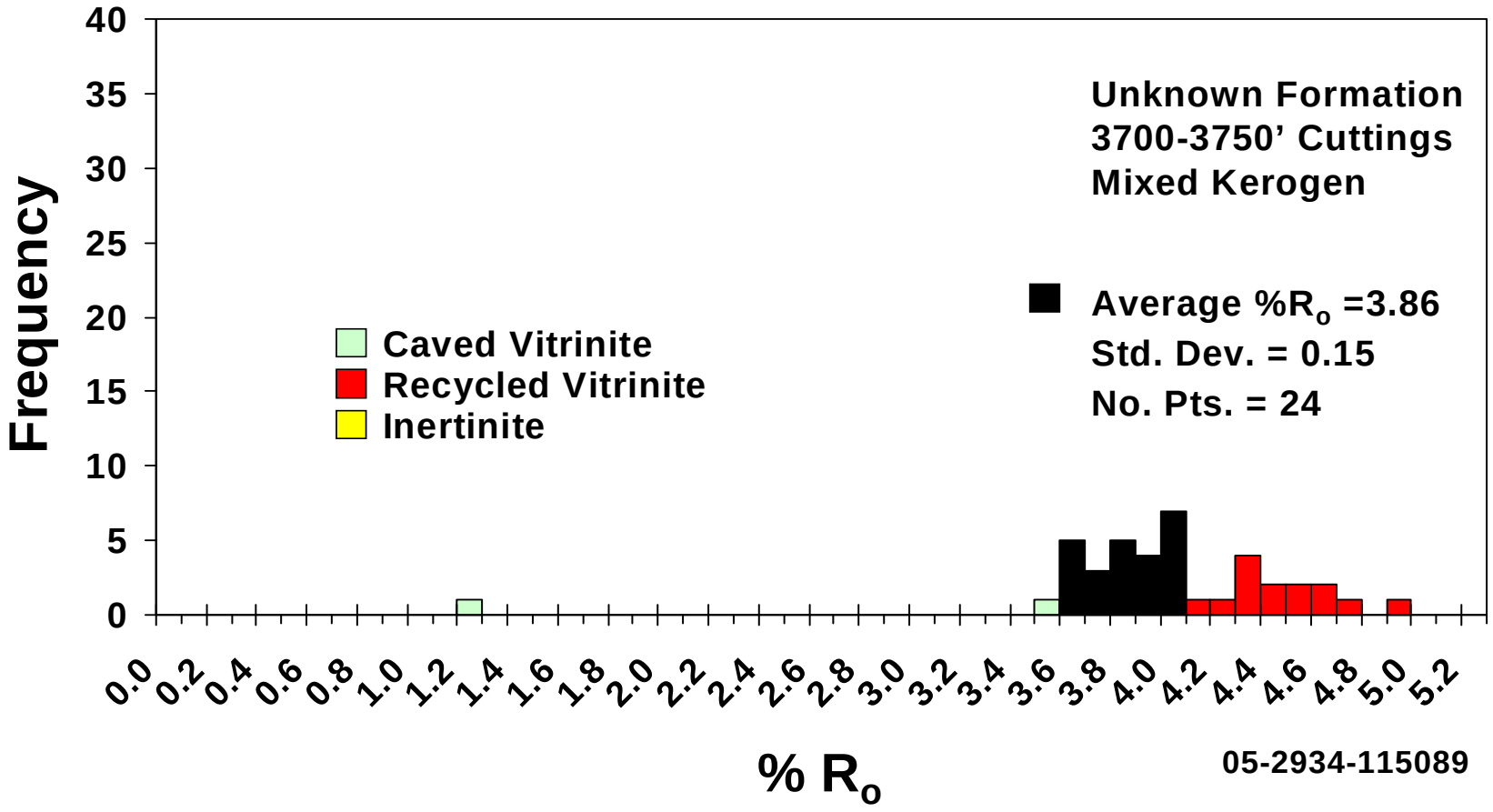
Fluorescence of pollen and spores is generally lost in the approximate vitrinite reflectance range of 1.0% to 1.1%. No spore fluorescence could be observed in these samples (Table 2). Vitrinite values are generally divided into the following categories of thermal maturity:

Immature:	0.02% to 0.60%
Oil window maturity:	0.60% to 1.10%
Condensate and /or wet-gas window:	1.10% to 1.40%
Dry gas window:	1.40% to 3.0 or 4.0%

Dan Pearson

API: 03077000040000

Pan American, Bosnick #1



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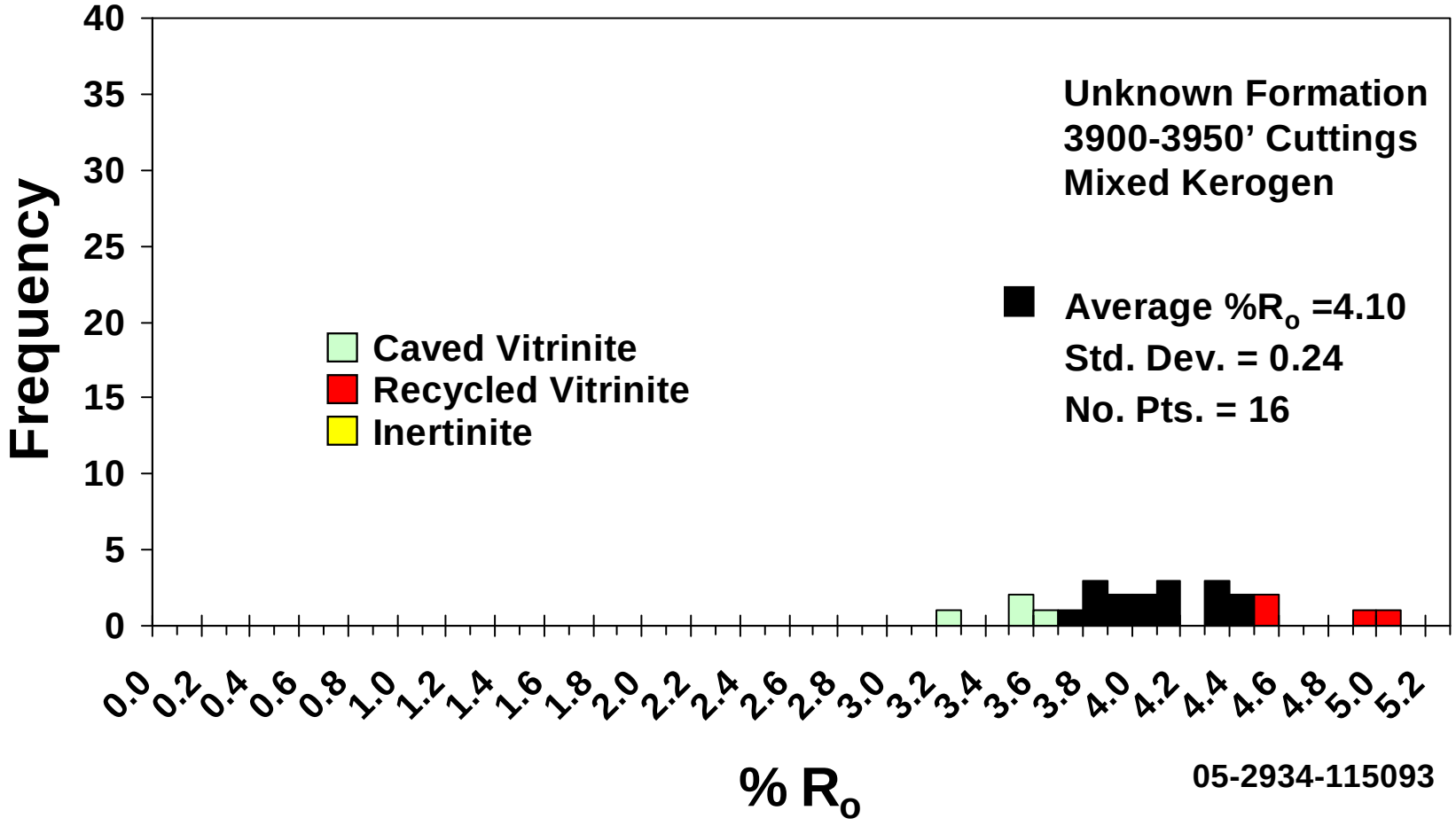
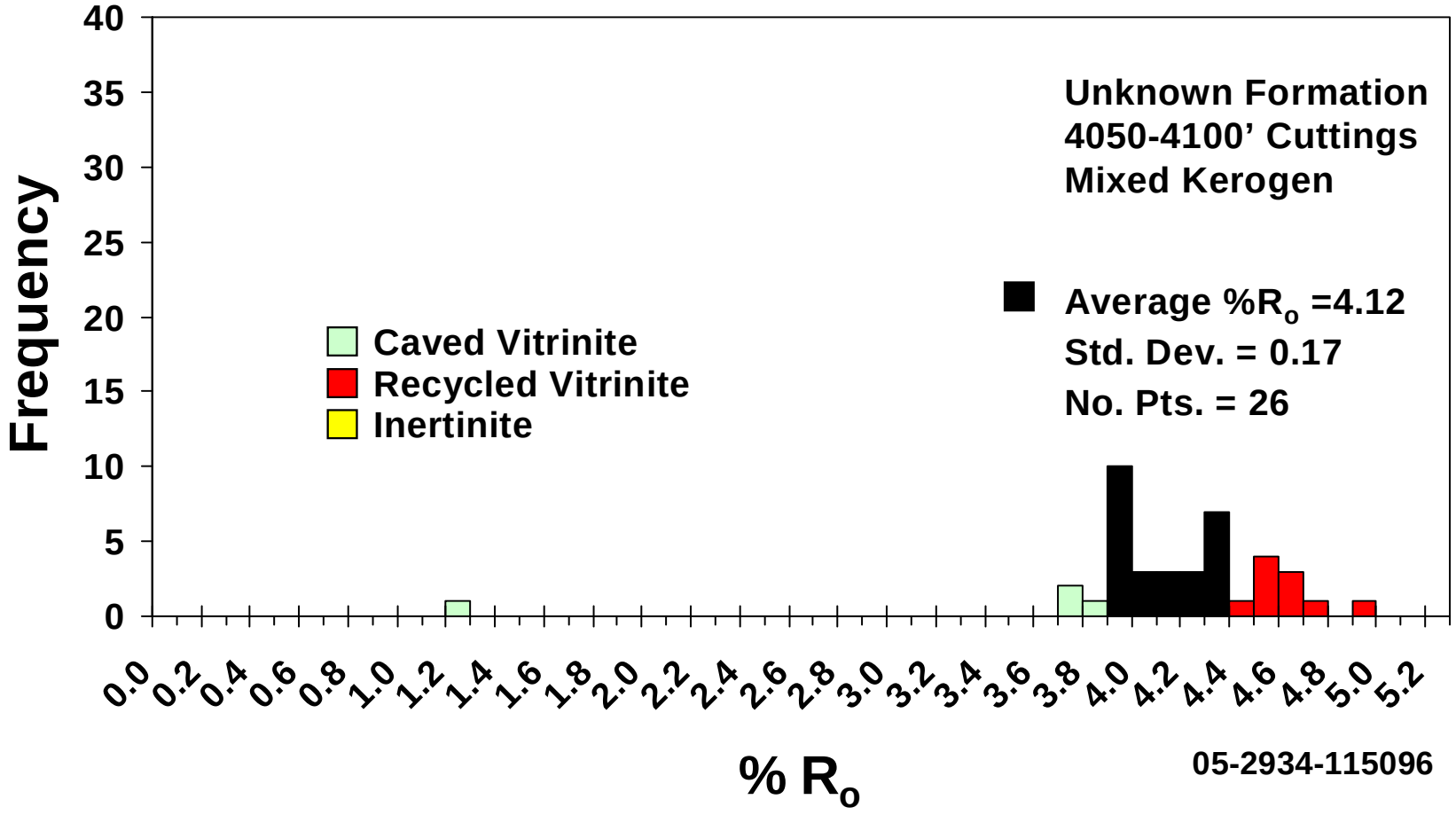
Pan American, Bosnick #1



Humble Geochemical Services

API: 03077000040000

Pan American, Bosnick #1



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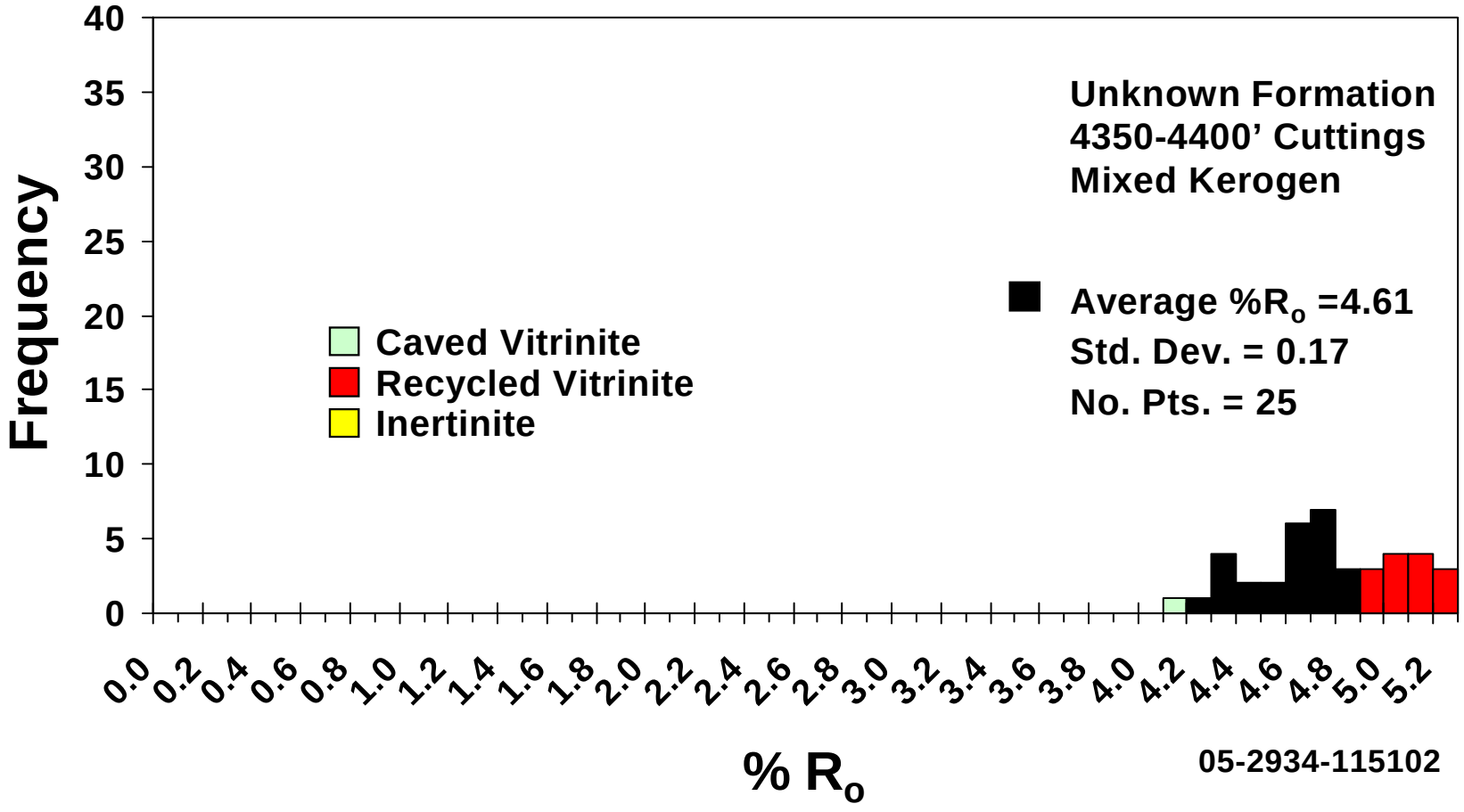
API: 03077000040000

Pan American, Bosnick #1



Humble Geochemical Services

Table 1
Dispersed Organic Matter Thermal Alteration, Kerogen Type and Total Compositional Analysis

Arkansas Geological Commission

API No. 03077000040000
Operator Pan American
Well Name/No: Bosnick #1

					Source Quality							% Source Material							Preservation				Recovery			% Kerogen Comp.							Vitrinite				
HGS ID	Well Name	Depth 1 (ft.)	Depth 2 (ft.)	Type	TOC	S2	Hydrogen Index (HI)	Tmax (oC)		Color	TAI	Amorphous Debris	Finely Dissem. OM	Herb. Plant Debris (Vit.)	Woody Plant Debris	Coaly Fragments	Algal Debris	Palynomorphs	Good	Fair	Poor	Very poor	Good	Very Poor	Barren	Indigenous Vitrinite	Caved Vitrinite	Recycled/Oxidized Vitrinite	Inertinite	Solid Bitumen	Drilling Additive/Contamination	Amorphous Kerogen	# of Readings	Total Sample Ro (%)	# of Indigeonus Readings	Indigenous Ro (%)	*Comments*
05-2934-115089	Bosnick #1	3700	3750	cuttings	2.21	0.50	23	355		BLK	4.5, 5	7	3	90				trace	X				X	X		79	1	5	5			10	40	4.00	24	3.86	Lycospora sp.
05-2934-115093	Bosnick #1	3900	3950	cuttings	1.15	0.34	30	427	*	BLK	4.5, 5	12	3	85				trace	X				X	X		74	1	5	5			15	24	4.11	16	4.10	Tripartites sp., Paleozoic spores
05-2934-115096	Bosnick #1	4050	4100	cuttings	1.76	0.43	24	355	*	BLK	4.5, 5	4	1	95				trace	X				X	X		84	1	5	5			5	40	4.15	26	4.12	Lycospora sp.
05-2934-115102	Bosnick #1	4350	4400	cuttings	1.23	0.65	53	363		BLK	4.5, 5	4	1	95				trace	X				X	X		85	trace	5	5			5	40	4.77	25	4.61	spores

* Tmax data not reliable due to poor S2 peak

Color Abbreviations:

GLY	Green-Light Yellow	B	Brown
Y	Yellow	DBDG	Dark Brown-Dark Gray
YO	Yellow-Orange	DGBL	Dark Gray-Black
OB	Orange-Brown	BLK	Black
LB	Light Brown		

TAI Scale:

1=Unaltered	3+ or 3.5
1+ or 1.5	4=Strong alteration
2=Slight alteration	4+ or 4.5
2+ or 2.5	5=Severe alteration
3=Moderate alteration	

Table 2. Kerogen Fluorescence colors and brightness intensities (subjective determinations)

Arkansas Geological Commission

API No. **03077000040000**
Operator **Pan American**
Well Name/No: **Bosnick #1**

0 = No fluorescence noted
1 = very low intensity
2 = low intensity
3 = medium intensity
4 = high intensity
5 = very high intensity

G = Green
Y = Yellow
O = Orange
B = Brown

HGS ID	Well Name	Depth 1 ft.	Depth 2 ft.	Type	Pollen/Spores				Amorphous				Mounting Medium			
					G	Y	O	B	G	Y	O	B	G	Y	O	B
05-2934-115089	Bosnick #1	3700	3750	cuttings	0	0	0	0	0	0	0	0	2			
05-2934-115093	Bosnick #1	3900	3950	cuttings	0	0	0	0	0	0	0	0	2			
05-2934-115096	Bosnick #1	4050	4100	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115102	Bosnick #1	4350	4400	cuttings	0	0	0	0	0	0	0	0	1			

Table 3. Pyrite types and abundance in kerogen

Arkansas Geological Commission

API No. **03077000040000**
Operator **Pan American**
Well Name/No: **Bosnick #1**

1 = very rare
2 = rare
3 = common
4 = abundant
5 = very abundant

HGS ID	Well Name	Depth 1 ft.	Depth 2 ft.	Type	Pyrite types		
					Finely Disseminated	Euhedral	Framboidal
05-2934-115089	Bosnick #1	3700	3750	cuttings	2	2	1
05-2934-115093	Bosnick #1	3900	3950	cuttings	2	2	1
05-2934-115096	Bosnick #1	4050	4100	cuttings	2	2	
05-2934-115102	Bosnick #1	4350	4400	cuttings	2	1	

Table 4. Individual Reflectance Readings

Wells: **Bosnick #1**

HGS ID	05-2934-115089		05-2934-115093		05-2934-115096		05-2934-115102	
Well Name	AR #10A		AR #10A		AR #10A		AR #10A	
Depth 1 (ft.)	3700.0		3900.0		4050.0		4350	
	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data
	1.23	3.61	3.24	3.77	1.23	3.92	4.19	4.28
	3.54	3.62	3.55	3.8	3.72	3.92	4.28	4.34
	3.61	3.65	3.56	3.83	3.78	3.93	4.34	4.34
	3.62	3.65	3.68	3.87	3.84	3.95	4.34	4.35
	3.65	3.66	3.77	3.9	3.92	3.96	4.35	4.39
	3.65	3.7	3.8	3.93	3.92	3.96	4.39	4.42
	3.66	3.72	3.83	4.03	3.93	3.96	4.42	4.49
	3.7	3.78	3.87	4.05	3.95	3.97	4.49	4.56
	3.72	3.81	3.9	4.12	3.96	3.97	4.56	4.56
	3.78	3.81	3.93	4.13	3.96	3.99	4.56	4.6
	3.81	3.82	4.03	4.16	3.96	4.01	4.6	4.62
	3.81	3.86	4.05	4.35	3.97	4.01	4.62	4.63
	3.82	3.88	4.12	4.35	3.97	4.09	4.63	4.65
	3.86	3.92	4.13	4.39	3.99	4.16	4.65	4.67
	3.88	3.92	4.16	4.43	4.01	4.17	4.67	4.68
	3.92	3.95	4.35	4.48	4.01	4.17	4.68	4.7
	3.92	3.97	4.35		4.09	4.2	4.7	4.7
	3.95	4	4.39		4.16	4.2	4.7	4.71
	3.97	4.01	4.43		4.17	4.26	4.71	4.72
	4	4.02	4.48		4.17	4.3	4.72	4.75
	4.01	4.03	4.56		4.2	4.3	4.75	4.78
	4.02	4.04	4.58		4.2	4.32	4.78	4.79
	4.03	4.05	4.93		4.26	4.35	4.79	4.82
	4.04	4.05	5.04		4.3	4.36	4.82	4.85
	4.05				4.3	4.36	4.85	4.87
	4.05				4.32	4.38	4.87	
	4.12				4.35		4.91	
	4.22				4.36		4.98	
	4.31				4.36		4.98	
	4.32				4.38		5	
	4.33				4.45		5.04	
	4.35				4.5		5.04	
	4.41				4.53		5.09	
	4.43				4.57		5.13	
	4.54				4.57		5.15	
	4.59				4.61		5.19	
	4.6				4.61		5.19	
	4.67				4.63		5.26	
	4.78				4.76		5.27	
	4.93				4.93		5.28	
Average %R_o	**4.00**	**3.86**	**4.11**	**4.10**	**4.15**	**4.12**	**4.77**	**4.61**
Standard Dev.		**0.15**		**0.24**		**0.17**		**0.17**
# of Points	**40**	**24**	**24**	**16**	**40**	**26**	**40**	**25**

Humble Geochemical Services

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September 26, 2005

Arkansas Geological Commission
API: 03077100010000
Cockrell Corp., Bunch #1

Introduction:

Four cuttings samples from 3700 to 4400 feet from the Bunch #1 well were analyzed for vitrinite reflectance (%Ro), visual kerogen, and thermal alteration index (TAI) determination. Maturity data indicate that these samples are in higher thermal maturity than what is normally considered as the 'Dry gas window' (Table 1). Ro data are consistent with the TAI (Thermal Alteration Index or 'spore color') and fluorescence data. There is a mix of amorphous and terrestrial kerogen in these samples but amorphous kerogen dominates overall.

Discussion:

Vitrinite reflectance data quality is very poor in 2 samples and fair in the other 2 samples. Ro values range from 4.38% to 4.68%. The 3 deeper samples had very sparse organic recovery for visual study. Spores are present and allow for a more confident TAI interpretation. However, at this high maturity everything present is black.

Framboidal pyrite is rare to very rare in these samples. This may indicate minimal marine influence here (Table 3). No indigenous marine palynomorphs were noted in any of these samples. There are some Cretaceous (?) palynomorphs (*Classopollis* sp., dinoflagellates, & *Taxodiaceaepollenites* sp.) present that are interpreted to be from cavings or contamination.

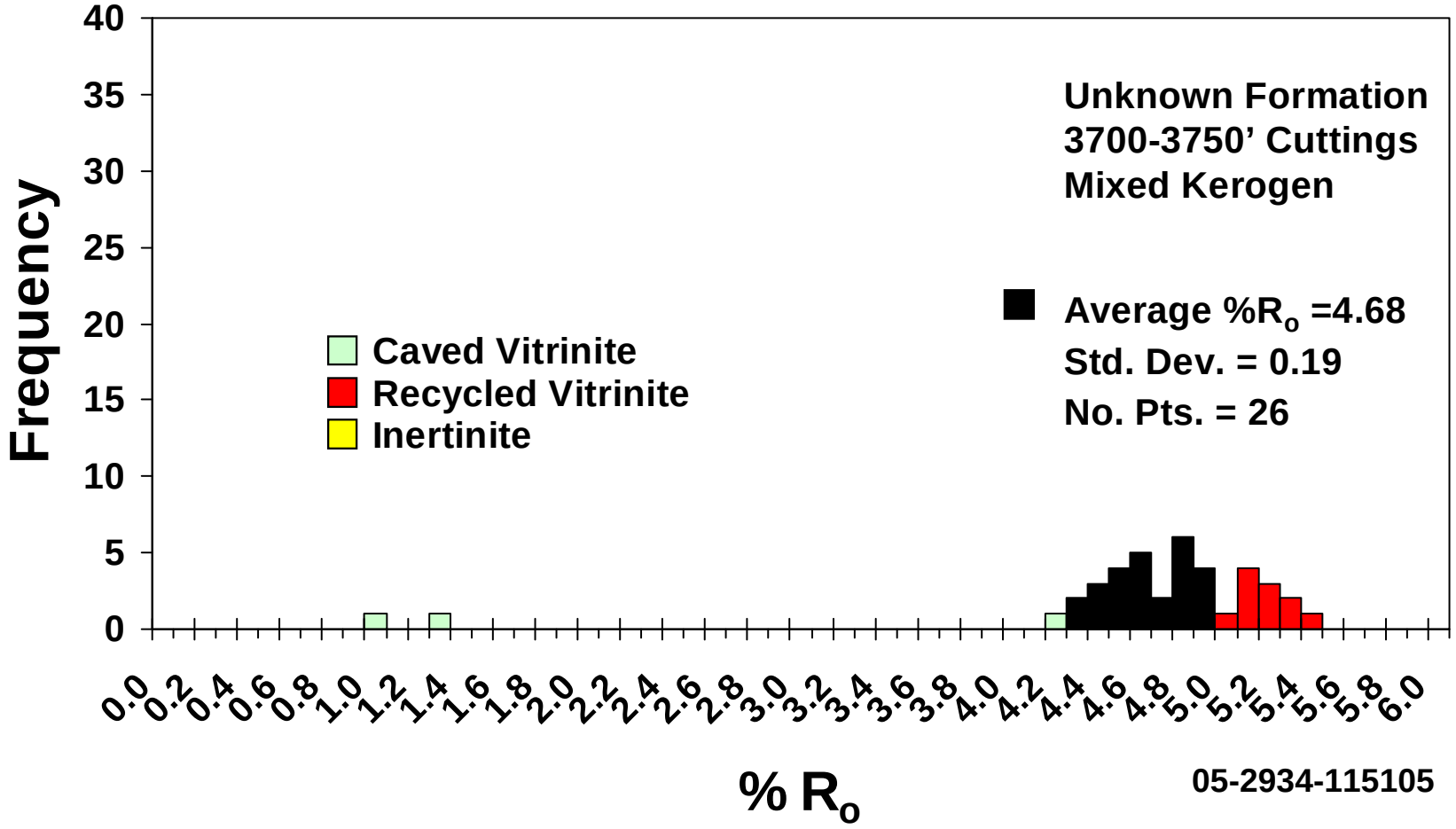
Fluorescence of pollen and spores is generally lost in the approximate vitrinite reflectance range of 1.0% to 1.1%. No spore fluorescence could be observed in these samples (Table 2). Vitrinite values are generally divided into the following categories of thermal maturity:

Immature:	0.02% to 0.60%
Oil window maturity:	0.60% to 1.10%
Condensate and /or wet-gas window:	1.10% to 1.40%
Dry gas window:	1.40% to 3.0 or 4.0%

Dan Pearson

API: 03077100010000

Cockrell Corp., Bunch #1



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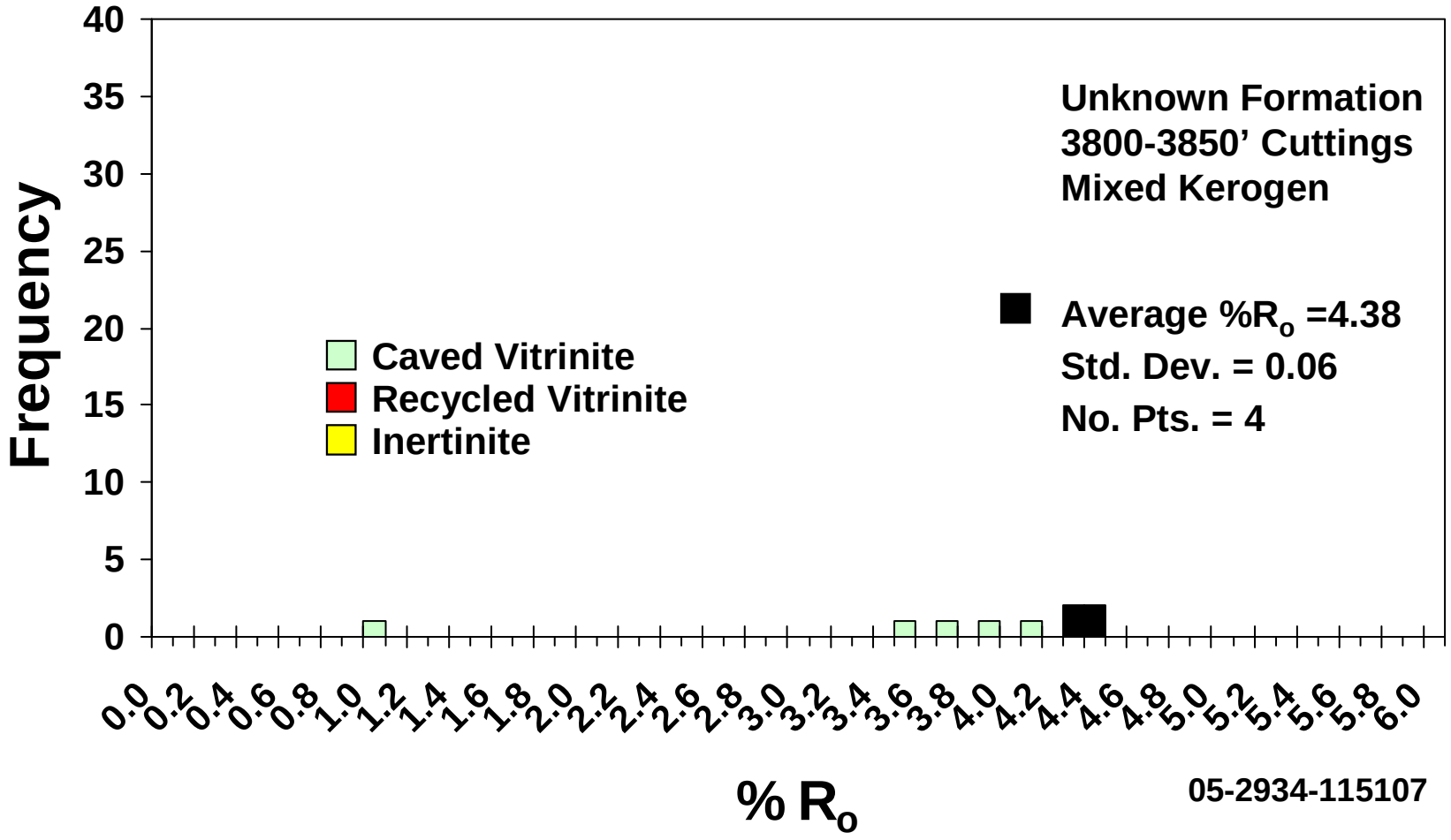
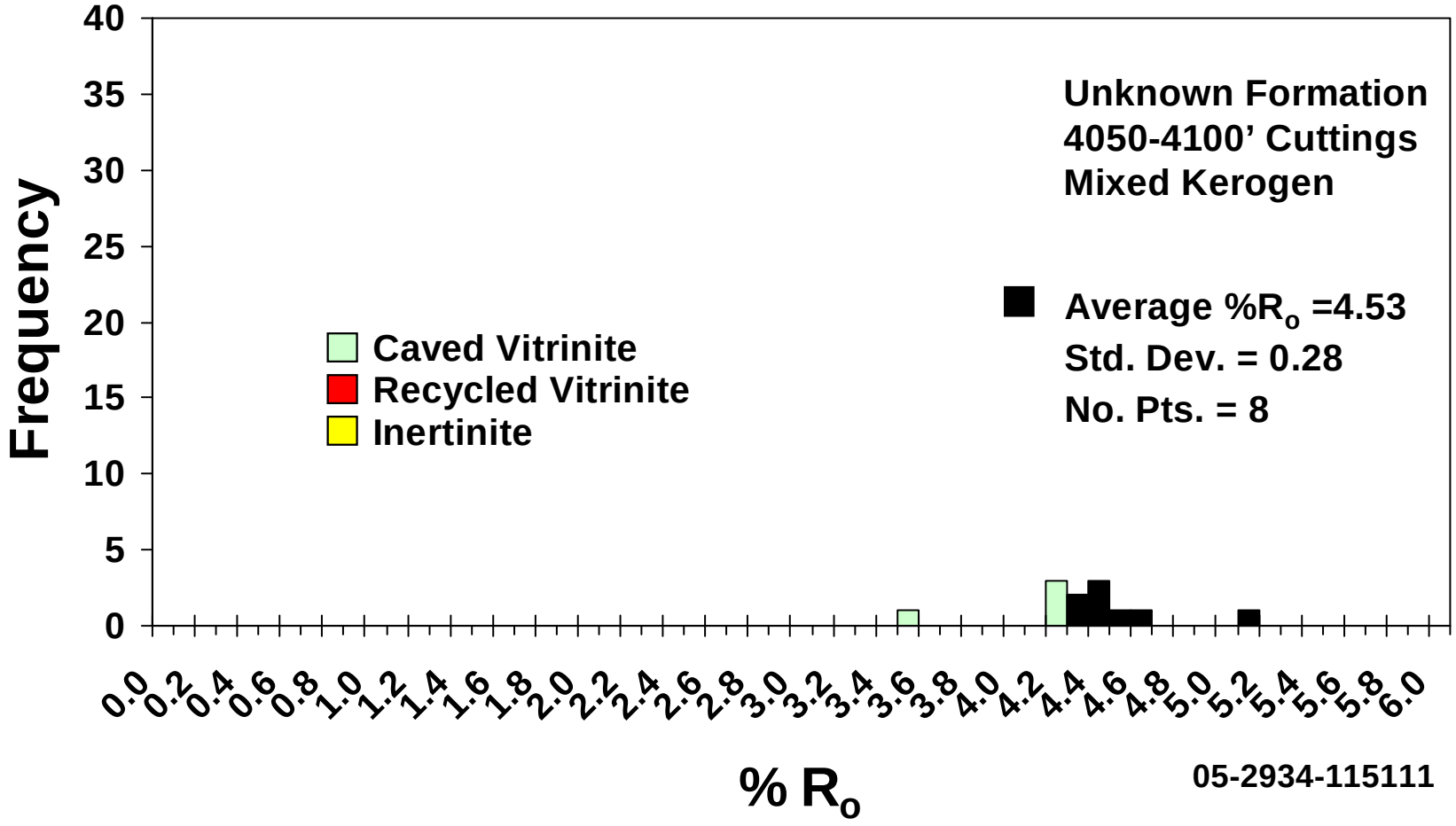
Cockrell Corp., Bunch #1



API: 03077100010000

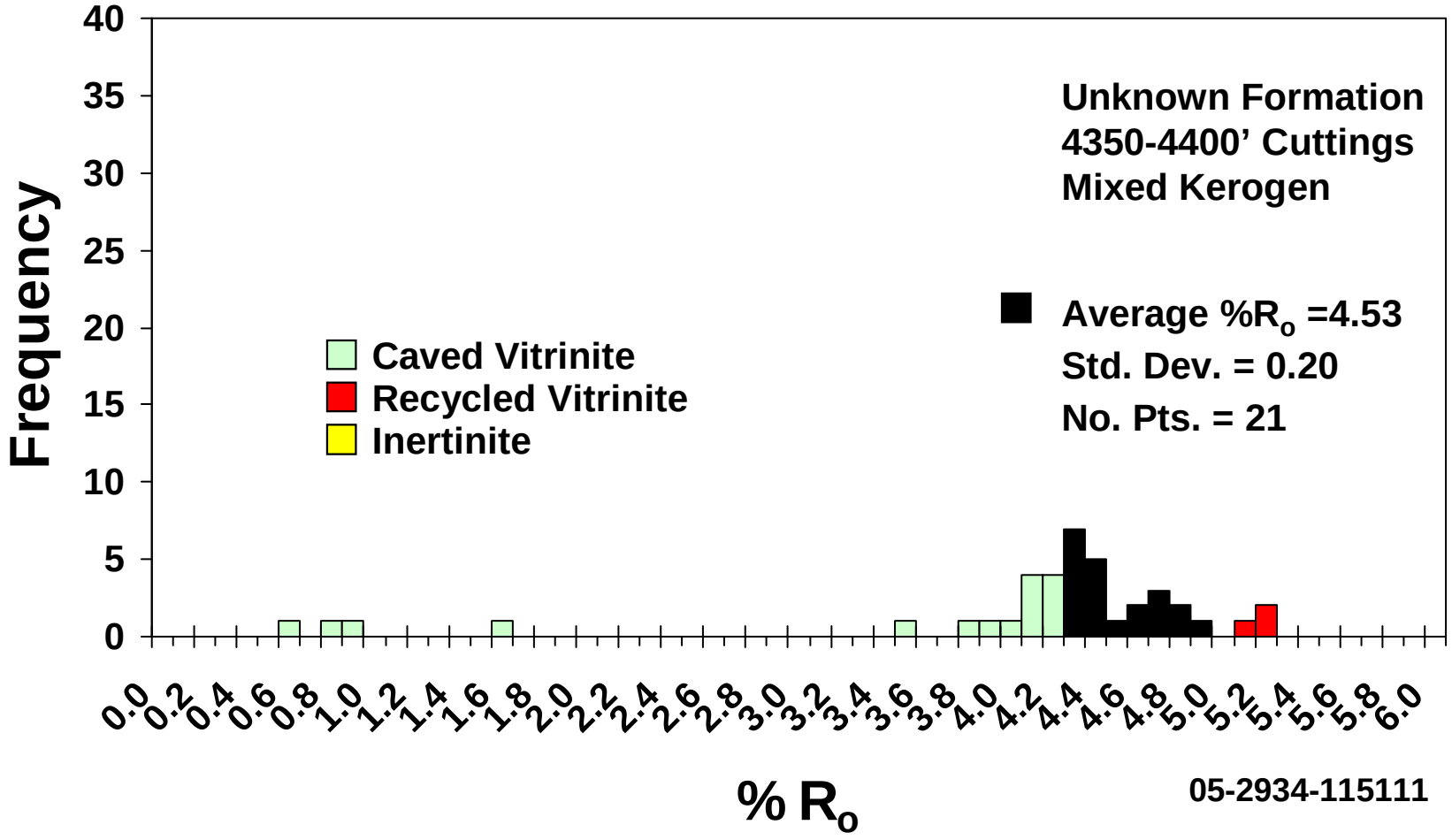
Cockrell Corp., Bunch #1



Humble Geochemical Services

API: 03077100010000

Cockrell Corp., Bunch #1



Humble Geochemical Services

Table 1
Dispersed Organic Matter Thermal Alteration, Kerogen Type and Total Compositional Analysis

Arkansas Geological Commission

API No. 03077100010000
Operator Cockrell Corp.
Well Name/No: Bunch #1

					Source Quality							% Source Material							Preservation				Recovery			% Kerogen Comp.							Vitrinite				
HGS ID	Well Name	Depth 1 (ft.)	Depth 2 (ft.)	Type	TOC	S2	Hydrogen Index (HI)	Tmax (oC)		Color	TAI	Amorphous Debris	Finely Dissem. OM	Herb. Plant Debris (Vit.)	Woody Plant Debris	Coaly Fragments	Algal Debris	Palynomorphs	Good	Fair	Poor	Very poor	Good	Very Poor	Barren	Indigenous Vitrinite	Caved Vitrinite	Recycled/Oxidized Vitrinite	Inertinite	Solid Bitumen	Drilling Additive/Contamination	Amorphous Kerogen	# of Readings	Total Sample Ro (%)	# of Indigeonus Readings	Indigenous Ro (%)	*Comments*
05-2934-115105	Bunch #1	3700	3750	cuttings	3.52	0.46	13	343	*	BLK	5.0	29	3	68				trace	X				X			55	1	9	5			30	40	4.65	26	4.68	spores
05-2934-115107	Bunch #1	3800	3850	cuttings	3.19	0.80	25	331		BLK	5.0	69?	1	30?				trace	X					X		trace?	30?	trace?	trace?			70?	9	3.77	4	4.38	spores
05-2934-115111	Bunch #1	4050	4100	cuttings	1.62	0.30	19	346	*	BLK	5.0	56	5	39				trace	X					X		20?	18?	1	1	trace		60	12	4.37	8	4.53	spores
05-2934-115117	Bunch #1	4350	4400	cuttings	2.70	0.58	21	369		BLK	5.0	69	2	29				trace	X				X	X		23	5	1	1			70	40	4.10	21	4.53	spores

*Tmax data not reliable due to poor S2 peak

tr = trace

Color Abbreviations:

GLY	Green-Light Yellow	B	Brown
Y	Yellow	DBDG	Dark Brown-Dark Gray
YO	Yellow-Orange	DGBL	Dark Gray-Black
OB	Orange-Brown	BLK	Black
LB	Light Brown		

TAI Scale:

1=Unaltered	3+ or 3.5
1+ or 1.5	4=Strong alteration
2=Slight alteration	4+ or 4.5
2+ or 2.5	5=Severe alteration
3=Moderate alteration	

Table 2. Kerogen Fluorescence colors and brightness intensities (subjective determinations)

Arkansas Geological Commission

API No. **03077100010000**
Operator **Cockrell Corp.**
Well Name/No: **Bunch #1**

0 = No fluorescence noted
1 = very low intensity
2 = low intensity
3 = medium intensity
4 = high intensity
5 = very high intensity

G = Green
Y = Yellow
O = Orange
B = Brown

HGS ID	Well Name	Depth 1 ft.	Depth 2 ft.	Type	Pollen/Spores				Amorphous				Mounting Medium			
					G	Y	O	B	G	Y	O	B	G	Y	O	B
05-2934-115105	Bunch #1	3700	3750	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115107	Bunch #1	3800	3850	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115111	Bunch #1	4050	4100	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115117	Bunch #1	4350	4400	cuttings	0	0	0	0	0	0	0	0	1			

Table 3. Pyrite types and abundance in kerogen

Arkansas Geological Commission

API No. **03077100010000**
Operator **Cockrell Corp.**
Well Name/No: **Bunch #1**

1 = very rare
2 = rare
3 = common
4 = abundant
5 = very abundant

HGS ID	Well Name	Depth 1 ft.	Depth 2 ft.	Type	Pyrite types		
					Finely Disseminated	Euhedral	Framboidal
05-2934-115105	Bunch #1	3700	3750	cuttings	2	2	1
05-2934-115107	Bunch #1	3800	3850	cuttings	2	2	1
05-2934-115111	Bunch #1	4050	4100	cuttings	2	2	1
05-2934-115117	Bunch #1	4350	4400	cuttings	2	2	2

Table 4. Individual Reflectance Readings

Wells: **Bunch #1**

HGS ID	05-2934-115105		05-2934-115107		05-2934-115111		05-2934-115117	
Well Name	AR #11A		AR #11A		AR #11A		AR #11A	
Depth 1 (ft.)	3700.0		3800.0		4050.0		4350	
	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data
	1.04	4.37	1.02	4.31	3.54	4.3	0.67	4.31
	1.39	4.39	3.58	4.34	4.21	4.39	0.86	4.32
	4.25	4.4	3.74	4.41	4.21	4.4	0.92	4.32
	4.37	4.42	3.98	4.45	4.26	4.41	1.62	4.33
	4.39	4.43	4.13		4.3	4.44	3.54	4.34
	4.4	4.52	4.31		4.39	4.5	3.89	4.35
	4.42	4.54	4.34		4.4	4.63	3.93	4.36
	4.43	4.56	4.41		4.41	5.18	4.01	4.4
	4.52	4.57	4.45		4.44		4.11	4.42
	4.54	4.6			4.5		4.11	4.43
	4.56	4.64			4.63		4.18	4.44
	4.57	4.65			5.18		4.19	4.45
	4.6	4.65					4.26	4.53
	4.64	4.66					4.28	4.66
	4.65	4.7					4.28	4.68
	4.65	4.75					4.29	4.7
	4.66	4.8					4.31	4.71
	4.7	4.84					4.32	4.76
	4.75	4.84					4.32	4.8
	4.8	4.85					4.33	4.88
	4.84	4.86					4.34	4.9
	4.84	4.88					4.35	
	4.85	4.93					4.36	
	4.86	4.93					4.4	
	4.88	4.97					4.42	
	4.93	4.99					4.43	
	4.93						4.44	
	4.97						4.45	
	4.99						4.53	
	5.08						4.66	
	5.12						4.68	
	5.13						4.7	
	5.17						4.71	
	5.19						4.76	
	5.23						4.8	
	5.24						4.88	
	5.27						4.9	
	5.35						5.11	
	5.37						5.21	
	5.4						5.28	
Average %R_o	**4.65**	**4.68**	**3.77**	**4.38**	**4.37**	**4.53**	**4.10**	**4.53**
Standard Dev.		**0.19**		**0.06**		**0.28**		**0.20**
# of Points	**40**	**26**	**9**	**4**	**12**	**8**	**40**	**21**

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September 22, 2005

Arkansas Geological Commission
API: 031231000100000
Cockrell Oil Corp., Carter #1

Introduction:

Five cuttings samples from the 2900 to 4700 feet of the Carter #1 were analyzed for vitrinite reflectance (%Ro), visual kerogen, and thermal alteration index (TAI) determination. Maturity data indicate that these samples are in the late 'Dry gas window' zone (Table 1). Ro data are consistent with the TAI (Thermal Alteration Index or 'spore color') and fluorescence data. Terrestrial kerogen dominates in all 5 of these samples.

Discussion:

Vitrinite reflectance data quality is fairly good overall. However, the 2 deepest samples had very sparse organic recovery for visual study. Ro values range from 3.05% to 3.67%. Spores are present and allow for a more confident TAI interpretation.

Framboidal pyrite is very rare to nil in these samples. This may indicate minimal marine influence here (Table 3). No indigenous marine palynomorphs were noted in any of these samples. There are some Cretaceous (?) palynomorphs (*Classopollis* sp., dinoflagellates, & *Taxodiaceaepollenites* sp.) present that are interpreted to be from cavings or contamination. *Lycospora* spp. spores were noted in several of these samples. *Lycospora* is typical of Middle Pennsylvanian (Desmoinesian) through Mississippian age rocks. Several species also range on down into the Devonian. Various other Paleozoic spores from terrestrial environments were also noted.

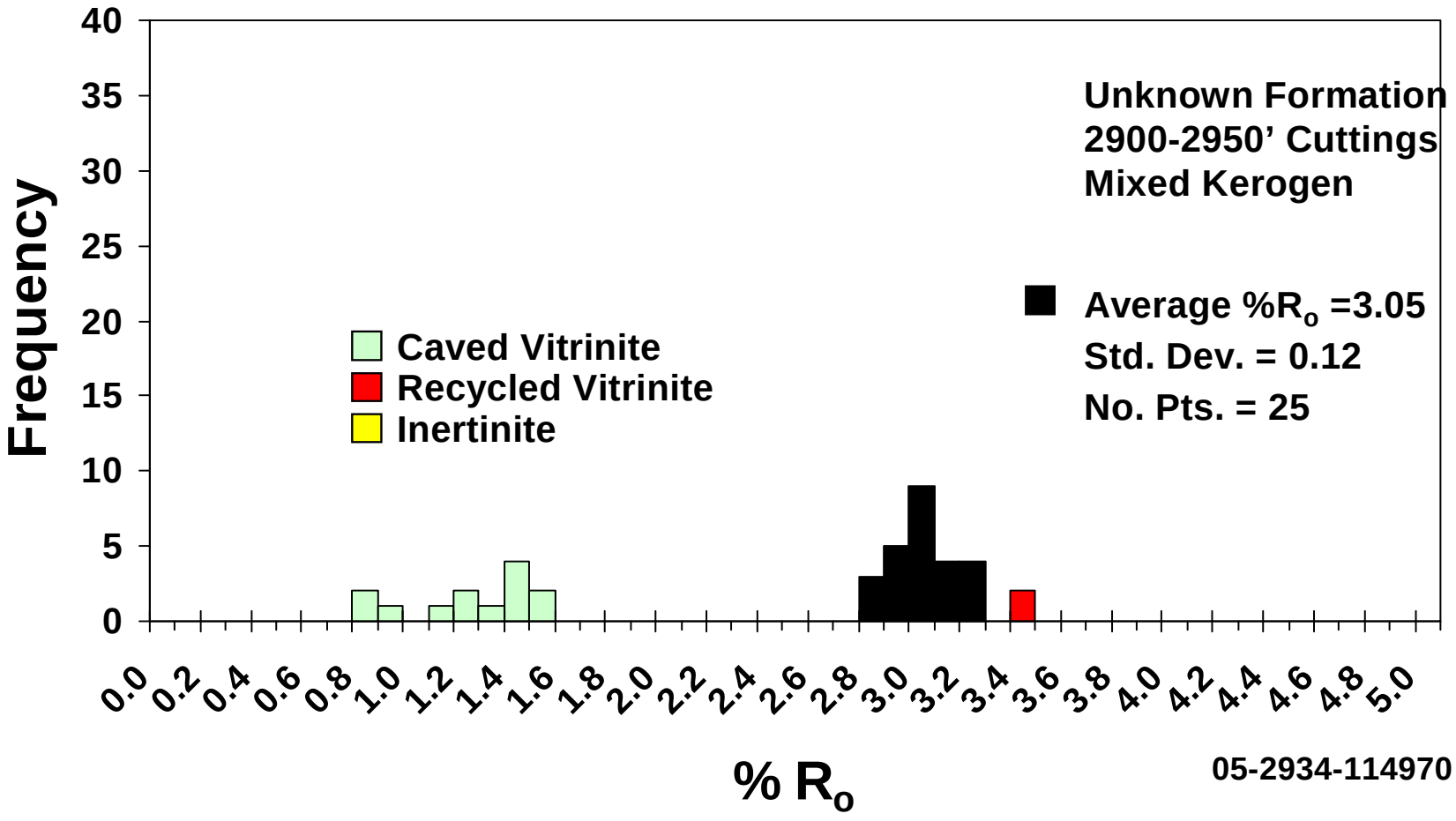
Fluorescence of pollen and spores is generally lost in the approximate vitrinite reflectance range of 1.0% to 1.1%. No spore fluorescence could be observed in these samples (Table 2). Vitrinite values are generally divided into the following categories of thermal maturity:

Immature:	0.02% to 0.60%
Oil window maturity:	0.60% to 1.10%
Condensate and /or wet-gas window:	1.10% to 1.40%
Dry gas window:	1.40% to 3.0 or 4.0%

Dan Pearson

API: 03123100010000

Cockrell Oil Corp., Carter #1



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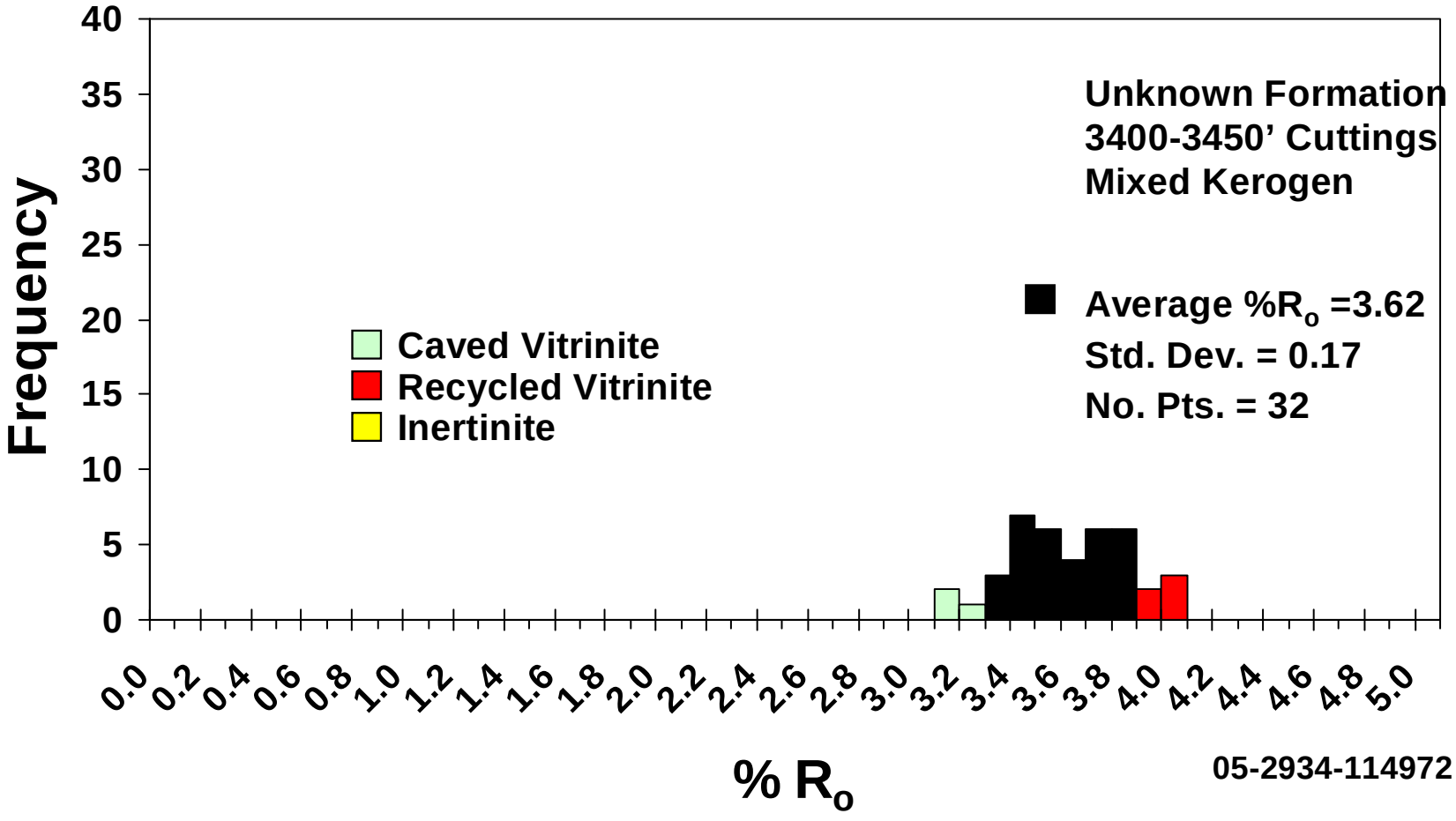
API: 03123100010000

Cockrell Oil Corp., Carter #1



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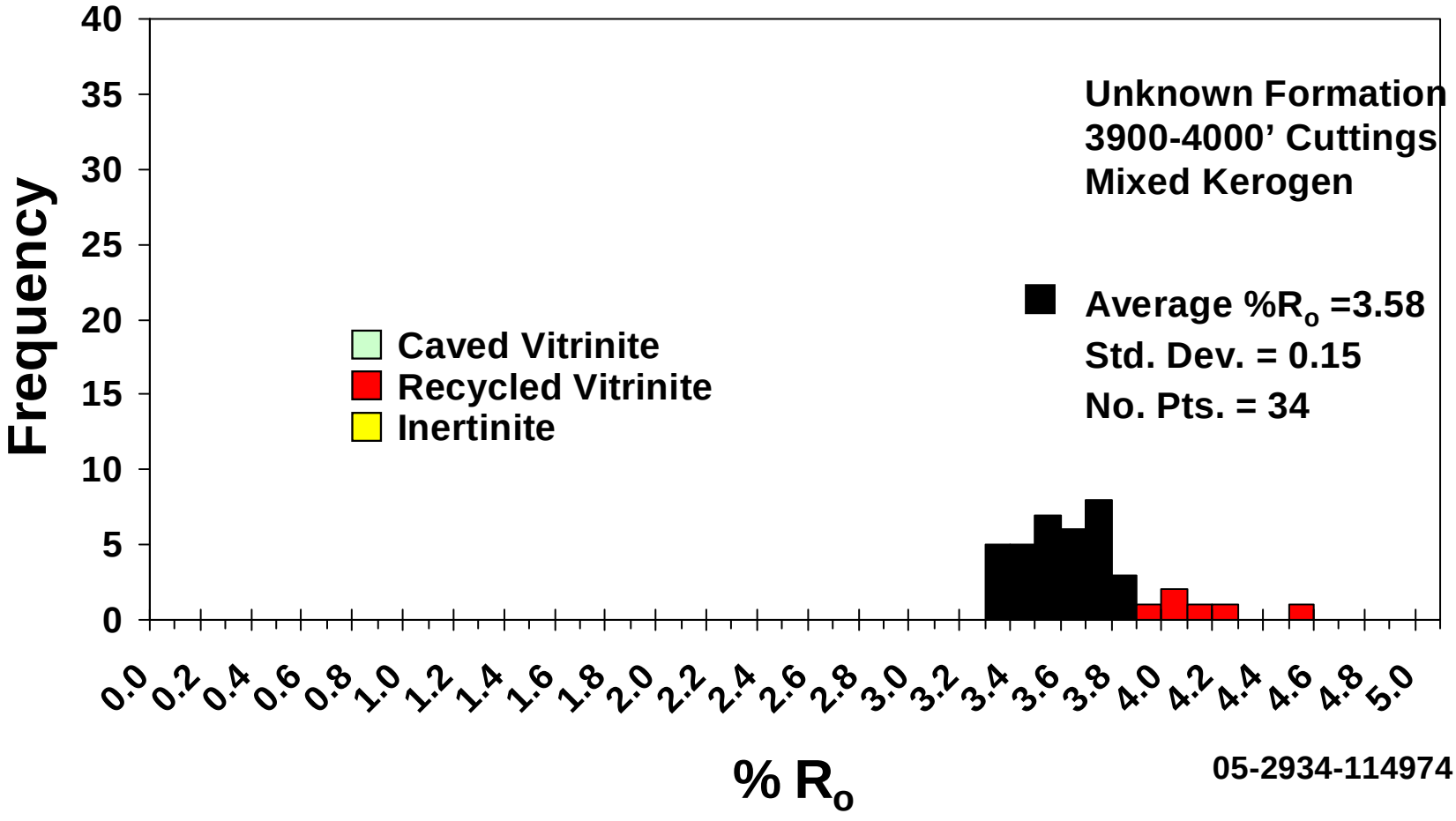
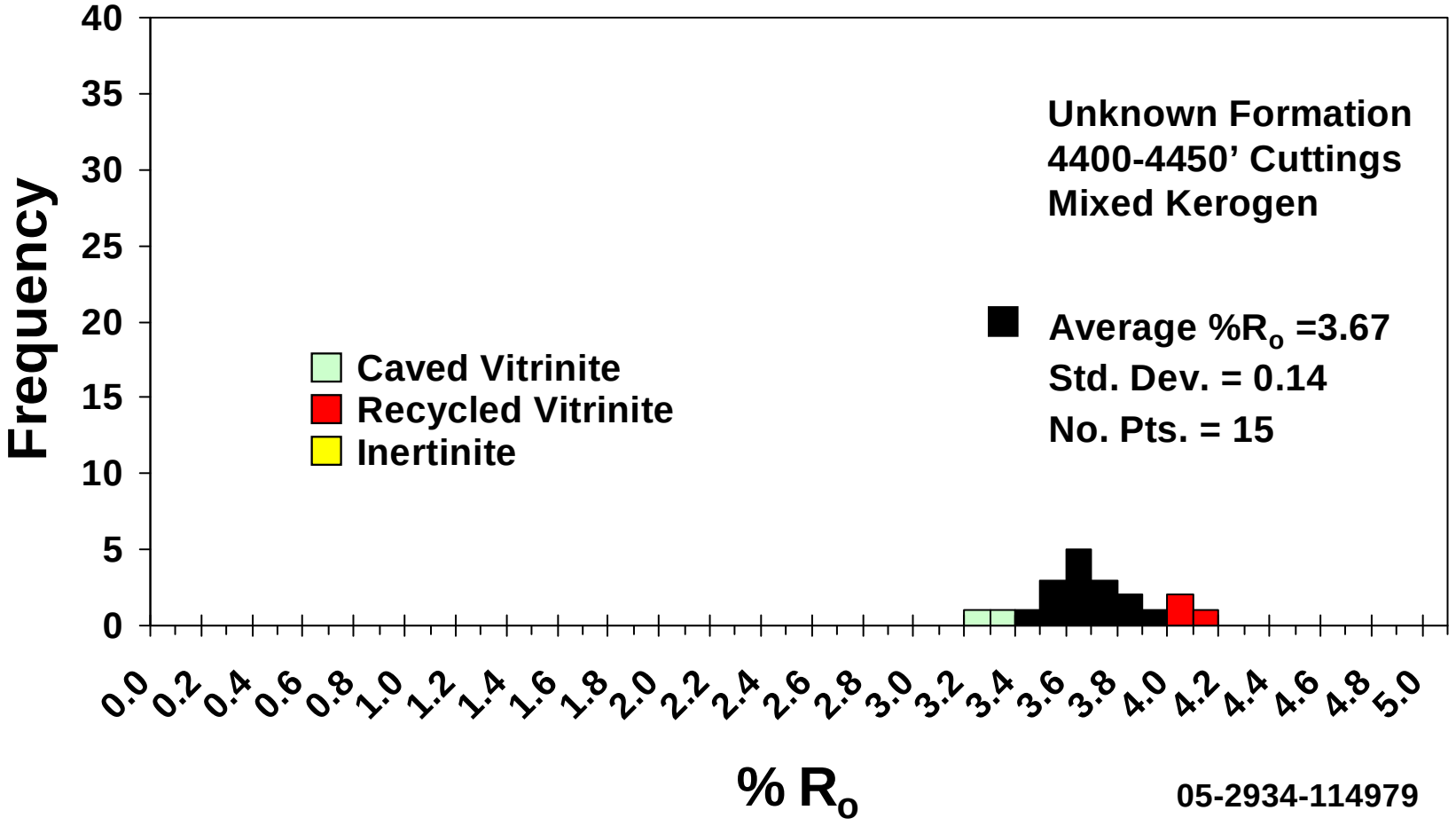
API: 03123100010000

Cockrell Oil Corp., Carter #1



API: 03123100010000

Cockrell Oil Corp., Carter #1



Humble Geochemical Services

API: 03123100010000

Cockrell Oil Corp., Carter #1

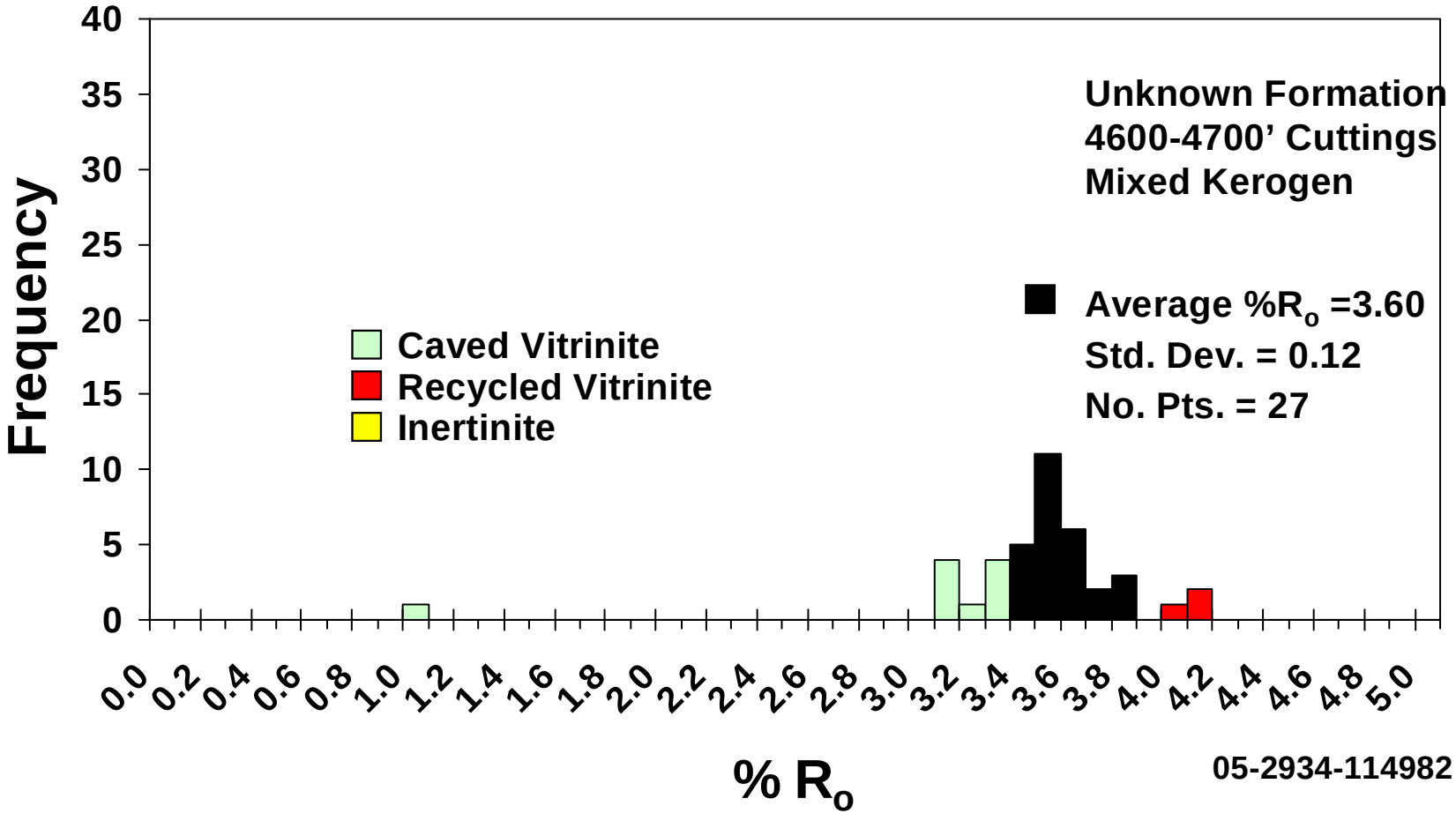


Table 1
Dispersed Organic Matter Thermal Alteration, Kerogen Type and Total Compositional Analysis

Arkansas Geological Commission

API No. 03123100010000
Operartor Cockrell Oil Company
Well Name/No: Carter #1

					Source Quality							% Source Material							Preservation				Recovery			% Kerogen Comp.							Vitrinite				
HGS ID	Well Name	Depth 1 (ft.)	Depth 2 (ft.)	Type	TOC	S2	Hydrogen Index (HI)	Tmax (oC)	Color	TAI	Amorphous Debris	Finely Dissem. OM	Herb. Plant Debris (Vit.)	Woody Plant Debris	Coaly Fragments	Algal Debris	Palynomorphs	Good	Fair	Poor	Very poor	Good	Very Poor	Barren	Indigenous Vitrinite	Caved Vitrinite	Recycled/Oxidized Vitrinite	Inertinite	Solid Bitumen	Drilling Additive/Contamination	Amorphous Kerogen	# of Readings	Total Sample Ro (%)	# of Indigeonus Readings	Indigenous Ro (%)	*Comments*
05-2934-114970	Carter #1	2900	2950	cuttings	0.98	0.24	25	419 *	DGBL, BLK	4, 4.5	3	1	95				1	X				X			70	15	5	5			5	40	2.49	25	3.05	Lycospora sp., 20% Cret.? Cave/Contam.
05-2934-114972	Carter #1	3400	3450	cuttings	2.52	0.19	8	338 *	BLK	4.5	4	1	95				trace	X				X			84	1	5	5			5	40	3.63	32	3.62	Lycospora sp.
05-2934-114974	Carter #1	3900	4000	cuttings	0.85	0.32	38	342 *	BLK	4.5	9	2	89				trace	X				X			79	1	5	5			10	40	3.67	34	3.58	Lycospora sp.
05-2934-114979	Carter #1	4400	4450	cuttings	1.75	0.21	12	365 *	BLK	4.5	42	3	55				trace	X				X	X		52	1	1	1			45	20	3.70	15	3.67	spores
05-2934-114982	Carter #1	4600	4700	cuttings	1.51	0.32	21	409 *	BLK	4.5	1	1	98				trace	X				X	X		85	10	2	1			2	40	3.50	27	3.60	spores

*Tmax data not reliable due to poor S2 peak

tr = trace

Color Abbreviations:

GLY	Green-Light Yellow	B	Brown
Y	Yellow	DBDG	Dark Brown-Dark Gray
YO	Yellow-Orange	DGBL	Dark Gray-Black
OB	Orange-Brown	BLK	Black
LB	Light Brown		

TAI Scale:

1=Unaltered	3+ or 3.5
1+ or 1.5	4=Strong alteration
2=Slight alteration	4+ or 4.5
2+ or 2.5	5=Severe alteration
3=Moderate alteration	

Table 2. Kerogen Fluorescence colors and brightness intensities (subjective determinations)

Arkansas Geological Commission

API No. **03123100010000**
Operartor **Cockrell Oil Company**
Well Name/No: **Carter #1**

0 = No fluorescence noted
1 = very low intensity
2 = low intensity
3 = medium intensity
4 = high intensity
5 = very high intensity

G = Green
Y = Yellow
O = Orange
B = Brown

HGS ID	Well Name	Depth 1 ft.	Depth 2 ft.	Type	Pollen/Spores				Amorphous				Mounting Medium			
					G	Y	O	B	G	Y	O	B	G	Y	O	B
05-2934-114970	Carter #1	2900	2950	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-114972	Carter #1	3400	3450	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-114974	Carter #1	3900	4000	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-114979	Carter #1	4400	4450	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-114982	Carter #1	4600	4700	cuttings	0	0	0	0	0	0	0	0	1			

Table 3. Pyrite types and abundance in kerogen

Arkansas Geologic Commission

API No. **03123100010000**
Operartor **Cockrell Oil Company**
Well Name/No: **Carter #1**

1 = very rare
2 = rare
3 = common
4 = abundant
5 = very abundant

HGS ID	Well Name	Depth 1 ft.	Depth 2 ft.	Type	Pyrite types		
					Finely Disseminated	Euhedral	Framboidal
05-2934-114970	Carter #1	2900	2950	cuttings	2	1	1
05-2934-114972	Carter #1	3400	3450	cuttings	2	2	
05-2934-114974	Carter #1	3900	4000	cuttings	2	2	
05-2934-114979	Carter #1	4400	4450	cuttings	4	2	
05-2934-114982	Carter #1	4600	4700	cuttings	2	2	

Table 4. Individual Reflectance Readings

Wells: **Carter #1**

HGS ID	05-2934-114970		05-2934-114972		05-2934-114974		05-2934-114979		05-2934-114982	
Well Name	AR #2A		AR #2A		AR #2A		AR #2A		AR #2A	
Depth 1 (ft.)	2900		3400		3900.0		4400.0		4600	
	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data
	0.89	2.8	3.11	3.31	3.33	3.33	3.25	3.41	1.06	3.47
	0.89	2.88	3.13	3.37	3.35	3.35	3.31	3.51	3.17	3.47
	0.95	2.89	3.25	3.38	3.36	3.36	3.41	3.52	3.18	3.47
	1.1	2.9	3.31	3.4	3.37	3.37	3.51	3.58	3.19	3.48
	1.22	2.9	3.37	3.4	3.39	3.39	3.52	3.6	3.19	3.49
	1.27	2.95	3.38	3.41	3.4	3.4	3.58	3.61	3.29	3.5
	1.36	2.96	3.4	3.46	3.41	3.41	3.6	3.64	3.32	3.5
	1.4	2.99	3.4	3.46	3.42	3.42	3.61	3.64	3.35	3.51
	1.4	3.01	3.41	3.46	3.42	3.42	3.64	3.68	3.4	3.52
	1.42	3.04	3.46	3.48	3.49	3.49	3.64	3.73	3.4	3.52
	1.44	3.05	3.46	3.52	3.5	3.5	3.68	3.75	3.47	3.52
	1.51	3.05	3.46	3.53	3.51	3.51	3.73	3.79	3.47	3.53
	1.55	3.05	3.48	3.55	3.51	3.51	3.75	3.86	3.47	3.53
	2.8	3.07	3.52	3.57	3.52	3.52	3.79	3.86	3.48	3.54
	2.88	3.07	3.53	3.58	3.53	3.53	3.86	3.9	3.49	3.54
	2.89	3.07	3.55	3.59	3.55	3.55	3.86		3.5	3.55
	2.9	3.09	3.57	3.62	3.56	3.56	3.9		3.5	3.64
	2.9	3.13	3.58	3.65	3.6	3.6	4.04		3.51	3.65
	2.95	3.15	3.59	3.66	3.61	3.61	4.08		3.52	3.67
	2.96	3.15	3.62	3.67	3.62	3.62	4.16		3.52	3.67
	2.99	3.19	3.65	3.72	3.63	3.63			3.52	3.67
	3.01	3.21	3.66	3.76	3.67	3.67			3.53	3.69
	3.04	3.22	3.67	3.77	3.68	3.68			3.53	3.7
	3.05	3.22	3.72	3.77	3.7	3.7			3.54	3.78
	3.05	3.25	3.76	3.78	3.71	3.71			3.54	3.82
	3.05		3.77	3.79	3.72	3.72			3.55	3.84
	3.07		3.77	3.8	3.72	3.72			3.64	3.89
	3.07		3.78	3.8	3.74	3.74			3.65	
	3.07		3.79	3.86	3.74	3.74			3.67	
	3.09		3.8	3.86	3.74	3.74			3.67	
	3.13		3.8	3.87	3.77	3.77			3.67	
	3.15		3.86	3.88	3.8	3.8			3.69	
	3.15		3.86		3.81	3.81			3.7	
	3.19		3.87		3.85	3.85			3.78	
	3.21		3.88		3.98				3.82	
	3.22		3.93		4				3.84	
	3.22		3.95		4.09				3.89	
	3.25		4		4.17				4.08	
	3.41		4		4.26				4.12	
	3.43		4.08		4.51				4.15	
Average %R_o	**2.49**	**3.05**	**3.63**	**3.62**	**3.67**	**3.58**	**3.70**	**3.67**	**3.50**	**3.60**
Standard Dev.		**0.12**		**0.17**		**0.15**		**0.14**		**0.12**
# of Points	**40**	**25**	**40**	**32**	**40**	**34**	**20**	**15**	**40**	**27**

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September 22, 2005

Arkansas Geological Commission
API: 03145000120000
Sunray DX Oil Co., Edgar Wright #1

Introduction:

Five cuttings samples from 3400 to 4850 feet from the Edgar Wright #1 well were analyzed for vitrinite reflectance (%Ro), visual kerogen, and thermal alteration index (TAI) determination. Maturity data indicate that these samples are in the 'Dry gas window' zone (Table 1). Ro data are consistent with the TAI (Thermal Alteration Index or 'spore color') and fluorescence data. Terrestrial kerogen dominates in all 5 of these samples.

Discussion:

Vitrinite reflectance data quality is reasonably good overall. Two samples had sparse organic recovery for visual study. Ro values range from 2.47% to 2.99%. Spores are present and allow for a more confident TAI interpretation.

Framboidal pyrite is very rare to nil in these samples. This may indicate minimal marine influence here (Table 3). No marine palynomorphs were noted in any of these samples. *Lycospora* spp. spores were noted in all of these samples. *Lycospora* is typical of Middle Pennsylvanian (Desmoinesian) through Mississippian age rocks. Several species also range on down into the Devonian. Various other Paleozoic spores from terrestrial environments were also noted.

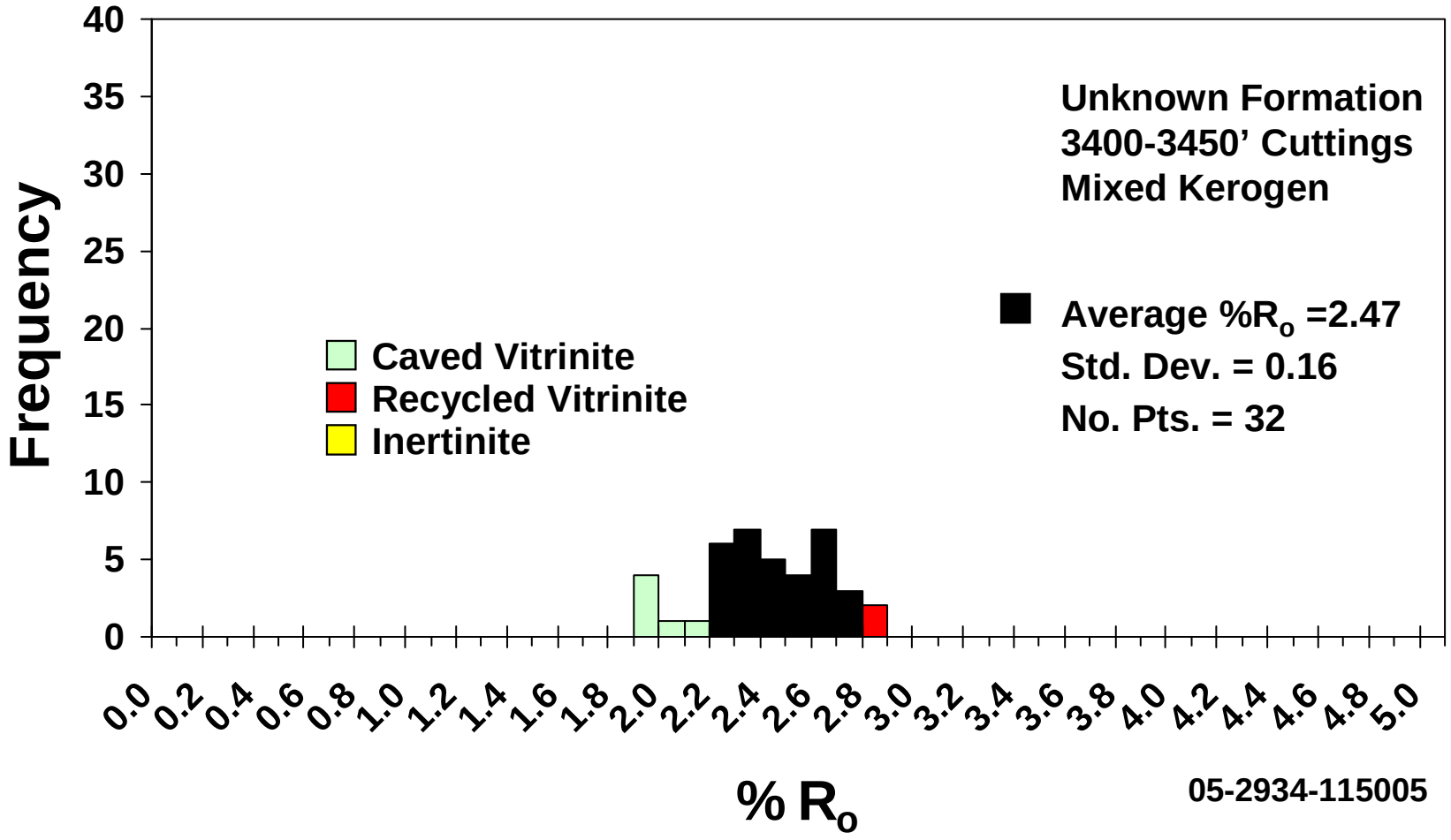
Fluorescence of pollen and spores is generally lost in the approximate vitrinite reflectance range of 1.0% to 1.1%. No spore fluorescence could be observed in these samples (Table 2). Vitrinite values are generally divided into the following categories of thermal maturity:

Immature:	0.02% to 0.60%
Oil window maturity:	0.60% to 1.10%
Condensate and /or wet-gas window:	1.10% to 1.40%
Dry gas window:	1.40% to 3.0 or 4.0%

Dan Pearson

API: 03145000120000

Sunray DX Oil Co., Edgar Wright #1



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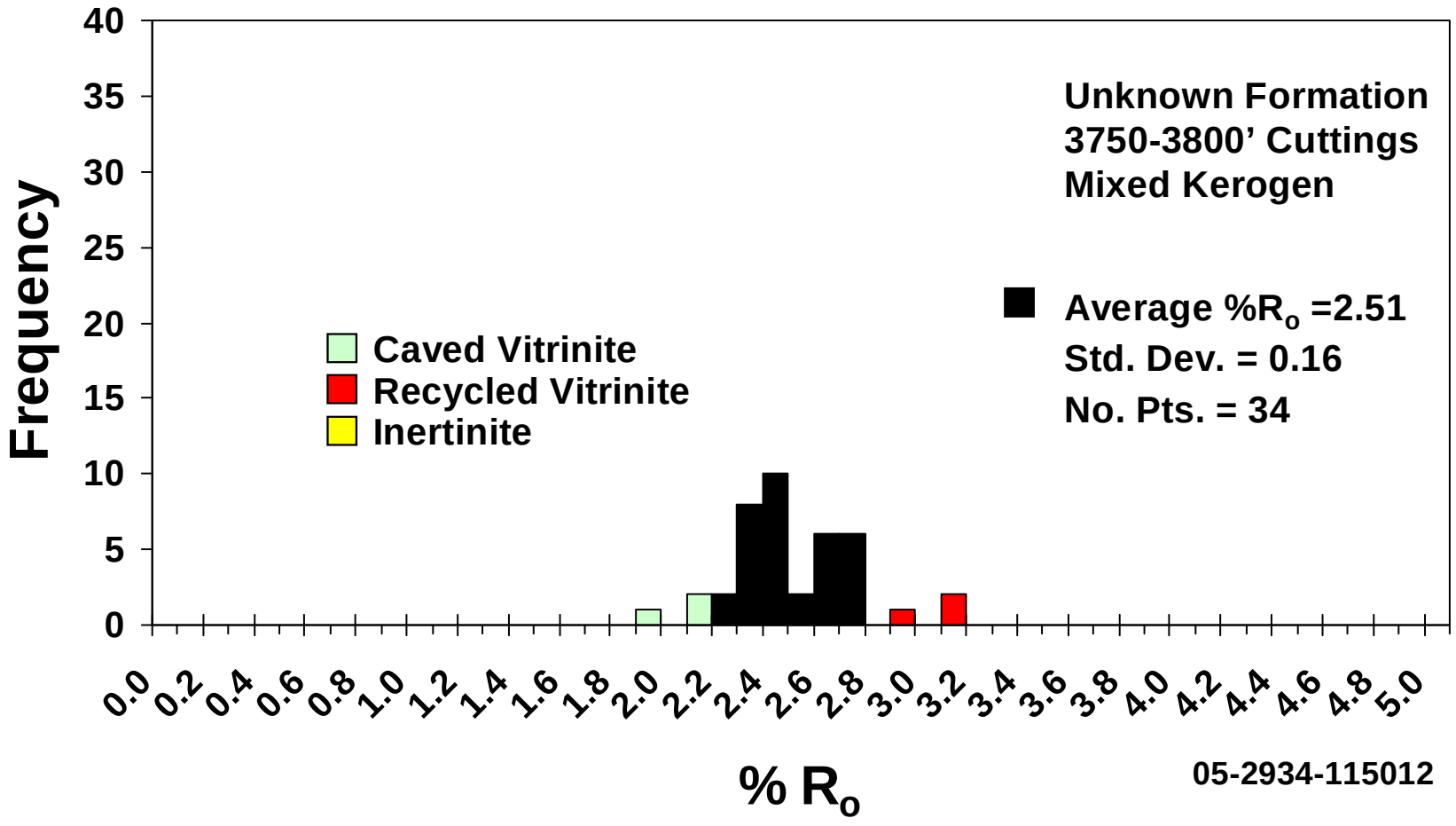
Sunray DX Oil Co., Edgar Wright #1



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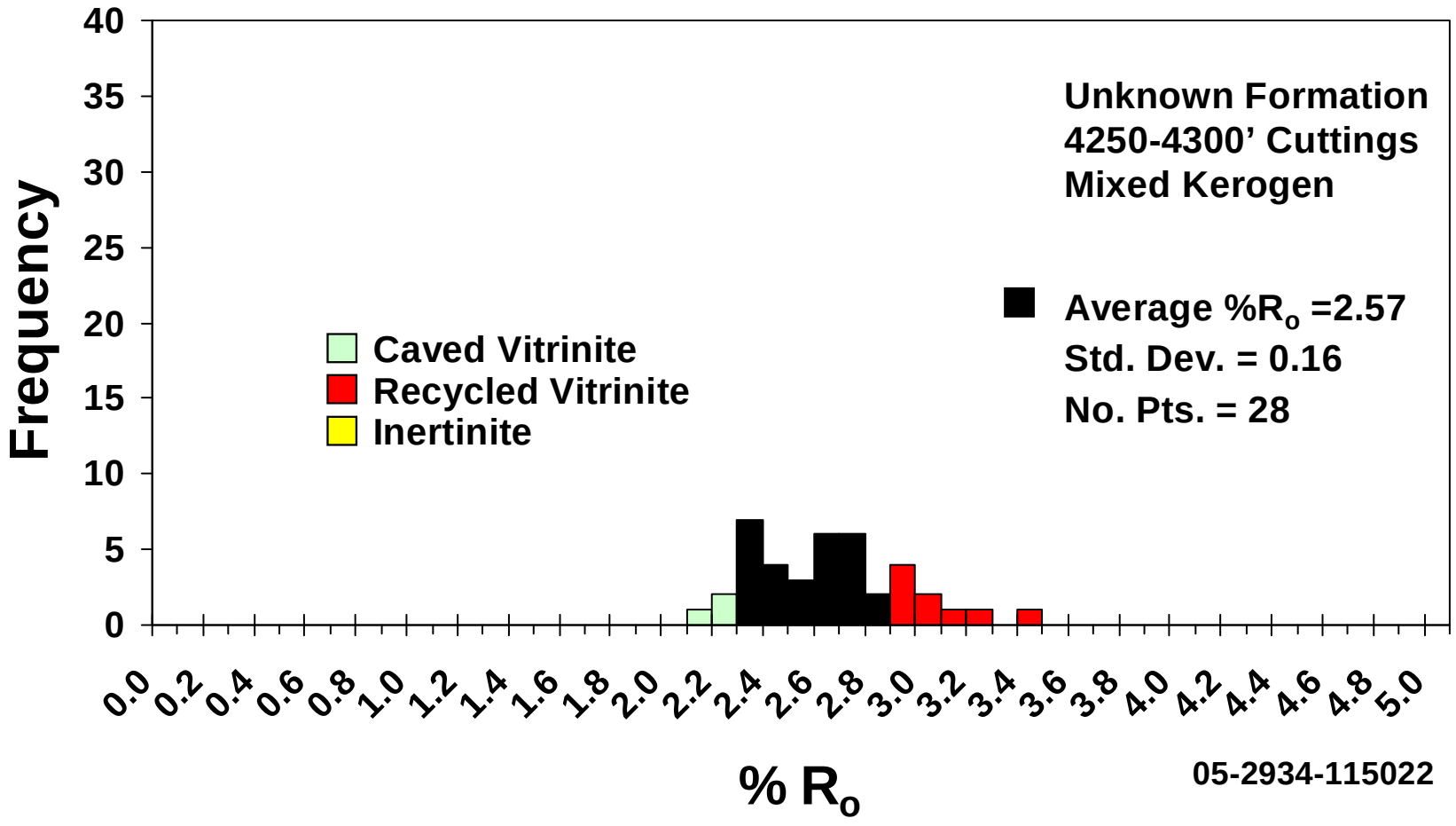
API: 03145000120000

Sunray DX Oil Co., Edgar Wright #1



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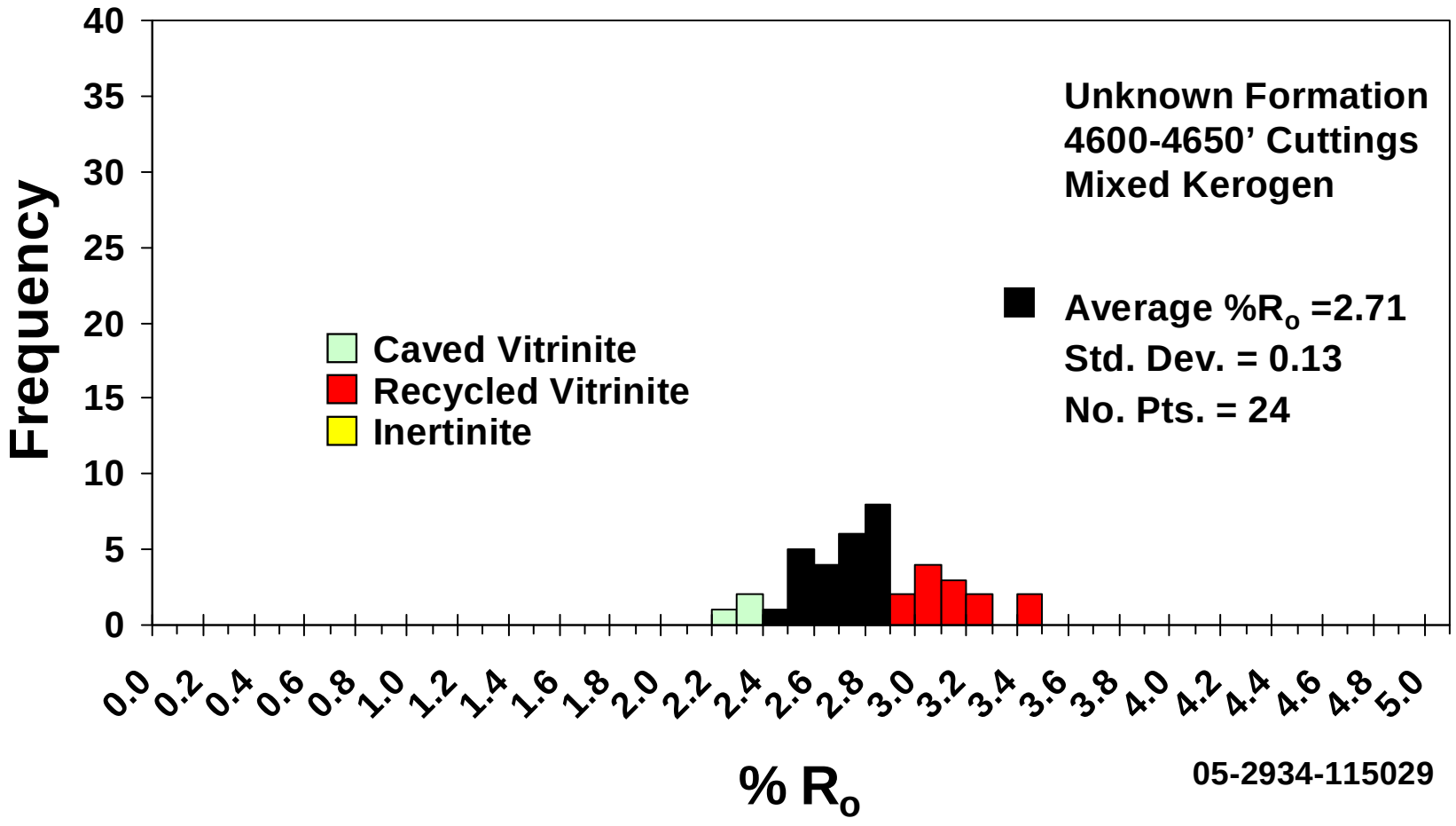
API: 03145000120000

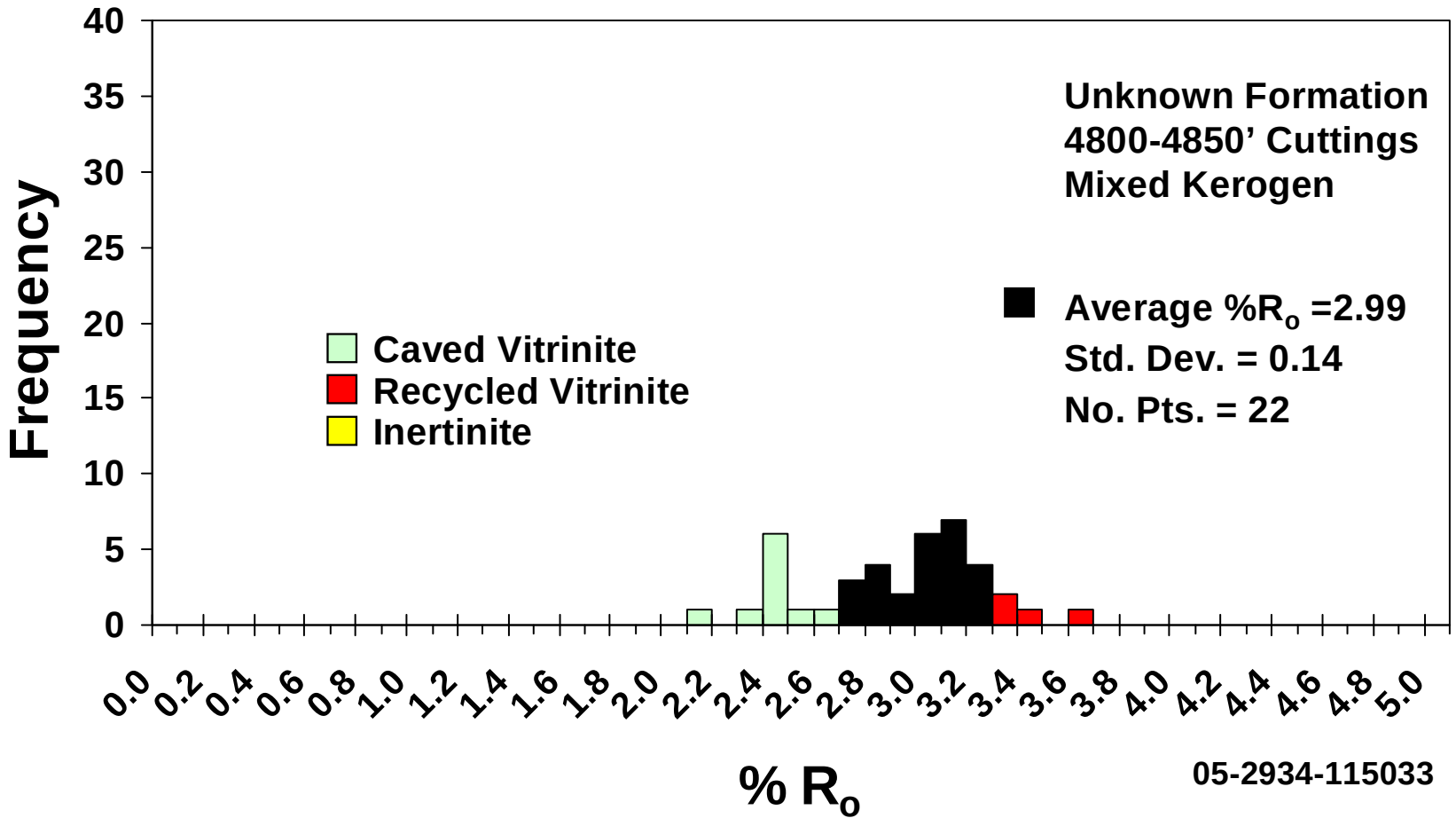
Sunray DX Oil Co., Edgar Wright #1



Humble Geochemical Services

API: 03145000120000

Sunray DX Oil Co., Edgar Wright #1



Humble Geochemical Services

Table 1
Dispersed Organic Matter Thermal Alteration, Kerogen Type and Total Compositional Analysis

Arkansas Geological Commission

API No. 03145000120000
Operator Sunray DX Oil Co.
Well Name/No: Edgar Wright #1

					Source Quality						% Source Material							Preservation				Recovery			% Kerogen Comp.							Vitrinite				
HGS ID	Well Name	Depth 1 (ft.)	Depth 2 (ft.)	Type	TOC	S2	Hydrogen Index (HI)	Tmax (oC)		Color	TAI	Amorphous Debris	Finely Dissem. OM	Herb. Plant Debris (Vit.)	Woody Plant Debris	Coaly Fragments	Algal Debris	Palynomorphs	Good	Fair	Poor	Very poor	Good	Very Poor	Barren	Indigenous Vitrinite	Caved Vitrinite	Recycled/Oxidized Vitrinite	Inertinite	Solid Bitumen	Drilling Additive/Contamination	Amorphous Kerogen	# of Readings	Total Sample Ro (%)	# of Indigeonus Readings	Indigenous Ro (%)	*Comments*
05-2934-115005	Edgar Wright #1	3400	3450	cuttings	1.07	0.20	19	457	*	DBDG, DGBL	3.7, 4	15	10	74				1	X				X			24	1	45	5			25	40	2.42	32	2.47	Lycospora sp.
05-2934-115012	Edgar Wright #1	3750	3800	cuttings	1.15	0.19	17	459	*	DGBL	4.0	19	1	80				trace	X				X	X		62	1	15	2			20	40	2.52	34	2.51	Lycospora sp.
05-2934-115022	Edgar Wright #1	4250	4300	cuttings	1.55	0.16	10	458	*	DGBL	4.0	3	2	95				trace	X				X	X		72	1	20	2			5	40	2.66	28	2.57	Lycospora sp.
05-2934-115029	Edgar Wright #1	4600	4650	cuttings	2.70	0.57	21	364		DGBL	4.0	8	2	90				trace	X				X			67	1	20	2			10	40	2.82	24	2.71	Lycospora sp.
05-2934-115033	Edgar Wright #1	4800	4850	cuttings	1.86	0.41	22	454	*	DGBL	4.0	23	3	74				trace	X				X			49	1	20	5			25	40	2.92	22	2.99	Lycospora sp.

* Tmax not reliable due to poor S2 peak

tr = trace

Color Abbreviations:

GLY	Green-Light Yellow	B	Brown
Y	Yellow	DBDG	Dark Brown-Dark Gray
YO	Yellow-Orange	DGBL	Dark Gray-Black
OB	Orange-Brown	BLK	Black
LB	Light Brown		

TAI Scale:

1=Unaltered	3+ or 3.5
1+ or 1.5	4=Strong alteration
2=Slight alteration	4+ or 4.5
2+ or 2.5	5=Severe alteration
3=Moderate alteration	

Table 2. Kerogen Fluorescence colors and brightness intensities (subjective determinations)

Arkansas Geological Commission

API No. **03145000120000**
Operator **Sunray DX Oil Co.**
Well Name/No: **Edgar Wright #1**

0 = No fluorescence noted
1 = very low intensity
2 = low intensity
3 = medium intensity
4 = high intensity
5 = very high intensity

G = Green
Y = Yellow
O = Orange
B = Brown

HGS ID	Well Name	Depth 1 ft.	Depth 2 ft.	Type	Pollen/Spores				Amorphous				Mounting Medium			
					G	Y	O	B	G	Y	O	B	G	Y	O	B
05-2934-115005	Edgar Wright #1	3400	3450	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115012	Edgar Wright #1	3750	3800	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115022	Edgar Wright #1	4250	4300	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115029	Edgar Wright #1	4600	4650	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115033	Edgar Wright #1	4800	4850	cuttings	0	0	0	0	0	0	0	0	1			

Table 3. Pyrite types and abundance in kerogen

Arkansas Geological Commission

API No. **03145000120000**
Operator **Sunray DX Oil Co.**
Well Name/No: **Edgar Wright #1**

1 = very rare
2 = rare
3 = common
4 = abundant
5 = very abundant

HGS ID	Well Name	Depth 1 ft.	Depth 2 ft.	Type	Pyrite types		
					Finely Disseminated	Euhedral	Framboidal
05-2934-115005	Edgar Wright #1	3400	3450	cuttings	2	1	1
05-2934-115012	Edgar Wright #1	3750	3800	cuttings	2	3	
05-2934-115022	Edgar Wright #1	4250	4300	cuttings	1	1	
05-2934-115029	Edgar Wright #1	4600	4650	cuttings	2	2	
05-2934-115033	Edgar Wright #1	4800	4850	cuttings	2	2	

Table 4. Individual Reflectance Readings

Wells: **Edgar Wright #1**

HGS ID	05-2934-115005		05-2934-115012		05-2934-115022		05-2934-115029		05-2934-115033	
Well Name	AR #4A		AR #4A		AR #4A		AR #4A		AR #4A	
Depth 1 (ft.)	3400		3750		4250.0		4600.0		4800	
	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data
	1.9	2.22	1.97	2.25	2.15	2.33	2.24	2.49	2.12	2.71
	1.95	2.23	2.1	2.26	2.24	2.35	2.3	2.52	2.38	2.75
	1.95	2.23	2.22	2.3	2.25	2.37	2.4	2.55	2.41	2.78
	1.97	2.25	2.25	2.31	2.33	2.37	2.49	2.56	2.44	2.8
	2.02	2.28	2.26	2.34	2.35	2.37	2.52	2.57	2.45	2.88
	2.18	2.29	2.3	2.34	2.37	2.38	2.55	2.58	2.48	2.89
	2.22	2.33	2.31	2.36	2.37	2.38	2.56	2.6	2.48	2.89
	2.23	2.33	2.34	2.37	2.37	2.42	2.57	2.6	2.49	2.92
	2.23	2.34	2.34	2.37	2.38	2.44	2.58	2.62	2.57	2.97
	2.25	2.34	2.36	2.38	2.38	2.47	2.6	2.65	2.61	3.01
	2.28	2.35	2.37	2.4	2.42	2.49	2.6	2.7	2.71	3.04
	2.29	2.36	2.37	2.4	2.44	2.5	2.62	2.72	2.75	3.04
	2.33	2.39	2.38	2.4	2.47	2.54	2.65	2.72	2.78	3.04
	2.33	2.4	2.4	2.44	2.49	2.58	2.7	2.75	2.8	3.05
	2.34	2.41	2.4	2.45	2.5	2.63	2.72	2.78	2.88	3.06
	2.34	2.46	2.4	2.46	2.54	2.63	2.72	2.79	2.89	3.11
	2.35	2.49	2.44	2.47	2.58	2.64	2.75	2.8	2.89	3.11
	2.36	2.49	2.45	2.47	2.63	2.65	2.78	2.82	2.92	3.13
	2.39	2.52	2.46	2.49	2.63	2.67	2.79	2.83	2.97	3.14
	2.4	2.56	2.47	2.49	2.64	2.68	2.8	2.86	3.01	3.15
	2.41	2.58	2.47	2.54	2.65	2.7	2.82	2.88	3.04	3.15
	2.46	2.59	2.49	2.55	2.67	2.7	2.83	2.89	3.04	3.17
	2.49	2.6	2.49	2.61	2.68	2.73	2.86	2.89	3.04	
	2.49	2.6	2.54	2.62	2.7	2.75	2.88	2.91	3.05	
	2.52	2.61	2.55	2.63	2.7	2.76	2.89		3.06	
	2.56	2.64	2.61	2.65	2.73	2.77	2.89		3.11	
	2.58	2.64	2.62	2.67	2.75	2.81	2.91		3.11	
	2.59	2.67	2.63	2.69	2.76	2.85	2.95		3.13	
	2.6	2.69	2.65	2.71	2.77		2.98		3.14	
	2.6	2.71	2.67	2.71	2.81		3		3.15	
	2.61	2.72	2.69	2.73	2.85		3.02		3.15	
	2.64	2.72	2.71	2.77	2.9		3.08		3.17	
	2.64		2.71	2.77	2.91		3.09		3.21	
	2.67		2.73	2.79	2.91		3.1		3.23	
	2.69		2.77		2.91		3.12		3.25	
	2.71		2.77		3.04		3.19		3.26	
	2.72		2.79		3.04		3.22		3.32	
	2.72		2.99		3.15		3.28		3.34	
	2.83		3.1		3.29		3.42		3.46	
	2.83		3.11		3.49		3.45		3.61	
Average %R_o	**2.42**	**2.47**	**2.52**	**2.51**	**2.66**	**2.57**	**2.82**	**2.71**	**2.92**	**2.99**
Standard Dev.		**0.16**		**0.16**		**0.16**		**0.13**		**0.14**
# of Points	**40**	**32**	**40**	**34**	**40**	**28**	**40**	**24**	**40**	**22**

Humble Geochemical Services

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September 19, 2006

Arkansas Geological Commission
API: 03095000030000
Pan American, Hart #1

Introduction:

Six cuttings samples from the 4700 to 6150 feet from Hart #1 were analyzed for vitrinite reflectance (%Ro), visual kerogen, and thermal alteration index (TAI). Maturity data indicate that these samples are in higher thermal maturity than what is normally considered as the 'Dry gas window' (Table 1). Ro data are consistent with the TAI (Thermal Alteration Index or 'spore color') and fluorescence data. Three of the samples are dominated by terrestrial kerogen and 3 are dominated by amorphous kerogen.

Discussion:

Vitrinite reflectance data quality is reasonably good overall. Ro values range from 4.64% to 4.83%. Four of the 6 samples had good organic recovery for visual study. Spores were common overall and allow for a more confident TAI interpretation. However, at this high maturity everything present is black.

Framboidal pyrite is rare to very rare in these samples. This may indicate minimal marine influence here (Table 3). A few small spherical palynomorphs noted in the 5100' sample may be acritarchs. *Lycospora* spp. spores were noted in several of these samples. *Lycospora* is typical of Middle Pennsylvanian (Desmoinesian) through Mississippian age rocks. Several species also range on down into the Devonian. Various other Paleozoic spores from terrestrial environments were also noted.

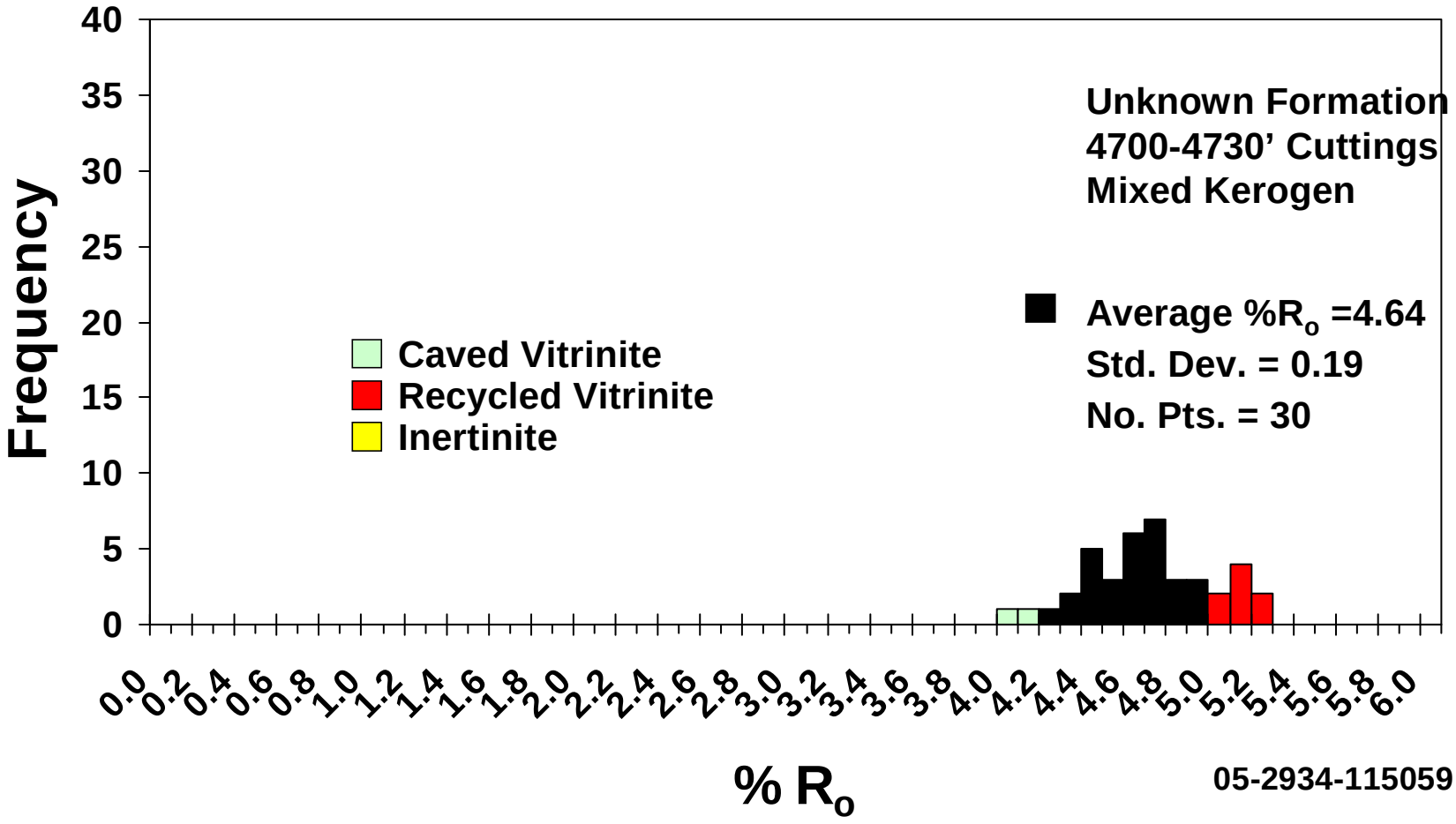
Fluorescence of pollen and spores is generally lost in the approximate vitrinite reflectance range of 1.0% to 1.1%. No spore fluorescence could be observed in these samples (Table 2). Vitrinite values are generally divided into the following categories of thermal maturity:

Immature:	0.02% to 0.60%
Oil window maturity:	0.60% to 1.10%
Condensate and /or wet-gas window:	1.10% to 1.40%
Dry gas window:	1.40% to 3.0 or 4.0%

Dan Pearson

API: 03095000030000

Pan American, Hart #1



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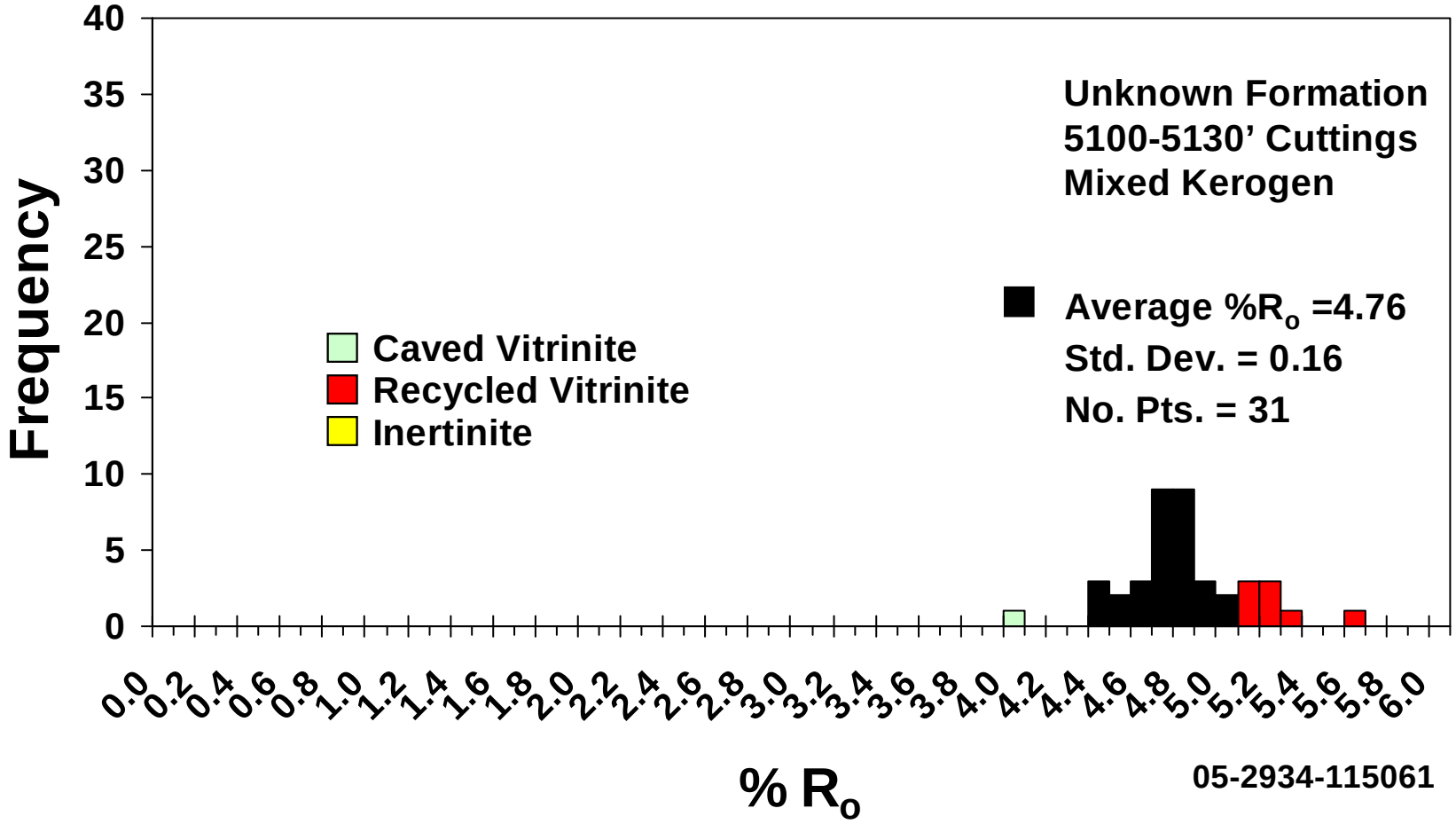
Pan American, Hart #1



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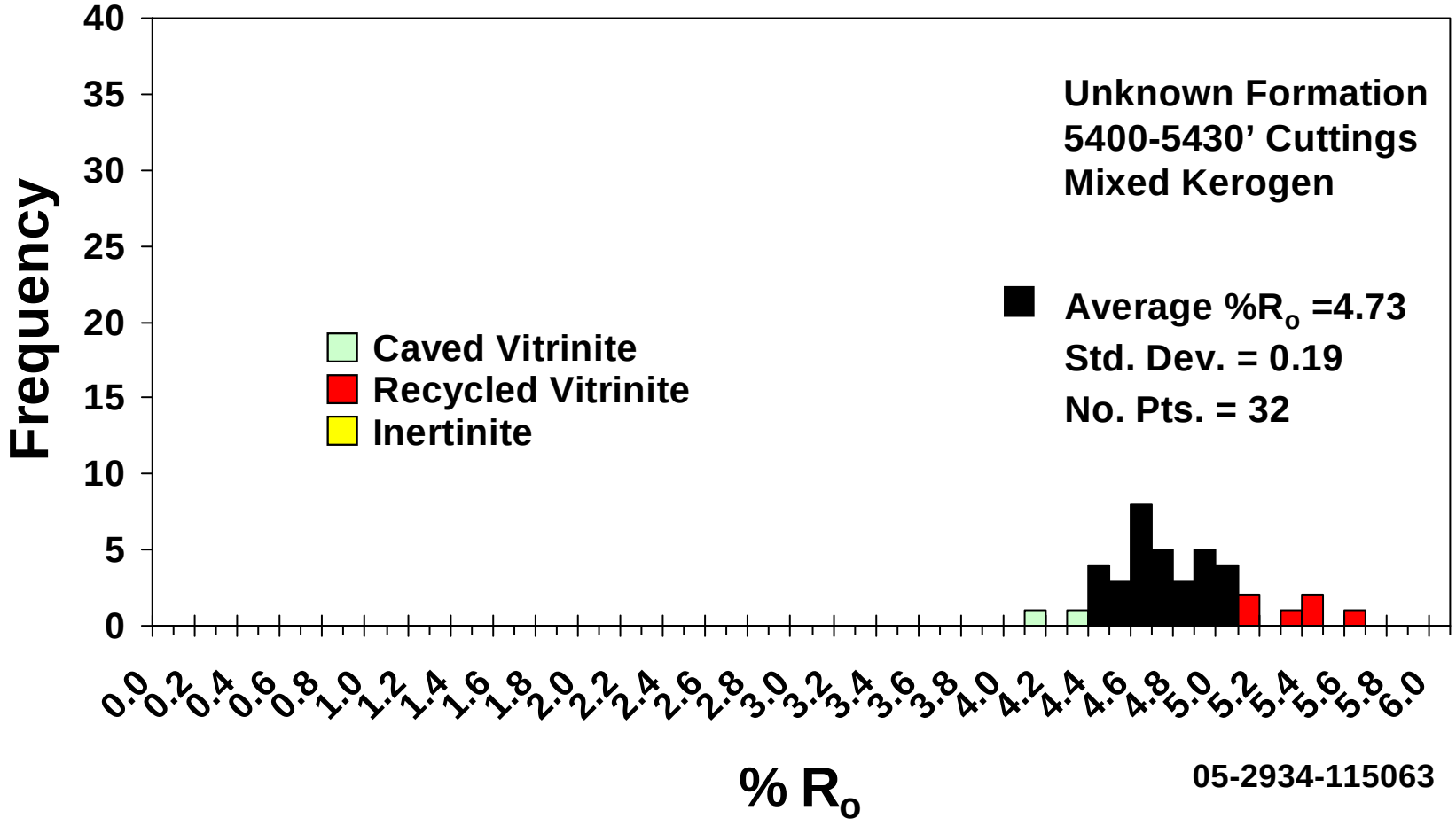
Pan American, Hart #1



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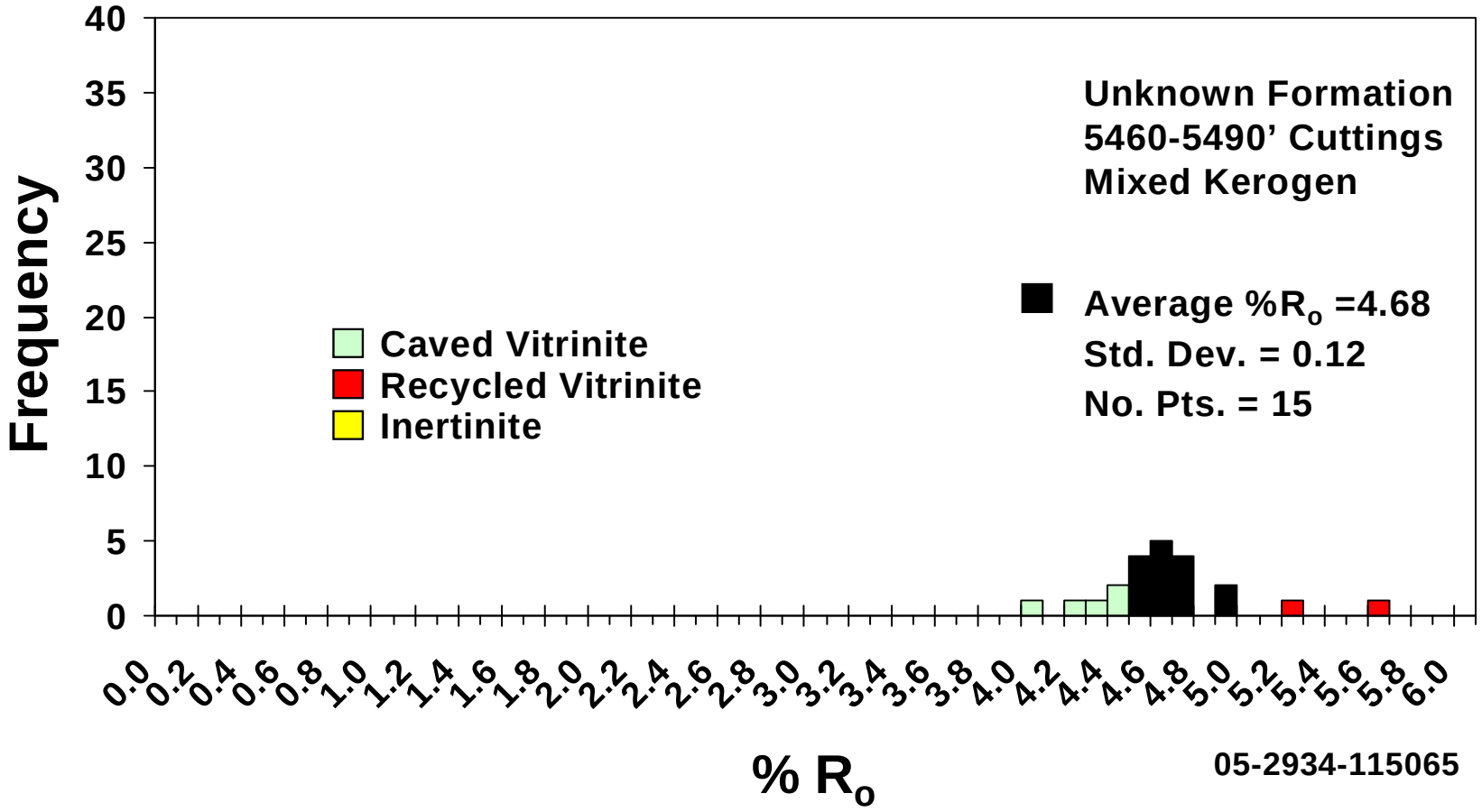
API: 03095000030000

Pan American, Hart #1



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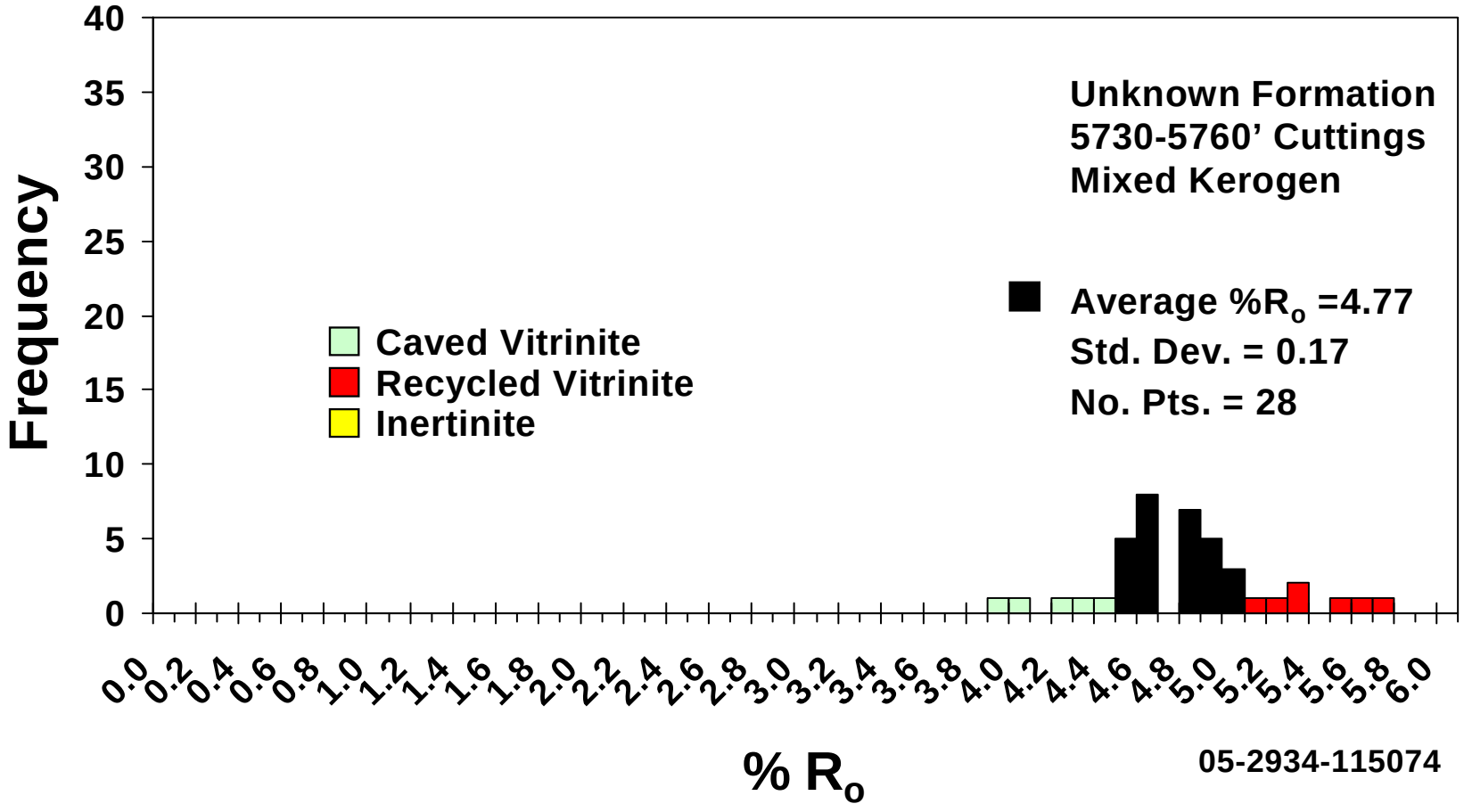
Pan American, Hart #1



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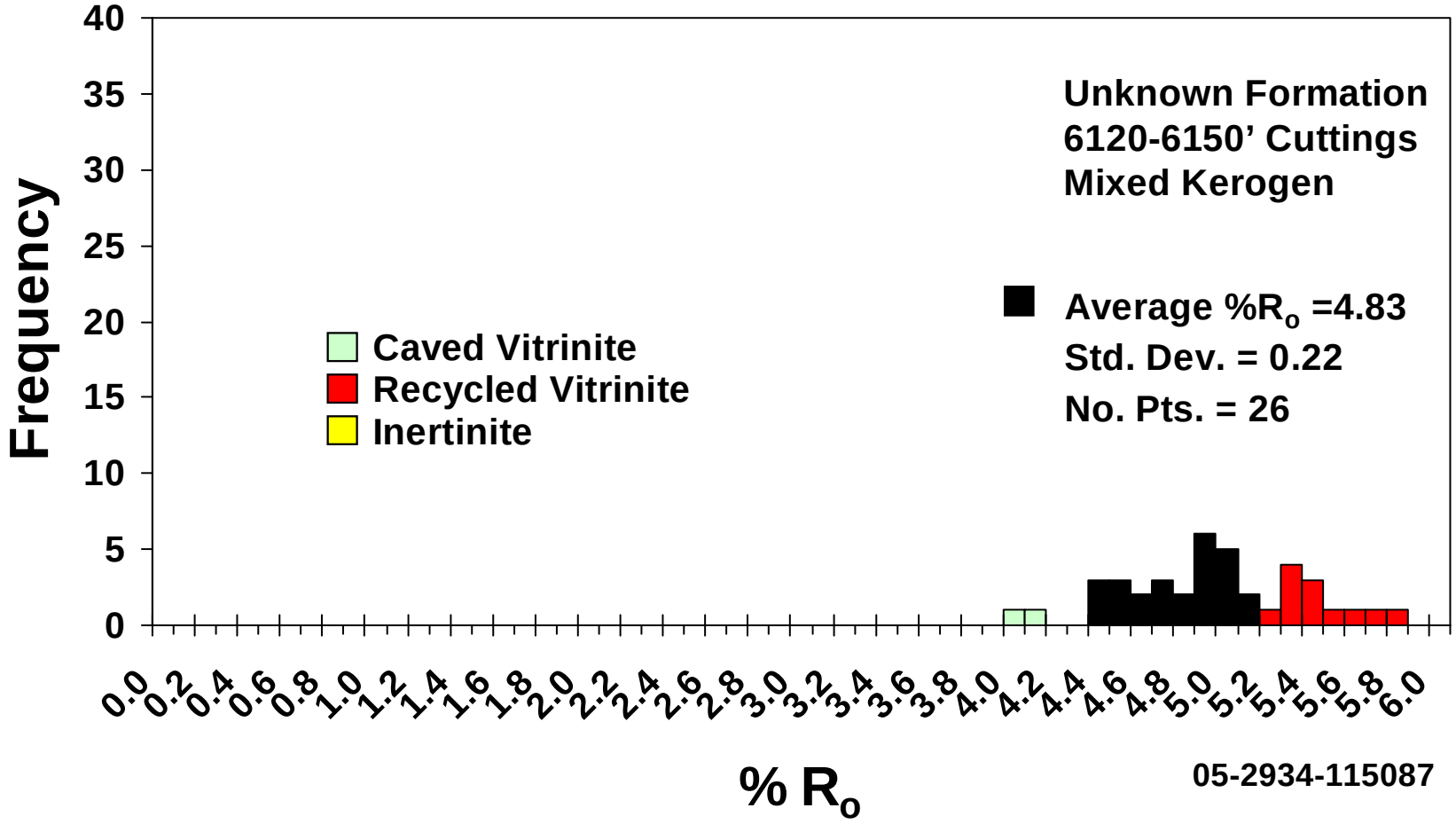
API: 03095000030000

Pan American, Hart #1



Humble Geochemical Services

Table 1
Dispersed Organic Matter Thermal Alteration, Kerogen Type and Total Compositional Analysis

Arkansas Geological Commission

API No. 03095000030000
Operator Pan American
Well Name/No: Hart #1

					Source Quality						% Source Material							Preservation				Recovery			% Kerogen Comp.							Vitrinite				
HGS ID	Well Name	Depth 1 (ft.)	Depth 2 (ft.)	Type	TOC	S2	Hydrogen Index (HI)	Tmax (oC)	Color	TAI	Amorphous Debris	Finely Dissem. OM	Herb. Plant Debris (Vit.)	Woody Plant Debris	Coaly Fragments	Algal Debris	Palynomorphs	Good	Fair	Poor	Very poor	Good	Very Poor	Barren	Indigenous Vitrinite	Caved Vitrinite	Recycled/Oxidized Vitrinite	Inertinite	Solid Bitumen	Drilling Additive/Contamination	Amorphous Kerogen	# of Readings	Total Sample Ro (%)	# of Indigeonus Readings	Indigenous Ro (%)	*Comments*
05-2934-115059	Hart #1	4700	4730	cuttings	1.11	0.06	5	358 *	BLK	5.0		10	90				trace	X				X			80	trace	5	5			10	40	4.72	30	4.64	Densosporites sp., PZ spores
05-2934-115061	Hart #1	5100	5130	cuttings	1.05	0.11	10	451 *	BLK	5.0	77	5	18				trace	X				X			15	trace	3	2			80	40	4.85	31	4.76	Lycospora sp., small spherical acritarch?
05-2934-115063	Hart #1	5400	5430	cuttings	0.96	0.09	9	451 *	BLK	5.0	85	2	13				trace	X				X			12	trace	1	2			85	40	4.80	32	4.73	Paleozoic spores
05-2934-115065	Hart #1	5460	5490	cuttings	0.86	0.18	21	452 *	BLK	5.0	36	1	63				trace	X				X	X		50	5	5	5			35	22	4.66	15	4.68	Lycospora sp.
05-2934-115074	Hart #1	5730	5760	cuttings	1.26	0.07	6	365 *	BLK	5.0	7	3	90				trace	X				X	X		80	1	4	5			10	40	4.82	28	4.77	Paleozoic spores
05-2934-115087	Hart #1	6120	6150	cuttings	2.52	0.16	6	368 *	BLK	5.0	57	10	33				trace	X				X			30	1	2	2			65	40	4.99	26	4.83	Paleozoic spores

* Tmax data not reliable due to poor S2 peak

tr = trace

Color Abbreviations:

GLY	Green-Light Yellow	B	Brown
Y	Yellow	DBDG	Dark Brown-Dark Gray
YO	Yellow-Orange	DGBL	Dark Gray-Black
OB	Orange-Brown	BLK	Black
LB	Light Brown		

TAI Scale:

1=Unaltered	1+ or 1.5	2=Slight alteration
2+ or 2.5	3=Moderate alteration	3+ or 3.5
4=Strong alteration	4+ or 4.5	5=Severe alteration

Table 2. Kerogen Fluorescence colors and brightness intensities (subjective determinations)

Arkansas Geological Commission

API No. **03095000030000**
Operator **Pan American**
Well Name/No: **Hart #1**

0 = No fluorescence noted
1 = very low intensity
2 = low intensity
3 = medium intensity
4 = high intensity
5 = very high intensity

G = Green
Y = Yellow
O = Orange
B = Brown

HGS ID	Well Name	Depth 1 ft.	Depth 2 ft.	Type	Pollen/Spores				Amorphous				Mounting Medium			
					G	Y	O	B	G	Y	O	B	G	Y	O	B
05-2934-115059	Hart #1	4700	4730	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115061	Hart #1	5100	5130	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115063	Hart #1	5400	5430	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115065	Hart #1	5460	5490	cuttings	0	0	0	0	0	0	0	0	2			
05-2934-115074	Hart #1	5730	5760	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115087	Hart #1	6120	6150	cuttings	0	0	0	0	0	0	0	0	1			

Table 3. Pyrite types and abundance in kerogen

Arkansas Geological Commission

API No. 03095000030000
Operator Pan American
Well Name/No: Hart #1

1 = very rare
2 = rare
3 = common
4 = abundant
5 = very abundant

HGS ID	Well Name	Depth 1 ft.	Depth 2 ft.	Type	Pyrite types		
					Finely Disseminated	Euhedral	Framboidal
05-2934-115059	Hart #1	4700	4730	cuttings	1	1	
05-2934-115061	Hart #1	5100	5130	cuttings	2	1	1
05-2934-115063	Hart #1	5400	5430	cuttings	2	1	2
05-2934-115065	Hart #1	5460	5490	cuttings	2	2	1
05-2934-115074	Hart #1	5730	5760	cuttings	2	2	1
05-2934-115087	Hart #1	6120	6150	cuttings	2	2	1

Table 4. Individual Reflectance Readings

Wells: **Hart #1**

HGS ID	05-2934-115059		05-2934-115061		05-2934-115063		05-2934-115065		05-2934-115074		05-2934-115087	
Well Name	AR #9A		AR #9A		AR #9A		AR #9A		AR #9A		AR #9A	
Depth 1 (ft.)	4700		5100		5400.0		5460		5730.0		6120	
	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data
	4.09	4.28	4.03	4.44	4.19	4.41	4.03	4.5	3.9	4.5	4.09	4.48
	4.12	4.3	4.44	4.48	4.37	4.42	4.24	4.51	4.06	4.54	4.19	4.49
	4.28	4.36	4.48	4.48	4.41	4.47	4.37	4.55	4.28	4.56	4.48	4.49
	4.3	4.4	4.48	4.52	4.42	4.47	4.43	4.59	4.31	4.57	4.49	4.54
	4.36	4.42	4.52	4.53	4.47	4.52	4.45	4.63	4.42	4.59	4.49	4.58
	4.4	4.43	4.53	4.6	4.47	4.53	4.5	4.63	4.5	4.6	4.54	4.59
	4.42	4.46	4.6	4.61	4.52	4.54	4.51	4.67	4.54	4.61	4.58	4.62
	4.43	4.49	4.61	4.62	4.53	4.6	4.55	4.68	4.56	4.62	4.59	4.66
	4.46	4.54	4.62	4.7	4.54	4.61	4.59	4.69	4.57	4.63	4.62	4.71
	4.49	4.58	4.7	4.74	4.6	4.62	4.63	4.7	4.59	4.66	4.66	4.71
	4.54	4.59	4.74	4.74	4.61	4.63	4.63	4.7	4.6	4.66	4.71	4.76
	4.58	4.6	4.74	4.75	4.62	4.65	4.67	4.74	4.61	4.67	4.71	4.81
	4.59	4.6	4.75	4.76	4.63	4.65	4.68	4.74	4.62	4.67	4.76	4.85
	4.6	4.63	4.76	4.76	4.65	4.65	4.69	4.9	4.63	4.81	4.81	4.9
	4.6	4.65	4.76	4.78	4.65	4.67	4.7	4.93	4.66	4.82	4.85	4.91
	4.63	4.66	4.78	4.79	4.65	4.73	4.7		4.66	4.84	4.9	4.92
	4.65	4.66	4.79	4.79	4.67	4.73	4.74		4.67	4.85	4.91	4.93
	4.66	4.7	4.79	4.81	4.73	4.77	4.74		4.67	4.86	4.92	4.98
	4.66	4.71	4.81	4.84	4.73	4.78	4.9		4.81	4.87	4.93	4.99
	4.7	4.74	4.84	4.84	4.77	4.78	4.93		4.82	4.89	4.98	5.03
	4.71	4.74	4.84	4.85	4.78	4.81	5.25		4.84	4.91	4.99	5.07
	4.74	4.74	4.85	4.85	4.78	4.81	5.6		4.85	4.91	5.03	5.07
	4.74	4.76	4.85	4.85	4.81	4.82			4.86	4.92	5.07	5.08
	4.74	4.77	4.85	4.87	4.81	4.9			4.87	4.93	5.07	5.09
	4.76	4.8	4.87	4.87	4.82	4.91			4.89	4.98	5.08	5.13
	4.77	4.81	4.87	4.88	4.9	4.91			4.91	5	5.09	5.18
	4.8	4.81	4.88	4.92	4.91	4.93			4.91	5.01	5.13	
	4.81	4.96	4.92	4.93	4.91	4.97			4.92	5.07	5.18	
	4.81	5	4.93	4.95	4.93	5.02			4.93		5.24	
	4.96	5	4.95	5.01	4.97	5.03			4.98		5.3	
	5		5.01	5.03	5.02	5.06			5		5.33	
	5		5.03		5.03	5.06			5.01		5.34	
	5.06		5.14		5.06				5.07		5.36	
	5.07		5.17		5.06				5.18		5.41	
	5.13		5.18		5.11				5.2		5.44	
	5.17		5.24		5.14				5.36		5.48	
	5.18		5.26		5.34				5.38		5.51	
	5.18		5.27		5.43				5.53		5.68	
	5.21		5.35		5.48				5.66		5.71	
	5.29		5.62		5.61				5.79		5.84	
Average %R_o	**4.72**	**4.64**	**4.85**	**4.76**	**4.80**	**4.73**	**4.66**	**4.68**	**4.82**	**4.77**	**4.99**	**4.83**
Standard Dev.		**0.19**		**0.16**		**0.19**		**0.12**		**0.17**		**0.22**
# of Points	**40**	**30**	**40**	**31**	**40**	**32**	**22**	**15**	**40**	**28**	**40**	**26**

Humble Geochemical Services

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September 19, 2006

Arkansas Geological Commission
API: 031171000040000
Reserve Oil Incorp., Hazen #28-1

Introduction:

Seventeen cuttings samples from 3000 to 10630 feet from the Hazen #28-1 well were analyzed for vitrinite reflectance (%Ro), visual kerogen, and thermal alteration index (TAI). Maturity data indicate that a couple of these samples are in the late 'Dry gas window' zone and that most of them are in higher maturity than what is normally considered as the 'Dry gas window' (Table 1). Ro data are consistent with the TAI (Thermal Alteration Index or 'spore color') and fluorescence data. Kerogen types seem to be a fairly equal mix of both terrestrial and amorphous kerogen. Amorphous kerogen is a little more dominant overall.

Discussion:

Vitrinite reflectance data indicate that the sample depths are apparently given in inverse order, so caution should be used in plotting and interpreting the data. Vitrinite reflectance values range from 3.78% (current depth label of 9200 feet) to 5.09% (current depth label of 3000 feet). Some vitrinite particles exhibit minor optical anisotropy (mottled appearance) but I don't believe this is the reason for the inverse sequence of maturity values. The reader might have another way to check this sequence. The sample labeled as 10580 feet consists of almost entirely mineral debris. This is normally consistent with a low total organic carbon content. If the log data and original lithology descriptions are available, the reader can check to see if it's more logical for the deepest sample or for the shallowest sample to have poor organic content.

Vitrinite reflectance data quality is only fair overall. All but 1 sample had good organic recovery for visual study. Spores were common overall and allow for a more confident TAI interpretation. However, at this high maturity everything present was black and it doesn't appear to be possible to distinguish a sample with 4.0% reflectance from a sample with 5.0% reflectance by using the spore color. Spores and kerogen in both are black.

Framboidal pyrite is common to abundant in 8 of these samples (Table 3). This may be indicative of some marine influence. The sulfate reducing bacteria activity on organic matter in marine deposits reportedly can result in this type of pyrite. It is normally most common in hydrogen rich (reducing) marine source rocks. No marine palynomorphs were noted in any of these samples. *Lycospora* spp. spores were noted in over half of these samples. *Lycospora* is typical of Middle Pennsylvanian (Desmoinesian) through

Mississippian age rocks. Several species also range on down into the Devonian. Various other Paleozoic spores from terrestrial environments were also noted in most of these samples.

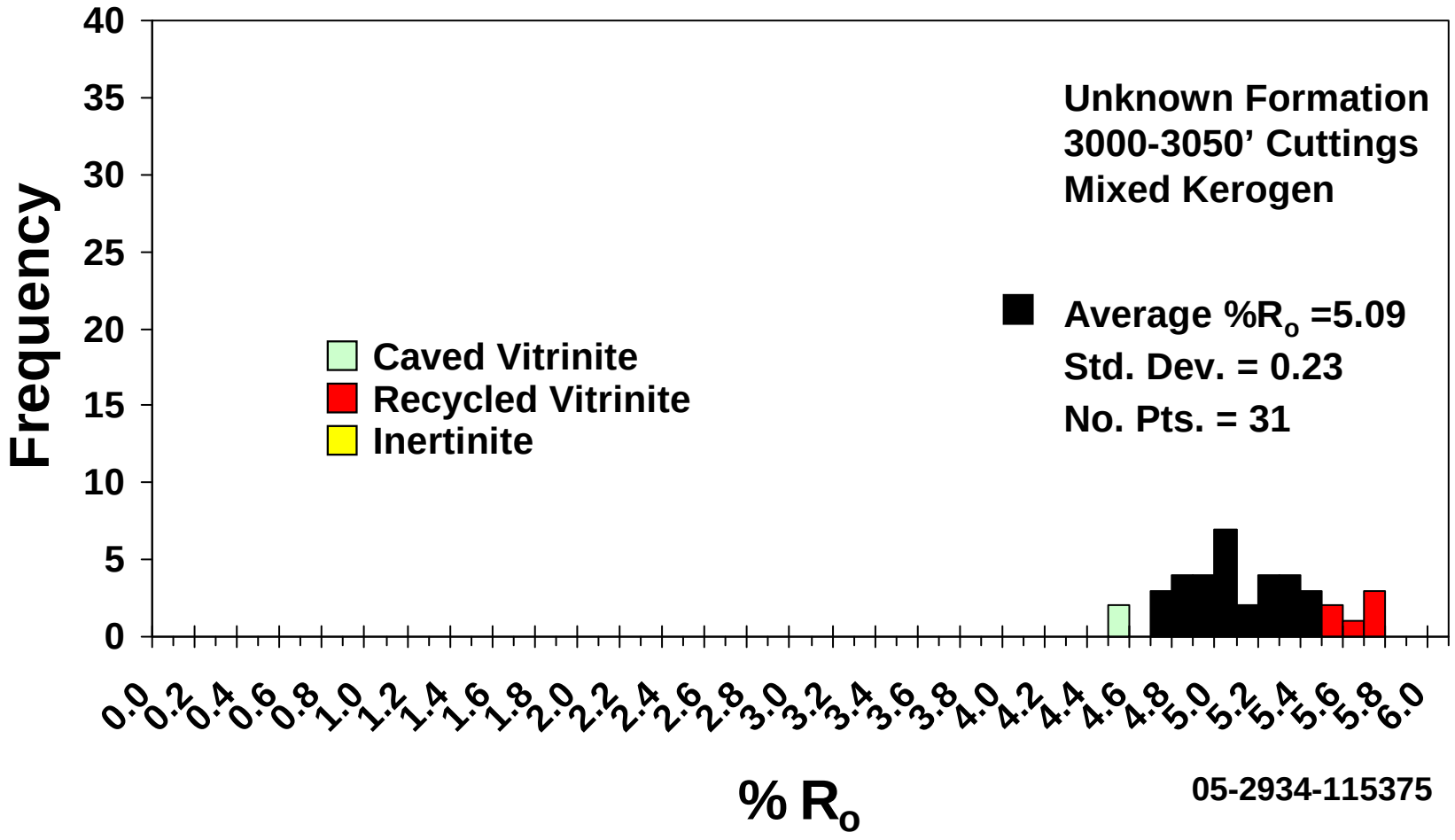
Fluorescence of pollen and spores is generally lost in the approximate vitrinite reflectance range of 1.0% to 1.1%. No spore fluorescence could be observed in these samples (Table 2). Vitrinite values are generally divided into the following categories of thermal maturity:

Immature:	0.02% to 0.60%
Oil window maturity:	0.60% to 1.10%
Condensate and /or wet-gas window:	1.10% to 1.40%
Dry gas window:	1.40% to 3.0 or 4.0%

Dan Pearson

API: 03117100040000

Reserve Oil Incorp, Hazen #28-1



Humble Geochemical Services

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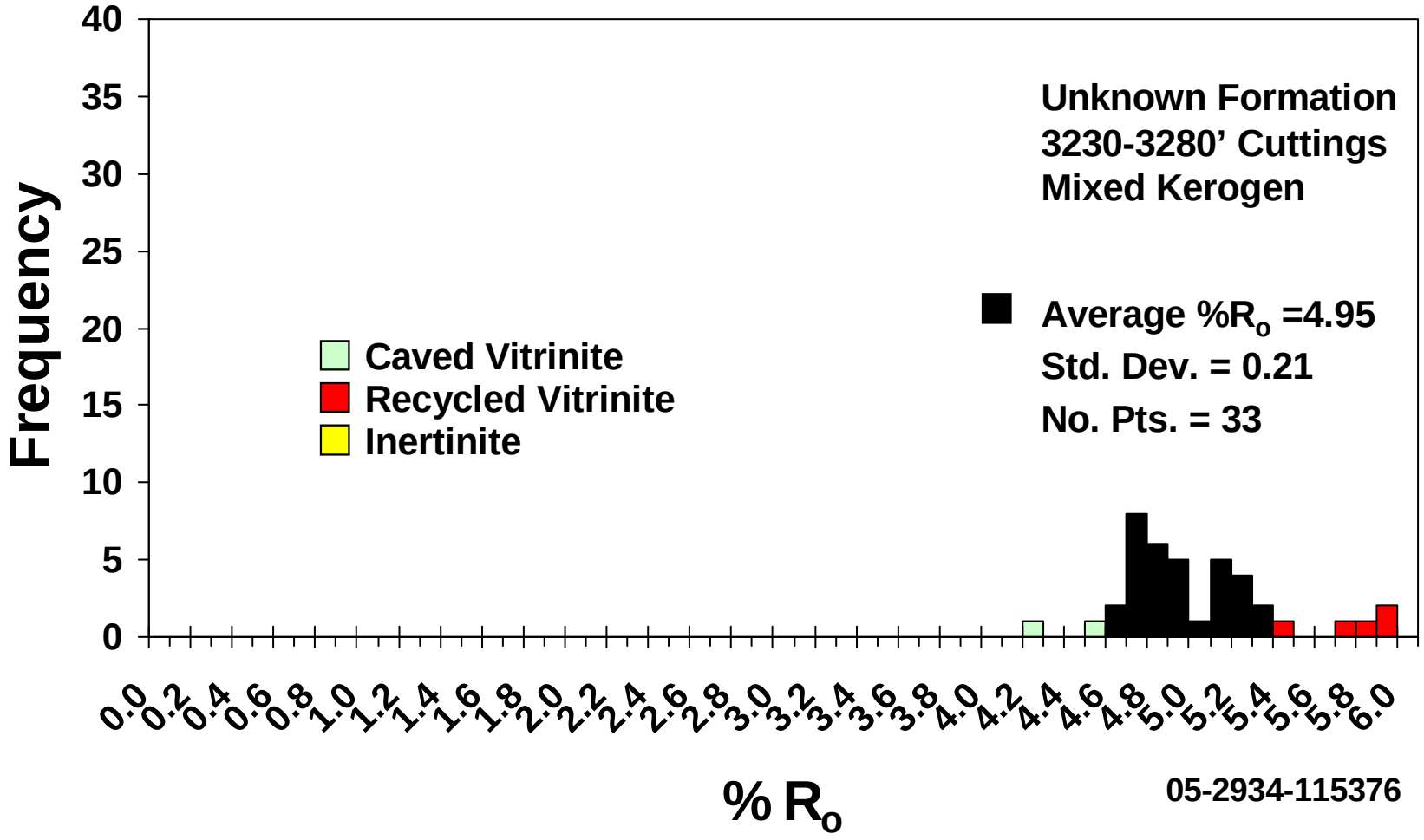
Reserve Oil Incorp, Hazen #28-1



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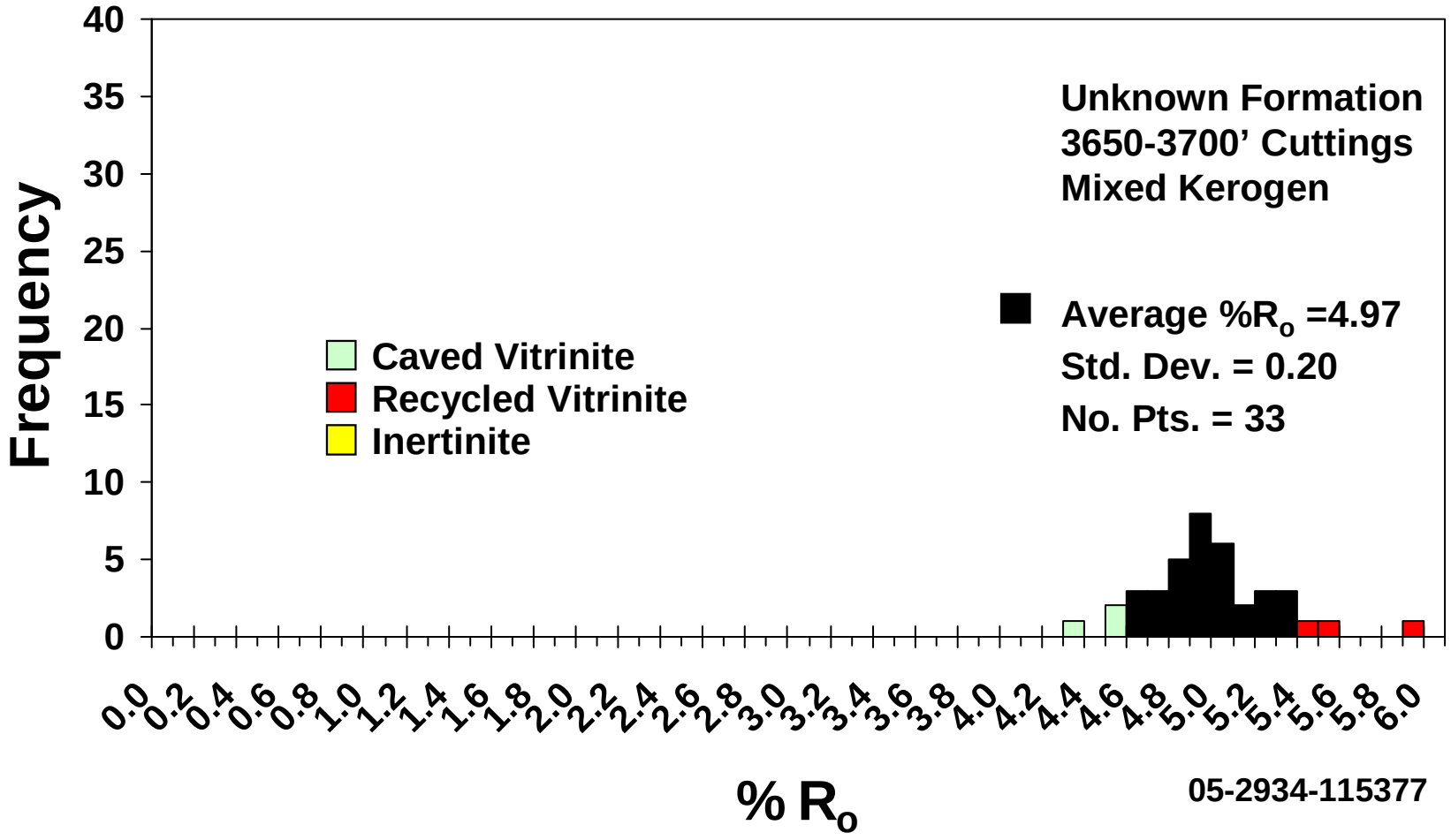

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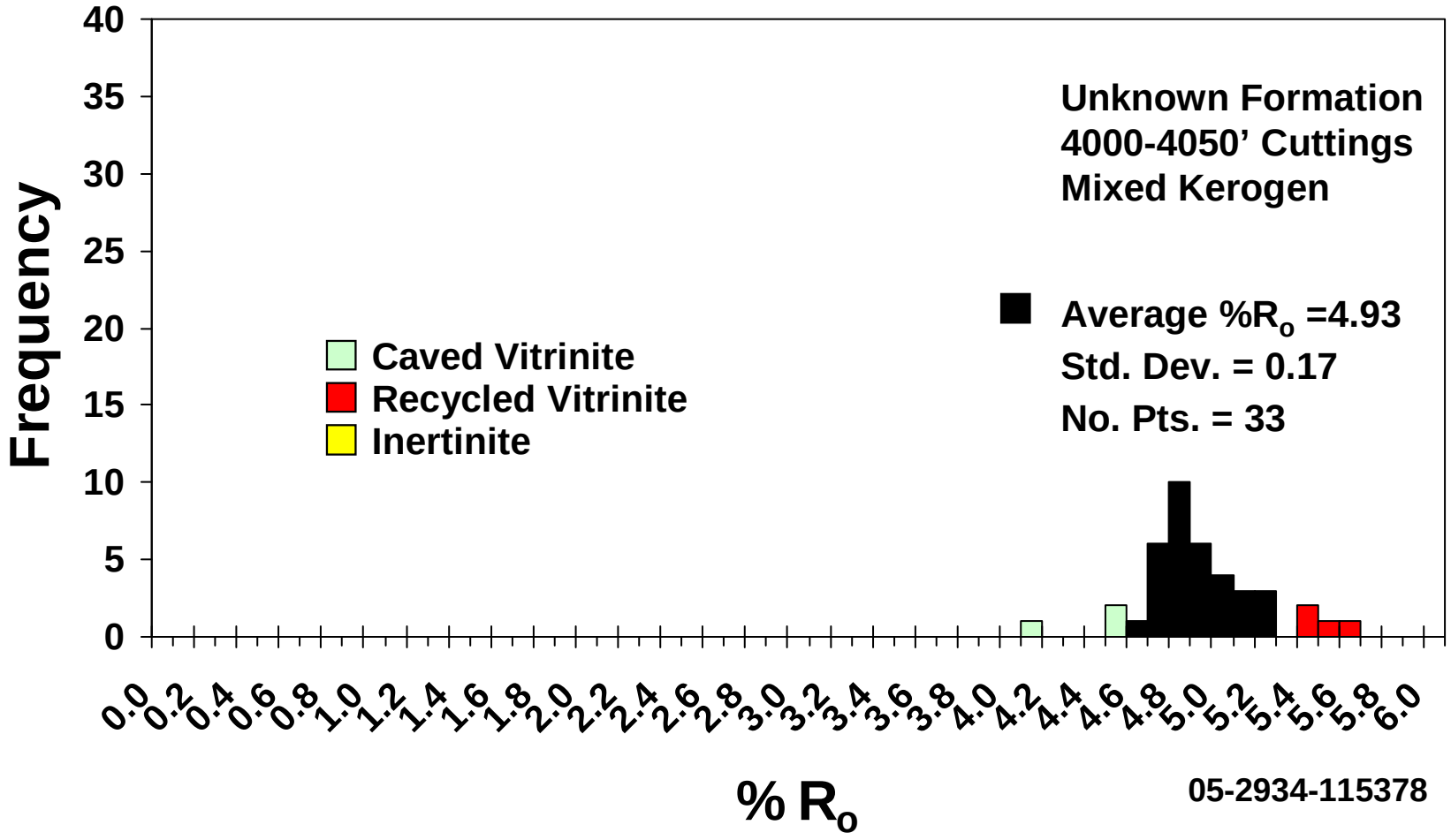

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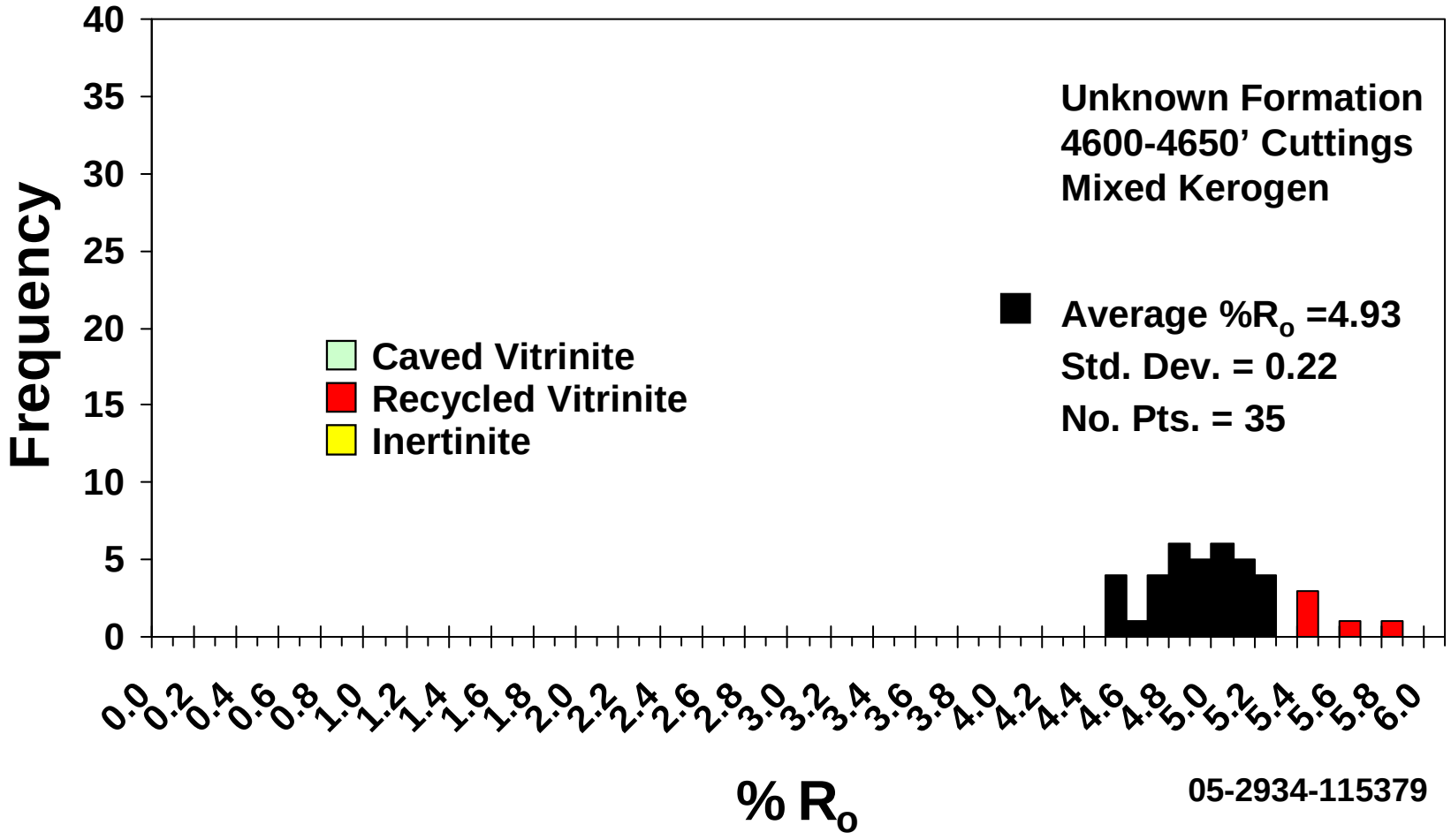

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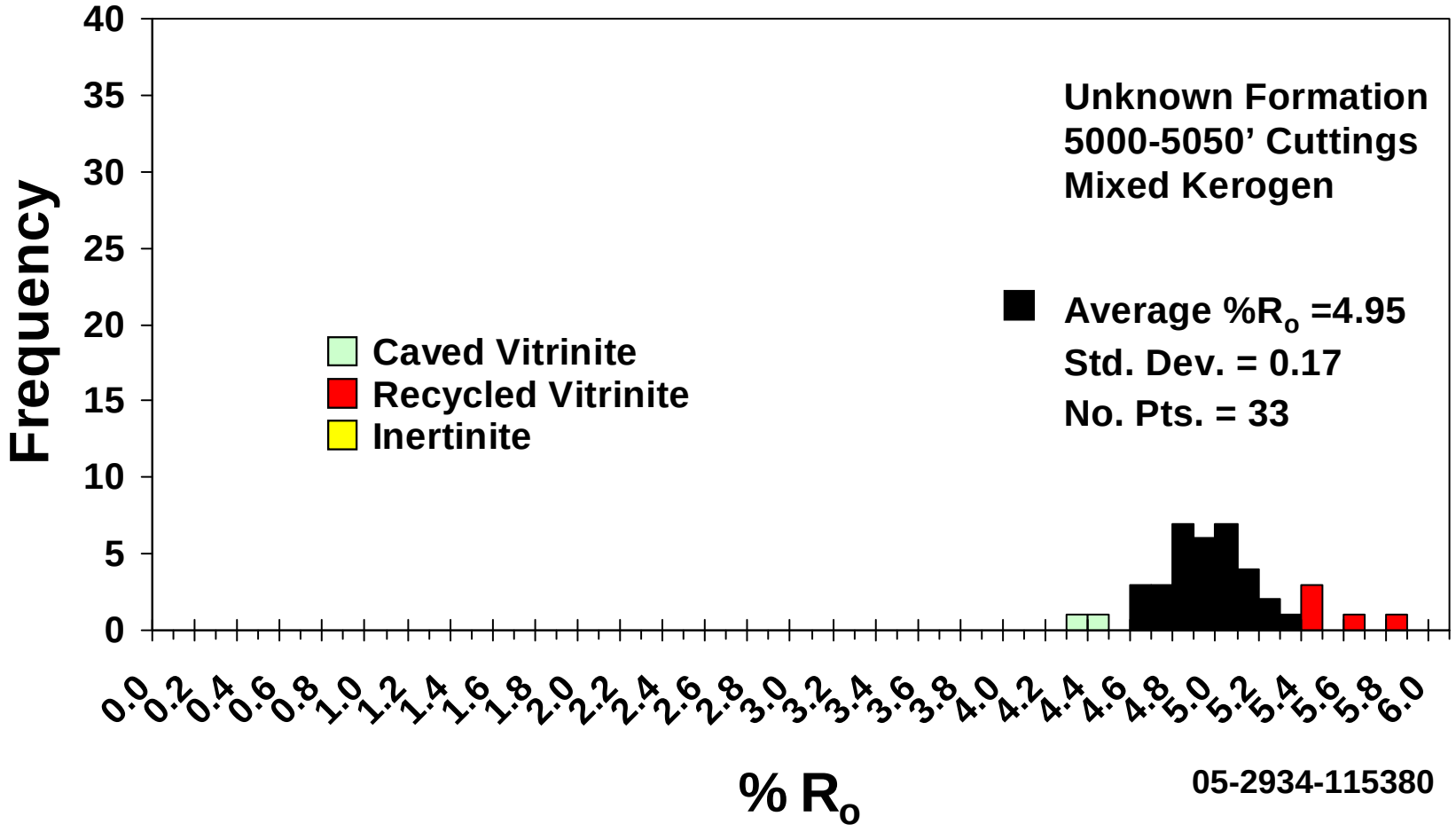

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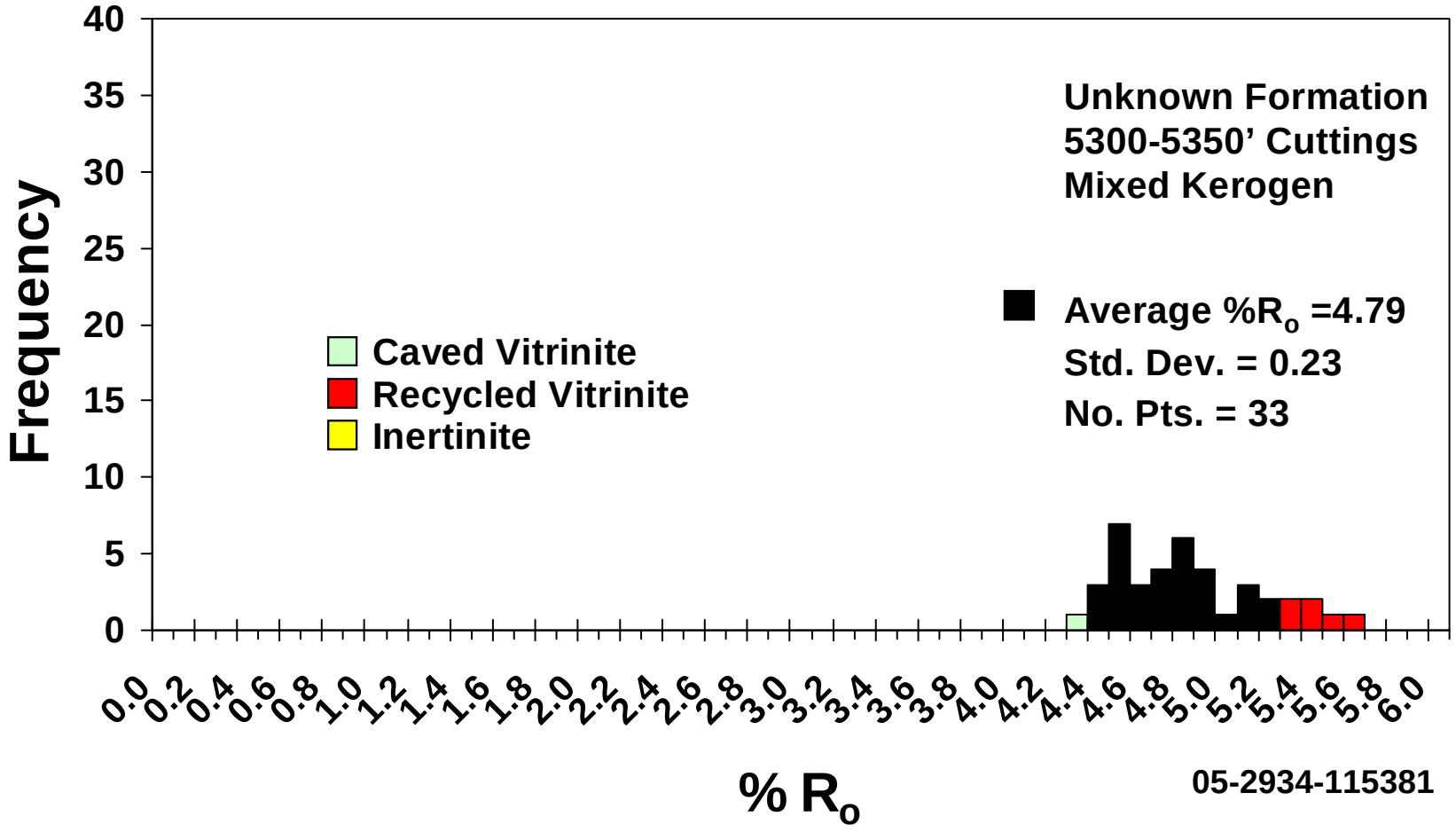

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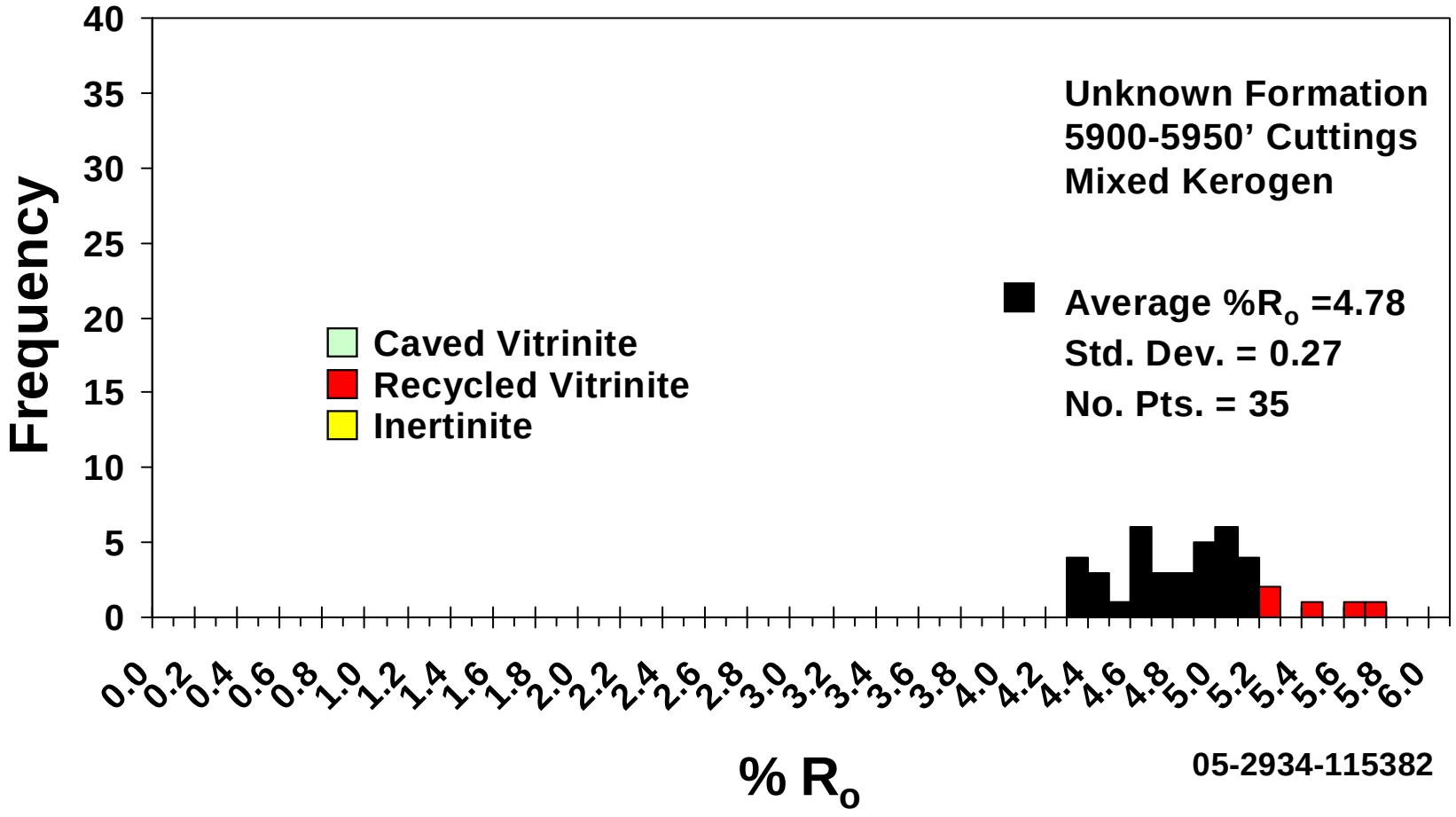

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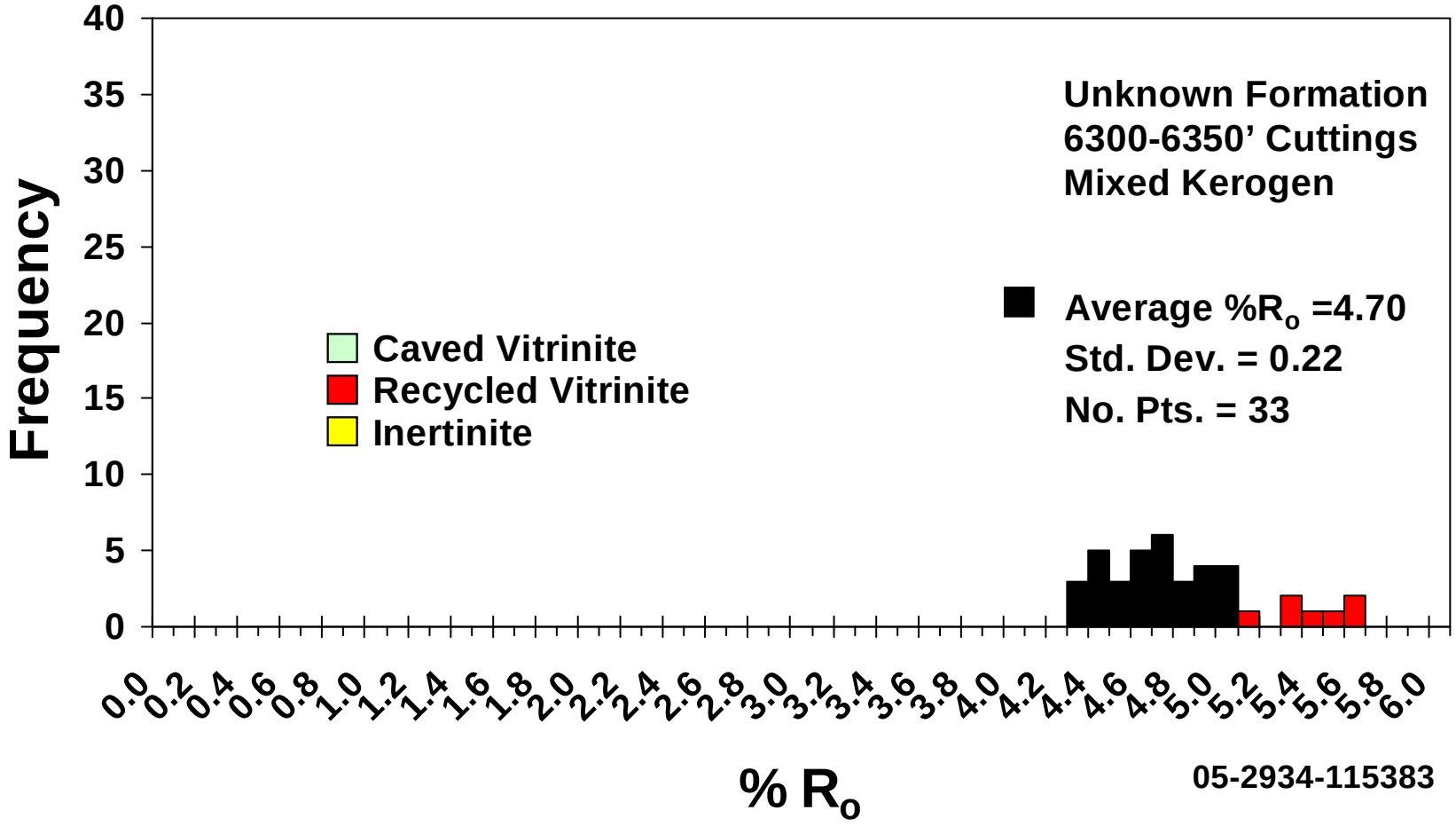

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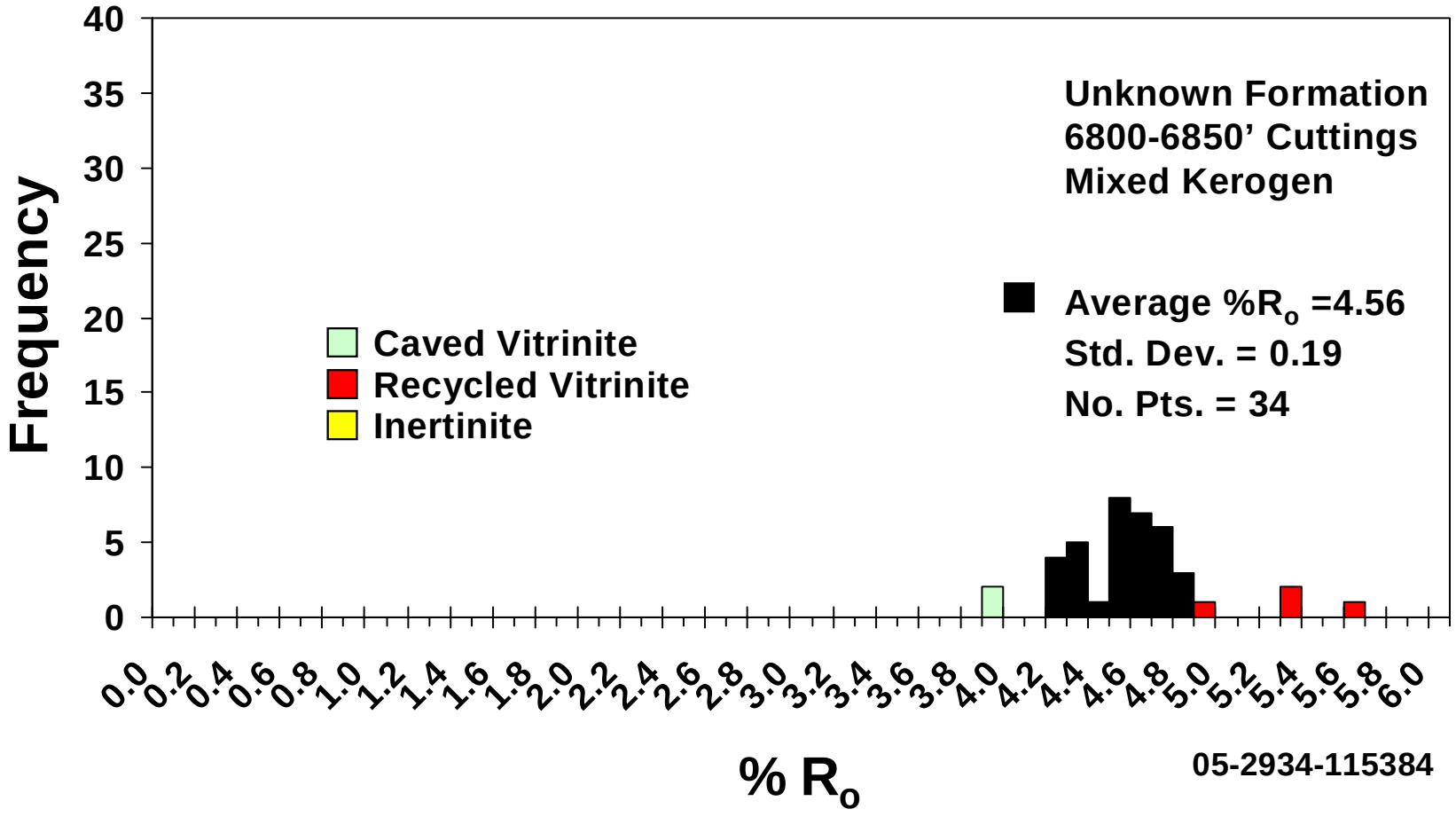

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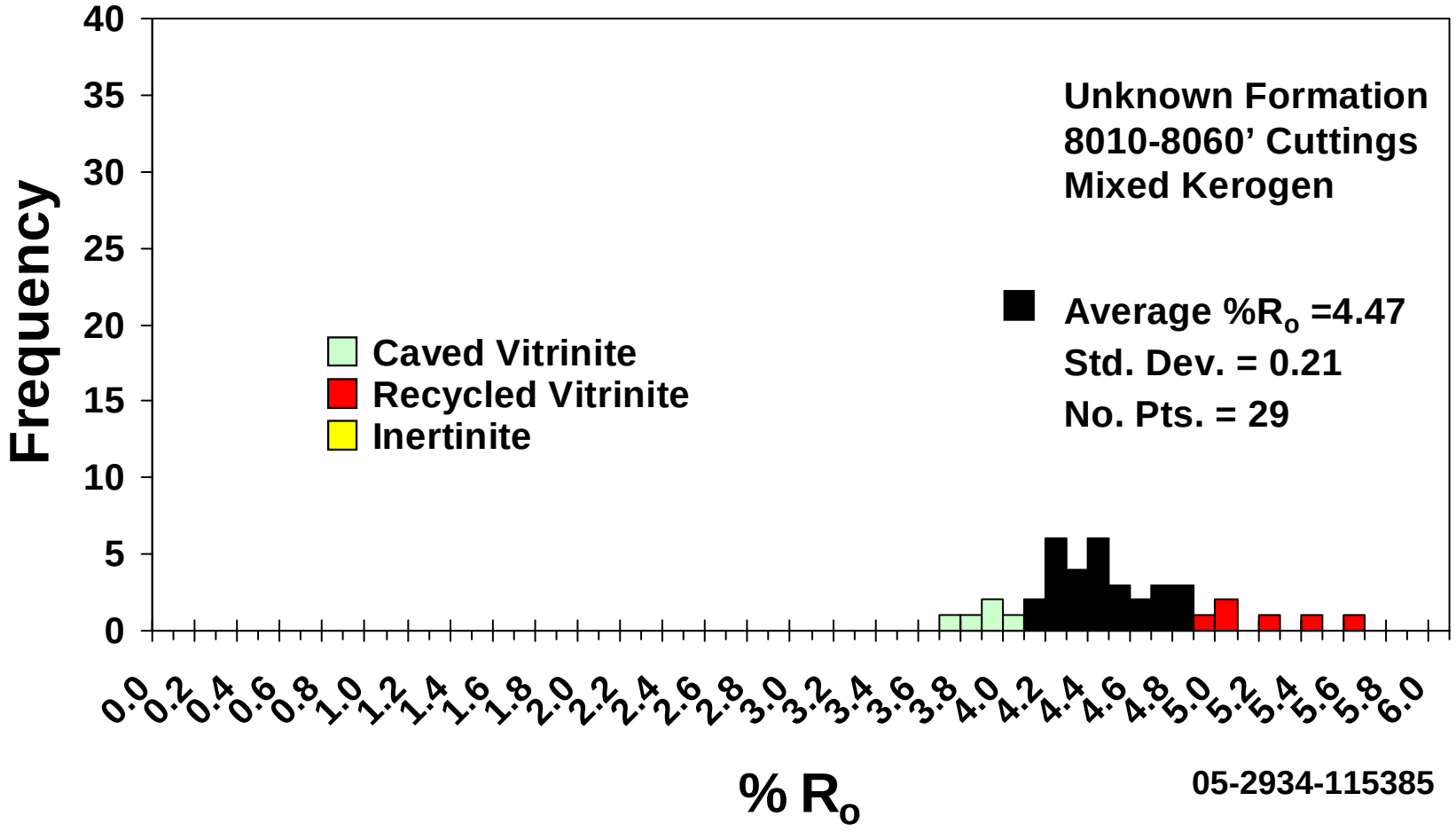

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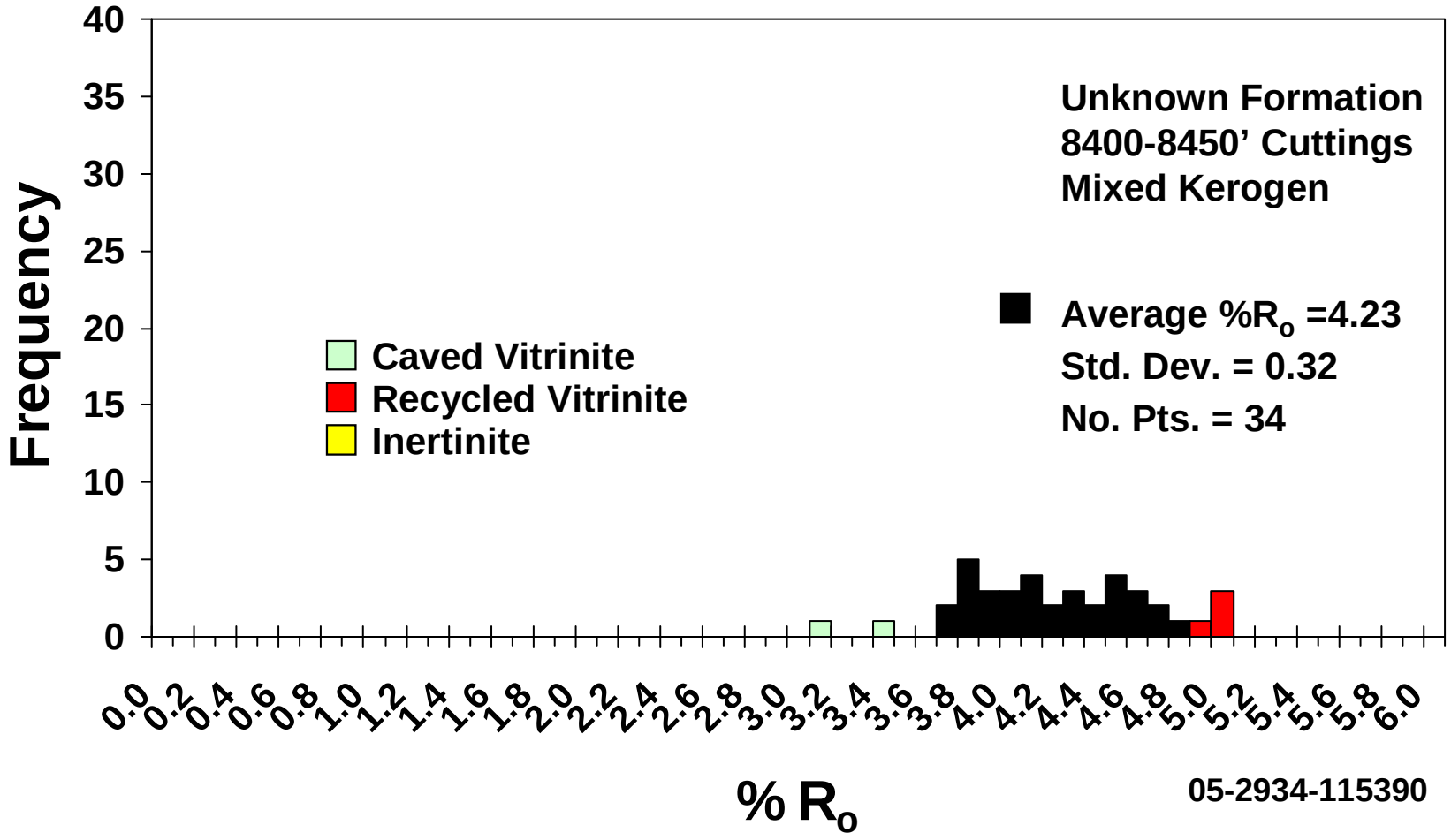

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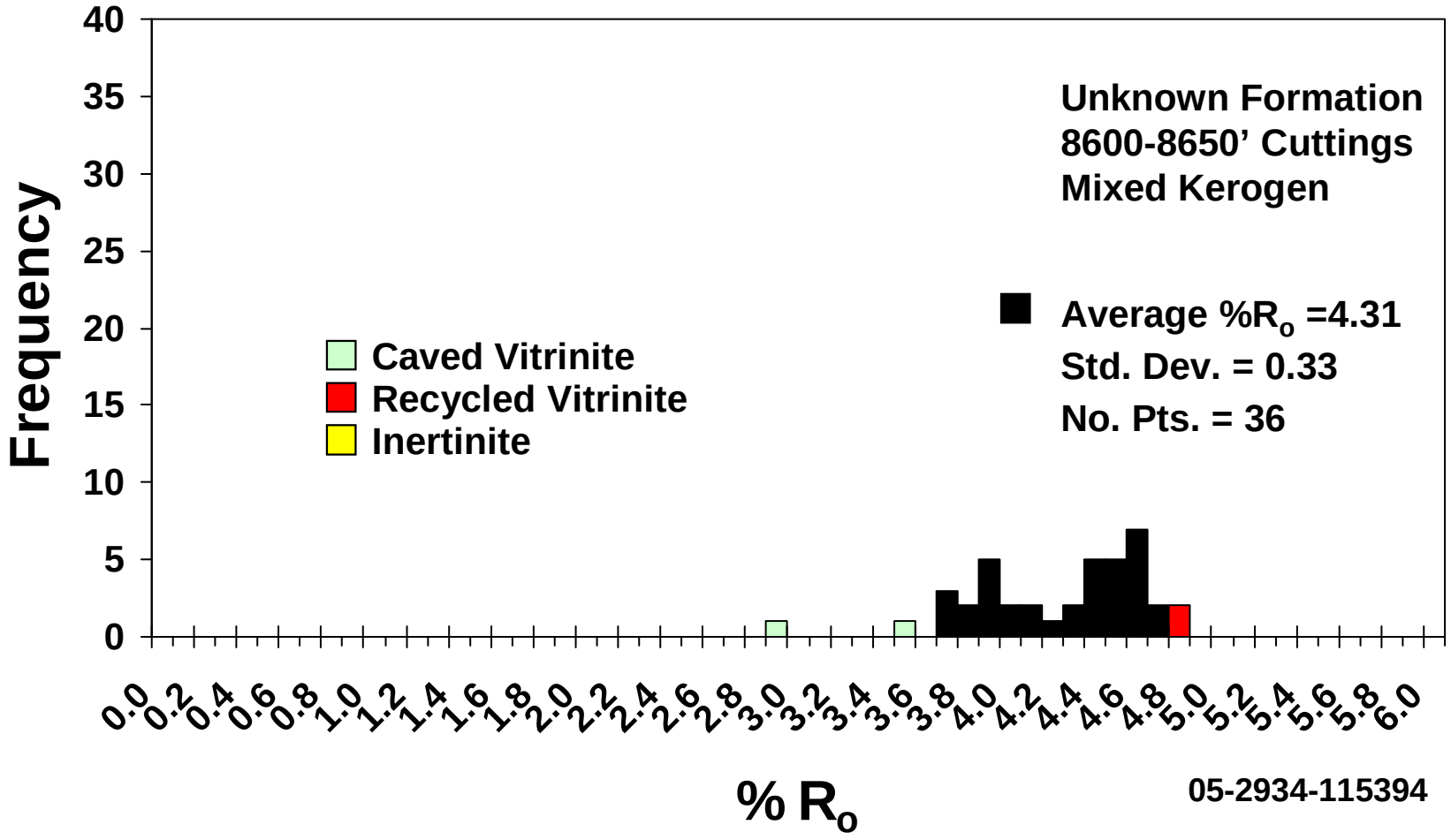

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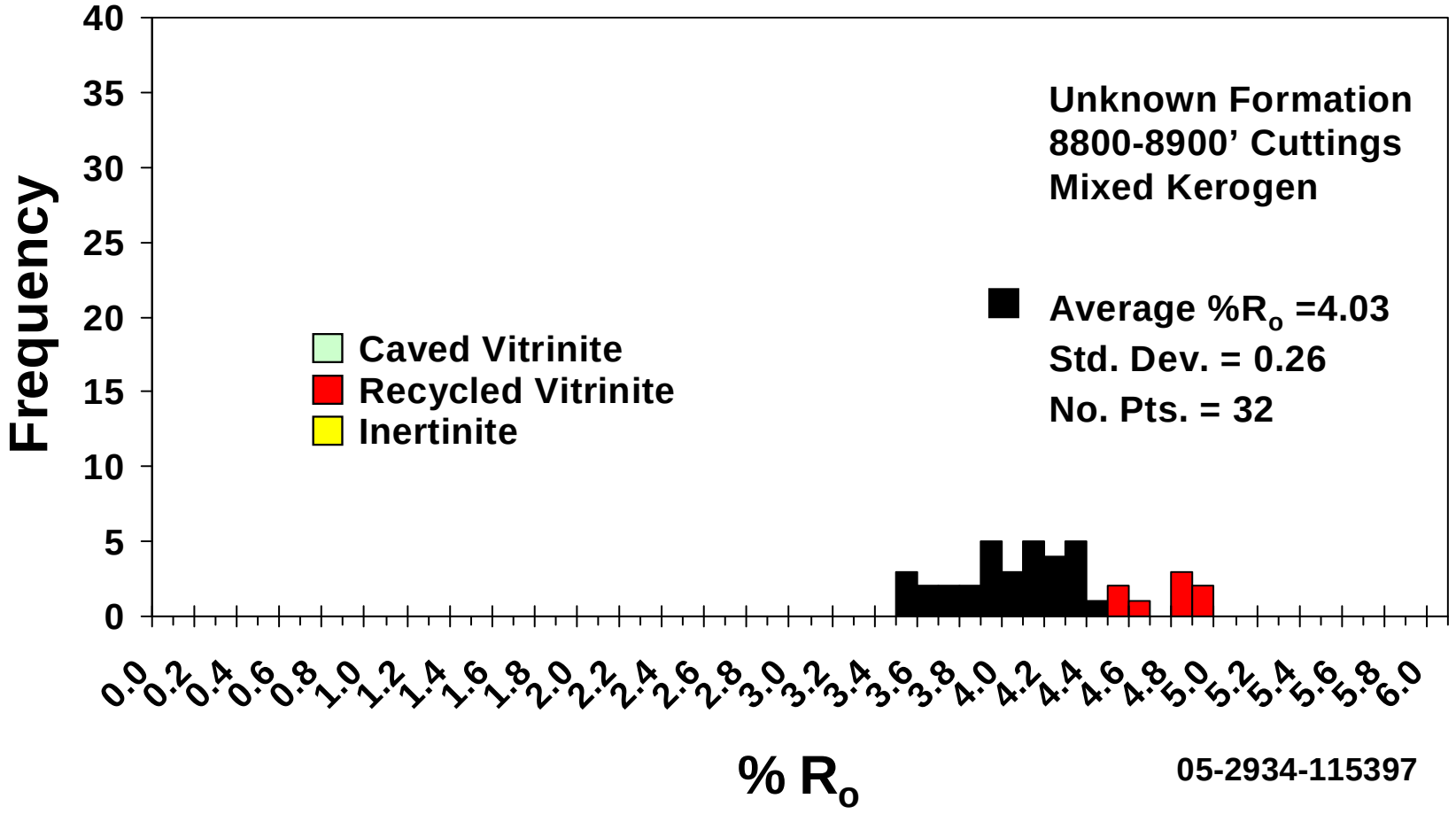

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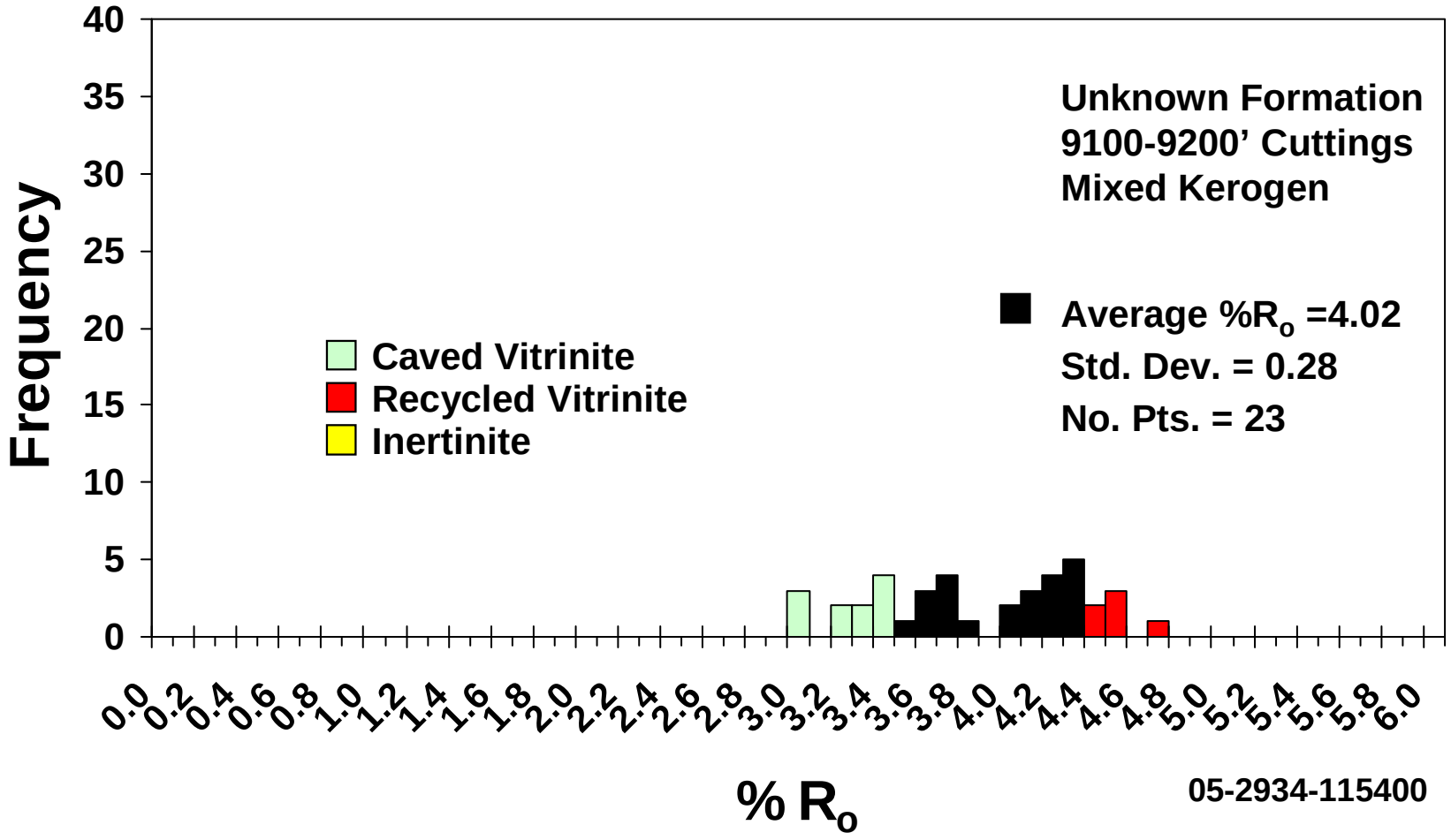

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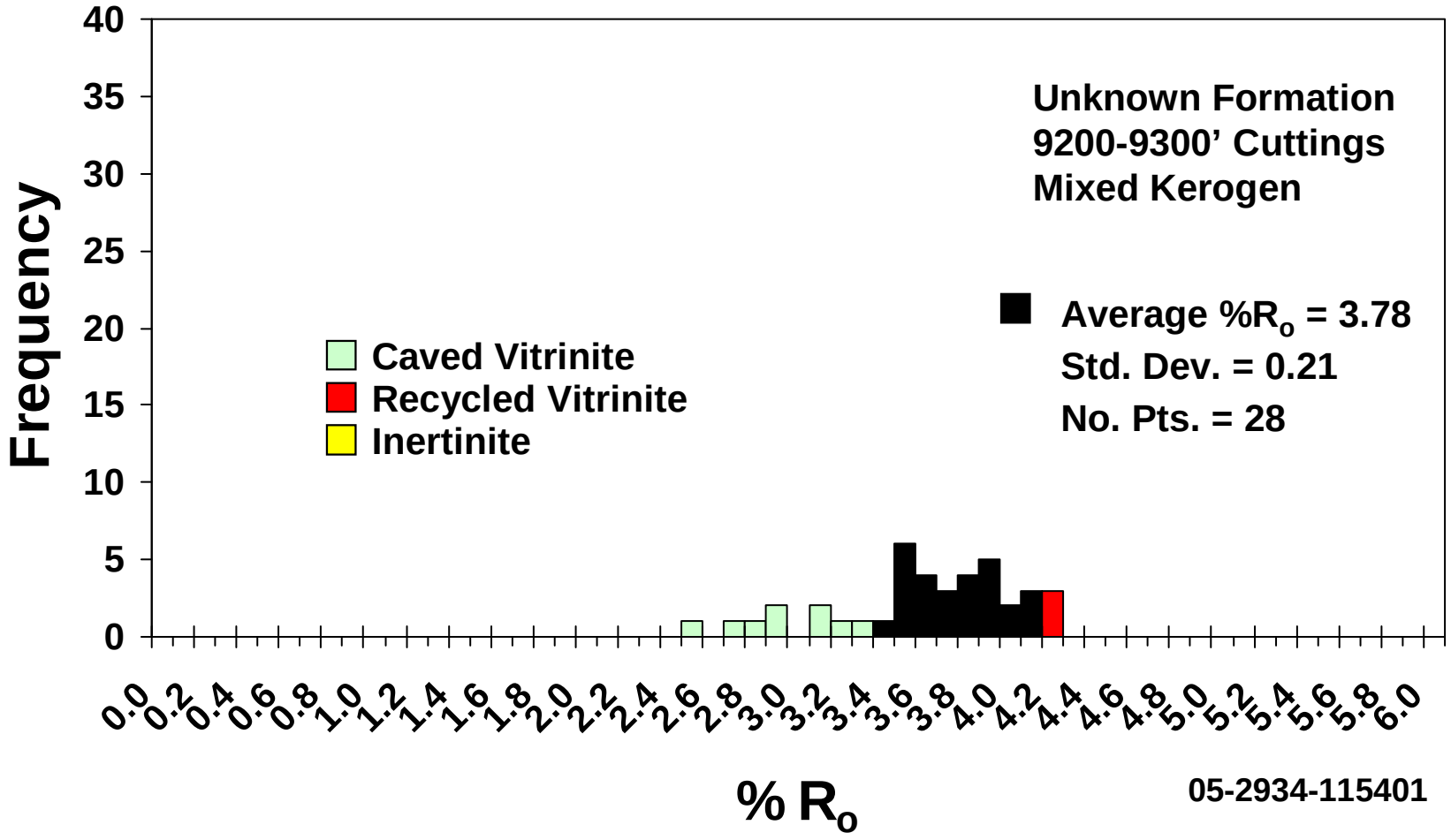

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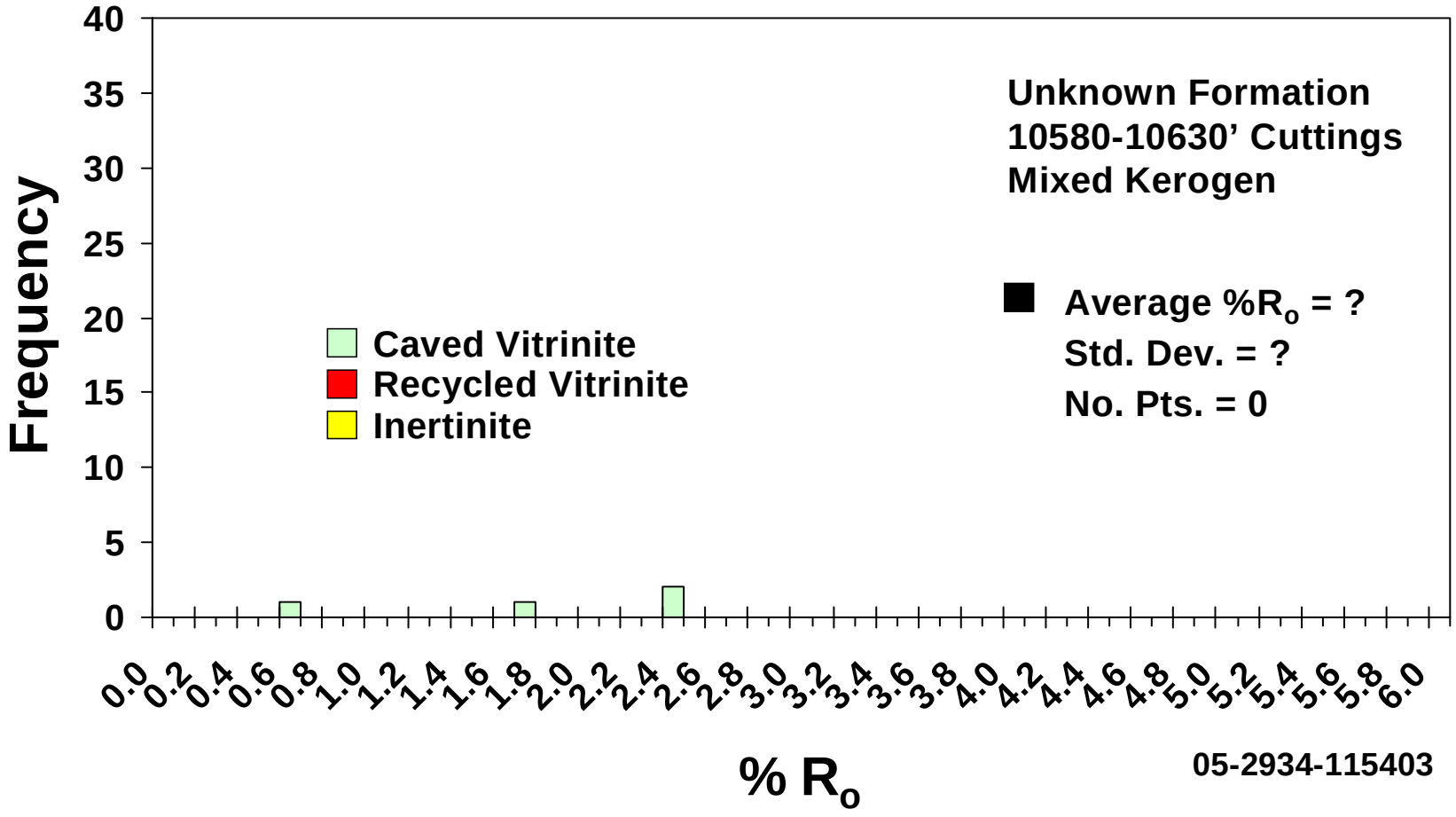

Table 1
Dispersed Organic Matter Thermal Alteration, Kerogen Type and Total Compositional Analysis

Arkansas Geological Commission

API No. 03117100040000
Operator Reserve Oil Incorp.
Well Name/No: Hazen #28-1

HGS ID	Well Name	Depth 1 (ft.)	Depth 2 (ft.)	Type	Source Quality: TOC	S2	Hydrogen Index (HI)	Tmax (oC)		Color	TAI	% Source Material: Amorphous Debris	Finely Dissem. OM	Herb. Plant Debris (Vit.)	Woody Plant Debris	Coaly Fragments	Algal Debris	Palynomorphs	Preservation: Good	Fair	Poor	Very poor	Recovery: Good	Very Poor	Barren	% Kerogen Comp.: Indigenous Vitrinite	Caved Vitrinite	Recycled/Oxidized Vitrinite	Inertinite	Solid Bitumen	Drilling Additive/Contamination	Amorphous Kerogen	Vitrinite: # of Readings	Total Sample Ro (%)	# of Indigeonus Readings	Indigenous Ro (%)	Comments
05-2934-115375	Hazen #28-1	3000	3050	cuttings	0.64	0.35	55	406	*	BLK, BLK	4.5, 5	36	10	53				1	X				X			45	tr	5	5			45	40	5.19	31	5.09	Lycospora sp., Acanthotriletes sp.
05-2934-115376	Hazen #28-1	3230	3280	cuttings	0.60	0.25	42	359	*	BLK, BLK	4.5, 5	41	5	53				1	X				X			45	tr	5	5			45	40	5.03	33	4.95	Paleozoic spores
05-2934-115377	Hazen #28-1	3650	3700	cuttings	0.71	0.32	45	379	*	BLK, BLK	4.5, 5	63	5	32				tr	X				X			25	tr	5	5			65	40	5.02	33	4.97	Lycospora sp.
05-2934-115378	Hazen #28-1	4000	4050	cuttings	0.72	0.40	56	389	*	BLK, BLK	4.5, 5	58	5	37				tr	X				X			30	tr	5	5			60	40	4.95	33	4.93	Lycospora sp.
05-2934-115379	Hazen #28-1	4600	4650	cuttings	0.67	0.23	34	342	*	BLK, BLK	4.5, 5	53	5	42				tr	X				X			35	tr	5	5			55	40	5.02	35	4.93	Lycospora sp.
05-2934-115380	Hazen #28-1	5000	5050	cuttings	0.75	0.24	32	495	*	BLK, BLK	4.5, 5	31	5	63				1	X				X			55	tr	5	5			35	40	5.00	33	4.95	Lycospora sp.
05-2934-115381	Hazen #28-1	5300	5350	cuttings	0.73	0.27	37	400	*	BLK, BLK	4.5, 5	53	5	42				tr	X				X			35	tr	5	5			55	40	4.88	33	4.79	Paleozoic spores
05-2934-115382	Hazen #28-1	5900	5950	cuttings	0.62	0.15	24	403	*	BLK, BLK	4.5, 5	42	5	53				tr	X				X			45	tr	5	5			45	40	4.87	35	4.78	
05-2934-115383	Hazen #28-1	6300	6350	cuttings	0.74	0.22	30	446	*	BLK, BLK	4.5, 5	58	5	37				tr	X				X			30	tr	5	5			60	40	4.83	33	4.70	Lycospora sp.
05-2934-115384	Hazen #28-1	6800	6850	cuttings	0.75	0.21	28	386	*	BLK, BLK	4.5, 5	58	5	37				tr	X				X			30	tr	5	5			60	40	4.60	34	4.56	
05-2934-115385	Hazen #28-1	8010	8060	cuttings	0.91	0.25	27	377	*	BLK, BLK	4.5, 5	55	3	42				tr	X				X			35	tr	5	5			55	40	4.52	29	4.47	Lycospora sp.
05-2934-115390	Hazen #28-1	8400	8450	cuttings	1.00	0.26	26	368	*	BLK, BLK	4.5, 5	70	3	27				tr	X				X			20	tr	5	5		tr	70	40	4.26	34	4.23	Paleozoic spores
05-2934-115394	Hazen #28-1	8600	8650	cuttings	1.05	0.44	42	419	*	BLK, BLK	4.5, 5	61	2	37				tr	X				X			25	tr	10	5			60	40	4.28	36	4.31	Lycospora sp.
05-2934-115397	Hazen #28-1	8800	8900	cuttings	1.09	0.46	42	386	*	BLK, BLK	4.5, 5	59	2	39				tr	X				X			20	tr	15	10			55	40	4.17	32	4.03	Paleozoic spores
05-2934-115400	Hazen #28-1	9100	9200	cuttings	1.40	0.43	31	375	*	BLK, BLK	4.5, 5	61	2	37				tr	X				X			20	tr	15	5			60	40	3.90	23	4.02	Lycospora sp.
05-2934-115401	Hazen #28-1	9200	9300	cuttings	1.55	0.61	39	384	*	BLK, BLK	4.5, 5	66	2	32				tr	X				X			20	tr	10	5			65	40	3.63	28	3.78	
05-2934-115403	Hazen #28-1	10580	10630	cuttings	0.15	0.04	27	374	*	BLK?, BLK?	4.5?, 5?	97?	2?	1?						X?				X		0?	tr?		tr?		1?	99?	4	1.83	0	?	98% mineral debris

* Tmax data not reliable due to poor S2 peak

tr = trace

Color Abbreviations:

GLY	Green-Light Yellow	B	Brown
Y	Yellow	DBDG	Dark Brown-Dark Gray
YO	Yellow-Orange	DGBL	Dark Gray-Black
OB	Orange-Brown	BLK	Black
LB	Light Brown		

TAI Scale:

1=Unaltered	3+ or 3.5
1+ or 1.5	4=Strong alteration
2=Slight alteration	4+ or 4.5
2+ or 2.5	5=Severe alteration
3=Moderate alteration	

Table 2. Kerogen Fluorescence colors and brightness intensities (subjective determinations)

Arkansas Geological Commission

API No. **03117100040000**
Operator **Reserve Oil Incorp.**
Well Name/No: **Hazen #28-1**

0 = No fluorescence noted
1 = very low intensity
2 = low intensity
3 = medium intensity
4 = high intensity
5 = very high intensity

G = Green
Y = Yellow
O = Orange
B = Brown

HGS ID	Well Name	Depth 1 ft.	Depth 2 ft.	Type	Pollen/Spores				Amorphous				Mounting Medium			
					G	Y	O	B	G	Y	O	B	G	Y	O	B
05-2934-115375	Hazen #28-1	3000	3050	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115376	Hazen #28-1	3230	3280	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115377	Hazen #28-1	3650	3700	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115378	Hazen #28-1	4000	4050	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115379	Hazen #28-1	4600	4650	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115380	Hazen #28-1	5000	5050	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115381	Hazen #28-1	5300	5350	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115382	Hazen #28-1	5900	5950	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115383	Hazen #28-1	6300	6350	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115384	Hazen #28-1	6800	6850	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115385	Hazen #28-1	8010	8060	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115390	Hazen #28-1	8400	8450	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115394	Hazen #28-1	8600	8650	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115397	Hazen #28-1	8800	8900	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115400	Hazen #28-1	9100	9200	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115401	Hazen #28-1	9200	9300	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115403	Hazen #28-1	10580	10630	cuttings	0	0	0	0	0	0	0	0	1			

Table 3. Pyrite types and abundance in kerogen

Arkansas Geological Commission

API No. **03117100040000**
Operator **Reserve Oil Incorp.**
Well Name/No: **Hazen #28-1**

1 = very rare
2 = rare
3 = common
4 = abundant
5 = very abundant

HGS ID	Well Name	Depth 1 ft.	Depth 2 ft.	Type	Pyrite types		
					Finely Disseminated	Euhedral	Framboidal
05-2934-115375	Hazen #28-1	3000	3050	cuttings	2	2	2
05-2934-115376	Hazen #28-1	3230	3280	cuttings	2	2	2
05-2934-115377	Hazen #28-1	3650	3700	cuttings	2	2	2
05-2934-115378	Hazen #28-1	4000	4050	cuttings	2	2	3
05-2934-115379	Hazen #28-1	4600	4650	cuttings	2	3	3
05-2934-115380	Hazen #28-1	5000	5050	cuttings	2	2	2
05-2934-115381	Hazen #28-1	5300	5350	cuttings	2	2	3
05-2934-115382	Hazen #28-1	5900	5950	cuttings	2	3	3
05-2934-115383	Hazen #28-1	6300	6350	cuttings	3	3	3
05-2934-115384	Hazen #28-1	6800	6850	cuttings	2	2	2
05-2934-115385	Hazen #28-1	8010	8060	cuttings	3	3	3
05-2934-115390	Hazen #28-1	8400	8450	cuttings	3	3	3
05-2934-115394	Hazen #28-1	8600	8650	cuttings	2	1	1
05-2934-115397	Hazen #28-1	8800	8900	cuttings	2	2	2
05-2934-115400	Hazen #28-1	9100	9200	cuttings	2	2	2
05-2934-115401	Hazen #28-1	9200	9300	cuttings	2	2	2
05-2934-115403	Hazen #28-1	10580	10630	cuttings	3	4	4

Table 4. Individual Reflectance Readings

Wells: **Hazen #28-1**

HGS ID	05-2934-115375		05-2934-115376		05-2934-115377		05-2934-115378		05-2934-115379		05-2934-115380		05-2934-115381		05-2934-115382		05-2934-115383		05-2934-115384		05-2934-115385		05-2934-115390		05-2934-115394		05-2934-115397		05-2934-115400		05-2934-115401		05-2934-115403	
Well Name	AR #8A		AR #8A		AR #8A		AR #8A		AR #8A		AR #8A		AR #8A		AR #8A		AR #8A		AR #8A		AR #8A		AR #8A		AR #8A		AR #8A		AR #8A		AR #8A	
Depth 1 (ft.)	3000		3230		3650.0		4000		4600.0		5000		5300		5900		6300		6800		8010		8400		8600		8800		9100		9200		10580	
	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data
	4.57	4.7	4.26	4.62	4.34	4.63	4.11	4.66	4.51	4.51	4.3	4.61	4.37	4.44	4.31	4.31	4.3	4.3	3.9	4.21	3.7	4.1	3.12	3.75	2.96	3.73	3.54	3.54	3	3.56	2.51	3.49	0.63	
	4.58	4.72	4.53	4.64	4.52	4.63	4.53	4.71	4.54	4.54	4.43	4.63	4.44	4.45	4.31	4.31	4.31	4.31	3.92	4.23	3.85	4.17	3.43	3.78	3.52	3.73	3.55	3.55	3	3.61	2.7	3.5	1.73	
	4.7	4.75	4.62	4.72	4.58	4.68	4.57	4.73	4.55	4.55	4.61	4.65	4.45	4.49	4.33	4.33	4.38	4.38	4.21	4.24	3.96	4.22	3.75	3.8	3.73	3.77	3.58	3.58	3.05	3.67	2.82	3.52	2.46	
	4.72	4.83	4.64	4.74	4.63	4.72	4.66	4.75	4.57	4.57	4.63	4.76	4.49	4.53	4.36	4.36	4.44	4.44	4.23	4.28	3.99	4.25	3.78	3.82	3.73	3.83	3.6	3.6	3.25	3.69	2.94	3.53	2.49	
	4.75	4.84	4.72	4.75	4.63	4.74	4.71	4.75	4.68	4.68	4.65	4.77	4.53	4.53	4.4	4.4	4.46	4.46	4.24	4.31	4.07	4.26	3.8	3.86	3.77	3.88	3.63	3.63	3.29	3.71	2.94	3.54		
	4.83	4.86	4.74	4.77	4.68	4.78	4.73	4.76	4.75	4.75	4.76	4.77	4.53	4.54	4.44	4.44	4.49	4.49	4.28	4.35	4.1	4.27	3.82	3.87	3.83	3.92	3.73	3.73	3.31	3.72	3.1	3.57		
	4.84	4.88	4.75	4.77	4.72	4.81	4.75	4.77	4.77	4.77	4.77	4.8	4.54	4.56	4.47	4.47	4.49	4.49	4.31	4.36	4.17	4.29	3.86	3.89	3.88	3.94	3.75	3.75	3.38	3.72	3.18	3.59		
	4.86	4.9	4.77	4.77	4.74	4.84	4.75	4.8	4.77	4.77	4.77	4.82	4.56	4.57	4.53	4.53	4.49	4.49	4.35	4.37	4.22	4.29	3.87	3.93	3.92	3.95	3.84	3.84	3.43	3.74	3.26	3.61		
	4.88	4.93	4.77	4.78	4.78	4.85	4.76	4.81	4.78	4.78	4.8	4.86	4.57	4.58	4.6	4.6	4.5	4.5	4.36	4.38	4.25	4.3	3.89	3.93	3.94	3.98	3.87	3.87	3.46	3.83	3.31	3.62		
	4.9	4.97	4.77	4.79	4.81	4.86	4.77	4.81	4.8	4.8	4.82	4.87	4.58	4.59	4.66	4.66	4.51	4.51	4.37	4.46	4.26	4.3	3.93	3.97	3.95	3.98	3.92	3.92	3.48	4.01	3.49	3.63		
	4.93	4.99	4.78	4.81	4.84	4.88	4.8	4.83	4.81	4.81	4.86	4.87	4.59	4.61	4.66	4.66	4.55	4.55	4.38	4.5	4.27	4.34	3.93	4.04	3.98	4	3.95	3.95	3.49	4.06	3.5	3.65		
	4.97	5.03	4.79	4.82	4.85	4.9	4.81	4.85	4.83	4.83	4.87	4.89	4.61	4.66	4.67	4.67	4.61	4.61	4.46	4.52	4.29	4.38	3.97	4.04	3.98	4.08	3.98	3.98	3.56	4.14	3.52	3.7		
	4.99	5.03	4.81	4.83	4.86	4.91	4.81	4.86	4.85	4.85	4.87	4.89	4.66	4.68	4.68	4.68	4.64	4.64	4.5	4.53	4.29	4.44	4.04	4.06	4	4.1	3.98	3.98	3.61	4.15	3.53	3.7		
	5.03	5.06	4.82	4.88	4.88	4.91	4.83	4.86	4.87	4.87	4.89	4.9	4.68	4.71	4.69	4.69	4.64	4.64	4.52	4.53	4.3	4.45	4.04	4.1	4.08	4.19	3.98	3.98	3.67	4.17	3.54	3.7		
	5.03	5.07	4.83	4.88	4.9	4.93	4.85	4.87	4.89	4.89	4.89	4.93	4.71	4.75	4.75	4.75	4.66	4.66	4.53	4.54	4.3	4.45	4.06	4.14	4.1	4.21	4.01	4.01	3.69	4.21	3.57	3.8		
	5.06	5.08	4.88	4.89	4.91	4.93	4.86	4.88	4.9	4.9	4.9	4.96	4.75	4.76	4.76	4.76	4.67	4.67	4.53	4.57	4.34	4.47	4.1	4.18	4.19	4.35	4.08	4.08	3.71	4.22	3.59	3.81		
	5.07	5.09	4.88	4.9	4.91	4.93	4.86	4.88	4.91	4.91	4.93	4.97	4.76	4.78	4.78	4.78	4.7	4.7	4.54	4.57	4.38	4.48	4.14	4.19	4.21	4.38	4.08	4.08	3.72	4.23	3.61	3.82		
	5.08	5.09	4.89	4.91	4.93	4.94	4.87	4.9	4.92	4.92	4.96	4.99	4.78	4.8	4.8	4.8	4.71	4.71	4.57	4.58	4.44	4.49	4.18	4.24	4.35	4.4	4.1	4.1	3.72	4.25	3.62	3.83		
	5.09	5.12	4.9	4.96	4.93	4.96	4.88	4.91	4.97	4.97	4.97	4.99	4.8	4.82	4.81	4.81	4.71	4.71	4.57	4.6	4.45	4.52	4.19	4.25	4.38	4.41	4.11	4.11	3.74	4.31	3.63	3.91		
	5.09	5.13	4.91	4.97	4.93	5	4.88	4.93	4.98	4.98	4.99	5.01	4.82	4.82	4.82	4.82	4.77	4.77	4.58	4.62	4.45	4.54	4.24	4.31	4.4	4.46	4.13	4.13	3.83	4.34	3.65	3.91		
	5.12	5.22	4.96	4.99	4.94	5.01	4.9	4.94	5	5	4.99	5.03	4.82	4.85	4.94	4.94	4.78	4.78	4.6	4.64	4.47	4.54	4.25	4.32	4.41	4.49	4.17	4.17	4.01	4.35	3.7	3.93		
	5.13	5.24	4.97	5.05	4.96	5.03	4.91	4.98	5.01	5.01	5.01	5.03	4.85	4.87	4.95	4.95	4.78	4.78	4.62	4.67	4.48	4.61	4.31	4.35	4.46	4.49	4.19	4.19	4.06	4.35	3.7	3.93		
	5.22	5.27	4.99	5.1	5	5.04	4.93	4.99	5.02	5.02	5.03	5.05	4.87	4.89	4.95	4.95	4.8	4.8	4.64	4.68	4.49	4.62	4.32	4.41	4.49	4.53	4.21	4.21	4.14	4.39	3.7	3.99		
	5.24	5.29	5.05	5.13	5.01	5.05	4.94	5	5.03	5.03	5.03	5.08	4.89	4.91	4.99	4.99	4.83	4.83	4.67	4.68	4.52	4.75	4.35	4.46	4.49	4.53	4.22	4.22	4.15		3.8	4		
	5.27	5.33	5.1	5.14	5.03	5.08	4.98	5.05	5.06	5.06	5.05	5.08	4.91	4.91	4.99	4.99	4.88	4.88	4.68	4.68	4.54	4.76	4.41	4.5	4.53	4.55	4.23	4.23	4.17		3.81	4.02		
	5.29	5.35	5.13	5.14	5.04	5.14	4.99	5.06	5.08	5.08	5.08	5.09	4.91	4.93	5	5	4.9	4.9	4.68	4.71	4.54	4.77	4.46	4.53	4.53	4.56	4.27	4.27	4.21		3.82	4.12		
	5.33	5.36	5.14	5.19	5.05	5.17	5	5.07	5.13	5.13	5.08	5.1	4.93	4.96	5.02	5.02	4.92	4.92	4.68	4.72	4.61	4.81	4.5	4.54	4.55	4.59	4.32	4.32	4.22		3.83	4.13		
	5.35	5.39	5.14	5.2	5.08	5.23	5.05	5.12	5.15	5.15	5.09	5.12	4.96	5.06	5.03	5.03	4.97	4.97	4.71	4.74	4.62	4.82	4.53	4.56	4.56	4.61	4.33	4.33	4.23		3.91	4.15		
	5.36	5.44	5.19	5.22	5.14	5.28	5.06	5.15	5.16	5.16	5.1	5.12	5.06	5.1	5.07	5.07	4.99	4.99	4.72	4.74	4.75	4.83	4.54	4.6	4.59	4.62	4.35	4.35	4.25		3.91			
	5.39	5.47	5.2	5.22	5.17	5.28	5.07	5.18	5.16	5.16	5.12	5.17	5.1	5.15	5.08	5.08	5	5	4.74	4.75	4.76		4.56	4.6	4.61	4.63	4.36	4.36	4.31		3.93			
	5.44	5.49	5.22	5.23	5.23	5.3	5.12	5.22	5.19	5.19	5.12	5.2	5.15	5.18	5.09	5.09	5.02	5.02	4.74	4.76	4.77		4.6	4.6	4.62	4.65	4.39	4.39	4.34		3.93			
	5.47		5.22	5.34	5.28	5.32	5.15	5.25	5.22	5.22	5.17	5.2	5.18	5.22	5.1	5.1	5.08	5.08	4.75	4.8	4.81		4.6	4.73	4.63	4.66	4.41	4.41	4.35		3.99			
	5.49		5.23	5.35	5.28	5.35	5.18	5.27	5.27	5.27	5.2	5.3	5.22	5.28	5.12	5.12	5.09	5.09	4.76	4.84	4.82		4.6	4.78	4.65	4.68	4.5		4.35		4			
	5.52		5.34		5.3		5.22		5.28	5.28	5.2		5.28		5.15	5.15	5.19		4.8	4.87	4.83		4.73	4.8	4.66	4.68	4.51		4.39		4.02			
	5.59		5.35		5.32		5.25		5.29	5.29	5.3		5.36		5.15	5.15	5.35		4.84		4.95		4.78		4.68	4.72	4.68		4.47		4.12			
	5.69		5.43		5.35		5.27		5.44		5.41		5.39		5.23		5.37		4.87		5.15		4.8		4.68	4.73	4.81		4.49		4.13			
	5.72		5.73		5.47		5.4		5.49		5.44		5.43		5.24		5.44		4.92		5.16		4.97		4.72		4.84		4.55		4.15			
	5.74		5.83		5.53		5.44		5.49		5.46		5.46		5.47		5.57		5.32		5.26		5		4.73		4.87		4.57		4.24			
	5.75		5.93		5.97		5.57		5.69		5.61		5.53		5.67		5.61		5.38		5.44		5.04		4.81		4.9		4.57		4.26			
	6.54		5.93		6.16		5.62		5.81		5.85		5.6		5.78		5.62		5.6		5.65		5.08		4.82		4.98		4.71		4.28			
Average $\%R_o$	5.19	5.09	5.03	4.95	5.02	4.97	4.95	4.93	5.02	4.93	5.00	4.95	4.88	4.79	4.87	4.78	4.83	4.70	4.60	4.56	4.52	4.47	4.26	4.23	4.28	4.31	4.17	4.03	3.90	4.02	3.63	3.78	1.83	#DIV/0!
Standard Dev.		0.23		0.21		0.20		0.17		0.22		0.17		0.23		0.27		0.22		0.19		0.21		0.32		0.33		0.26		0.28		0.21		#DIV/0!
# of Points	40	31	40	33	40	33	40	33	40	35	40	33	40	33	40	35	40	33	40	34	40	29	40	34	40	36	40	32	40	23	40	28	4	0

Humble Geochemical Services

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September 19, 2006

Arkansas Geological Commission
API: 03147100050000
Sunmark Exploration, Nichols Trust #14-1

Introduction:

Six cuttings samples from 6500 to 8050 feet from the Nichols Trust #14-1 were analyzed for both vitrinite reflectance (%Ro), visual kerogen and thermal alteration index (TAI). Maturity data indicate that these samples are in higher thermal maturity than what is normally considered as the 'Dry gas window' (Table 1). Ro data are consistent with the TAI (Thermal Alteration Index or 'spore color') and fluorescence data. Five of the samples are dominated by terrestrial kerogen and 1 is dominated by amorphous kerogen.

Discussion:

Vitrinite reflectance data quality is reasonably good overall. Ro values range from 4.70% to 4.79%. All but 1 sample had good organic recovery for visual study. Spores were common overall and allow for a more confident TAI interpretation. However, at this high maturity everything present is black.

Framboidal pyrite is rare to very rare in these samples. This may indicate minimal marine influence here (Table 3). No marine palynomorphs were noted in any of these samples. *Lycospora* spp. spores were noted in several of the upper samples. *Lycospora* is typical of Middle Pennsylvanian (Desmoinesian) through Mississippian age rocks. Several species also range on down into the Devonian. Various other Paleozoic spores from terrestrial environments were also noted.

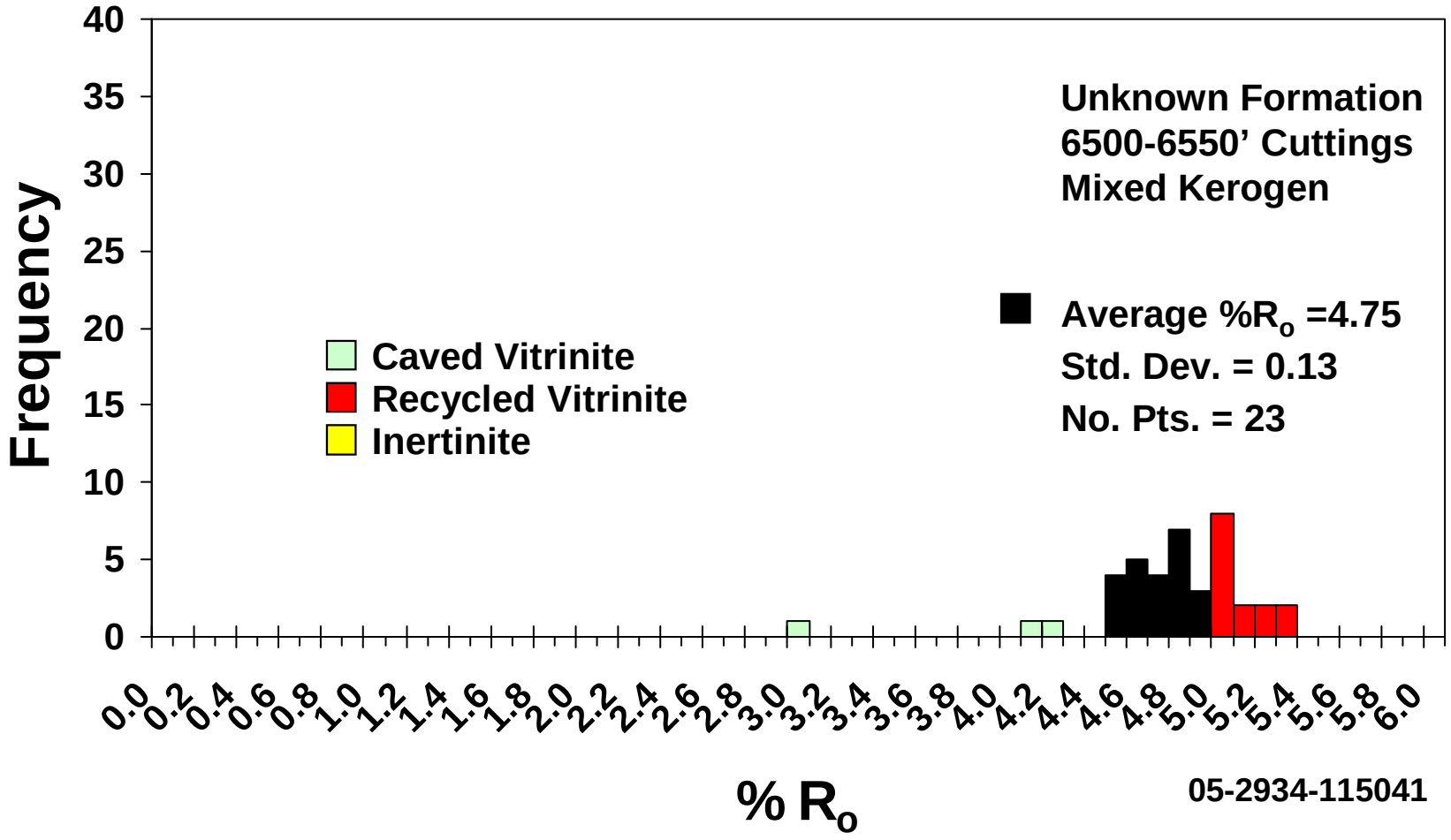
Fluorescence of pollen and spores is generally lost in the approximate vitrinite reflectance range of 1.0% to 1.1%. No spore fluorescence could be observed in these samples (Table 2). Vitrinite values are generally divided into the following categories of thermal maturity:

Immature:	0.02% to 0.60%
Oil window maturity:	0.60% to 1.10%
Condensate and /or wet-gas window:	1.10% to 1.40%
Dry gas window:	1.40% to 3.0 or 4.0%

Dan Pearson

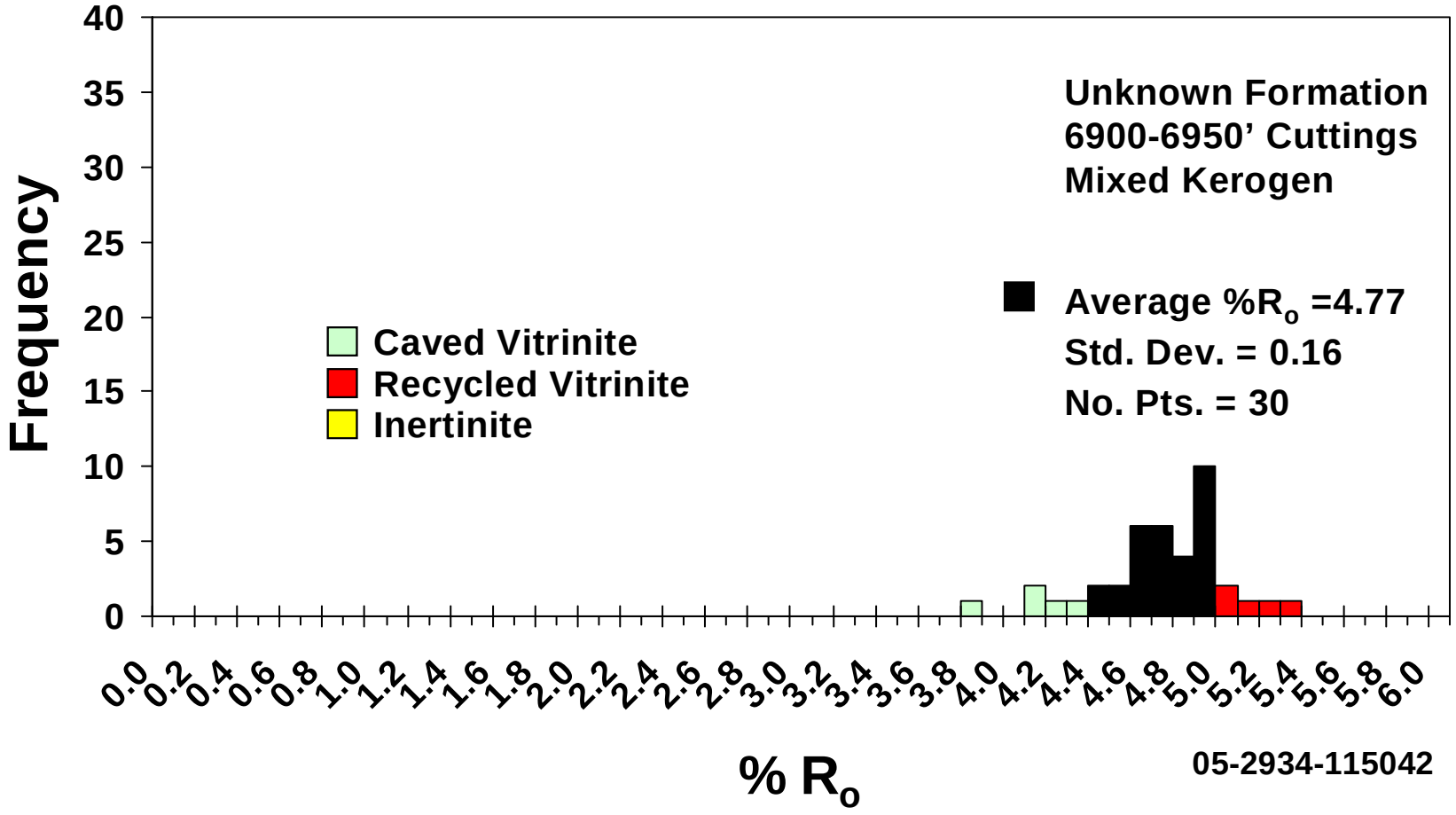
API: 03147100050000

Sunmark Exploration, Nichols Trust #14-1



API: 03147100050000

Sunmark Exploration, Nichols Trust #14-1



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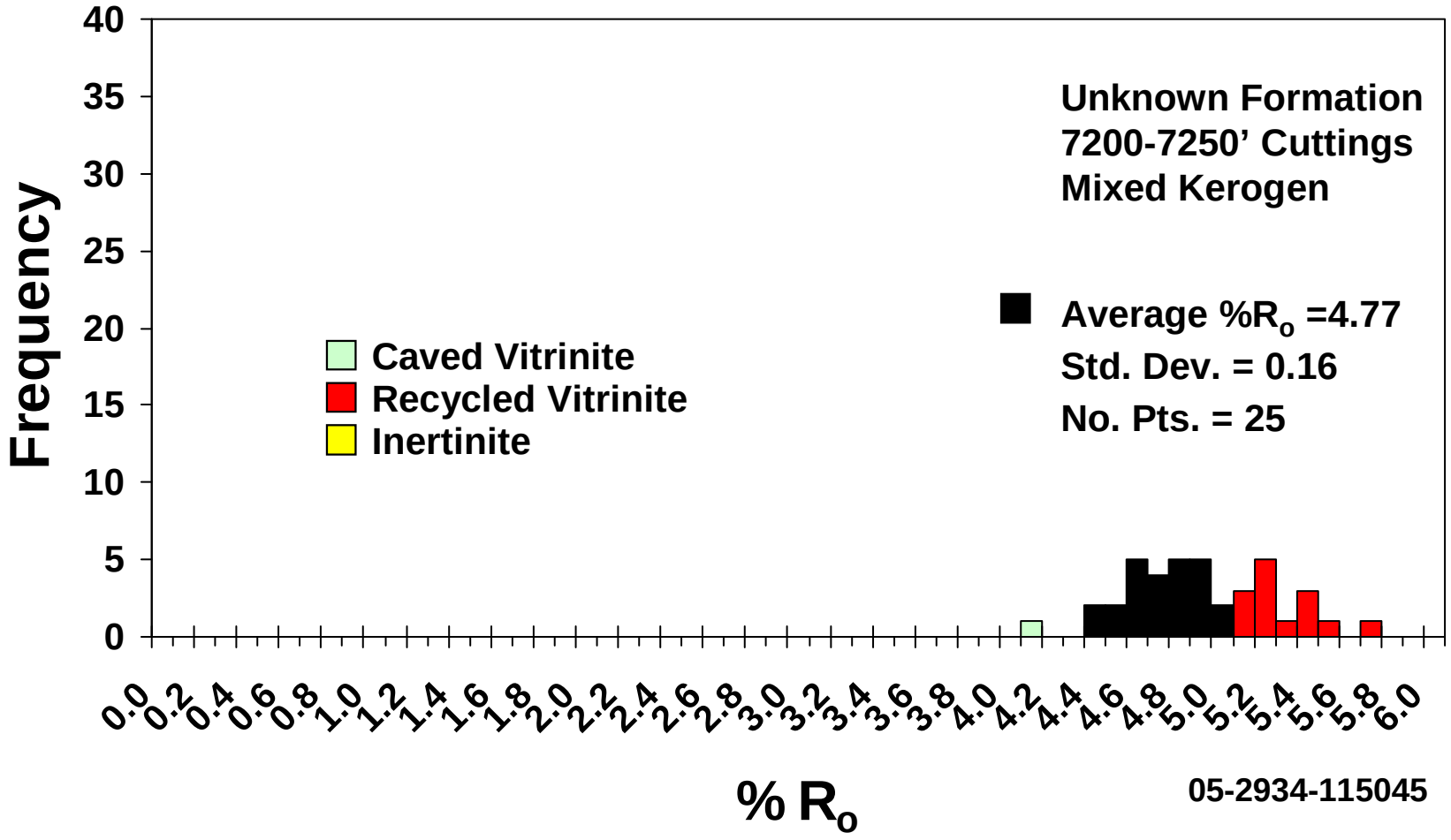

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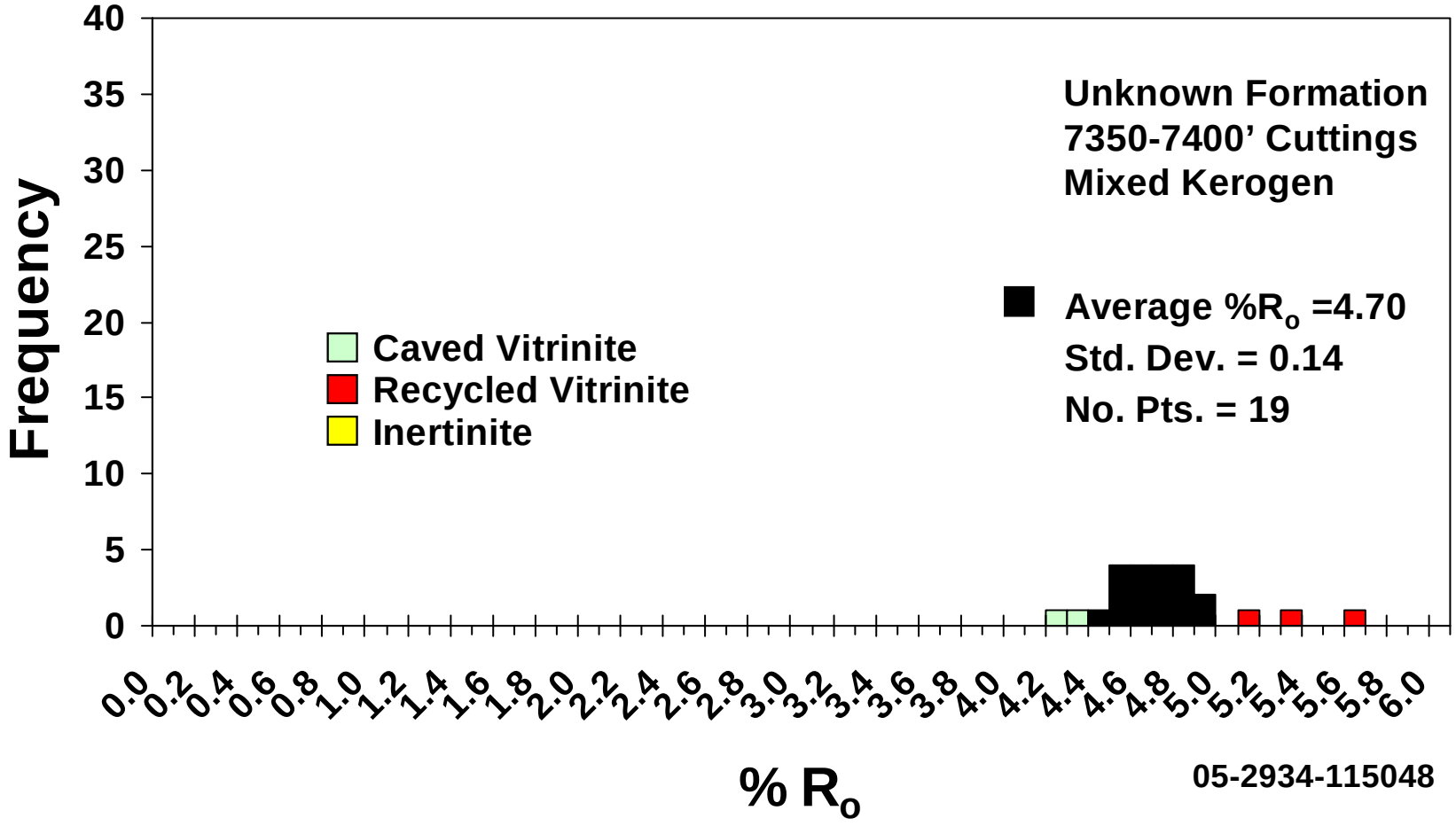
Sunmark Exploration, Nichols Trust #14-1



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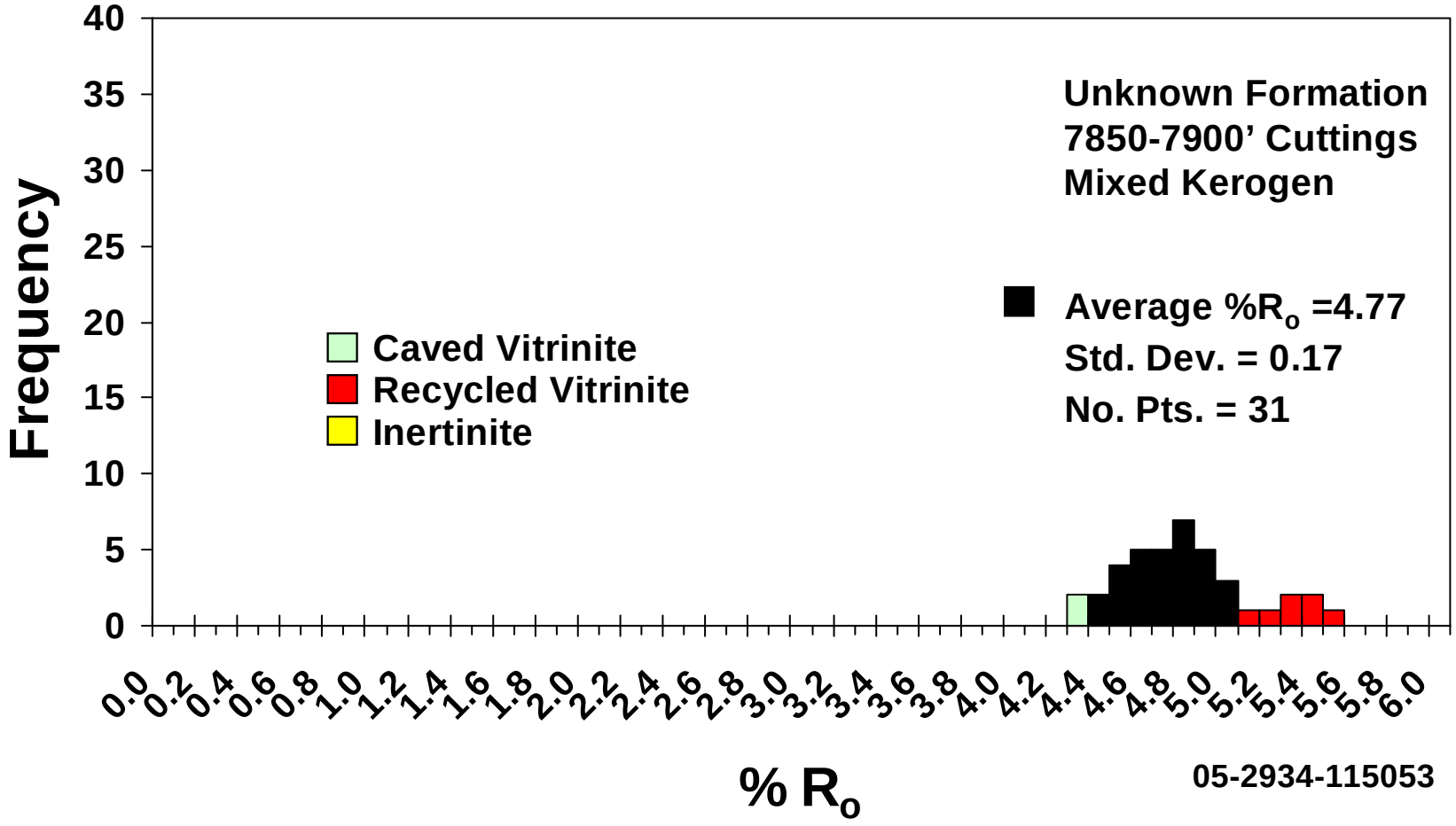
Sunmark Exploration, Nichols Trust #14-1



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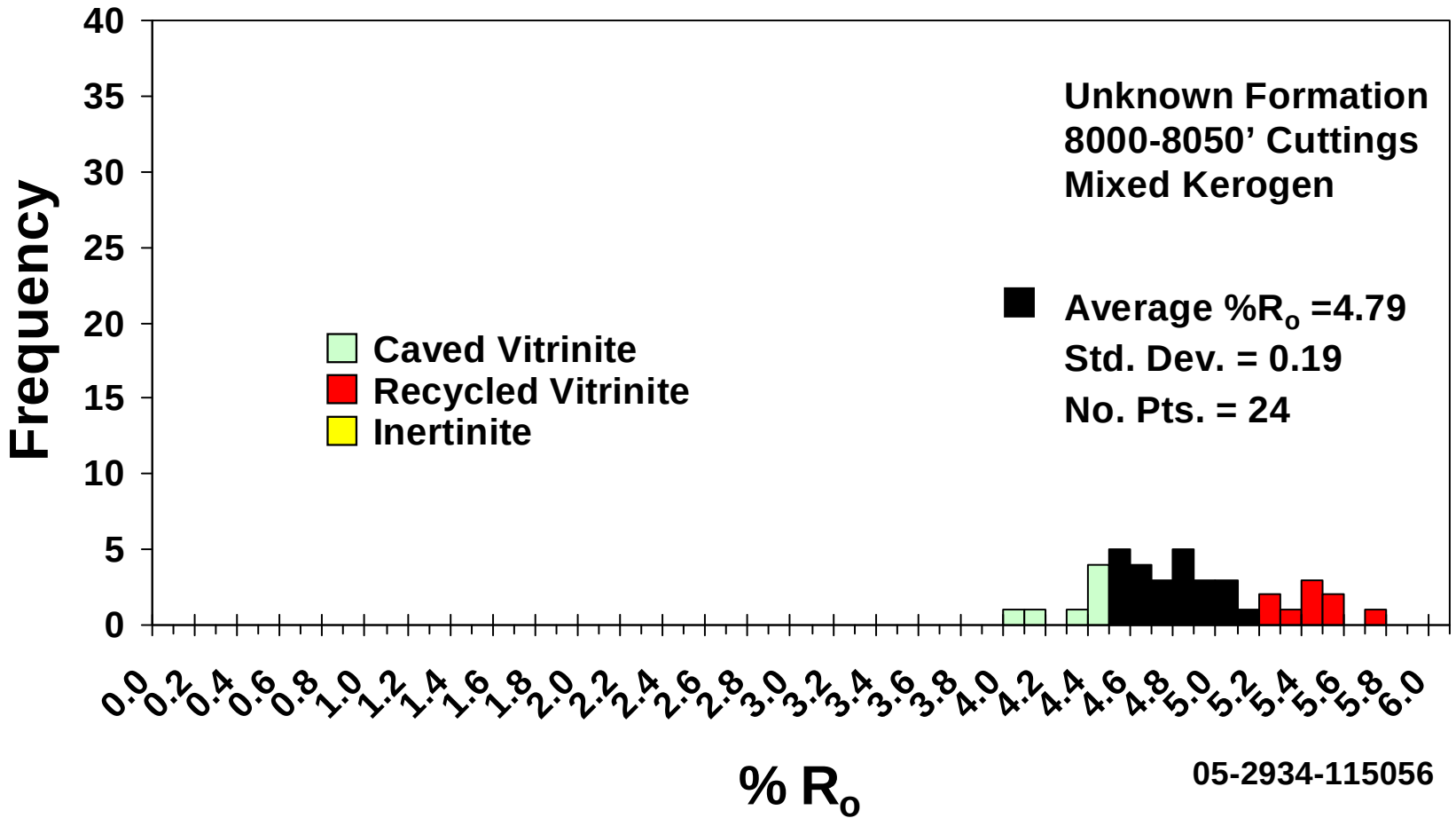
Sunmark Exploration, Nichols Trust #14-1



Humble Geochemical Services

Table 1
Dispersed Organic Matter Thermal Alteration, Kerogen Type and Total Compositional Analysis

Arkansas Geological Commission

API No. 03147100050000
Operator Sunmark Exploration
Well Name/No: Nichols Trust #14-1

					Source Quality						% Source Material							Preservation				Recovery			% Kerogen Comp.							Vitrinite				
HGS ID	Well Name	Depth 1 (ft.)	Depth 2 (ft.)	Type	TOC	S2	Hydrogen Index (HI)	Tmax (oC)	Color	TAI	Amorphous Debris	Finely Dissem. OM	Herb. Plant Debris (Vit.)	Woody Plant Debris	Coaly Fragments	Algal Debris	Palynomorphs	Good	Fair	Poor	Very poor	Good	Very Poor	Barren	Indigenous Vitrinite	Caved Vitrinite	Recycled/Oxidized Vitrinite	Inertinite	Solid Bitumen	Drilling Additive/Contamination	Amorphous Kerogen	# of Readings	Total Sample Ro (%)	# of Indigeonus Readings	Indigenous Ro (%)	*Comments*
05-2934-115041	Nichols Trust #14-1	6500	6550	cuttings	1.11	2.80	252	426	BLK	5.0	11	5	84				trace	X				X			60	trace	20	5			15	40	4.81	23	4.75	Lycospora sp.
05-2934-115042	Nichols Trust #14-1	6900	6950	cuttings	1.36	2.08	153	416	BLK	5.0	5	5	90				trace	X				X			50	trace	35	5			10	40	4.74	30	4.77	Lycospora sp.
05-2934-115045	Nichols Trust #14-1	7200	7250	cuttings	1.01	0.33	33	381 *	BLK	5.0	3	2	95				trace	X				X			80	trace	10	5			5	40	4.95	25	4.77	Paleozoic spores
05-2934-115048	Nichols Trust #14-1	7350	7400	cuttings	1.20	0.36	30	360 *	BLK	5.0	84	3	13				trace	X				X	X		10	trace	3	2			85	24	4.75	19	4.70	
05-2934-115053	Nichols Trust #14-1	7850	7900	cuttings	1.18	0.27	23	407 *	BLK	5.0	7	35	58				trace	X				X			50	trace	5	5			40	40	4.86	31	4.77	
05-2934-115056	Nichols Trust #14-1	8000	8050	cuttings	1.01	0.18	18	358 *	BLK	5.0	12	35	53				trace	X				X			44	1	5	5			45	40	4.85	24	4.79	

*Tmax data not reliable due to poor S2 peak

tr = trace

Color Abbreviations:

GLY	Green-Light Yellow	B	Brown
Y	Yellow	DBDG	Dark Brown-Dark Gray
YO	Yellow-Orange	DGBL	Dark Gray-Black
OB	Orange-Brown	BLK	Black
LB	Light Brown		

TAI Scale:

1=Unaltered	3+ or 3.5
1+ or 1.5	4=Strong alteration
2=Slight alteration	4+ or 4.5
2+ or 2.5	5=Severe alteration
3=Moderate alteration	

Table 2. Kerogen Fluorescence colors and brightness intensities (subjective determinations)

Arkansas Geological Commission

API No. **03147100050000**
Operator **Sunmark Exploration**
Well Name/No: **Nichols Trust #14-1**

0 = No fluorescence noted
1 = very low intensity
2 = low intensity
3 = medium intensity
4 = high intensity
5 = very high intensity

G = Green
Y = Yellow
O = Orange
B = Brown

HGS ID	Well Name	Depth 1 ft.	Depth 2 ft.	Type	Pollen/Spores				Amorphous				Mounting Medium			
					G	Y	O	B	G	Y	O	B	G	Y	O	B
05-2934-115041	Nichols Trust #14-1	6500	6550	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115042	Nichols Trust #14-1	6900	6950	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115045	Nichols Trust #14-1	7200	7250	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115048	Nichols Trust #14-1	7350	7400	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115053	Nichols Trust #14-1	7850	7900	cuttings	0	0	0	0	0	0	0	0	1			
05-2934-115056	Nichols Trust #14-1	8000	8050	cuttings	0	0	0	0	0	0	0	0	1			

Table 3. Pyrite types and abundance in kerogen

Arkansas Geological Commission

API No. **03147100050000**
Operator **Sunmark Exploration**
Well Name/No: **Nichols Trust #14-1**

1 = very rare
2 = rare
3 = common
4 = abundant
5 = very abundant

HGS ID	Well Name	Depth 1 ft.	Depth 2 ft.	Type	Pyrite types		
					Finely Disseminated	Euhedral	Framboidal
05-2934-115041	Nichols Trust #14-1	6500	6550	cuttings	2	1	
05-2934-115042	Nichols Trust #14-1	6900	6950	cuttings	3	3	1
05-2934-115045	Nichols Trust #14-1	7200	7250	cuttings	1	1	
05-2934-115048	Nichols Trust #14-1	7350	7400	cuttings	2	2	2
05-2934-115053	Nichols Trust #14-1	7850	7900	cuttings	2	3	1
05-2934-115056	Nichols Trust #14-1	8000	8050	cuttings	2	2	1

Table 4. Individual Reflectance Readings

Wells: **Nichols Trust #14-1**

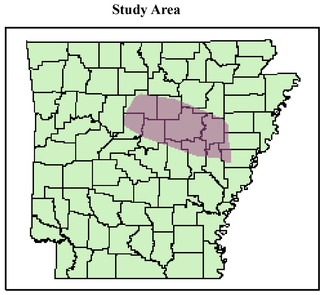
HGS ID	05-2934-115041		05-2934-115042		05-2934-115045		05-2934-115048		05-2934-115053		05-2934-115056	
Well Name	AR #7A		AR #7A		AR #7A		AR #7A		AR #7A		AR #7A	
Depth 1 (ft.)	6500		6900		7200.0		7350		7850.0		8000	
	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data	All Data	Indigenous Data
	3.09	4.53	3.83	4.46	4.1	4.42	4.27	4.42	4.38	4.46	4.01	4.5
	4.15	4.53	4.11	4.48	4.42	4.44	4.36	4.5	4.4	4.47	4.17	4.51
	4.23	4.54	4.16	4.52	4.44	4.57	4.42	4.52	4.46	4.53	4.31	4.54
	4.53	4.59	4.29	4.58	4.57	4.59	4.5	4.57	4.47	4.54	4.41	4.57
	4.53	4.61	4.33	4.6	4.59	4.65	4.52	4.58	4.53	4.57	4.42	4.59
	4.54	4.68	4.46	4.61	4.65	4.67	4.57	4.62	4.54	4.58	4.45	4.61
	4.59	4.69	4.48	4.61	4.67	4.68	4.58	4.62	4.57	4.61	4.46	4.62
	4.61	4.69	4.52	4.67	4.68	4.69	4.62	4.63	4.58	4.62	4.5	4.63
	4.68	4.69	4.58	4.68	4.69	4.69	4.62	4.68	4.61	4.64	4.51	4.63
	4.69	4.7	4.6	4.68	4.69	4.73	4.63	4.75	4.62	4.68	4.54	4.75
	4.69	4.76	4.61	4.7	4.73	4.74	4.68	4.75	4.64	4.68	4.57	4.79
	4.69	4.77	4.61	4.71	4.74	4.75	4.75	4.77	4.68	4.72	4.59	4.79
	4.7	4.77	4.67	4.72	4.75	4.77	4.75	4.77	4.68	4.74	4.61	4.81
	4.76	4.82	4.68	4.73	4.77	4.81	4.77	4.8	4.72	4.74	4.62	4.82
	4.77	4.82	4.68	4.75	4.81	4.83	4.77	4.8	4.74	4.74	4.63	4.85
	4.77	4.82	4.7	4.79	4.83	4.83	4.8	4.82	4.74	4.78	4.63	4.86
	4.82	4.82	4.71	4.8	4.83	4.85	4.8	4.83	4.74	4.83	4.75	4.86
	4.82	4.83	4.72	4.81	4.85	4.87	4.82	4.9	4.78	4.85	4.79	4.92
	4.82	4.84	4.73	4.86	4.87	4.9	4.83	4.92	4.83	4.87	4.79	4.95
	4.82	4.86	4.75	4.86	4.9	4.91	4.9		4.85	4.87	4.81	4.97
	4.83	4.93	4.79	4.9	4.91	4.91	4.92		4.87	4.88	4.82	5.01
	4.84	4.93	4.8	4.91	4.91	4.96	5.12		4.87	4.88	4.85	5.06
	4.86	4.94	4.81	4.92	4.96	4.97	5.36		4.88	4.89	4.86	5.09
	4.93		4.86	4.92	4.97	5	5.61		4.88	4.9	4.86	5.14
	4.93		4.86	4.93	5	5.02			4.89	4.92	4.92	
	4.94		4.9	4.94	5.02				4.9	4.93	4.95	
	5		4.91	4.95	5.1				4.92	4.94	4.97	
	5.02		4.92	4.96	5.11				4.93	4.96	5.01	
	5.03		4.92	4.97	5.19				4.94	5.02	5.06	
	5.03		4.93	4.99	5.22				4.96	5.03	5.09	
	5.03		4.94		5.22				5.02	5.04	5.14	
	5.06		4.95		5.23				5.03		5.22	
	5.08		4.96		5.27				5.04		5.26	
	5.08		4.97		5.29				5.14		5.38	
	5.11		4.99		5.33				5.29		5.43	
	5.19		5.05		5.41				5.34		5.45	
	5.22		5.08		5.41				5.34		5.49	
	5.27		5.17		5.48				5.45		5.5	
	5.3		5.27		5.53				5.49		5.55	
	5.31		5.35		5.76				5.56		5.78	
Average %R_o	**4.81**	**4.75**	**4.74**	**4.77**	**4.95**	**4.77**	**4.75**	**4.70**	**4.86**	**4.77**	**4.85**	**4.79**
Standard Dev.		**0.13**		**0.16**		**0.16**		**0.14**		**0.17**		**0.19**
# of Points	**40**	**23**	**40**	**30**	**40**	**25**	**24**	**19**	**40**	**31**	**40**	**24**

Location Map of All Wells Examined for Total Organic Carbon or Vitrinite Reflectance in the Fayetteville Shale Study Area

Scale: 1:280,000

0 3 6 12 18 24 Miles

Study Area



N W E S

Drill holes examined in study area

Approximate western boundary of the Mississippi Embayment

City

Fayetteville Shale Study Area

City Limits

Fayetteville Shale Gas Field
No geochemical data utilized from commercial wells in the gas fields

Upper Mississippian Outcrop Belt
Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

Disclaimer: This map was prepared using ESRI software on computers at the Arkansas Geological Commission. The Arkansas Geological Commission does not guarantee the accuracy of this map, especially when used in another system or with other software.

Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

Arkansas Geological Commission
Bekki White, State Geologist
Technical Review by Ed Ratchford

Digital Compilation by Des Heyliger
8 February 2005

Plate Number
1
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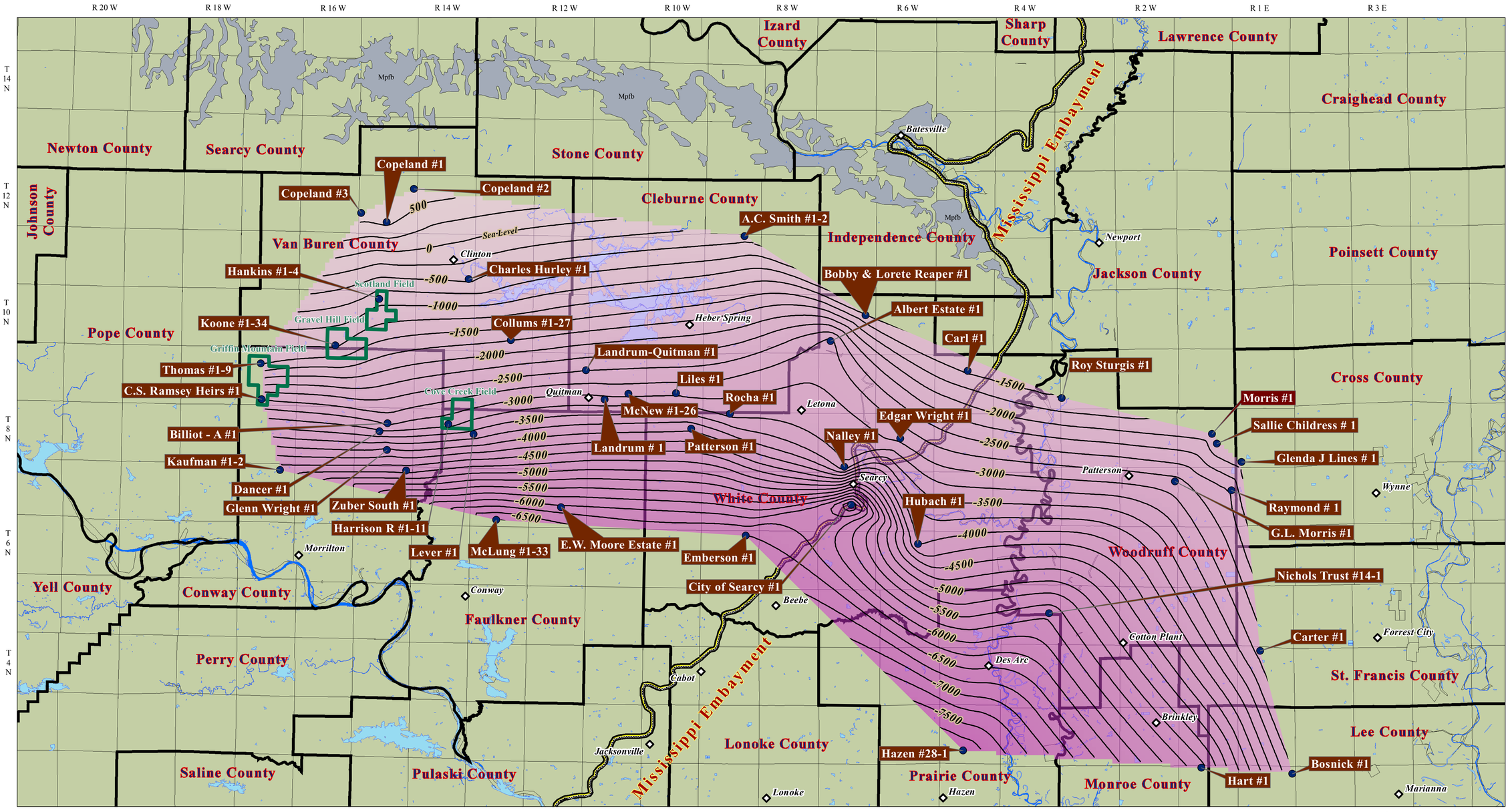
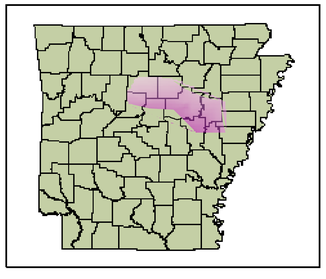


0 5 10 20 30 40 Miles

Scale: 1:280,000

Study Area



Structure Contour Map of the Top of the Mississippian Fayetteville Shale

(Map Reflects the Current Study Area Only)

Contour Interval = 250 feet

- -800 Structure contour line
- Rocha Drill holes included in analysis
- Cities
- Gas field boundary
- Approximate western boundary of the Mississippi Embayment
- Mpfb Upper Mississippian Outcrop Belt
  Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

Elevation of Formation Top from Sea Level

High : 659.085

Low : -7955.41

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Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Datum: North American Datum 1983
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Bekki White, State Geologist
Technical Review by Ed Ratchford

Digital Compilation by Des Heyliger
8 February 2005

Plate Number

2

Information Circular 37

R 20 W R 18 W R 16 W R 14 W R 12 W R 10 W R 8 W R 6 W R 4 W R 2 W R 1 E R 3 E

T 14 N T 12 N T 10 N T 8 N T 6 N T 4 N T 2 N

Izard County
Sharp County
Lawrence County
Independence County
Batesville
Mississippi Embayment
Craighead County
Newton County
Searcy County
Stone County
Johnson County
Copeland #1
Copeland #2
Copeland #3
Hearst #1-23
Cleburne County
A.C. Smith #1-2
Albert Estate #1
Newport
Clinton
Van Buren County
Jackson County
Poinsett County
Scotland Field
Charles Hurley #1
Sample #1
Gravel Hill Field
Heber Springs
Bobby & Lorete Reaper #1
Pope County
Griffin Mountain Field
Collums #1-27
Landrum # 1
Carl #1
Roy Sturgis
Liles #1
C.S. Ramsey Heirs #1
Billiot - A #1
Cove Creek Field
Quitman
Rocha #1
Letona
Cross County
Lever #1
McNew #1-26
Sallie Childress # 1
Dancer #1
Patterson #1
Glenda J Lines # 1
Kaufman #1-2
Searcy
Edgar Wright #1
Patterson
Wynne
Glenn Wright #1
White County
G.L. Morris #1
Raymond # 1
Zuber South #1
McLung #1-33
E.W. Moore Estate #1
Emberson #1
Woodruff County
Morrilton
Conway County
Yell County
Conway
Nichols Trust #14-1
Beebe
Faulkner County
Cotton Plant
Forrest City
Perry County
Cabot
Des Arc
Carter #1
Prairie County
St. Francis County
Brinkley
Lee County
Jacksonville
Lonoke County
Hazen #28-1
Bosnick #1
Pulaski County
Monroe County
Marianna
Lonoke
Hazen
Hart #1
Bunch #1
Saline County

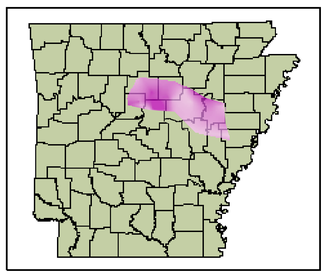
Mpfb

300 200 400 500 600 100

0 3 6 12 18 24 Miles

Scale: 1:280,000

Study Area



N W E S

Statistical Interpolation of Gross Pay Zone Thickness for Selected Wells in the Fayetteville Shale

Contour Interval = 100 feet

Rocha Drill holes included in analysis
City
City Limits
600 Gross Pay Zone contour
Approximate western boundary of the Mississippi Embayment
Fayetteville Shale Gas Field
Mpfb Upper Mississippian Outcrop Belt
Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

Gross Pay Zone Thickness
High : 641.763
Low : 65.6183

Disclaimer: This map was prepared using ESRI software on computers at the Arkansas Geological Commission. The Arkansas Geological Commission does not guarantee the accuracy of this map, especially when used in another system or with other software.

Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

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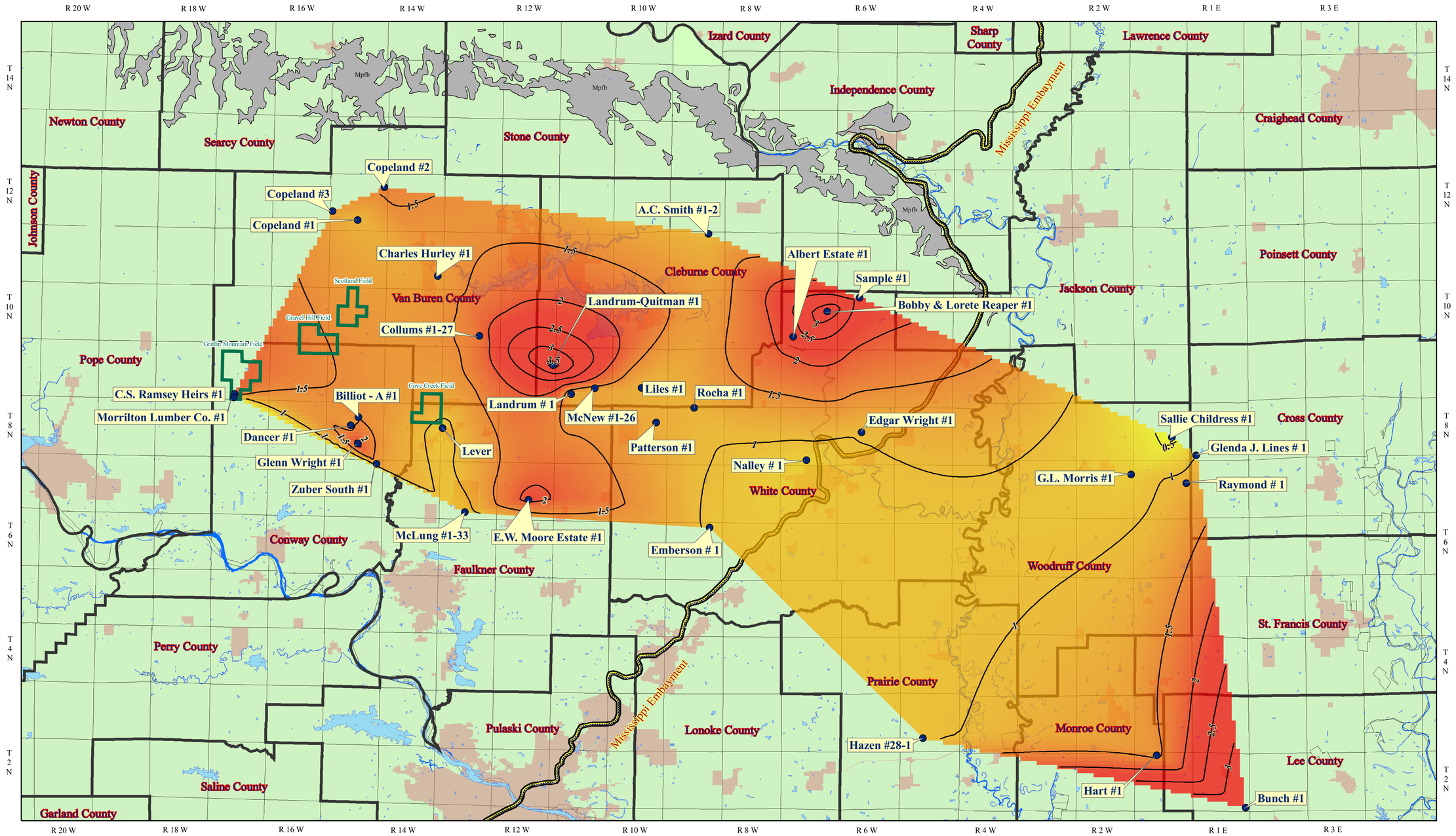
Bekki White, State Geologist
Technical Review by Ed Ratchford

Digital Compilation by Des Heyliger
8 February 2005

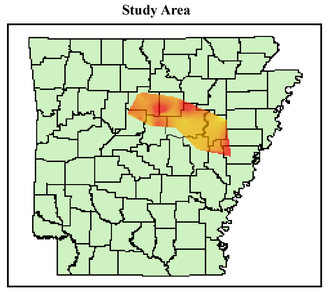
Plate Number
3
Information Circular 37



0 3 6 12 18 24 Miles

Scale: 1:280,000

Study Area



Statistical Interpolation of Total Organic Carbon (TOC) Values for Selected Wells in the Fayetteville Shale Plotted at 0-50ft below the Estimated Top of the Formation

- Rocha — Drill holes included in analysis
- 3.5 — TOC contour line
- Approximate western boundary of the Mississippi Embayment
- City limits
- Fayetteville Shale Gas Fields
  No geochemical data utilized from commercial wells within the gas fields
- Mpfb — Upper Mississippian Outcrop Belt
  Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

TOC predicted values

High : 3.6461

Low : 0.403416

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Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Geochemical Data provided by Humble Geochemical Services

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

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Bekki White, State Geologist
Technical Review by Ed Ratchford

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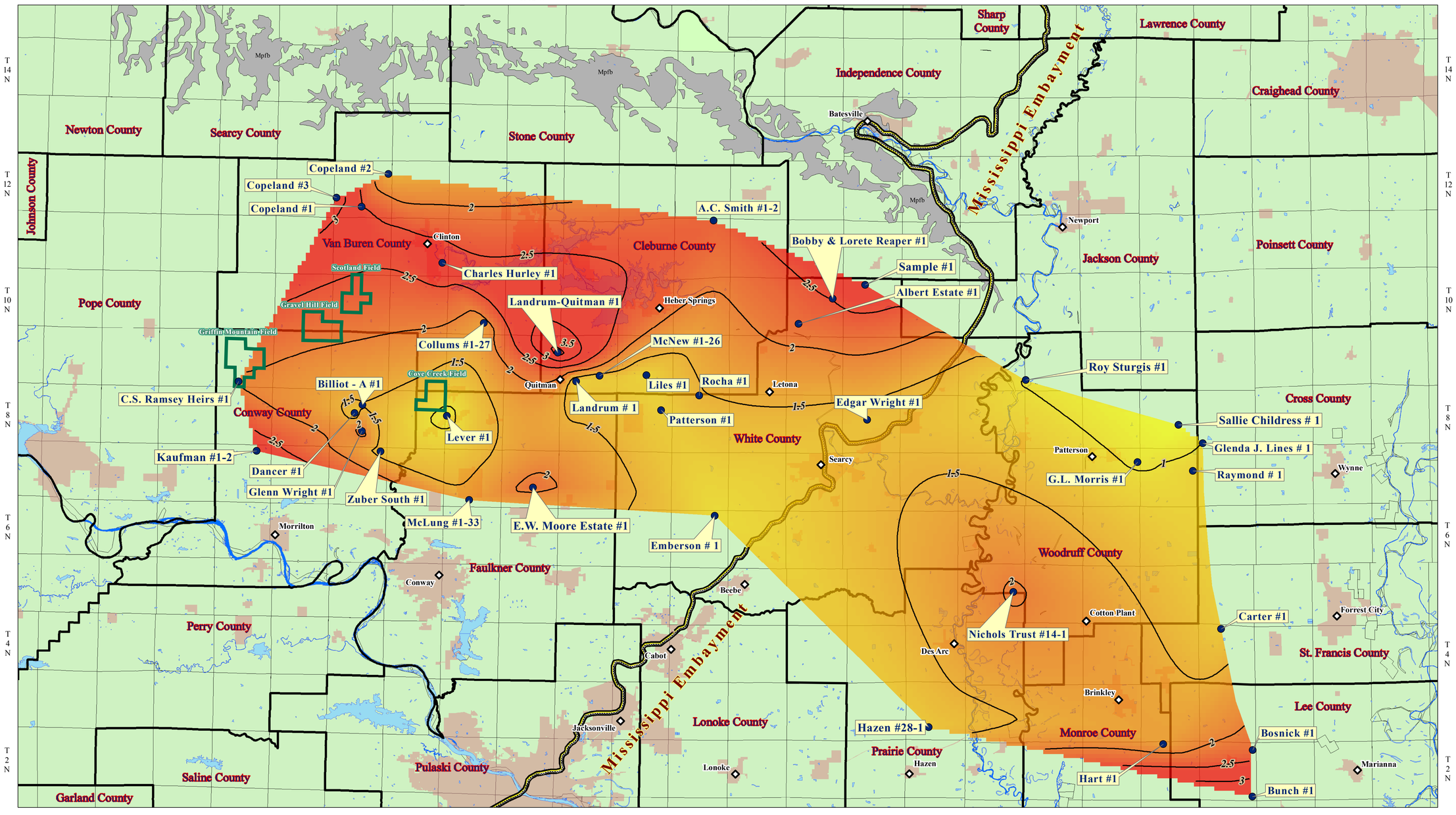
Plate Number

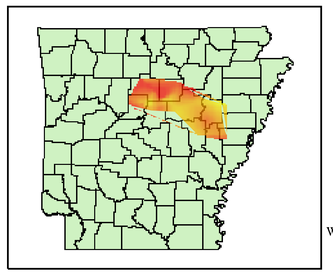
4

Information Circular 37



Scale: 1:280,000

Study Area



Statistical Interpolation of Total Organic Carbon (TOC) Values for Selected Wells in the Fayetteville Shale Plotted at 0-50ft below the Estimated Top of the Pay Zone

- TOC contour line
- Approximate western boundary of the Mississippi Embayment
- Drill holes included in analysis
- City
- City Limits
- Fayetteville Shale Gas Field
  - No geochemical data utilized from commercial wells in the gas fields
- Upper Mississippian Outcrop Belt
  - Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

TOC predicted values

High : 3.64547

Low : 0.712819

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Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Geochemical Data provided by Humble Geochemical Services

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

Arkansas Geological Commission
Bekki White, State Geologist
Technical Review by Ed Ratchford

Digital Compilation by Des Heyliger
8 February 2005

Plate Number

5

Information Circular 37

R 20 W R 18 W R 16 W R 14 W R 12 W R 10 W R 8 W R 6 W R 4 W R 2 W R 1 E R 3 E

T 14 N T 12 N T 10 N T 8 N T 6 N T 4 N T 2 N

Newton County
Searcy County
Stone County
Izard County
Sharp County
Lawrence County
Independence County
Craighead County
Johnson County
Van Buren County
Cleburne County
Poinsett County
Jackson County
Pope County
Conway County
Faulkner County
White County
Woodruff County
Cross County
Perry County
Pulaski County
Saline County
Garland County
Lonoke County
Prairie County
Monroe County
Lee County
St. Francis County

Mississippi Embayment

Batesville
Newport
Clinton
Heber Springs
Quitman
Letona
Searcy
Patterson
Wynne
Morrilton
Conway
Beebe
Cabot
Jacksonville
Lonoke
Des Arc
Cotton Plant
Brinkley
Hazen
Forrest City
Marianna

Mpfb

Copeland #2
Copeland #1
Copeland #3
A.C. Smith #1-2
Bobby & Lorete Reaper #1
Sample #1
Albert Estate
Charles Hurley #1
Collums #1-27
Landrum-Quitman #1
McNew #1-26
Liles #1
Roy Sturgis #1
Sallie Childress # 1
Rocha #1
Edgar Wright #1
Glenda J Lines # 1
Raymond # 1
G.L. Morris #1
C.S. Ramsey Heirs #1
Billiot - A #1
Dancer #1
Lever #1
Landrum # 1
Patterson #1
Kaufman #1-2
Glenn Wright #1
Zuber South #1
McLung #1-33
E.W. Moore Estate #1
Emberson # 1
Nichols Trust #14-1
Carter #1
Hart #1
Bosnick #1
Bunch #1

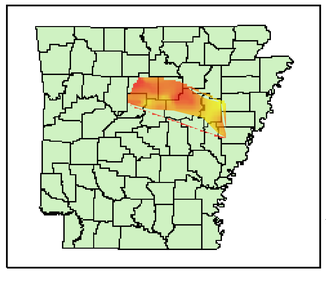
Scotland Field
Gravel Hill Field
Griffin Mountain Field
Cove Creek Field

2 2.5 3 1.5 1

0 3 6 12 18 24 Miles

Scale: 1:280,000

Study Area



N W E S

Statistical Interpolation of Total Organic Carbon (TOC) Values for Selected Wells in the Fayetteville Shale Plotted at 50-100ft below the Estimated Top of the Pay Zone

3.5 TOC contour line

Approximate western boundary of the Mississippi Embayment

Rocha Drill holes included in analysis

City

City Limits

Fayetteville Shale Gas Field
No geochemical data utilized from commercial wells in the gas fields

Mpfb Upper Mississippian Outcrop Belt
Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

TOC predicted values
High : 3.72058
Low : 0.552067

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Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

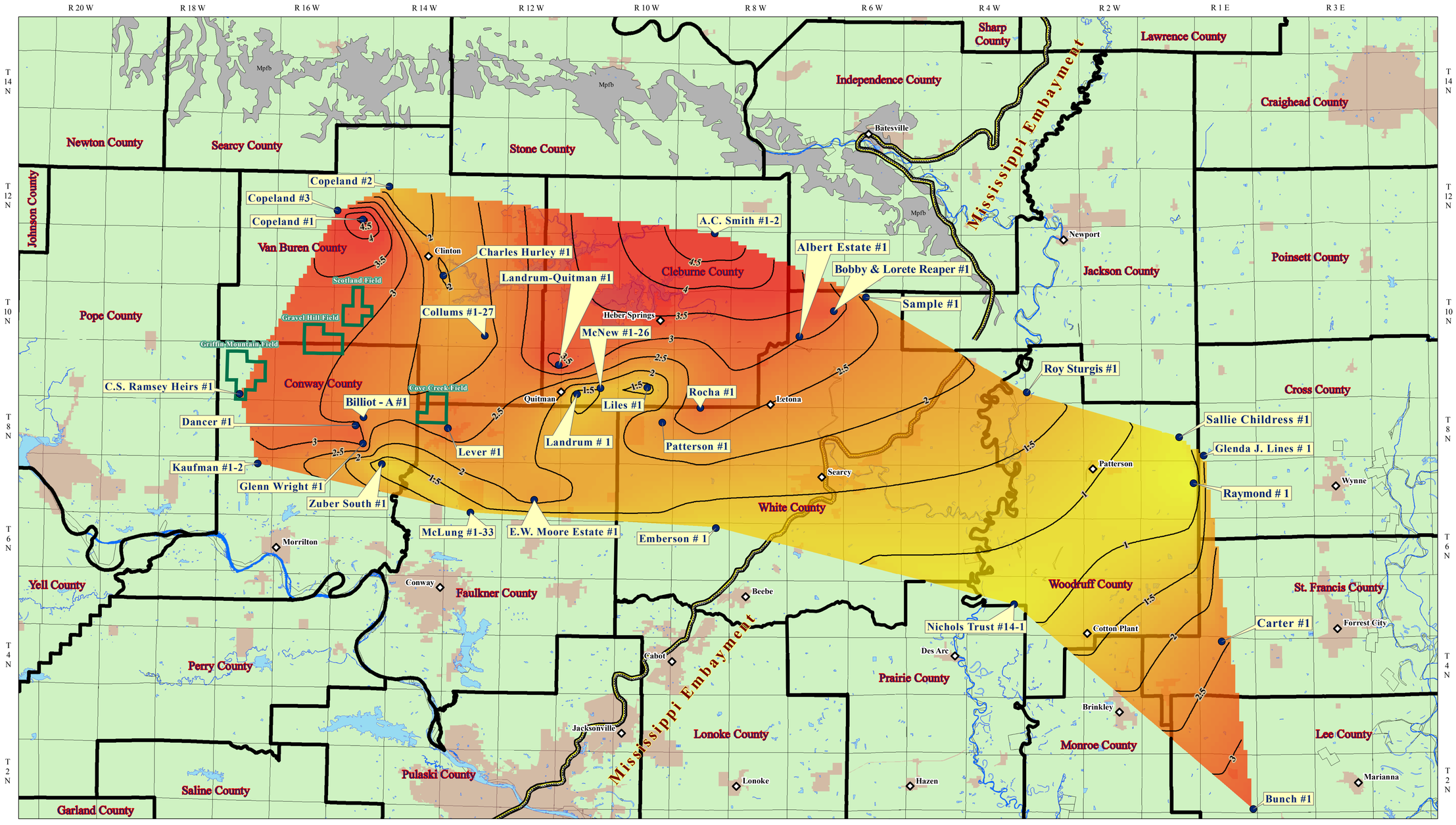
Geochemical Data provided by Humble Geochemical Services

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

Arkansas Geological Commission
Bekki White, State Geologist
Technical Review by Ed Ratchford

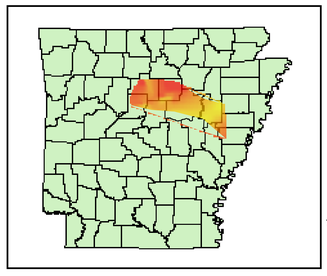
Digital Compilation by Des Heyliger
8 February 2005

Plate Number
6
Information Circular 37



Scale: 1:280,000

Study Area



Statistical Interpolation of Total Organic Carbon (TOC) Values for Selected Wells in the Fayetteville Shale Plotted at 100-150ft below the Estimated Top of the Pay Zone

- TOC contour line
- Approximate western boundary of the Mississippi Embayment
- Drill holes included in analysis
- City
- City Limits
- Fayetteville Shale Gas Field
  No geochemical data utilized from commercial wells in the gas fields
- Upper Mississippian Outcrop Belt
  Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

TOC predicted values

High : 5.00139

Low : 0.54876

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Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Geochemical Data provided by Humble Geochemical Services

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

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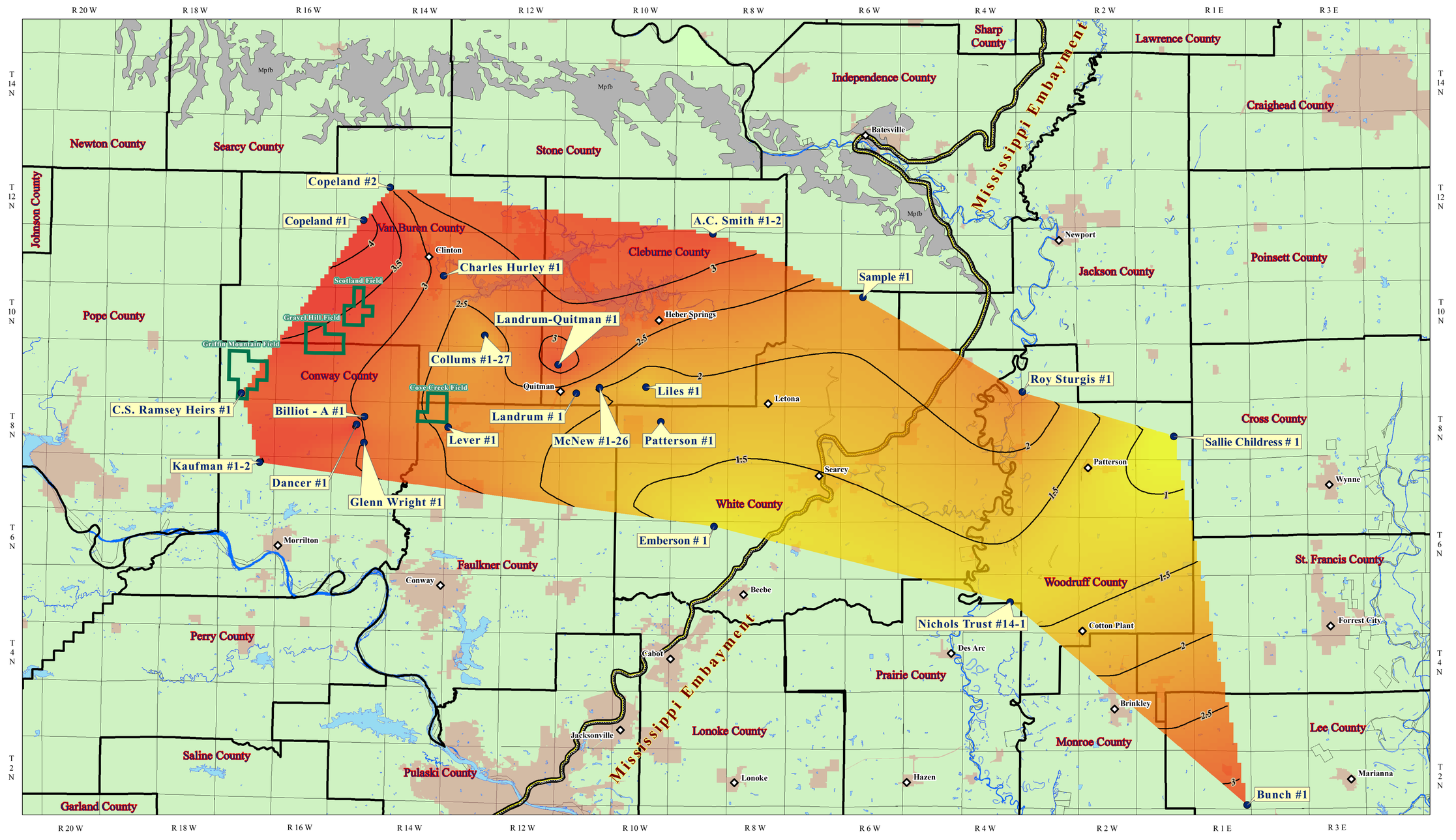
Bekki White, State Geologist
Technical Review by Ed Ratchford

Digital Compilation by Des Heyliger
8 February 2005

Plate Number

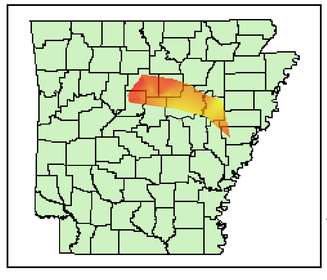
7

Information Circular 37



Scale: 1:280,000

Study Area



Statistical Interpolation of Total Organic Carbon (TOC) Values for Selected Wells in the Fayetteville Shale Plotted at 150-200ft below the Estimated Top of the Pay Zone

Drill holes included in analysis

TOC contour line

Approximate western boundary of the Mississippi Embayment

City

City Limits

Fayetteville Shale Gas Field
No geochemical data utilized from commercial wells in the gas fields

Upper Mississippian Outcrop Belt
Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

TOC predicted values
High : 4.30675
Low : 0.667832

Disclaimer: This map was prepared using ESRI software on computers at the Arkansas Geological Commission. The Arkansas Geological Commission does not guarantee the accuracy of this map, especially when used in another system or with other software. The predicted Total Organic Carbon values between wells do not necessarily represent exact values and are subject to personal interpretation.

Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

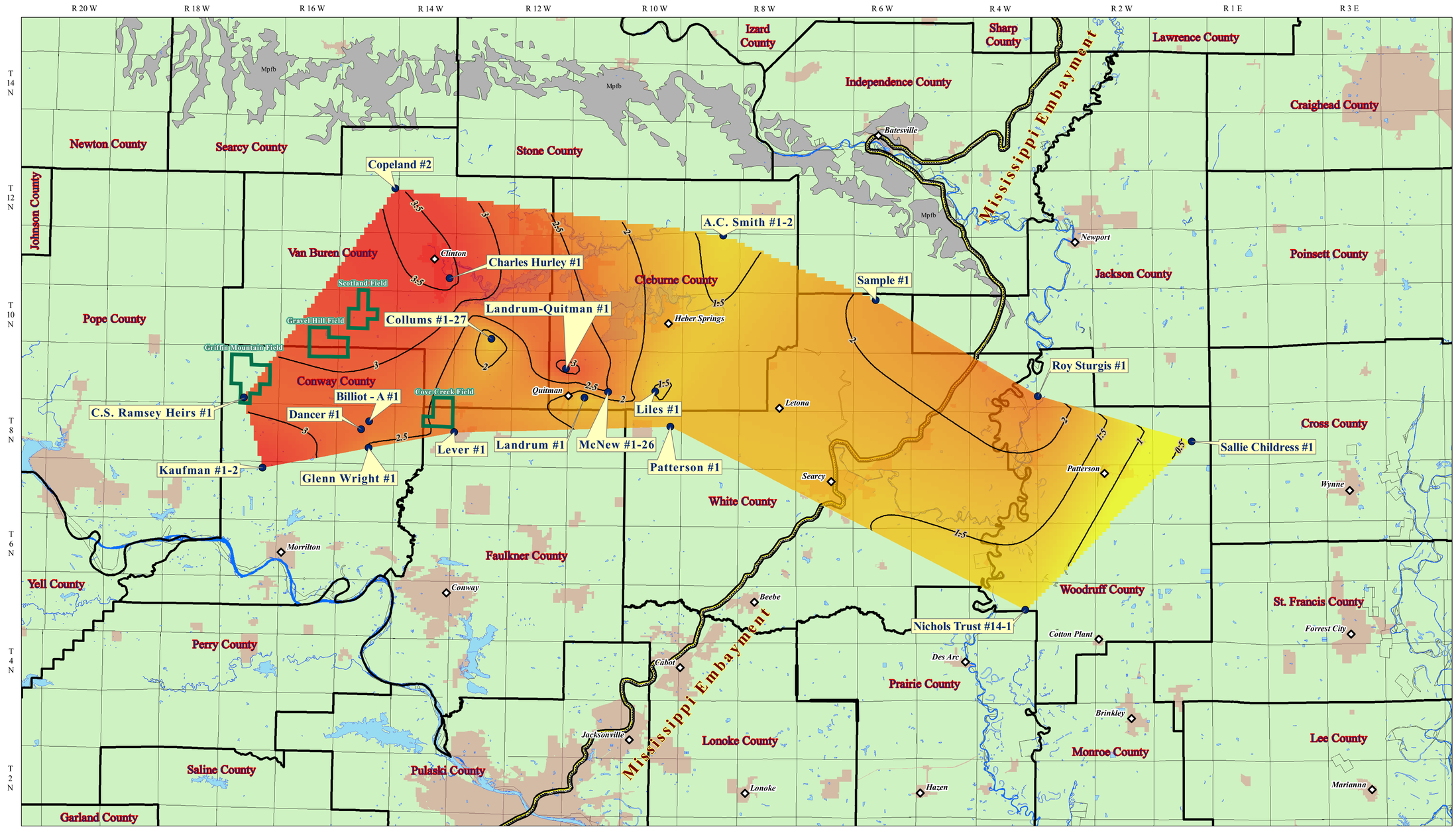
Geochemical Data provided by Humble Geochemical Services

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

Arkansas Geological Commission
Bekki White, State Geologist
Technical Review by Ed Ratchford

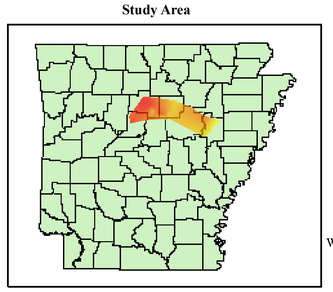
Digital Compilation by Des Heyliger
8 February 2005

Plate Number
8
Information Circular 37



Scale: 1:280,000

Study Area



Statistical Interpolation of Total Organic Carbon (TOC) Values for Selected Wells in the Fayetteville Shale Plotted at 200-250ft below the Estimated Top of the Pay Zone

Drill holes included in analysis
TOC contour line
Approximate western boundary of the Mississippi Embayment
City
City Limits
Fayetteville Shale Gas Field
No geochemical data utilized from commercial wells in the gas fields
Upper Mississippian Outcrop Belt
Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

TOC predicted values
High : 3.70597
Low : 0.417693

Disclaimer: This map was prepared using ESRI software on computers at the Arkansas Geological Commission. The Arkansas Geological Commission does not guarantee the accuracy of this map, especially when used in another system or with other software. The predicted Total Organic Carbon values between wells do not necessarily represent exact values and are subject to personal interpretation.

Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Geochemical Data provided by Humble Geochemical Services

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

Arkansas Geological Commission
Bekki White, State Geologist
Technical Review by Ed Ratchford

Digital Compilation by Des Heyliger
8 February 2005

Plate Number
9

Information Circular 37

R 20 W R 18 W R 16 W R 14 W R 12 W R 10 W R 8 W R 6 W R 4 W R 2 W R 1 E R 3 E

T 14 N T 12 N T 10 N T 8 N T 6 N T 4 N T 2 N

Izard County
Sharp County
Lawrence County
Independence County
Craighead County
Newton County
Searcy County
Stone County
Johnson County
Van Buren County
Cleburne County
Poinsett County
Jackson County
Pope County
Cross County
White County
Conway County
Yell County
Faulkner County
Woodruff County
St. Francis County
Perry County
Prairie County
Pulaski County
Lonoke County
Monroe County
Lee County
Saline County
Garland County

Mississippi Embayment

Mpfb

Batesville
Newport
Clinton
Heber Springs
Letona
Searcy
Patterson
Wynne
Morrilton
Conway
Beebe
Cotton Plant
Des Arc
Forrest City
Cabot
Brinkley
Jacksonville
Lonoke
Hazen
Marianna

A.C. Smith #1-2
Charles Hurley #1
Sample #1
Roy Sturgis #1
Sallie Childress #1
Landrum-Quitman #1
Collums #1-27
Landrum # 1
Billiot - A #1
Liles #1
Morrilton Lumber Co. #1
Dancer #1
Lever #1
McNew #1-26
Patterson #1
Kaufman #1-2
Glenn Wright #1
E.W. Moore Estate #1

Scotland Field
Gravel Hill Field
Griffin Mountain Field
Cove Creek Field

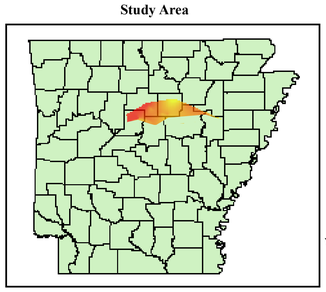
Quitman

1 2 2.5 3 3.5

0 3 6 12 18 24 Miles

Scale: 1:280,000

Study Area



N W E S

Statistical Interpolation of Total Organic Carbon (TOC) Values for Selected Wells in the Fayetteville Shale Plotted at 250-300ft below the Estimated Top of the Pay Zone

Rocha Drill holes included in analysis

TOC contour line

Approximate western boundary of the Mississippi Embayment

City

City Limits

Fayetteville Shale Gas Field
No geochemical data utilized from commercial wells in the gas fields

Upper Mississippian Outcrop Belt
Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

TOC predicted values
High : 3.83056
Low : 0.537053

Disclaimer: This map was prepared using ESRI software on computers at the Arkansas Geological Commission. The Arkansas Geological Commission does not guarantee the accuracy of this map, especially when used in another system or with other software. The predicted Total Organic Carbon values between wells do not necessarily represent exact values and are subject to personal interpretation.

Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

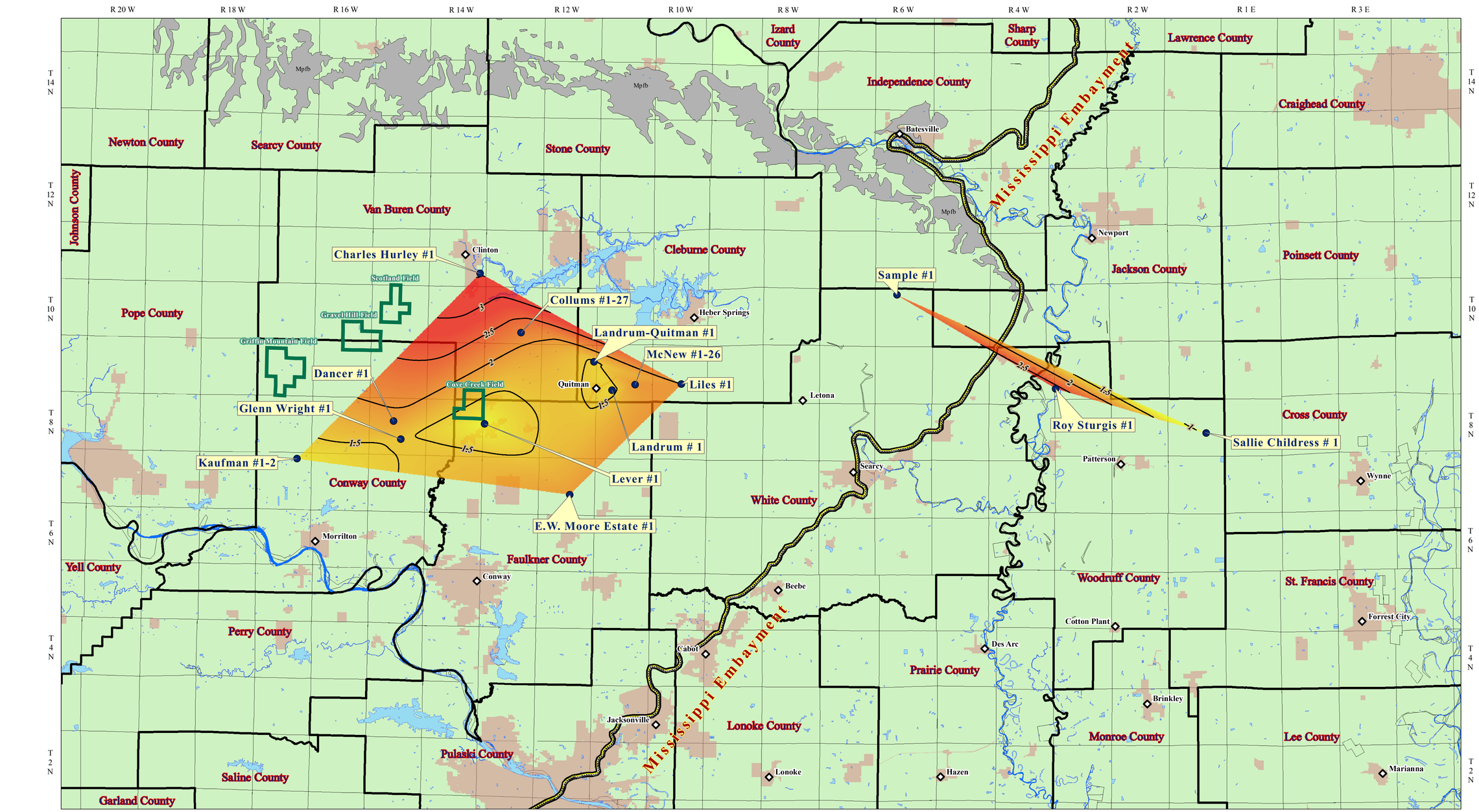
Geochemical Data provided by Humble Geochemical Services

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

Arkansas Geological Commission
Bekki White, State Geologist
Technical Review by Ed Ratchford

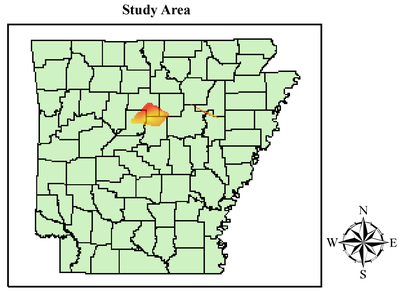
Digital Compilation by Des Heyliger
8 February 2005

Plate Number
10
Information Circular 37



Scale: 1:280,000

Study Area



Statistical Interpolation of Total Organic Carbon (TOC) Values for Selected Wells in the Fayetteville Shale Plotted at 300-350ft below the Estimated Top of the Pay Zone

Drill holes included in analysis

TOC contour line

Approximate western boundary of the Mississippi Embayment

City

City Limits

Fayetteville Shale Gas Field
No geochemical data utilized from commercial wells in the gas fields

Upper Mississippian Outcrop Belt
Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

TOC predicted values

High : 3.54869

Low : 0.902828

Disclaimer: This map was prepared using ESRI software on computers at the Arkansas Geological Commission. The Arkansas Geological Commission does not guarantee the accuracy of this map, especially when used in another system or with other software. The predicted Total Organic Carbon values between wells do not necessarily represent exact values and are subject to personal interpretation.

Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Geochemical Data provided by Humble Geochemical Services

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

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Bekki White, State Geologist
Technical Review by Ed Ratchford

Digital Compilation by Des Heyliger
8 February 2005

Plate Number
11

Information Circular 37

R 20 W R 18 W R 16 W R 14 W R 12 W R 10 W R 8 W R 6 W R 4 W R 2 W R 1 E R 3 E

T 14 N T 12 N T 10 N T 8 N T 6 N T 4 N T 2 N

Izard County
Sharp County
Lawrence County
Independence County
Craighead County
Newton County
Searcy County
Stone County
Johnson County
Van Buren County
Cleburne County
Poinsett County
Jackson County
Pope County
Conway County
Faulkner County
White County
Cross County
Yell County
Perry County
Woodruff County
St. Francis County
Prairie County
Saline County
Pulaski County
Lonoke County
Monroe County
Lee County
Garland County

Mississippi Embayment

Batesville
Clinton
Heber Springs
Newport
Letona
Searcy
Patterson
Wynne
Morrilton
Conway
Beebe
Cotton Plant
Forrest City
Des Arc
Cabot
Brinkley
Jacksonville
Lonoke
Hazen
Marianna

Mpfb

Scotland Field
Gravel Hill Field
Griffin Mountain Field
Cove Creek Field

Collums #1-27
Landrum-Quitman #1
McNew #1-26
Quitman
Liles #1
Landrum # 1
Dancer #1
Lever #1
E.W. Moore Estate #1
Sample #1
Carl #1
Roy Sturgis #1

1
2
1.5

0 3 6 12 18 24 Miles

Scale: 1:280,000

Study Area

Statistical Interpolation of Total Organic Carbon (TOC) Values for Selected Wells in the Fayetteville Shale Plotted at 350-400ft below the Estimated Top of the Pay Zone

Rocha Drill holes included in analysis
3.5 TOC contour line
Approximate western boundary of the Mississippi Embayment
City
City Limits
Fayetteville Shale Gas Field
No geochemical data utilized from commercial wells in the gas fields
Mpfb Upper Mississippian Outcrop Belt
Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

TOC predicted values
High : 2.42229
Low : 0.981091

Disclaimer: This map was prepared using ESRI software on computers at the Arkansas Geological Commission. The Arkansas Geological Commission does not guarantee the accuracy of this map, especially when used in another system or with other software. The predicted Total Organic Carbon values between wells do not necessarily represent exact values and are subject to personal interpretation.

Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Geochemical Data provided by Humble Geochemical Services

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

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Bekki White, State Geologist
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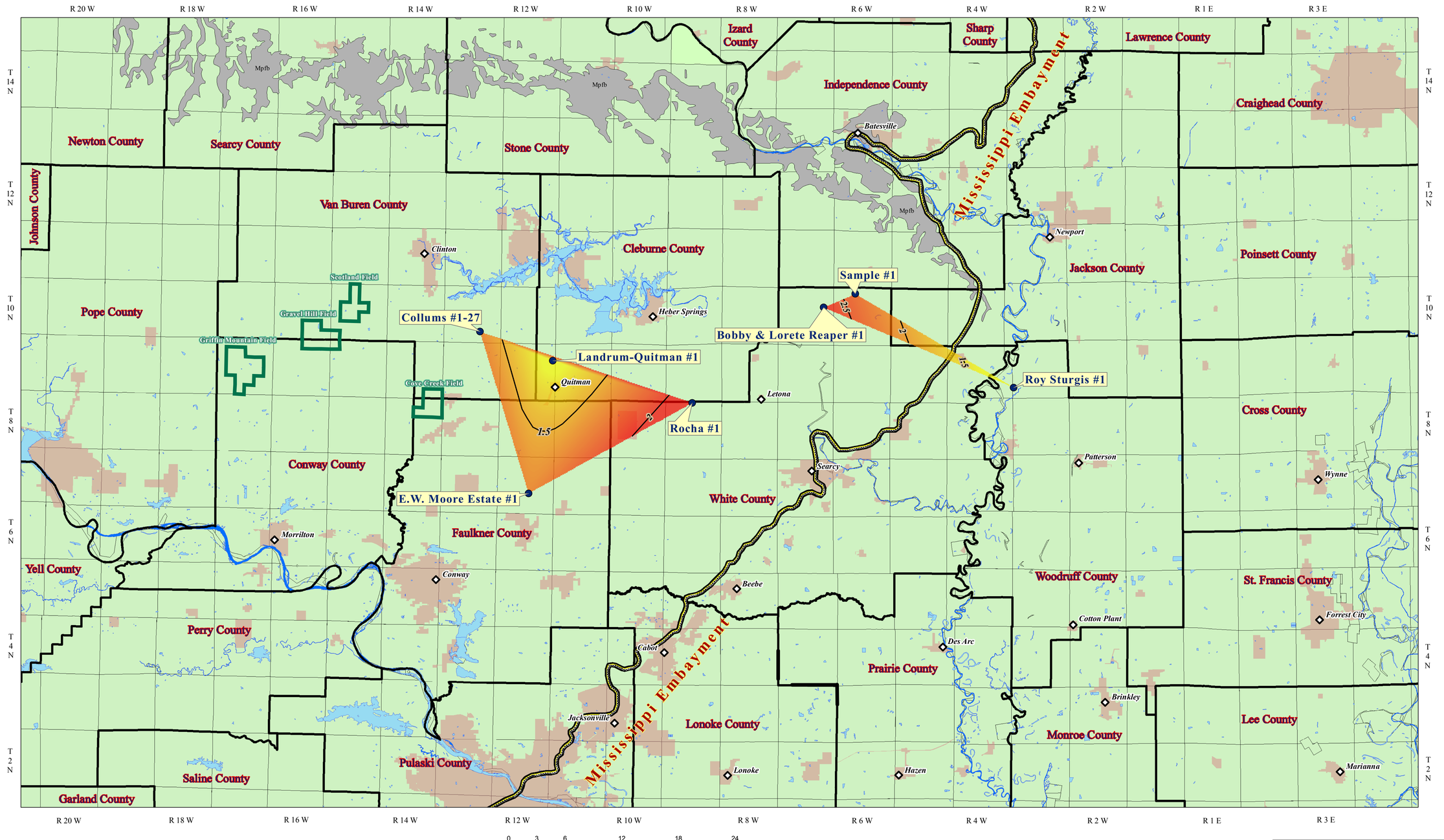
Plate Number
12
Information Circular 37



Scale: 1:280,000

Study Area

Statistical Interpolation of Total Organic Carbon (TOC) Values for Selected Wells in the Fayetteville Shale Plotted at 400-450ft below the Estimated Top of the Pay Zone

- Drill holes included in analysis
- TOC contour line
- Approximate western boundary of the Mississippi Embayment
- City
- City Limits
- Fayetteville Shale Gas Field
  No geochemical data utilized from commercial wells in the gas fields
- Upper Mississippian Outcrop Belt
  Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

TOC predicted values

High : 2.73182

Low : 1.06386

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Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Geochemical Data provided by Humble Geochemical Services

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

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Bekki White, State Geologist
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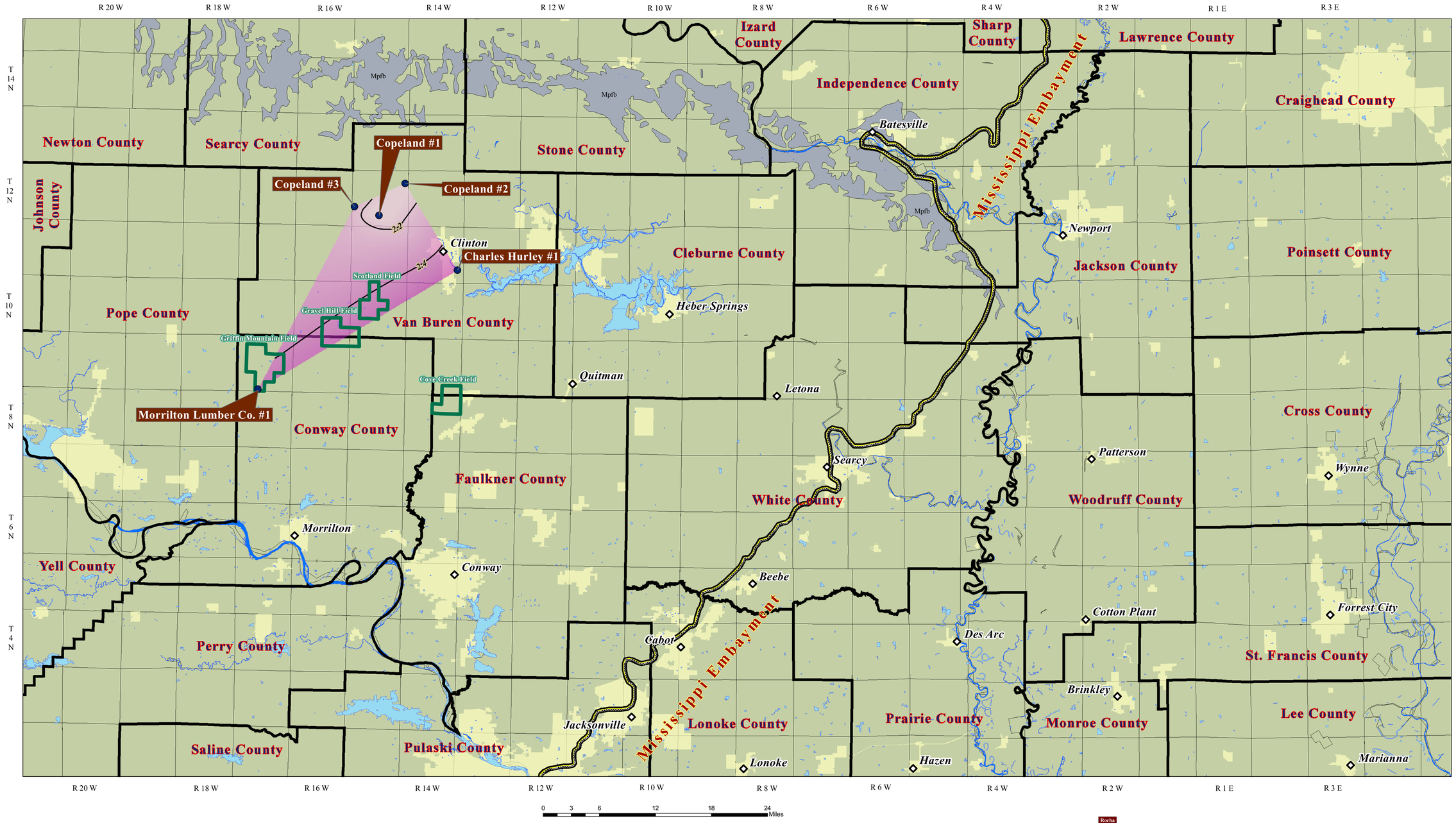
Plate Number

13

Information Circular 37



Scale: 1:280,000

Study Area

Statistical Interpolation of Vitrinite Reflectance Values for Selected Wells in the Fayetteville Shale Study Area Plotted at 800-1050ft below the Surface

Drill holes included in analysis
City
City Limits
Vitrinite Reflectance contour
Approximate western boundary of the Mississippi Embayment
Fayetteville Shale Gas Field
No geochemical data utilized from commercial wells in the gas fields
Upper Mississippian Outcrop Belt
Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

Vitrinite Reflectance
High : 2.46961
Low : 2.10132

Disclaimer: This map was prepared using ESRI software on computers at the Arkansas Geological Commission. The Arkansas Geological Commission does not guarantee the accuracy of this map, especially when used in another system or with other software. The predicted Vitrinite Reflectance values between wells do not necessarily represent exact values and are subject to personal interpretation.

Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Geochemical Data provided by Humble Geochemical Services

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

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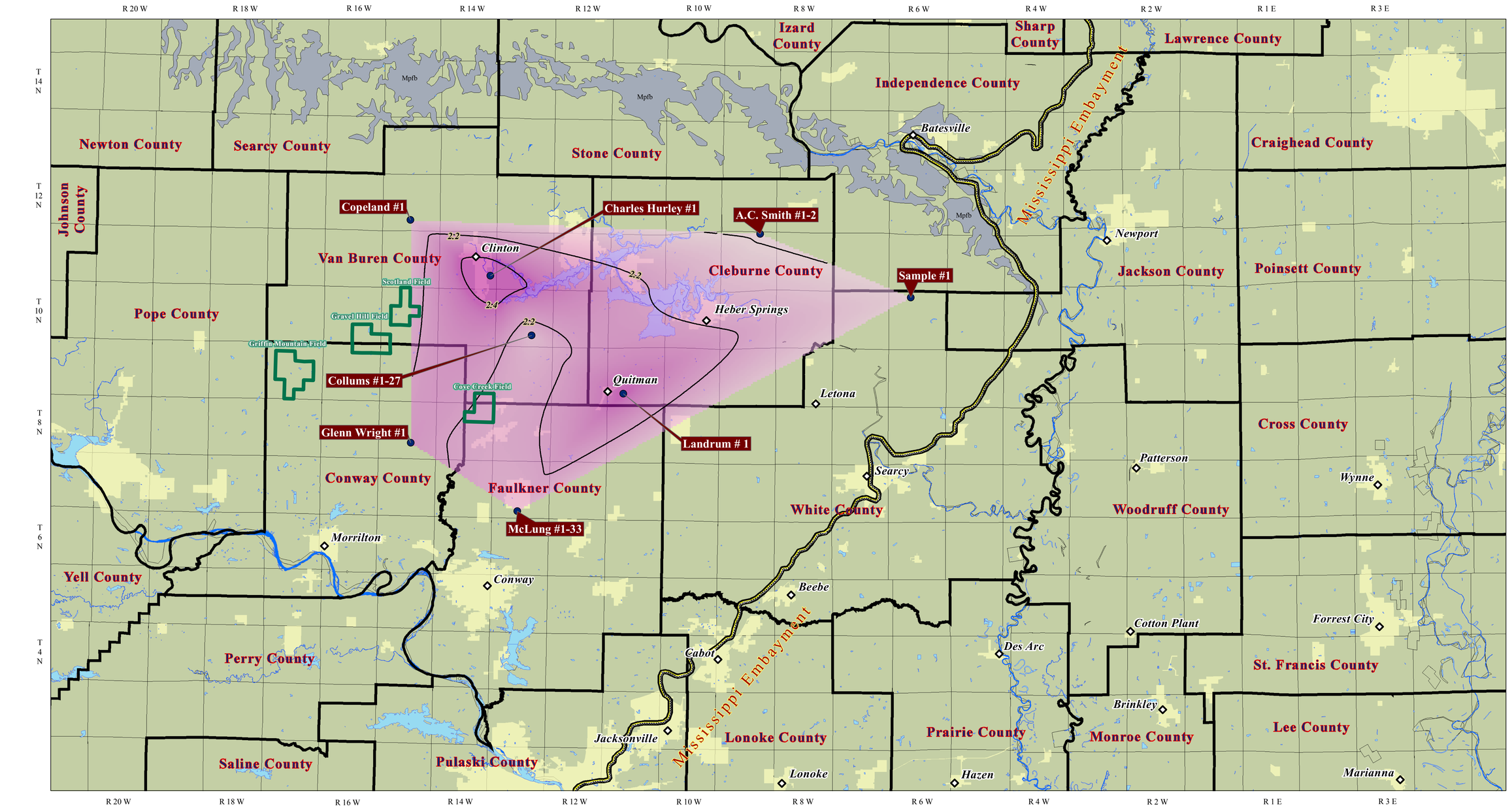
Bekki White, State Geologist
Technical Review by Ed Ratchford

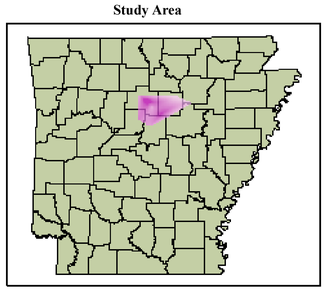
Digital Compilation by Des Heyliger
8 February 2005

Plate Number
14
Information Circular 37



Scale: 1:280,000

Study Area



Statistical Interpolation of Vitrinite Reflectance Values for Selected Wells in the Fayetteville Shale Study Area Plotted at 1400-1650ft below the Surface

- Rocha — Drill holes included in analysis
- City
- City Limits
- 2.2 — Vitrinite Reflectance contour
- Approximate western boundary of the Mississippi Embayment
- Fayetteville Shale Gas Field
  No geochemical data utilized from commercial wells in the gas fields
- Mpfb — Upper Mississippian Outcrop Belt
  Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

Vitrinite Reflectance
High : 2.5662
Low : 1.98079

Disclaimer: This map was prepared using ESRI software on computers at the Arkansas Geological Commission. The Arkansas Geological Commission does not guarantee the accuracy of this map, especially when used in another system or with other software. The predicted Vitrinite Reflectance values between wells do not necessarily represent exact values and are subject to personal interpretation.

Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Geochemical Data provided by Humble Geochemical Services

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

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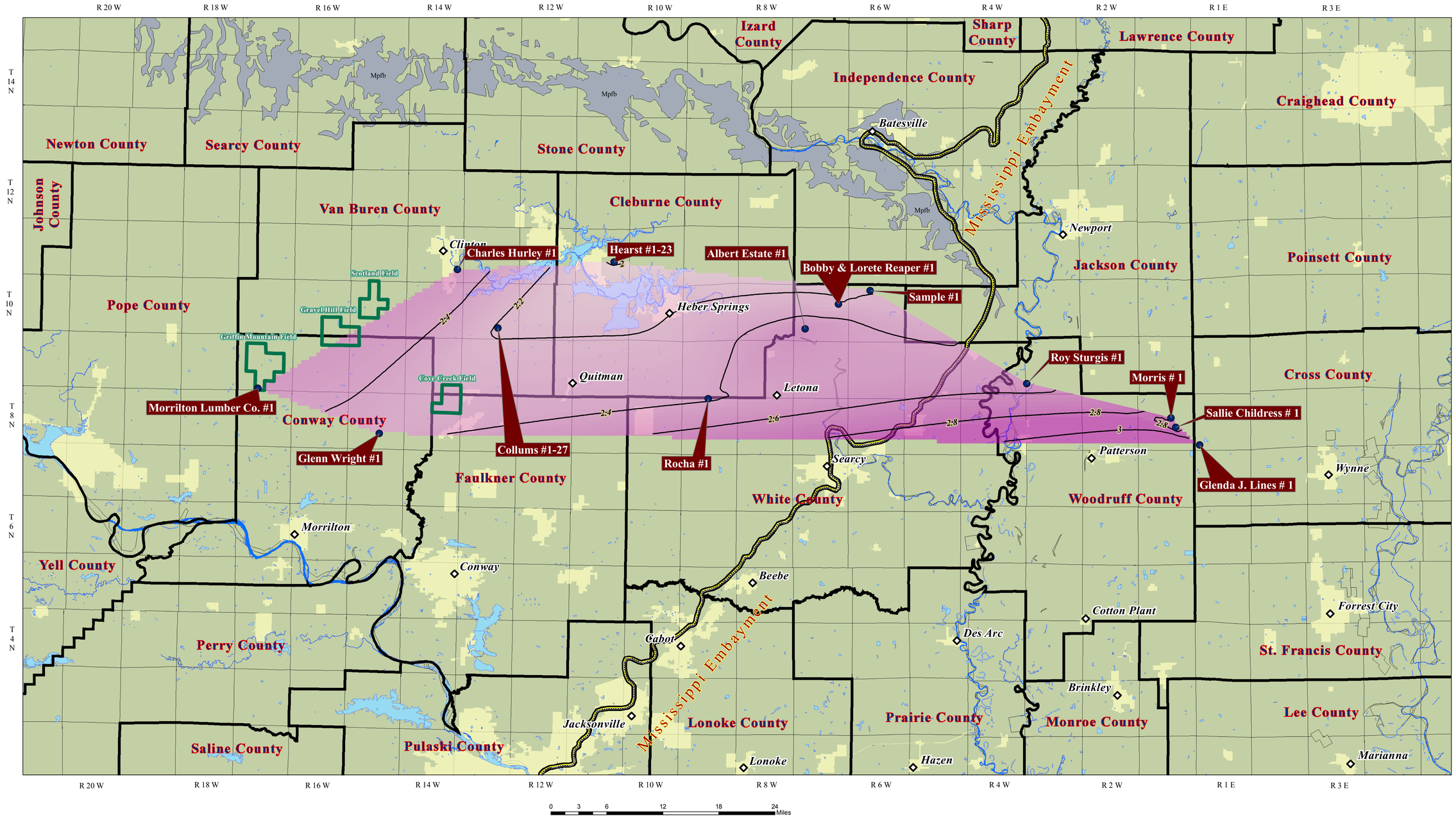
Bekki White, State Geologist
Technical Review by Ed Ratchford

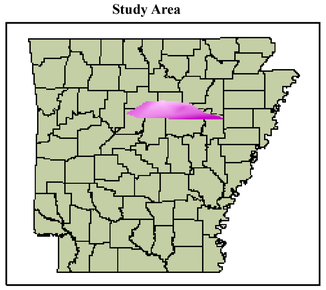
Digital Compilation by Des Heyliger
8 February 2005

Plate Number
15
Information Circular 37



Scale: 1:280,000

Study Area



Statistical Interpolation of Vitrinite Reflectance Values for Selected Wells in the Fayetteville Shale Study Area Plotted at 2450-2700ft below the Surface

Drill holes included in analysis
City
City Limits
Vitrinite Reflectance contour
Approximate western boundary of the Mississippi Embayment
Fayetteville Shale Gas Field
No geochemical data utilized from commercial wells in the gas fields
Upper Mississippian Outcrop Belt
Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

Vitrinite Reflectance
High : 3.15341
Low : 1.99514

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Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Geochemical Data provided by Humble Geochemical Services

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

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Bekki White, State Geologist
Technical Review by Ed Ratchford

Digital Compilation by Des Heyliger
8 February 2005

Plate Number
16
Information Circular 37

R 20 W R 18 W R 16 W R 14 W R 12 W R 10 W R 8 W R 6 W R 4 W R 2 W R 1 E R 3 E

T 14 N T 12 N T 10 N T 8 N T 6 N T 4 N

Newton County
Searcy County
Stone County
Izard County
Sharp County
Lawrence County
Independence County
Craighead County
Johnson County
Van Buren County
Cleburne County
Jackson County
Poinsett County
Pope County
Conway County
Faulkner County
White County
Woodruff County
Cross County
Yell County
Perry County
Saline County
Pulaski County
Lonoke County
Prairie County
Monroe County
St. Francis County
Lee County

Batesville
Clinton
Newport
Heber Springs
Quitman
Letona
Searcy
Patterson
Wynne
Morrilton
Conway
Beebe
Cabot
Des Arc
Cotton Plant
Forrest City
Jacksonville
Brinkley
Lonoke
Hazen
Marianna

Mississippi Embayment

Mpfb

Scotland Field
Gravel Hill Field
Griffin Mountain Field
Cove Creek Field

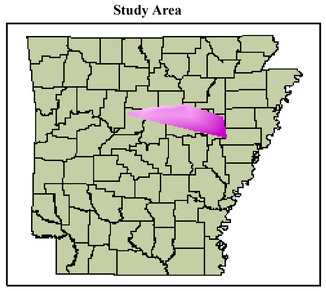
Albert Estate #1
Landrum-Quitman #1
Collums #1-27
Bobby & Lorete Reaper #1
Roy Sturgis #1
G.L. Morris #1
Wright #1
Morris #1
Raymond #1
Morrilton Lumber Co. #1
Billiot - A #1
Glenn Wright #1
Carter #1

2:2
2:4
2:6
2:8
3
3-2
3:4
3:6

0 3 6 12 18 24 Miles

Scale: 1:280,000

Study Area



N W E S

Statistical Interpolation of Vitrinite Reflectance Values for Selected Wells in the Fayetteville Shale Study Area Plotted at 3300-3550ft below the Surface

Rocha Drill holes included in analysis
City
City Limits
2.2 Vitrinite Reflectance contour
Approximate western boundary of the Mississippi Embayment
Fayetteville Shale Gas Field
No geochemical data utilized from commercial wells in the gas fields
Mpfb Upper Mississippian Outcrop Belt
Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

Vitrinite Reflectance
High : 3.60514
Low : 2.06256

Disclaimer: This map was prepared using ESRI software on computers at the Arkansas Geological Commission. The Arkansas Geological Commission does not guarantee the accuracy of this map, especially when used in another system or with other software. The predicted Vitrinite Reflectance values between wells do not necessarily represent exact values and are subject to personal interpretation.

Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Geochemical Data provided by Humble Geochemical Services

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

Arkansas Geological Commission
Bekki White, State Geologist
Technical Review by Ed Ratchford

Digital Compilation by Des Heyliger
8 February 2005

Plate Number
17
Information Circular 37

R 20 W R 18 W R 16 W R 14 W R 12 W R 10 W R 8 W R 6 W R 4 W R 2 W R 1 E R 3 E

T 14 N T 12 N T 10 N T 8 N T 6 N T 4 N T 2 N

Izard County
Sharp County
Lawrence County
Craighead County
Newton County
Searcy County
Stone County
Mpfb
Batesville
Mississippi Embayment
Johnson County
Van Buren County
Clinton
Cleburne County
Independence County
Newport
Jackson County
Poinsett County
Scotland Field
Gravel Hill Field
Griffin Mountain Field
Heber Springs
Landrum-Quitman #1
Landrum # 1
McNew #1-26
Liles #1
Billiot - A #1
Cove Creek Field
Rocha #1
Letona
Edgar Wright #1
Pope County
Morrilton Lumber Co. #1
Dancer #1
Glenn Wright #1
Quitman
2:6
2:4
2:4
2:6
2:8
3
3:2
3:4
3:6
3:8
4
4:2
4:4
Searcy
Patterson
G.L. Morris #1
Wynne
Cross County
Conway County
White County
Woodruff County
Faulkner County
Morrilton
Stewart #1
Conway
Beebe
Yell County
Perry County
Cotton Plant
Carter #1
Forrest City
Cabot
Des Arc
St. Francis County
Brinkley
Jacksonville
Lonoke County
Prairie County
Monroe County
Lee County
Bosnick #1
Saline County
Pulaski County
Lonoke
Hazen
Marianna
Bunch #1

0 3 6 12 18 24 Miles

Scale: 1:280,000

Study Area

N W E S

Statistical Interpolation of Vitrinite Reflectance Values for Selected Wells in the Fayetteville Shale Study Area Plotted at 4250-4500ft below the Surface

Drill holes included in analysis
City
City Limits
Vitrinite Reflectance contour
Approximate western boundary of the Mississippi Embayment
Fayetteville Shale Gas Field
No geochemical data utilized from commercial wells in the gas fields
Upper Mississippian Outcrop Belt
Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

Vitrinite Reflectance
High : 4.51888
Low : 2.23841

Disclaimer: This map was prepared using ESRI software on computers at the Arkansas Geological Commission. The Arkansas Geological Commission does not guarantee the accuracy of this map, especially when used in another system or with other software. The predicted Vitrinite Reflectance values between wells do not necessarily represent exact values and are subject to personal interpretation.

Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Geochemical Data provided by Humble Geochemical Services

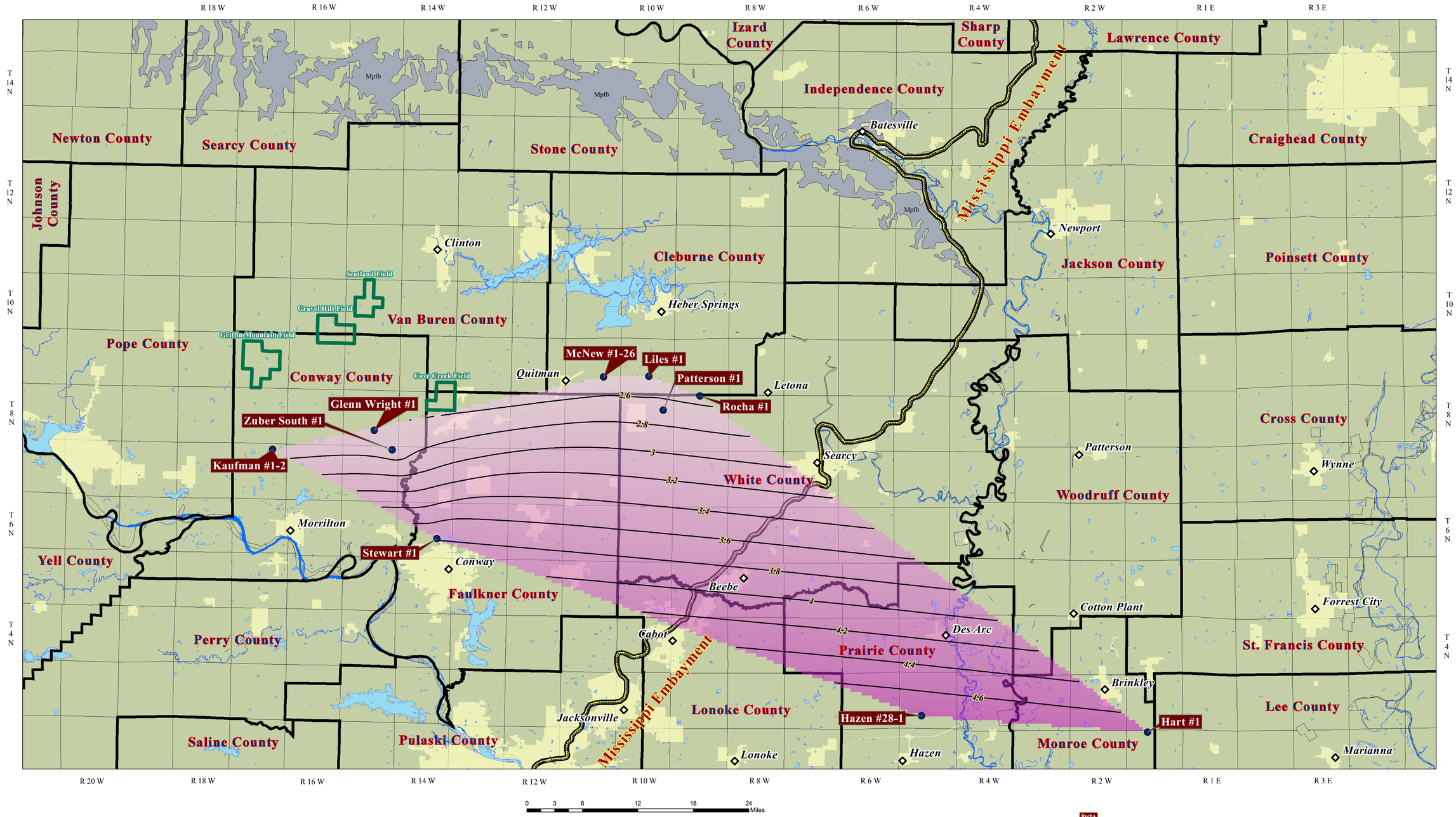
Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

Arkansas Geological Commission
Bekki White, State Geologist
Technical Review by Ed Ratchford

Digital Compilation by Des Heyliger
8 February 2005

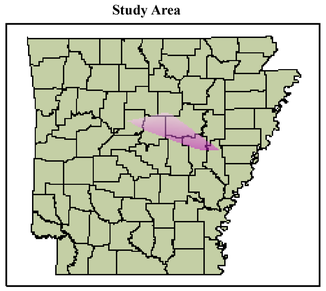
Plate Number
18

Information Circular 37



Scale: 1:280,000

Study Area



Statistical Interpolation of Vitrinite Reflectance Values for Selected Wells in the Fayetteville Shale Study Area Plotted at 5250-5500ft below the Surface

- Rocha — Drill holes included in analysis
- City
- City Limits
- 2.2 — Vitrinite Reflectance contour
- Approximate western boundary of the Mississippi Embayment
- Fayetteville Shale Gas Field
  No geochemical data utilized from commercial wells in the gas fields
- Mpfb — Upper Mississippian Outcrop Belt
  Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

Vitrinite Reflectance
High : 4.78272
Low : 2.45831

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Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Geochemical Data provided by Humble Geochemical Services

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

Arkansas Geological Commission
Bekki White, State Geologist
Technical Review by Ed Ratchford

Digital Compilation by Des Heyliger
8 February 2005

Plate Number
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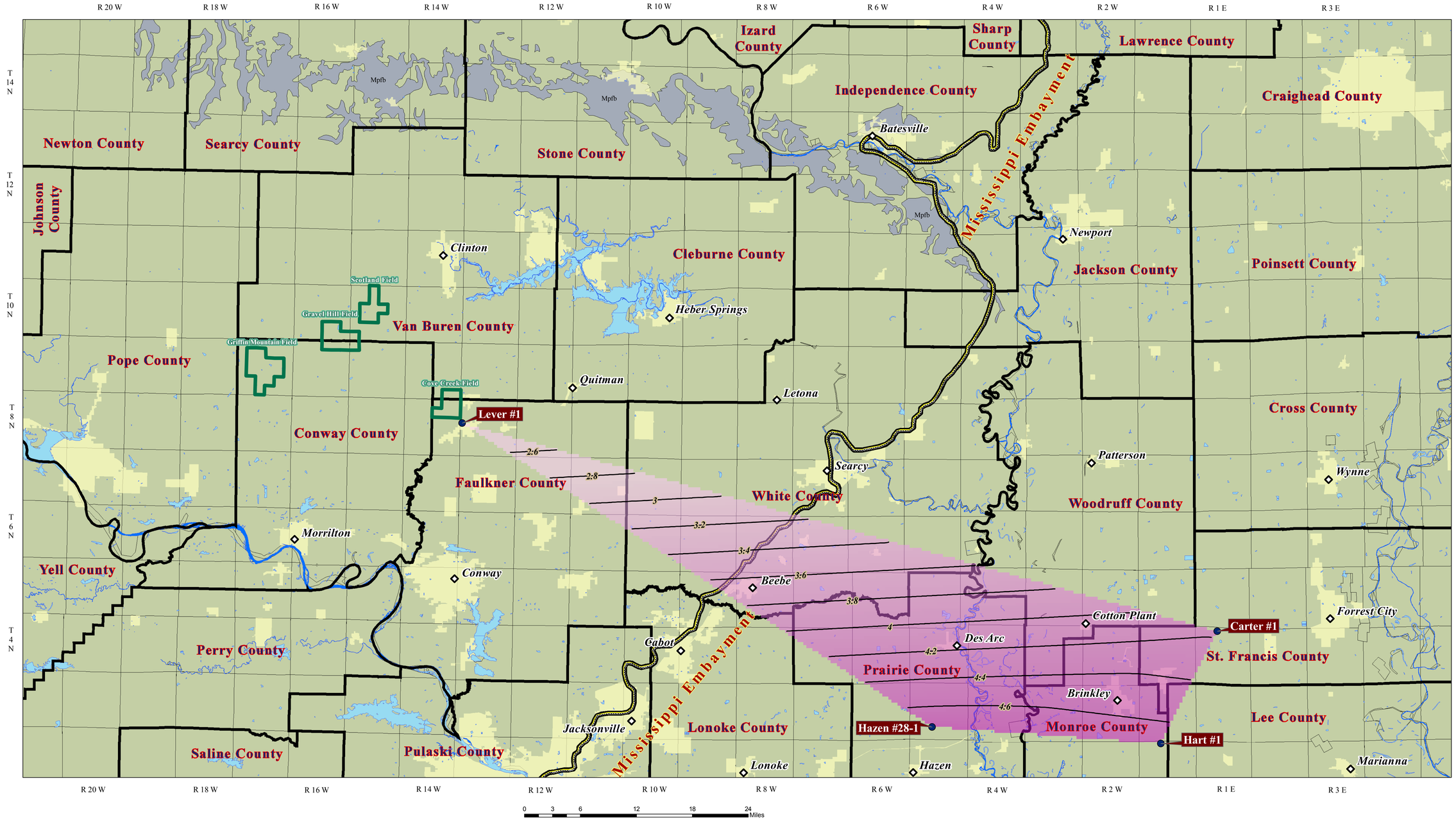
Information Circular 37



Scale: 1:280,000

Study Area

Statistical Interpolation of Vitrinite Reflectance Values for Selected Wells in the Fayetteville Shale Study Area Plotted at 6300-6550ft below the Surface

- Drill holes included in analysis
- City
- City Limits
- Vitrinite Reflectance contour
- Approximate western boundary of the Mississippi Embayment
- Fayetteville Shale Gas Field
  No geochemical data utilized from commercial wells in the gas fields
- Upper Mississippian Outcrop Belt
  Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

Vitrinite Reflectance
High : 4.74478
Low : 2.38498

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Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Geochemical Data provided by Humble Geochemical Services

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

Arkansas Geological Commission
Bekki White, State Geologist
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8 February 2005

Plate Number
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R 20 W R 18 W R 16 W R 14 W R 12 W R 10 W R 8 W R 6 W R 4 W R 2 W R 1 E R 3 E

T 14 N T 12 N T 10 N T 8 N T 6 N T 4 N

Izard County
Sharp County
Lawrence County
Independence County
Craighead County
Newton County
Searcy County
Stone County
Johnson County
Mississippi Embayment
Batesville
Clinton
Cleburne County
Newport
Jackson County
Poinsett County
Scotland Field
Gravel Hill Field
Griffin Mountain Field
Van Buren County
Heber Springs
Pope County
Cove Creek Field
Quitman
Letona
Conway County
Cross County
Searcy
Patterson
Wynne
E.W. Moore Estate #1
McLung #1-33
2.6
3.8
4.2
4.4
4.6
White County
Woodruff County
Morrilton
Stewart #1
Nichols Trust #14-1
Yell County
Conway
Beebe
Faulkner County
St. Francis County
Cotton Plant
Forrest City
Perry County
Cabot
Des Arc
Brinkley
Jacksonville
Lonoke County
Prairie County
Monroe County
Lee County
Saline County
Pulaski County
Lonoke
Hazen
Marianna

0 3 6 12 18 24 Miles

Scale: 1:280,000

Study Area

N W E S

Statistical Interpolation of Vitrinite Reflectance Values for Selected Wells in the Fayetteville Shale Study Area Plotted at 7300-7550ft below the Surface

Rocha — Drill holes included in analysis
City
City Limits
2.2 — Vitrinite Reflectance contour
Approximate western boundary of the Mississippi Embayment
Fayetteville Shale Gas Field
No geochemical data utilized from commercial wells in the gas fields
Mpfb — Upper Mississippian Outcrop Belt
Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

Vitrinite Reflectance
High : 4.68643
Low : 2.56988

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Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Geochemical Data provided by Humble Geochemical Services

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

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Bekki White, State Geologist
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Plate Number
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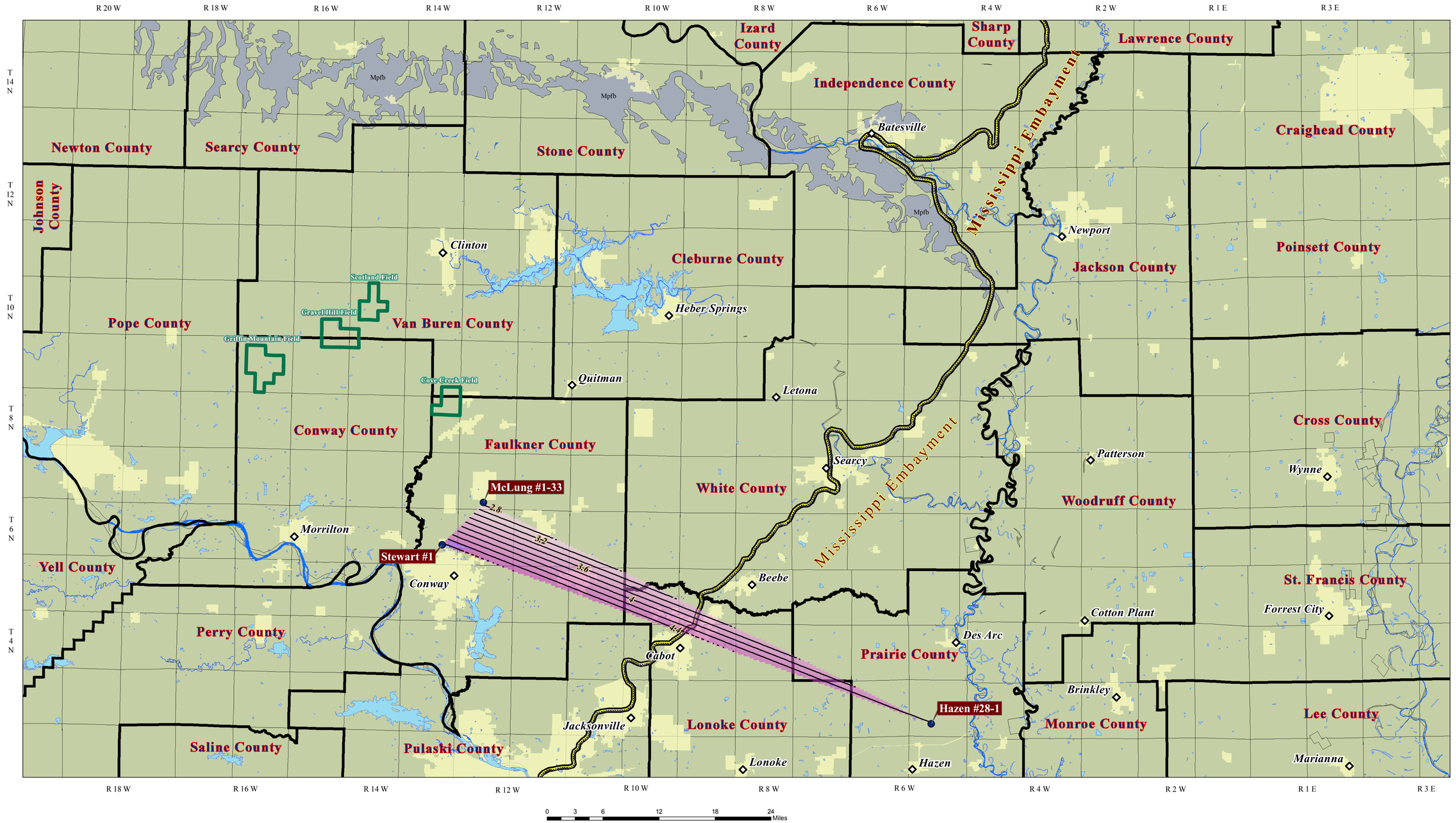
Information Circular 37



Scale: 1:280,000

Study Area

Statistical Interpolation of Vitrinite Reflectance Values for Selected Wells in the Fayetteville Shale Study Area Plotted at 8350-8600ft below the Surface

Drill holes included in analysis
City
City Limits
2.2 Vitrinite Reflectance contour
Approximate western boundary of the Mississippi Embayment
Fayetteville Shale Gas Field
No geochemical data utilized from commercial wells in the gas fields
Mpfb Upper Mississippian Outcrop Belt
Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

Vitrinite Reflectance
High : 4.65771
Low : 2.73972

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Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Geochemical Data provided by Humble Geochemical Services

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

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Bekki White, State Geologist
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Digital Compilation by Des Heyliger
8 February 2005

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R 20 W R 18 W R 16 W R 14 W R 12 W R 10 W R 8 W R 6 W R 4 W R 2 W R 1 E R 3 E

T 12 N T 10 N T 8 N T 6 N T 4 N T 2 N

Newton County
Searcy County
Stone County
Independence County
Craighead County
Johnson County
Van Buren County
Cleburne County
Poinsett County
Jackson County
Pope County
Conway County
Cross County
White County
Woodruff County
St. Francis County
Yell County
Perry County
Faulkner County
Lonoke County
Prairie County
Lee County
Pulaski County
Saline County
Monroe County

Mississippi Embayment

Mpfb

Batesville
Newport
Clinton
Heber Springs
Quitman
Letona
Searcy
Patterson
Wynne
Morrilton
Conway
Beebe
Cotton Plant
Forrest City
Des Arc
Brinkley
Jacksonville
Cabot
Lonoke
Hazen
Marianna

Copeland #2
Copeland #1
Copeland #3
Charles Hurley #1
Hearst #1-23
A.C. Smith #1-2
Albert Estate #1
Bobby & Lorete Reaper #1
Sample #1
Carl #1
Roy Sturgis #1
Childress Sallie # 1
Glenda J. Lines # 1
Raymond # 1
G.L. Morris #1
Edgar Wright #1
Landrum-Quitman #1
Collums #1-27
McNew #1-26
Liles #1
Rocha #1
Landrum #1
Patterson #1
Lever
C.S. Ramsey Heirs #1
Billiot - A #1
Kaufman #1-2
Dancer #1
Glenn Wright #1
Zuber South #1
McLung #1-33
E.W. Moore Estate #1
Emberson # 1
Nichols Trust #14-1
Carter #1
Bosnick #1
Hart #1
Bunch #1
Hazen #28-1

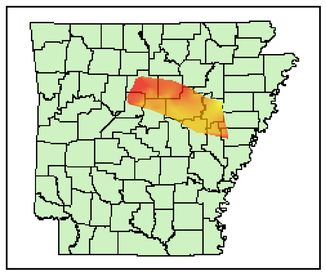
Scotland Field
Gravel Hill Field
Griffin Mountain Field
Cove Creek Field

2.5
3
3.5
2
1.5
4
4.5
1

0 3 6 12 18 24 Miles

Scale: 1:280,000

Study Area



Two Component Statistical Interpolation of Averaged Total Organic Carbon (TOC) Values and Averaged Vitrinite Reflectance Values in the Fayetteville Shale Pay Zone

(Average TOC Values Derived through Entire Range of Pay Zone)

Drill holes included in analysis
Well used for vitrinite reflectance analysis only
Well used for TOC analysis only
TOC contour line
Vitrinite Reflectance contour line
Approximate western boundary of the Mississippi Embayment
City
City Limits
Fayetteville Shale Gas Field
No geochemical data utilized from commercial wells in the gas fields
Upper Mississippian Outcrop Belt
Contains Pitkin Limestone, Fayetteville Shale (Including the Wedington Sandstone Member), and Batesville Sandstone (including the Hindsville Limestone Member)

TOC predicted values
High : 3.66766
Low : 0.711425

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Sources: United States Geological Survey, Arkansas Highway and Transportation Department, Environmental Systems Research Institute

Geochemical Data provided by Humble Geochemical Services

Datum: North American Datum 1983
Projection: Universal Transverse Mercator, Zone 15

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